

City of San Diego

CONTRACTOR'S NAME: TechCom International, Corp.

ADDRESS: 11 Redondo, Laguna Niguel, CA 92677

TELEPHONE NO.: 949-453-1900 Ext. 223 **FAX NO.:**

CITY CONTACT: Antoinette Sanfilippo, Contract Specialist **Email:** ASanfilippo@sandiego.gov

Phone No.: (619) 533-3439

I. da Rosa/R. Bustamante/cc

BIDDING DOCUMENTS



FOR

MBC COOLING WATER SYSTEM CHILLER UPGRADE

BID NO.: _____ **K-19-1802-DBB-3**

SAP NO. (WBS/IO/CC): _____ **B-16165**

CLIENT DEPARTMENT: _____ **2000**

COUNCIL DISTRICT: _____ **6**

PROJECT TYPE: _____ **BO**

THIS CONTRACT WILL BE SUBJECT TO THE FOLLOWING:

- PHASED-FUNDING
- THE CITY'S SUBCONTRACTING PARTICIPATION REQUIREMENTS FOR SLBE PROGRAM.
- PREVAILING WAGE RATES: STATE FEDERAL
- APPRENTICESHIP

BID DUE DATE:

2:00 PM

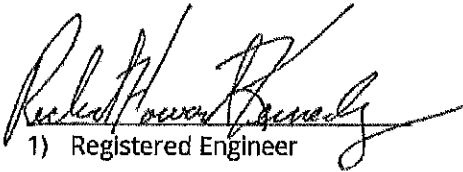
FEBRUARY 21, 2019

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

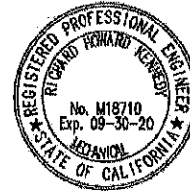
<http://www.sandiego.gov/cip/bidopps/index.shtml>


ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:


1) Registered Engineer _____ 1/7/2019
Date

Seal:




2) For City Engineer _____ 1/8/2019
Date

Seal:



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NOTICE INVITING BIDS

1. **SUMMARY OF WORK:** This is the City of San Diego's (City) solicitation process to acquire Construction services for **MBC Cooling Water System Chiller Upgrade**. For additional information refer to Attachment A.
2. **FULL AND OPEN COMPETITION:** This contract is open to full competition and may be bid on by Contractors who are on the City's current Prequalified Contractors' List. For information regarding the Contractors Prequalified list visit the City's web site: <http://www.sandiego.gov>.
3. **ESTIMATED CONSTRUCTION COST:** The City's estimated construction cost for this project is **\$2,400,000**.
4. **BID DUE DATE AND TIME ARE: FEBRUARY 21, 2019 at 2:00 PM**
5. **PREVAILING WAGE RATES APPLY TO THIS CONTRACT:** Refer to Attachment D.
6. **LICENSE REQUIREMENT:** To be eligible for award of this contract, Prime contractor must possess the following licensing classification: **A**
7. **SUBCONTRACTING PARTICIPATION PERCENTAGES:** Subcontracting participation percentages apply to this contract.
 - 7.1. The City has incorporated **mandatory** SLBE-ELBE subcontractor participation percentages to enhance competition and maximize subcontracting opportunities. For the purpose of achieving the mandatory subcontractor participation percentages, a recommended breakdown of the SLBE and ELBE subcontractor participation percentages based upon certified SLBE and ELBE firms has also been provided to achieve the mandatory subcontractor participation percentages:

1. SLBE participation	2.2%
2. ELBE participation	3.3%
3. Total mandatory participation	5.5%
 - 7.2. The Bid may be declared non-responsive if the Bidder fails to meet the following requirements:
 - 7.2.1. Include SLBE-ELBE certified subcontractors at the overall mandatory participation percentage identified in this document; **OR**
 - 7.2.2. Submit Good Faith Effort documentation, saved in searchable Portable Document Format (PDF) and stored on Compact Disc (CD) or Digital Video Disc (DVD), demonstrating the Bidder made a good faith effort to outreach to and include SLBE-ELBE Subcontractors required in this document within 3 Working Days of the Bid opening if the overall mandatory participation percentage is not met.

8. AWARD PROCESS:

- 8.1.** The Award of this contract is contingent upon the Contractor's compliance with all conditions of Award as stated within these documents and within the Notice of Intent to Award.
- 8.2.** Upon acceptance of bids and determination of the apparent low bidder, the City will prepare the contract documents for execution within approximately 21 days of the date of the bid opening. The City will then award the contract upon receipt of properly signed Contract, bonds, and insurance documents.
- 8.3.** This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form by the City Attorney's Office.
- 8.4.** The low Bid will be determined by the Base Bid.
- 8.5.** Once the low bid has been determined, the City may, at its sole discretion, award the contract for the Base bid alone.

9. SUBMISSION OF QUESTIONS:

- 9.1.** The Director (or Designee) of Public Works Department is the officer responsible for opening, examining, and evaluating the competitive Bids submitted to the City for the acquisition, construction and completion of any public improvement except when otherwise set forth in these documents. Any questions related to this solicitation shall be submitted to:

Public Works Contracts
525 B Street, Suite 750, (7th Floor)
San Diego, California, 92101
Attention: Antoinette Sanfilippo

OR:

ASanfilippo@sandiego.gov

- 9.2.** Questions received less than 14 days prior to the date for opening of Bids may not be considered.
- 9.3.** Questions or clarifications deemed by the City to be material shall be answered via issuance of an addendum and posted to the City's online bidding service.
- 9.4.** Only questions answered by formal written addenda shall be binding. Oral and other interpretations or clarifications shall be without legal effect. It is the Bidder's responsibility to be informed of any addenda that have been issued and to include all such information in its Bid.

10. PHASED FUNDING: For Phased Funding Conditions, see Attachment B.

INSTRUCTIONS TO BIDDERS

1. PREQUALIFICATION OF CONTRACTORS:

- 1.1. Contractors submitting a Bid must be pre-qualified for the total amount proposed, including all alternate items, prior to the date of submittal. Bids from contractors who have not been pre-qualified as applicable and Bids that exceed the maximum dollar amount at which contractors are pre-qualified may be deemed **non-responsive** and ineligible for award.
- 1.2. The completed application must be submitted online no later than 2 weeks prior to the bid opening.
- 1.3. **Joint Venture Bidders Cumulative Maximum Bidding Capacity:** For projects with an engineer's estimate of \$30,000,000 or greater, Joint Ventures submitting bids may be deemed responsive and eligible for award if the cumulative maximum bidding capacity of the individual Joint Venture entities is equal to or greater than the total amount proposed.
 - 1.3.1. Each of the entities of the Joint Venture must have been previously prequalified at a minimum of \$15,000,000.
 - 1.3.2. Bids submitted with a total amount proposed of less than \$30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification. To be eligible for award in this scenario, the Joint Venture itself or at least one of the Joint Venture entities must have been prequalified for the total amount proposed.
 - 1.3.3. Bids submitted by Joint Ventures with a total amount proposed of \$30,000,000 or greater on a project with an engineer's estimate of less than \$30,000,000 are not eligible for Cumulative Maximum Bidding Capacity prequalification.
 - 1.3.4. The Joint Venture designated as the Apparent Low Bidder shall provide evidence of its corporate existence and furnish good and approved bonds in the name of the Joint Venture within 14 Calendar Days of receipt by the Bidder of a form of contract for execution.
- 1.4. Complete information and links to the on-line prequalification application are available at:

<http://www.sandiego.gov/cip/bidopps/prequalification>
- 1.5. Due to the City's responsibility to protect the confidentiality of the contractors' information, City staff will not be able to provide information regarding contractors' prequalification status over the telephone. Contractors may access real-time information about their prequalification status via their vendor profile on [PlanetBids™](#).

2. **ELECTRONIC FORMAT RECEIPT AND OPENING OF BIDS:** Bids will be received in electronic format (eBids) EXCLUSIVELY at the City of San Diego’s electronic bidding (eBidding) site, at: <http://www.sandiego.gov/cip/bidopps/index.shtml> and are due by the date, and time shown on the cover of this solicitation.
- 2.1. **BIDDERS MUST BE PRE-REGISTERED** with the City’s bidding system and possess a system-assigned Digital ID in order to submit an electronic bid.
- 2.2. The City’s bidding system will automatically track information submitted to the site including IP addresses, browsers being used and the URLs from which information was submitted. In addition, the City’s bidding system will keep a history of every login instance including the time of login, and other information about the user’s computer configuration such as the operating system, browser type, version, and more. Because of these security features, Contractors who disable their browsers’ cookies will not be able to log in and use the City’s bidding system.
- 2.3. The City’s electronic bidding system is responsible for bid tabulations. Upon the bidder’s or proposer’s entry of their bid, the system will ensure that all required fields are entered. **The system will not accept a bid for which any required information is missing.** This includes all necessary pricing, subcontractor listing(s) and any other essential documentation and supporting materials and forms requested or contained in these solicitation documents.
- 2.4. **BIDS REMAIN SEALED UNTIL BID DEADLINE.** eBids are transmitted into the City’s bidding system via hypertext transfer protocol secure (https) mechanism using SSL 128-256 bit security certificates issued from Verisign/Thawte which encrypts data being transferred from client to server. Bids submitted prior to the “Bid Due Date and Time” are not available for review by anyone other than the submitter who has until the “Bid Due Date and Time” to change, rescind or retrieve its proposal should it desire to do so.
- 2.5. **BIDS MUST BE SUBMITTED BY BID DUE DATE AND TIME.** Once the bid deadline is reached, no further submissions are accepted into the system. Once the Bid Due Date and Time has lapsed, bidders, proposers, the general public, and City staff are able to immediately see the results on line. City staff may then begin reviewing the submissions for responsiveness, EOCB compliance and other issues. The City may require any Bidder to furnish statement of experience, financial responsibility, technical ability, equipment, and references.
- 2.6. **RECAPITULATION OF THE WORK.** Bids shall not contain any recapitulation of the Work. Conditional Bids may be rejected as being non-responsive. Alternative proposals will not be considered unless called for.

2.7. BIDS MAY BE WITHDRAWN by the Bidder only up to the bid due date and time.

2.7.1. Important Note: Submission of the electronic bid into the system may not be instantaneous. Due to the speed and capabilities of the user's internet service provider (ISP), bandwidth, computer hardware and other variables, it may take time for the bidder's submission to upload and be received by the City's eBidding system. It is the bidder's sole responsibility to ensure their bids are received on time by the City's eBidding system. The City of San Diego is not responsible for bids that do not arrive by the required date and time.

2.8. ACCESSIBILITY AND AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE: To request a copy of this solicitation in an alternative format, contact the Public Works Contract Specialist listed on the cover of this solicitation at least five (5) working days prior to the Bid/Proposal due date to ensure availability.

3. ELECTRONIC BID SUBMISSIONS CARRY FULL FORCE AND EFFECT

3.1. The bidder, by submitting its electronic bid, acknowledges that doing so carries the same force and full legal effect as a paper submission with a longhand (wet) signature.

3.2. By submitting an electronic bid, the bidder certifies that the bidder has thoroughly examined and understands the entire Contract Documents (which consist of the plans and specifications, drawings, forms, affidavits and the solicitation documents), and that by submitting the eBid as its bid proposal, the bidder acknowledges, agrees to and is bound by the entire Contract Documents, including any addenda issued thereto, and incorporated by reference in the Contract Documents.

3.3. The Bidder, by submitting its electronic bid, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certification, forms and affidavits submitted as part of this bid are true and correct.

3.4. The Bidder agrees to the construction of the project as described in Attachment "A – Scope of Work" for the City of San Diego, in accordance with the requirements set forth herein for the electronically submitted prices. The Bidder guarantees the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee shall be extended by the number of days required for the City to obtain all items necessary to fulfill all conditions precedent.

4. BIDS ARE PUBLIC RECORDS: Upon receipt by the City, Bids shall become public records subject to public disclosure. It is the responsibility of the respondent to clearly identify any confidential, proprietary, trade secret or otherwise legally privileged information contained within the Bid. General references to sections of the California Public Records Act (PRA) will not suffice. If the Contractor does not provide applicable case law that clearly establishes that the requested information is exempt from the disclosure requirements of the PRA, the City shall be free to release the information when required in accordance with the PRA, pursuant to any other applicable law, or by order of any court or government agency, and the Contractor will hold the City harmless for release of this information.

5. CONTRACTOR REGISTRATION AND ELECTRONIC REPORTING SYSTEM:

5.1. **Prior** to the Award of the Contract or Task Order, you and your Subcontractors and Suppliers must register with the City’s web-based vendor registration and bid management system. For additional information go to:

<http://www.sandiego.gov/purchasing/bids-contracts/vendorreg>.

5.2. The City may not award the contract until registration of all subcontractors and suppliers is complete. In the event this requirement is not met within the time frame specified in the Notice of Intent to Award letter, the City reserves the right to rescind the Notice of Award / Intent to Award and to make the award to the next responsive and responsible bidder / proposer.

6. JOINT VENTURE CONTRACTORS: Provide a copy of the Joint Venture agreement and the Joint Venture license to the City within 14 Calendar Days after receiving the Contract forms.

7. INSURANCE REQUIREMENTS:

7.1. All certificates of insurance and endorsements required by the contract are to be provided upon issuance of the City’s Notice of Intent to Award letter.

7.2. Refer to sections within 5-4, “INSURANCE” of the Supplementary Special Provisions (SSP) for the insurance requirements which must be met.

8. REFERENCE STANDARDS: Except as otherwise noted or specified, the Work shall be completed in accordance with the following standards:

Title	Edition	Document Number
Standard Specifications for Public Works Construction (“The GREENBOOK”) http://www.greenbookspecs.org/	2018	PWPI010119-01
City of San Diego Standard Specifications for Public Works Construction (“The WHITEBOOK”)* https://www.sandiego.gov/publicworks/edocref/greenbook	2018	PWPI010119-02
City of San Diego Standard Drawings* https://www.sandiego.gov/publicworks/edocref/standarddraw	2018	PWPI010119-03
Citywide Computer Aided Design and Drafting (CADD) Standards https://www.sandiego.gov/publicworks/edocref/drawings	2018	PWPI010119-04
California Department of Transportation (CALTRANS) Standard Specifications – http://www.dot.ca.gov/des/oe/construction-contract-standards.html	2015	PWPI092816-05

Title	Edition	Document Number
CALTRANS Standard Plans http://www.dot.ca.gov/des/oe/construction-contract-standards.html	2015	PWPI092816-06
California Manual on Uniform Traffic Control Devices Revision 1 (CA MUTCD Rev 1) - http://www.dot.ca.gov/trafficops/camutcd/	2014	PWPIO92816-07
<p>NOTE: *Available online under Engineering Documents and References at: http://www.sandiego.gov/publicworks/edocref/index.shtml</p> <p>*Electronic updates to the Standard Drawings may also be found in the link above.</p>		

9. **CITY'S RESPONSES AND ADDENDA:** The City, at its discretion, may respond to any or all questions submitted in writing via the City's eBidding web site in the **form of an addendum**. No other responses to questions, oral or written shall be of any force or effect with respect to this solicitation. The changes to the Contract Documents through addenda are made effective as though originally issued with the Bid. The Bidders shall acknowledge the receipt of Addenda at the time of bid submission.
10. **CITY'S RIGHTS RESERVED:** The City reserves the right to cancel the Notice Inviting Bids at any time, and further reserves the right to reject submitted Bids, without giving any reason for such action, at its sole discretion and without liability. Costs incurred by the Bidder(s) as a result of preparing Bids under the Notice Inviting Bids shall be the sole responsibility of each bidder. The Notice Inviting Bids creates or imposes no obligation upon the City to enter a contract.
11. **CONTRACT PRICING:** This solicitation is for a Lump Sum contract with Unit Price provisions as set forth herein. The Bidder agrees to perform construction services for the City of San Diego in accordance with these contract documents for the prices listed below. The Bidder further agrees to guarantee the Contract Price for a period of 120 days from the date of Bid opening. The duration of the Contract Price guarantee may be extended, by mutual consent of the parties, by the number of days required for the City to obtain all items necessary to fulfill all contractual conditions.
12. **SUBCONTRACTOR INFORMATION:**
- 12.1. **LISTING OF SUBCONTRACTORS.** In accordance with the requirements provided in the "Subletting and Subcontracting Fair Practices Act" of the California Public Contract Code, the Bidder shall provide the **NAME** and **ADDRESS** of each Subcontractor who will perform work, labor, render services or who specially fabricates and installs a portion [type] of the work or improvement, in an amount in excess of 0.5% of the Contractor's total Bid. The Bidder shall also state within the description, whether the subcontractor is a **CONSTRUCTOR, CONSULTANT** or **SUPPLIER**. The Bidder shall state the **DIR REGISTRATION NUMBER** for all subcontractors and shall further state

within the description, the **PORTION** of the work which will be performed by each subcontractor under this Contract. The Contractor shall list only one Subcontractor for each portion of the Work. The **DOLLAR VALUE** of the total Bid to be performed shall be stated for all subcontractors listed. Failure to comply with this requirement may result in the Bid being rejected as **non-responsive** and ineligible for award. The Bidder's attention is directed to the Special Provisions - General; Paragraph 2-3, "Subcontracts", which stipulates the percent of the Work to be performed with the Bidders' own forces. The Bidder shall list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which Bidders are seeking recognition towards achieving any mandatory, voluntary (or both) subcontracting participation goals.

Additionally, pursuant to California Senate Bill 96 and in accordance with the requirements of Labor Code sections 1771.1 and 1725.5, by submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the California Department of Industrial Relations (DIR). **The Bidder shall provide the name, address, license number, DIR registration number of any Subcontractor - regardless of tier** - who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement pursuant to the contract.

12.2. LISTING OF SUPPLIERS. Any Bidder seeking the recognition of Suppliers of equipment, materials, or supplies obtained from third party Suppliers towards achieving any mandatory or voluntary (or both) subcontracting participation goals shall provide, at a minimum, the **NAME, LOCATION (CITY), DIR REGISTRATION NUMBER** and the **DOLLAR VALUE** of each supplier. The Bidder will be credited up to 60% of the amount to be paid to the Suppliers for materials and supplies unless vendor manufactures or substantially alters materials and supplies, in which case, 100% will be credited. The Bidder is to indicate within the description whether the listed firm is a supplier or manufacturer. If no indication is provided, the listed firm will be credited at 60% of the listed dollar value for purposes of calculating the Subcontractor Participation Percentage.

12.3. LISTING OF SUBCONTRACTORS OR SUPPLIERS FOR ALTERNATES. For subcontractors or suppliers to be used on additive or deductive alternate items, in addition to the above requirements, bidder shall further note "ALTERNATE" and alternate item number within the description.

13. SUBMITTAL OF "OR EQUAL" ITEMS: See Section 4-6, "TRADE NAMES" in The WHITEBOOK and as amended in the SSP.

14. AWARD:

14.1. The Award of this contract is contingent upon the Contractor's compliance with all conditions precedent to Award.

- 14.2.** Upon acceptance of a Bid, the City will prepare contract documents for execution within approximately 21 days of the date of the Bid opening and award the Contract approximately within 7 days of receipt of properly executed Contract, bonds, and insurance documents.
- 14.3.** This contract will be deemed executed and effective only upon the signing of the Contract by the Mayor or his designee and approval as to form the City Attorney's Office.
- 15. SUBCONTRACT LIMITATIONS:** The Bidder's attention is directed to Standard Specifications for Public Works Construction, Section 3-2, "SELF-PERFORMANCE" in The GREENBOOK and as amended in the SSP which requires the Contractor to self-perform not less than the specified amount. Failure to comply with this requirement shall render the bid **non-responsive** and ineligible for award.
- 16. AVAILABILITY OF PLANS AND SPECIFICATIONS:** Contract Documents may be obtained by visiting the City's website: <http://www.sandiego.gov/cip/>. Plans and Specifications for this contract are also available for review in the office of the City Clerk or Public Works Contracts.
- 17. ONLY ONE BID PER CONTRACTOR SHALL BE ACCEPTED:** No person, firm, or corporation shall be allowed to make, file, or be interested in more than one (1) Bid for the same work unless alternate Bids are called for. A person, firm or corporation who has submitted a sub-proposal to a Bidder, or who has quoted prices on materials to a Bidder, is not hereby disqualified from submitting a sub-proposal or quoting prices to other Bidders or from submitting a Bid in its own behalf. Any Bidder who submits more than one bid will result in the rejection of all bids submitted.
- 18. SAN DIEGO BUSINESS TAX CERTIFICATE:** The Contractor and Subcontractors, not already having a City of San Diego Business Tax Certificate for the work contemplated shall secure the appropriate certificate from the City Treasurer, Civic Center Plaza, First floor and submit to the Contract Specialist upon request or as specified in the Contract Documents. Tax Identification numbers for both the Bidder and the listed Subcontractors must be submitted on the City provided forms within these documents.
- 19. BIDDER'S GUARANTEE OF GOOD FAITH (BID SECURITY) FOR DESIGN-BID-BUILD CONTRACTS:**
- 19.1.** For bids \$250,000 and above, bidders shall submit Bid Security at bid time. Bid Security shall be in one of the following forms: a cashier's check, or a properly certified check upon some responsible bank; or an approved corporate surety bond payable to the City of San Diego for an amount of not less than 10% of the total bid amount.
- 19.2.** This check or bond, and the monies represented thereby, will be held by the City as a guarantee that the Bidder, if awarded the contract, will in good faith enter into the contract and furnish the required final performance and payment bonds.

- 19.3. The Bidder agrees that in the event of the Bidder's failure to execute this contract and provide the required final bonds, the money represented by the cashier's or certified check will remain the property of the City; and the Surety agrees that it will pay to the City the damages, not exceeding the sum of 10% of the amount of the Bid, that the City may suffer as a result of such failure.
- 19.4. At the time of bid submission, bidders must upload and submit an electronic PDF copy of the aforementioned bid security. Whether in the form of a cashier's check, a properly certified check or an approved corporate surety bond payable to the City of San Diego, the bid security must be uploaded to the City's eBidding system. Within twenty-four (24) hours after the bid due date and time, the first five (5) apparent low bidders must provide the City with the original bid security.
- 19.5. Failure to submit the electronic version of the bid security at the time of bid submission AND failure to provide the original within twenty-four (24) hours may cause the bid to be rejected and deemed **non-responsive**.

20. AWARD OF CONTRACT OR REJECTION OF BIDS:

- 20.1. This contract may be awarded to the lowest responsible and reliable Bidder.
- 20.2. Bidders shall complete ALL eBid forms as required by this solicitation. Incomplete eBids will not be accepted.
- 20.3. The City reserves the right to reject any or all Bids, to waive any informality or technicality in Bids received, and to waive any requirements of these specifications as to bidding procedure.
- 20.4. Bidders will not be released on account of their errors of judgment. Bidders may be released only upon receipt by the City within 3 Working Days of the bid opening, written notice from the Bidder which shows proof of honest, credible, clerical error of a material nature, free from fraud or fraudulent intent; and of evidence that reasonable care was observed in the preparation of the Bid.
- 20.5. A bidder who is not selected for contract award may protest the award of a contract to another bidder by submitting a written protest in accordance with the San Diego Municipal Code.
- 20.6. The City of San Diego will not discriminate in the award of contracts with regard to race, religion creed, color, national origin, ancestry, physical handicap, marital status, sex or age.
- 20.7. Each Bid package properly signed as required by these specifications shall constitute a firm offer which may be accepted by the City within the time specified herein.
- 20.8. The City reserves the right to evaluate all Bids and determine the lowest Bidder on the basis of the base bid and any proposed alternates or options as detailed herein.

21. BID RESULTS:

- 21.1.** The availability of the bids on the City's eBidding system shall constitute the public announcement of the apparent low bidder. In the event that the apparent low bidder is subsequently deemed non-responsive or non-responsible, a notation of such will be made on the eBidding system. The new ranking and apparent low bidder will be adjusted accordingly.
- 21.2.** To obtain the bid results, view the results on the City's web site, or request the results by U.S. mail and provide a self-addressed, stamped envelope. If requesting by mail, be sure to reference the bid name and number. The bid tabulations will be mailed to you upon their completion. The results will not be given over the telephone.

22. THE CONTRACT:

- 22.1.** The Bidder to whom award is made shall execute a written contract with the City of San Diego and furnish good and approved bonds and insurance certificates specified by the City within 14 days after receipt by Bidder of a form of contract for execution unless an extension of time is granted to the Bidder in writing.
- 22.2.** If the Bidder takes longer than 14 days to fulfill these requirements, then the additional time taken shall be added to the Bid guarantee. The Contract shall be made in the form adopted by the City, which includes the provision that no claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.
- 22.3.** If the Bidder to whom the award is made fails to enter into the contract as herein provided, the award may be annulled and the Bidder's Guarantee of Good Faith will be subject to forfeiture. An award may be made to the next lowest responsible and reliable Bidder who shall fulfill every stipulation embraced herein as if it were the party to whom the first award was made.
- 22.4.** Pursuant to the San Diego City Charter section 94, the City may only award a public works contract to the lowest responsible and reliable Bidder. The City will require the Apparent Low Bidder to (i) submit information to determine the Bidder's responsibility and reliability, (ii) execute the Contract in form provided by the City, and (iii) furnish good and approved bonds and insurance certificates specified by the City within 14 Days, unless otherwise approved by the City, in writing after the Bidder receives notification from the City, designating the Bidder as the Apparent Low Bidder and formally requesting the above mentioned items.
- 22.5.** The award of the Contract is contingent upon the satisfactory completion of the above-mentioned items and becomes effective upon the signing of the Contract by the Mayor or designee and approval as to form by the City Attorney's Office. If the Apparent Low Bidder does not execute the Contract or submit required documents and information, the City

may award the Contract to the next lowest responsible and reliable Bidder who shall fulfill every condition precedent to award. A corporation designated as the Apparent Low Bidder shall furnish evidence of its corporate existence and evidence that the officer signing the Contract and bond for the corporation is duly authorized to do so.

- 23. EXAMINATION OF PLANS, SPECIFICATIONS, AND SITE OF WORK:** The Bidder shall examine carefully the Project Site, the Plans and Specifications, other materials as described in the Special Provisions, Section 3-9, and the proposal forms (e.g., Bidding Documents). The submission of a Bid shall be conclusive evidence that the Bidder has investigated and is satisfied as to the conditions to be encountered, as to the character, quality, and scope of Work, the quantities of materials to be furnished, and as to the requirements of the Bidding Documents Proposal, Plans, and Specifications.
- 24. CITY STANDARD PROVISIONS:** This contract is subject to the following standard provisions. See The WHITEBOOK for details.
- 24.1.** The City of San Diego Resolution No. R-277952 adopted on May 20, 1991 for a Drug-Free Workplace.
 - 24.2.** The City of San Diego Resolution No. R-282153 adopted on June 14, 1993 related to the Americans with Disabilities Act.
 - 24.3.** The City of San Diego Municipal Code §22.3004 for Contractor Standards.
 - 24.4.** The City of San Diego's Labor Compliance Program and the State of California Labor Code §§1771.5(b) and 1776.
 - 24.5.** Sections 1777.5, 1777.6, and 1777.7 of the State of California Labor Code concerning the employment of apprentices by contractors and subcontractors performing public works contracts.
 - 24.6.** The City's Equal Benefits Ordinance (EBO), Chapter 2, Article 2, Division 43 of The San Diego Municipal Code (SDMC).
 - 24.7.** The City's Information Security Policy (ISP) as defined in the City's Administrative Regulation 90.63.
- 25. PRE-AWARD ACTIVITIES:**
- 25.1.** The contractor selected by the City to execute a contract for this Work shall submit the required documentation as specified in the herein and in the Notice of Award. Failure to provide the information as specified may result in the Bid being rejected as **non-responsive**.
 - 25.2.** The decision that bid is non-responsive for failure to provide the information required within the time specified shall be at the sole discretion of the City.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND

FAITHFUL PERFORMANCE BOND AND LABOR AND MATERIALMEN'S BOND:

TechCom International Corporation dba Solar 2 Power a corporation, as principal, and Nationwide Mutual Insurance Company, a corporation authorized to do business in the State of California, as Surety, hereby obligate themselves, their successors and assigns, jointly and severally, to The City of San Diego a municipal corporation in the sum of two million nine hundred fifteen thousand seven hundred twenty-six dollars and eighty-three cents (\$2,915,726.83) for the faithful performance of the annexed contract, and in the sum of two million nine hundred fifteen thousand seven hundred twenty-six dollars and eighty-three cents (\$2,915,726.83) for the benefit of laborers and materialmen designated below.

Conditions:

If the Principal shall faithfully perform the annexed contract with the City of San Diego, California, then the obligation herein with respect to a faithful performance shall be void; otherwise it shall remain in full force.

If the Principal shall promptly pay all persons, firms and corporations furnishing materials for or performing labor in the execution of this contract, and shall pay all amounts due under the California Unemployment Insurance Act then the obligation herein with respect to laborers and materialmen shall be void; otherwise it shall remain in full force.

The obligation herein with respect to laborers and materialmen shall inure to the benefit of all persons, firms and corporations entitled to file claims under the provisions of Article 2. Claimants, (iii) public works of improvement commencing with Civil Code Section 9100 of the Civil Code of the State of California.

Changes in the terms of the annexed contract or specifications accompanying same or referred to therein shall not affect the Surety's obligation on this bond, and the Surety hereby waives notice of same.

The Surety shall pay reasonable attorney's fees should suit be brought to enforce the provisions of this bond.

PERFORMANCE BOND, LABOR AND MATERIALMEN'S BOND (continued)

Dated April 16, 2019

Approved as to Form

TechCom International Corporation dba Solar 2 Power

Principal

By B. Katerbian

BOB KATERBIAN

Printed Name of Person Signing for Principal

Mara W. Elliott, City Attorney

By Coleone

Deputy City Attorney

Nationwide Mutual Insurance Company

Surety

By James W. Johnson

James W. Johnson, Attorney-In-Fact
Attorney-in-fact

Approved:

15901 Red Hill Avenue, Ste. 100

Local Address of Surety

By Stephen Samara

Stephen Samara
Principal Contract Specialist
Public Works Department

Tustin, CA 92780

Local Address (City, State) of Surety

(714) 505-7011

Local Telephone No. of Surety

Premium \$ \$27,469.00

Bond No. BD762201

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA

County of ORANGE }

On APRIL 18, 2019 before me, JENNIFER C. ANAYA, NOTARY PUBLIC, Notary Public,
Date Insert Name of Notary exactly as it appears on the official seal

personally appeared B. KATEBIAN

Name(s) of Signer(s)

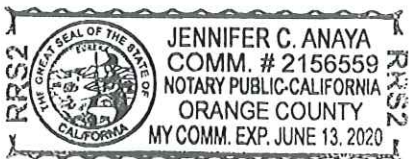
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

Witness my hand and official seal.

Signature

Signature of Notary Public JENNIFER C. ANAYA



Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of the form to another document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

RIGHT THUMBPRINT
OF SIGNER

Top of thumb here

Signer is Representing: _____

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

RIGHT THUMBPRINT
OF SIGNER

Top of thumb here

Signer is Representing: _____

CALIFORNIA ALL-PURPOSE CERTIFICATE OF ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California

County of Orange

On APR 16 2019, before me, Frances Lefler Notary Public,
personally appeared

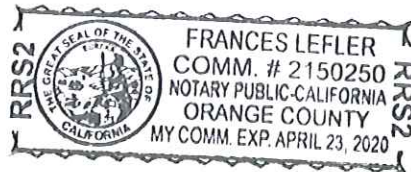
James W. Johnson,

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under **PENALTY OF PERJURY** under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal

Frances Lefler



(Seal)

OPTIONAL

Description of attached document:

Document Title: _____

Date of Document: _____

Number of Pages: _____

Additional Signers Not Named Above: _____

Power of Attorney

KNOW ALL MEN BY THESE PRESENTS THAT:

Nationwide Mutual Insurance Company, an Ohio corporation hereinafter referred to as the "Company" and does hereby make, constitute and appoint:
Erik K. Johansson, Melissa Lopez, James W. Johnson

each in their individual capacity, its true and lawful attorney-in-fact, with full power and authority to sign, seal, and execute on its behalf any and all bonds and undertakings, and other obligatory instruments of similar nature, in penalties not exceeding the sum of

UNLIMITED

and to bind the Company thereby, as fully and to the same extent as if such instruments were signed by the duly authorized officers of the Company; and all acts of said Attorney pursuant to the authority given are hereby ratified and confirmed.

This power of attorney is made and executed pursuant to and by authority of the following resolution duly adopted by the board of directors of the Company:

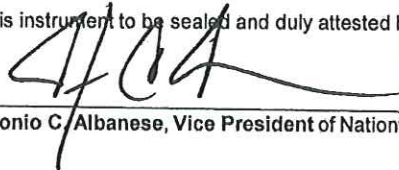
"RESOLVED, that the president, or any vice president be, and each hereby is, authorized and empowered to appoint attorneys-in-fact of the Company, and to authorize them to execute and deliver on behalf of the Company any and all bonds, forms, applications, memorandums, undertakings, recognizances, transfers, contracts of indemnity, policies, contracts guaranteeing the fidelity of persons holding positions of public or private trust, and other writings obligatory in nature that the business of the Company may require; and to modify or revoke, with or without cause, any such appointment or authority; provided, however, that the authority granted hereby shall in no way limit the authority of other duly authorized agents to sign and countersign any of said documents on behalf of the Company."

"RESOLVED FURTHER, that such attorneys-in-fact shall have full power and authority to execute and deliver any and all such documents and to bind the Company subject to the terms and limitations of the power of attorney issued to them, and to affix the seal of the Company thereto; provided, however, that said seal shall not be necessary for the validity of any such documents."

This power of attorney is signed and sealed under and by the following bylaws duly adopted by the board of directors of the Company.

Execution of Instruments. Any vice president, any assistant secretary or any assistant treasurer shall have the power and authority to sign or attest all approved documents, instruments, contracts, or other papers in connection with the operation of the business of the company in addition to the chairman of the board, the chief executive officer, president, treasurer or secretary; provided, however, the signature of any of them may be printed, engraved, or stamped on any approved document, contract, instrument, or other papers of the Company.

IN WITNESS WHEREOF, the Company has caused this instrument to be sealed and duly attested by the signature of its officer the 1st day of May, 2017.



Antonio C. Albanese, Vice President of Nationwide Mutual Insurance Company

ACKNOWLEDGMENT

STATE OF NEW YORK, COUNTY OF NEW YORK: ss

On this 1st day of May, 2017, before me came the above-named officer for the Company aforesaid, to me personally known to be the officer described in and who executed the preceding instrument, and he acknowledged the execution of the same, and being by me duly sworn, deposes and says, that he is the officer of the Company aforesaid, that the seal affixed hereto is the corporate seal of said Company, and the said corporate seal and his signature were duly affixed and subscribed to said instrument by the authority and direction of said Company.



BARRY T. BASSIS
Notary Public, State of New York
No. 02BA4656400
Qualified in New York County
Commission Expires April 30, 2019



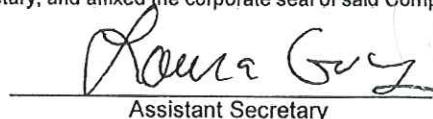
Notary Public
My Commission Expires
April 30, 2019

CERTIFICATE

I, Laura B. Guy, Assistant Secretary of the Company, do hereby certify that the foregoing is a full, true and correct copy of the original power of attorney issued by the Company; that the resolution included therein is a true and correct transcript from the minutes of the meetings of the boards of directors and the same has not been revoked or amended in any manner; that said Antonio C. Albanese was on the date of the execution of the foregoing power of attorney the duly elected officer of the Company, and the corporate seal and his signature as officer were duly affixed and subscribed to the said instrument by the authority of said board of directors; and the foregoing power of attorney is still in full force and effect.

IN WITNESS WHEREOF, I have hereunto subscribed my name as Assistant Secretary, and affixed the corporate seal of said Company this _____ day of _____, 20_____.

APR 16 2019


Assistant Secretary

ATTACHMENTS

ATTACHMENT A
SCOPE OF WORK

SCOPE OF WORK

- SCOPE OF WORK:** The project involves the replacement of: two existing 370-ton chillers with three new units 250-ton units; three existing primary water pumps with four new pumps; the Staefa process control unit with Programmable Controls tied directly to the Ovation Distributed Control System (DCS); all of the existing valves and valve actuators with new unites that meet specifications and DCS requirements; and two secondary water pumps and associated variable frequency drives. This project also includes the replacement of all the concrete slab and pads within existing chiller area to accommodate the new equipment and all necessary piping, mechanical, electrical, instrumentation and controls as required by the cooling water system chillers upgrades.

The project is located with the Metro Biosolids Center located at 5240 Convoy Street, San Diego, CA 92111 and is part of the Miramar Landfill which is sited within the Miramar Marine Corps Air Station north of the Kearny Mesa Community Planning Area (Council District 6).

1.1. The Work shall be performed in accordance with:

1.1.1. The Notice Inviting Bids and Plans numbered **40054-1-D** through **40054-70-D**, inclusive.

- LOCATION OF WORK:** The location of the Work is as follows:

Metro Biosolids Center, 5240 Convoy Street, San Diego, CA 92111

- CONTRACT TIME:** The Contract Time for completion of the Work shall be **250 Working Days**.

ATTACHMENT B
PHASED FUNDING PROVISIONS

PHASED FUNDING PROVISIONS

1. PRE-AWARD

- 1.1. Within 10 Working Days of the Notice of Intent to Award, the Contractor must contact the Project Manager to discuss fund availability for each phase and shall also submit the following:
 - 1.1.1. Construction Cost Loaded Schedule in accordance with 6-1, "CONSTRUCTION SCHEDULE AND COMMENCEMENT OF THE WORK" and 7-3, "PAYMENT.
- 1.2. Contractor's failure to perform any of the following may result cancelling the award of the Contract:
 - 1.2.1. Meeting with the City's Project Manager to discuss the Phased Funding Schedule.
 - 1.2.2. Agreeing to a Phased Funding Schedule within **thirty** days of meeting with the City's Project Manager.

2. POST-AWARD

- 2.1. Do not start any construction activities for the next phase until the Notice to Proceed (NTP) has been issued by the City. The City will issue a separate NTP for each phase.
- 2.2. The City may issue the NTP for a subsequent phase before the completion of the preceding phase.

PHASED FUNDING SCHEDULE AGREEMENT

The particulars left blank below, such as the total number of phases and the amounts assigned to each phase, will be completed with funding specific information from the Pre-Award Schedule and Construction Cost Loaded Schedule submitted to and approved by the City.

BID NUMBER: K-19-1802-DBB-3

CONTRACT OR TASK TITLE: MBC Cooling Water System Chiller Upgrade

CONTRACTOR: TechCom International, Corp.

Funding Phase	Phase Description	Phase Start	Phase Finish	Not-to-Exceed Amount
1	Bonds, Mobilization, Project Initiation	NTP	8/31/2109	\$290,000.
2	Project Construction, Start Up	09/01/2019	NOC	\$2,625,726.83
Contract Total				\$2,915,726.83

Notes:

- 1) WHITEBOOK section 7-3.10, "Phased Funding Compensation" applies.
- 2) The total of all funding phases shall be equal to the TOTAL BID PRICE as shown on BID SCHEDULE 1 - PRICES.
- 3) This PHASED FUNDING SCHEDULE AGREEMENT will be incorporated into the CONTRACT and shall only be revised by written modifications to the CONTRACT.

CITY OF SAN DIEGO

CONTRACTOR

PRINT NAME: Michael Marks, PE


PRINT NAME: Butch Whittle

Senior Construction Manager

Signature: 

Title: Vice President

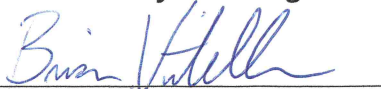
Date: 4/16/19

Signature: 

PRINT NAME: Brian Vitelle, PE

Date: 4-10-2019

Senior Project Manager

Signature: 

Date: 4/16/19

ATTACHMENT C
INTENTIONALLY LEFT BLANK

ATTACHMENT D
PREVAILING WAGES

PREVAILING WAGES

1. **PREVAILING WAGE RATES:** Pursuant to San Diego Municipal Code section 22.3019, construction, alteration, demolition, repair and maintenance work performed under this Contract is subject to State prevailing wage laws. For construction work performed under this Contract cumulatively exceeding \$25,000 and for alteration, demolition, repair and maintenance work performed under this Contract cumulatively exceeding \$15,000, the Contractor and its subcontractors shall comply with State prevailing wage laws including, but not limited to, the requirements listed below.
 - 1.1. **Compliance with Prevailing Wage Requirements.** Pursuant to sections 1720 through 1861 of the California Labor Code, the Contractor and its subcontractors shall ensure that all workers who perform work under this Contract are paid not less than the prevailing rate of per diem wages as determined by the Director of the California Department of Industrial Relations (DIR). This includes work performed during the design and preconstruction phases of construction including, but not limited to, inspection and land surveying work.
 - 1.1.1. Copies of such prevailing rate of per diem wages are on file at the City and are available for inspection to any interested party on request. Copies of the prevailing rate of per diem wages also may be found at <http://www.dir.ca.gov/OPRL/DPreWageDetermination.htm>. Contractor and its subcontractors shall post a copy of the prevailing rate of per diem wages determination at each job site and shall make them available to any interested party upon request.
 - 1.1.2. The wage rates determined by the DIR refer to expiration dates. If the published wage rate does not refer to a predetermined wage rate to be paid after the expiration date, then the published rate of wage shall be in effect for the life of this Contract. If the published wage rate refers to a predetermined wage rate to become effective upon expiration of the published wage rate and the predetermined wage rate is on file with the DIR, such predetermined wage rate shall become effective on the date following the expiration date and shall apply to this Contract in the same manner as if it had been published in said publication. If the predetermined wage rate refers to one or more additional expiration dates with additional predetermined wage rates, which expiration dates occur during the life of this Contract, each successive predetermined wage rate shall apply to this Contract on the date following the expiration date of the previous wage rate. If the last of such predetermined wage rates expires during the life of this Contract, such wage rate shall apply to the balance of the Contract.
 - 1.2. **Penalties for Violations.** Contractor and its subcontractors shall comply with California Labor Code section 1775 in the event a worker is paid less than the prevailing wage rate for the work or craft in which the worker is employed. This shall be in addition to any other applicable penalties allowed under Labor Code sections 1720 – 1861.

- 1.3. Payroll Records.** Contractor and its subcontractors shall comply with California Labor Code section 1776, which generally requires keeping accurate payroll records, verifying and certifying payroll records, and making them available for inspection. Contractor shall require its subcontractors to also comply with section 1776. Contractor and its subcontractors shall submit weekly certified payroll records online via the City's web-based Labor Compliance Program. Contractor is responsible for ensuring its subcontractors submit certified payroll records to the City.
- 1.3.1.** Contractor and their subcontractors shall also furnish records specified in Labor Code section 1776 directly to the Labor Commissioner in the manner required by Labor Code section 1771.4.
- 1.4. Apprentices.** Contractor and its subcontractors shall comply with California Labor Code sections 1777.5, 1777.6 and 1777.7 concerning the employment and wages of apprentices. Contractor is held responsible for the compliance of their subcontractors with sections 1777.5, 1777.6 and 1777.7.
- 1.5. Working Hours.** Contractor and their subcontractors shall comply with California Labor Code sections 1810 through 1815, including but not limited to: (i) restrict working hours on public works contracts to eight hours a day and forty hours a week, unless all hours worked in excess of 8 hours per day are compensated at not less than 1½ times the basic rate of pay; and (ii) specify penalties to be imposed on contractors and subcontractors of \$25 per worker per day for each day the worker works more than 8 hours per day and 40 hours per week in violation of California Labor Code sections 1810 through 1815.
- 1.6. Required Provisions for Subcontracts.** Contractor shall include at a minimum a copy of the following provisions in any contract they enter into with a subcontractor: California Labor Code sections 1771, 1771.1, 1775, 1776, 1777.5, 1810, 1813, 1815, 1860 and 1861.
- 1.7. Labor Code Section 1861 Certification.** Contractor in accordance with California Labor Code section 3700 is required to secure the payment of compensation of its employees and by signing this Contract, Contractor certifies that "I am aware of the provisions of Section 3700 of the California Labor Code which require every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and I will comply with such provisions before commencing the performance of the work of this Contract."
- 1.8. Labor Compliance Program.** The City has its own Labor Compliance Program authorized in August 2011 by the DIR. The City will withhold contract payments when payroll records are delinquent or deemed inadequate by the City or other governmental entity, or it has been established after an investigation by the City or other governmental entity that underpayment(s) have occurred. For questions or assistance, please contact the City of San Diego's Prevailing Wage Unit at 858-627-3200.

- 1.9. Contractor and Subcontractor Registration Requirements.** This project is subject to compliance monitoring and enforcement by the DIR. A contractor or subcontractor shall not be qualified to bid on, be listed in a bid or proposal, subject to the requirements of section 4104 of the Public Contract Code, or engage in the performance of any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code section 1725.5. It is not a violation of this section for an unregistered contractor to submit a bid that is authorized by Section 7029.1 of the Business and Professions code or by Section 10164 or 20103.5 of the Public Contract Code, provided the contractor is registered to perform public work pursuant to Section 1725.5 at the time the contract is awarded.
- 1.9.1.** A Contractor's inadvertent error in listing a subcontractor who is not registered pursuant to Labor Code section 1725.5 in response to a solicitation shall not be grounds for filing a bid protest or grounds for considering the bid non-responsive provided that any of the following apply: (1) the subcontractor is registered prior to bid opening; (2) within twenty-four hours after the bid opening, the subcontractor is registered and has paid the penalty registration fee specified in Labor Code section 1725.5; or (3) the subcontractor is replaced by another registered subcontractor pursuant to Public Contract Code section 4107.
- 1.9.2.** By submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the DIR in compliance with Labor Code sections 1771.1 and 1725.5, and Contractor shall provide proof of registration for themselves and all listed subcontractors to the City at the time of bid or proposal due date or upon request.
- 1.10. Stop Order.** For Contractor or its subcontractors engaging in the performance of any public work contract without having been registered in violation of Labor Code sections 1725.5 or 1771.1, the Labor Commissioner shall issue and serve a stop order prohibiting the use of the unregistered contractors or unregistered subcontractor(s) on ALL public works until the unregistered contractor or unregistered subcontractor(s) is registered. Failure to observe a stop order is a misdemeanor.
- 1.11. List of all Subcontractors.** The Contractor shall provide the list of subcontractors (regardless of tier), along with their DIR registration numbers, utilized on this Contract prior to any work being performed; and the Contractor shall provide a complete list of all subcontractors with each invoice. Additionally, Contractor shall provide the City with a complete list of all subcontractors (regardless of tier) utilized on this contract within ten working days of the completion of the contract, along with their DIR registration numbers. The City shall withhold final payment to Construction Management Professional until at least thirty (30) days after this information is provided to the City.

1.12. Exemptions for Small Projects. There are limited exemptions for installation, alteration, demolition, or repair work done on projects of \$25,000 or less. The Contractor shall still comply with Labor Code sections 1720 et. seq. The only recognized exemptions are listed below:

1.12.1. Registration. The Contractor will not be required to register with the DIR for small projects. (Labor Code section 1771.1)

1.12.2. Certified Payroll Records. The records required in Labor Code section 1776 shall be required to be kept and submitted to the City of San Diego, but will not be required to be submitted online with the DIR directly. The Contractor will need to keep those records for at least three years following the completion of the Contract. (Labor Code section 1771.4).

1.12.3. List of all Subcontractors. The Contractor shall not be required to hire only registered subcontractors and is exempt from submitting the list of all subcontractors that is required in section 4.20.11 above. (Labor code section 1773.3).

ATTACHMENT E
SUPPLEMENTARY SPECIAL PROVISIONS

SUPPLEMENTARY SPECIAL PROVISIONS

The following Supplementary Special Provisions (SSP) modifies the following documents:

1. The **2018 Edition** of the Standard Specifications for Public Works Construction (The "GREENBOOK").
2. The **2018 Edition** of the City of San Diego Standard Specifications for Public Works Construction (The "WHITEBOOK"), including the following:
 - a) General Provisions (A) for all Construction Contracts.

SECTION 1 – GENERAL, TERMS, DEFINITIONS, ABBREVIATIONS, UNITS OF MEASURE, AND SYMBOLS

- 1-2 TERMS AND DEFINITIONS.** To the "WHITEBOOK", item 54, "Normal Working Hours", ADD the following:

The **Normal Working Hours** are 7:30 AM to 3:30 PM.

SECTION 3 – CONTROL OF THE WORK

- 3-2 SELF-PERFORMANCE.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

1. You shall perform, with your own organization, Contract Work amounting to at least 55% of the base Bid **AND** 55% of any alternates.

- 3-10 SURVEYING.** To the "GREENBOOK", DELETE in its entirety and SUBSTITUTE with the following:

- 3-10 SURVEYING.**

1. You shall locate and mark all features related to the building and site, including landscaping and hardscape, using industry standard contractor's construction tools.
2. You shall preserve construction survey stakes, control points, and other survey related marks described in 3-10.1, "Survey Services Provided by the City" for the duration of the Project. If any construction survey stakes are lost or disturbed and need to be replaced, such replacement shall be performed by the City at your expense.

3-10.1 Survey Services Provided by the City.

1. The City will provide surveying services and on-site survey staking for the following:
 - a) Locations of any property lines, boundaries, or easement surveys within the project boundaries as required by the project.
 - b) Locations of up to four corners per building.
 - c) Verification of building pad finish surface elevation.
 - d) A maximum of 4 site control points.
 - e) Location and perpetuation of survey monuments within the project boundary in accordance with 400-2, "Permanent Survey Markers".
2. Notify the Resident Engineer in writing at least 2 Working Days prior to requesting survey services provided by the City.

3-10.2 Line and Grade.

1. The Work shall conform to the lines, elevations, and grades shown on the Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, you shall be responsible for any error in the grade of the Work.
2. Grades for underground conduits will be set at the surface of the ground. You shall transfer them to the bottom of the trench.

3-10.3 Payment.

1. The payment for survey services Work shall be included in the Contract Price.

SECTION 4 - CONTROL OF MATERIALS

4-3.6 Preapproved Materials. To the "WHITEBOOK", ADD the following:

3. You shall submit in writing a list of all products to be incorporated in the Work that are on the AML.

4-6 TRADE NAMES. To the "WHITEBOOK", ADD the following:

11. You shall submit your list of proposed substitutions for an "equal" item **no later than 5 Working Days after the determination of the Apparent Low Bidder** and on the City's Product Submittal Form available at:

<http://www.sandiego.gov/publicworks/edocref/index.shtml>

SECTION 5 – LEGAL RELATIONS AND RESPONSIBILITIES

5-4 **INSURANCE.** To the “GREENBOOK”, DELETE in its entirety and SUBSTITUTE with the following:

5-4 **INSURANCE.**

1. The insurance provisions herein shall not be construed to limit your indemnity obligations contained in the Contract.

5-4.1 **Policies and Procedures.**

1. You shall procure the insurance described below, at its sole cost and expense, to provide coverage against claims for loss including injuries to persons or damage to property, which may arise out of or in connection with the performance of the Work by you, your agents, representatives, officers, employees or Subcontractors.
2. Insurance coverage for property damage resulting from your operations is on a replacement cost valuation. The market value will not be accepted.
3. You shall maintain this insurance for the duration of this Contract and at all times thereafter when you are correcting, removing, or replacing Work in accordance with this Contract. Your liabilities under the Contract, e.g., your indemnity obligations, is not deemed limited to the insurance coverage required by this Contract.
4. The payment for insurance shall be included in the Contract Price as bid by you. Except as specifically agreed to by the City in writing, you are not entitled to any additional payment. Do not begin any Work under this Contract until you have provided and the City has approved all required insurance.
5. Policies of insurance shall provide that the City is entitled to 30 Days (10 Days for cancellation due to non-payment of premium) prior written notice of cancellation or non-renewal of the policy. Maintenance of specified insurance coverage is a material element of the Contract. Your failure to maintain or renew coverage or to provide evidence of renewal during the term of the Contract may be treated by the City as a material breach of the Contract.

5-4.2 **Types of Insurance.**

5-4.2.1 **Commercial General Liability Insurance.**

1. Commercial General Liability Insurance shall be written on the current version of the ISO Occurrence form CG 00 01 07 98 or an equivalent form providing coverage at least as broad.
2. The policy shall cover liability arising from premises and operations, XCU (explosions, underground, and collapse), independent contractors,

products/completed operations, personal injury and advertising injury, bodily injury, property damage, and liability assumed under an insured's contract (including the tort liability of another assumed in a business contract).

3. There shall be no endorsement or modification limiting the scope of coverage for either "insured vs. insured" claims or contractual liability. You shall maintain the same or equivalent insurance for at least 10 years following completion of the Work.
4. All costs of defense shall be outside the policy limits. Policy coverage shall be in liability limits of not less than the following:

<u>General Annual Aggregate Limit</u>	<u>Limits of Liability</u>
Other than Products/Completed Operations	\$2,000,000
Products/Completed Operations Aggregate Limit	\$2,000,000
Personal Injury Limit	\$1,000,000
Each Occurrence	\$1,000,000

5-4.2.2 Commercial Automobile Liability Insurance.

1. You shall provide a policy or policies of Commercial Automobile Liability Insurance written on the current version of the ISO form CA 00 01 12 90 or later version or equivalent form providing coverage at least as broad in the amount of \$1,000,000 combined single limit per accident, covering bodily injury and property damage for owned, non-owned, and hired automobiles ("Any Auto").
2. All costs of defense shall be outside the limits of the policy.

5-4.2.5 Contractors Builders Risk Property Insurance..

1. You shall provide at your expense, and maintain until Final Acceptance of the Work, a Special Form Builders Risk Policy or Policies. This insurance shall be in an amount equal to the replacement cost of the completed Work (without deduction for depreciation) including the cost of excavations, grading, and filling. The policy or policies limits shall be 100% of this Contract value of the Work plus 15% to cover administrative costs, design costs, and the costs of inspections and construction management.
2. Insured property shall include material or portions of the Work located away from the Site but intended for use at the Site and shall cover material or portions of the Work in transit. The policy or policies shall include as insured property scaffolding, falsework, and temporary buildings located at the Site. The policy or policies shall cover the cost of removing debris, including demolition.
3. The policy or policies shall provide that all proceeds thereunder shall be payable to the City as Trustee for the insured, and shall name the City, the Contractor,

Subcontractors, and Suppliers of all tiers as named insured. The City, as Trustee, will collect, adjust, and receive all monies which may become due and payable under the policy or policies, may compromise any and all claims thereunder, and will apply the proceeds of such insurance to the repair, reconstruction, or replacement of the Work.

4. Any deductible applicable to the insurance shall be identified in the policy or policies documents and responsibility for paying the part of any loss not covered because of the application of such deductibles shall be apportioned among the parties except for the City as follows: if there is more than one claimant for a single occurrence, then each claimant shall pay a pro-rata share of the per occurrence deductible based upon the percentage of their paid claim to the total paid for insured. The City shall be entitled to 100% of its loss. You shall pay the City any portion of that loss not covered because of a deductible at the same time the proceeds of the insurance are paid to the City as trustee.
5. Any insured, other than the City, making claim to which a deductible applies shall be responsible for 100% of the loss not insured because of the deductible. Except as provided for under California law, the policy or policies shall provide that the City is entitled to 30 Days prior written notice (10 Days for cancellation due to non-payment of premium) of cancellation or non-renewal of the policy or policies.

5-4.3 Rating Requirements. Except for the State Compensation Insurance Fund, all insurance required by this Contract as described herein shall be carried only by responsible insurance companies with a rating of, or equivalent to, at least "A-, VI" by A.M. Best Company, that are authorized by the California Insurance Commissioner to do business in the State, and that have been approved by the City.

5-4.3.1 Non-Admitted Carriers. The City will accept insurance provided by non-admitted, "surplus lines" carriers only if the carrier is authorized to do business in the State and is included on the List of Approved Surplus Lines Insurers (LASLI list).

All policies of insurance carried by non-admitted carriers shall be subject to all of the requirements for policies of insurance provided by admitted carriers described herein.

5-4.4 Evidence of Insurance. Furnish to the City documents e.g., certificates of insurance and endorsements evidencing the insurance required herein, and furnish renewal documentation prior to expiration of this insurance. Each required document shall be signed by the insurer or a person authorized by the insurer to bind coverage on its behalf. We reserve the right to require complete, certified copies of all insurance policies required herein.

5-4.5 Policy Endorsements.

5-4.5.1 Commercial General Liability Insurance.

5-4.5.1.1 Additional Insured.

1. You shall provide at your expense policy endorsement written on the current version of the ISO Occurrence form CG 20 10 11 85 or an equivalent form providing coverage at least as broad.
2. To the fullest extent allowed by law e.g., California Insurance Code §11580.04, the policy shall be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured.
3. The additional insured coverage for projects for which the Engineer's Estimate is \$1,000,000 or more shall include liability arising out of:
 - a) Ongoing operations performed by you or on your behalf,
 - b) your products,
 - c) your Work, e.g., your completed operations performed by you or on your behalf, or
 - d) premises owned, leased, controlled, or used by you.
4. The additional insured coverage for projects for which the Engineer's Estimate is less than \$1,000,000 shall include liability arising out of:
 - a) Ongoing operations performed by you or on your behalf,
 - b) your products, or
 - c) premises owned, leased, controlled, or used by you.

5-4.5.1.2 Primary and Non-Contributory Coverage. The policy shall be endorsed to provide that the coverage with respect to operations, including the completed operations, if appropriate, of the Named Insured is primary to any insurance or self-insurance of the City and its elected officials, officers, employees, agents and representatives. Further, it shall provide that any insurance maintained by the City and its elected officials, officers, employees, agents and representatives shall be in excess of your insurance and shall not contribute to it.

5-4.5.1.3 Project General Aggregate Limit. The policy or policies shall be endorsed to provide a Designated Construction Project General Aggregate Limit that will apply only to the Work. Only claims payments which arise from the Work shall reduce the Designated Construction Project General Aggregate Limit. The Designated Construction Project General Aggregate Limit shall be in addition to the aggregate limit provided for the products-completed operations hazard.

5-4.5.2 Commercial Automobile Liability Insurance.

5-4.5.2.1 Additional Insured. Unless the policy or policies of Commercial Auto Liability Insurance are written on an ISO form CA 00 01 12 90 or a later version of this form or equivalent form providing coverage at least as broad, the policy shall be endorsed to include the City and its respective elected officials, officers, employees, agents, and representatives as additional insured, with respect to liability arising out of automobiles owned, leased, hired or borrowed by you or on your behalf. This endorsement is limited to the obligations permitted by California Insurance Code §11580.04.

5-4.5.5 Builders Risk Endorsements.

5-4.5.5.1 Waiver of Subrogation. The policy or policies shall be endorsed to provide that the insurer will waive all rights of subrogation against the City, and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from Work performed by the Named Insured for the City.

5-4.5.5.2 Builders Risk – Partial Utilization. If the City desires to occupy or use a portion or portions of the Work prior to Acceptance in accordance with this Contract, the City will notify you and you shall immediately notify your Builder's Risk insurer and obtain an endorsement that the policy or policies shall not be cancelled or lapse on account of any such partial use or occupancy. You shall obtain the endorsement prior to the City's occupation and use.

5-4.6 Deductibles and Self-Insured Retentions. You shall pay for all deductibles and self-insured retentions. You shall disclose deductibles and self-insured retentions to the City at the time the evidence of insurance is provided.

5-4.7 Reservation of Rights. The City reserves the right, from time to time, to review your insurance coverage, limits, deductibles and self-insured retentions to determine if they are acceptable to the City. The City will reimburse you, without overhead, profit, or any other markup, for the cost of additional premium for any coverage requested by the Engineer but not required by this Contract.

5-4.8 Notice of Changes to Insurance. You shall notify the City 30 Days prior to any material change to the policies of insurance provided under this Contract.

5-4.9 Excess Insurance. Policies providing excess coverage shall follow the form of the primary policy or policies e.g., all endorsements.

5-4.10 Architects and Engineers Professional Insurance (Errors and Omissions Insurance).

1. For Contracts with required engineering services (e.g., Design-Build, preparation of engineered Traffic Control Plans (TCP), and etc) by you, you shall keep or require all of your employees or Subcontractors, who provide professional engineering services under this contract, Professional Liability coverage with a limit of **\$1,000,000** per claim and **\$2,000,000** annual aggregate in full force and effect.
2. You shall ensure the following:
 - a) The policy retroactive date is on or before the date of commencement of the Project.
 - b) The policy will be maintained in force for a period of 3 years after completion of the Project or termination of this Contract, whichever occurs last. You agree that for the time period specified above, there will be no changes or endorsements to the policy that affect the specified coverage.
3. If professional engineering services are to be provided solely by the Subcontractor, you shall:
 - a) Certify this to the City in writing and
 - b) Agree in writing to require the Subcontractor to procure Professional Liability coverage in accordance with the requirements set forth above.

5-4.11 Workers' Compensation Insurance and Employers Liability Insurance.

1. In accordance with the provisions of §3700 of the California Labor Code, you shall provide at your expense Workers' Compensation Insurance and Employers Liability Insurance to protect you against all claims under applicable state workers compensation laws. The City, its elected officials, and employees will not be responsible for any claims in law or equity occasioned by your failure to comply with the requirements of this section.
2. Limits for this insurance shall be not less than the following:

<u>Workers' Compensation</u>	<u>Statutory Employers Liability</u>
Bodily Injury by Accident	\$1,000,000 each accident
Bodily Injury by Disease	\$1,000,000 each employee
Bodily Injury by Disease	\$1,000,000 policy limit
3. By signing and returning the Contract you certify that you are aware of the provisions of §3700 of the Labor Code which requires every employer to be

insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that code and you shall comply with such provisions before commencing the Work as required by §1861 of the California Labor Code.

5-4.11.1. Waiver of Subrogation. The policy or policies shall be endorsed to provide that the insurer will waive all rights of subrogation against the City and its respective elected officials, officers, employees, agents, and representatives for losses paid under the terms of the policy or policies and which arise from Work performed by the Named Insured for the City.

5-13 ELECTRONIC COMMUNICATION. To the "WHITEBOOK", ADD the following:

2. Virtual Project Manager shall be used on this Contract. For more information, refer to the VPM training videos at the location below:

<https://www.sandiego.gov/publicworks/edocref>

SECTION 6 – PROSECUTION AND PROGRESS OF THE WORK

6-1.1 Construction Schedule. To the "WHITEBOOK", item 1, subsection "s", DELETE in its entirety and SUBSTITUTE with the following:

- s) Submit an updated cash flow forecast with every pay request (for each Project ID or WBS number provided in the Contract) showing periodic and cumulative construction billing amounts for the duration of the Contract Time. If there has been any Extra Work since the last update, include only the approved amounts.
 - i. Refer to the Sample City Invoice materials in **Appendix D – Sample City Invoice with Cashflow Forecast** and use the format shown.
 - ii. See also the "Cashflow Forecast Example" at the location below:

<https://www.sandiego.gov/publicworks/edocref>

ADD:

6-6.1.1 Environmental Document.

1. The City of San Diego has prepared a **Notice of Exemption** for **Metropolitan Biosolids Center Cooling Water System Chiller Upgrade**, Project No. **B-16165**, as referenced in the Contract Appendix. You shall comply with all requirements of the **Notice of Exemption** as set forth in **Appendix A**.
2. Compliance with the City's environmental document shall be included in the Contract Price.

SECTION 7 – MEASUREMENT AND PAYMENT

7-3.1 General. To the WHITEBOOK, ADD the following:

3. The Lump Sum Bid item for “**Temporary Chiller Construction**” shall include, and not be limited to, Temporary Chiller System with Adequate Capacity to provide Temporary Service with Complete Redundancy, Temporary Chiller Skid Portable Cables, Temporary Chiller Mobilization and Demobilization, Hot Taps and Pipe Stops, Contractor Oversight of Operation and Control as specified in the Plans, Contract Documents, and Technical Divisions 1 (Sections 01080), 11, 15 and 18.
4. The Lump Sum Bid item for “**Chiller Demolition**” shall include, and not be limited to, Removal of Fencing, Demolition of Existing Bypass Line, Chiller Removal and Disposal, Primary and Secondary Pump Removal and Disposal, Piping Removal and Disposal, Concrete Slab Removal and Disposal as specified in the Plans, Contract Documents, and Technical Section 02050.
5. The Lump Sum Bid item for “**Structural Improvements – Concrete Pad**” shall include, and not be limited to, Cast-in-place Concrete, including Formwork, Reinforcement, and Concrete Materials, as specified in the Plans, Contract Documents, and Technical Section 03300.
6. The Lump Sum Bid item for “**Mechanical Improvements**” shall include, and not be limited to: Chiller Replacement with Three Integral Vendor Control Panels, and a Forth Central Control Panel, Welded Steel Piping and Fittings, Valves, Meters, Primary and Secondary Pump Replacement, and Vendor Representative Services as specified in the Plans, Contract Documents, and Technical Divisions 11, 15 and other related sections.
7. The Lump Sum Bid item for “**Plumbing**” shall include, and not be limited to, Piping, Floor Drains, Clean Outs, Traps, Emergency Shower, as specified in the Plans, Contract Documents, and Technical Sections 15410, 15490 and other related sections.
8. The Lump Sum Bid item for “**Electrical Improvements**” shall include, and not be limited to, General Electrical, Removal & Replacement of Existing 480 Volt Feeders, Replacement of Variable Frequency Drives, Relocation of Paging System, Demolition of Existing Electrical, , and Startup as specified in the Plans, Contract Documents, and Technical Division 16 and other related sections.
9. The Lump Sum Bid item for “**Instrumentation and Controls Improvements**” shall include, and not be limited to, General Conduit and Circuit Fit-up, Instrumentation, System Integration and Startup as specified in the Plans, Contract Documents, and Technical Divisions, 1, 11 and 13 and other related sections.

7-3.2 Partial and Final Payment. To the "GREENBOOK", paragraph (3), DELETE in its entirety and SUBSTITUTE with the following:

Upon commencement of the Work, an escrow account shall be established in a financial institution chosen by you and approved by the City. Documentation for an escrow payment shall have an escrow agreement signed by you, the City, and the escrow agent. From each progress payment, no less than 5% will be deducted and deposited by the City into the escrow account. Upon completion of the Contract, the City will notify the Escrow agent in writing to release the funds to you. Only the designated representative of the City shall sign the request for the release of Escrow funds.

7-3.11 Compensation Adjustments for Price Index Fluctuations. To the "WHITEBOOK" ADD the following:

5. This Contract is not subject to the provisions of The "WHITEBOOK" for Compensation Adjustments for Price Index Fluctuations for paving asphalt.

END OF SUPPLEMENTARY SPECIAL PROVISIONS (SSP)

TECHNICALS

MBC – CHILLER WATER SYSTEM UPGRADE

(009.SAN.0012)

CITY OF SAN DIEGO

DECEMBER 2018

TECHNICAL SPECIFICATIONS



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SUPPLEMENTAL TECHNICAL SPECIFICATIONS

DIVISION 1

GENERAL REQUIREMENTS

SECTION 01080	Construction Sequencing
SECTION 01600	General Equipment Provisions
SECTION 01611	Seismic Design Criteria
SECTION 01615	Equipment and Valve Identification
SECTION 01650	Startup Requirements
SECTION 01730	Operation and Maintenance Data

DIVISION 2

SITWORK

SECTION 02050	Demolition
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DIVISION 3

CONCRETE

SECTION 03300	Cast-In-Place Concrete
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DIVISION 5

METALS

SECTION 05120	Structural Steel
SECTION 05500	Miscellaneous Metalwork

DIVISION 9

FINISHES

SECTION 09900	Painting and Coating
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DIVISION 11

EQUIPMENT

SECTION 11033	Variable Frequency Drives
SECTION 11060	Equipment Installation
SECTION 11070	Variable Speed Screw Water Chillers
SECTION 11071	Chiller Water Primary Pumps
SECTION 11072	Chiller Water Secondary Pumps
SECTION 11075	Ancillary Equipment and Appurtenances

DIVISION 13

INSTRUMENTATION

SECTION 13010	Instrumentation and Controls General Requirements
SECTION 13080	Control Panels
SECTION 13329	Primary Sensors and Field Instrumentation

DIVISION 15

MECHANICAL

SECTION 15011	Hot Taps and Temporary Piping Systems
SECTION 15053	Duct Iron Pipe
SECTION 15054	Cast Iron Pipe
SECTION 15062	Steel Pipe
SECTION 15064	Copper Pipe

SECTION 15080	Pipe Specialties
SECTION 15085	Piping Insulation System
SECTION 15100	Valves
SECTION 15140	Pipe Supports
SECTION 15410	Installation of Plumbing Piping
SECTION 15430	Waste and Vent Piping Systems
SECTION 15490	Testing of Plumbing Piping Systems

DIVISION 16 ELECTRICAL

SECTION 16040	Electric Motors
SECTION 16050	Basic Electrical Materials and Methods
SECTION 16920	Motor Control Center
SECTION 16950	Electrical Tests

SECTION 01080 - WORK SEQUENCE AND TEMPORARY CHILLER SYSTEM

PART 1 - GENERAL

1.1 CONTINUITY OF PLANT OPERATIONS

- A. General: The existing MBC facilities are continuously receiving and treating wastewater biosolids. The chilled water system facilitates operation in nearly every process area of the plant. The operation of the chilled water system shall not be interrupted as specified herein. The Contractor shall coordinate the work to avoid any interference with normal operation of plant equipment and processes. Plant personnel shall be allowed access to all areas at all times.
- B. Submittal: The Contractor shall submit a detailed plan and time schedule for making and removing temporary piping connections, electrical power connections, temporary chilled water equipment setup and operation, and provisions for maintaining signals to the plant's Distributed Control System (DCS). The schedule shall fit within the requirements of the overall project schedule and the restrictions and conditions specified in this section. The detailed plan shall describe the Contractor's method and sequence for making each connection and disconnection and in a detailed sequence, length of time required to complete, and the necessary equipment which the Contractor shall provide for testing of the temporary connections and operation of temporary equipment. Systems or individual equipment items shall be isolated, dewatered, decommissioned, deenergized, or depressurized in accordance with the detailed Contractor's outage plan and schedule. The Construction Manager shall be notified in writing at least 14 days in advance of any planned operation.

1.2 COMPLETION TIMES

- A. Complete the Work within the specified Contract Time in accordance with the contract conditions.

1.3 LIMITATIONS OF CONSTRUCTION

- A. General: To permit continuous operation of the plant, the construction schedule shall provide for the following specific conditions:
 - 1. As a minimum, provide 500 tons (two 250 ton chillers) of temporary chilled water cooling capacity to the existing air handlers and plant cooling system at all times without interruption while the existing chiller area is demolished and renovated, and the three new chillers and ancillary equipment are being installed.
 - 2. Maintain facility monitoring and control functions.
 - 3. Maintain facility electrical power.

B. Planned Outages and Construction Schedule:

1. Outage: An outage is defined as taking out of service any process, or component of a process, including utility and control systems. Operating processes, systems, individual equipment items or controls shall be isolated, dewatered, decommissioned, de-energized, or depressurized only by the plant operations staff in accordance with the Contractor's detailed outage plan and schedule. The Resident Engineer and Construction Manager shall be notified in writing at least 14 days in advance of any planned outage. If requested by plant staff, the Contractor shall send a representative to meet with plant operations and the Resident Engineer to plan activities associated with any of the requested outages. Outages shall not be scheduled for Fridays or weekends without prior approval. Except as approved by the Construction Manager, multiple outages required for the same system shall not occur less than seven (7) calendar days apart subject to the system being returned to normal operation after the first outage.
2. Construction Schedule: The Contractor shall propose and submit its own construction schedule and the order in which activities are to be performed for review and concurrence of the Resident Engineer and Construction Manager as part of the construction schedule. The proposed construction schedule, sequence, and related activities shall ensure that the frequency and duration of planned outages are not materially changed from the constraints specified in these Contract Documents. The Contractor shall provide a graphically represented construction schedule indicating the various subdivisions of work and the dates for commencing and finishing each work item. The schedule shall show the time allowed for testing and other procedures that must be completed prior to the work being placed into operation.
3. Schedule Revisions: Revisions to the accepted construction schedule may be made only with the written approval of the Contractor and the Construction Manager. A change affecting the contract value of any activity, the completion time, and sequence may only be made in accordance with the applicable provisions of this section.

1.4 WORK SEQUENCE AND CONSTRAINTS

- A. General: The work sequences described below are intended to minimize interruption of the continuous operation of the MBC facility. This section describes one method to accomplish the required work. The construction techniques or sequences herein are presented to illustrate the principles involved, but other techniques and sequences could potentially be used. Disruptions may be required that are not itemized herein. The construction sequence outlined herein is not all inclusive and does not cover all work required by the contract documents. The Contractor is responsible for the coordination of all required work involving all trades. No extra payment will be approved for any disruptions not described herein, nor will extra payment be approved should the construction techniques or sequences described herein prove infeasible or more costly than alternative approaches. The use of any construction techniques or schedules described herein shall not relieve the

Contractor of responsibility for detailed planning, coordination, scheduling, liabilities, and other responsibilities described in this Section.

- B. Coordination: The Contractor shall make themselves aware of other concurrent and ongoing projects in the vicinity of the chiller upgrade that may require coordination. Contractor shall make provisions in the construction schedule to accommodate these other projects and coordinate as needed to accomplish the work.
- C. Work Sequence – Area 70 Chiller System: The following is a work sequence alternative for the Chilled Water System in Area 70.
1. Provide temporary chilled water connections using welded flanged connections utilizing long neck flanges or reinforcing saddles, and valves utilizing a hot tapping and/or pipe stops at three different places, specifically:
 - 8-inch chilled water supply line
 - 8-inch chilled water return line
 - Existing 8-inch chilled water bypass line removal

The connections will allow for the chilled water supply and return for the temporary chiller system (See criteria in Item 2 below) to be tested and function simultaneously with the existing chilled water system until such time the operation of the temporary system is deemed competent, by the Construction Manager and plant operations staff, as a viable substitute for the existing system.

Prior to dismantling the existing chilled water piping within the chiller area, hot taps and pipe stops must be installed with adjacent flanges and valves as shown on the drawings to facilitate connection to the new chiller piping.

Description of each of the specific tapping and pipe stop operations are shown on the drawings and described as follows:

- The 8-inch chilled water supply line shall not be interrupted and will require a hot tap providing the tapping gate valve to be used as the connection point for the temporary chilled water supply piping. Once the temporary chiller system is operational, an upstream pipe stop is required for a duration sufficient for installation of an 8-inch slip-on flange blind flange allowing demolition of all the upstream piping, and in preparation for the permanent upstream chilled water supply flow. The permanent supply piping connects to the pipe stop tapping valve. These two tapping procedures accommodate either the temporary and/or permanent system to operate alone or at the same time by opening or closing either of the tapping gate valves. With the permanent chiller system tested, operational and complete, the temporary piping is removed, and the associated tapping gate valve is flanged off and remains.
- The 8-inch chilled water return line shall not be interrupted and will require a hot tap providing the tapping gate valve to be used as the

connection point for the temporary chilled water return piping. Once the temporary chiller system is operational, a downstream pipe stop is required for a duration sufficient for installation of an 8-inch slip-on flange and butterfly valve allowing demolition of all the downstream piping in preparation for the permanent downstream chilled water return flow. The permanent return piping connects to the downstream side of the butterfly valve, and the new bypass piping connects to the pipe stop tapping valve. These two tapping procedures accommodate either the temporary and/or permanent system to operate alone or at the same time by opening or closing either the gate or butterfly valve. With the permanent chiller system tested, operational and complete, the temporary piping is removed the associated tapping gate valve is flanged off and remains.

- The existing 8-inch chilled water bypass shall be removed once the temporary chiller system is tested and found to be operational. A pipe stop within the existing boiler room is required for a duration sufficient for installation of an 8-inch slip-on flange and blind flange allowing demolition of all the existing bypass piping in the chiller area on the north side of the boiler room wall. The resulting open wall penetration shall be grout filled with finish to match the existing wall. The resulting open penetration through the existing out-of-doors steel canopy shall be welded closed using sheet metal of the same gauge and painted to match existing color sheet and texture.

2. Provide a temporary chilled water closed system substituting for, and similar to, the existing consisting of one duty and one standby chiller, associated primary and secondary pumps and ancillary equipment, extended insulated and supported chilled water pipelines, and meeting the requirements below:

Capacity:	250 tons each
Design Supply Temperature:	42 °F
Design Return Temperature:	57 °F
Design Temperature Differential:	15 °F
Design Flow Rate:	800 gpm
Reclaimed or Potable Water:	City provides (See below
System Control:	See below
Electrical Service:	See below
Term of Temporary Chiller Water:	15-days beyond acceptance
Maximum CW Outage:	Zero hrs (See below.)
Area of Installation:	As noted on the drawings
Operational Responsibility:	Contractor (See below.)
CW Corrosion Control:	Contractor (See below.)
Primary Pump Suction Pressure:	40 psig

Reclaimed water or potable water to be used within the temporary chiller system will be paid for by the City. The Contractor shall coordinate with the Construction Manager and provide connections to hydrants or to existing utilities within Area 70 and provide necessary high lines to accommodate the temporary chilled water system.

Integral to the temporary chiller shall be controls to monitor and maintain a set differential pressure between the suction and discharge of the secondary chilled water pump(s). Secondary chilled water pump speed shall be adjusted by means of VFD to maintain the differential pressure setpoint. The Contractor shall coordinate with plant operations staff, as they monitor the chilled water system differential pressure sensor through the existing STAFSA system, to establish an acceptable temporary system differential pressure setpoint. The Contractor's temporary chiller system shall operate under automatically control, including lag/lead of chillers and pumps and differential pressure setpoint, over the duration of the need for the temporary system. A pair of dry contacts with cabling shall provide a common trouble alarm to the City's DCS to alert City operations staff of the need for chiller system attention. Any programming of the City's DCS will be performed by the City.

Electrical power of 480 volts from the City's system for the temporary chiller skids will be provided by the Contractor using portable multi-conductor cable laid on grade. Cable protection shall be provided by the Contractor and may include surface mounting PVC schedule 80 conduit or other means. The cable will enter the substation cable trench adjacent to the chiller area via the manhole cover at grade and terminate at an existing spare breaker. Control power of 120 volts ac and DCS common alarm will be by portable cable and enter the energy building electrical room via a temporary opening near grade. The cables will be removed after the new chillers are installed.

There is no acceptable Chilled Water Cooling System downtime or outage except for inadvertent outages of 2 hours (March 15 - November 15) or 3 hours (November 16 - March 14).

Outage durations beyond those described above are subject to liquidated damages (LD's) of \$1,000/hour between November 16 and March 14, or \$2,000/hour between March 15 and November 15.

The Contractor shall be responsible for the operation of the entire temporary chilled water system including water treatment, water make-up, volume expansion and surge, and sustained primary pump suction pressure.

3. Coordinate outages of utilities associated with the chiller area of Area 70 with the Construction Manager and the plant operations staff. Potable water, reclaimed water, process water, trap primer system piping, and the sanitary sewer system will have to be interrupted for short periods of time over the course of project. All outages are to be planned and scheduled by the Contractor providing the Construction Manager with a minimum of 14 days of notice. Prior to the necessary demolition of portions of these systems, outages will be necessary to cap off specific lines as appropriate,

and in some cases arrangements for bypassing and highlining particular services may be necessary. With the installation of the new chillers, these utilities will undergo short outages for reconnections as may be necessary to complete the project requirements.

The main sanitary sewer system for Area 70 extends through the chiller area under the slab. The Contractor is responsible to coordinate outages of the sewer system and provide pumping or other means of sustaining the sewer system over the duration of the project.

4. With the temporary chilled water connections complete, temporary chilled water system installed and operating, and utilities temporarily capped and bypassed, the following work can proceed:
 - Perform all the demolition work as appropriate.
 - Install all new concrete, slab drains, and conduit.
 - Install permanent piping as required by the project including: three chillers, primary pumps, diaphragm expansion tank, air separator, chemical pot, valves, piping, field instruments, secondary pumps.
 - Install all new electrical, and control wiring.
 - Provide the 1 1/2- inch hot tap connection and install the temperature element and transmitter for 70TT2202.
 - Coordinate control system Common alarm interface to the City's DCS.
 - Coordinate electrical service and switchover.
 - Startup new chiller system including the associated new control system.

The Contractor shall operate the new system functionally for a period of 7 days consecutive without automatic shutdown events before moving to the next phase of the work.

5. Acceptance testing will focus on operating the new system for a period of 14 days consecutive without automatic shutdown events. Removal of all the temporary piping, equipment and electrical material, and finish painting and cleaning is necessary to achieve project completion.

1.5 RELATED SECTIONS

- A. Section 15011 – Hot Taps, Pipe Stops and Temporary Piping Systems

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

****END OF SECTION****

SECTION 01600 – GENERAL EQUIPMENT PROVISIONS

PART 1 - GENERAL

1.1 SCOPE

- A. These General Equipment Provisions apply to all equipment furnished under this Contract including equipment specified in other Sections. They shall supplement the Detailed Technical Specification Sections, but in case of conflict the Detailed Technical Specification Sections shall govern.
- B. The Contractor shall have sole responsibility to ensure his equipment suppliers, manufacturers, fabricators and subcontractors review this Section in conjunction with all other Sections of these Contract Documents and Contract Drawings. The Contractor shall fully coordinate their efforts to avoid potential claims that are based on failure to review all relevant Contract Documents, including the Contract Drawings.
- C. This Section describes general product requirements and product delivery, storage, and handling requirements.
- D. Products are defined as material, machinery, components, equipment, fixtures, and systems incorporated into and forming the Work.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to Work of this Section. Work of other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of the Work.
 - 1. Section 01611 – Seismic Design Criteria
 - 2. Section 01650 – Startup Requirements
 - 3. Division 11 – Equipment
 - 4. Division 15 – Mechanical

1.3 SUBMITTALS

- A. Within 30 days after date established in Notice to Proceed, submit a complete list of submittals, that include major products proposed for use, with name of manufacturer, trade name, and model number of each product.
- B. Submit Shop Drawings and other submittals as required elsewhere in the Specification.

1.4 PRODUCT DELIVERY

- A. Contractor shall make all arrangements for transportation, delivery and handling

of equipment and materials required for prosecution and completion of the Work.

- B. Product fabrication, manufacture, or purchase shall not begin until related Shop Drawings are returned without objection by the City.
- C. Contractor shall use the following address for the Project: MBC, 5240 Convoy Street, San Diego, 92111. All deliveries shall be made to that address. No deliveries will be accepted by the Engineer.
- D. Arrange deliveries of products in accord with progress schedules and in sufficient time to facilitate inspection prior to installation.
- E. Coordinate deliveries to avoid conflict with Work and conditions at site and to accommodate the following:
 - 1. Work of other contractors, or City.
 - 2. Limitations of storage space.
 - 3. Availability of equipment and personnel for handling products.
 - 4. City's use of premises.
- F. Products shall not be shipped from the manufacturer's or fabricator's facility or delivered to project site until related Shop Drawings, data sheets, shop or factory test reports and records, have been returned without objection by the City.
- G. Shipments of materials to Contractor or subcontractors shall be delivered to the site only during regular working hours. Shipments shall be addressed and consigned to the proper party giving name of project, street number and city. Shipments shall not be delivered to the City.
- H. Products shall not be delivered to the site until required storage facilities have been provided and are ready to receive products for storage.
- I. Products shall be delivered to site in manufacturer's original, unopened, labeled containers. Keep City informed of delivery of all equipment to be incorporated in the Work.
- J. Partial deliveries of component parts of equipment shall be clearly marked to identify the equipment, to permit easy accumulation of parts and to facilitate assembly.
- K. Immediately on delivery, inspect shipment to assure:
 - 1. Product complies with requirements of Contract Documents and reviewed submittals.
 - 2. Quantities are correct.

3. Containers and packages are intact, and labels are legible.
 4. Products are properly protected and undamaged.
- L. Package or crate products to protect from damage during shipping, handling, and storage.
1. Mark or tag outside of packing to indicate contents by name and equipment number, special precautions for handling, and recommended requirements for storage.
 2. Protect machined and unpainted parts subject to damage by the elements.
 3. Transport and handle products in accordance with manufacturer's written instructions.
 4. Inspect shipments to assure products comply with requirements, quantities are correct, and products are undamaged.
- M. Subsection 1.5 Product Handling below also applies to this Subsection, Product Delivery

1.5 PRODUCT HANDLING

- A. Provide equipment and personnel necessary to handle products, including those furnished by City, by methods to prevent soiling or damage to products or packaging.
- B. Provide additional protection during handling as necessary to prevent scraping, marring or otherwise damaging products or surrounding surfaces.
- C. Handle products by methods to prevent bending or over stressing.
- D. Lift heavy components only at designated lifting points.
- E. Materials and equipment shall at all times be handled in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them. Do not drop, roll or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer's product containers shall not be opened until time of installation.
- B. Contractor shall make all arrangements and provisions necessary for the storage of materials and equipment. All excavated materials, construction equipment, and materials and equipment to be incorporated into the Work shall be placed so as not to injure any part of the Work or existing facilities, and so that free access can be maintained at all times to all parts of the Work and to all public utility installations in the vicinity of the Work. Materials and equipment shall be kept neatly and

compactly stored in locations that will cause a minimum of inconvenience to the City, other contractors, public travel, adjoining owners, tenants and occupants. Arrange storage in a manner to provide easy access for inspection.

- C. Areas available on the construction site for storage of materials and equipment shall be within the project site or at other sites approved by the City. Products shall not be stored inside structures being constructed.
- D. Materials and equipment shall be stored to facilitate inspection and to ensure preservation of the quality and fitness of the Work, including proper protection against damage by freezing and moisture.
 - 1. Arrange storage to provide access for inspection and inventory control.
 - a. Periodically inspect to assure products are undamaged and are maintained under required conditions.
 - b. Maintain an inventory of materials stored to facilitate inspection and estimate progress payments for materials delivered but not yet installed.
 - 2. Store products in accordance with manufacturer's written instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's written instructions.
- E. Products subject to damage by moisture, freezing, or other effects of the elements shall be stored inside weatherproof storage areas equipped with suitable temperature and moisture controls.
- F. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide space heaters and ventilation to avoid condensation.
- G. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.
- H. Lawns, grass plots, or other private property shall not be used for storage purposes without written permission of the owners or other person in possession or control of such premises.
- I. Contractor shall be fully responsible for loss or damage to stored materials and equipment.
- J. If necessary to relocate stored materials and equipment prior to or during construction, Contractor shall move materials and equipment without any additional compensation.

1.7 ADAPTATION OF EQUIPMENT

- A. Equipment shall be readily adaptable for installation and operation in the structures

as shown on the Contract Drawings. No responsibility for alteration of a planned structure to accommodate other types of equipment shall be assumed by the City. Equipment which requires alteration of the structures shall be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such necessary alterations shall be signed by a Licensed Engineer Registered in the State of California at the Contractor's expense. All such alterations including required engineering reviews by the Engineer shall be made at the Contractor's expense.

- B. Equipment approved by the Engineer as being of equal quality, performance, integrity, etc., may be used in place of that specified. Any revisions to structures, piping, electrical or other work made necessary by such substitution is subject to review by the Engineer. The Engineer shall be the sole judge of equivalency. Any revisions to structural, piping, electrical or other work made necessary from deviations from approved submittals shall be at the Contractor's expense including engineering and administration costs.

1.8 EQUIPMENT GUARANTEE

- A. The Contractor shall guarantee all equipment against (a) faulty or inadequate design, (b) improper assembly or erection, (c) defective workmanship or materials, and (d) leakage, breakage, or other failures. The guarantee period shall be as defined in the Whitebook (latest edition) except as may be required by individual specification sections.

1.9 WORKMANSHIP AND MATERIALS

- A. All equipment shall be designed, fabricated and assembled in accordance with the best modern engineering and shop practice and in accordance with applicable standards including ASTM, ANSI and AWWA. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units, shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required for tests.
- B. In various Sections of the Contract Documents, Manufacturer's names have been used for clarity and to establish minimum product standards only. The Contractor shall be responsible for selection and coordination of all materials required for construction.
- C. All parts and components of mechanical equipment shall be designed for satisfactory service under continuous duty without undue wear under the specified and indicated operating conditions for the period of time specified in these Documents. Any part of mechanical equipment that shows undue or excessive wear or fails due to wear under normal operating conditions within the warranty period shall be considered as evidence of defective material or defective workmanship, and it shall be replaced by the Contractor with equipment or parts to meet the specified requirements at no cost to the City.
- D. Materials shall be suitable for the service conditions to be encountered. Unless

otherwise specified, structural steel shall conform to ASTM A992. Iron castings shall be of tough, close-grained gray iron, free from blow-holes, flaws, or other imperfections and shall conform to ASTM A48. All mechanisms or parts shall be amply proportioned for the stresses which may occur during operation or for any other stresses which may occur during fabrication, erection, and transportation.

- E. Unless otherwise specified, all materials shall conform to the structural and miscellaneous standards of the American Institute of Steel Construction.
- F. Bronze which shall be in contact with water or any liquid, used in the manufacture of any equipment shall not contain lead, aluminum nor more than 6 percent zinc, and shall conform to ASTM B62, or equivalent.
- G. All steel bars, shapes and plates shall be clean and straight before being worked. Straightening or flattening, if necessary, shall be done by a process and in a manner that shall not injure the metal. Sharp kinks or bends shall be cause for rejection. Steel that has been heated partially shall be annealed, unless it is to be used in minor parts. Finished members shall be true to line and free from twists, bends, and other joints.
- H. Tolerances and clearances shall be as indicated on the Shop Drawings and these tolerances and clearances shall be closely followed to secure proper operation of the equipment.
- I. All flanges on equipment and appurtenances furnished shall conform in dimensions and drilling to ANSI B16.1, Class 125 or 150, unless otherwise specified or noted.
- J. All specific requirements of these Contract Documents must be adhered to, and modifications shall be made at the Contractor's expense to the specified model of manufacturer's equipment to make it conform to the specific requirements of these Contract Documents if the standard product does not fulfill all requirements.

1.10 EQUIPMENT INSTALLATION

- A. The Contractor shall obtain installation instruction booklets or other recommendations from the equipment manufacturers as to procedures for, sequence of, and tolerances allowed in equipment installation. In particular, the Manufacturer's recommendations as to grout spaces required, type of grout to be used, and tolerances for level and alignment, both vertical and horizontal, shall be obtained and followed. One (1) copy of this material shall be given to the Engineer prior to the installation of the equipment.
- B. Whenever applicable, the Contractor shall obtain the services of a Manufacturer's representative specifically trained in erection of his equipment to supervise the installation. The Contractor shall be responsible for the proper alignment of all installed driven equipment and drives in accordance with the tolerance recommendation of the manufacturers for both City furnished and Contractor furnished equipment. Within fourteen (14) calendar days after installation, the Contractor shall submit to the City a letter from the Manufacturer, on the

Manufacturer' letterhead, stating all equipment and components are installed per the Manufacturer's requirements and installation instructions as described in these Contract Documents.

- C. Skilled craftsmen experienced in installation of the equipment or similar equipment shall be used. Applicable specialized tools and equipment, such as precision machinist levels, dial indicators, and gauges shall be utilized as required in the installations. The Work shall be accomplished in a workmanlike manner to produce satisfactory equipment installation free of vibration or other defects.
- D. Prior to installation of equipment, all sacking and concrete preparation shall be completed, and the work area shall be maintained in a broom-clean condition during the equipment installation.
- E. No equipment and materials shall be altered or repaired, and no burning or welding will be permitted on any parts having machined surfaces, except by written permission of the City.
- F. No rigging shall be done from any structure without the permission of the City, and the Contractor shall be completely responsible for any damage to the structure due to his operations.
- G. Only such equipment and materials as will not damage the structure or equipment and materials shall be used on the Work.

1.11 MANUFACTURER'S NAMES

- A. Manufacturer's name and catalog numbers are for the convenience of the Contractor. The detailed Specifications shall apply in the event of a conflict. If detailed Specifications have not been given, the Manufacturer's name and catalog number shall determine the design criteria for comparison should an equal be submitted.

1.12 SPECIAL TOOLS

- A. All special tools that are required to assemble, disassemble, repair, and maintain any item of equipment furnished under the terms of this Contract shall be furnished with the equipment. When special tools are provided, they shall be marked or tagged, and a list of such tools shall be included with the maintenance and operation instructions for the equipment.

1.13 REGULATIONS AND CODES

- A. Where equipment or materials are specified to conform to requirements of organizations such as American Society of Mechanical Engineers (ASME), Underwriters Laboratories (UL), American Gas Association (AGA), and American Refrigeration Institute (ARI), that use a label or listing as method of indicating compliance, proof of such conformance shall be submitted. The label or listing of the specified organization will be acceptable evidence. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization

stating that the item has been tested and found to conform to the specified standard.

- B. Electrical Work, including connection to electrical equipment integral with mechanical equipment, shall be performed in accordance with the latest published regulations of the National Electrical Code (NEC), state and local codes, the City of San Diego Code, and according to the latest Institute of Electrical and Electronic Engineers (IEEE); American National Standards Institute (ANSI); American Society for Testing and Materials (ASTM); Insulated Power Cable Engineers Association (IPCEA); National Electrical Manufacturer's Association (NEMA) Standards, and the latest published regulations of the Federal Occupational Safety and Health Act (OSHA). All material used in the performance of the electrical Work shall be approved by the Underwriter's Laboratories, Inc. (UL) for the class of service for which they are intended.
- C. All components and additives shall be certified in accordance with NSF-60/61 for contact with potable water.

1.14 COORDINATION

- A. The Contractor shall take all measurements for his Work at the installation sites, verify all subcontractor's and Manufacturer's drawings and be responsible for the proper installation within the available space of the apparatus specified and shown on the Contract Drawings and must inform the Engineer of any variations and shall submit all proposed changes for review before making any changes.

1.15 BEARINGS

- A. Unless otherwise specified, all equipment bearings shall be oil or grease lubricated, ball or roller anti-friction type of standard manufacture. Bearings shall be conservatively designed to withstand all stresses of the service specified. Each bearing, except as otherwise noted, shall be rated in accordance with the latest revisions of Anti-Friction Bearing Manufacturer's Association's (AFBMA) Methods of Evaluating Load Ratings of Ball and Roller Bearings for B-10 (L-10) rating life of 100,000 hours.
- B. All grease lubricated bearings, except those specified to be factory sealed lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings of the standard hydraulic type. Extension tubes shall be provided for easy access and shall be constructed of 316 L stainless steel unless otherwise specified or otherwise shown.
- C. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 50 °C and shall be equipped with a filler pipe and an external level gauge. Fittings for pressure lubrication shall be 1/4-inch straight-type.
- D. To avoid work hardening or "Brinelling" damage from vibration, bearings shall be

separately packed or otherwise suitably protected during transport.

1.16 LUBRICATION AND LUBRICATION FITTINGS

- A. Equipment shall be adequately lubricated by systems which require attention no more often than weekly during continuous operation. Lubrication systems shall not require attention during start-up or shutdown and shall not waste lubricants. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity for consumption prior to completion of required testing and acceptance of equipment by the Engineer. The Contractor shall provide the City, prior to equipment start-up, four (4) copies of a list showing the proper lubricants for each item of mechanical equipment, approximate quantities needed per year of continuous operation, and recommended lubrication intervals. Wherever possible, the types of lubricants shall be consolidated with the manufacturer's approval to minimize the number of different lubricants required for plant maintenance. Following approval of the lubricant survey by the City the Contractor shall submit 11 copies of the approved lubrication survey to the City.
- B. All lubricants furnished shall be food-grade, NSF-certified lubricants that are suitable for service in potable water.
- C. Equipment lubrication fittings shall be extended with piping beyond obstructions such as guards or covers to provide ease of lubrication without disassembly of the unit.
- D. All lubrication fittings shall be constructed of 316L stainless steel and shall be brought to the outside of all equipment, so they are readily accessible from the outside without the necessity of removing covers, plates, housing, or guards. Fittings shall be of button head type. Lubrication fittings shall be mounted together wherever possible and shall be made of factory-mounted multiple fitting assemblies. Fittings shall not be individual fittings field-mounted together.

1.17 GAUGES AND GAUGE CONNECTIONS

- A. Pressure Gauges: The Contractor shall furnish and install all pressure gauges as indicated on the Contract Drawings and as specified herein. Unless noted otherwise, all pressure gauges shall be 4.5-inches diameter in a weatherproof 316 stainless steel case. The dial shall be plastic coated with black figures on a white face. The scale shall have a 270- degree minimum arc. The movement shall be stainless steel and nylon or all stainless steel, whichever is the manufacturer's standard. The pressure gauges shall be equipped with 316 stainless steel bourdon tube, socket, and connection, an overrange pressure of up to 130 percent of maximum scale reading shall not affect calibration of the gauge. Accuracy shall be within 1.0 percent of scale range. All pressure gauges shall be provided with gauge guards, cocks, diaphragm seals, flushing connections, snubbers, tubular seals, and other appurtenances required or as shown on the Contract Drawings. The scales shall be as specified. The pressure gauges shall be manufactured by U.S. Gauge, Robert Shaw, or equal.
- B. Pump Suction and Discharge Pressure Gauge Connection. Except where permanent pressure gauges are shown on the plans, a 2" NPT connection and

316 stainless steel isolation cock shall be furnished and installed on the suction and discharge piping of all pumps. Unless connections are provided on the pump casing at the suction and discharge, the connections shall be provided immediately upstream of the pump suction connection and immediately downstream of the pump discharge connection.

1.18 EQUIPMENT BASES AND BEDPLATES

- A. A heavy cast iron or welded steel base shall be provided for each item of equipment which is to be installed on a concrete base. Equipment assemblies, unless otherwise specified or shown on the Contract Drawings, shall be mounted on a single, heavy, cast iron or welded steel bedplate. Bases and bedplates shall be provided with machined support pads, tapered dowels for alignment of mating or adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Seams and contact edges between steel plates and shapes shall be continuously welded and ground smooth. Bedplate drain fittings shall be piped to the nearest sump or designated drainage area as shown on the Contract Drawings.

1.19 BASE AND BEDPLATE GROUTING

- A. After assembly and installation on the concrete base, each unit shall be leveled using a precision level and aligned in place, but not grouted until after the initial fitting and alignment of connecting piping. Each unit shall then be grouted to the concrete base. Each base and bedplate shall be completely filled with grout. The grout shall extend to the edge of each base or bedplate and shall be beveled at 45 degrees all around the unit. Grout which is exposed at horizontal surfaces shall be rounded to provide drainage to appropriate points. After grout has set, jacking screws shall be removed and nuts on anchor bolts shall be tightened, followed by an overall check on leveling and alignment. Should equipment not meet tolerances of leveling and alignment, as recommended by the manufacturer, corrective measures shall be taken to obtain the tolerances required. Reciprocating equipment shall be grouted with non-shrinking epoxy grout as specified under Section 03315, Grout.

1.20 JACKING SCREWS AND ANCHOR BOLTS

- A. All equipment and piping shall be anchored to supporting members by bolts or other connections to accommodate all operating forces and satisfy the requirements of Part 1.34, Seismic Requirements for Anchoring Equipment.
- B. Anchor bolts for storage tanks and outdoor vertical structures shall also be sized for wind loads assuming a minimum basic wind speed of 100 mph.
- C. Jacking screws shall be provided in the heavy equipment bases and bedplates and where required elsewhere to aid in leveling during installation.
- D. Anchor bolt setting drawings shall be delivered sufficiently early to permit setting the anchor bolts when the structural steel support frame is fabricated by others.

- E. All anchor bolts and anchoring hardware shall be of Type 316 stainless steel unless otherwise shown or otherwise specified.

1.21 SAFETY REQUIREMENTS

- A. Belt or chain drives, fan blades, couplings, exposed shafts and other moving or rotating parts shall be covered on all sides by safety guards which conform to the General Industry Safety Orders of the California Division of Industrial Safety. Safety guards shall be fabricated from 15 USS gauge or heavier galvanized or aluminum-clad sheet steel or 3/8-inch galvanized expanded metal, unless other materials are specified. Each guard shall be designed for easy installation and removal. Necessary supports and accessories shall be provided for each guard. Safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water. Drawings of safety guards shall be submitted to the City for approval prior to fabrication or delivery.

1.22 EQUIPMENT NAME PLATES

- A. Equipment name plates shall be engraved or stamped on stainless steel and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins. The nameplate shall include manufacturer's name, equipment model number, identification tag number, drive speed, motor horsepower, and rated capacity. Nameplates for pumps shall also include rated total dynamic head and impeller size where applicable.
- B. Identification Plates: The Contractor shall furnish and install identification plates and shall mount on or adjacent to each item of equipment and device including tanks, gates, motor operated valves, electrical and instrumentation items and all other mechanical equipment items to identify its title. Instrumentation identification numbers shall conform to the requirements of Divisions 13. Motor Control Centers, Switchboards and Distribution Panel Boards shall include the corresponding equipment identification number in addition to the requirement of Division 16. Nameplates shall be approximately 1-inch by 3-inches made from phenolic material having a black exterior and white center. Letters shall be engraved and shall not be smaller than 3/16-inch high. The Contractor shall be responsible for compiling a list of all equipment titles and identification numbers as they will appear on the identification plates. The Contractor shall submit the list of titles along with a sample identification plate to the City for review. The plates shall be supplied by a single Manufacturer. All plates shall be fastened with 316 stainless steel pins or screws.

1.23 WARNING SIGNS

- A. The Contractor shall furnish and install permanent warning signs and shall mount them at all mechanical equipment, as decided by the Engineer, which may be started automatically or from remote locations. Signs shall be in accordance with OSHA safety regulations and shall be suitable for exterior use.

- B. Warning signs shall be colored yellow and black on not less than 18-gauge vitreous enameling stock. Copy shall read:

“CAUTION: THIS EQUIPMENT STARTS AUTOMATICALLY”

1.24 SPROCKETS

- A. General: Sprockets shall be used in conjunction with chain drives and chain-type material handling equipment.
- B. Materials: Except as otherwise indicated, sprockets shall comply with the following:
 - 1. Sprockets with 25 teeth or less, normally used as a driver, shall be medium carbon steel in the 0.40 to 0.45 percent carbon range.
 - 2. Type A and B sprockets with 26 teeth or more, normally used as driven sprockets, shall be minimum 0.20 percent carbon steel.
 - 3. Large diameter sprockets with Type C hub shall be cast iron conforming to ASTM A 48, Class 30.
- C. Sprockets shall be accurately machined to ANSI Standards. Sprockets shall have deep hardness penetration in tooth sections.
- D. Finish bored sprockets shall be provided complete with keyset and set screws.
- E. Sprockets shall be of the split type or shall be provided with taper-lock bushings.
- F. Idler sprockets shall be provided with brass or Babbitt bushings, complete with oil hole and axial or circumferential grooving. Steel collars with set screws in both sides of the hub shall be provided.
- G. Idler sprockets shall be installed so that not less than one-quarter of the total adjustment is available for future use.

1.25 ELECTRICAL EQUIPMENT

- A. All electrical equipment shall be capable of continuously operating successfully at full-rated load, without failure, at an ambient air temperature of 32 F° to 105 F° and at an elevation of approximately 550 feet (MSL).
- B. All electrical devices and equipment shall have ratings based on 75 F° terminations.

1.26 HORSEPOWER RATING

- A. Motor horsepower ratings noted in individual equipment specifications are estimates only and it is the responsibility of the Contractor to furnish motors, electric circuits, and other equipment of ample horsepower capacity to operate the equipment furnished without exceeding the nameplate full-load current at rated

nameplate voltage. Full-load amps information shall be furnished with submittals on all motors.

1.27 PAINTING

- A. Surfaces requiring painting or coating for corrosion protection shall be smooth, free from sharp edges, burrs, and projections, and shall have all welds ground smooth and all edges and corners of structural members rounded. Non-conformance shall be grounds for rejection of equipment as determined by the Engineer.
- B. All protective coatings shall be done in accordance with the approved painting submittal submitted under Division 9. The Contractor shall be required to submit his proposed protective coating schemes for review prior to any other equipment, piping, or hardware submittals that require protective coatings. After review of the protective coating submittals by the Engineer to indicate no further submittals are required, the Contractor shall be required to furnish only the approved protective coatings throughout the project.
- C. Equipment shall be shop primed in accordance with the approved Section 09900 - Painting and Coating Submittal prior to delivery to the jobsite unless otherwise specified. Removal of shop coatings and application of protective coatings shall be as specified in Section 09900 - Painting and Coating.
- D. Surfaces of equipment which will be inaccessible after assembly shall be painted or otherwise protected before assembly by a method which provides protection for the life of the equipment. Contractor shall furnish new equipment to replace any equipment which the City determines to be damaged beyond repair by rust or mishandling, etc., while in storage or during installation by the Contractor. Name plates shall not be painted.
- E. Electric motors, drives, control panels and other equipment that would be damaged by sandblasting shall be cleaned by methods specified in Section 09900 - Painting and Coating. Following cleaning, the components shall be shop painted with a primer, intermediate and final coat per the requirements of Section 09900 - Painting and Coating. The Contractor shall certify, by letter from the equipment supplier included with the equipment submittal, and that the painting subcontractor was consulted and confirmed that the proposed primer, intermediate and finish coating described above is identical with the approved painting scheme. After delivery to the jobsite, the surfaces shall be inspected and evaluated. The Contractor shall have the painting subcontractor prepare and apply a touch-up coat of paint to the equipment in the field if required and in accordance with Section 09900 – Painting and Coating.
- F. Machined, polished, and other ferrous and non-ferrous surfaces which are not to be painted shall be coated with rust preventative compound, Dearborn Chemical "NO-Ox-Id," Houghton "Rust Veto 344," Rust-oleum "R9," or approved equal. Should rust occur during shipment and/or storage, the Contractor shall be responsible for correction as determined by the City.
- G. Galvanized metal surfaces are to be solvent cleaned of residual oils and primed

with an approved galvanized metal primer before shipment.

- H. All galvanizing, where called for in the Contract Documents, shall be hot dip process conforming to ASTM A-123 and the appropriate American Hot Dip Galvanizers Association, Inc. Specifications.
- I. Copper, bronze, chromium plate, nickel, stainless steel, aluminum, Monel metal, lead, lead coated copper, brass and plastic are not to be painted or finished unless called for in other parts of the Contract Documents or as recommended by the manufacturer.
- J. All metallic surfaces requiring a shop applied primer shall be primed with the approved priming system that has been verified with the painting subcontractor as being compatible with the coating systems proposed and shall be applied in accordance with the recommendations of the paint manufacturer. Submittals for equipment shall include the following:
 - 1. Coating manufacturers "Cut-sheet" describing components, surface preparation requirements, recommended mil thicknesses, and application procedures for the proposed primer.
 - 2. A letter from the Contractor stating that the equipment supplier has contacted the Painting subcontractor and confirmed that the proposed primers are compatible, and that the primer will be applied per the coating manufacturers requirements shall be submitted with the equipment submittals in accordance with the procedures specified in Section 01300, Record Drawings and Submittals and Section 01340, Submittal Requirements. In addition, the letter shall certify that the appropriate surface preparations will be made by the manufacturer prior to primer application.
 - 3. After delivery to the job site, equipment surfaces shall be inspected and evaluated by the City. Touch-up or complete removal of shop priming, by sandblasting or other approved method, may be required as determined by the City, based on the condition of the equipment primer prior to final, in place, finish coat application.
 - 4. Field touch-up, final surface preparation, and final finish coatings shall be in accordance with Section 09900 - Painting and Coating.

1.28 DISSIMILAR METALS

- A. Where aluminum surfaces come in contact with dissimilar metals, except Type 304 or 316 stainless steel, aluminum surfaces shall be kept from direct contact with said metal by use of neoprene gaskets or washers, polyethylene self-adhesive tape (two wraps of 20-mil tape), or washers. Galvanizing or paint shall not be considered as adequate protection.
- B. All stainless-steel bolt and screw surfaces in contact with aluminum shall be coated with Never Seez by Never Seez Compound Corp., WLR No. 111 by Oil Research

Inc., or equal.

1.29 MACHINED FIBERGLASS

- A. All machined fiberglass edges shall be sealed to prevent wicking.

1.30 PROTECTION

- A. Equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. Each container or piece of equipment shall be clearly marked with the Contractor's name, project name and location. Equipment shall be stored on raised supports protected from exposure to the elements and shall be kept thoroughly dry at all times. Pumps, motors, drives, and other equipment having anti-friction or sleeve bearings shall be stored in weather tight storage facilities such as warehouses. Covering with visquine or similar material will not be considered as a weather tight enclosure.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration and other damage. Painted equipment surfaces which are damaged prior to acceptance shall be repainted in entirety to the satisfaction of the Engineer.
- C. All electrical equipment, controls, instrumentation and control panels shall be protected against moisture or water damage by storage in a dry, heated, and completely enclosed space. Space heaters provided in the equipment shall be connected and operating at all times until equipment is placed in operation.

1.31 ELECTRIC MOTORS

- A. Motor voltage, speed and enclosures are specified in the detailed equipment specifications. Motors furnished with equipment shall comply with this general specification.
- B. Motors shall be designed and applied in compliance with NEMA, ANSI, USDA, IEEE, ASA C50, and AFBMA standards and the NEC for the specific duty imposed by the driven equipment. All motors 15 hp and greater shall be NEMA Code G or lower.
- C. All motor shall be of The Motor Manufacturer's Premium energy-efficient design, different from Manufacturer's standard product through the use of premium materials, design and improved manufacturing process that reduces motor losses approximately 40% from standard efficient designs.
- D. Motor efficiency shall be determined in accordance with NEMA Standard MG1-12.54.1 and full load efficiency labeled on motor nameplate in accordance with NEMA Standard MG1-12.54.2 or MG1-10.40.1.

- E. The minimum full load efficiency for each motor furnished by the Contractor shall be not less than the minimum value associated with the nominal efficiency as shown in the following table, whichever is higher:

hp	Open Motors			Enclosed Motors		
	3600 rpm	1800 rpm	1200 rpm	3600 rpm	1800 rpm	1200 rpm
1	--	82.5	80.0	72.5	82.5	80.0
1.5	82.5	84.0	84.0	82.5	85.5	86.5
2	84.0	84.0	85.5	84.0	84.0	87.5
3	84.0	86.5	86.5	86.5	88.5	89.5
5	85.5	87.5	87.5	88.5	88.5	89.5
7.5	87.5	88.5	88.5	89.5	90.2	91.0
10	88.5	89.5	90.2	89.5	90.2	91.0
15	89.5	91.0	90.2	91.0	92.4	91.0
20	90.2	91.0	91.0	90.2	91.1	90.6
25	91.0	91.7	91.7	91.7	93.0	92.4
30	91.0	92.4	92.4	91.7	93.6	92.4
40	91.7	93.0	93.0	92.4	93.6	94.1
50	92.4	93.0	93.0	92.4	94.1	94.1
60	93.0	93.6	93.6	93.6	94.5	93.0
75	93.0	94.1	93.6	94.1	95.0	94.1
100	93.0	94.1	94.1	93.6	94.5	93.6
125	93.6	94.5	94.1	94.5	94.5	94.1
150	93.6	95.0	94.5	94.5	95.0	94.1
200	94.5	95.0	94.5	95.0	95.0	95.0

- F. Vertical motors and motors with speeds other than 1,800 and 1,200 rpm shall also be of the premium efficiency and high-power factor type with ratings similar to that described above.
- G. The machine noise of the motors shall not exceed the following sound power levels when measured in accordance with IEEE Standard 85:

Overall Sound Power Level, Decibels, A-Weighted		
Horsepower	1800 RPM	1200 RPM
2 - 2	70	67
3 - 5	74	71
7-1/2 - 10	77	74
15 - 20	81	78
25 - 30	85	80

40 - 50	89	84
60 - 75	90	88
100 - 150	90	93

- H. All motors shall successfully operate under power supply variations per NEMA MG1-14.30.
- I. All motors shall be NEMA Design B with torque and starting currents in accordance with NEMA MG1-12.35 and 12.37 except in special applications requiring higher starting torques where NEMA Design C or D is permitted.
- J. All motors shall have a 1.15 service factor. Polyphase integral horsepower motors shall be sized so that, under maximum load conditions imposed by the driven equipment, for the conditions specified, the motor nameplate rated horsepower and temperature rise will not be exceeded. Motors with a service factor of 1.15 shall be selected for operation within their full load rating without applying the service factor.
- K. Each motor shall be of the speed and horsepower specified or required to properly operate the driven equipment, torque characteristics as required by the drive load and suitable for direct coupling or V- belt drive as shown on the Contract Drawing and specified herein. Motors shall be designed for full voltage starting unless otherwise specified. All motors 125 HP and greater shall be designed to accelerate the driven equipment with reduced voltage starting unless otherwise specified or shown on the Contract Drawings.
- L. Frames shall be of corrosion-resistant cast iron with integrally cast feet or bases. End bells, conduit box and cover bases shall be cast iron, with precision machined bearing fits, ASTM Type A-48, Class 25 or better. Type 316 Stainless steel automatic breather drains shall be provided in the lowest part of front and back brackets to allow drainage of condensation on TEFC motors.
- M. Each stator core assembly shall consist of stacked laminations made from specially selected electrical sheet silicon steel.
- N. For non-VFD driven motors, insulation materials shall be non-hygroscopic and meet or exceed Class F definition, utilizing materials and insulation systems evaluated in accordance with IEEE 117 classification tests. Motor temperature rating shall not exceed Class B temperature limits as measured by resistance method when the motor is operated at full load at 1.0 service factor continuously in a maximum ambient temperature of 40°C. Windings shall be copper.
- O. Rotor cages shall be die cast aluminum or fabricated copper. Shafts shall be carbon steel.
- P. Rotors on frames 213T and above shall be keyed shrunk or welded to shaft and rotating assembly dynamically balanced to NEMA limits per MG1-12.06. Balance weights, if required, shall be secured to the rotor resistance ring or fan blades by rivets. Machine screws and nuts are prohibited. The entire rotating assembly

between bearing inner caps shall be coated with a corrosion-resistant epoxy.

- Q. Bearings shall be ball, open, single row, deep groove, Conrad type, and shall have a Class 3 internal fit conforming to AFBMA Std. 20. For belted duty applications, drive end bearing may be cylindrical roller type. Bearings shall be selected to provide L10 rating life of 17,500 hours minimum for belted applications, 100,000 hours minimum for flexible direct coupled applications. Calculations shall be based on external loads using NEMA belted applications limits per MG1-14.41 and typical sheave weights and internal loads defined by the manufacturer including magnetic pull and rotating assembly weight.
- R. Bearing temperature rise at rated load shall not exceed 60-degree temperature rise to be measured by RTD or thermocouple at bearing outer race. Bearing AFBMA identification number shall be stamped on motor nameplate.
- S. Motor lubrication system shall consist of a sealed bearing or a grease inlet on motor bracket with capped grease fitting on inlet, grease relief plug 180 degree from inlet, grease reservoir in bracket and grease reservoir in cast inner cap. Motor shall be greased by manufacturer with a premium moisture resistant polyuria thickened grease containing rust inhibitors and suitable for operation over temperature from -25 °C to 120 °C. Vertical motors lubrication system shall be manufacturer's standard oil or grease.
- T. External conduit boxes on motors shall be one minimum size larger than NEMA standards. The conduit boxes shall be diagonally split, and rotatable in 90-degree steps. A gasket shall be furnished between the conduit box and frame. Motor leads shall be stranded copper wire, Class F insulated, non-wicking, with permanent identifications spaced 1-1/2" maximum. Clamp type grounding terminals shall be provided in the conduit boxes. A tapped hole shall be provided on the frame for external connection of a ground cable.
- U. All bolt and cap screws shall be of high strength, SAE Grade 5 zinc-plated and chromatic steel. Screwdriver slot fasteners are unacceptable.
- V. All motor parts including frame, brackets, fan cover and terminal box shall be painted per Section 09900 - Painting and Coating, for the particular location and service conditions. Motor assembly shall successfully withstand salt spray test for corrosion per ASTM B-117 for 96 hours.
- W. Name plates shall be 316 Stainless steel with embossed or pre-printed lettering and fastened to the motor frame with 316 Stainless steel pins. Nameplates shall have stamped on them the motor manufacturer's name, design voltage; number of hertz and phase; horsepower rating; amperage, and temperature rise at rated load, full load speed, NEMA code letter, service factor, ambient temperature, model number, AFBMA bearing number, serial number, and maintenance manual number per NEMA MG1-10.40.1.
- X. A separate nameplate shall provide lubrication instructions and connection diagram for dual voltage and multi-speed motors.

- Y. Motors driven by VFD's shall be sized so that motor load will not exceed 80% of the motor service factor rating by any load imposed by the driven equipment at any specified operating condition or point in the equipment's performance curve at maximum operating speed. VFD fed motor windings shall be provided with one normally closed temperature switch in each phase. Contacts shall open on rising temperature and automatically close when motor winding temperature drops to a safe operating value. Contacts shall be rated 2A, 250V AC.
- Z. Motors for use with variable frequency drives shall be compatible with the characteristics of the intended VFD's. Insulation shall be Class H with extra phase insulation for high dV/dt peaks. End turns shall receive extra bracing. Silicon steel shall be of highest quality. An extra VIP cycle shall be applied. The motors shall be capable of operating successfully with IGBT based VFD's. At a minimum, motors shall meet NEMA MG1 Part 31.40.4.2 Standards. In addition, motors shall have a published minimum Corona Inception Voltage (CIV) rating of 1600V at rated operating temperature for 480V AC ratings. Test data for similar motors and ratings shall be made available if requested by the City. The pulse width modulated IGBT VFD's utilized with the motor shall have a carrier frequency of not more than 2000 Hertz, unless otherwise specified or approved.

1.32 CONTROL CABINETS AND PANELS

- A. All control cabinets, panels, and junction boxes located outdoors, indoors below grade, or in corrosive environments shall be NEMA 4X 316 Stainless steel with 316 stainless steel hardware unless otherwise specified or noted on the Contract Drawings.
- B. All control cabinets, panels, and junction boxes located in hazardous areas shall be NEMA 7. Control panels and cabinets shall be in accordance with Section 17250, Control Panels.

1.33 EQUIPMENT AND TANK FOOTINGS AND ANCHORING

- A. Unless otherwise specified or noted on the Contract Drawings, all equipment including tanks shall be provided with a reinforced concrete pad consisting of an eight (8) inch thick slab with a minimum of #4 re-bars at 8 inches on centers each way and 316 stainless steel anchor bolts as required to accommodate the equipment or tank. Where supported on grade, the area under the pad shall be graded, backfilled and compacted prior to placement of the pad. Pads shall not be placed on top of asphalt concrete paving. All asphalt in the pad area including any additional area required for formwork shall be saw cut and removed to grade. The area under the pad shall be graded and compacted as required prior to placement of the pad.

- B. All anchoring shall satisfy the seismic requirements of Section 1.34, Seismic Requirements for Anchoring Equipment and Piping, of this Section. All submittals shall indicate compliance with this requirement where applicable. Submittals shall include all design calculations and shall be signed by a California Civil or Structural Registered Engineer.

1.34 SEISMIC REQUIREMENTS FOR ANCHORING EQUIPMENT AND PIPING

- A. General: Machinery, equipment, and components such as pumps, tanks, piping, electrical panels, and other items, including their supports and anchorages, supplied by manufacturers or suppliers, shall be designed in accordance with ASCE 7, and their anchorage, shall be designed and detailed in accordance with the Seismic Design Criteria section.
- B. Submit seismic design calculations and drawings stamped by a California licensed professional civil or structural engineer. Submittals shall be certified, by the Contractor, that designs are in conformance with the specifications and that all applicable loads, including seismic, have been included. All anchor bolts shall be cast-in-place unless otherwise specified or otherwise shown. Inasmuch as all anchorage of equipment is to be made in cast-in-place concrete elements, types of anchorage shall be coordinated with the concrete subcontractor so that anchorage may be installed at the time of concrete placement. If calculations and anchorage details are not submitted prior to placement of concrete, the Contractor shall be responsible for any strengthening of concrete elements because of superimposed seismic loading.
- C. Equipment: Equipment with vibration isolators shall be provided with snubbers capable of retaining the equipment in its designated location without any material failure or deformation of the snubbers when exposed to a vertical or horizontal force at the contact surface equal to 100 percent of the operating weight of the equipment. Air gaps between retainer and equipment base shall not exceed 1/4 inch. Deflection must be considered with respect to piping attached to the equipment. Equipment without vibration isolators shall be anchored directly to the supporting floor, wall or overhead support system. In addition to the anchorage, all equipment shall be internally designed so that all static and moving parts are anchored to the supporting framework to resist the imposed seismic forces. All forces must be transmitted to the base in order to be anchored as required. All piping, raceways, ductwork, accessories, appurtenances, and other items furnished with equipment shall be anchored to resist a lateral seismic force specified without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration. Lighting fixtures shall be provided with safety cable attached to the structure and to the fixture at each support point capable of supporting four times the vertical load.
- D. Piping: All piping installed shall be anchored to the supporting floor, wall or overhead system(s) to resist the lateral seismic forces specified above without excessive deflection or pipe stress in compliance with ANSI/ASME B31.1 latest edition. This force shall be considered acting at the center of gravity of the pipe under consideration. Piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the

pipng system.

1.35 SCHEMATIC DIAGRAMS

- A. Schematic diagrams are provided for the Contractor's guidance in fulfilling the operational intent of the Contract Documents.
- B. It shall be the Contractor's responsibility to meet all safety and electrical codes, and to provide all equipment, appurtenances and specialty items required to provide for complete and operable systems.
- C. Review of control schemes submitted by the Contractor shall not relieve the Contractor of his contractual responsibility to provide complete and successfully operating systems.

1.36 MANUFACTURERS AND SUPPLIERS FIELD AND TEST DATA

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment as required in these Specifications shall visit the site of the Work and inspect, check, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the City.
- B. Six (6) copies of all test and field data collected by the manufacturers/suppliers of equipment during installation supervision and start-up services, shall be submitted to the City within fourteen (14) calendar days after the start-up services are complete. The test and field data shall be submitted whether specified or not in the detailed equipment specifications and shall include but not be limited to the motor amperage readings to verify drives are properly sized, tolerance and alignment measurements where applicable to verify equipment has been satisfactorily installed, and all other information collected by the manufacturers/suppliers to satisfy themselves that equipment has been properly installed. The manufacturer shall submit to the City, a certification on the manufacturer's letterhead stating that the equipment (1) has been properly installed and lubricated, (2) is in accurate alignment, (3) is free from any undue stress imposed by connecting piping or anchor bolts, and (4) has been operated under full load conditions and it operated satisfactorily. In cases where the manufacturer/suppliers feels equipment is not properly installed, he shall include with this submittal a punch list detailing the problems noted. The information required under this Section shall be furnished for all equipment and devices requiring installation and start-up services as specified in these Specifications including the detailed mechanical, electrical and instrumentation specifications.
- C. The costs for this work shall be included in the prices quoted by equipment suppliers. The Contractor shall perform all Work required to install and place into operation the equipment in accordance with the manufacturer's recommendations.

1.37 FACTORY TEST AND CERTIFICATION

- A. All equipment, devices, and systems requiring factory tests and certifications as specified in the Contract Documents shall be tested and certified at the Contractor's expense and may be witnessed by the City, the Engineer, or the City by reporting an intent to do so to the Contractor.
- B. The Contractor shall not schedule factory testing until the Contractor has received an approved submittal from the City.
- C. The Contractor shall notify the City and the Engineer via the City, in writing, at least twenty-one (21) calendar days prior to testing, unless otherwise specified, and shall submit, with the written notification, a testing plan. Slight changes in the schedule of testing to accommodate the schedules of the City, the Engineer, and the City and their staff will not be considered to constitute a change in the Contractor's cost or schedule.
- D. The written notifications shall specify the exact time and date of the testing, the location where the tests will be conducted, and shall define the test procedures to be utilized. Testing shall be performed during normal business hours and shall be subject to review by the City, the Engineer, and the City as specified herein.
- E. Within 7 days of receiving the written notification of the schedule for factory testing, the City shall provide the Contractor written notification of the representatives who will attend the witness tests. If no representatives of the City, the Engineer or the City attend, the Contractor shall be notified in writing. Notification shall not relieve the Contractor of his obligation to conduct the specified testing and submit test reports.
- F. Where the Contract Documents specify several witness tests for a particular unit, all tests shall be performed by the Contractor during a single witness testing session.
- G. If the test results indicate that any unit does not conform to the specified and/or guaranteed performance, the unit shall be modified and retested at no additional cost to City until full compliance with specified and guaranteed performance can be demonstrated.
- H. The City, the Engineer, and the City shall be permitted to witness the retests and shall be given 7 days' notice of intent of the Contractor to retest. All costs including labor, transportation and lodging for the City, the Engineer, and the City and other required witnesses to witness retests shall be borne by the Contractor.

1.38 AIR RELEASE VALVES

- A. The Contractor shall furnish and install air release valves on the discharge header from each pumping system when and where the discharge header or pipeline changes from a horizontal (zero slope) or positive slope to a negative slope. Unless specified otherwise or shown otherwise on the Contract Drawings the air release valve shall be an Apco Model 200 or equal for water lines, and an Apco Model 400

or equal for sewage and sludge lines. Each valve shall be installed with an isolation valve of the size and type shown or specified.

1.39 VARIABLE FREQUENCY DRIVES

A. Unit Responsibility.

1. The Contractor shall have unit responsibility for proper coordination and compatibility of all variable frequency drives and other driver equipment, and controls furnished under Division 16 with the pumping equipment and motors specified in these Specifications and shall have total responsibility for the satisfactory installation and operation of the entire pumping system including pumps, motors, drives, and controls as specified in these Specifications.
2. The pump or driven-equipment manufacturer shall assume the sole unit responsibility for the pumps and motors, and shall assume responsibility that the motors supplied with the pumps will successfully operate the pumps over the specified operating speed range, and that the pump package including motors will operate successfully over the speed range and all other operating characteristics provided by the Variable Frequency Drives specified in the Division 16.
3. The pump manufacturer shall submit written approval, in letter form, of the variable frequency drives to be furnished as part of the submittal package. The pump manufacturer shall perform all field testing necessary to confirm compatibility of the drives with successful pump operation throughout the pumps' operating range.

1.40 START-UP AND O&M SERVICES

- #### A.
- Contractor shall provide a qualified manufacturer's representative for each piece of equipment specified in the Contract Documents for a minimum of one 8-hour day to instruct City's Operation and Maintenance personnel in the operation and maintenance of the equipment furnished unless otherwise specified. Check-out and start-up may involve separate trips. Additional start-up and O&M services beyond the minimum specified above shall be provided as specified in Section 01650 - Startup Requirements, in individual technical sections and as specified elsewhere. Equipment check-out and start-up shall be coordinated by Manufacturer and Contractor. Training shall consist of both classroom and field training. A Lesson Plan used for training shall be submitted for review by the City at least thirty (30) days prior to the scheduled start of training and training. All costs for manufacturer start-up and O&M services shall be included in Contractor's Bid.

1.41 SOLID STATE REDUCED VOLTAGE STARTERS

- #### A.
- The Contractor shall have unit responsibility for proper coordination and compatibility of all solid state reduced voltage starters and controls furnished under Division 16 with the pumping equipment or other driver equipment and motors specified in these Specifications and shall have total responsibility for the

satisfactory installation and operation of the entire pumping system including pumps, motors, drives, and controls as specified in these Specifications.

- B. The pump or driven-equipment manufacturer shall assume the sole responsibility for the pumps, motors, and solid state reduced voltage starters, and shall assume responsibility that the solid motors supplied with the pumps will successfully accelerate to full speed with the specified number of starts per hour.
- C. The pump manufacturer shall submit acceleration speed/torque curves of the pump and starter for approval. The pump manufacturer shall perform all field testing necessary to confirm compatibility of the drives with successful pump acceleration to full speed at all suction and discharge net head conditions.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. Provide new industrial quality products for the Work, unless used or reuse of existing is specifically authorized in the Contract Documents.
- B. Provide standard catalogue products of manufacturers regularly engaged in the manufacture of the products unless specifically authorized otherwise.
 - 1. Provide products that comply with specified requirements and that will function properly in their expected environment and under expected service conditions.
 - 2. Where two or more units of the same product class are provided, provide products from the same manufacturer that are interchangeable.
 - 3. Factory assemble equipment when practical.
 - 4. For equipment shipped unassembled, provide with assembly plans and written instructions. Match-mark or tag separate parts and assemblies to facilitate field assembly.
 - 5. Install products in accordance with requirements of Contract Documents and approved manufacturer's recommendations.

PART 3 - EXECUTION

3.1 PREPARATION FOR SHIPMENT

- A. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.

- B. Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.
- C. Grease and lubricating oil shall be applied to all bearings and similar items.

3.2 SHIPPING

- A. Before shipping each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

3.3 SYSTEMS DEMONSTRATION

- A. Prior to final inspection, demonstrate satisfactory operation of each system to City.

3.4 INSTRUCTION OF CITY'S PERSONNEL

- A. Instruct City's personnel in the operation, adjustment, and maintenance of equipment and systems.

****END OF SECTION****

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SECTION 01611 SEISMIC DESIGN CRITERIA

PART 1 – GENERAL

1.1 SCOPE

This section provides the seismic design criteria for designing non-structural components. In the event of conflict with requirements in other sections, the more stringent criteria shall be followed.

1.2 DESIGN CRITERIA

- A. Non-structural components structures including anchorage of such items, shall be designed in accordance with the following criteria.
- B. General Design Data:
 - 1. Building Code and References: IBC 2009, ASCE 7-05 “Minimum Design Loads for Buildings and Other Structures”, AISC 360 “Specification for Structural Steel Buildings”, AISC 341 “Seismic Provisions for Structural Steel Buildings”
 - 2. Site elevation
 - 3. Site elevation, above mean sea level: 400ft
 - 4. Design flood elevation, DFE: N/A
 - 5. Design groundwater elevation: N/A
- C. Wind Design Data:
 - 1. Basic wind speed, V (Service Loads): 85 mph
 - 2. Exposure category: C
 - 3. Importance factor, I_w (Occupancy Category III): 1.15
- D. Design Data for Non-structural Components:
 - 1. Design short period spectral response acceleration: ion, SDS, 0.885g
 - 2. Site soil classification (Default Value): D
 - 3. Seismic Design Category: D
 - 4. Component importance factor, IP: As indicated in the Non-Structural Component Schedule

1.3 WIND ANCHORAGE

Equipment that is to be located outdoors shall have anchor bolts designed for the effects of wind forces, as determined in accordance with ASCE 7, Chapter 6. Shop drawings shall include full anchor bolt details, and shall be sealed by a professional engineer licensed in the state of the project. Calculations shall be furnished when requested by Engineer.

1.4 SEISMIC DESIGN

- A. General. Structural systems shall provide continuous load paths, with adequate strength and stiffness to transfer all seismic forces from the point of application to the point of final resistance.
- B. Pre-Engineered Buildings (Not Used)
- C. Non-Structural Components. Non-structural components are architectural, mechanical, and electrical items that are permanently attached to and supported by a structure but are not part of the structural system, as indicated in Chapter 13 of ASCE 7, and in the Non-Structural Components Schedule at the end of this section.
- D. The Non-Structural Components Schedule identifies the components that require some level of seismic design. The requirements of this paragraph are applicable only to the items listed in the Non-Structural Components Schedule.
- E. All components, and the anchorage of those components to the main structure, shall be shown on construction documents prepared and sealed by a registered design professional that is licensed in the state of the project. The construction documents shall be submitted in accordance with the Greenbook and Whitebook Submittals section. Structural calculations shall be submitted when requested by Engineer.
- F. Design of non-structural components shall be in accordance with all applicable provisions of ASCE 7, Chapter 13. Non-structural components shall have sufficient strength and ductility to resist the specified seismic effects, and shall meet all of the design, proportioning, detailing, inspection, and quality assurance provisions of the specified building code and other referenced codes.
- G. Non-structural components shall be attached so that seismic forces are transferred to the structural system. Curbs that support roof-mounted equipment shall be designed to transfer forces from the equipment into the main structural roof members. All structural attachments shall be bolted, welded, or otherwise positively fastened. Frictional resistance due to gravity shall not be considered in evaluating the required resistance to seismic forces.

- H. When the Non-Structural Components Schedule indicates that seismic design of any component is required, the component shall be designed to be operable during and following a design level seismic event without collapsing, breaking away from supports, creating an ignition hazard, or releasing any contents.
- I. “W_p” shall include the total operating weight of the component or system, including, but not limited to, any insulation, fluids, and concentrated loads such as valves, condensate traps, and similar components.
- J. Seismic effects that shall be analyzed in the design of piping systems include the dynamic effects of the piping system, contents, and supports. The interaction between piping systems and the supporting structures, including other mechanical and electrical equipment, shall also be considered. Where pipe supports are to be designed by Contractor, as required by the Pipe Supports section, both the piping and support systems shall be designed to meet the applicable requirements of ASCE 7, Chapter 13.
- K. Non-Building Structures. (Not Used)

****END OF SECTION****

Non-Structural Component Schedule				
Component	Applicable Specification Section	Importance Factor (Ip)	Design of Supports and Attachments	Design of Component
Variable Frequency Drives	11033	1.0	x	
Variable Speed Screw Water Chillers	11070	1.0	x	
Chilled Water Primary Pumps	11071	1.0	x	
Chilled Water Secondary Pumps	11072	1.0	x	
Ancillary Equipment and Appurtenances	11075	1.0	x	
Steel Pipe	15062	1.0	x	
Valves	15100	1.0	x	
Pipe Supports	15140	1.0	x	
Electrical	Division 16			
Instrumentation and Control	Division 17			

SECTION 01615 - EQUIPMENT AND VALVE IDENTIFICATION

PART 1 – GENERAL

1.1 SCOPE

- A. This section covers the furnishing and installation of nameplates and tags for identification of equipment, valves, panels, and instruments.

1.2 GENERAL

- A. Except as otherwise specified in equipment, valve, and instrumentation sections, nameplates and tags shall be as specified herein. Nameplates or tags shall be provided for all equipment, valves, operator interfaces, control and electrical panels, cabinets, instruments, and instrument racks that have been named and/or tagged on the Drawings.

1.3 SUBMITTALS

- A. Drawings and data shall be submitted in accordance with the requirements of the Greenbook and Whitebook Submittals section for each type of tag provided including materials, colors, sizes, letter sizes, and installation instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT NUMBER PLATES

- A. All equipment tagged on the drawings shall be provided with number plates bearing the equipment tag number identified on the Drawings. Number plates shall be bevelled, 1/8th inch thick laminated black phenolic plastic engraving stock with white core. Lettering on number plates shall be capitalized block letters 3/4 inch high.
- B. Number plate height shall be twice the letter height. Number plate length shall be as needed, with suitable margins all around. Lettering shall be placed in one row where practicable; however, where necessary due to excessive length, lettering shall be placed on more than one row and centered.
- C. Number plates shall be attached with stainless steel panhead screws, rivets, or drive screws.
- D. When a number plate cannot be installed due to the physical size, space, or mounting surface geometry of the equipment, the Contractor shall provide a 12-gauge stainless steel tag with engraved or imprinted equipment tag number.

- E. Lettering on tags shall be $\frac{1}{4}$ inch high. Tags shall be rectangular with smooth edges and shall be fastened to the equipment with stainless steel mechanical fasteners or with a stainless-steel chain.

2.2 EQUIPMENT INFORMATION PLATES

- A. Equipment shall be provided with engraved or stamped equipment information plates securely affixed with mechanical fasteners to the equipment in an accessible and visible location.
- B. Equipment information plates shall be in addition to the number plates specified. Equipment information plates shall indicate the manufacturer's name, address, product name, catalog number, serial number, capacity, operating and power characteristics, labels of tested compliances, and any other pertinent design data. Equipment information plates listing the distributing agent only will not be acceptable.

2.3 VALVE TAGS

- A. Temporary Tags
 - 1. Each valve and piece of equipment with an identifying number indicated on the Drawings or listed in the valve or gate schedule, shall be tagged or marked in the factory with the identifying number.
- B. Permanent Tags
 - 1. All valves and pieces of equipment that have been assigned a number on the Drawings or in the valve or gate schedule, shall be provided with a permanent number plate. Tags shall be permanently attached to valves and gates with stainless steel mechanical fasteners or with stainless steel chains. Numerals shall be $\frac{3}{4}$ -inch-high and shall be black baked enamel on an anodized aluminum plate.

2.4 PANEL NAMEPLATES

- A. Nameplates shall be provided on the face of each panel and cabinet. Panel identification nameplates shall be mounted at the top of the panel shall include the panel descriptive name and tag number as indicated on the Drawings, in two or three lines of text. Lettering shall be $\frac{3}{4}$ inch high.
- B. Nameplates for devices mounted on or in the panel shall be inscribed with the text as indicated on the Drawings. Where nameplate information is not indicated on the Drawings, inscriptions shall be in accordance with information in the supplier's submittal drawings as guided by information in the relevant specification section. Panel device nameplates shall have engraved letters $\frac{3}{16}$ inch high.

- C. Nameplate material and size shall be as specified above for equipment number plates. Nameplates shall be secured to the panel with stainless steel panhead screws.

2.5 INSTRUMENT TAGS

A. Temporary Tags

- 1. Where instruments are not provided with permanent tags furnished from the factory, instruments shall be tagged or marked in the factory with the instrument tag number indicated on the Drawings.

B. Permanent Tags

- 1. Instruments shall be tagged with the instrument tag number indicated on the Drawings. Tags shall be 12-gauge stainless steel with engraved or imprinted symbols. Lettering on tags shall be $\frac{1}{4}$ inch high. Tags shall be rectangular with smooth edges and shall be fastened to the instrument with stainless steel mechanical fasteners or with a stainless-steel chain.

PART 3 – EXECUTION (NOT USED)

****END OF SECTION****

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SECTION 01650 - STARTUP REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. This section includes the requirements for startup and testing all items of equipment and systems that form a part of this CONTRACT. The purpose of this section is to define the requirements for bringing individual equipment, systems, and facilities online and for proving proper operation and performance of that work. Contractor is required to develop, submit, and maintain detailed plans, including designation of management and staff, for these activities as specified herein. Additional requirements such as training are specified in other sections.

- B. As the Metro Biosolids Center is an active, continuous operating facility, placement of improvements online in an expeditious manner is critical. Shutdown requirements and placement of the temporary chilled water system into service are included in the Construction Sequencing Plans (CSP) guidelines in the Construction Sequencing Section. The Contractor will perform startup checks and functional testing of the systems as specified prior to making connections to the existing system. Upon making a connection(s), functional acceptance testing (F.A.T.) will be performed by the Contractor with support from Plant Personnel as specified in this Section.

- C. The startup and testing services referenced or specified herein include the following:
 - 1. Startup checks – By Contractor
 - 2. Functional testing – By Contractor
 - 3. Functional acceptance testing – By Plant Personnel as part of standard plant operations once system is placed back online.
 - 4. Contractor in standby mode to address failures.
 - a. Pre-Startup Activities and Checks - Inspections, tests and other activities necessary to determine that equipment, systems and subsystems have been properly manufactured and installed. Pre-startup activities shall include an audit of all factory testing of equipment and compiling the results for comparison to startup testing.
 - b. Functional Testing – Initial limited operation of equipment, to demonstrate capability of installed components to perform their intended functions, respond to controls, and safely interface with external systems, followed by operation of individual systems in manual and automatic mode to test full functionality of individual systems.
 - c. Functional Acceptance Testing shall demonstrate capability

of installed components to perform their intended functions for the complete chilled water system.

1.2 RELATED SECTIONS

- A. Division 11 – Equipment
- B. Division 13 – Instrumentation
- C. Division 15 - Mechanical
- D. Division 16 – Electrical

1.3 GENERAL

- A. The Contractor shall be responsible for and furnish all labor, materials, instruments, incidentals, and equipment required for startup and testing. Temporary facilities required to carry out the specified testing, including temporary pipe, pumps, and other appurtenances, shall be furnished and installed, and removed when no longer required for startup and testing. Refer to the Whitebook and Greenbook Responsibilities of the Contractor section for requirements concerning water and power for startup and testing.
- B. Startup and testing shall be conducted during normal working hours during the workweek of Monday through Friday, unless otherwise approved by the Engineer. Where continuous long-term testing is required, testing may continue over the weekends and holidays with prior approval from the Engineer and Plant Personnel.
- C. The Contractor's startup manager shall be on site full time at least 30 days prior to any field startup and testing activities and shall remain on site until all startup and testing activities are complete.

1.4 STARTUP MANAGER

- A. The Contractor's startup manager shall be a startup and testing expert in starting up equipment and systems of similar type, size, capacity, and complexity to the equipment and systems included in this Project. The startup manager shall have the necessary experience to fully understand all startup requirements, to manage the Contractor's resources providing the startup services, and to prepare all startup documentation, as specified. The startup manager's assigned duties and responsibilities are those specifically related to planning, supervising, and executing startup activities and shall include, but shall not be limited to the following:
 - 1. Coordinating all testing and startup activities.
 - 2. Preparing all startup and field testing plans, documentation, and forms.
 - 3. Liaising between the Contractor, Engineer, and Plant Personnel for

all startup and testing activities.

4. Developing a comprehensive schedule for all startup activities and providing regular schedule updates. The startup and testing schedule shall be incorporated into the Progress Schedule.
5. Scheduling and leading startup and testing planning meetings.
6. Conducting coordination meetings during startup and testing at least weekly.
7. Coordinating manufacturers' services and their certification of proper installation and/or operation of equipment as required by the Specifications.
8. Overseeing and administering all startup and testing activities, including either direct participation in the activities and/or oversight and monitoring of activities. It shall be the startup manager's responsibility to assure that all tests have been completed in accordance with accepted testing procedures.
9. Ensuring readiness for and coordinating maintenance, repair, and adjustment of equipment and systems during startup and testing.
10. Conducting or overseeing pre-test checks to ensure readiness for testing.
11. Verify all piping hydrostatic testing and flushing has been completed prior to field testing connected equipment.
12. Ensuring all testing equipment is in proper working order and has been calibrated to appropriate standards.
13. Developing safe work policies and procedures including lockout/tagout procedures and personal protective equipment policies, that will be followed during all field startup and testing activities. At a minimum the Contractor shall comply with OSHA and the City's established safety guidelines. It shall be the startup manager's responsibility to assure all safety procedures are followed at all times.
14. Reviewing and approving all equipment training sessions prior to submission to Engineer, to assure that the training is compliant with the requirements of the Specifications and includes all applicable operation, maintenance, safety, functional, performance, and startup and testing information.

15. Organizing teams made up of qualified representatives of Suppliers, Subcontractors, and others, as appropriate, to efficiently and expeditiously startup and test the equipment and systems installed and constructed under this CONTRACT. The objective of this program shall be to demonstrate to the Engineer that the structures, systems, and equipment constructed and installed under this CONTRACT meet all performance requirements and the facility is ready for operation as intended. In addition, the testing program shall produce baseline operating conditions for the City to use in a preventive maintenance program.
16. Ensuring the development and maintenance of records documenting all startup and testing activity. The records shall be organized by major process system into organized files/binders and turned over to the Engineer prior to applying for final payment. Testing records shall be accessible to the Engineer and Plant Personnel at all times to allow monitoring of the progress.
17. Ensuring the startup team is equipped and ready to make emergency repairs and adjustments to equipment installed and modified as part of the Project.
18. Scheduling and conducting a one day workshop with the Engineer and Plant Personnel to resolve submittal review comments to the Contractor's startup and testing plan submittal.
19. Notifying the Engineer and all respective equipment manufacturers at least 20 days prior to the date when each equipment system is scheduled for pre-startup activities and checks.
20. Organize International Electrical Testing Association (NETA) acceptance testing in accordance with the Electrical Equipment Installation section.

1.5 STARTUP TEAM

- A. The startup team shall include the startup manager and all staff deemed necessary for successful completion of startup and testing. This will typically include Engineers, major equipment vendors, operators, and representatives from the Instrumentation and Control System Supplier. Additional trade representatives may be included as project requirements dictate.

1.6 MANUFACTURER'S FIELD SERVICES REPRESENTATIVE

- A. The manufacturers shall provide a technically qualified field-service representative for the installation, startup, and testing of equipment furnished, as specified in the equipment sections. The manufacturer shall submit qualifications for all key personnel to be involved in startup activities.

- B. The manufacturer's field services representative shall be employed full-time in installation, startup, and testing of similar equipment and facilities and work directly for the manufacturer. The representative shall have conducted startup activities similar to those required herein on at least one other project of similar complexity. The Engineer shall have the right to reject the manufacturer's field services representative at any time, for immediate replacement by the manufacturer, if the accepted qualifications are not representative of the actual experience or abilities of the representative, as determined by the Engineer.

1.7 SUBMITTALS

- A. Contractor shall submit the following information in accordance with the requirements of the Greenbook and Whitebook Submittals section.
 - 1. Startup manager's qualifications. Submittal shall be made at the preconstruction conference.
 - 2. Manufacturers' field services representative's qualifications. Qualification submittals shall be made 3 weeks before the manufacturer's representative is scheduled to be on site.
 - 3. Manufacturer's certification of proper installation of all equipment as specified in the equipment sections.
 - 4. Equipment and system startup and testing plans and schedule in accordance with the requirements of this section. Startup manager shall coordinate with Subcontractors and include their information in the startup and testing plan.
 - 5. Unless otherwise specified in the equipment sections, preliminary copies of field calibration results. Submittal shall be made prior to the start of each test for associated systems.
 - 6. Daily logs.

1.8 STARTUP AND TESTING REQUIREMENTS

- A. Startup Checks
 - 1. Prior to field testing of all equipment, the Contractor shall perform the following:
 - a. Inspect and clean equipment, devices, and connected piping so they are free of foreign material.
 - b. Lubricate equipment in accordance with manufacturer's instructions. Turn rotating equipment by hand.
 - c. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

- d. Test and commission related electrical system components in accordance with the requirements specified in the Electrical and the Common Motor Requirements For Process Equipment sections.
 - e. Calibrate all instruments associated with the equipment.
 - f. Check for proper rotation, adjustment, alignment, balancing, mechanical and electrical connections, and any other conditions that may damage or impair equipment from functioning properly.
 - g. Inspect and verify proper anchorage.
 - h. Obtain manufacturer's certification of proper installation where specified in the equipment sections.
2. All equipment shall be confirmed ready to test by the Engineer based on the following:
- a. Acceptance of Contractor's startup and testing plan.
 - b. Notification in writing by the startup manager that each piece of equipment or system is ready for testing.
 - c. Verification by the Engineer that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.
 - d. Cleanliness of equipment, devices, and connected work.
 - e. Completion of work adjacent to or interfacing with equipment to be tested.
 - f. Confirmation of manufacturer's representative's availability to assist with testing, where specified, and fulfillment of all other manufacturers' responsibilities as specified.
 - g. Engineer's inspection of all related civil construction, mechanical, and electrical installations.
 - h. Confirmation of completion of testing of all adjacent piping, duct work and other affected WORK.

B. Functional Testing

- 1. All startup checks shall be completed prior to functional testing. Functional testing shall be in accordance with relevant standards and in accordance with instructions of the manufacturers.
- 2. Ancillary and/or temporary facilities necessary to recycle, control, or discharge water, air, chemical, or gas from facilities being tested, shall be operational.
- 3. Functional testing shall include the functional operation of each piece of equipment. All moving parts of equipment and machinery shall be tested and adjusted so that they move freely and function satisfactorily. Functional testing shall demonstrate correct operation of all hardwired interlocks and controls.

4. Functional testing of power actuated valves shall include at least 4 full open-close operations. Testing shall demonstrate the maximum number of operations per hour as recommended by the actuator manufacturer without overheating.
5. Once functional testing of individual pieces of equipment is completed, individual systems functional testing shall commence. Individual system functional testing shall include startup of the complete system of mechanical, electrical, and instrumentation and control equipment as a functional process system. Field inspection prior to startup as specified in the Instrumentation and Control section, other testing by the instrumentation and control system supplier required to verify readiness for automatic operation of the individual system, shall be completed before commencement of individual system functional testing.
6. Individual system functional testing shall include operation in manual and automatic modes, startup operation, and shutdown in normal and emergency modes. Individual systems shall be tested over their entire operating range and for sufficient time to demonstrate the intended functionality of each piece of equipment and the system. If any part of a system shows evidence of unsatisfactory or improper operation during the test period, correction or repairs shall be made and the functional testing shall be repeated until satisfactory results are obtained.
7. Functional testing of all process and pumping equipment and drive motors, including auxiliary equipment, shall be in accordance with the appropriate and approved test codes, such as those specified by the American Society of Mechanical Engineers, Hydraulic Institute Standards, and IEEE.
8. Qualified personnel from the electrical and mechanical trades responsible for installation of the equipment shall be available during functional testing involving electrically operated equipment. Where appropriate, a representative of the instrumentation and control system supplier shall also be available.

C. Functional Acceptance Testing (F.A.T.)

1. Upon completion of the Contractor's functional testing and associated documentation has been submitted and accepted by the Engineer, the Contractor shall make final connections to the existing operational chilled water system. Upon connection, the Contractor shall assist the Plant Personnel to conduct F.A.T. of each complete process system by placing the improvements online under normal plant operations. The F.A.T. shall demonstrate individual systems meet the specified requirements. F.A.T. shall include the successful demonstration of all operating functions and conditions that are

specified for the equipment, system, and controls. The Contractor shall provide staff “on-call” during the F.A.T. period who can be onsite at the MBC facility within two hours of a call from the Plant Personnel due to a system failure. The “on-call” status shall remain in effect for thirty days for each system as it is placed online. Equipment manufacturer’s representative shall be on site during F.A.T. when specified in the equipment specifications.

2. The Contractor shall be responsible for preparing and coordinating with the Engineer in the preparation of documents for submission noted below to perform the F.A.T. The F.A.T. shall include the following submissions prior to commencement:
3. Prerequisite checklist, to be acknowledged by the Engineer and Plant Personnel prior to initiating the test that demonstrates that all testing and other Work required to be completed prior to the test is complete.
 - a. Listing of Plant Personnel necessary to operate the system and conduct any related monitoring of performance.
 - b. A listing of Contractor's personnel designated to supervise and direct the Plant Personnel as required herein.
 - c. A listing of Contractor's personnel available for “on-call” status as specified above.
 - d. Listing of standby personnel, equipment, and materials that will be available if needed during the test period.
 - e. Step-by-step procedures for operation of the facility showing how local and remote control of equipment will be demonstrated.
 - f. Description of all data and other information to be reported in support of the completed test. Include any blank data logs that may be used for recording results.
 - g. Descriptions of all necessary calculations that must be completed to verify the specified results are being achieved, including formulas.
 - h. Blank sign-off form for the test acknowledging the Contractor’s, Engineer’s, Plant Personnel’s, and the equipment manufacturer’s acceptance of the F.A.T.
4. Contractor shall provide Engineer 14 days’ notice prior to testing of any individual system.
5. Individual system F.A.T. shall continue for 7 days without interruption for each system, and all parts shall operate satisfactorily in all respects under a range of conditions to simulate the full operating range of the equipment or system. If there are multiple parallel components or trains, then the testing duration will be 7 days for each individual train.
6. If any part of a system shows evidence of unsatisfactory or improper operation during the testing period, correction or repairs shall be

made and the test repeated until the test is successfully completed. Testing interrupted by power failure will not be required to be repeated, but the test shall be continued upon restoration of power and extended to the specified duration at no additional cost to the City.

7. During this F.A.T. period, the Plant Personnel shall operate all equipment.

1.9 STARTUP SCHEDULE AND STARTUP PLANS

- A. Plans and schedules shall be developed to facilitate coordinated and efficient startup and testing of the Project equipment and systems.
- B. The Contractor shall submit a startup and testing plan and schedule to the Engineer no later than 90 calendar days prior to the commencement of startup and testing. A minimum of 20 working days shall be allowed for review by Engineer. The schedule and plan must be accepted a minimum of 30 days prior to commencement of startup and testing. The schedule and plan shall include sections for startup checks, functional testing, and functional acceptance testing.
- C. Forms for startup and testing shall include identification of equipment or system, startup/test date, nature of startup/test, startup/test objectives, startup/test prerequisites, startup/test results, instruments employed for the startup/test and signature spaces for the Engineer's witness (where applicable) and the Contractor's startup manager.
- D. Startup Schedule
 - 1. A startup schedule that provides an overall sequence and duration for all startup and testing activities shall be prepared and maintained. This schedule shall serve as a companion to but shall not be a replacement for the startup plan. The startup schedule described in this section shall be integrated into the overall construction schedule and shall be prepared as specified in the Greenbook. The startup schedule shall be updated weekly during the startup and testing period.
- E. Startup Plan
 - 1. The Startup Plan shall include the following:
 - a. Introduction with a narrative description of the overall testing and startup program. The description shall include all contractual or regulatory treatment requirements to be demonstrated.
 - b. A summary of the objectives and approach for startup checks, functional testing, and functional acceptance testing.
 - c. List of the instruments, equipment, and systems that will undergo startup and testing with references to the appropriate

- piping and instrumentation diagrams, equipment tags/identification numbers, Specification number and standards for testing procedures.
- d. Schedule for startup and field testing for each instrument, piece of equipment (including redundant equipment), and system.
 - e. Safety and emergency response plan including a list of emergency and non-emergency contacts (email and phone).
 - f. Organization chart for Contractor's startup and testing personnel with assigned responsibilities for each.
 - g. Startup and testing record keeping plan.
 - h. Plan for reuse and disposal of water/wastewater from startup and testing, including information on any required regulatory permits/approvals.
 - i. Description of temporary facilities that will be provided.
2. Within 7 to 14 days of initial submittal of the startup plan, the Contractor shall schedule a workshop with the Engineer and Plant Personnel to present the plan. The Contractor shall submit minutes of the workshop, including action items and a schedule for updating the startup plan, to the Engineer within 3 days of the workshop.
 3. Individual plans for each phase of startup and testing can be assembled as chapters in the startup plan or submitted as individual documents but should be correlated to ensure there is not disagreement between chapters or separate documents.
 4. Startup Checks Plan
 - a. The startup checks plan shall be subdivided into plans for each system and major component. Each system/major component plan shall include but not be limited to the following:
 - 1) Identification of information for each component or piece of equipment to be inspected as part of the system. All applicable tag numbers shall be included.
 - 2) Specific activities to be completed on each component, piece of equipment, or system as required to demonstrate proper installation and connection.
 - 3) A tracking checklist of prerequisites for the checks and each step of the checking procedure, including any temporary facilities or utility requirements.
 - 4) Listing of manufacturer's representative(s) to be on site during the check.
 - 5) Sign off forms for the Contractor's startup manager.
 5. Functional Testing and Functional Acceptance Testing Plans

- a. The functional testing plan and F.A.T. plan shall include procedures and reporting for testing. The plans shall be subdivided into testing plans for each system. Each system test plan shall include but not be limited to the following:
- 1) A narrative description of the purpose and goals of the test for each component, piece of equipment, or system, which should include all activities (including those required by vendors/suppliers) necessary to verify proper equipment and system functionality.
 - 2) Identification of each component or piece of equipment to be tested as part of the system. All applicable tag numbers shall be included.
 - 3) Schedule and duration for the tests.
 - 4) Prerequisites for each test, including any temporary facilities or utility requirements.
 - 5) Pass/fail criteria for the test.
 - 6) A checklist for tracking testing progress which includes prerequisites for the test and each step of the testing procedure. The check list shall include specified performance criteria that are to be met.
 - 7) A description of test apparatus required to conduct the test.
 - 8) Identification of all temporary facilities required during startup.
 - 9) Listing of manufacturer's representative(s) to be on site during the test. Certificates of proper installation, as applicable to the test.
 - 10) Step-by-step detailed procedure of the test. The level of detail shall be sufficient for a witness to be able to follow the steps during the test and be confident that the test is being performed as planned. All steps required to proceed through the test in an orderly manner are considered significant and each of these steps shall be included in the procedure.
 - 11) Copies of the data recording forms that will be used during the test.
 - 12) Calculation methodologies to be used to evaluate the data and/or test criteria for the test.
 - 13) Sample computations or analyses for the test with results in the same format as the final report. This item is intended to demonstrate how data collected will be used to generate final results. A sample shall be included for each type of computation required for the test and analysis of results.
 - 14) Blank sign-off forms for the test acknowledging the startup manager's, Engineer's, Plant Personnel, and equipment manufacturer's acceptance of the test where applicable.

1.10 REPORTS AND RECORDS

- A. Records of all startup and testing shall be compiled by the Contractor and submitted to the Engineer. Prior to being submitted to the Engineer, the startup manager shall certify that the results recorded and the tested systems comply with the CONTRACT requirements. Records shall include all documentation assembled for each piece of equipment or system involved in the startup and testing, including all certifications, forms, and check lists completed during the startup and test, and sign-off forms.
- B. Records of all startup and testing shall be compiled as separate documents for each system tested, and shall be submitted within 48 hours of completion of the startup and testing for each system. Testing samples that require analysis periods greater than 48 hours shall be clearly defined in the startup plan but shall not preclude delivery of the balance of the records within the 48 hour timeframe.
- C. The Contractor shall provide formal reporting and documentation of failures, malfunctions or defects, and repairs made during the startup and/or testing activities. A "System Problem Report" form is included at the end of this section, and shall be used by the Contractor to document problems that arise during these tests and their resolution. Records submitted shall include "System Problem Report" forms completed during testing.

****END OF SECTION****

SYSTEM PROBLEM REPORT

Project Name: MBC Chilled Water System Upgrade			
Test Name:			
Test Number:			
Problem Type: Hardware Software Documentation Unknown Other			
SYMPTOMS:	Time:	Date:	By:
Description:			
Can problem be reproduced at will? Y /N			
DIAGNOSIS:	Time:	Date:	By:
Description:			
CORRECTION:	Time:	Date:	By:
Description:			
FINAL SIGN OFF	Time:	Date:	By:

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SECTION 01730 – OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide operation and maintenance data in the form of instructional manuals for use by City personnel for all equipment and systems including but not limited to pumps, motors, and drives, all valves, gates and related accessories, and all instruments and control devices.
- B. Definitions:
 - 1. Operation and Maintenance Data:
 - a. The term "operation and maintenance data" includes all product related information and documents which are required for preparation of the operation and maintenance manual. It also includes all data, which must accompany said manual as directed by current regulations of any participating government agency.
 - b. Required operation and maintenance data includes, but is not limited to, the following:
 - 1) Complete, detailed written operating instructions for each product or piece of equipment including: equipment function; operating characteristics; limiting conditions; operating instructions for startup, normal and emergency conditions; regulation and control; and shutdown.
 - 2) Exploded view of the equipment with all individual parts labeled and accompanied by a complete parts list with part numbers and parts ordering information.
 - 3) Complete, detailed written preventive maintenance instructions as defined below.
 - 4) Recommended spare parts lists and local sources of supply for parts.
 - 5) Written explanations of all safety considerations relating to operation and maintenance procedures.
 - 6) Name, address and phone number of manufacturer, manufacturer's local service representative, and Subcontractor or installer.
 - 7) Copy of all approved Shop Drawings, and copy of warranty bond and service contract as applicable.

1.2 RELATED SECTIONS

- A. Section 01600 – General Equipment Provisions
- B. Section 01650 –Startup Requirements
- C. Division 11 – Equipment

- D. Division 13 – Instrumentation
- E. Division 15 – Mechanical
- F. Division 16 – Electrical

1.3 SUBMITTALS

- A. The following shall be submitted in compliance with Section 01300:
 - 1. The Contractor shall submit six (6) copies of all the operations and maintenance data to the Engineer within 30 days after approval of the final Shop Drawing.
 - 2. Provide a letter of transmittal with each submittal and include the following in the letter:
 - a. Date of submittal.
 - b. Contract title and number.
 - c. Contractor's name and address.
 - d. A list of the attachments and the Specification Sections to which they relate.
 - e. Reference to or explanation of related submittals already made or to be made at a future date.
- B. Format Requirements:
 - 1. The Contractor shall use 8-1/2 inch by 11-inch paper of high quality. Larger drawings or illustrations are acceptable if neatly folded to the specified size in a manner, which will permit easy unfolding without removal from the binder. Provide reinforced punched binder tab or provide fly-leaf for each product.
 - 2. All text must be legible typewritten, or machine printed originals or high-quality copies of same.
 - 3. Each page shall have a binding margin of approximately 1-1/2 inches and be punched for placement in a three D-ring loose-leaf or triple post binder. Provide binders not less than one inch or more than 2-1/2 inches thick. Identify each binder on the spine and outside front cover with the following:
 - a. Title "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - b. Title of Project: _____.
 - c. Project Number: _____.
 - d. Identity of building, structure, or area as applicable.
 - e. Identity of general subject matter covered.
 - f. Date _____.

4. The Contractor shall use dividers and typewritten indexed tabs between major categories of information such as operating instructions, preventive maintenance instructions, or other. When necessary, place each major category in a separate binder.
5. The Contractor shall provide a table of contents for each binder.
6. The Contractor shall identify products by their functional names in the table of contents and at least once in each chapter or Section. Thereafter, abbreviations and acronyms may be used if their meaning is explained in a table in the back of each binder. Use of model or catalog numbers or letters for identification is not acceptable.

1.4 PREVENTIVE MAINTENANCE INSTRUCTIONS

- A. The term "preventive maintenance instructions" includes all information and instructions required to keep a product or piece of equipment properly lubricated, adjusted and maintained so that the item functions properly throughout its full design life.
- B. Preventive maintenance instructions include, but are not limited to, the following:
 1. A written explanation with illustrations for each preventive maintenance task.
 2. Recommended schedule for execution of preventive maintenance tasks.
 3. Lubrication charts.
 4. Table of alternative lubricants.
 5. Trouble shooting instructions.
 6. List of required maintenance tools and equipment.
 7. List of spare parts, if applicable.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

****END OF SECTION****

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SECTION 02050 - DEMOLITION AND SALVAGE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes general procedures for the demolition and disposal of material associated with the work.
- B. Definitions:
 - 1. Existing Conditions: Contractor shall visit the site and inspect the nature and condition of all facilities to be demolished, partially demolished, modified, or altered in any way prior to submittal of its Bid. No increase in cost or extension of Contract time will be considered for failure to know the conditions of the site and structures.
 - 2. Demolition and Disposal: All materials removed under demolition work, including dismantled structural members, concrete footing, miscellaneous and structural metals, and other construction debris shall become the property of the Contractor and be removed from the site as trash. Trash and debris shall be disposed legally, off site, by the Contractor. Upon removal from site, Contractor shall have the rights of salvage of materials.
 - 3. Abandon in Place: Items to be abandoned shall remain in place and be abandoned in accordance with procedures as shown and specified in the Contract Documents. Abandonment shall be limited to the items shown on the Contract Drawings and those required by the Engineer. All abandonment methods shall be discussed and approved by the Engineer.
 - 4. Salvage: Any equipment and/or appurtenances to be salvaged will be identified by the Engineer and delivered to City undamaged.

1.2 QUALITY ASSURANCE

- A. Protection of Existing Facilities: The Contractor shall diligently protect existing structures and property of the City while proceeding with work of this section and the entire Contract. All damage shall be repaired at once to the satisfaction of the Engineer. All such repairs shall be at the expense of the Contractor and no claims for additional payment will be accepted.

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. The following referenced sections of the Standard Specifications for Public Works Construction (SSPWC, hereinafter, the Greenbook) apply to the work of this section:
 - 1. Greenbook Section 5
 - 2. Greenbook Section 306

1.4 SUBMITTALS

- A. Submittals shall be provided in accordance with Section 2-5 and applicable subsections of the Greenbook and the City Supplement to the Greenbook (hereinafter Whitebook), and shall include the following information:
 - 1. Submit copy of permits required by regulatory agencies for demolition work and handling of hazardous materials.

1.5 PROJECT CONDITIONS

- A. Engineer assumes no responsibility for actual condition of structures to be demolished.

1.6 DEMOLITION OF EXISTING FACILITIES

- A. Comply with environmental regulations for removal and disposal of hazardous material components.

PART 2 - PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 GENERAL REQUIREMENTS

- A. All demolition, salvage, and renovation work shall be conducted in a manner which will protect the environment, promote public health and safety, and preclude nuisance conditions.
- B. Erect and maintain security devices as necessary, including fencing and gates, for protection of the public and City. Do not close or obstruct roadways, sidewalks, or hydrants without applicable permits.
- C. Protect existing improvements and facilities not to be demolished, including but not limited to adjacent structures; walls; fences; sidewalks and roadways not designated to be demolished; utilities not designated to be abandoned, removed, or salvaged; and any other items not designated to be abandoned, removed, or salvaged.
- D. Remove materials from site as work progresses. Do not allow materials to accumulate on-site.
- E. Accurately record actual locations of capped utilities for record documents.

3.2 INSPECTION

- A. The Contractor shall inspect existing structures prior to beginning abandonment procedures.

3.3 REPAIR AND RESTORATION

- A. General: The Contractor shall alter or rework existing structures as shown and specified. Generally, when structural items are removed, the areas and surfaces from which these items were removed shall be left with a neat appearance and finish compatible with surrounding areas, colors, and surfaces. The Contractor shall do all painting, sanding, and other work as necessary to comply with the above requirements. Prior to structural modifications, all surfaces shall be subject to inspection by the Engineer. Colors shall match existing colors as closely as possible. For replacement, repair or restoration of work removed, comply with the specifications for the type of work to be done.

3.4 DEMOLITION OF EXISTING STRUCTURES

- A. Structures that are in the way of new construction shall be removed completely, regardless of whether they are above or below existing or proposed ground or grade.
- B. This work may be done in any manner selected by the Contractor, and reviewed by the Engineer, that does not endanger adjacent structures and property. The use of explosives will not be permitted for any purposes.
- C. Structural steel members shall be cut into sections of such weight and size as will permit convenient handling, hauling, and storage. Concrete to be demolished and removed shall be broken into pieces not greater than 24-inches in any dimension by methods reviewed by the Engineer.

3.5 SALVAGE

- A. When the Contractor is required to remove existing items from the site it will be the property of the Contractor, unless stipulated otherwise based on the discretion of the Engineer to be considered salvage. All materials identified as salvage are considered property of the City.
- B. The Contractor shall store all materials identified as salvage in a safe location, out of traffic or otherwise disrupting the work, or shall deliver salvage to the City's Field Operations Yard as directed by the Engineer.
- C. The Contractor shall legally dispose of all other materials in an appropriate manner. Disposal is the responsibility of the Contractor. Obtain concurrence from the agency having disposal jurisdiction with respect to disposal sites and transportation methods.

****END OF SECTION****

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SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SCOPE

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 SUBMITTALS

- A. Submittals shall be provided in accordance with Section 2-5 and applicable subsections of the Greenbook and the Whitebook, and shall include the following information:
 - 1. Product Data: For each type of product indicated.
 - 2. Design Mixtures: For each concrete mixture.
 - 3. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.
 - 4. Welding Certificates
 - 5. Material Certificates
 - 6. Material Test Reports
 - 7. Floor Surface Flatness and Levelness Measurements

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- C. ACI Publications: Comply with the following unless modified by requirements in the Contract.
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed. Reinforcing steel shall not be welded.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.3 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type II/V, gray. Supplement with the following:
 - a. Fly Ash: ASTM C 618, Class F.
 - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
 - 1. Maximum Coarse-Aggregate Size: 1 inch. Free of materials with deleterious reactivity to alkali in cement.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94 and potable.

2.4 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494, Type A.
 - 2. Retarding Admixture: ASTM C 494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
 - 6. Plasticizing and RETARDING Admixture: ASTM C 1017, Type II.

2.5 VAPOR RETARDERS (NOT USED)

2.6 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.7 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

2.8 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast- furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 15 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in all concrete.
- D. Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 3250 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: 4 inches before adding water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

2.9 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.10 CONCRETE MIXING

- A. Ready-Mixed Concrete:
 - 1. Measure, batch, mix, and deliver concrete according to ASTM C 94 and furnish batch ticket information.
 - 2. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

- C. Chamfer exterior corners and edges of permanently exposed concrete.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.3 VAPOR RETARDERS (NOT USED)

3.4 STEEL REINFORCEMENT

- A. General:

1. Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
2. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
- C. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- D. Cold-Weather Placement: Comply with ACI 306.1.
- E. Hot-Weather Placement: Comply with ACI 301.

3.7 FINISHING FORMED SURFACES

- A. Rough-Formed Finish:

1. As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove all fins and other projections.
 2. Apply to concrete surfaces not exposed to view.
- B. Smooth-Formed Finish:
1. As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove all fins and other projections that exceed specified limits on formed-surface irregularities.
 2. Apply to concrete surfaces exposed to view.
- C. Rubbed Finish (NOT USED)
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure Concrete:
1. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - a. **MOISTURE CURING:** Keep surfaces continuously moist for not less than seven days.
 - b. **MOISTURE-RETAINING-COVER CURING:** Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - c. **CURING COMPOUND:** Apply curing compound with fugitive dye uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Apply two coats

minimum. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.9 REMOVAL

- A. After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.10 CONCRETE SURFACE REPAIRS

- A. DEFECTIVE CONCRETE: Repair and patch defective areas as approved. Remove and replace concrete that cannot be repaired and patched to Owner's satisfaction.

3.11 FIELD QUALITY CONTROL

- A. TESTING AND INSPECTING: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

****END OF SECTION****

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SECTION 05120 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SCOPE

- A. This section describes the requirements for furnishing and installing structural steel.
- B. Materials and fabrication procedures are subject to inspection and tests in mill, shop, and components field, conducted by a qualified inspection agency. Promptly remove and replace materials which do not comply.
- C. Design of Members and Connections: Details are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site.

1.2 RELATED SECTIONS

- A. The work of the following sections applies to the work of this section. Other sections of the specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
 - 1. Section 05500 - Miscellaneous Metalwork
 - 2. Section 09900 – Painting and Coating

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS (NOT USED)

1.4 SUBMITTALS

- A. Submittals shall be provided in accordance with Section 2-5 and applicable subsections of the Greenbook and the Whitebook, and shall include the following information:
 - 1. Shop Drawings:
 - a. Furnish shop drawings prepared under the supervision of a registered professional engineer, including complete details and schedules for fabrication and assembly of structural steel members, procedures and diagrams.
 - b. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
 - c. Furnish setting diagrams, templates, and directions for installation of anchor bolts and other anchorages to be installed as work of other sections.
 - d. Prepare erection drawings with sequencing in compliance with all current OSHA requirements.

2. Test Reports: Furnish copies of test reports conducted on welded connections. Include data on types of tests conducted and test results.
3. Surveys: Furnish certified copies of each survey conducted by a registered professional engineer, showing elevations and locations of existing actuators, beams and columns in the vicinity of the platform, and final elevations and locations for new members. Show discrepancies between actual installation, as-built documents and contract documents.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Prior to commencing welding, welding procedures, welding operations, all welders shall be qualified in accordance with AWS D1.1.
- B. Codes: All work shall be executed in accordance with Chapter 22 of the "California Building Code, current edition (CBC)".

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to site at intervals to ensure uninterrupted progress of the work.
- B. Deliver rebar and anchorage devices, which are to be embedded in cast-in-place concrete.
- C. Store materials to permit easy access for inspection and identification.
- D. Keep structural steel members off ground, using pallets, platforms, or other supports.
- E. Protect steel members and packaged materials from erosion and deterioration.
- F. Do not store materials on structure in a manner to cause distortion or damage to members or supporting structures.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: For fabrication of work which will be exposed to view, comply with AISC AESS (Architecturally Exposed Structural Steel) Category 2 and use only materials which are smooth and free of surface blemishes including pitting, rust and scale, seam marks, roller marks, rolled trade names, and roughness. Remove blemishes by grinding or by welding and grinding, prior to cleaning, treating, and application of surface finishes.
- B. Structural Steel Shapes: ASTM A992.
- C. Structural Steel Plates, Bars and Angles: ASTM A36, ASTM A572 if noted on plans or AISI Type 316 stainless steel if noted on plans.

- D. High Strength Threaded Fasteners: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers. Provide quenched and tempered medium-carbon steel bolts, nuts, and washers, complying with ASTM A325.
- E. Welding Electrodes: Comply with AWS Code. AWS Code E70XX min.
- F. Non-Metallic Non-Shrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents; Euclid Chemical Co. "Euco N.S.", L&M Construction chemicals, Inc. "Crystex", Master Builders "Masterflow 713" or approved equal.

2.2 FABRICATION

- A. Shop Fabrication and Assembly:
 - 1. Fabricate and assembly structural assemblies in shop where possible.
 - 2. Fabricate items in accordance with AISC Specifications and as indicated on approved shop drawings.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Fabricate for delivery sequence, which will expedite erection and minimize field handling.
 - 5. Where shop priming is required, complete assembly, including welding, before start of finishing operations. Provide finish surfaces of members exposed-to-view which are free of markings, butts and other defects.
- B. Connections:
 - 1. Weld connections as indicated.
- C. Welded Construction: Comply with AWS Code for procedures, appearance, and quality of welds and methods. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

2.3 SHOP PAINTING:

- A. General:
 - 1. Shop paint structural steel, except members to be embedded in concrete or mortar. Paint embedded steel which is partially exposed on exposed portions and initial 2-inches of embedded areas only.
 - 2. Do not paint surfaces which are to be field welded or high-strength bolted with friction-type connections.

3. Apply 2 coats of paint to surfaces inaccessible after assembly or erection. Each coat shall be a different color.
- B. Surface Preparation: After inspection and after shipping, clean steel to be painted. Remove loose rust, loose mill scale, and spatter, slag or flux deposits. Clean steel to be field-painted in accordance with SSPC SP-6. Clean steel concealed in finish work in accordance with SP-3.
- C. Painting: Immediately after surface preparation, apply primer at dry film thickness of not less than 1.5 mils, in accordance with manufacturer's instructions. Use painting methods which result in full coverage of joints, corners edges and exposed surfaces.

PART 3 - EXECUTION

3.1 ERECTION

- A. Surveys: Check elevations of existing beams and columns before fabrication and erection of new tie-rods proceeds. Do not proceed with erection until corrections have been made.
- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made.
- C. Setting Concrete Bases:
 1. Clean concrete surfaces of bond-reducing materials and roughen to improve surface bond.
 2. Clean bottom surfaces of base and bearing plates.
 3. Provide wedges or shims as necessary.
 4. Tighten anchor bolts after supported members have been positioned. Do not remove wedges or shims; cut off flush with edge of base or bearing plate prior to packing with grout.
 5. Pack grout solidly between bearing surfaces and bases or plates filling voids. Finish exposed surfaces, protect installed materials, and allow to dry.
- D. Field Assembly:
 1. Set structural members to lines and elevations indicated. Align and adjust members before permanently fastening.
 2. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly.

3. Adjust for discrepancies in elevations and alignment.
 4. Level and plumb individual members within specified AISC tolerances. Establish measurements on mean operating temperature of structure. Make allowances for differences between temperature at time of erection and mean temperature of structure when completed.
 5. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.
 6. Do not enlarge unfair holes in members by burning or by use of drift pins. Ream holes requiring enlargement to admit bolts.
- E. Touch-Up Painting:
1. Clean field welds, bolted connections, and abraded areas of shop paint.
 2. Apply paint by brush or spray to exposed areas using same material and thickness as used for shop painting.
 3. Apply by brush or spray, minimum dry film thickness of 1.5 mils.

3.2 FIELD QUALITY CONTROL

- A. The Engineer will:
1. Review certificates of compliance.
 2. Inspect high strength bolted connections as required by CBC Section 2228 and Section 1701.5.6.
 3. Visually inspect all welding while operators are making welds and after work is completed as required by CBC Section 2228 and Section 1701.5.5.
 4. Non-destructive test all complete penetration groove welds larger than 3/8 inches by ultrasonic or radiographic methods for conformance with the weld quality and standard of acceptance of AWS D1.1 for welds subject to tensile stress.

****END OF SECTION****

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SECTION 05500 - MISCELLANEOUS METALWORK

PART 1 - GENERAL

1.1 SCOPE

- A. The work of this section includes providing miscellaneous metalwork and appurtenances including the following:
1. Post Installed Adhesive Anchors/Rebars

1.2 RELATED SECTIONS

- A. The work of the following sections applies to the work of this section. Other sections of the specifications, not referenced below, shall also apply to the extent required for proper performance of this work.
1. Section 05120 - Structural Steel
 2. Section 09900 – Painting and Coating

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Except as otherwise indicated in this section of the specifications, comply with the Standard Specifications for Public Works Construction (SSPWC).
- B. The current editions of the following apply to the work of this section:
1. Commercial Standards:

Reference	Title
AISC MO11	Manual of Steel Constructions
ASTM A36	Specification for Structural Steel (Angles, channels, etc.)

Reference	Title
ASTM A283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A489	Carbon Steel Eyebolts

ASTM A 569	Specification for Steel, Carbon, (0.15 Maximum Percent) Hot Rolled, Sheet and Strip, Commercial Quality
ASTM A572	Specification for Structural Steel (Grade 50)
ASTM A 575	Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A992	Structural Steel Shapes
ANSI/AWS	Structural Welding Code
NFPA 101	Life Safety Code

1.4 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals shall be provided in accordance with Section 2-5 and applicable subsections of the Greenbook and the Whitebook, and shall include the following information:
1. Shop drawings of miscellaneous metalwork including seat angles, supports and guides.
 2. Shop drawings showing proposed use of post installed adhesive anchors with proposed products.
 3. Welding procedures and welder qualifications.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS METALWORK

- A. Materials: Products fabricated of structural steel shapes shall comply with the requirements of ASTM A572, or A9920, and structural steel angles, channels, plates, and bars shall comply with the requirements of ASTM A 36.
- B. Corrosion Protection: Miscellaneous metalwork of fabricated steel shall be primed and top coated after fabrication.
- C. Welding:
1. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" and supplemented by other standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.

2. In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS Code. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

D. Adhesive Anchors/Rebars:

1. Unless otherwise indicated, drilled concrete rebar dowels shall be drilled and epoxy grouted dowels. Substitutions will not be considered.
2. Glass capsule, polyester resin adhesive anchors shall not be permitted.

2.2 MANUFACTURERS

A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):

1. Epoxy Adhesive Anchors:
 - a. Sika/FI System with Sikadur Injection Gel Epoxy
 - b. Masterbuilders Concrete Epoxy Cartridge Dispensing System and Concrete Paste LPL

PART 3 - EXECUTION

3.1 GENERAL

A. Fabrication and Erection: Fabrication and erection of miscellaneous steel fabrications shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."

B. General:

1. Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if indicated, recesses or blockouts shall be formed in the concrete. The surfaces of metalwork in contact with or embedded in concrete shall be cleaned. Recesses may be neatly cored in the concrete after it has attained its design strength and the metalwork grouted in place.
2. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise indicated. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.

3.2 INSTALLATION OF ANCHOR BOLTS/REBARS

- A. Installation of post installed, drilled-in adhesive anchors shall comply with the following:
1. Installation recommendations by the anchor system manufacturer shall be followed, including maximum hole diameter.
 2. Concrete temperature (not air temperature) shall be compatible with curing requirements recommended by adhesive manufacturer. Anchors shall not be placed in concrete below 25 degrees F.
 3. Anchor/rebar diameter and grade of steel shall comply with equipment supplier specifications. Anchor/rebar shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.
 4. Holes shall have rough surfaces, such as can be achieved using a rotary percussion drill.
 5. Holes shall be blown clean with compressed air and be free of dust or standing water prior to installation.
 6. Anchor/rebar shall be left undisturbed and unloaded for full adhesive curing period.

****END OF SECTION****

SECTION 09900 – PAINTING AND COATING

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide painting and coatings, complete and in place, in accordance with the Contract Documents.
- B. Definitions:
 - 1. The term "paint," "coatings," or "finishes" as used herein, shall include surface treatments, enamels, paints, epoxy resins, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
 - 2. The term "DFT" means minimum dry film thickness.
- C. The Contractor and Painting Subcontractor shall attend a Pre-Painting Conference prior to commencing work on the job.

1.2 RELATED SECTIONS

- A. Division 11 - Equipment
- B. Division 15 - Mechanical

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. References herein to "SSPC Specifications" or "SSPC" shall mean the published standards of SSPC, the Society for Protective Coatings.
- B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers.
- C. Federal Specifications:
 - 1. OSHA 1910.144 Safety Color Code for Marking Physical Hazards
 - 2. Regulatory Agency Requirements: All coatings shall be approved by the local Air Pollution Control District. The Contractor shall revise painting systems specified herein to provide manufacturer's regulatory agency approved coating system where required. All painting systems shall be VOC compliant. Equivalent systems are to be submitted at no additional costs to meet any new regulations.
- D. The work of this section shall comply with the current edition of the Uniform Building Code

- E. Inspection records of field-applied coatings shall be submitted within 15 days after the work has been accepted.

1.4 SUBMITTALS

- A. Submit coating manufacturer's technical and material safety data sheets for the products to be applied. Data sheets shall show the following information at a minimum, but shall show all data necessary to indicate conformance to specifications:
 - 1. Percent solids by volume.
 - 2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
 - 3. Recommended surface preparation.
 - 4. Recommended thinners.
 - 5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
 - 6. Application instructions including recommended equipment and temperature limitations.
 - 7. Curing requirements and instructions.
 - 8. Colors (where applicable).
- B. Submit the name of the company and abrasive to be used, the generic type of abrasive, the CARB certification, and product data sheets.

1.5 QUALITY ASSURANCE

- A. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

1.6 DELIVERY, STORAGE AND HANDLING (NOT USED)

1.7 WARRANTY

- A. Warranty Inspection: A warranty inspection may be conducted during the eleventh month following completion of all coating and painting work. The Contractor and a representative of the coating applicator and the coating material manufacturer shall attend this inspection.
- B. All defective work shall be repaired in accordance with these Specifications and to the satisfaction of the Engineer. The Engineer may, by written notice to the

Contractor, reschedule the warranty inspection to another date within the 2-year correction period, or may cancel the warranty inspection altogether. If a warranty inspection is not held, the Contractor is not relieved of its responsibilities under the Contract Documents.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal of each material and color applied.

1.9 SAFETY AND HEALTH REGULATIONS

- A. General: In accordance with the requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and the applicable requirements of regulatory agencies having jurisdiction, as well as manufacturer's printed instructions and appropriate technical bulletins and manuals, the Contractor shall provide and require use of personnel protective lifesaving equipment for persons working in or about the project site.
- B. Head and Face Protection and Respiratory Devices: Equipment shall include protective helmets which shall be worn by all persons while in the vicinity of the Work. In addition, workers engaged in or near the work during sandblasting shall wear OSHA approved eye and face protection devices and air purifying, halfmask or mouthpiece respirators. Barrier creams shall be used on any exposed areas of skin.
- C. Ventilation: Where ventilation is used to control hazardous exposure, all equipment shall be explosion-proof. Forced air ventilation shall be provided to reduce the concentration of air contaminant to a safe limit. Air circulation and exhausting of solvent vapors shall be continued until coatings have fully cured.
- D. Sound Levels: Whenever the occupational noise exposure exceeds maximum allowable sound levels, the Contractor shall implement furnish and require the use of approved ear protective devices.
- E. Illumination: Adequate illumination shall be provided while Work is in progress, which may include explosion-proof lights, scaffolding and electrical equipment. Whenever required by the Engineer, the Contractor shall provide additional illumination to cover all areas to be inspected. The level of illumination for inspection purposes shall be determined by the Engineer.
- F. Temporary Ladders and Scaffolding: All temporary ladders and scaffolding shall conform to applicable safety requirements. They shall be erected where requested by the Engineer to facilitate inspection and shall be moved by the Contractor to locations as requested by the Engineer.

1.10 CLEANUP

- A. Upon completion of the Work, all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Coating spots and oil or stain upon adjacent surfaces shall be removed and the job site cleaned. All damage to adjacent surfaces or facilities resulting from the Work shall be cleaned, repaired or refinished to the satisfaction of the Engineer at no additional cost to the City.

PART 2 - MATERIALS

2.1 GENERAL

- A. Coating products shall conform to State of California air quality regulations, which limits volatile organic compounds per gallon of coating product. The following index lists the various painting and coating systems by service and generic type.

PAINT COATINGS SYSTEM INDEX

No.	Title	Generic Coating
15	Exposed Metal, Atmospheric Weathering Environment	Epoxy/Polyurethane
41	PVC, CPVC and FRP, Ultraviolet Exposure	Epoxy/Polyurethane

- B. These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses. At least two manufacturer's products are listed for each system.

2.2 SYSTEM NO. 15 – EXPOSED METAL, ATMOSPHERIC WEATHERING ENVIRONMENT

- A. Type: Polyurethane enamel having a minimum volume solids content of 46% with an epoxy primer.
- B. Service Conditions: For use on exterior metal and piping subject to sunlight and weathering.
- C. Surface Preparation: SSPC-SP 6.
- D. Prime Coat: Provide Tnemec Series V69 Epoxoline II, or ICI/Devoe Devran 224HS, or Engineer approved equal. Apply to a minimum dry film thickness of 3 mils DFT.
- E. Finish Coats: Provide one coat Tnemec Series 1075 Endura-Shield II, or ICI/Devoe Devthane 379HS, or Engineer approved equal. Apply to a minimum dry film thickness of 3 mils.

2.4 PVC, CPVC AND FRP COATING SYSTEM

A. System No. 41 - Exposed, Exterior:

1. Type: Epoxy and Semigloss Polyurethane enamel with color.
2. Service Conditions: For use on exterior PVC piping and appurtenances, such as chemical piping and exposed water PVC water lines.
3. Surface Preparation: Check for moisture with ASTM 4263. Clean and scarify surface.
4. Prime Coat: Tnemec Series 66 Hi-Build Epoxoline, 1 coat, 2-3 dry mils polyline 1900B65-500 hardner – 2 to 3 dry mills.
5. Finish Coats: Tnemec Series 73 Enduroshield.1 coat 2 to 3 dry mils DFT/Acrylon 218 BG50-400 semi-gloss 3 to 5 dry mills.

2.5 ABRASIVES FOR SURFACE PREPARATION

A. Abrasives used for dry unconfined blast cleaning shall conform to the requirements of the State of California Air Resources Board (CARB) Executive Order G-425. Use abrasives that are currently certified by CARB and appear on the Approved Abrasives List.

B. Abrasives used for preparation of iron and steel surfaces shall be one of the following:

1. 16 to 30 or 16 to 40 mesh silica sand or mineral grit
2. 20 to 40 mesh garnet
3. Crushed iron slag, 100% retained on No. 80 mesh
4. SAE Grade G-40 or G-50 iron grit

C. Abrasives used for preparation of copper and aluminum surfaces shall be one of the following:

1. Crushed slag, 80 to 100 mesh
2. Very fine silica sand, 80 to 100 mesh

D. In the above gradations, 100% of the material shall pass through the first stated

PART 3 – EXECUTION

3.1 PRE-PAINTING CONFERENCE

- A. Conduct a pre-painting conference at the job site to review specified requirements. Meeting attendees shall include General Contractor, Subcontractor Painting Applicator and its supervisor, the Engineer and the Engineer.

3.2 WEATHER CONDITIONS

- A. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5 °F above the dew point.
- B. Do not apply paint when the relative humidity is above 85% or the temperature is above 90 °F.
- C. Do not paint when temperature of metal to be painted is above 120 °F.
- D. Do not apply paints if air or surface temperature is below 40 °F or expected to be below 40 °F within 24 hours.
- E. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60 °F or expected to drop below 60 F in 24 hours.

3.3 SURFACE PREPARATION

- A. Do not sandblast or prepare more surface area than can be coated in one day. Remove all sharp edges, burrs, and weld spatter. Do not sandblast PVC, CPVC, or FRP piping or equipment. Do not sandblast epoxy, enamel coated, or fusion-bonded epoxy pipe that has already been factory coated, except to repair scratched or damaged coatings.
- B. Surface preparation shall conform to the SSPC specifications as follows:

Solvent Cleaning	SP 1
Hand Tool Cleaning	SP 2
Power Tool Cleaning	SP 3
White Metal Blast Cleaning	SP 5
Commercial Blast Cleaning	SP 6
Brush-Off-Blast Cleaning	SP 7
Pickling	SP 8
Near-White Blast Cleaning	SP 10
- C. Wherever the words "solvent cleaning," "hand tool cleaning," "wire brushing," or "blast cleaning" or similar words are used in these specifications or in paint manufacturer's specifications, they shall be understood to refer to the applicable SSPC (Steel Structure Painting Council, Surface Preparation Specifications, ANSI A159.1) specifications listed above.

- D. Dust blasting is defined as cleaning the surface through the use of very fine abrasives, such as siliceous or mineral abrasives, 80 to 100 mesh. Apply a fine etch to the metal surface to clean the surface of any contamination or oxide.
- E. Remove oil and grease from metal surfaces in accordance with SSPC-SP 1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before sandblasting.
- F. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges in accordance with SSPC-SP 2 and SSPC-SP 3.
- G. Neutralize welds with a chemical solvent that is compatible with the specified coating materials. Use clean cloths and chemical solvent. Wipe dry with clean cloths. Do not leave a residue on the cleaned surfaces.

3.4 ABRASIVE BLAST CLEANING

- A. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.
- B. After blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.
- C. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.
- D. During blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.5 PROCEDURES FOR ITEMS HAVING SHOP-APPLIED PRIME COATS

- A. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

3.6 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

- A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC-SP 1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.

- B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.
- C. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC-SP 7. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
- D. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC-SP 10. Take care that remaining primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.
- E. Use repair procedures on damaged primer which protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.
- F. After abrasive blast cleaning of damaged and deflective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.
- G. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer to cover all scratches or abraded areas.
- H. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

3.7 PAINT MIXING

- A. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touchup painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.8 PROCEDURES FOR THE APPLICATION OF COATINGS

- A. Conform to the requirements of SSPC-PA 1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

- B. Stir, strain, and keep coating materials at a uniform consistency during application. Apply each coating evenly, free of brush marks, sags, runs, holidays, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.
- C. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.
- D. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.
- E. Apply coating systems to the specified minimum dry-film thicknesses as measured from above the peaks of the surface profile.
- F. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.
- G. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. The brush coat shall be done prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

3.9 SURFACES NOT TO BE COATED

- A. The following surfaces shall not be painted and must be protected during painting of adjacent areas unless otherwise noted on the Drawings or in other Specification sections:
 1. Steel to be encased in concrete or masonry
 2. Cement mortar coated pipe and fittings
 3. Stainless steel
 4. Metal plates/nameplates or letters
 5. Electrical fixtures except for factory coatings
 6. Grease fittings

7. Buried pipe unless specifically required in the piping specifications
8. Plastic and fiberglass surfaces
9. Aluminum handrails, stairs and grating, unless in contact with concrete
13. Platform gratings, stair treads, door thresholds, and other walking surfaces
14. Roofing
15. Galvanized steel

3.10 PROTECTION OF SURFACES NOT TO BE PAINTED

- A. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

3.11 SURFACES TO BE COATED

- A. Coat mechanical equipment excluding chillers as described in the various mechanical equipment specifications. Color shall match the color of the connecting piping.
- B. Coat aboveground and exposed piping as described in the various piping specifications. Color shall be as indicated or as selected by the Engineer.
- C. Coat valves as described in the various valve specifications. Above ground valves shall match the color of the connecting piping.
- D. Coat exposed surfaces of enclosures, guard posts, marker posts, fire hydrants, valve boxes, and test boxes as described in the particular specifications for the above items.
- E. Coat the following list of existing items associated with the Chiller Area:
 1. Fire-Sprinkler Piping and system except sprinkler nozzles
 2. Plant air system piping
 3. Recycled water system piping
 4. Potable water system piping
 5. Remaining steel fence on west east and south side of the Chiller Area

6. Trap primer piping
7. Colors area as indicated in the specification or as selected by the Engineer.

3.12 SHOP AND FIELD INSPECTION AND TESTING

- A. General: Furnish the Engineer with a minimum of 3 days advance notice of the start of any field surface preparation work or coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.
- B. All inspection, testing, and operation of inspection tools for field-applied coatings and linings shall be performed only in the presence of the Engineer, unless the Engineer has granted prior approval to perform such Work in its absence.
- C. At no additional cost to the City, the inspection shall be performed by a third-party inspection agency acceptable to the Engineer and certified in the inspection of coating application procedures.
- D. Inspection by the Engineer, or the waiver of inspection of any particular portion of the Work, shall not relieve the Contractor of its responsibility to perform the Work in accordance with these Specifications.
- E. For external coating materials for buried or submerged piping systems, the Contractor shall supply inspection procedures for use by the Engineer. Procedures shall be supplied in advance of starting work.
- F. Inspection Devices: Furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the Engineer's use at all times while coating is being done, until final acceptance of such coatings. Furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of the Engineer.
- G. Holiday Testing: Holiday test all coated metal surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the coating manufacturer's printed instructions and then retested. Electrical inspection for coatings shall be in accordance with applicable NACE standards RPO 188 and/or RPS 274.
 1. Coatings with Thickness Exceeding 20 Mils: For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Razor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the specified coating thickness.
 2. Coatings with Thickness of 20 Mils or Less: For surfaces having a total dry film coating thickness of 20 mils or less, Tinker & Razor Model M1

nondestructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 V. For thicknesses between 10 and 20 mils, a nonsudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water before wetting the detector sponge.

- H. Film Thickness Testing: On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 2" using a magnetic-type dry film thickness gauge such as Mikrotest model FM, Elcometer model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On nonferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- I. Surface Preparation: Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standards TM-01-70 and TM-01-75.
- J. Third-Party Inspection: At no additional cost to the City, the inspection of coatings and linings for submerged and buried service conditions shall be performed by a third-party inspection agency acceptable to the Engineer and certified in the inspection of coating and lining application procedures.

****END OF SECTION****

SECTION 11033 – VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide pulse width modulated (PWM) variable frequency drive (VFD) units with motor, controls, and accessories for used with the Chilled Water Secondary Pumps. The Contractor shall have unit responsibility for the VFD and Chilled Water Secondary Pumps. The VFD's will replace existing free-standing VFD's. Line reactors are not required. VFD's will have upstream isolation transformers.
- B. The Work requires that one City-approved manufacturer be given responsibility for furnishing the indicated Work but without altering the Contractor's responsibilities under the Contract Documents.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 1. Division 11 – Equipment
 2. Section 13010 - Instrumentation and Control General Requirements
 3. Division 16 – Electrical

1.3 CODES

- A. The Work of this Section shall comply with the current edition of NFPA 70, National Electrical Code (NEC), as adopted by the City of San Diego.

1.4 SUBMITTALS

- A. The Contractor shall furnish submittals in accordance with the General Conditions, except that shop drawing information for the drives shall be submitted as part of the drawing information for the driven equipment.
- B. Shop Drawings: Shop drawings shall include the following information:
 1. The manufacturer's qualifications, which shall include performing system engineering, including harmonic filter calculations, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and startup, operator instruction, and maintenance training.
 2. Equipment Information:

- a. Name of drive manufacturer
 - b. Type and model
 - c. Assembly drawing and nomenclature
 - d. Maximum heat dissipation capacity in kW
3. Written description of ladder diagram operation, system operation, and analog signal processing.
 4. Calculation of VFD/motor efficiencies at 50, 75, and 100% speed. The system efficiency shall include power losses from the cooling system, controls, contactors, isolation transformers (if required), line reactors, and harmonic filters.
 5. System block diagram, system schematic diagram, and interconnection diagrams
 6. Enclosure outline and seismic support calculations stamped and signed by a Structural Engineer registered in California.
 7. Factory test data certifying compliance with requirements of similar equipment from the same manufacturer.
 8. Justification for any proposed exception taken to the requirements of this Section. Exceptions shall be in bold letters and be underlined.
- C. The Contractor shall submit operations and maintenance Information including:
1. O & M Manual
 2. Manufacturer's 1-year warranty
- D. Spare Parts List: The Contractor shall submit the list of spare parts recommended by the drive manufacturer.

1.5 SERVICES OF MANUFACTURER

- A. Inspection, Startup and Field Adjustment: An authorized service representative of the manufacturer shall visit the site for not less than two days per drive system to perform the following services:
1. Verify proper installation of the equipment.
 2. Inspection, checking and adjusting the equipment.
 3. Startup and field testing of the VFD controller.
- B. Instruction of City's Personnel: The authorized service representative shall instruct the City's personnel in all aspects of drive operation and maintenance, including step-by-step troubleshooting procedures with necessary test equipment. Instruction shall be provided for a maximum of 6 personnel for 3 days.

PART 2 - PRODUCTS

2.1 PRE-APPROVED VFD MANUFACTURERS

- A. VFDs shall be the same manufacturer as the motor control center. The following manufacturers, or equal, are pre-approved for the MCC:
 - 1. Square D
 - 2. Allen-Bradley PowerFlex 753
 - 3. Eaton
 - 4. Mitsubishi
 - 5. Toshiba

2.2 QUALIFICATIONS, APPROVAL, AND DOCUMENTATION OF VFD MANUFACTURER'S NOT PRE-APPROVED

- A. Procedures: The procedure for the review of VFD manufacturers that are not pre-approved is defined herein.
- B. Approval: If the Contractor proposes a manufacturer that is not pre-approved, the Contractor shall submit the name and documented qualifications of the proposed manufacturer. The Engineer will review the Contractor's proposed selection. If the Engineer does not approve the proposed selection, the Contractor shall select one of the pre-approved manufacturers listed above at no additional cost to the City.
- C. Documentation to be Submitted by the Manufacturer:
 - 1. A list of at least three PWM variable frequency drive installation of this type, voltage and similar horsepower operating successfully. The VFD manufacturer shall have performed system engineering, including harmonic filter and power factor correction calculations, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), field testing, calibration and startup, operator instruction, and maintenance training. In addition, the list shall include the following information for each project:
 - a. Name of facility, owner, contact name, and telephone number.
 - b. Name and type of drive equipment, including horsepower, voltage, speed range, and application.
 - c. Drive system furnished.
 - 2. The names and qualifications of manufacturer's representatives who will be responsible for the following:

- a. Office engineering
 - b. Project management
 - c. Field testing, calibration, startup
 - d. Operator training
3. A letter certifying that the manufacturer's representatives have read and studied the Contract Documents and agreed to the requirements of this Section.

2.3 DRIVE NAME

A. General:

1. Number of drive units - Two
2. Driven equipment - 480 volt, 20HP, variable torque centrifugal pump

B. Service Conditions: The VFD shall be designed and constructed to operate within the following service conditions:

1. Elevation - to 3300 feet
2. Ambient Temperature Range - 32 to 104 degrees F
3. Atmosphere - Noncondensing relative humidity to 95%, indoors, air conditioned room
4. AC Line Voltage Variation - 5% to +10%
5. AC Line Frequency Variation - \pm 3 Hz

C. Operating Conditions:

1. Minimum VFD efficiency shall be 95% at 100% speed and 100% torque and 87% at 60% speed based on nominal 450 RPM motor with load horsepower to vary as cube of speed.
2. Distribution voltage shall be 480 V, three phase, three wire, 60 Hz as indicated.

2.4 GENERAL

A. Basic Features: The controller(s) shall be suitable for use with any standard NEMA-B squirrel-cage induction motor(s) having a 1.15 service factor or with existing standard NEMA-B squirrel-cage induction motor(s) with nameplate data as indicated. The controller shall have the following basic features:

1. The door of each power unit shall include:

- a. Input disconnect switch handle integrally interlocked with power unit door.
 - b. One manual speed control potentiometer.
 - c. One 3-position mode selector switch marked "LOCAL-OFF-IN COMPUTER".
 - d. A "Power On" light.
 - e. A human interface module.
 - f. One elapsed time meter with five digits, without reset.
 - g. One VFD fault reset pushbutton.
 - h. VFD fault diagnostics.
 - i. Indicating lights to show running and ready status.
 - j. Other devices indicated.
2. Switches in the door shall control the drive as follows:
- a. With the "LOCAL-OFF-IN COMPUTER" switch in the "LOCAL" position, the drive output speed shall be controlled by the manual potentiometer. Start/Stop will be by local pushbuttons.
 - b. With the "LOCAL-OFF-IN COMPUTER" switch in the "IN COMPUTER" position, the drive shall start when an external isolated contact closes and its speed shall be controlled by a 4-20 mA external reference signal.
3. The VFD shall be selectable to provide automatic restart after a trip condition resulting from overcurrent, overvoltage, undervoltage, or over-temperature. For safety, the drive shall shut down and require manual reset and restart if the automatic reset/restart function is not successful within a maximum of three attempts within a short time period.
4. Speed Profile: Individual adjustable settings for start, stop, entry, slope, and minimum and maximum speed points. Speed reference shall be from an external 4 to 20 mA DC signal.
5. Control Circuit: Fused 120 VAC control transformer and control relays for system logic functions. For system logic, see electrical drawings.
6. Provision for an external 4 to 20 mA DC speed reference input signal. VFD manufacturer shall provide a signal current isolator to ensure signal and galvanic isolation of the grounded or ungrounded input speed reference signal. Where indicated, a frequency proportional 4 to 20 mA powered output signal shall be provided for external use and wired out to terminals.
7. Status and alarm outputs, each consisting of SPDT electrically isolated auxiliary contacts rated 5 A at 120 VAC.
- a. Alarm output shall consist of two separate outputs; VFD fault, and motor fault. VFD fault is either:
 - 1) Output or input under-voltage.
 - 2) SCR over-temperature.

- 3) Instantaneous overcurrent.
 - 4) Commutation failure.
 - 5) Converter saturation.
 - 6) Current limit timeout.
 - 7) Incorrect phase sequence or control power failure.
- b. VFD and motor failure shall latch in the trip mode and shall require operator intervention to reset the drive.
 - c. Status outputs shall consist of three separate unpowered outputs; two run status outputs, and a VFD enable output. VFD enable status contacts shall monitor the emergency (coast to a stop) circuit. Wiring shall be as required by the electrical control diagrams.
8. Automatic and safety inputs, each consisting of a remote contact closure rated 5 A at 120 VAC maximum. Opening of the automatic input remote contact shall cause the motor speed to ramp down to zero speed by controlled deceleration. Opening of the safety input remote contact shall cause the VFD SCRs to be shorted and motor speed to coast to a complete stop. Wiring shall be as required by the electrical control diagrams.
 9. Adjustable minimum to maximum frequency limits of 30 to 66 Hz.
 10. Independent timed linear acceleration and deceleration functions, adjustable from 4 to 300 seconds.
 11. Terminal blocks for wires entering and leaving the VFD unit. Terminals shall be identified with alpha- numeric characters identical to the terminal identifiers indicated on the schematic and connection diagrams.
 12. Frequency regulator to operate within the following tolerances:
 - a. Frequency regulator span shall be 4 mA at minimum speed and 20 mA at maximum speed.
 - b. Frequency regulator accuracy shall be within 1.0% of span.
 - c. Frequency regulator deadband shall be within 0.5% of span.
 - d. Frequency regulator repeatability shall be within 0.5% of span.
 - e. Frequency reference signal input resistance shall be 0 to 550 ohms.
 13. Provide output sine wave filter where indicated.

2.5 ENCLOSURE

- A. The enclosure shall be a dead-front, freestanding assembly with cabinet base and maximum 30-inches wide and 24-inches deep to match existing enclosure footprint. Wall mounted enclosures are not allowed. Working height shall be not greater than 72-inches. Doors shall be 11- gauge sheet steel with full length piano hinges. Removable lifting angles shall be provided.

- B. Unless otherwise indicated, the enclosure shall be NEMA 12 with gasketed doors and door fans. Enclosure shall be front access only, as indicated. The enclosure shall be suitable for either top or bottom cable entry as indicated.
- C. Enclosure shall be painted ANSI 61. Inside shall be white.

2.6 PROTECTIVE FEATURES AND CIRCUITS

- A. The controller shall include the following protective features:
 - 1. Static instantaneous overcurrent and overvoltage trip.
 - 2. Power loss and undervoltage protection.
 - 3. Power unit over-temperature protection.
 - 4. Electronic motor inverse time overload protection.
 - 5. Responsive action to motor winding and bearing temperature detectors and any bearing vibration switches indicated.
 - 6. The VFD shall be capable of transient operation with a line voltage dip of 20% of normal operating voltage on a variable torque load. During line dip, the VFD shall automatically provide a speed droop limiting maximum capable speed for the duration of the input voltage dip.
 - 7. When power is restored after a complete power outage, the VFD shall be capable of catching the motor while it is still spinning and restoring it to proper operating speed.
- B. The VFD system shall include distribution class arrestors to protect the VFD against voltage surges. The VFD shall include power fuses on the input to the converter rectifier.
- C. The power circuit design shall be such that the following fault conditions can occur without damage to the power circuit components:
 - 1. Single phase fault or three-phase short circuit on VFD output terminals.
 - 2. Failure to commutate inverter IGBT due to severe overload or other conditions.
 - 3. Opening of VFD output contactor or motor disconnect switch during VFD operation.
 - 4. Loss of input power due to opening of VFD input disconnect device or utility power failure during VFD operation.
 - 5. Loss of one phase of input power.

- D. Drive shall be provided with a main circuit breaker mechanically interlocked with the drive cabinet door. Interlock shall be provided with def eater. Unless otherwise indicated, circuit breaker or fuse shall have a minimum short circuit interrupting capacity of 35,000 RMS symmetrical amps. Provide current limiting fuses if required.

2.7 CONTROL DEVICES

- A. Pilot devices and instruments shall be flush mounted on a VFD unit door. Pilot devices shall be heavy duty with contacts rated 10 A minimum at 600 VAC. Indicating lights shall be "push-to-test" LED type. Lens colors shall be in accordance with details shown on Drawings. Door-mounted indicating lights shall be removable without removing related wiring. The control units of a given type and size shall be made interchangeable. Relays shall be hermetically sealed.
- B. Provide programmable I/O module per the contract drawings control diagrams.
- C. Provide Ethernet IP communications module.

2.8 DIAGNOSTICS

- A. The VFD shall include a microprocessor based digital diagnostic system which monitors its own control functions and displays faults and operating conditions.

2.9 POWER FACTOR

- A. The collective power factor of the VFD and the motor, when running at full load amps, shall not be less than 0.95.

2.10 SPARE PARTS

- A. Spare Parts: Furnish the following spare parts for each VFD:
 - 1. 3 spare fuses of each type used.
 - 2. 2 spare relays of each type used.
 - 3. 2 cans of aerosol spray touch-up paint.

2.11 FACTORY TESTING

- A. Component Tests:
 - 1. All components shall be 100% tested. Components shall be burned-in for 24 hours at 125 degrees F and retested to detect any drift. All printed circuit boards shall be burned-in continuously for 24 hours at 149 degrees F. The printed circuit boards shall be tested after burn-in to ensure they are functioning within specification. Every thyristor shall have the following critical parameters tested at rated current: gating, turn-on, turn-off, high temperature, forward blocking, reverse blocking, and waveform

characteristics. All assembled phase cells shall be tested for cell balance at rated voltage, maximum current, maximum dV/dT and maximum dI/dT.

2. Control power shall be applied to microprocessors, printed circuit boards, diagnostic boards and similar devices including software to test for proper operation, sequencing, logic, and diagnostics.
3. All wiring shall be checked for continuity and for compliance with the wiring diagrams.

B. System Tests: Provide factory standard testing with certified testing report.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. VFDs shall be installed in accordance with manufacturer's recommendations.
- B. Inspection, field adjustment and startup services shall be provided by manufacturer's service representative in accordance with Subsection 11033-1.6.

3.2 FIELD TESTING

- A. Field testing shall be performed in accordance with Section 16950 - Electrical Tests.

****END OF SECTION****

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SECTION 11060 - EQUIPMENT INSTALLATION

PART 1 - GENERAL

1.1 SCOPE

- A. This section covers general installation requirements of new equipment units that have been purchased by Contractor as part of this Work. Equipment specific installation requirements are covered in the equipment sections.
- B. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- C. When manufacturer's field services are provided by the equipment manufacturer, Contractor shall coordinate the services with the equipment manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's field services furnished by others.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Grout, as specified in the Grouting section.
- B. Anti-Seize thread lubricant for SS bolts as specified in the Anchorage in Concrete and Masonry Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results as specified in the Startup Requirements section.
- B. Each equipment unit shall be leveled, aligned, and shimmed into position. Installation procedures shall be as recommended by the equipment manufacturer and as required herein. Shimming between machined surfaces will not be permitted.
- C. Anti-seize thread lubricant shall be liberally applied to the threaded portion of all stainless-steel bolts during assembly.
- D. When specified in the equipment sections, the equipment manufacturer will provide installation supervision and installation checks. For installation supervision, the manufacturer's field representative will observe, instruct, guide, and direct Contractor's erection or installation procedures as specified in the

equipment specifications. For installation checks, the manufacturer's field representative will inspect the equipment installation immediately following installation by Contractor, and observe the tests indicated in the Startup Requirements section. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to the Engineer.

- E. All equipment shall be protected after installation, prior to final acceptance by the Engineer. Protection provisions shall be as recommended by the manufacturer, and shall include provisions to prevent rust, mechanical damage, and foreign objects entering the equipment.

3.2 STARTUP AND TESTING

- A. Startup requirements, and tests associated with startup shall be as indicated in the Section 01650 Startup Requirements Section. Other field tests shall be as indicated in the specific equipment sections.

****END OF SECTION****

SECTION 11070 - VARIABLE SPEED SCREW WATER CHILLERS

PART 1 – GENERAL

1.1 SCOPE

- A. The contractor shall provide variable speed screw water chillers complete with, controls and control connections, chilled water connections, charge of refrigerant and oil, motor starters, and electrical power connections.
- B. The work requires the chiller manufacturer to provide controls and programming for multiple chillers in operation simultaneously and most efficiently, all ancillary chiller related equipment including primary and secondary pumps, and related lag/lead selection, and providing control signals to City DCS.

1.2 RELATED SECTIONS

- A. Section 11060 - Equipment Installation
- B. Section 11071 - Chilled Water Primary Pumps
- C. Section 11072 - Chilled Water Secondary Pumps
- D. Section 11075 - Ancillary Equipment and Appurtenances
- E. Division 13 – Instrumentation
- F. Division 15 – Mechanical
- G. Division 16 – Electrical

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. AHRI 550/590 - Standard for Water Chilling Packages using the Vapor Compression Cycle.
- B. AHRI 370 - Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment.
- C. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- D. ANSI/ASHRAE 90.1 - Energy Efficient Design of New Buildings.
- E. ANSI/ASME - Boiler and Pressure Vessel Code SEC VIII, Division 1.
- F. UL 1995 - Central Cooling Air Conditioners.
- G. ANSI/AFBMA 9-1978 - Load Ratings and Fatigue Life for Ball Bearings.

- H. California Administrative Code - Title 24
- I. ASTM B117 - Standard Method of Salt Spray (Fog) Testing
- J. ASTM A123 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- K. ASTM A525 - Zinc (Hot-Dip Galvanized) Coatings on Sheet Steel Products
- L. ASTM D1654 - Evaluation of Painted or Coated Specimens, Subjected to Corrosive Environments
- M. IEEE 519 – IEEE Recommended Practice and Requirements for Harmonic Control in Electrical Systems – 2014

1.4 SUBMITTALS

- A. Submit dimensional plan and elevation view drawings, weights and loadings, required clearances, location and size of all field connections, electrical requirements and wiring diagrams.
- B. Submit product data indicating rated capacities with certified ratings/performance, and all specialties and accessories.
- C. Submit manufacturer's installation instructions.
- D. Control Narratives
- E. Loop diagrams for CAC4
- F. Data base register for CAC4

1.5 OPERATION AND MAINTENANCE DATA

- A. Submit operation data.
- B. Include start-up instructions, maintenance data, controls, and accessories.
- C. Submit maintenance data.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Unit controls shall be capable of withstanding 203 F (95 C) storage temperatures in the control compartment for an indefinite period of time.

1.7 WARRANTY

- A. Provide a full parts and packaged control systems warranty for 5 years from

start-up or 66 months from shipment, whichever occurs first.

- B. Duration of the motor/transmission/compressor warranty shall be provided based upon the RPM of the compressor as follows:

Compressor RPM	Warranty Term
0 - 10,000	5 years from start-up
10,001 and above	10 years plus annual oil and refrigerant analysis

- C. OEM provides several Extended Warranty options to include:

1. 5 Year Whole Units Parts Warranty
2. 5 Year Whole Unit Labor Warranty

1.8 CODES AND STANDARDS

- A. Conform to AHRI 550/590 Standard for testing and certified rating of Water Chilling Packages using the Vapor Compression Cycle.
- B. Conform to ANSI/UL 1995 code for construction of water chillers. In the event the unit is not UL approved, the manufacturer shall, at manufacturer expense, provide for a field inspection by an UL representative to verify conformance to UL standards. If necessary, contractor shall perform modifications to the unit to comply with UL, as directed by the UL representative.
- C. Conform to ANSI/ASME Boiler and Pressure Vessel Code SEC 8 for construction and testing of water chillers.
- D. Conform to ANSI/ASHRAE 15 code for construction and operation of water chillers.
- E. Conform to the most recent versions of the International Building Code (IBC) for seismic applications.
- F. Chiller must be built in an ISO 9001 classified facility.

1.9 VERIFICATION OF CAPACITY, EFFICIENCY AND OPERATION

- A. All proposals for chiller performance must include an AHRI approved selection method. Verification of date and version of computer program selection or catalog is available through AHRI.
- B. Operational Test with Water: Chiller shall be functionally tested with power and water flowing through the chiller before shipment. A test report showing date and time of test shall be provided.
 1. The following allowable tolerances must be referenced:
 - a. The tolerance on capacity shall be as defined by AHRI Standard

- 550/590 for full and part load points.
- b. The tolerance on efficiency shall be defined by AHRI Standard 550/590 for IPLV/NPLV, full load and all part load test points.
2. The performance test shall be run with clean tubes in accordance with AHRI Standard 550/590 to include the following:
 - a. A downward temperature adjustment shall be made to the design leaving evaporator water temperature to adjust from the design fouling to the clean tube condition.
 3. The factory test instrumentation shall be per AHRI Standard 550/590, and the calibration of all instrumentation shall be traceable to the National Institute of Standards and Technology (formerly NBS).
 4. The owner or his representative shall be notified 14 days in advance to witness the factory performance test. If the owner or his representative desires to witness the performance test, all travel expenses will be the owner's responsibility.
 5. A certified test report of all data shall be submitted to the Engineer prior to completion of the project. The factory certified test report shall be signed by an officer of the manufacturer's company. Preprinted certification will not be acceptable; certification shall be in the original.
 6. As part of the factory test, harmonic measurements will be recorded at the skid, provided as part of the factory test report and compared to IEEE 519 statement.

1.10 MAINTENANCE SERVICE

- A. All inspections and service of units shall be accomplished by factory trained and authorized servicing technicians.
- B. In conjunction with and supporting Factory warranty OEM shall furnish complete factory authorized service and maintenance of Applied Chillers for 5 years from Date of Substantial Completion.
- C. OEM shall provide and report quarterly, annual, and bi-annual maintenance in compliance with or better than ASHRAE Standard 180-2008.
- D. Include maintenance items as recommended in manufacturer's operating and maintenance data.
- E. Submit copy of service call work orders and summary report to the Owner, including description of work performed, operating performance status and noted exceptions.

PART 2 - PRODUCTS

2.1 SUMMARY

- A. The contractor shall furnish and install air-cooled water chillers as shown as scheduled on the contract documents. The chillers shall be installed in accordance with this specification and perform at the specified conditions as scheduled.
- B. Acceptable Manufacturers
 - 1. Trane
 - 2. York
 - 3. Carrier
 - 4. No Substitutions
- C. Factory Functional Test: The chiller shall be pressure tested, evacuated and fully charged with R134a refrigerant and oil. In addition, a factory functional test shall be conducted to verify correct operation by cycling condenser fans and compressors and confirmation operation of temperature and pressure sensors.
- D. Minimum Efficiency Requirements

Cooling efficiency (EER)	10.993
IPLV.IP (EER)	18.806
NPLV.IP (EER)	18.363

2.2 COMPRESSORS

- A. Construct chiller using semi-hermetic, direct-drive, helical rotary screw compressors with independent circuits.
- B. Provide oil lubrication system with oil charging valve and oil filter to ensure adequate lubrication during starting, stopping, and normal operation.
- C. Provide compressor with automatic capacity reduction equipment consisting of a capacity control variable speed drive. The controls system logic must decelerate the compressor to minimum speed for a soft start.
- D. Provide direct-drive compressor motors with suction gas cooling, of robust construction, and designed for VFD operation.
- E. Provide compressor heater to evaporate refrigerant returning to compressor during shut down. Energize heater when compressor is not operating.

2.3 EVAPORATOR

- A. The evaporator shall be designed, tested, and stamped in accordance with ASME code for a refrigerant side working pressure of 200 psig. Waterside

working pressure shall be 150 psig.

- B. Insulate the evaporator with a minimum of K=0.28 UV rated insulation. If the insulation is field installed, the additional money to cover material and installation costs in the field should be included in the bid.
- C. Evaporator heaters shall be factory installed and shall protect unit down to -20 F. Contractor shall wire separate power to energize heat tape and protect cooler while chiller is disconnected from the main power.
- D. Provide shell and tube type evaporator, seamless or welded steel construction with cast iron or fabricated steel heads, seamless internally and externally finned copper tubes, roller expanded into tube sheets.
- E. Provide ability to remove evaporator tubes from either end of the heat exchanger.
- F. Provide water drain connection, vent and fittings for factory installed leaving water temperature control and low temperature cutout sensors.
- G. Water connections shall be grooved-end or flanged pipe. Evaporator shall have only one entering and one leaving connection. If manufacturer provides 2 separate evaporators, contractor shall provide manifold and pressure gauges to ensure equal flow is provided to each evaporator.
- H. Proof of flow shall be provided by the equipment manufacturer, mechanically installed and electrically wired, at the factory of origin.

2.4 CONDENSER AND FANS

- A. Low sound fans shall be dynamically and statically balanced, direct-drive, corrosion resistant, glass fiber reinforced composite molded into a low noise fan blade.
- B. Chiller shall be able to start and operate in ambient conditions down to 32F (0C) and up to 105F (40.6C).
- C. Condenser coils shall be micro-channel type, parallel flow aluminum alloy tubes metallurgically brazed as one piece to aluminum alloy fins. Condenser coils shall be made of a single material to avoid galvanic corrosion due to dissimilar metals. Tube and fin type condenser coils are an acceptable alternate when tubes and fins are fabricated of the same metal material to avoid galvanic corrosion due to dissimilar metals. Coils shall be designed for 525 psig or higher working pressure.
- D. Coils shall be post-coated with an electro-deposited and baked flexible epoxy coating that is finished with a polyurethane UV resistant top-coat suitable for highly corrosive applications.
- E. Unit shall include Louvered Panels (Condenser Coils): Painted steel to match unit panels, over external condenser coil faces.

- F. Provide factory installed louvered "architecturally pleasing" guard panels. Panel louvers shall cover condenser, evaporator and compressor sections so all are hidden from sight. Wire screens or wire mesh will not be allowed.

2.5 ENCLOSURES/STARTER

- A. House components in a galvanized steel frame and mounted on a formed steel base. Hot-dip galvanized steel frame coating shall be Underwriters Laboratories Inc. (UL) recognized as G90-U, UL guide number DTHW2.
- B. Unit panels, base rails and control panels shall be finished with a baked-on powder paint. Control panel doors shall have door stays. Paint system shall meet the requirements for outdoor equipment of Federal Government Agencies.
- C. Mount starters and Terminal Blocks in a UL 1995 rated weatherproof panel provided with full opening access doors. If a circuit breaker is chosen, it should be a lockable, through-the-door type with an operating handle and clearly visible from outside of unit indicating if power is on or off.
- D. Casings fabricated from steel that do not have a Zinc coating conforming to ASTM A 123 or ASTM A525 shall be treated for the prevention of corrosion with a factory coating or paint system. The coating or paint system shall withstand 500 hours in a salt-spray fog test in accordance with ASTM B 117. Each specimen shall have a standard scribe mark as defined in ASTM D 1654. Upon completion of exposure, the coating or paint system shall be evaluated and rated in accordance with procedures A and B of ASTM D 1654. The rating of failure at the scribe mark shall be not less than six (average creepage not greater than 1/8 inch). The rating of the unscribed area shall not be less than ten (no failure). Thickness of coating or paint system on the actual equipment shall be identical to that on the test specimens with respect to materials, conditions of application, and dry-film thickness. For each compressor provide a variable speed drive starter. Across-the-line and Delta-Delta shall be unacceptable.
- E. A control power transformer shall be factory-installed and factory-wired to provide unit control power.

2.6 VARIABLE SPEED DRIVE

- A. The water chiller shall be furnished with a variable speed drive (VSD) to minimize maintenance and maximize cooling efficiency. The VSD shall be factory mounted on the chiller and shipped completely factory assembled, wired and tested.
- B. The VSD will be specifically designed to interface with the water chiller controls and allow for the operating ranges and specific characteristics of the chiller. The VSD control logic shall optimize chiller efficiency by coordinating compressor motor speed to maintain the chilled water setpoint.
- C. The VSD efficiency shall be 95% or better at full speed and full load.

Fundamental displacement power factor shall be a minimum of 0.95.

- D. The VSD shall be solid state, microprocessor-based pulse-width modulated (PWM) design. The VSD shall be voltage and current regulated. Output power devices shall be IGBT transistors.
- E. Power semi-conductor and capacitor cooling shall be from a liquid cooled heatsink.
- F. The VSD shall have thin film capacitors.
 - 1. If thin film capacitors are not factory provided, then manufacturer should include a 5-year warranty on the drive.
- G. The VSDs shall each be furnished in a UL 1995 rated metal enclosure having as minimum a short circuit withstand rating of 65,000 amps. It will include three phase input lugs plus a grounding lug for electrical connections, output motor connection via factory installed bus bars and all components properly segregated and completely enclosed in a single metal enclosure.
 - 1. Enclosure shall include a padlockable, door-mounted circuit breaker with shunt trip and AIC rating of 65,000 amps. Provide single point power connection.
 - 2. The entire chiller package shall be UL/CUL listed.
- H. The following VSD status indicators shall be available to facilitate startup and maintenance:
 - 1. Output speed in hertz and rpm
 - 2. Input line voltage
 - 3. Input line kW
 - 4. Output/load amps
 - 5. Average current in percent RLA
 - 6. Load power factor
 - 7. Fault
 - 8. VSD transistor temperature
- I. The VSD shall include the following features:
 - 1. All control circuit voltages are physically and electrically isolated from power circuit voltage.

2. Soft start, adjustable linear acceleration, coast-to-stop.
3. Adjustable current limiting and UL approved electronic motor overload protection.
4. Insensitivity to incoming power phase sequence.
5. VSD and motor protection from the following faults:
 - a. Output line-to-line short circuit protection
 - b. Line-to-ground short circuit protection
 - c. Phase loss at AFD input
 - d. Phase reversal / Imbalance
 - e. Over-voltage / Under-voltage
 - f. Over temperature

J. Warranties

1. The variable speed drive shall be warranted by the manufacturer for a period of 5 years from the date of installation. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory-authorized on-site service.

2.7 REFRIGERANT CIRCUIT

- A. Each unit shall have 2 refrigeration circuits to provide redundancy, each with one or two (manifolded) compressor(s) on each circuit.
- B. Provide for refrigerant circuit:
 1. Liquid line shutoff valve.
 2. Suction service valve
 3. Filter (replaceable core type).
 4. Liquid line sight glass.
 5. Electronic expansion valve sized for maximum operating pressure.
 6. Charging valve.
 7. Discharge and oil line check valves.
 8. High side pressure relief valve.
 9. Full operating charge of HFC-134a and oil.
- C. Capacity Modulation: Provide capacity modulation by a variable speed drive. Unit shall be capable of operation down to 20%.

2.8 CONTROLS

- A. Chilled water temperature control shall be microprocessor-based, proportional and integral controller to show water and refrigerant temperature, refrigerant pressure, and diagnostics. This microprocessor-based controller is to be supplied with each chiller by the chiller manufacturer. Controls shall include the following readouts and diagnostics:
1. Phase reversal/unbalance/single phasing and over/under voltage protection.
 2. Low chilled water temperature protection.
 3. High and low refrigerant pressure protection.
 4. Load limit thermostat to limit compressor loading on high return water temperature.
 5. Condenser fan sequencing to automatically cycle fans in response to load, expansion valve pressure, condenser pressure, and differential pressure to optimize unit efficiency.
 6. Display diagnostics.
 7. Oil pressure control based off of maintaining system differential pressure.
 8. Compressors: Status (on/off), %RLA, % speed, anti-short cycle timer, and automatic compressor lead-lag.
- B. The on-chiller mounted weatherproof control panel shall contain starters, power and control wiring, factory wired with terminal block power connections. Provide primary and secondary fused control power transformer and a single 115-volt 60 Hz single phase connection for evaporator freeze protection heaters.
1. The unit controller shall utilize the following components to automatically take action to prevent unit shutdown due to abnormal operating conditions which will perform as follows:
 - a. High pressure switch that is set 20 PSIG lower than factory pressure switch that will automatically unload the compressor to help prevent a high-pressure condenser control trip. One switch is required for each compressor and indicating light shall also be provided.
 - b. Motor surge protector that is set at 95% of compressor RLA that will automatically unload the compressor to help prevent an over current trip. One protector is required for each compressor and indicating light shall also be provided.
 - c. Low pressure switch that is set at 5 PSIG above the factory low pressure switch that will automatically unload the compressor to

help prevent a low evaporator temperature trip. One switch is required for each compressor and indicating light shall also be provided.

- C. In the above case of a chiller unit operating in an unloaded condition as a result of situations presented in B.1.a, b and c., the chiller will continue to run in an unloaded state and will continue to produce some chilled water in an attempt to meet the cooling load. However, if the chiller reaches the trip-out limits, the chiller controls will take the chiller off line for protection, and a manual reset will be required. Once the "near-trip" condition is corrected, the chiller will return to normal operation and can then produce full load cooling.
- D. Provide the following safety controls with indicating lights or diagnostic readouts.
 - 1. Low chilled water temperature protection.
 - 2. High refrigerant pressure.
 - 3. Low oil flow protection.
 - 4. Loss of chilled water flow.
 - 5. Contact for remote emergency shutdown.
 - 6. Motor current overload.
 - 7. Phase reversal/unbalance/single phasing.
 - 8. Over/under voltage.
 - 9. Failure of water temperature sensor used by controller.
 - 10. Compressor status (on or off).
- E. Provide the following operating controls for each chiller unit:
 - 1. A variable method to control capacity in order to maintain leaving chilled water temperature based on PI algorithms. Five-minute solid state anti-recycle timer to prevent compressor from short cycling. Compressor minimum stop-to-start time limit shall be 2 minutes. If a greater than 5-minute start-to-start, or greater than 2-minute stop-to-start timer is included, hot gas bypass shall be provided to insure accurate chilled water temperature control in light load applications.
 - 2. Chilled water pump output relay that closes when the chiller is given a signal to start.
 - 3. Load limit thermostat to limit compressor loading on high return water temperature to prevent nuisance trip outs.

4. High ambient unloader pressure controller that unloads compressors to keep head pressure under control and help prevent high pressure nuisance trip outs on days when outside ambient is above design.
 5. Compressor current sensing unloader unit that unloads compressors to help prevent current overload nuisance trip outs.
 6. Auto lead-lag functions that constantly even out run hours and compressor starts automatically.
 7. Low ambient lockout control with adjustable setpoint.
 8. Condenser fan sequencing which adjusts the speed of all fans automatically in response to ambient, condensing pressure and expansion valve pressure differential thereby optimizing unit efficiency.
- F. Provide user interface, with protective cover, on the front of the panel. If display is on the inside of the panel, then a control display access door shall be provided to allow access to the display without removal of panels. Provide user interface with a minimum of the following features:
1. Leaving chilled water setpoint adjustment from LCD input
 2. Entering and leaving chilled water temperature output
 3. Percent RLA output for each compressor
 4. Pressure output of condenser
 5. Pressure output of evaporator
 6. Ambient temperature output
 7. Voltage output
 8. Current limit setpoint adjustment from LCD input.

2.9 SOUND

- A. At full load chiller sound power shall not exceed the following levels. Submitted sound data shall be in accordance with AHRI 370. Minimum sound requirements are:

A-weighted sound power (dBA)	102
A-weighted 75% sound power (dBA)	99
A-weighted 50% sound power (dBA)	95
A-weighted 25% sound power (dBA)	91
A-weighted sound pressure (dBA)	73
A-weighted 75% sound pressure (dBA)	69

A-weighted 50% sound pressure (dBA)	64
A-weighted 25% sound pressure (dBA)	60

If manufacturer cannot meet this sound specification, then sound attenuation devices and/or barrier walls must be field installed at the contractor's expense to meet the specified level.

2.10 Harmonic Filtration

- A. Factory-installed harmonic attenuation package is to be provided with skid mounted active or passive filters. Passive filters may be 12 Pulse Auto-Transformers or TCI Harmonic Guard passive filter with switched capacitor. The passive filter shall be switched to minimize leading power factor at light loads. The filter shall provide less than maximum Total Demand Distortion (TDD) and Total Voltage Harmonic Distortion (THDv) levels in accordance with IEEE 519-2014. Harmonic levels shall meet IEEE 519 levels at the skid input terminals. Failure to meet this requirement shall be rectified by the supplier at no cost to the City.

2.11 Special Features:

- A. Provide Modine "Insitu" Es2, a spray applied, water based, single part, low VOC synthetic polymer coating embedded with #316 stainless steel applied to all coil surfaces, internal components exposed to ambient, evaporator/condenser refrigerant lines and surface areas associated to the condenser section. External cabinet surface areas and base rails are also included.
 - 1. Superior hardness characteristics of HB-F per ASTM D3363-92A and a cross hatch adhesion of 4B-5B per ASTM B3359-93. Humidity and water immersion resistance shall be up to a minimum 500 and 2000 hours respectively (ASTM D2247-92 and ASTM D870-02.) Corrosion durability shall be confirmed though testing to meet 10,000 hours salt spray per ASTM B117-90.
 - 2. Engineered for Waste Water Treatment Plants for unitary applications and air-cooled chillers, post manufacturing.
- B. Unit-Mounted Disconnect:
 - 1. Unit shall be supplied with factory-installed, lockable, 65kaic circuit breaker for main power supply.
- C. Energy Management Module:
 - 1. A factory or field-installed module shall provide the following energy management capabilities: 4 to 20 mA signals for leaving fluid temperature reset, cooling set point reset or demand limit control; 2-step demand limit control (from 0% to 100%) activated by a remote contact closure; and discrete input for "Ice Done" indication for ice storage system interface. When a factory-installed version of this device is selected, a GFI

convenience outlet is also included.

D. Condenser Coil Trim Panels:

1. Unit shall be supplied with factory-installed or field-installed coil covers. Factory-installed coil trim panels are not available when a factory-installed full hail guard is selected.

E. BACnet*/Modbus† Translator Control:

1. Unit shall be supplied with factory or field-installed interface between the chiller and a BACnet Local Area Network (LAN, i.e., MS/TP EIA-485). Field programming shall be required. BACnet shall communicate with the Chill Water System Custom Application Controller (CAC).

F. Isolation Valve Option:

1. Unit shall be supplied with factory-installed isolation valve which provides a means of isolating the compressors from the evaporator vessel, which is beneficial in servicing the chiller. The selection of the isolation valve option results in chillers which are equipped with a liquid line service valve, a discharge service valve (motorized or manual type), and a series of valves on or near the evaporator. The net effect is to provide isolation capability in the condenser area, the evaporator area and the compressor area.

NOTE: The only situation in which the isolation of the condenser area allows the full charge to be stored in the condenser is when round tube, plate fin (RTPF) coils are employed.

G. Suction Line Insulation:

1. Unit shall be supplied with suction line insulation. Insulation shall be tubular closed-cell insulation.

H. Control Transformer:

1. Unit shall be supplied with a factory-installed transformer that will allow supply control circuit power from the main unit power supply.

I. High SCCR (Short Circuit Current Rating):

1. A high SCCR (short circuit current rating) device shall allow the chiller to tolerate a 65 kA (all voltages except 575-v) or a 25 kA (575-v units) short circuit current for a brief period of time while protecting downstream components. The high SCCR option shall provide a higher level of protection than the standard unit.

J. Security Grilles (Sides) and Hail Guard (Ends):

1. Unit shall be equipped with a factory-installed option consisting of louvered panels on the ends of the machine and security grilles on the sides of the machine. These coverings shall firmly fasten to the chiller frame and provide coverage from the top to the bottom of the unit.
- K. Low Sound Kit:
1. Unit shall be provided with factory-installed sheet metal enclosures with sound-absorbing panels for each compressor as well as an external muffler between each compressor and its associated oil separator.
- L. Chill Water System Custom Application Controller (CAC)
1. A fourth remote mounted control panel (CAC) shall be provided by the chiller manufacturer to communicate with the three chiller skids, field I/O, and central DCS. The CAC controller will be located indoors in an air-conditioned environment. THE CAC enclosure shall be NEMA 12 with a 3-point, padlockable door handle. The CAC shall contain sufficient I/O modules with 15% spares to monitor and control off-skid chill water processes indicated in the P&ID's. The CAC shall provide an Ethernet IP or Modbus IP communication with the Owners DCS. The CAC enclosure shall have an Ethernet switch along with a graphic display. Provide internal dc power supplies as required for internal hardware and local I/O. The CAC master controller shall be Carrier ChillerVu or equal by other suppliers. Provide system diagrams showing panel internal and external elevations, power diagrams, ladder logic, and I/O loop diagrams.
 2. The enclosure and requirements shall be in accordance with Section 17010 Instrumentation and Controls General Requirements and Section 17080 Control Panels.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Align chiller package on steel or concrete foundations.
- C. Install units on level base.
- D. Connect to electrical service.
- E. Connect to chilled water piping.
- F. Confer with the Engineer if the Contractor desires to modify the piping arrangement to provide easier dismantling to permit tube cleaning, or other reasons.

3.2 MANUFACTURER'S FIELD SERVICES

- A. OEM Startup is performed by factory trained and authorized servicing technicians confirming equipment has been correctly installed and passes specification checklist prior to equipment becoming operational and covered under OEM warranty.
 - 1. Included in OEM Factory Startup:
 - a. Centrifugal and Rotary Screw/Scroll Chillers
- B. Applied Chiller manufacturers shall maintain service capabilities no more than 40 miles from the jobsite.
- C. The manufacturer shall furnish complete submittal wiring diagrams of the package unit as applicable for field maintenance and service.

PART 4 – CONTROL SEQUENCE OF OPERATIONS

4.1 SEQUENCE OF OPERATION

- A. System General Description:
 - 1. The chilled water system consists of the following:
 - Three (3) chillers, configured as: one (1) lead and two (2) lag
 - One (1) chilled water supply isolation valve per chiller
 - Four (4) primary chilled water pumps, configured as: one (1) lead, one (1) lag and two (2) standby
 - Two (2) secondary chilled water pumps, configured as one (1) lead, one (1) lag
 - 2. The Chilled Water System Custom Application Controller (CAC) provides stand-alone control or control from a higher level (plantwide DCS) system and provides start/stop and lead/lag/standby control for the primary chilled water pumps and also provides lead/lag/standby control of the secondary chilled water pumps in order to maintain the system chilled water system differential pressure setpoint (adj.). The CAC also monitors and controls off-skid actuators and sensors and stages the three chilled water skids. The CAC communicates with the plant Distributed Control System (DCS) for central DCS status and alarm. Any alarms generated from the CAC4 shall have the ability to be cleared and reset from the DCS. Details shall be delineated through the CAC4 data base register submittal process.
- B. Chilled Water System Enable/Disable:
 - 1. The chilled water system shall be controlled via BacNet communication with the CAC. On cooling demand, the CAC controller shall start the lead

system primary pump. When run status for that pump is proven, the CAC controller shall report that status to City DCS. The CAC shall then begin making requests for starting chillers.

2. The primary chilled water pumps shall be controlled on a contact closure from the CAC. As an additional chiller is needed to meet cooling loads an additional primary pump is requested (one pump per chiller) and the next primary chilled water pump in the sequence shall be started by the CAC.
3. When the chilled water system is disabled, the secondary chilled water pumps shall be off, and the primary pumps shall be off unless requested by one of the chillers.

C. Primary Chilled Water Pump Start/Stop:

1. The CAC controller shall start a chilled water pump through a contact closure of the pumps motor starter enable contacts.

D. Primary Chilled Water Pump Status:

1. The CAC controller shall detect chilled water pump run status by a flow switch.

E. Primary Chilled Water Pump Lead/Lag:

1. The chilled water pump lead/lag/standby sequence shall be rotated on a weekly schedule. The sequence shall be based on calculated run time with the pump having the least run time as lead, the pump with the next lowest run time will be the second in the sequence, etc. (Least Run Time Mode). From the CAC an operator shall be able to manually change the lead/lag sequence (Alternate Mode). From the DCS an operator shall be able to stop and start any pump and place any pump in manual mode (Operator Mode).

F. Primary Chilled Water Pump Failure:

1. If the lead start/stop relay is enabled and the flow switch status is off for more than 30 seconds (adj.), the CAC controller shall annunciate a chilled water pump failure alarm to the CAC and start the next pump in the sequence.
2. Once the problem has been corrected, the operator shall be able to clear the alarm failure from the CAC controller.
3. This shall re-enable the lead/lag sequence.

G. Chiller Isolation Valves:

1. Chiller isolation valves shall prevent the flow of water through non-operating chillers. Chiller primary water pump operation will be

coordinated with the isolation valve operation.

- H. Secondary Chilled Water Pump Start/Stop:
 - 1. The CAC controller shall start a secondary chilled water pump through a contact closure of the pumps VFD run-enable contacts.

- J. Secondary Chilled Water Pump Status:
 - 1. The CAC controller shall detect secondary chilled water pump run status by a flow switch.

- K. Secondary Chilled Water Pump Lead/Lag:
 - 1. The chilled water pump lead/lag/standby sequence shall be rotated on a weekly schedule. The sequence shall be based on calculated run time with the pump having the least run time as lead, the pump with the next lowest run time will be the second in the sequence, etc. (Least Run Time Mode). From the CAC an operator shall be able to manually change the lead/lag sequence (Alternate Mode). From the DCS an operator shall be able to stop and start any pump and place any pump in manual mode (Operator Mode).
 - 2. If the chilled water system differential pressure falls 0.5 psig (adj.) below the setpoint of 38 psi (adj.), and the lead pump is at 100% (adj.) for more than 5 minutes (adj.), the next pump in the sequence shall start. If the pump speed control output is below 40% (adj.) for more than 5 minutes (adj.), the last operating pump in the sequence shall be disabled.

- L. Secondary Chilled Water Pump Failure:
 - 1. If the lead start/stop relay is enabled and the associated flow switch status is off for more than 30 seconds (adj.), the CAC controller shall annunciate a secondary chilled water pump failure alarm to the CAC and start the lag pump. When a secondary chilled water pump failure exists, lead/lag/standby automation shall be disabled and the currently running pump becomes the lead pump. Once the problem has been corrected, the operator shall be able to clear the alarm failure from the CAC controller or DCS workstation. This shall re-enable the lead/lag/standby sequence.

- M. Secondary Chilled Water Pump Speed:
 - 1. The CAC shall monitor the chilled water system differential pressure sensor. When the pump variable frequency drive is enabled, the CAC controller shall control the analog speed signal that is sent to the variable frequency drives of operating pumps to maintain a chilled water system differential pressure setpoint of 38.0 psig (adj.).

4.2 CAC-3 I/O POINTS LIST

A. Analog Outputs

- Secondary Pump 1 Speed Command
- Secondary Pump 2 Speed Command
- Chiller 1 Outlet Valve Position Command
- Chiller 2 Outlet Valve Position Command
- Chiller 3 Outlet Valve Position Command

B. Analog Inputs

- Secondary Pump 1 Speed
- Secondary Pump 2 Speed
- Chill Water System Flow
- Chill Water Distribution Supply Temperature
- Chill Water Distribution Return Temperature
- Chiller 1 Outlet Temperature
- Chiller 1 Flow
- Chiller 1 Outlet Valve Position
- Chiller 2 Outlet Temperature
- Chiller 2 Flow
- Chiller 2 Outlet Valve Position
- Chiller 3 Outlet Temperature
- Chiller 3 Flow
- Chiller 3 Outlet Valve Position

C. Digital Outputs

- Primary Pump 1 Start/Stop
- Primary Pump 2 Start/Stop
- Primary Pump 3 Start/Stop
- Primary Pump 4 Start/Stop
- Secondary Pump 1 Start/Stop
- Secondary Pump 2 Start/Stop

D. Digital Inputs

- Primary Pump 1 Run
- Primary Pump 1 Flow Switch
- Primary Pump 1 In Computer
- Primary Pump 1 AC Control Power Ready
- Primary Pump 2 Run
- Primary Pump 2 Flow Switch
- Primary Pump 2 In Computer
- Primary Pump 1 AC Control Power Ready
- Primary Pump 3 Run
- Primary Pump 3 Flow Switch

- Primary Pump 3 In Computer
- Primary Pump 1 AC Control Power Ready
- Primary Pump 4 Run
- Primary Pump 4 Flow Switch
- Primary Pump 4 In Computer
- Primary Pump 1 AC Control Power Ready
- Secondary Pump 1 Run
- Secondary Pump 1 Flow Switch
- Secondary Pump 1 In Computer
- Primary Pump 1 AC Control Power Ready
- Secondary Pump 1 VFD Fail
- Secondary Pump 2 Run
- Secondary Pump 2 Flow Switch
- Secondary Pump 2 In Computer
- Primary Pump 1 AC Control Power Ready
- Secondary Pump 2 VFD Fail
- Chiller 1 Outlet Valve In Computer
- Chiller 1 Outlet Valve Fail
- Chiller 2 Outlet Valve In Computer
- Chiller 1 Outlet Valve Fail
- Chiller 3 Outlet Valve In Computer
- Chiller 1 Outlet Valve Fail

****END OF SECTION****

SECTION 11071 – CHILLED WATER PRIMARY PUMPS

PART 1 – GENERAL

1.1 SCOPE

A. Provide pumps and required system trim for heating, chilled water, and dual temperature water systems including all related appurtenances for a complete and operating systems. Pump shall be end suction type, long-coupled and base mounted.

B. Design Criteria for Primary Pumps

Tag Nos.: 70-P-01, 70-P-02, 70-P-03, 70-P-20

Duty Point: 650 gpm @ 37 feet

Second Operating Point: 450 gpm @ 45 feet

Shut Off Head: 57 feet

Pump Speed: 1770

Maximum Horsepower: 10

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division 1 Specification Sections, apply to these sections:

1. Section 01080 - Construction Sequencing
2. Section 09900 - Painting and Coating
3. Section 11060 - Equipment Installation
4. Section 11070 – Variable Speed Screw Water Chillers
5. Section 11075 – Ancillary Equipment and Appurtenances
6. Section 16040 - Electric Motors

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. HI - Hydraulic Institute.
- B. ANSI - American National Standards Institute.
- C. OSHA - Occupational Safety & Health Administration.
- D. ASHRAE – American Society of Heating, Refrigeration and Air-Conditioning Engineers.
- E. NEMA - National Electrical Manufacturers Association.

- F. UL - Underwriters Laboratories.
- G. ETL - Electrical Testing Laboratories.
- H. CSA - Canadian Standards Association.
- I. NEC - National Electric Codes.
- J. ISO - International Standards Organization.
- K. IEC - International Electrotechnical Commission.
- L. ASME – American Society of Mechanical Engineers.

1.4 SUBMITTALS

- A. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts lists.
- B. Product Data including certified performance curves and rated capacities of selected model, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate pump's operating point on curves.
- C. Complete Package Information Product Data including:
 - 1. System summary sheet
 - 2. Shop drawing indicating dimensions, required clearances and location and size of each field connection
 - 3. Power and control wiring diagram
 - 4. Pump curves and variable speed pump curves
 - 5. Pump data sheets - Rated capacities of selected model and indication of pump's operating point on curves.
 - 6. Submittals on furnished specialties and accessories
- D. Support requirements should follow the recommendations in the manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.

- B. Ensure pump operation at specified system fluid temperatures without vapor binding and cavitation, is non-overloading in parallel or individual operation, and operates to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.
- C. Ensure pump pressure ratings are at least equal to system's maximum operating pressure at point where installed but not less than specified.
- D. Equipment manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment.
- E. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Materials damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- B. Store materials in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- C. Use all means necessary to protect equipment before, during, and after installation.
- D. All scratched, dented, and otherwise damaged units shall be repaired or replaced as directed by the Engineer.

1.7 WARRANTY

- A. Provide a minimum one (1) year warranty on materials and installation.

PART 2 – PRODUCTS

2.1 PUMP AND MOTOR

- A. Contractor shall furnish and install new end suction, base-mounted primary pumps for chilled water system as shown on the Drawings.
- B. The pumps shall be long coupled, base mounted, single stage, end suction, vertical split case design, in cast iron stainless steel fitted, specifically designed for quiet operation.

- C. Maximum operating temperature and pressure: 225°F and 175 psig working pressure
- D. The pumps shall be composed of three separable components a motor, bearing assembly, and pump end (wet end). The motor shaft shall be connected to the pump shaft via a replaceable flexible coupling.
- E. A bearing assembly shall support the shaft with two heavy-duty regreaseable ball bearings. Bearing assembly shall be replaceable without disturbing the system piping and shall have foot support at the coupling end. Pump bearings shall be regreaseable without removal of the bearings from the bearing assembly. Thermal expansion of the shaft toward the impeller shall be prevented via an inboard thrust bearing.
- F. The bearing assembly shall have a solid SAE1144 steel shaft. A Type 316 stainless steel shaft sleeve shall be employed to completely cover the wetted area under the seal.
- G. Pump shall be equipped with an internally-flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Application of an internally flushed mechanical seal shall be adequate for seal flushing without requiring external flushing lines. Seal assembly shall be Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary silicon carbide face.
- H. Bearing assembly shaft shall connect to a stainless-steel impeller. Impeller shall be both hydraulically and dynamically balanced to ANSI/HI 9.6.4-2009, balance grade G6.3 and secured by a stainless-steel locking capscrew or nut.
- I. Pump should be designed to allow for back pull-out allowing access to the pump's working components, without disturbing motor or piping, for ease of maintenance.
- J. A center drop-out type coupling, capable of absorbing torsional vibration, shall be employed between the pump and motor. Pumps for variable speed application shall be provided with a suitable coupling sleeve. Coupling shall allow for removal of pump's wetted end without disturbing pump volute or movement of the pump's motor and electrical connections. On variable speed applications the coupling sleeve should be constructed of an neoprene material to maximize performance life.
- K. An ANSI and OSHA rated coupling guard shall shield the coupling during operation. Coupling guard shall be dual rated ANSI B15.1 and OSHA 1910.219 compliant coupling guard and contain viewing windows for inspection of the coupling. No more than .25 inches of either rotating assembly shall be visible beyond the coupling guard.
- L. Pump volute shall be of a cast iron design with integrally cast pedestal volute support, rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges. Volute shall have internal aluminum bronze volute wear rings

and shall include gauge ports at nozzles, and vent and drain ports.

- M. Motor shall be TEFC, 460V, 3 phase, 60 Hz Premium NEMA Efficient motor.
- N. Pump and motors shall be factory aligned and shall be realigned after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve.
- O. Base plate shall be of structural steel or fabricated steel channel configuration fully enclosed at sides and ends, with securely welded cross members and fully open grouting area (for field grouting). The minimum base plate stiffness shall conform to ANSI/HI 1.3.8.2.1- 2009 for grouted Horizontal Baseplate Design standards.
- P. The pump(s) vibration limits shall conform to Hydraulic Institute ANSI/HI 9.6.4-2009 for recommended acceptable unfiltered field vibration limits (as measured per ANSI/HI 9.6.4-2009 Figure 9.6.4.2.3.1) for pumps with rolling contact bearings.
- Q. Each pump shall be hydrostatically tested 1.5 times the maximum rated working pressure and name-plated before shipment.
- R. Pump shall conform to ANSI/HI 9.6.3.1-2012 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.

2.2 MANUFACTURER

- A. Pumps shall be Model e-1510 4BD as manufactured by Bell & Gossett or Engineer approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. All components shall be installed in accordance with manufacturer's installation instructions.
- B. Reduction from line size to pump connection size shall be made with eccentric reducers attached to the pump with tops flat to allow continuity of flow.
- C. Furnish and install valves and a suction diffuser as shown on the Drawings.

3.1 SYSTEMS DEMONSTRATION

- A. Prior to final inspection, demonstrate satisfactory operation of each system to Engineer. Provide technical representative for start-up and acceptance testing for up to two 8-hour days, exclusive of travel time.

3.2 INSTRUCTION OF CITY PERSONNEL

- A. Instruct City personnel in operation, adjustment, and maintenance of equipment and systems, using operation and maintenance data as the basis of instruction.

****END OF SECTION****

11072 – CHILLED WATER SECONDARY PUMPS

PART 1 – GENERAL

1.1 SCOPE

A. Provide Chilled Water Secondary Pump and required system trim for heating, chilled water, and dual temperature water systems including all related appurtenances for a complete and operating system. Pumps shall be double-suction, vertical split case, base-mounted and described herein.

B. Design Criteria for Secondary Pumps

Tag Nos.: 70-P-04, 70-P-05

Duty Point: 1040 gpm @ 175 ft

Second Operating Point: 1700 gpm @ 140 feet

Shut Off Head: 190 feet

Pump Speed: 1775

Maximum Horsepower: 75

1.2 RELATED SECTIONS

A. Drawings and general provisions of the Contract, including General and supplementary Conditions and Division 1 Specification Sections, apply to these sections:

1. Section 01080 - Construction Sequencing
2. Section 09900 - Painting and Coating
3. Section 11060 - Equipment Installation
4. Section 11070 – Variable Speed Screw Water Chillers
5. Section 11075 – Ancillary Equipment and Appurtenances
6. Section 16040 - Electric Motors

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. HI - Hydraulic Institute.
- B. ANSI - American National Standards Institute.
- C. OSHA - Occupational Safety & Health Administration.
- D. ASHRAE – American Society of Heating, Refrigeration and Air-Conditioning Engineers.
- E. NEMA - National Electrical Manufacturers Association.

- F. UL - Underwriters Laboratories.
- G. ETL - Electrical Testing Laboratories.
- H. CSA - Canadian Standards Association.
- I. NEC - National Electric Codes.
- J. ISO - International Standards Organization.
- K. IEC - International Electrotechnical Commission.
- L. ASME – American Society of Mechanical Engineers.

1.4 SUBMITTALS

- A. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts lists.
- B. Product Data including certified performance curves and rated capacities of selected model, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate pump's operating point on curves.
- C. Complete Package Information Product Data including:
 - 1. System summary sheet
 - 2. Shop drawing indicating dimensions, required clearances and location and size of each field connection
 - 3. Power and control wiring diagram
 - 4. Pump curves and variable speed pump curves
 - 5. Pump data sheets - Rated capacities of selected model and indication of pump's operating point on curves.
 - 6. Submittals on furnished specialties and accessories
- D. Support requirements should follow the recommendations in the manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- A. All equipment or components of this specification section shall meet or exceed the requirements and quality of the items herein specified, or as denoted on the drawings.

- B. Ensure pump operation, at specified system fluid temperatures without vapor binding and cavitation, is non-overloading in parallel or individual operation, and operates to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.
- C. Ensure pump pressure ratings are at least equal to system's maximum operating pressure at point where installed but not less than specified.
- D. Equipment manufacturer shall be a company specializing in manufacture, assembly, and field performance of provided equipment.
- E. Equipment provider shall be responsible for providing certified equipment start-up and, when noted, an in-the-field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the site in such a manner as to protect the materials from shipping and handling damage. Provide materials on factory provided shipping skids and lifting lugs if required for handling. Materials damaged by the elements should be packaged in such a manner that they could withstand short-term exposure to the elements during transportation.
- B. Store materials in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage.
- C. Use all means necessary to protect equipment before, during, and after installation.
- D. All scratched, dented, and otherwise damaged units shall be repaired or replaced as directed by the Architect Engineer.

1.7 WARRANTY

- A. Provide a minimum one (1) year warranty on materials and installation.

PART 2 – PRODUCTS

2.1 PUMPS AND MOTORS

- A. Contractor shall furnish and install new double suction vertically split case pumps for chilled water cooling system as shown on the Drawings.
- B. The pumps shall be long-coupled, base mounted, single stage, double suction, vertical split case design suitable for standard operations at 300° F and 175 psig working pressure.

- C. The bearing housing shall supply support for heavy-duty single row permanently lubricated ball bearings, with flushing provision. Polyurea grease, capable of handling both high and low temperatures and that is resistant to washout and condensation shall be provided. The bearings shall be capable of absorbing both radial and thrust loads and maintaining the rotating element in proper axial alignment. Bearings shall be capable of being inspected and repaired by removal of only a bearing bracket.
- D. The impeller shaft shall be of solid 1045 steel with 316 SS sleeves covering the wetted area of the shaft.
- E. Mechanical seal assemblies shall be unitized, single spring, EPR elastomer bellows with drive ring, Carbon face rotating against a stationary Silicon Carbide face.
- F. Impeller shall be of the enclosed double suction type made of low zinc silicon brass, both hydraulically and dynamically balanced to ISO 1940-1:2003 balance grade G6.3 and keyed to the shaft.
- G. A spacer coupling, capable of absorbing torsional vibration and of operating in variable speed applications, shall be employed between the pump and motor. The spacer coupling shall allow for removal of pump's wetted end without disturbing pump volute or movement of the pump's motor and electrical connections.
- H. A coupler guard shall shield the coupler during operation. It shall be an ANSI B15.1 and OSHA 1910.219 compliant coupling guard with viewing windows for inspection of the coupling. No more than .25-inch opening in the guard around the rotating assembly shall be visible.
- I. Pump volute shall be of a cast iron ASTM A159 material design with an integrally cast pump discharge and an integrally cast pump suction. Flanges shall be extra heavy-duty design and will be of 250# thickness while capable of being drilled for 125# ANSI flat face use. Volute shall have integrally cast support feet, gauge ports at nozzles, and vent and drain ports. Volute shall have internal aluminum bronze wear rings.
- J. Motor shall be TEFC, 460V, 3 phase, 60 Hz Premium NEMA Efficient motor.
- K. Pump and motors shall be factory aligned and shall be realigned after installation by the manufacturer's representative. Motors shall be non-overloading at any point on the pump curve.
- L. Base plate shall be welded structural steel fully enclosed at sides and ends, with securely welded cross members. The minimum base plate stiffness shall conform to ANSI/HI 1.3-2000, section 1.3.5.3 for *Horizontal Base Plate Design* standards. First modal frequency of the base shall be no less than 20% higher than the maximum operating speed (29.7 Hz at 1780RPM) of the unit.

- M. The pump(s) vibration limits shall conform to Hydraulic Institute ANSI/HI 1.1-1.5, section 1.4.6.1.1 for recommended acceptable unfiltered field vibration limits (as measured per HI 1.4.6.5.2, Figure 1.108) for pumps with rolling contact bearings. Pump manufacturer shall be ISO-9001 certified.
- N. The seismic capability of the pump shall allow it to withstand a horizontal load of 0.5g, excluding piping and/or fasteners used to anchor the pump to mounting pads or to the floor, without adversely affecting pump operation.
- O. Each pump shall be hydrostatically tested and painted with one coat of high quality factory approved paint and name-plated before shipment from the factory.

2.2 MANUFACTURER

- A. Pumps shall be Model 4 x 6 x 17 1/2 VSC as manufactured by Bell & Gossett or Engineer approved equal.

PART 3 – EXECUTION

3.1 SYSTEMS DEMONSTRATION

- A. Prior to final inspection, demonstrate satisfactory operation of each system to Engineer. Provide technical representative for start-up and acceptance testing for up to two 8-hour days, exclusive of travel time.

3.2 INSTRUCTION OF CITY PERSONNEL

- A. Instruct City personnel in operation, adjustment, and maintenance of equipment and systems, using operation and maintenance data as the basis of instruction.

****END OF SECTION****

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SECTION 11075 ANCILLARY EQUIPMENT AND APPURTENANCES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes all labor, material, tools, incidentals, and equipment necessary to furnish and install ancillary equipment and piping and appurtenances for the chilled water system as specified herein and as shown on the Contract Drawings.

B. Major Ancillary Equipment Summary

70 AS 01	Air Separator with Vent
70 ET 01	Expansion (Bladder) Tank
70 CP 01	Chemical Pot Feeder

C. Pump and Ancillary Equipment Appurtenances

1. High capacity air vent
2. Expansion tank air charging vent
3. Expansion tank purge valve
4. Automatic air vent
5. Water make-up station fill pressure reducing valve
6. Suction diffuser
7. Strainers
8. Wafer style check valve
9. Butterfly valve
10. Flexible hose connectors
11. Pipe union

1.2 RELATED SECTIONS

- A. Section 01600 - General Equipment Provisions
- B. Section 01650 - Startup Requirements
- C. Section 01730 - Operation and Maintenance Data
- D. Section 09900 - Painting and Coating

- E. Section 11060 - Equipment Installation
- F. Section 11070 - Variable Speed Screw Water Chillers
- G. Section 11071 - Chilled Water Primary Pumps
- H. Section 11072 - Chilled Water Secondary Pumps
- I. Section 13329 – Primary Sensors and Field Instrumentation
- J. Section 15100 - Valves
- K. Section 15140 - Pipe Supports

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. ASME – American Society of Mechanical Engineers.
- B. ANSI – American National Standards Institute.
- C. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers

1.4 SUBMITTALS

- A. Submit data cover sheet
- B. Manufacturer’s catalog cut sheet or shop drawings with dimensions
- C. Manufacturers’ product data
- D. Materials of construction
- E. Installation, operation & maintenance manual.

1.5 UNIT RESPONSIBILITY

- A. To assure a properly integrated and chilled water system, ancillary equipment described in this section shall be furnished by the same vendor, who shall assume full responsibility for the proper operation of the chilled water primary and secondary pumps and the associated ancillary equipment.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Air Separator and Appurtenances

1. Contractor shall furnish, install and make ready for operation an air separator (70 AS 01) and appurtenances. The air separator shall be designed to collect and release entrained air in the chilled water primary system. The air separator will be an ASME vessel designed with tangential flanged openings.
 2. The Air Separator shall be designed, constructed, and stamped in accordance with section VIII, Division I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. Flange end connections should be designed according to ANSI Standards.
 3. The air separator shall incorporate the following design features:
 - a. Threaded air removal connection on top of the unit so an air vent or expansion/compression tank can be connected, allowing collected air to be removed from the unit.
 - b. Carbon steel perforated baffle with 3/16" perforations and 51% open area
 - c. Removable 304 stainless steel perforated strainer with 3/16" perforations and 51% open area
 4. Materials of Construction: cast iron or carbon steel
 5. Design Criteria:
 - a. Capacity: 1900 gpm
 - b. Flange Size: 8 inches
 - c. Maximum Working Pressure: 125 psi
 - d. Maximum Temperature Rating: 350°F
 - e. NPT end connections: See Drawings
 - f. Model No.: Rolairtrol RL-8F
 6. Manufacturer: Bell & Gossett or Approved Equal
- B. Air Separator Appurtenances
1. High Capacity Air Vent
 - a. Materials of Construction: Cast Iron
 - b. Inlet and Outlet Size (inches): 3/4 FNPT inlet and 1/2" FNPT outlet
 - c. Maximum Working Pressure (psi): 150
 2. Manufacturer: Bell & Gossett or Approved Equal
- C. Expansion Tank
1. Contractor shall furnish, install and make ready for operation an ASME rated pre-charged bladder-type expansion tank (70 ET 01) for use in the chilled water primary loop. The expansion tank will be fitted with a system

connection, an air charging valve, lifting ring, drain and system connections. The tank shall be located per the Drawings.

2. The expansion tank shall be equipped with a heavy-duty butyl rubber bladder containing water on the inside. The tank will be pre-charged to 12 psi at the factory.
3. Design Criteria:
 - a. Volume: 53 gallons
 - b. Size: 24 inches in diameter by 37 inches tall
 - c. Materials of Construction:
 - d. Tank: Carbon steel
 - e. Bladder: Heavy duty butyl rubber
 - f. Design Standard: ASME Section VIII, Division 1
 - g. Maximum Design Pressure 125 psi
 - h. Design Temperature: 240 °F
4. Expansion Tank Appurtenances:
 - a. Tank purge valve (TPV) is a combination full port shut-off valve and drain valve with a tank connection, system connection and two 1/4" NPT pipe plugs for draining. The TPV shall include a 5/8" hose connection.
 - 1) Materials of construction:
Valve Body: Brass
Ball: Chrome Plated
Ball Seal: Teflon
Stem: Explosion Proof
O-Rings: EDPM
 - 2) Size: 1" NPT
System Connection: 1" Female SWT
Tank Connection: 1" Male NPT
Maximum Operating Pressure: 400 psi
Maximum Temperature: 250 °F
 - 3) Model No. TPV 1 SM
 - b. Automatic Air Vent is designed to vent troublesome air.
 - 1) Materials of construction:
Valve Body: Brass
Internals:
 - 2) Materials of construction:
Valve Body: Brass
Internals: Non-ferrous
 - 3) Model No. 87
 - c. Pressure Gauge – See Section 17329
 - d. Air Charging Vent

- 1) Design Criteria:
- 2) Maximum Working Pressure: 150 psi
- 3) Body Material: Cast Iron
- 4) Dimensions (height and width in inches): 4-3/4" – 1/4"
- 5) Model No. 87

3. Manufacturer: Bell & Gossett or Approved Equal

D. Chemical Pot Feeder

1. A new chemical pot feeder will replace the existing, (70 CP 01) and will be a 6.3-gallon carbon steel vessel designed for a maximum pressure of 200 psi. The chemical pot feeder will have a dome bottom with bypass feeder. Any necessary chemicals will be added to the pot and valving will be aligned to allow a small amount of flow from the discharged side of the primary pumps to the return side to move the chemical into the CW system.

2. Design Criteria:

- a. Volume (gal): 6.3
- b. Dimensions (inches wide by inches tall): 10 X 23
- c. Model No.: DB-5HD

3. Manufacturer: J. L. Wingert Co or Approved Equal

E. Suction Diffuser

1. A suction diffuser shall be installed upstream of the primary chilled water pumps. The suction diffuser is used to provide optimal flow conditions to the pump.

2. The suction diffuser shall have the following:

- a. Flow Cone to eliminate recirculation.
- b. A full-length, 4-plane, removable straightening vane.
- c. A fully-removable orifice cylinder with 3/16-inch perforations and 51% open area.
- d. A full length removable start-up strainer.

3. Materials of Construction:

- a. Body: Cast Iron or Ductile Iron
- b. Straightening Vanes: Carbon steel
- c. Orifice Cylinder: Carbon steel
- d. Removable start-up strainer: 16 mesh bronze wire

4. Flange ends up to 175 psi maximum working pressure
Maximum working temperature: 250°F

5. Manufacturer: Bell and Gossett or Approved Equal
- F. Strainer – Upstream of Primary Pumps
1. The strainer shall be located upstream of both the primary and secondary chilled water pumps.
 2. The strainer shall have the following:
 - a. Blow off at 22.5° with plug
 - b. C_v of 952 for a 6-inch flange unit, where C_v is the flow rate in gallons of 60 °60 water that will pass through the strainer in 1 minute at 1 psi pressure drop.
 - c. C_v of 1580 for an 8-inch flange unit
 - d. Ports: Two 3/8" ports for differential pressure measurement and one 1" dry well port
 3. Materials of Construction:
 - a. Body, Flange, Cover Plate: Cast Iron
 - b. Screen: 304 Stainless Steel
 - c. Perforation Size: 0.125 inches
 - d. O-ring: Viton
 4. Flange size per Drawings
 - a. Flange type: 125 lb ANSI
 - b. Maximum Working Pressure: 175 psi
 - c. Maximum Working Temperature: 150°F
 5. Manufacturer: Model No. LPD by Metraflex or Approved Equal
- G. Strainer – Upstream of Water Chiller
1. Strainers shall be Y-type for potable and nonpotable water service
 2. Ends: 2 inches and greater – flanged
 3. Body: 125 lbs. Class Cast Iron Wye Strainer
 4. Screen: Type 304 stainless steel, 40 Mesh.
 5. Manufacturer:
- H. Check Valve
1. Check valves shall be of the wafer style, center-guided, silent, non-slam type. A mating flange with full gasket shall be installed with the check valve.

2. All check valve component parts shall be field replaceable.
3. Materials of Construction:
 - a. Body: Cast Iron
 - b. Disc and Seat: Bronze
 - c. Spring: Stainless Steel
4. Valve flange size per Drawings
 - a. ANSI B16.1 Class 125/250
 - b. Mating flange size per Drawings and to match valve
 - c. ANSI 16.1 Class 125/250 with full bolt hole gasket
5. Maximum Working Pressure and Temperature: 175 psi and 150°F
6. Manufacturer: Model No. CVO700-DINC by Metraflex or Approved Equal

I. Butterfly Valve

1. Butterfly valves shall be lug body style.
2. Materials of Construction:
 - a. Body: Cast Iron
 - b. Liner: EDPM
 - c. Disc: Ductile Iron with Nickel Coating
 - d. Upper Stem: ASIA 420 Stainless Steel
 - e. Lower Stem: ASIA 420 Stainless Steel
 - f. Upper Stem Bearing: PTFE
 - g. Upper Stem O-Ring: EDPM
 - h. Lower Stem O-Ring: EDPM
 - i. Lower Stem Set Screw: ASTM A-582 Steel
 - j. Position Plate: Carbon Steel
3. Flange size per Drawings
4. Maximum Working Pressure and Temperature: 200 psi and 250 °F.
5. Manufacturer: Model BW/BL by Metraflex or Approved Equal

J. Flexible Hose Connectors

1. Provide flexible hose connectors as indicated on the contract drawings. Flexible hose connectors shall be capable of compensating for lateral movement and vibration. Flexible hose connectors shall be manufactured complete with section of corrugated metal house, compatible braid, with inlet and outlet connections as required.

2. Materials of Construction:
 - a. Corrugated Hose: 304 Stainless Steel
 - b. Braid: 304 Stainless Steel
 3. Flange size per Drawings
 4. Maximum Working Pressure and Temperature: 200 psi and 250 °F.
 5. Manufacturer: METRA_MINI by Metraflex or Approved Equal
- K. Water Fill Connection Pressure Reducing Valve – Contractor shall furnish and install a fast-fill dual pressure reduction valve/ relief valve to provide fast fill function with fill overpressure protection. The valve shall be of the fast fill type and have a cleanable strainer, a corrosion resistant seat and a large diaphragm for positive action. The valve shall be installed in the location as shown on the Drawings.
1. Materials of Construction:
 - a. Valve Body: Brass
 - b. Wetted Parts: Corrosion Resistant
 - c. Pressure Reducing Setting Range: 12 with 10 to 25 psi adjustable range
 - d. Pressure Relief Valve Setting Range: 30 psi setting with 20 to 40 psi adjustable range
 - e. Maximum Operating Temperature: 225°F
 - f. Maximum Operating Pressure: 125 psi
 - g. Valves ends: ½” sweat/NPT
 2. Manufacturer: Bell & Gossett or Approved Equal
- K. Pipe Union
1. Screw unions may be employed on pipelines 2-1/2-inches in diameter and smaller. Pipes and fittings made of non-ferrous metals shall be isolated from ferrous metals by nylon insulating pipe bushings, unions or couplings manufactured by Smith-Blair, Pipe Seal and Insulator Co. or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install piping specialties in accordance with manufacturer's instructions.
- B. PAINTING
 1. Clean and prime coat ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900 Painting and Coating.

2. Coat machined, polished and non-ferrous surfaces bearing surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.
3. Field painting per Section 09900 Painting and Coating

****END OF SECTION****

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SECTION 13010 - INSTRUMENTATION AND CONTROLS - GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE

A. Work Included:

1. Provide all tools, equipment, materials, and supplies and be responsible for all labor required to complete the installation, startup and operational testing of the Area 70 chill water control system as indicated on the Drawings and as specified herein and other technical sections.
2. Provide all the necessary equipment components and interconnections along with the services of manufacturers' engineering representatives necessary to ensure the City receives a completely integrated and operational Instrumentation and Control (I&C) system as herein specified.
3. Provide all terminations for wiring at field mounted instruments, equipment enclosures, alarm, and status contacts.
4. Provide all Instrumentation and Control wire required for a fully functioning I&C system as shown on the Drawings except for wire specifically specified in Division 16.
5. Provide all terminations for power and control wiring, control cables, and Ethernet cables to terminate in the Chill Water System Custom Application Controller (CAC) at terminal blocks, switches, Ethernet connections, etc. Check and confirm continuity of field wiring, control cables, serial and Ethernet cables between instruments, chiller skids, and CAC.
6. System integration, to be performed by the City or contractors and consultants working directly for the City.
 - a. Modifications to City DCS (PCM) and Ovation programming.
7. Provide panel drawings and loop diagrams described herein. Provide a complete and accurate Ethernet map of the chilled water custom control panel (CAC-3) for network signals to the remote DCS (70-PCM-01)

B. Work Specified in Other Divisions:

1. Process piping and other mechanical work and equipment as specified in Divisions 11 or 15.
2. Instruments and controls which are not directly used for process control, i.e., those provided as part of a package system, such as a chiller skid, etc. as specified in Divisions 11, 15, or 16.

3. Division 16 Work, including all instrumentation and controls conduit, and only that wire specified in Division 16. Refer to Division 16 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.

1.2 RESPONSIBILITIES

- A. Provide all engineering, documentation, labor, and materials required to resolve signal, power, or functional incompatibilities between the wiring and cable points of termination in the CAC and interfacing devices. This includes all interface to existing instruments and equipment.
- B. As a minimum, the Contractor shall perform the following work:
 1. Prepare analog and digital hardware submittals
 2. Procure hardware
 3. Fabricate panels
 4. Perform factory tests on panels
 5. Perform bench calibration and verify calibration after installation
 6. Oversee and certify installation
 7. Oversee, document, and certify loop testing
 8. Oversee, document, and certify system commissioning
 9. Conduct the performance test
 10. Prepare Owner's Manuals
 11. Conduct training classes
 12. Prepare record drawings
- C. Integration of the chill water control system with instrumentation and control devices being provided under other sections:
 1. Resolve signal, power, or functional incompatibilities between the points of termination at the RTU and interfacing devices.

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. American National Standard Institute (ANSI) Publications:

Y14.15a	Drafting Practice
C62.1	Surge Arrestors

B. Instrumentation Society of America (ISA) Publications:

- S5.4 Instrument Loop Diagrams
- S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

1.4 SUBMITTALS

A. General: It is incumbent upon the Contractor to coordinate the work specified in these Sections so that a complete instrumentation, communication networks and control system for the Area 70 chill water system will be provided and will be supported by accurate shop and record drawings. As a part of its responsibility the Contractor shall prepare and submit complete and organized shop drawings, as specified herein. Interface between instruments, existing control panels, motor control centers, starters, control valves, flowmeters, variable frequency drives, and other equipment related to the instrumentation and control system shall be included in the shop drawing submittal.

1. In these Contract Documents all systems, meters, instruments, and other elements are represented schematically, and are designated by numbers, as derived from criteria in Instrument Society of America Standard ANSI/ISA S5.1. The Contractor shall assign nomenclature and instrument tags on their submittal drawings. ANSI nomenclature and numbers shall be employed exclusively throughout shop drawings, data sheets, computer programming and similar materials. Any other symbols, designations, and nomenclature unique to the manufacturer's standard methods shall not replace those prescribed above.
2. Should an error be found in a shop drawing during installation or startup of equipment, the correction, including any field changes found necessary, shall be noted on the drawing and submitted finally "as-built" prior to acceptance of the project.
3. The Contractor shall respond to all comments on shop drawing resubmittals made by the City either by making the noted correction or stating why it was not revised. Any resubmittal received by the City, which do not contain responses to the City's previous comments, shall be returned to the Contractor marked "rejected." No further review by the City shall be performed until the Contractor responds to these comments.

B. Submittals:

1. Control System Hardware: This submittal to include instrumentation and control panels shall be included in a singular, all-inclusive submittal which shall include but not be limited to:
 - a. A complete index appearing in the front of each bound submittal volume. Labeled tags shall separate system groups.

- b. Panel, and cabinet layout drawings shall be prepared, and they shall include the following information:
 - 1) Front, side, and plan views to scale.
 - 2) Dimensions.
 - 3) Arrangement (interior and exterior).
 - 4) Mounting information, including conduit entrance locations.
 - 5) Finish data.
 - 6) Tag number and functional name of items mounted in and on panel, console and cabinet.
 - 7) Nameplate legend which includes text, letter size, and colors to be used
- c. Installation, mounting, and anchoring details for all components and assemblies, including access requirements and conduit connection or entry details.
- d. Panel wiring diagrams shall be prepared and integrate the field wiring. They shall include the following information:
 - 1) Name of panel.
 - 2) Wiring sizes and types.
 - 3) Terminal strip numbers.
 - 4) Functional name and manufacturer's designation for items to which wiring is connected.
 - 5) Electrical control schematics in accordance with ANSI standards.
- e. Field wiring diagrams shall be prepared and be integrated with the panel-wiring diagram. They shall include the following information:
 - 1) Wire and piping sizes and types to existing and new field devices.
 - 2) Conduits in which wiring is to be located.
 - 3) Panel termination strip numbers.
 - 4) Location, functional name, and manufacturer's designation of items to which wiring, and piping are connected.
- f. Drawings showing schematic diagrams for control circuits. Complete details on the circuit interrelationship of all devices within and outside each Control Panel shall be submitted using schematic control diagrams. The diagrams shall show numbered terminals on components together with the unique number of the wire to be connected to each terminal. The diagrams shall also show terminal assignments from all primary measurement devices, such as flowmeters, and to all final control devices, such as samplers, pumps, valves and chemical feeders. The Contractor shall furnish all necessary equipment suppliers' shop drawings to facilitate inclusion of this information for the System Integrator.
- g. Interface with existing control and monitoring system. This shall include any and all modifications made to existing measurement

and control circuits, equipment and wiring, that are at the site but not indicated on the plan drawings, as applicable to this project. The plans primarily indicate new field devices and not necessarily extension of existing field wiring. It is the responsibility of the Contractor to ascertain actual field conditions of the existing circuits, equipment and wiring. The City will provide to the Contractor copies of all drawings and data the City can find showing such existing conditions. The City makes no representation as to the completeness or correctness of any such drawings and data and cannot guarantee that complete or partial data exists for any of the facilities included in this contract. Lack of such drawings or detail shall not alleviate the contractual responsibility to ascertain and implement interfaces and modifications to existing measurement and control circuits, equipment and wiring. The existence of the electrical drawings reflecting existing control and monitoring functions within these contract documents are for guidance only and do not relieve the Contractor from meeting the requirements stated herein.

- h. Complete and detailed bills of materials: A bill of material list, including quantity, description, manufacturer, and part number, shall be submitted for each field mounted device or assembly, cabinet assemblies and subassemblies. Bills of material shall include all items within an enclosure.
 - i. Data sheets for each component, together with a technical product brochure or bulletin: The data sheets shall show:
 - 1) Component functional description used herein and on the Drawings;
 - 2) Manufacturer's model number or other product designation;
 - 3) Project system or loop of which the component is a part;
 - 4) Project location or assembly at which the component is to be installed;
 - 5) Requirements for electric supply (if any);
 - 6) Special requirements or features, such as specifications for ambient operating conditions.
 - 7) Features and options which are furnished.
 - j. A list of recommended spare parts covering items which are furnished under this Contract with the name, address, and phone number of manufacturer and manufacturer's local service representative of these parts.
- 1. Report Submittal: Six (6) sets of sample reports shall be supplied to the Engineer for review. The submittal shall include a short description of the methods and procedures to be performed by operators to print the reports including the automatic reporting capabilities.
 - 2. Test Reports: The Contractor shall provide reports detailing the results of tests performed on the system including the Field Functional Test Report. Three (3) sets shall be provided of each report.

3. Start-up Test Procedure Submittal: The Start-up Test Procedure Submittal shall be included in a singular all-inclusive package which shall include but not be limited to:
 - a. The proposed procedures to be followed during start-up of the Control System and its components.
 - b. The forms and checklists needed to document the completion of a successful start-up.

4. Technical Manuals: Four (4) final sets of technical manuals shall be supplied for the City in accordance with Division 1 and two (2) additional final sets shall be supplied for the City, as a condition of acceptance of the project. Two sets shall consist of 1 or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3 inches. The other four sets will be recorded on CD ROM in PDF format.
 - a. Initially, 3 sets of these manuals shall be submitted to the Engineer for review after return of favorably reviewed shop drawings and data required herein. Following the City's review, one set will be returned to the Contractor with comments. The sets shall be revised and/or amended as required and the requisite final sets shall be submitted to the City 15 days prior to startup of systems. The City will distribute the copies.
 - b. In addition to updated shop drawing information reflecting actual existing conditions, each set of technical manuals shall include installation, connection, operating, calibration, set points (e.g., pressure, pump control, time delays, etc.) adjustment, test, troubleshooting, maintenance and overhaul instructions in complete detail. This shall provide the City with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded or other detailed views of all instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.
 - c. This manual shall be provided prior to project acceptance.
 - d. Security Manual: The Contractor shall furnish a document identifying all security access codes (username, passwords) assigned in the as-built system. This document shall be provided as a separate item.
 - e. This manual shall be provided prior to project acceptance.
 - f. As Built Shop Drawings: Shop drawings shall be updated to reflect actual as-built conditions.
 - g. This manual shall be provided prior to system acceptance.

5. Record Drawings: The Contractor shall keep current a set of complete schematic diagrams that shall include all field and panel wiring. These drawings shall include all of the hardwired signals shown on the P&ID drawings. One set of drawings electronically formatted in AutoCad (DWG)

and two hard copies shall be submitted after completion of all field functional tasks but prior to acceptance of the completed work by the City.

1.5 QUALITY ASSURANCE

- A. Standard of Quality: The Contractor shall provide equipment of the types and sizes specified which has been demonstrated to operate successfully. Provide equipment which is new and of recent proven design.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element that could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Notify the City in writing in the event that any equipment or material is damaged. Obtain prior favorable review by the City before making repairs to damaged products

1.7 WARRANTY

- A. Correction of Defects: The Contractor shall correct all defects in the contractor-supplied Control System upon notification from the City for a period of one year from the date of Acceptance Test Completion. Mechanical corrections shall be completed within 5 days of notification. Programming issues shall be corrected within 24 hours.

1.8 DRAWINGS

- A. Drawings: The Instrumentation Drawings are diagrammatic; exact locations of instrumentation products shall be determined in the field. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
- B. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, and ground wells are approximate unless dimensioned; verify locations with the CONSTRUCTION MANAGER prior to installation. Field verify scaled dimensions on Drawings.
- C. Review the Drawings and Specification Divisions of other trades and perform the instrumentation work that will be required for the installations.
- D. Should there be a need to deviate from the Instrumentation Drawings and Specifications, submit written details and reasons for all changes to the City for favorable review.
- E. Resolution of varying interpretations of the Contract Documents shall conform to Division 1, General and Supplementary Conditions.

- F. The Drawings provide details of installation and supersede the manufacturer's recommendation where a conflict exists.
- G. Provide panel and loop drawings for the chill water custom control panel (CAC-3). Diagrams shall include power distribution, internal terminal labeling, field terminal block labeling, and field instrument terminal numbers and tags

PART 2 – PRODUCTS

2.1 MATERIALS AND STANDARD SPECIFICATIONS

- A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to insure instruments and equipment are of a uniform quality and manufacture throughout the plant. All instruments in the plant of the same type shall be made by the same manufacturer.

2.2 NAMEPLATES

- A. For each piece of equipment, provide a manufacturer's nameplate showing their name, location, the pertinent ratings and the model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the City, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the City upon prior request by the Contractor.
- C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the City.
- D. Provide CAUTION or SAFETY nameplates to alert operators of special conditions that may result in faulty equipment operations. Devices containing batteries that must be replaced periodically must be clearly identified. Nameplates are not required if the device senses and displays a low battery warning.
- E. Provide arc flash labeling on new VFD's and at each chiller control panel.

2.3 NAME TAGS

- A. All instrumentation and equipment items or systems shall be identified by name tags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Instrument Schedule.
- B. Name tags shall be stainless steel with engraved or stamped black characters of 3/16-inch minimum height. Tags shall be attached to equipment with a tag holder

and stainless-steel band with a worm screw clamping device. Use 20-gauge stainless steel wire where banding is impractical. For field panels or large equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

2.4 FIELD-MOUNTED EQUIPMENT

- A. All instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120 Vac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of ANSI C62.1.

2.5 EQUIPMENT OPERATING CONDITIONS

- A. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:
 - 1. Electrical Power: 120 Vac \pm 10%, 60 Hz, unregulated, except where specifically stated otherwise on the Drawings or in the Specifications, or when two-wire, loop-powered devices are specified.
 - 2. Field Instruments:
 - a. Outdoor Areas:
Ambient Temperature: +15°F to +120°F
Ambient Relative Humidity: 5% to 100%
Weather: Rain, and ice
 - b. Indoor Unheated Areas:
Ambient Temperature: +40°F to +120°F
Ambient Relative Humidity: 5% to 95%, non-condensing
 - c. Indoor Environmentally Controlled Areas:
Ambient Temperature: +60°F to +104°F
Ambient Relative Humidity: 10% to 90%, non-condensing

2.6 EQUIPMENT LOCATIONS

- A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 16. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 4X gasketed cases unless noted otherwise on the Drawings.

2.7 CURRENT TECHNOLOGY

- A. All meters, instruments, and other components shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.

2.8 LOOP ACCURACY

- A. The accuracy of each instrumentation system or loop shall be determined as a probable maximum error; this shall be the square-root of the sum of the squares of certified "accuracies" of the designated components in each system, expressed as a percentage of the actual span or value of the measured variable. Each individual instrument shall have a minimum accuracy of plus and minus 0.5 percent of full scale and a minimum repeatability of plus and minus 0.25 percent of full scale unless otherwise indicated. Instruments which do not conform to or improve upon these criteria are not acceptable.

2.9 SIGNAL ISOLATORS, CONVERTORS, AND CONDITIONERS

- A. Ensure that input-out signals of all instruments and control devices are compatible. Provide signal isolators and converters as necessary to obtain the required system performance. Mount the devices in the field at point of application. Provide items as manufactured by AGM or equal.

2.10 ANALOG SIGNAL INDICATED UNITS

- A. For all instruments with local or remote indicators, provide indicators scaled in actual engineering units, i.e., gallons per minute, feet, psi, etc., rather than 0 to 100%, unless noted otherwise on the Drawings or Instrument Schedule.

2.11 SIGNAL TRANSMISSION

- A. Analog:
 - 1. Signal transmission between electric or electronic instruments shall be 4-20 mA and shall operate at 24 Vdc. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating.
 - 2. Nonstandard transmission systems such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted in the Instrument Schedule or shown on the Drawings. When transmitters with nonstandard outputs do occur, their output shall be converted to 4-20 mA prior to transmission.
- B. Discrete: All alarm and status signals shall be 120 Vac unless specified otherwise. Ethernet and serial transmissions shall be allowed to the extent shown on the Drawings.

2.12 PAINTING

- A. Factory paint all instruments and equipment except where installed in pipelines. Where instrument panels are installed adjacent to electrical control panels provided under Division 16, provide instrument panels of identical color to that of electrical control panels. Paint as required in Division 9 for structural supports, brackets, etc. Repair damaged factory paint to satisfaction of the City. Feathering,

priming and painting shall produce a reasonable match to the surrounding paint work.

2.13 FASTENERS

- A. Fasteners for securing equipment to walls, floors and the like shall be 316 stainless steel. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8-inch.

2.14 INSTRUMENT CALIBRATION

- A. Each field instrument shall be calibrated at 0%, 25%, 50%, 75% and 100% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments must have accuracies traceable to the National Institute of Standards and Technology (NIST).
- B. Submit a written report to the City on each instrument. This report shall include a laboratory calibration sheet or the manufacturer's standards calibration sheet on each instrument and calibration reading as finally adjusted within tolerances.
- C. The Contractor may, at his option, choose to perform calibration on an instrument by acquiring the services of an independent test lab, or by obtaining the required test instruments and performing the calibration.

2.15 BINDERS

- A. Submittals shall be furnished separately bound in a "D" standard size, 3-ring with gap free D-ring, loose-leaf, vinyl plastic, heavy duty, hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 3 inches.

2.16 ELECTRONIC MEDIA

- A. Manuals and Drawings shall be provided in hardcopy and electronic format. As-built Documents shall be provided in Adobe Acrobat (pdf) format on CD – ROMs. The Contractor shall provide vendor manuals electronically and include these manuals on the CD set. The CD shall be organized to simplify user browsing.

PART 3 – EXECUTION

3.1 PROCESS CONTROL SYSTEM

- A. Control Philosophy and Loop Functional Descriptions are described in Section 11070 Variable Speed Screw Water Chillers, Part 4, which is hereby incorporated by reference.

3.2 MOUNTINGS

- A. Mount and install equipment as indicated. Mount field instruments on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.
- B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting, surface-mounted indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet-6 inches nor higher than 6 feet above walkways, platforms, catwalks, and the like.
- C. Note that applicable specifications require detail drawings showing seismic sway bracing design and anchorage requirements for their equipment. Seismic zone requirements are specified in Division 1.
- D. All devices shall be accessible to operators for servicing, operating, reading, etc. Provide permanent platforms to assure devices are continuously accessible.

3.3 FIELD WIRING

- A. Ring out signal wiring prior to termination and perform surge withstand tests where required. Verify wire number and terminations are satisfactory as designated on the Loop Diagrams. Verify all terminations are tight and shields are uniformly grounded at one location.

3.4 ELECTROMAGNETIC INTERFERENCE (EMI)

- A. Construction shall proceed in a manner which minimizes the introduction of noise (RFI/EMI) into the I&C System.
- B. Cross signal wires and wires carrying ac power or control signals at right angles.
- C. Separate signal wires from wires carrying ac power or switched ac/dc control signals within control panels, terminal cabinets, telemetry equipment, multiplexer cabinets, and data loggers as much as possible. Provide the following minimum separations within such equipment unless indicated otherwise on the Drawings:

Power Wiring Capacity	Separation (Inches)
120 volts ac or 10 amps	12
240 volts ac or 50 amps	18

3.5 SIGNAL GROUNDING

- A. Proper grounding of equipment and systems in this Division is critical, since computer and associated networks and peripherals are involved. The Drawings and Division 16 specify safety grounding for all equipment in this Division.

- B. A single-point grounding system for instrument signals is required for all instrument panels. This instrument single point grounding system does not use building steel or conduit systems for its ground path.
- C. Ground all signal shields, signal grounds, and power supplies at an isolated signal bus within each instrument panel, rack, or enclosure. The shields at the far ends of these signal cables must be disconnected (floated) from any ground to prevent ground loops.

Do not connect the rack or enclosure frames to the signal grounding buses.

3.6 PREPARATION

- A. Ensure that installation areas are clean, and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.
- B. Panels shall be protected during construction to prevent damage to front panel devices and prevent dust accumulation in the intervals. Other protective measures (lamp, strip heaters, etc.) shall be included as weather conditions dictate.

3.7 CALIBRATION

- A. General: All devices provided under Division 17 shall be calibrated according to the manufacturer's recommended procedures to verify operational readiness and ability to meet the indicated functional and tolerance requirements.
- B. Calibration Points: Each instrument shall be calibrated at 0, 25, 50, 75, and 100% of span using test instruments to simulate inputs. The test instruments shall have accuracies traceable to National Institute of Testing Standards.
- C. Bench Calibration: Instruments which have been bench-calibrated shall be examined in the field to determine whether any of the calibrations are in need of adjustment. Such adjustments, if required, shall be made only after consultation with the City.
- D. Field Calibration: Instruments which were not bench-calibrated shall be calibrated in the field to insure proper operation in accordance with the instrument loop diagrams or specification data sheets.
- E. Calibration Sheets: Each instrument calibration sheet shall provide the following information and a space for sign-off on individual items and on the completed unit:
 - 1. Project name
 - 2. Loop number
 - 3. Tag number
 - 4. Manufacturer

5. Model number
 6. Serial number
 7. Calibration range
 8. Calibration Data: Input, output, and error at 10 percent, 50 percent, and 90 percent of span
 9. Switch setting, contact action, and deadband for discrete elements
 10. Space for comments
 11. Space for sign-off by System Integrator and date
 12. Test equipment used and associated serial numbers
 13. Space for sign-off by City I&C technician with date
- F. Calibration Tags: A calibration and testing tag shall be attached to each piece of equipment or system at a location determined by the City. The Contractor shall have the System Integrator sign the tag when calibration is complete. The City will sign the tag when the calibration and testing has been accepted.

3.8 LOOP TESTING

- A. General: Individual instrument loop diagrams per ISA Standard S5.4 – Instrument Loop Diagrams, expanded format, shall be submitted to the City for review prior to the loop tests. The Contractor shall notify the City of scheduled tests a minimum of 30 days prior to the estimated completion date of installation and wiring of the control system. After the City's review of the submitted loop diagrams for correctness and compliance with the specifications, loop testing shall proceed. The loop check may be witnessed by the City.
- B. Control Valve Tests: All control valves, cylinders, drives and connecting linkages shall be stroked from the operator interface units as well as local control devices and adjusted to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position. Control valve actions and positioner settings shall be checked with the valves in place to ensure that no changes have occurred since the bench calibration.
- C. Interlocks: All hardware and software interlocks between the instrumentation and the motor control circuits control circuits of variable-speed controllers and packaged equipment controls shall be checked to the maximum extent possible.
- D. Instrument and Instrument Component Validation: Each instrument shall be field tested, inspected, and adjusted to its indicated performance requirement in accordance to its Manufacturer's specifications and instructions. Any instrument

which fails to meet any Contract requirement, or, in the absence of a Contract requirement, any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced.

- E. Loop Validation: Controllers and electronic function modules shall be field tested and exercised to demonstrate correct operation. All control loops shall be checked under simulated operating conditions by impressing input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the CAC. Actual signals shall be used whenever available. Following any necessary corrections, the loops shall be retested. Specified accuracy tolerances for each analog network are defined as the root-mean-square-summation of individual component accuracy requirements. Individual component accuracy requirements shall be as indicated by Contract requirements or by published manufacturer accuracy specifications, whenever Contract accuracy requirements are not indicated. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks which incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 50, 75, and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root-mean-square-summation accuracy tolerance requirements. Continuously variable analog inputs shall be applied to verify the proper operation and setting of discrete devices. Provisional settings shall be made on controllers and alarms during analog loop test. All analog loop test data shall be recorded on test forms which include calculated root-mean-square-summation system accuracy tolerance requirements for each output.
- F. Loop Validation Sheets: The Contractor shall prepare loop confirmation sheets for each loop covering each active instrumentation and control device except simple hand switches and lights. Loop confirmation sheets shall form the basis for operational tests and documentation. Each loop confirmation sheet shall cite the following information and shall provide spaces for sign-off on individual items and on the complete loop by the System Integrator:
1. Project name
 2. Loop number
 3. Tag number, description, manufacturer and model number for each element
 4. Installation bulletin number
 5. Specification sheet number
 6. Loop description number
 7. Adjustment check
 8. Space for comments

9. Space for loop sign-off by System Integrator and data
 10. Space for sign-off by System Integrator and date
- G. Loop Certification: When installation tests have been successfully completed for all individual instruments and all separate analog control networks, a certified copy of all test forms shall be retained by the Contractor.

3.9 FIELD FUNCTIONAL TESTING

- A. General: Field functional testing shall commence after acceptance of all wire test, calibration tests and loop tests, and all inspections have demonstrated that the instrumentation and control system complies with all Contract requirements. Field functional testing shall demonstrate proper operation of all systems with process equipment operating over full operation ranges under conditions as closely resembling actual operation conditions as possible.
- B. Field functional Test Procedures and Documentation: All field functional testing activities shall follow detailed test procedures and check lists accepted by the City. All test data shall be acquired using equipment as required and shall be recorded on test forms accepted by the City, which include calculated tolerance limits for each step. Completion of all system field functional testing activities shall be documented by a certified report, including all test forms with test data entered and retained by the Contractor.
- C. Operational Validation: Where feasible, system field functional testing activities shall include the use of water to establish service conditions that simulate, to the greatest extent possible, normal final control element operation conditions in terms of applied process loads, operation ranges, and environmental conditions. Final control elements, control panels, and ancillary equipment shall be tested under start-up and steady-state operation conditions to verify that proper and stable control is achieved using motor control center and local field mounted control circuits. All hardwired and software control circuit interlocks and alarms shall be operational. The control of final control element and ancillary equipment shall be tested using both manual and automatic (where provided) control circuits. The stable steady-state operation of final control elements running under the control of field mounted controllers as required eliminating oscillatory final control element operation. The transient stability of final control elements operation under the control of field mounted, and software based automatic analog controllers shall be verified by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations (if any) and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates.
- D. Loop Tuning: All electronic control stations incorporating proportional, integral or differential control circuits shall be optimally tuned, by a qualified control systems engineer, by applying control signal disturbances and adjusting the gain, reset, or rate settings as required to achieve a proper response. Measured final control element variable position/speed setpoint settings shall be compared to measured

final control element position/speed values at 0, 25, 50, 75, and 100 % of span and the results checked against indicated accuracy tolerances.

- E. Field Functional Test Validation Sheets: Field functional testing shall be documented on a test form as follows:
1. For functions which can be demonstrated on a loop-by-loop basis, the form shall include:
 - a. Project name
 - b. Loop number
 - c. Loop description
 - d. Tag number, description, manufacturer and data sheet number for each component.
 - e. Specification page and paragraph of function demonstrated
 - f. Description of function
 - g. Space for sign-off and date by both the System Integrator and City.
- F. Field Functional Test Certification: The Contractor shall submit an instrumentation and control system field functional test completion report which shall state that all Contract requirements have been met and shall include a listing of all instrumentation and control system maintenance and repair activities conducted during the field functional testing. Acceptance of the instrumentation and control system field functional testing must be provided in writing by the City before the acceptance testing may begin. Final acceptance of the control system shall be based upon plant completion as stated in the General Conditions.

3.10 ON-SITE SUPERVISION

- A. The Contractor shall furnish the services of an on-site resident engineer to supervise and coordinate installation, adjustment, testing, and start-up of the chill water control system. The resident engineer shall be present during the total period required to affect a complete operation system. A team of engineering personnel shall be on site to check all equipment, perform the tests indicated in this Section, and furnish startup services.

3.11 ACCEPTANCE TEST

- A. General: Subsequent to Field Functional Test and instrument calibration, verifying substantial completion of field installation and start-up, the system will be given a final 30-day acceptance test. The 30-day test must be successfully completed, including resolution of punch-list items generated during the test period, prior to the date of substantial completion of the entire project. The system must run continuously for 30 consecutive days. During this period, all system functions shall be exercised, and any system interruption and accompanying component, subsystem, or program failure shall be logged for cause of failure, as well as time of occurrence and duration of each failure. The Contractor shall provide a competently trained technician or programmer on call during all normal working days and hours from the start of the acceptance test until final acceptance of the system.

- B. Testing: The systems to be tested on-line will include general operations as well as remote interface with the City Ovation system. Each system function, e.g., status report-backs, logs, and displays shall be exercised several times at a minimum, and in a manner, which approximates "normal" system operation. Failure of the system during the above program testing shall be considered as indicating that the programs and operating system do not meet the requirements of the specifications and corrective action shall be required before restarting the acceptance test. Only those components, subsystems, and systems covered in this specification shall be considered for this acceptance test. Problems and failures of other systems shall not be considered as part of this test (except as they display the capabilities of this system to detect failures).
- C. Failures: Failures shall be classified as either major or minor. A minor failure would be a small and non-critical component failure, which can be corrected by the City operators. This occurrence shall be logged but shall not be reason enough for stopping the test and shall not be grounds for non-acceptance. However, should the same or similar component failure occur repeatedly, this may be considered as grounds for non-acceptance. A major failure shall be considered to have occurred when a component, subsystem, or program fault causes a halt in operation of the system and/or when a technician's work is required to make a repair or to re-initiate operation of the system. A major failure shall cause termination of the acceptance test. When the causes of a major failure have been corrected, a new acceptance test with a new 30-day duration shall be started.
- D. Technician Report: Each time a technician is required to respond to a system malfunction, he or she must complete a report which shall include details concerning the nature of the complaint or malfunction and the resulting repair action required and taken. If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report shall be required (logged as specified above). If a technician has performed work but no report is written, then a major failure shall be considered to have occurred. Each report shall be as specified above). Each report shall be submitted within 24 hours to the Engineer

3.12 TRAINING AND INSTRUCTION

- A. General: The Contractor shall provide maintenance and operator training courses by a qualified instructor as described herein. The training courses shall be given on-site during the final stages of the system checkout. All instruction, tools and training material shall be provided by the Contractor.
- B. Instructors: The training shall be performed by qualified representatives of the equipment manufacturers and shall be specific to each piece of equipment.
- C. Schedule: Training shall be performed during the field functional testing phase of the project. The training sessions shall be scheduled a minimum of 2 weeks in advance of when the courses are to be initiated. The City will review the course outline for suitability and provide comments that shall be incorporated.

- D. Agenda: The training shall include operation and maintenance procedures, troubleshooting with necessary test equipment, and changing set points, and calibration for that specific piece of equipment.
- E. Operator Training: An operator's training course shall be given for up to eight (8) designated personnel of the City. This course shall be designed to teach operations, maintenance, and supervisory personnel how to operate the instrumentation and control systems. Two separate classes shall be offered. Each class shall have a duration of 4 hours. Operator training shall be completed when operations staff are all on duty.
- F. Hands-On Instruction: In addition to the maintenance and the operator training courses, the operating and maintenance personnel shall be given hands-on instruction in the functions and operation of the system and instruments 7 days (minimum) prior to startup. This instruction shall be scheduled for two identical sessions of 2 hours each with the City. Qualified persons who have been made familiar in advance with the systems shall give instruction.

****END OF SECTION****

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SECTION 13080 - CONTROL PANELS

PART 1 - GENERAL

1.1 SCOPE

- A. Provisions: Requirements of Division 1 and Section 13010 form a part of this Section.
- B. Work Included: This Section covers requirements for the non-bussed control section of the motor control center.

1.2 RELATED SECTIONS

- A. Section 13010 - Instrumentation and Controls General Requirements

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS 1 General Standards for Industrial Controls and Systems
 - 2. ICS 2 Standards for Industrial Control Devices, Controllers and Assemblies
 - 3. ICS 4 Terminal Blocks for Industrial Control Equipment and Systems
 - 4. ICS 6 Enclosures for Industrial Controls and Systems
- B. Underwriters Laboratories (UL) Publication:
 - 1. 508 Industrial Control Equipment
- C. National Fire Protection Association (NFPA)
 - 1. 70E – Standard for Electrical Safety in the Workplace

1.4 SUBMITTALS

- A. The Control System Hardware Submittal shall be furnished in accordance with Section 13010 – Instrumentation and Controls General Requirements.
- B. Technical Manuals: Provide technical manuals as specified in Section 13010.

1.5 CERTIFICATION

- A. UL Label:
 - 1. Each control panel and terminal cabinet shall bear the UL label except as noted in the following paragraph. The UL label shall apply to the enclosure,

the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault interrupters, isolation transformers, fuses, and any other necessary equipment, even though such equipment is not indicated on the Drawings. The fabricator shall be an approved UL listed manufacturer.

2. Control panel enclosures containing instruments mounted through the enclosure walls or door shall meet all requirements for UL labeling as above, but no UL label is required. This exception applies only if UL Recognized instruments for the intended purpose are not made.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Ship assembled control panels in sections that facilitate handling and field installation.

1.7 ARC FLASH LABELS

- A. Provide arc flash labels on the control panel doors. Arc Flash labels shall be based on an Arc Flash Analysis to be completed by the City.

1.8 WORK PAYMENT

- A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto, including all Work and materials specified herein and as may be required to complete this portion of the Work.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Environmental Suitability:
 1. Forced air ventilation shall be provided in indoor control enclosures to prevent internal panel temperatures from exceeding 105°F. Provide heat calculations for each control panel to determine cooling requirements.
 2. Louvers shall be provided, when required for forced air ventilation, near the bottoms and tops on the side of panels.
 3. Provide a thermostatically controlled fan in each enclosure when required for forced air ventilation. Ventilation fans shall be low acoustic type suitable for control rooms. Provide removable cleanable or disposable dust filter for each remote site enclosure.
- B. The control panel controls shall be 120 VAC. Control conductors shall be provided in accordance with the indicated requirements.

- C. Control panels shall be housed in NEMA 12 enclosures with gasketed doors with 3-point latch unless otherwise indicated. Control panels shall be floor or wall-mounted, as indicated. Internal control components shall be mounted on an internal back-panel or side-panel as required. Panels covered under this specification are:
 - 1. Chilled Water System Custom Application Controller (CAC).
- D. Safety Requirements: The electrical supply to each control panel shall be arranged to be disconnected by a local 15-amp thermal magnetic circuit breaker, except for necessary foreign circuits. Each source of foreign voltage shall be isolated by providing disconnecting or pull-apart terminal blocks or a disconnect operable from the control panel front. Each control panel shall be provided with identified terminal strips for the connection of all external conductors. The Contractor shall provide sufficient terminal blocks to connect 25 percent additional conductors for future use.
- E. Discrete outputs from the control panel shall be provided by electrically isolated contacts rated for 5 amps at 120 VAC. Analog inputs and outputs shall be isolated 4-20 mA signals with power supply.
- F. All control panel mounted devices shall be mounted a minimum of 36 inches above finished grade.

2.2 CONTROL PANEL MATERIALS

- A. Panel section faces shall be No. 10 gauge minimum thickness steel for free standing panels and No. 14 gauge minimum thickness steel for wall mounted or pedestal mounted panels. All materials shall be selected for levelness and smoothness.
- B. The following requirements apply to the front and rear face of the panel, both sides and the edges of all flanges, and the periphery of all holes or cut-outs.
 - 1. All high spots, butts, and rough spots shall be ground smooth.
 - 2. The surfaces shall be sanded or sandblasted to a smooth, clean bright finish.
 - 3. All traces of oil shall be removed with a solvent.
 - 4. The first coat of primer shall be applied immediately.
- C. Structural shapes and strap steel shall comply with ASTM A 283 – Low and Intermediate Tensile Strength Carbon Steel Plates, Grade C.
 - 1. Bolting Material: Commercial quality carbon steel bolts, nuts, and washers shall be 1/2-inch diameter with UNC threads. Carriage bolts shall be used for attaching end plates. All other bolts shall be hex end machine bolts. All nuts shall be hot pressed hex, American Standard, heavy. Standard

wrought washers shall be used for foundation bolts and attachments to building structures. All other bolted joints shall have SAE standard lock washers.

- D. Panels shall be of sufficient size to adequately enclose all instruments designated as “panel-mounted” plus ample interior clearance to allow for installation, general servicing, and maintenance of the instruments. Elevations and horizontal spacing shall be subject to Engineer’s approval. Where indicated, PLCs mounted in wall mounted enclosures shall be 48-inches tall by 30-inches wide by 12-inches deep, minimum. Enclosures shall be as manufactured by Hoffman or approved equal. Provide 3-point latch with padlock.

2.3 CONTROL PANEL ELECTRICAL REQUIREMENTS

- A. Wiring Duct: Wiring duct shall be manufactured of Noryl and shall be of the restricted slot design, white in color. Panduit or approved equal. Size shall be based on actual wiring requirements. All duct shall be precisely cut for a precision fit. All covers shall be readily accessible. All analog signals shall be run in separate ducts.
- B. Cable Ties: Cable ties shall be self-locking with stainless steel locking tables as manufactured by Thomas & Betts. Adhesive backed type mounting bases shall not be used.
- C. Terminal Blocks: Terminal blocks shall be din rail mounted. All terminals shall be complete with marking tags.
- D. Wiring Methods: Wiring methods and materials for all panels shall be in accordance with the N.E.C. requirements for General Purpose (no open wiring) unless otherwise indicated.
- E. Signal and Control Circuit Wiring:
 - 1. Wire type and sizes: Conductor shall be flexible stranded copper machine tool wire, UL listed Type MTW, and shall be rated 600-volts. Wires for instrument control circuits and alarm input circuits shall be No. 14 AWG. All other wires, including shielded cables, shall be No. 16 AWG minimum.
 - 2. Wire Insulation Colors:

CONTROL PANEL WIRE COLOR CODE	
115 VAC POWER – HOT	BLACK
115 VAC POWER – SWITCHED	RED
115 VAC POWER – NEUTRAL	WHITE
120 VAC DIGITAL INPUTS	RED
24 VDC DIGITAL INPUTS	BLUE

120 VAC DIGITAL OUTPUTS	RED
24 VDC DIGITAL OUTPUTS	BLUE
24 VDC POWER +	BLUE
24 VDC POWER -	BLUE WITH WHITE STRIPE

3. Signal Cable – Non-Computer Use:
 - a. Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG copper signal wires with THWN or THHN insulation.
 - b. Color code for instrument signal wiring shall be as follows: Positive (+) – White; Negative (-) - Black.
 - c. A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.
 4. Industrial Ethernet Cable:
 - a. Shielded (STP) Ethernet Cable shall be used to connect the CAC, OIT, and DCS (PCM) to the Industrial Ethernet Switches.
 5. Wire Marking: Wire numbers shall be marked using white numbered wire markers made from plastic-coated cloth, Brady Type B-500 or approved equal, or shall be heat-shrink plastic.
 6. Flexible conduit is not acceptable except when specifically approved by the Engineer in writing.
 7. Conduit fittings shall be Crouse-Hinds cast fittings or approved equal.
 8. Panels shall be provided with two separate ground bars, one for power ground and one for signal ground. Provide the ground bars with tapped holes to accommodate ground connections from various devices in the panel. Provide insulator kit for signal ground bar. Connect all signal shield grounds within the panel to the signal ground bar.
 9. For case grounding, panel shall be provided with a 1/4-inch by 1-inch copper ground bus complete with solderless connector for one No. 4 AWG bare stranded copper cable. The copper cable shall be provided by the Contractor and be connected to a system ground loop.
- F. Panel Lights and Receptacles: Panels shall be internally lighted by LED lamps, provided with guards and a toggle switch located convenient to each access door. Provide one duplex GFI type receptacles in each panel section. The lights and receptacles shall be wired to outgoing terminal blocks for dedicated 120-volt, 60 Hertz, single-phase supply.

- G. Power Supply Wiring:
1. Unless otherwise indicated, all instruments and motor controls shall operate on 115-volt, 60 Hz circuits.
 2. When instruments do not come equipped with integral fuses, provide fuses as required for the protection of individual instruments against fault currents. Fuses shall be mounted on the back of the panel in a fuse holder, and each fuse shall be identified by a service name tag. Fuses shall be manufactured by Bussmann Manufacturing Division, Type KAW TRON or approved equal.
- H. 24 VDC Power Supply: Panels shall be equipped with a linear 24-volt D.C. power supply for driving current loops and other D.C. powered equipment. It shall be solidly mounted, labeled and located in plain view oriented for ease of maintenance. Unit shall be sized based on 200% of load requirements of equipment actually furnished. 24 VDC power supply shall be manufactured by Power One or approved equal.
- I. DIN Rail Mount Circuit Breakers: Circuit breakers shall be 115 VAC, single pole as manufactured by Allen Bradley Series 1492-CB1; no equals.
- J. Relays shall be of the 120VAC, 10-amp, plug-in type. Contacts shall be silver cadmium oxide unless otherwise noted on the contract drawings. Drop out speed shall be 12 milliseconds typical. Coil windings shall be polyurethane insulated. Contact arrangement shall be Form C. Each unit shall be furnished complete with coil pilot light to aid troubleshooting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.
- B. Exercise care at all times after installation of control panels to keep out foreign matter, dust, dirt, debris, or moisture. Use protective sheet metal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.
- C. For all metal panels mounted on concrete walls or floors, install 1/8-inch shims, and paint the back sides and bottom of the panels with Mobil Hi-Build Bituminous Coating 35-J-10; Koppers Bitumastic Super Tank Solution; or approved equal. Film thickness shall be 10-mils minimum.

****END OF SECTION****

SECTION 13329 - PRIMARY SENSORS AND FIELD INSTRUMENTS

PART 1 - GENERAL

1.1 SCOPE

- A. Contactor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish, install, calibrate, test, adjust and place into satisfactory operation all primary sensors and field instruments furnished under this Section.
- B. Drawings and Specifications illustrate and specify functional and general construction requirements of the sensors and field instruments and do not necessarily show or specify all components, wiring, piping and accessories required to make a completely integrated system. Contactor shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Contactor shall be responsible for installing in-line flow elements (magmeter flow tubes, insert flow tubes, etc.) and for providing taps in the process piping systems for installation of other flow, pressure and temperature sensing instrumentation.
- D. This Specification Section includes specifications for field instruments. All instruments shall be installed, loop-tested, checked out and started up by the Contactor. All field instruments shall comply with this Section.
- E. Coordination: Coordinate the installation of all items specified herein and required to ensure the complete and proper interfacing of all the components and systems.

1.2 RELATED SECTIONS

- A. Section 01610 – General Equipment Provisions
- B. Division 11 - Equipment
- C. Section 13010 – Instrumentation and Controls General Requirements.
- D. Division 15 - Mechanical
- E. Division 16 - Electrical.

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS (NOT USED)

1.4 SUBMITTALS

- A. Comply with the requirements specified in Section 13010.

1.5 QUALITY ASSURANCE

- A. Comply with the requirements of Section 13010
- B. Acceptable Manufacturers:
 - 1. Furnish primary sensors and field instruments by the named manufacturers or equal equipment by other manufacturers.
 - 2. The named manufacturers have been specified to establish the standard of quality and performance of the equipment to be supplied.
 - 3. Obtain all sensors and field instruments of a given type from the same manufacturer.
- C. Manufacturers' Responsibilities and Services:
 - 1. Design and manufacture the primary sensors and field instruments in accordance with the applicable general design requirements specified in Section 17010 and the detailed specifications herein.
 - 2. Field supervision, inspection, start-up and training in accordance with the requirements of Sections 01660 and 13010.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Comply with the requirements specified in Section 13010.
- B. Primary sensors and field instruments shall not be delivered to the site until all product information and system shop drawings for the sensors and instruments have been approved.

1.7 WARRANTY

- A. Provide a 12-month warranty on materials and workmanship for all devices. Should any fail due to an identified defect in materials or workmanship it shall be repaired or replaced at no cost to the CITY.
- B. The warranty period shall commence once the project achieves substantial completion.

1.8 IDENTIFICATION TAGS

- A. All sensors and field instruments shall have an identification tag meeting the following requirements:
 - 1. Tag numbers for sensors and field instruments shall be as listed on the Contract Drawings.

2. The identifying tag number shall be permanently etched or embossed onto a stainless-steel tag which shall be fastened to the device housing with stainless steel rivets or self-tapping screws of appropriate size.
3. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circllet of 1/16-inch diameter stainless steel wire rope.
4. All sensors and field instruments mounted on or within panels shall have the stainless-steel identification tag installed so that the numbers are easily visible to service personnel.

PART 2 - PRODUCTS

2.1 PROCESS TAPS, SENSING LINES, INSERTION MOUNTING AND ACCESSORIES

A. Water Pressure Sensing Lines and Accessories for Flow and Pressure Transmitters:

1. Material: Type 316 stainless steel; .035 wall thickness.
2. Pressure Rating: 150 psi.
3. Size: 1/2-inch outside diameter.
4. Connections: Type 316 stainless steel compression type, "Swagelok", as manufactured by Crawford or equal.
5. Shut-off Valves: Ball valve
6. Manifolds:
 - a. Type: 3-valve meter manifolds.
 - b. Materials: Type 316 stainless steel body, bonnets and stems; delrin seats; Teflon packing.
 - c. Manufacturer: Provide manifolds of one of the following:
 - 1) Whitey.
 - 2) Anderson-Greenwood
 - 3) Or Equal.

B. Pressure Tap Sensing Lines and Accessories for Pressure Gages and Pressure Switches:

1. Material and Fittings: Type 316 stainless steel tubing (ASTM A 269 or A213) with a minimum working pressure of 150 psi, and hardness of Rb 80. Tube fittings shall be type 316, dual ferrule design, Swagelok or equal.
2. Sizes: 1/2-inch minimum for main sensing piping and gage and switch

connections.

3. Pressure Rating: Equal to or greater than the applicable system test pressure as specified in the Schedule in Section 15052.
4. Accessories:
 - a. For applications not requiring diaphragm seals, provide separate 1/2-inch Type 316 stainless steel threaded gauge cocks for each gage and switch.
 - b. For applications requiring diaphragm seals, provide a separate 1/2-inch threaded ball valve for seal process side shutoff for each gage and switch. Materials shall match the connected piping. Ball valves shall be provided in accordance with Specifications in Section 15100.

2.2 MAGNETIC FLOWTUBE AND TRANSMITTER

A. Functions:

1. Flowtube: Produce low level, high impedance pulsed dc signal proportional to the rate of fluid flow using the principle of electromagnetic induction.
2. Pulsed dc Magnetic Flow Transmitter: Drive the flowtube coils with pulsed dc power and convert the flowtube output signal into a dc current output linear to the flow rate.

A. System (Flowtube and Transmitter) Performance Requirements:

1. Flow Range: 0 - 3000 gpm
2. System Accuracy (with Analog Output): ± 0.5 % of flow rate over full flow range
3. System Repeatability: ± 0.1 % of flow rate
4. Drift: Complete zero stability.
5. Minimum Fluid Conductivity Limit: 5 micro Siemens per centimeter or less.
6. Minimum Pre-amp Input Impedance: 10^{12} ohms.
7. Fluid Property Effects: Accuracy unaffected by changes in fluid velocity, density, pressure, temperature or conductivity (above minimum conductivity limits).
8. Transmitter Outputs:

- a. 4-20 mAdc HART, direct acting and isolated, into 0-1000 ohms.
 - b. High accuracy, field adjustable scaled pulse output (0.1 to 10 Hz or greater) to drive local totalizer.
9. Power Consumption: Not to exceed 50 watts for flowtube and transmitter combined.
10. Operating Temperature: Suitable for operation with process fluid temperature from 0°F to 140°F.
11. Pressure Rating: Greater than or equal to test pressure specified in Division 15 for appropriate piping system.
- B. Construction and Required Features:
- 1. Flowtube:
 - a. Type: Lined metal flowtubes. Lined to match chemical properties of fluid being measured.
 - b. Interchangeability: Ratio of flow velocity to voltage reference signals generated identical for all meter sizes to permit interchangeability with transmitter without requiring circuit modifications.
 - c. System accuracy in Paragraph B.2 shall be proven by submittal of flow test curves of the actual meters being furnished.
 - d. Test curves shall show a minimum of ten equally spaced flow points. Tests shall be performed using water and a weight or volume tank. A "Master Meter" used as a reference standard is not acceptable. The test setup shall be submitted and approved prior to testing.
 - e. Flow tube Liner Material:
 - 1) Meter tubes 12-inch and smaller
 - 2) Material for Threshold Inhibitor: EDPM
 - f. Electrodes:
 - 1) Conical or elliptical shaped.
 - 2) Material for Threshold Inhibitor: Type 316 stainless steel.
 - g. Enclosure:
 - 1) Materials and Rating: Cast low-copper aluminum alloy or fabricated sheet steel.
 - 2) Finish: Finish exterior, except for flange faces, with a high build epoxy paint.
 - h. End Connections: ANSI Class 150 suitable for mating with pipe specified.
 - i. Electrical Connections: 3/4-inch NPT tapped holes for power

conduit fitting and signal conduit fittings.

2. Pulsed dc Magnetic Flow Transmitter:

- a. Microprocessor-based, solid state construction.
- b. Pulse and analog outputs galvanically isolated from input and earth ground.
- c. Automatic zeroing feature making it unnecessary to zero the instrument before or after placing it in operation.
- d. Precalibrated span adjustment providing continuous span adjustment over entire range.
- e. Range adjustment: Direct reading, continuously adjustable for full scale settings from 1 to 31 feet per second.
- f. Signal Conditioning: Adjustable damping circuit with response times of 1 to 25 seconds minimum.
- g. Low Flow Cutoff: Provide automatic low flow cutoff circuitry to stop pulse output and local totalization when flow drops below a specified value. Cutoff setpoint shall be adjustable from 0 to 10 percent of the calibrated upper range value.
- h. Enclosure:
 - 1) Die cast, low-copper aluminum alloy, NEMA 4.
 - 2) Finish: Epoxy coating.
- i. Mounting:
 - 1) All transmitter and driver electronics shall be integrally mounted at the flow tubes.
- j. Local Indication:
 - 1) LCD meter with field selectable engineering units or 0-100 percent display for flow rate indication. Provide stainless steel tag indicating 100 percent value in engineering units as specified in the Instrument Index.
 - 2) 7-digit electronic totalizer with reset. Totalizer shall be integral with transmitter and visible through viewing window.
- k. Power Requirements: Designed for operation on 120 Vac \pm 10 percent, 60 Hz, \pm 3 Hz power supply.

3. Accessories:

- a. Shielded cable assemblies of sufficient length for connection between flowtube and transmitter electronics.
- b. 316 stainless steel grounding rings for all services.
- c. 316 stainless steel grounding straps.
- d. Contactor shall provide a NEMA 4X rated SPST ON-OFF manual disconnect switch for 120 Vac input power to transmitter and

- driver electronics.
 - e. Provide spool piece for replacement of each different size flow tube where no bypass piping is provided.
 - f. Provide a ground conductor and connect the unit to the ground grid as shown on the Drawings.
 - g. Provide one calibrator suitable to calibrate all flow tubes provided.
- C. Manufacturer: Provide one of the following:
 - 1. Rosemount
 - 2. Endress + Houser
 - 3. Yokogawa
 - 4. Or equal.

2.3 PRESSURE AND DIFFERENTIAL PRESSURE TRANSMITTERS

- A. The differential pressure transmitter shall be Micro-Processor Based unit featuring 'Smart' electronics and shall have a 4 to 20 mADC, two wire, loop powered 24 VDC output linear to differential pressure input and shall feature HART super-imposed on the 4 to 20 mA DC signal. Capacitance shall be measured via an electronic resonance circuit between the moving plates and fixed plates.
- B. Design Criteria:
 - 1. Accuracy: +/- 0.075% of full scale range
 - 2. Rangeability: 120 to 1
 - 3. Pressure Rating: 2000 psig of static pressure to either the high input side or low input side of the transmitter without any shift in calibration or accuracy.
 - 4. Process wetted parts: Type 316 stainless steel.
 - 5. Hardware such as bolts, nuts and washers: Type 316 stainless steel.
- C. The differential pressure transmitter shall have an integral programmable output signal simulation for external loop testing. An integral temperature sensor shall be provided in the circuit to compensate for temperature resulting in high accuracy and rangeability.
- D. The differential pressure transmitter shall have a programmable dampening feature of at least 0 to 32 seconds.
- E. Electronics housing shall have a programmable LCD display in direct engineering units and shall be provided in an IP66/68 Ingress Protection rated housing.

- F. Each differential pressure transmitter is to be provided with a 316SS isolation valve
- G. Instrument Manifold integrally mounted to the transmitter with 1/2" FNPT process impulse piping connections and a 316SS mounting bracket for wall mounting.
- H. A five-point factory calibration certificate, traceable to NIST, shall be provided with each differential pressure transmitter.
- I. Manufacturer: Smar Model LD301D, or equal.

2.4 FLOW SWITCH

- A. Flow switches shall be thermal dispersion, electronic type with dual switch point circuitry and mounted in a UL-approved cast iron enclosure or an FM-approved cast aluminum enclosure. All wetted surfaces shall be Type 316 stainless steel. Power requirements shall be 24 VDC. Flow switches shall be FCI Model No. 12-64, or equal.

2.5 PRESSURE GAUGE

- A. Bourdon Tube Pressure Element Type, Liquid Filled Gage:
 - 1. Performance Requirements:
 - a. Range: 0-150 psi
 - b. Accuracy: ± 0.5 percent of span (ANSI B40.1 Grade 2A).
 - 2. Construction Features:
 - a. Case:
 - 1) Solid front design constructed of glass filled polyester.
 - 2) Color: Black.
 - b. Ring: Threaded, glass filled polyester.
 - c. Full blowout back.
 - d. Window: Glass.
 - e. Dial: White with black marking; 270-degree scale. Gauge shall be installed with face in vertical position.
 - f. Bourdon Tube and Socket: Type 316 Stainless Steel, heliarc welded unless otherwise specified in the Instrument Schedule.
 - g. Movement: Cam and roller movement, 300 series stainless steel.
 - h. Size: 4-1/2-inch.
 - i. Connection: 1/2-inch male NPT bottom connection.
 - j. Mounting: Stem, flush panel or wall mounting as required.
 - k. Adjustable pointer.
 - l. Externally accessible zero adjustment.
 - m. Built-in overload and underload movement stops.

- n. Pressure Snubber: Sintered stainless-steel snubber threaded into gage socket or in external stainless-steel housing with 1/2-inch NPT male and female connections.
 - o. Filling Liquid: All applications: Silicone Oil, except Chlorine and Fluoride Systems: Provide only Fluorlube Oil.
 - p. Process Isolation: Provide gage cocks or ball valves for process isolation in accordance with the requirements of Article 2.1.
 - q. Provide diaphragm seal.
3. Product and Manufacturer: Provide one of the following:
- a. Ashcroft.
 - b. US Gauge.
 - c. Process Gauges, as manufactured by Wika.
 - d. 3D Instruments
 - e. Or equal.

2.6 DIAPHRAGM SEAL

- A. General: Furnish diaphragm seals for pressure gauges, pressure transmitters, and pressure switches at locations shown on the Contract Drawings
- B. Required Features:
- 1. Provide fill/bleed screw to permit filling of instrument and diaphragm seal.
 - 2. Instrument Connection: 1/2-inch NPT.
 - 3. Diaphragm material must be compatible with fluid in process piping.
 - 4. Process Connection: 1/2-inch NPT.
 - 5. Working Pressure Rating: Equal to or greater than the instrument system pressure or that shown in the instrument index.
 - 6. Bolting Materials: Type 316 stainless steel.
 - 7. 1/4-inch NPT flushing connection.
 - 8. Filling Fluid: Silicone Oil, except Chlorine: Provide only Fluorlube Oil.
 - 9. Provide a clean-out ring which holds the diaphragm captive in the upper housing to allow the upper housing assembly to be removed for recalibration or cleaning of the process side housing without the loss of filling liquid or change in calibration.
- C. Construction Features:
- 1. Top Housing: Type 316 stainless steel.

2. Diaphragms, O-rings and Gaskets: Provide manufacturer recommended material to chemicals diaphragm is exposed per Section 1.8 of this specification.
 3. Process Side Housing Material: 316 SS for metallic piping; PVC or CPVC to match non-metallic piping. Material must be compatible with fluid.
- D. Assembly and Calibration:
1. The complete diaphragm seal assembly, including gage, switch or transmitter, shall be factory assembled, filled and calibrated to the ranges and switch set-points specified prior to shipment.
 2. System Supplier Manufacturer shall be responsible for assuring that fill volumes and sensitivities of the supplied seals and diaphragms are suitable to provide the required gage, switch or transmitter accuracy over the specified measurement range or at switch set-points.
 3. Location and orientation of the gages, switches and seal assemblies shall be coordinated with the actual piping and equipment installations so that gages and indicators shall be easily read and accessed for maintenance by plant personnel.
 4. Where field mounting and orientation conflicts arise due to incomplete coordination with field changes in the process piping and equipment installation, assemblies shall be relocated, re-oriented, re-assembled and re-calibrated as directed by Engineer.
- E. Product and Manufacturer: Provide diaphragm seal assemblies of one of the following:
1. Type R, as manufactured by Ametek USG
 2. Type 100, as manufactured by Ashcroft
 3. Or equal

2.7 TEMPERATURE GAUGE

- A. Function
1. Measure and indicate locally the temperature in a chemical pipeline.
 2. Where required, actuate an alarm switch for local annunciation or control.
- B. Sensor
1. Type: Direct drive, N-type bourdon coil actuated.
 2. Range: As noted.

3. Compensator: Case mounted, bimetal for head and line as a unit.

C. Gauge

1. Dial Size: 4 inches, nominal.
2. Engineering Units: As noted.
3. Dial Colors: Black on white.
4. Pointer: Needle edged.
5. Process Connection: Factory connected to capillary.
6. Mounting: Remote panel mount, with front flange for flush face.

D. Capillary

1. Type: Flexible metallic, liquid filled, with bulb.
2. Capillary Length: As required to suit device locations; 2 feet minimum, 33 feet maximum.
3. Bulb Length: To suit required range.
4. Bulb Style: Sliding union type (thermowell required).
5. Process Connections:
 - a. Bulb: 1/2" MNPT.
 - b. Thermowell: 5/8" to 1" MNPT, to suit installation.

E. Alarm Relays (when noted or shown)

1. Number: One.
2. Form: SPDT, dry type.
3. Rating: 5A at 125 VAC.
4. Setpoint: Initial setpoint as noted, externally adjustable over the full range of the gauge.
5. Actuation: On rising temperature via mechanical microswitch directly coupled to the gauge assembly.
6. Enclosure: NEMA 4 rated, aluminum alloy.

F. Performance Characteristics

1. Accuracy: $\pm 1\%$ of full scale.
2. Overtemperature Protection: 150% of maximum rated temperature without shift.

G. Materials of Construction

1. Bourdon Tube Sensor: Inconel X-750
2. Pointer Shaft: Eligiloy.
3. Shaft Bearings: Synthetic sapphire
4. Pointer: Type 316 stainless steel.
5. Connecting Capillary: Type 316 stainless steel.
6. Case: Aluminum alloy.
7. Crystal: Glass.
8. Fittings: Type 316 stainless steel.
9. Bulb: Type 316 stainless steel.
10. Thermowell: Type 316 stainless steel.

H. Manufacturer

1. 3D Instruments Inc., Model 136X with specified accessories;
2. Or equal.

2.8 TEMPERATURE TRANSMITTER

- A. The Temperature Transmitter shall be a Micro-Processor Based electronic unit featuring "Smart" electronics and shall have a 4 to 20 mADC output signal with HART super-imposed on the 4 to 20 mADC signal.
- B. The temperature transmitter shall be a 24 VDC, two wire, loop powered unit and shall have an accuracy of $\pm 0.02\%$.
- C. The electronic housing shall feature a programmable LCD display for direct engineering units and shall be housed in an IP66/68 Ingress Protection rated housing.
- D. The temperature transmitter shall feature a programmable output simulation for external loop testing. All adjustments shall be via a non-intrusive electronic screwdriver or via a HART configuration tool.

- E. The temperature transmitter shall be 'universal' and capable of working with all thermocouple and RTD temperature sensors.
- F. The temperature transmitter shall feature programmable dampening between 0 to 32 seconds for output signal stability. Each temperature transmitter shall be provided with a matched temperature sensor per Callendar Van Dusen equation.
- G. The temperature sensor shall be a 100-ohm platinum, 3 wire, DIN 385, RTD with stainless steel sheath, MGO insulation, 0.250" OD, spring loaded design and provided with a 316SS corresponding thermowell assembly with stepped shank and lagging dimension to allow for piping insulation.
- H. The temperature sensor shall be directly connected to the Temperature Transmitter. Each sensor/thermowell assembly shall be properly sized for each pipe size to account for proper temperature transfer.
- I. The Temperature Transmitter shall be provided with a 5-point factory calibration certificate traceable to NIST.
- J. Manufacturer: Smar Model TT301, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contactor shall require the system supplier to furnish the services of qualified factory-trained servicemen to assist in the installation of the instrumentation and control system equipment.
- B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Transmitters and instruments which require access for periodic calibration or maintenance shall be mounted so they are accessible while standing on the floor.
- C. All items shall be mounted and anchored using stainless steel hardware unless otherwise noted.
- D. All field instruments shall be rigidly secured to walls, stands or brackets as required by the manufacturer and as shown.
- E. Conform to all applicable provisions of the NEMA standards, NEC and local, State and Federal codes when installing the equipment and interconnecting wiring.

3.2 START-UP, CALIBRATION, AND TESTING AND TRAINING

- A. The Contactor shall utilize qualified personnel to accomplish, or supervise the physical installation of all elements, components, accessories, or assemblies that it provides. The Contactor shall employ installers who are skilled and experienced

in the installation and connection of all elements, components, accessories, and assemblies it provides.

- B. All components of the instrumentation and control system, including all communication cabling, shall be the installation responsibility of the Contactor unless specifically noted otherwise. Grounding shall be shown on submittal drawings. After installation of the instrumentation and control system is completed, the installation shall be inspected jointly by the Contactor, the CSI and the Equipment Manufacturer's representatives. Any problems shall be corrected, and when both are satisfied with the installation, a written certification of the installation shall be delivered to the Engineer. The certification shall state that all probes/analyzers/transmitters and controllers and all other components of the process sampling, analyzing and transmission system have been inspected and are installed in accordance with the CSI and Manufacturer's guidelines.
- C. Calibration: All probes and analyzers shall be calibrated and tested after installation.
- D. The Contactor shall submit to the Engineer a system testing completion report when each process system and all aspects of the configuration software have been successfully tested as described herein. The report shall note any problems encountered and what action was required to correct them. It shall include a clear and unequivocal statement that the process systems have been thoroughly tested and are complete and functional in accordance with all Specification requirements.

****END OF SECTION****

SECTION 15011 - HOT TAPS, PIPE STOPS, AND TEMPORARY PIPING SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

This Section describes general requirements for hot taps, pipe stops, and temporary piping systems, and their appurtenances. This Section is to be used as a guideline in conjunction with the Contractor's design of temporary piping systems and for the Contractor's preparation of a sequence of work for hot taps, pipe stops, and temporary piping systems.

1.2 RELATED SECTIONS

- A. Section 01080 – Construction Sequencing
- B. Section 15100 – Valves
- C. Section 15490 – Testing of Plumbing and Pressure Testing Pipe Systems

1.3 PIPE TAPPING (HOT TAP AND PIPE STOPS)

- A. Pipe tap connections (hot taps) to existing chiller piping shall be performed at locations indicated on the drawings.
- B. The sequence of work and materials for hot taps and pipe stops shall be approved by the City. Tapping operations shall be continuously witnessed by the City.
- C. The Contractor shall provide all materials, labor, and equipment to access the piping as necessary to accomplish the tapping and stops, at the locations shown, and in accordance with the Contract Documents.

1.4 TEMPORARY PIPELINES

- A. Temporary chilled water piping, to facilitate the temporary chillers, shall be sized and routed to support the temporary chillers as necessary to meet the cooling requirements of the plant, and allow for construction activities within the chiller and surrounding areas.
- B. All temporary piping, fittings, and service connections shall be furnished, installed, and maintained by the Contractor, and approved by the City.
- C. Upon completion of the work, the Contractor shall remove the temporary piping and appurtenances and shall restore all surfaces to the satisfaction of the Owner

1.5 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:

1. Detailed drawings and data on temporary pipe and fittings including routing to the temporary chiller location, dimensions, thickness, weight, gaskets, and materials information.
 2. Detail drawings of hot tap and pipe stop configuration at each location including specific location relative to the nearest elbow of the existing system to remain as part of the project, dimensions, fittings, tapping valve, pipe and fitting thicknesses, gaskets, and specifics of the type of hot tap and pipe stop to be used, installing equipment manufacturer and other related materials information.
- B. Information on Installing firm including name, address, contact information, lead field supervisor, welders, and welding certifications.

1.6 QUALITY ASSURANCE

- A. Hot taps and pipe stops shall be accomplished by personnel and firm specializing in performing these services. Substitution of approved materials or personnel presented in the submittal process will not be allowed.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturer's Product Data: The Contractor shall submit manufacturer's product data for all materials and products to be used in the work in accordance with Section 01300 including, but not limited to, tapping connections, tapping valves, flanges and gasket materials, special pieces, and all other items required to provide an operable temporary chilled water system, and ultimately a complete and final chilled water system.
- B. The Contractor shall submit the proposed temporary piping layout.
- C. All components of temporary piping systems pipe furnished by the Contractor shall be of good quality, thermally insulated, clean, and suitable for conveying chilled water in the opinion of the City.

2.2 TAPPING EQUIPMENT

- A. The tapping machine shall have the ability to positively flush all shavings and other residue created when installing tapped outlets of 4 inches or larger.
- B. The shell cutter bell on the tapping machine shall be tapped with a 2-inch minimum outlet.
- C. A ball valve shall be installed on the outlet to regulate flow.
- D. A hose and filter shall be connected to the ball valve to retrieve shavings and residue generated during the tapping process.

- E. The shell cutter pilot tool shall be designed to capture the coupon generated by performing the tap.
- F. The tapping machine shall be filled with water prior to commencing the tapping procedure.
- G. Tapping valve shall be specified in Section 15100 Valves.
- H. Contractor shall pipe stop configurations including simple short type pipe stops and pipe stops with bypass options.
- I. Tapping equipment and service provided by Koppl Pipeline Services, Inc., or equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. The Contractor shall furnish tapping connections, valves, and all other materials as required to accomplish the desired a complete and functional installation.
- B. The Contractor shall provide emergency standby equipment or materials.
- C. The Contractor shall submit the proposed construction schedule, sequence of work, and materials for all work to be performed by the Contractor. The work shall not be scheduled until Contractor has obtained the City's written approval.

3.2 TAPS, STOPS AND TEMPORARY PIPING INSTALLATIONS

- A. Prior to construction, Contractor shall provide a written detailed plan with sketches for making the tapping arrangements at each of the location of the proposed connections. Contractor shall record the following information on the construction drawings for record purposes:
 - 1. Pipe size, outside diameter
 - 2. Pipe type, steel in the case of chilled water pipe
 - 3. Pipe schedule and flange pressure rating
 - 4. Elevation
 - 5. Location of fittings or couplings within 3 feet of the proposed connection point
 - 6. Potential conflicts
- B. After the City has given approval to proceed with the connection, the Contractor shall schedule the wet tap or pipe stop installation with the City.

1. Shutdowns will be scheduled at the convenience of the City. No shutdowns will be scheduled on a Friday. Shutdowns may be scheduled for nights or weekends if required by operational criteria of the City.
 2. The Contractor shall give the City a minimum of five (5) working days' notice prior to any proposed shutdown of existing mains or services. Scheduling shall be subject to City approval.
 3. The City may postpone or reschedule any shutdown operation if, for any reason, the City believes that the Contractor is inadequately prepared with competent personnel, equipment, or materials to proceed with the connection.
 4. If progress in completing the connection within the time specified is inadequate, the City may order necessary corrective measures. Corrective measures may consist of directing City personnel or another contractor to complete the work. All costs for corrective measures shall be borne by the Contractor.
- C. The Contractor may proceed only when the materials and sequence of work have been approved, materials have been delivered, hot tap or pipe stop installation has been scheduled and the written detailed tapping plan has been furnished and approved by the City.
1. The Contractor shall provide lights, scaffolding temporary supports as deemed necessary for the City.
 2. The Contractor shall provide all scaffolding, temporary supports and lights when necessary, one day prior to the hot tap or pipe stop installation.
 3. The Contractor shall perform all operations in the presence of the Owner. Only Owner personnel are authorized to operate existing valves. The Contractor shall be responsible for any and all damage resulting from unauthorized operation of existing City facilities.
 4. Tapping:
 - a. Install the tapping flange connection and tapping valve. Clean the tapping machine prior to attachment to the tapping valve.
 - b. Constantly monitor feed settings and motor speed of the tapping machine to ensure a successful tapping operation.
 5. Pipe Stops:
 - a. Cut and remove portions of existing piping and install caps, flanges, tees, valves, install or remove temporary piping and other appurtenances required to complete the stop or bypass flow configuration. The Contractor shall discard pipe and appurtenances removed from service in accordance with the Contract Documents.

6. After the tapping or pipe stop operations are completed, and the City has given approval to proceed, the Contractor shall complete the installation as shown on the Contract Documents including, but not limited to:
 - a. Installing the pipe section(s) necessary to make the closure to the new system.
 - b. Installing valves,
 - c. Repairing, painting, and reinsulating as necessary to obtain City approval.

3.3 TEMPORARY PIPE SYSTEMS

- A. The temporary piping shall be installed in such a manner that it will not present a hazard to City operations staff and Contractor's personnel and will not interfere with access to work areas.
- B. Isolation valves shall be installed as shown and/or as required by the City.
- C. If repairs to temporary piping are necessary, the Contractor shall make such repairs in a timely manner and as approved by the City. If progress in making repairs is inadequate in the sole opinion of the City, or in the event of an emergency, the City may take corrective measures, which may include the performance of repair work by City personnel or another contractor. All costs for corrective measures shall be borne by the Contractor.

****END OF SECTION****

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SECTION 15053 – DUCTILE IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install ductile iron pipe and fittings.

1.2 RELATED SECTIONS

- A. Section 15410 - Installation of Plumbing Piping
- B. Section 15490 - Testing of Plumbing Piping

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. AWWA C110, Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in., for Water and Other Liquids.
 - 2. AWWA C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 3. AWWA C115, Flanged Ductile-Iron Pipe with Threaded Flanges.
 - 4. AWWA C150, Thickness Design of Ductile-Iron Pipe.
 - 5. AWWA C151, Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
 - 6. AWWA C153, Ductile-Iron Compact Fittings, 3 in. Through 24 inches and 54 inches through 64 inches for Water Service.
 - 7. AWWA M41, Ductile - Iron Pipe and Fittings.
 - 8. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
 - 9. ANSI B18.2.1, Square and Hex Bolts and Screws Inch Series, Including Hex Cap Screws and Lag Screws.
 - 10. ANSI B18.2.2, Square and Hex Nuts.
 - 11. ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
 - 12. ASTM A 354, Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.

13. ASTM A 746, Standard Specifications for Ductile Iron Gravity Sewer Pipe.

1.4 SUBMITTALS

A. Shop Drawings: Submit for approval the following:

1. Detailed drawings and data on pipe and fittings including dimensions, thickness, weight, gaskets, linings, coatings and materials information.

B. Certificates: Submit certificates of compliance with referenced standards.

1.5 QUALITY ASSURANCE

A. Ductile iron pipe and fittings shall be the product of one manufacturer. Substitution of approved materials by the submittal process with other manufacturers not identified in the approved submittals will not be allowed.

1.6 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 01600 – General Equipment Provisions

PART 2 - PRODUCTS

2.1 MATERIALS

A. Ductile Iron Pipe and Fittings:

1. Pipe: Fabricate in accordance with requirements of AWWA C115.

2. Joints:

a. Push-On Joints: Conform to AWWA C111.

1) Gaskets: Molded rubber.

2) Stripes: Each plain end shall be painted with a circular stripe to provide a guide for visual check that joint is properly assembled.

b. Restrained Joints for Push-On Joint Piping:

1) Product and Manufacturer: Provide one of the following for restrained push-on joint pipe and fittings:

a) Flex-Ring Joint Pipe, TR Flex Pipe.

b) Or equal.

3. Coatings and Linings:

a. Pipe shall be lined with epoxy coating.

B. Couplings:

1. Couplings between ductile iron and cast iron or PVC shall be Fernco 1156 series or equal.

C. Specials:

1. Transition Pieces:

- a. Furnish suitable transition pieces (adapters) for connections to existing piping.
- b. Unless shown on Drawings, Contractor shall expose existing piping to determine material, dimensions and other data required for transition pieces.

2. Taps:

- a. Provide taps, where shown or required, for small diameter pipe connections.
- b. Provide corporation stops where shown or required.

2.2 MARKING FOR IDENTIFICATION

A. All pipeline materials shall be stamped, marked or identified with the following:

1. Name or trade mark of the manufacturer.
2. Pipe class.
3. Size and length dimensions.
4. Date and place of manufacture.

PART 3 – EXECUTION

3.1 See Section 15410 - Installation of Plumbing Piping.

****END OF SECTION****

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SECTION 15054 – CAST IRON PIPE AND FITTINGS

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all hubless cast iron pipe, fittings and couplings on the project.

1.2 RELATED SECTIONS

- A. Section 15410 - Installation of Plumbing Piping
- B. Section 15430 - Waste and Vent Piping Systems
- C. Section 15490 - Testing of Plumbing Systems

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. ASTM A 74. Standard Specification for Cast Iron Soil Pipe and Fittings
 - 2. ASTM A 888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
 - 3. ASTM C 1540, Hubless Medium Duty and Heavy-Duty Couplings
 - 4. ASTM C 564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings
 - 5. CISPI Standard 301, Hubless Cast Iron Soil Pipe and Fittings.
 - 6. CISPI Standard 310, Hubless Couplings for Cast Iron Soil Pipe and Fittings.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Detailed drawings and data on pipe and fittings including dimensions, thickness, weight, gaskets, linings, coatings and materials information.
- B. Certificates: Submit certificates of compliance with referenced standards.

1.5 QUALITY ASSURANCE

- A. Cast iron pipe and fittings shall be the product of one manufacturer. Substitution of approved materials by the submittal process with other manufacturers not identified in the approved submittals will not be allowed.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 01600 – General Equipment Provisions

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cast Iron Pipe and Fittings:

1. Pipe shall be manufacturer from gray cast iron and shall conform to ASTM A 888 and CISPI Standard 301.
2. Pipe shall be marked with the collective trademark of the CIPI.
3. Hubless joints shall conform to the CISPI Standard 310
4. Pipe, joint and fittings shall be manufactured in the USA.

B. Gaskets:

1. Gaskets shall be molded one-piece neoprene Quik-Tite in conformance with ASTM A 74.

C. Couplings:

1. Couplings shall be Fernco 1056 series or equal.

D. Specials:

1. Transition Pieces:

- a. Furnish suitable transition pieces (adapters) for connections to existing piping.
- b. Unless shown on Drawings, Contractor shall expose existing piping to determine material, dimensions and other data required for transition pieces.

PART 3 – EXECUTION

3.1 See Section 15410, Installation of Plumbing Piping

****END OF SECTION****

SECTION 15062 - STEEL PIPE

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install steel pipe and fittings.

1.2 RELATED SECTIONS

- A. Section 01600 - General Equipment Provisions
- B. Section 09900 - Painting and Coating
- C. Section 15080 - Piping Specialties
- D. Section 15100 – Valves
- E. Section 15140 – Pipe Supports

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the WORK of this Section.
 - 1. ANSI B 36.10, Welded and Seamless Wrought Steel Pipe
 - 2. ASTM A 53, Standard Specification for Pipe, Steel, Black and Hot Dipped
 - 3. ANSI, B16.5, Steel Pipe Flanges and Flanged Fittings
 - 4. ASTM, A234, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
 - 5. ASTM, A370, Test Methods and Definitions for Mechanical Testing of Steel Product
 - 6. ASTM, E165, Practice for Liquid Penetrant Inspection Method
 - 7. AWS, D1.1, Structural Welding Code.

1.4 SUBMITTALS

- A. Shop drawings:
 - 1. Tabulated layout schedule showing location and dimension of each special piece or pipe.
 - 2. Material of construction, with ASTM or API reference and grade

3. Outside diameter, working pressure rating and wall thickness of steel pipe and fittings
 4. Full and complete information regarding location, type, size, and extent of all welds shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds.
 5. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them.
 6. Submit all shop welding procedure specifications, including welder/welding operator qualifications, fabricator welding inspection qualifications, welding procedure specifications, procedure qualification records including all destructive and non-destructive test results and welding bead profiles as required.
- B. Test Reports:
1. The Contractor shall furnish certified reports of the following tests:
 - a. Physical and chemical properties of all steel
 - b. Hydrostatic test reports (shop and field)
 - c. Results of production weld tests

1.5 QUALITY ASSURANCE

- A. Inspection of the pipe and fittings will also be made by the Engineer after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the requirements of this Section even though sample pipes may have been accepted as satisfactory at the place of manufacture. Pipe rejected after delivery shall be marked for identification and shall be removed from the job at once.
- B. Where new pipe is to be connected to existing pipes, the Contractor shall field verify the location, elevation, pipe material, pipe outside diameter, and any other characteristics of the existing pipe before proceeding with fabrication of pipe or special pieces. The field verification shall be performed in the presence of the Engineer. The Contractor shall fabricate special pieces and adjust and align the new pipe as necessary, to meet the field conditions and provide all required material, labor, and equipment to make the connection.

1.6 WELDING

- A. All welding procedures used to fabricate pipe shall be pre-qualified under the provisions of AWS D1.1.
- B. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth for pipe cylinders, spigot and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

- C. All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used.
- D. Welders shall be qualified under the provisions of AWS D1.1 by an independent local, approved testing agency not more than 6 months prior to commencing work on the pipeline. Machines and electrodes similar to those used in the WORK shall be used in qualification tests.
- E. The Contractor shall furnish all material and bear the expense of qualifying welders.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Material, manufacturing operations, testing and inspection of pipe shall be in conformance with applicable portions of ASTM A53.
- B. Specials are defined as fittings, closure pieces, bends, reducers, wyes, tees, crosses, outlets, manifolds, and other steel plate specials, wherever located, and all in structures.
- C. The pipe shall be of the diameter shown, furnished complete with welded joints, as indicated in the Contract Documents. All welded joints shall be double welded on the outside.
- D. The inside diameter shall not be less than the nominal diameter specified or shown.
- E. Closures and correction pieces shall be provided as required so that closures may be made due to different headings in the pipe laying operation and so that correction may be made to adjust the pipe laying to conform to pipe stationing shown on the Drawings.
- F. The Contractor shall be fully liable for the cost of replacement or repair of pipe and specials which are damaged during storage, loading, transport and off-loading.
- G. The Contractor shall legibly mark all pipes and specials in accordance with the laying schedule and marking diagram. Each pipe shall be numbered in sequence and said number shall appear on the laying schedule and marking diagram in its proper location for installation.
- H. All special pipe sections and fittings shall be marked at each end indicating the top. The word "top" shall be painted or marked on the outside top spigot end of each pipe section.

2.2 MATERIALS

- A. Steel Pipe, NPS $\frac{3}{4}$ through NPS 1½: ASTM A 53, Type S (seamless) Grade A, Schedule 40, black steel, plain ends.
- B. Steel Pipe, NPS 2 through NPS 10: ASTM A 53, Type S (seamless) and Type ERW (welded) Grade A or B, Schedule 40, black steel, plain ends.
- C. Steel Pipe Nipples: ASTM A733 made of ASTM A53, Schedule 40, black steel; seamless.
- D. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.
- E. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- F. Flanged Fittings: ASME B16.1, Classes 125, and 250; raised ground face, and bolt holes spot faced.
- G. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - 1. Material Group: 1.1.
 - 2. End Connections: Butt welding.
 - 3. Facings: Raised face.
- H. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- I. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.
- J. All steel used for the fabrication of pipe shall have a maximum carbon content of 0.25 percent, a maximum sulfur content of 0.015 percent, and shall have a minimum elongation of 22 percent in a 2-inch gauge length.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Piping Installation:
 - 1. Install straight runs true to line and elevation.
 - 2. Install vertical pipe truly plumb in all directions.

3. Install piping parallel or perpendicular to building walls. Piping at angles and 45 degree runs across corners will not be accepted unless specifically shown or approved.
4. Install small diameter piping generally as shown when specific locations and elevations are not indicated. Locate such piping as required to avoid equipment, beams, and other obstructions.
5. Install piping so as to leave all corridors, walkways, work areas, and like spaces unobstructed. Unless otherwise approved or otherwise shown, provide a minimum headroom clearance under all piping of 7 feet 2 inches.
6. Protect and keep clean water pipe interiors, fittings and valves.
7. Provide temporary caps or plugs over all pipe openings at the end of each days' work, and when otherwise required or directed by Engineer.
8. Cutting: Cut pipe from measurements taken at site, not from Drawings.
9. Install dielectric unions wherever dissimilar metals are connected except for bronze, brass or stainless-steel valves in ferrous piping.
10. Provide a union downstream of each valve with screwed connections.
11. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.

B. Flanged Joints:

1. Assemble flanged joints using 1/8-inch ring-type gaskets for raised face flanges. Use full face or ring-type gaskets for flat face flanges. Gaskets shall be suitable for the service intended in accordance with the manufacturer's ratings and instructions. Gaskets shall be properly centered.
2. Bolts shall be tightened in a sequence which will insure equal distribution of bolt loads.
3. The length of bolts shall be uniform, and they shall not project beyond the nut more than 1/4-inch or fall short of the nut when fully taken up. The ends of bolts shall be machine cut so as to be neatly rounded. No washers shall be used except as required on PVC pipe.
4. Bolt threads and gasket faces for flanged joints shall be lubricated prior to assembly.
5. Alternately tighten bolts 180 degrees apart to compress the gasket evenly.

C. Steel Pipe Joints:

1. Joints in steel pipe shall be butt welded, lap welded slip joints, flanged, or threaded joints, except that flexible couplings, mechanical couplings, or flanged connections shall be provided where shown on the Drawings.
2. After welding, the joint and the surrounding damaged or uncoated area shall be coated with the same material and to the same thickness as the shop applied coating and lining.
3. For threaded joints, use standard, right hand tapered full depth threads on steel piping and apply an approved joint compound to the male threads only, before installation. Remove all cuttings and foreign matter from the inside of the pipe. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.

D. Installing Valves and Accessories:

1. Provide supports for large valves, flow meters and other heavy items as shown or required.
2. Install floor stands as shown and as recommended by the manufacturer.
3. Position valve operators as shown. When the position is not shown, install the valve so that it can be conveniently operated and as approved by Engineer. Avoid placing operators at angles to the floors, walls or walkways.
4. Position flow measuring devices in pipe lines so that they have the length of straight upstream and downstream runs between devices and pipe changes recommended by the manufacturer, unless specific location dimensions are shown. Position check valves so that they do not conflict with the discs of butterfly valves.

E. Unions:

1. Install dielectric unions wherever dissimilar metals are connected except for bronze or brass valves in ferrous piping.
2. Provide a union downstream of each valve with screwed connections.
3. Provide screwed unions or flanged connections at each piece of equipment, where shown, and where necessary to install or dismantle piping.

F. Eccentric Reducers: Use eccentric reducers where shown and where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

G. Transitions from One Type of Pipe to Another:

1. Provide all necessary adapters, dielectric gaskets, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

3.3 PAINTING

- A. Field painting is specified under Section 09900 – Painting and Coating

3.4 TESTING OF PIPING

- A. General:

1. Test all piping as specified below unless otherwise authorized by Engineer.
2. Notify Engineer 48 hours in advance of testing.
3. Provide all testing apparatus including pumps, hoses, gages, and fittings.
4. Pipelines shall hold the specified test pressure for two hours.
5. Test any encased piping prior to pouring slabs or encasement.
6. Repair and retest pipelines which fail to hold specified test pressures, or which exceed the allowable leakage rate.
7. Test pressures required are measured at the lowest elevation of the pipeline section being tested, unless otherwise specified.
8. Conduct all tests in the presence of the Engineer. Repeat tests in the presence of local authorities having jurisdiction, if required.
9. CONTRACTOR shall provide temporary plugs, caps and blind flanges to facilitate pressure testing.

- B. Pressure Test Procedure:

1. Ensure that all supports, and restraint protection are securely in place.
2. Fill section to be tested slowly with water and expel all air. Install cocks, if necessary, to ensure removal of air.
3. Test only one section of pipe at a time.
4. Apply specified test pressure required for two hours and observe pressure gage. Check carefully for leaks while test pressure is being maintained.
5. No pressure drop or leakage is permitted.

****END OF SECTION****

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SECTION 15064 - COPPER PIPE

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish and install copper pipe and fittings.
- B. All jointing materials, end caps and other appurtenances and accessories shall be provided.
- C. It is the intent of the Contract Documents to provide complete and workable piping systems. Any supplementary fittings and appurtenances required for proper completion of the work shall be considered as having been included under this section.

1.2 RELATED SECTIONS

- A. Section 01600 – General Equipment Provisions
- B. Section 15080 – Piping Specialties
- C. Section 15100 – Valves, (General)
- D. Section 15140 – Pipe Supports

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. ANSI B 16.22, Wrought Copper and Bronze Solder Joint Pressure Fittings.
- B. ASTM B 32, Specification for Solder Metal.
- C. ASTM B 42, Specification for Standard Size Seamless Copper Pipe.
- D. ASTM B 68, Specification for Bright Annealed Seamless Copper Tube.
- E. ASTM B 75, Specification for Seamless Copper Tube.
- F. ASTM B 88, Specification for Seamless Copper Water Tube.
- G. ASTM B 302, Specification for Threadless Copper Pipe.
- H. ASTM B 306, Specification for Copper Drainage Tube (DWV).
- I. ASTM B 280, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration.

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following: Detailed drawings and data on pipe fittings and appurtenances.

1.5 QUALITY ASSURANCE

- A. Each type of pipe and fitting shall be obtained from no more than one manufacturer.
- B. Requirements of Regulatory Agencies: Comply with the applicable provisions of the following regulatory agencies, where applicable:
 - 1. Underwriters' Laboratories, Incorporated.
 - 2. National Fire Protection Association.
 - 3. ASME, Boiler and Pressure Vessel Code.
 - 4. State and Local Building Codes and Ordinances.
 - 5. Uniform Plumbing Code.

1.6 DELIVERY, STORAGE AND HANDLING

- A. See Section 01600 – General Equipment Provisions

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Potable Piping: Potable piping shall conform to the requirements of ASTM B 88. Underground, buried piping, unless otherwise specified, shall be Type K. All fittings shall be soldered, except at valves which may be flared or compression types. Non-potable and process piping shall conform to the above requirements. Above floor piping shall be Type L, unless otherwise specified.
- B. Threadless Copper Pipe: Pipe shall be assembled with soldering-joint pipe fittings. Material shall conform to ASTM B 302.
- C. Copper Drainage Pipe: Pipe for sanitary drainage or soil, waste and vent pipe, shall conform to ASTM B 306.

2.2 JOINTING

- A. Except as noted above, all copper piping shall be assembled with soldered type joints. Fittings shall conform to ANSI B 16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

1. Soldered joints shall be 95-5 tin-antimony solder, conforming to ASTM B 32.
- B. All joints shall conform to manufacturer's recommendations and shall be made by skilled workmen.
- C. Joints shall develop full strength and shall be greater than the pipe joined.

2.3 MARKING

- A. All items shall be marked or labeled with the following information:
 1. Metal or alloy designation.
 2. Temper.
 3. Size and schedule.
 4. ASTM specification number.
 5. Name and location of supplier.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Joints:
 1. Assemble copper tubing with soldered joints. Solder shall be 95-5 tin-antimony solder conforming to ASTM B 32.
 2. Ream or file pipe to remove burrs.
 3. Clean and polish contact surfaces of joints.
 4. Apply flux to both male and female ends.
 5. Insert end of tube into full depth of fitting socket.
 6. Heat joint evenly.
 7. Form continuous solder bead around entire circumference of joint.
 8. Runs shall contain unions at connection to equipment and at reasonable distances along the lengths of runs to permit convenient disassembly of piping and removal of equipment.
 9. Stubbing exposed to view shall be wiped after sweating.

- A. All copper pipes passing through a concrete slab or wall shall be installed in a PVC, Schedule 80 sleeve.

3.2 INSPECTION

- A. Contractor shall inspect all piping to assure that piping is free from defects in material and workmanship. The compatibility of all pipe, fittings and coatings shall be verified by the Contractor.

****END OF SECTION****

SECTION 15080 – PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install all piping specialties

1.2 RELATED SECTIONS

- A. Section 01600 – General Equipment Provisions

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Uniform Plumbing Code

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 - 1. Detailed drawings and data on each type of specialty to be furnished.
 - 2. Operations and Maintenance data

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have experience in the production of similar types of piping specialties specified.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Emergency Shower and Eyewash Stations:
 - 1. Emergency Shower and Eyewash Station:
 - a. Materials:
 - 1) Shower: ABS plastic shower head with 1-1/2-inch instant action stay-open stainless-steel ball valve and stainless steel 24-inch rigid pull rod.
 - 2) Eye/Face-Wash: ABS plastic bowl with twin Buna-N covered ABS plastic heads and stainless-steel ball valve, instant action, stay-open type.
 - 3) Pipe: All PVC parts shall be Schedule 80.
 - 4) Flowrate at 30 psi:

- a) Eye/Face Wash - 5.5 gpm.
 - b) Shower - 33 gpm
 - b. Manufacturers: Provide emergency shower and eyewash stations of one of the following:
 - 1) Haws Drinking Faucet Company, Model No. 8330.
 - 2) Or equal.
- 2. Alarm System: At each emergency shower and/or eyewash station:
 - a. Type: Audible and visual alarm system, complete and factory wired, except for power connection, operated by a waterproof flow switch.
 - 1) Light: UL listed. Light intensity 9000 lumens on horizontal axis, solid state, weatherproof.
 - 2) Alarm: High audible 106 decibels at 1 foot.
 - 3) Flow Switch: Paddle-type, watertight for horizontal mounting, AC, 125V, 5 amps, single pole, double throw, UL listed. Two flow switches shall be provided, one for local alarm and one for signal to the remote-control panel for the particular system.
 - 4) Electrical Connection: 3/4-inch conduit, 115-volt, 60 cycle single phase. Refer to Division 16, Electrical
 - b. Manufacturers: Provide one of the following:
 - 1) Haws Drinking Faucet Company, Model 9000
 - 2) Or equal

2.2 PAINTING

- A. Field painting according to Section 09900 Painting and Coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install piping specialties in accordance with manufacturer's instructions.

****END OF SECTION****

SECTION 15085 – PIPING INSULATION SYSTEM

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install insulation, vapor barrier and aluminum exterior cladding and thermal blanket at all pumps and valves, strainers and meters to make for a fully operational and compliant chilled water system.

1.2 RELATED SECTIONS

- A. Section 01600 – General Equipment Provisions
- B. Division 11 – Equipment
- C. Division 15 – Mechanical

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. Federal Specification HH-1-558B, Insulation Blocks, Boards, Blankets, Felts, Sleeving, Pipe Fitting Covering
 - 2. ASTM C 272, Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
 - 3. ASTM C 273, Standard Test Method for Shear Properties of Sandwich Core Materials
 - 4. ASTM C 450, Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
 - 5. ASTM C 518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 6. ASTM C 552, Standard Specification for Cellular Glass Thermal Insulation
 - 7. ASTM C 585, Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
 - 8. ASTM C 795, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
 - 9. ASTM C 871, Standard Test Methods for Chemical Analysis of Thermal Insulation Materials for Leachable Chloride, Fluoride, Silicate, and Sodium Ions

10. ASTM C921, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
11. ASTM D 1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics
12. ASTM D 1622, Standard Test Method for Apparent Density of Rigid Cellular Plastics
13. ASTM D 1623, Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics
14. ASTM D 2126, Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
15. ASTM D 2842, Standard Test Method for Water Absorption of Rigid Cellular Plastics
16. ASTM D 2856, Standard Test Method for Open-Cell Content of Rigid Cellular Plastics by the Air Pycnometer
17. ASTM E 84, Standard Test Method for Surface Burning Characteristics of Building Materials
18. ASTM E 96, Standard Test Method for Water Vapor Transmission of Materials

1.4 SUBMITTALS

- A. Submit for approval the following:
 1. Manufacturer's literature, specifications, engineering data and samples including adhesives, tapes and vapor retarder.
 2. Fabrication instructions for pipe fitting and valve insulation and coating.
 3. Installation instructions for pipe and pipe fitting insulation.
 4. Detailed Shop Drawings showing layout of all insulation including all fittings. Identify any exposed fittings and piping.
 5. MSDS for insulation materials.
 6. Insulation Installer Qualifications.

1.5 QUALITY ASSURANCE

- A. The Contractor shall provide a qualified installer of the piping insulation.

1. The insulation installer shall have at least five (5) installations of similar type and size. The Contractor shall provide a list of these installations with description of the work and client reference.
 2. The Contractor shall ensure that the installer has been trained by the manufacturer of the pipe insulation on proper installation methods for cryogenic service.
- B. Requirements of Regulatory Agencies:
1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
 - a. Comply with applicable requirements of all governing authorities and the Uniform Plumbing Code.
 2. Certifying Agency: Certified by Underwriters' Laboratories, Incorporated.
 3. Permits: Contractor shall obtain and pay for all required permits, fees, inspections and approvals by authorities having jurisdiction.
- C. Field Measurement: Take field measurements where required prior to installation to ensure proper fitting of work.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery of Material: Material shall be delivered to the job site in waterproof packaging.
- B. Storage of Material:
1. Store material in clean, dry area, out of the weather and off the ground.
 2. Material shall be tightly covered to protect against dirt, water and mechanical and chemical damage.
 3. Material shall remain in original packaging till time of installation.

PART 2 - PRODUCTS

2.1 MATERIALS - PIPING INSULATION

- A. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- B. Calcium silicate, mineral-fiber, phenolic, polyisocyanurate, polystyrene, and mineral fiber pipe insulation wicking system insulation shall not be used.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam Insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Where pipe/insulation diameter permits, the jacketing shall be factory applied to insulation. Nominal density is 7.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 75 deg F is maximum 0.29 Btu x in./h x sq. ft. x deg F. Provide factory-applied jacket requirements as specified in "Factory-Applied Jackets" paragraph 2.8.7
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cell-U-Foam Corporation; Ultra-CUF.
 - b. Pittsburgh Corning Corporation; Foamglas.
 - c. Or equal.
 - 2. Block Insulation: ASTM C 552, Type I, Grade 1.
 - 3. Special-Shaped Insulation: ASTM C 552, Type III.
 - 4. Board Insulation: ASTM C 552, Type IV.
 - 5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II.
 - 6. Preformed Pipe Insulation with Factory-Applied ASJ or ASJ-SSL: Comply with ASTM C 552, Type II.
 - 7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
 - 8. Minimum insulation thickness: 3-inch

2.2 THERMAL BLANKETS

- A. Thermal blankets: custom fit pre-engineered insulation system, flexible and removable after installation to allow reinstallation and access to valves, pumps, flanges, equipment, and other hard to insulate items.
 - 1. Insulation Material: ASTM C 1086, encapsulated 11 lb/cu. ft. fiberglass needled mat, Type E fiber
 - 2. Inner and Outer Jacket: Minimum 16.5 oz./sq. yd. PTFE Teflon impregnated fiberglass.

3. Blanket Construction: Double sewn lock stitch with a minimum of 7 stitches per inch. Raw jacket edges shall have a PTFE Teflon fiberglass cloth binding with Teflon coated fiberglass thread stitching.
4. Quilting: Stainless steel tufts or pins placed at random locations no greater than 16" inches apart, with stainless steel speed washers for securing the insulation in place.
5. Fasteners: Stainless Steel "D" ring strap with Velcro tab both matching straps are spaced along the closing seam edge no greater than 8" apart.
6. I.D. Tags: Stainless steel with embossed lettering.
7. Insulation thickness: 2-inch minimum thickness, or thicker to comply with insulation schedule in Part 3.
8. Products:
 - a. Advance Thermal Corporation.
 - b. Shannon Enterprises of W.N.Y., Inc.; Insultech LT 450 TT for high temperature water and LT 450 SS for steam and condensate or other models.
 - c. Or equal.
9. Thermal blankets installed outdoors shall be installed in a manner that rain and dew will not collect on blankets or seep inside of blanket. Provide removable aluminum jackets water shields or rain guards.

2.3 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested and certified to provide a 1 or 2-hour fire rating as required by the installation.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. CertainTeed Corp.; FlameChek.
 - b. Johns Manville; Firetemp Wrap.
 - c. Nelson Firestop Products; Nelson FSB Flameshield Blanket.
 - d. Thermal Ceramics; FireMaster Duct Wrap.
 - e. 3M; Fire Barrier Wrap Products.
 - f. Unifrax Corporation; FyreWrap.
 - g. Or equal.

2.4 INSULATING CEMENTS

- A. Insulating cements shall be suitable for temperature range equivalent to that of the insulation.

- B. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; Triple I.
 - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
 - c. Or equal.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Insulco, Division of MFS, Inc.; SmoothKote.
 - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
 - c. Rock Wool Manufacturing Company; Delta One Shot.
 - d. Or equal.

2.5 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated. Adhesives shall contain no flammable solvents if that option is available.

- B. Cellular-Glass Adhesive: Solvent-based resin adhesive, with a service temperature range equal to the insulation.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Design Polymerics
 - b. Foster Products Corporation
 - c. Or equal.

- C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Design Polymerics DD2590-CA.
 - b. ITW TACC, Division of Illinois Tool Works; SP80, T1080
 - c. Marathon Industries, Inc.
 - d. Or equal.

2.6 MASTICS

- A. Materials shall be water based and be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-35.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
 - c. ITW TACC, Division of Illinois Tool Works; CB-50.
 - d. Marathon Industries, Inc.; 590.
 - e. Mon-Eco Industries, Inc.; 55-40.
 - f. Vimasco Corporation; 749.
 - g. Or equal.
 - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.

2.7 SEALANTS

- A. Joint Sealants:
 - 1. Joint Sealants for Cellular-Glass Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Pittsburgh Corning Corporation; Pittseal 444.
 - f. Vimasco Corporation; 750.
 - g. Or equal.
 - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 - 3. Permanently flexible, elastomeric sealant.
 - 4. Service Temperature Range: Minus 100 to plus 300 deg F.

5. Color: White or gray.
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76-8.
 - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
 - c. Marathon Industries, Inc.; 405.
 - d. Mon-Eco Industries, Inc.; 44-05.
 - e. Vimasco Corporation; 750.
 - f. Or equal.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: equal to the insulation.
 5. Color: Aluminum.
- C. ASJ Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; CP-76.
 - b. Or equal.
 2. Materials shall be compatible with insulation materials, jackets, and substrates.
 3. Fire- and water-resistant, flexible, elastomeric sealant.
 4. Service Temperature Range: Minus 40 to plus 250 deg F.
 5. Color: White.

2.8 FACTORY-APPLIED JACKETS

- A. The factory-applied jackets shall comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Vimasco Corporation; Elastafab 894.
 - b. Or equal.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Chil-Glas No. 5.
 - b. Or equal.

2.10 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. Metal Jacket:
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Products, Division of ITW; Metal Jacketing Systems.
 - b. PABCO Metals Corporation; Surefit.
 - c. RPR Products, Inc.; Insul-Mate.
 - d. Or equal.
 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing.

- b. Finish and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and 40-pound kraft paper.
- d. Factory-Fabricated Fitting Covers:
 - 1) Aluminum, 0.024-inch-thick, smooth or stucco embossed finish.
 - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.11 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136. Product performance is based on products manufactured by Venture Tape; there are slight variations among manufacturers listed.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
 - b. Compac Corp.; 104 and 105.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
 - e. Or equal.
 - 3. Width: 3 inches.
 - 4. Thickness: 11.5 mils.
 - 5. Adhesion: 90 ounces force/inch in width.
 - 6. Elongation: 2 percent.
 - 7. Tensile Strength: 40 lbf/inch in width.
 - 8. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - b. Compac Corp.; 110 and 111.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 - e. Or equal.
 2. Width: 3 inches.
 3. Thickness: 6.5 mils.
 4. Adhesion: 90 ounces force/inch in width.
 5. Elongation: 2 percent.
 6. Tensile Strength: 40 lbf/inch in width.
 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - b. Compac Corp.; 120.
 - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
 - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
 - e. Or equal.
 2. Width: 2 inches.
 3. Thickness: 3.7 mils.
 4. Adhesion: 100 ounces force/inch in width.
 5. Elongation: 5 percent.
 6. Tensile Strength: 34 lbf/inch in width.

2.12 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Products; Bands.
 - b. PABCO Metals Corporation; Bands.
 - c. RPR Products, Inc.; Bands.
 - d. Or equal.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015-inch thick 1/2-inch-wide with wing seal.
 3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch-thick, 3/4-inch-wide with wing or closed seal.
- B. Insulation Pins and Hangers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; CWP-1.
 - 2) GEMCO; Cupped Head Weld Pin.
 - 3) Midwest Fasteners, Inc.; Cupped Head.
 - 4) Nelson Stud Welding; CHP.
 - 5) Or equal.
 2. Self-Sticking-Base Insulation Hangers for Equipment: Baseplate welded to projecting spindle that is capable of holding insulation securely in position when self-locking washer is in place. Comply with the following requirements:
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
 - 2) GEMCO; Press and Peel.
 - 3) Midwest Fasteners, Inc.; Self Stick.
 - 4) Or equal.
 - b. Baseplate: Galvanized carbon-steel sheet, 0.015-inch-thick by 2 inches square.
 - c. Spindle: Low carbon steel, fully annealed, 0.105-inch-diameter (12 gage) shank, length to suit depth of insulation indicated.
 - d. Adhesive-backed base with a peel-off protective cover.
 3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) AGM Industries, Inc.; RC-150.
 - 2) GEMCO; R-150.
 - 3) Midwest Fasteners, Inc.; WA-150.
 - 4) Nelson Stud Welding; Speed Clips.
 - 5) Or equal.
 - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed stainless steel.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. C & F Wire.
 - b. Childers Products.
 - c. PABCO Metals Corporation.
 - d. RPR Products, Inc.
 - e. Or equal.

2.13 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040-inch-thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Verify that pressure testing of piping and equipment connections has been completed and that the pipe system is ready for installation of insulation.
- B. Clean and dry piping and equipment connections to be insulated.
- C. Field verify the dimensions of the installed piping prior to installation of insulation and confirm to the Engineer that it is physically possible to install the pipe insulation in accordance with project drawings, operation performance parameters and limitations of this specification.

- D. Inspect insulation materials including the insulation facing, jacket, vapor barrier prior to installation. All material applied in one day shall have any required vapor barrier applied the same day and exposed ends shall be temporarily protected with a moisture barrier sealed to the pipe.

****END OF SECTION****

SECTION 15100 – VALVES

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall furnish all labor, materials, equipment appurtenances, specialty items and services required to provide all valves and appurtenances as shown and specified in the Contract Documents. This Section also covers electric motor operators for valves.
- B. Coordination: To ensure that all valves and appurtenant equipment area properly coordinated and will function in accordance with the requirements of the Contract Documents, the Contractor shall obtain each specific valve and valve actuator from a single supplier.
- C. The Contractor shall retain ultimate responsibility under this Contract for equipment coordination, installation, operation and guarantee, and the Contractor shall furnish and install all equipment, labor, materials, appurtenances, specialty items and services not provided by the supplier(s) but required for complete and operable systems. The equipment and appurtenances covered by this specification are intended to be standard equipment of proven ability as manufactured by reputable concerns having extensive experience in production of such equipment. The equipment furnished shall be manufactured and installed in accordance with the best practices and methods and shall operate satisfactory when installed as shown and specified in the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 01600 – General Equipment Provisions
- B. Section 01615 – Equipment and Valve Identification
- C. Section 01650 – Startup Requirements
- D. Section 11070 – Variable Speed Screw Water Chillers
- E. Section 11071 – Chilled Water Primary Pumps
- F. Section 11072 – Chilled Water Secondary Pumps
- G. Section 11075 – Ancillary Equipment and Appurtenances
- H. Section 15062 – Steel Pipe
- I. Section 15080 - Piping Specialties
- J. Section 15140 - Pipe Supports
- K. Division 16 – Electrical

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings.
- B. ANSI B16.4, Cast Iron Fittings.
- C. ASTM A 48, Standard Specification for Gray Iron Castings.
- D. ASTM A 126, Standard Specification for Gray Iron Castings for Valves.
- E. ASTM A 307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
- F. ASTM A 354, Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners.
- G. ASTM A 436, Standard Specification for Austenitic Gray Iron Castings.
- H. ASTM A 536, Standard Specification for Ductile Iron Castings.
- I. ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.
- J. Motors: All actuator motors and drives shall be sized to be non-overloading over the full range of operating conditions specified herein, and shall comply with all state, federal and local requirements for designated area classification as shown and specified in the Contract Documents.

1.4 SUBMITTALS

- A. Submittals Requirements:
 - 1. Drawings and Data: Complete fabrication, assembly, foundation, and installation drawings including data and position drawings for all electrically operated valves showing how each valve will be oriented and the amount of clearance at each location, and operation, maintenance and storage instructions, together with detailed specifications and data covering materials used, power drive assembly, parts, devices and other accessories forming a part of the equipment furnished, shall be submitted for review.
 - 2. Submit detailed drawings and data on all valves listed, in this section, including type, size, service, rating and descriptions, as well as description of all specified requirements and all special features.
 - 3. Submit seismic calculations as described in Section 01600 and 01611.
 - 4. Complete operation and maintenance instruction, lubrication schedules and troubleshooting guides shall be submitted.

5. Automatically Actuated Valves:
 - a. The Contractor shall submit a single package for all automatically actuated valves which provides the following:
 - 1) A single submittal package for each automated valve including manufacturer's literature for the valve and the actuator.
 - 2) Where the submittal package for one automatically actuated valve is typical for many, the cover sheet of the submittal package shall indicate all the actuated valves for which the submitted package is typical.
 - 3) Detailed installation drawings depicting the orientation of the actuator on the valve and the orientation of the valve/actuator assembly at the location shown on the drawings.
 - 4) Wiring diagrams of the actuators.
6. Verification that painting shall be per Section 09900 and the approved Section 09900 Submittals.

1.5 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Manufacturer shall have experience in the production of the equipment to be furnished.
2. Each type of valve shall be the product of one manufacturer.

PART 2 – PRODUCTS

2.1 VALVES

A. Gate Valves (Hot Tapping and Pipe Stops):

1. Provide valves complete with operating handwheels, linings, and coatings.
2. Cast or mold onto the valve body or bonnet the name of the manufacturer and the valve size. Do not attach identification plates to the valve body or bonnet.
3. Provide valves with 125/150 flanged ends.
4. Unless otherwise indicated, valves shall be the same size as the pipe in which they are installed.
5. Unless otherwise indicated, valves shall have a working pressure rating not less than the pipe in which they are installed.

a. Gate Valve

- 4" through 12", Full Port, Non-Rising Type 304 Stainless Steel Stem, ASTM Ductile-Iron Grade A536 65/45/12 Body and Bonnet, Wax Encapsulated Cap Screws, Bronze Wedge Nut, Designed to AWWA C515 with Fusion Bonded Epoxy Lined Interior. Manufactured to AWWA C515, with 250 PSI Rating.
- Gate valves shall be Smith Cooper, or other approved equal.

B. Ball Valve

1. True Union PVC Ball Valve

- a. Type of Service: Sewage, water
- b. Type of end connection: True union threaded, flanged, or solvent weld.
- c. Size (inches): 1/2" - 6"
- d. Solvent weld, flanged or bell and spigot
- e. Rating and Description: PVC, CPVC body, Teflon seats, true union, and Viton O-ring seals. Valve shall provide for 100% flow waterway and quarter turn operation. 150 psi at 70°C
- f. Manufacturer: Provide products as manufactured by one of the following:
 - 1) Hayward MFG. Co.
 - 2) GF Plastics Systems, Inc.
 - 3) Or Equal

2. Brass Ball Valve

- a. Type of Service: Water, air
- b. Type of end connection: Threaded
- c. Size (inches): 1/4" - 4".
- d. Rating and Description: 720 psi, brass body with stainless steel trim, full port, two-piece bar stock, and reinforced teflon seats and seals.
- e. Manufacturer and Product: Provide the following:
 - 1) Apollo
 - 2) Jamesbury
 - 3) Or equal.

C. Check Valves – See Sections 11071, 11072 and 11075

D. Butterfly Valves – See Sections 11071, 11072 and 11075

E. Air Release and Vacuum Valves Air Release and Vacuum Valves:

1. Type of Valve: Air release.
2. Type of Service: Water, drainage.
3. Type of end connection: Threaded or flanged.
4. Size (inches): 1/2" – 6".
5. Rating and Description:
 - a. Cast iron body and cover: ASTM A126, Grade B.
 - b. Float: Stainless steel, ASTM A240
 - c. Linkage: Stainless steel, ASTM A296, Type 316.
 - d. Needle: BUNA-N.
6. Manufacturer and Product: Provide the following:
 - a. APCO Valve and Primer Co. Series 50 for 1/2", 3/4" inlet size.
 - b. APCO Valve and Primer Co. Series 200 for 1" to 6" inlet size.
 - c. Or equal.

F. Pressure Reducing Valves - See Section 11075

2.2 ELECTRIC MOTOR ACTUATORS

A. General:

1. Electric motor actuators shall be furnished and installed on valves where indicated on the Drawings and specified in the Contract Documents.
2. Each valve actuator shall be furnished according to the specified type, and with the specified features.
3. Painting shall be per Section 09900 and the submittals approved under Section 09900.

B. Coordination and Responsibility:

1. It shall be the unit responsibility of the supplier of the valves to coordinate the electric motor actuator with the driven equipment to obtain a successfully functioning unit.
2. The coordination shall include mechanical compatibility; opening, closing, and running torque requirements; torque seating or back-seating control requirements; operating speed and rating of actuator motor; external control requirements.
3. The valve and valve actuator shall be factory-assembled and tested at the valve manufacturer's facility, and shipped directly from the valve

manufacturer's facility to the site; or the valve and electric actuator shall be assembled at facilities of a local electric actuator supplier (EAS) contingent on the following:

- a. The EAS shall provide written submittal information from the valve manufacturer and the electric actuator manufacturer to the facility operated by the EAS is certified to conduct assembly and testing that would otherwise be conducted at the factory.
 - b. The EAS and actuator manufacturer shall show evidence of having conducted at least one similar project using the actuators specified.
4. The Contractor shall ensure that all actuators, including those specified in other Sections or shown on the Contract Drawings shall be of the same type and supplied by the same manufacturer. The Contractor shall provide all necessary coordination between the actuator manufacturer and driven equipment manufacturer in order to satisfy the conditions specified herein.

C. Electric Actuator for Open/Close Operation of Metallic Body Valves

1. General:

- a. Actuators shall be furnished and installed for non-modulating services where indicated on the Contract Drawings and as specified herein.
- b. The actuator shall be attached to the driven equipment by a suitable flanged connection for the actuator.
- c. Hardware for the flanged bolted connection shall be Type 316 stainless steel.

2. Valve Actuator Housing:

- a. The electric actuator housing shall be cast iron or aluminum and shall form a single, self-contained, weatherproof housing containing the motor, gearing, control, switches, electronic interfaces, and a separately sealed isolated terminal compartment for external connections. Power supply and control terminals shall be physically isolated from one another to protect against transient voltages. Terminal strips shall be shrouded to prevent accidental contact by personnel. Module shall include a snubber circuit to provide protection from voltage surges.
- b. The Actuator housing shall be rated NEMA 6, IP68.
- c. Double O-ring seals shall be provided to seal the terminal compartment, the motor enclosure, and the torque and limit switch compartment from rain and moisture. Similarly, O-ring seals shall be provided to seal the compartments from the oil bath gear box.
- d. Separate threaded hubs for NPT conduit connections shall be furnished for power wiring, analog signal wiring and control signal wiring.
- e. Provide a pad and 1/4-20 threaded hole for grounding lug.

- f. Sheet metal or plastic housings attached to the cast metal actuator enclosure for control components shall not be acceptable.
3. Reduction Gearing and Shafts:
- a. Reduction gearing shall run in an oil bath gearbox sealed for any operating angle. Shafts shall be mounted in anti-friction bearings. Fill/drain plugs shall be furnished for the required operating position.
 - b. Actuators shall be designed so that a hammer blow is imparted to the stem nut when opening or closing a valve, slide gate, or sluice gate. The design shall allow free movement at the stem nut before imparting the hammer blow. The actuator motor shall gain full speed before stem load is encountered.
 - c. Where an actuator is specified with a quarter-turn valve, the valve actuator shall be provided with a worm and quadrant gear assembly to operate the valve.
 - 1) The position indicator shall be manufactured by Westlok or equal and the indicator shall be furnished in lieu of a position indicator on the actuator gearbox. The position indicator plate shall be retrofitted with an adapter keyed to mate with the indicator. Position switches shall not be required.
 - 2) When a position indicator is not required, the position indicator plate shall be furnished on the actuator housing with an indicating arrow and name plates to indicate the OPEN and CLOSED position of the valve.
 - d. The gear reduction assembly for the actuator shall consist of a spur gear (if necessary to meet time requirements), worm gear, and quadrant gear designed to provide the required time to open as specified on the Drawing and herein.
 - e. The assembly shall be grease lubricated for its life of operation and rated for an ambient temperature range from -40°C to 95°C.
4. Handwheels:
- a. A permanently attached handwheel shall be provided for emergency manual operation. The handwheel shall not rotate during electrical operation and shall form an integral part of the mechanism. To place the operator in manual operation, a lever shall be used to mechanically disconnect the motor drive from the gear train. The operator shall return automatically to motor operation as the motor control is energized. The maximum torque required on the handwheel under the most adverse conditions specified herein shall not exceed 60-lb-ft; the maximum force on the handwheel shall not exceed 60 lbs. An arrow and the word "open" shall be cast on the handwheel to indicate the direction to turn the disengaged or engaged position. Failure of any primary motor drive gearing shall

not inhibit manual operation.

5. Torque Switches:

- a. Torque switches shall be furnished for actuators to disconnect the actuator motor and pick up a monitor relay when torque limits are exceeded.
- b. Torque switches shall be provided, where required, with mechanical means or bypass switches for driven equipment whose end travel is signaled by torque developed in seating or unseating.
- c. Torque switch settings shall be readily adjustable via non-intrusive means without removing any electrical covers.
- d. Torque output value will be displayed locally at the actuator via an integral 0 - 100% LCD display.

6. Travel and Position Limit Switches:

- a. End of travel and position limit switches shall be provided.
- b. Limit switches, cam operated and adjustable, shall be furnished for control, interlocking and indication. Switches shall be wired to accessible terminal blocks. Switches shall be snap action, double break, rated minimum SA, 125V AC. Electro-magnetically latching relays set by means of an infrared setting tool are an acceptable alternative.
- c. Each actuator shall be provided with 4 independently adjustable auxiliary switches in addition to those required for actuator operation.
- d. Position feedback value will be displayed locally at the actuator via an integral 0 - 100% LCD display.

7. Starters:

- a. The actuator shall have an integral, 120 VAC operated reversing starter. The contactors shall be mechanically and electrically interlocked. The contactor shall be mounted on a removable chassis along with a 120 V, fused, control power transformer.
- b. Chassis for the starter shall include a spare fuse cartridge.
- c. Phase rotation protection shall be furnished with the starter.

8. Controls:

- a. All actuator controls shall be integral to the valve housing.
- b. The electric actuator will be furnished with integral controls to provide instant reverse protection for the valve actuator components during valve travel such that an operator cannot initiate travel from full open to full closed, or vice-versa, and instantly reverse the direction of travel by depressing the CLOSE switch.
- c. Devices such as selector switches, pushbuttons, indicating lights

- and nameplates on the exterior of the actuator housing shall be NEMA 4X non-metallic. Fastening hardware shall be Type 316 stainless steel.
- d. Actuator shall be provided with an OPEN/STOP/CLOSE pushbutton switch and a LOCAL/OFF/REMOTE SWITCH mounted on the actuator housing. Switches shall be non-intrusive and not penetrate any actuator covers.
 - e. The switches shall be lockable with a padlock to prevent unauthorized field changes to the position of the control switches.
 - f. A 120 VAC monitor relay powered by the 120-control voltage at the actuator shall be provided to monitor actuator status. The monitor relay shall be deenergized on phase loss, over torque, opening of the motor temperature switch, or when the "LOR" switch is not in remote.
 - g. Adjustable torque switches and position limit switches shall be furnished for deenergizing the motor on end of travel. An over-torque limit switch contact shall be wired to the common fault monitor relay for remote indication.
 - h. Remote inputs for Open/Closed control shall be optically isolated to protect actuator control circuits from high voltage transients. Isolators shall provide protection for transients up to 2 KV.
 - i. Actuator housing shall include red, amber and green LED's to locally indicate actuator position: green for open; amber for mid-travel; and red for closed. Local diagnostics on the integral LCD display shall indicate motor overload and over torque alarms.
 - j. A normally open isolated contact output shall be provided to indicate that the valve is in remote control.
 - k. Contacts shall have a minimum contact rating of 120V, 5A.
 - l. In addition to the above, control devices and wiring shall be as indicated on the Contract Drawings and in Division 13.
9. Space Heaters: A space heater shall be furnished in the control and switch compartment and in the motor compartment of the actuator. Space heaters shall be powered by the control transformer.
10. Power Supply and Motors:
- a. Power supply shall be 120V, 1 phase, 60Hz
 - b. With a line voltage of not more than +/- 10% of rated voltage, the motor shall develop the rated torque continuously for 15 minutes without exceeding the rated temperature rise and without causing the overload protective devices in the motor starter to trip. When running time exceeds 15 minutes Class H motors shall be used.
 - c. Motors shall be integral with the actuator, totally enclosed, non-ventilated, with high starting torque and low inertia and inrush current. Motors shall have Class F or Class H insulation. An embedded automatic reset temperature switch shall be provided to disconnect the motor. An internal LED or local diagnostic screen located integrally with the actuator housing shall signal motor overload.

- d. Motors shall be sized so that the observed temperature rise by thermometer shall not exceed 55°C above an ambient of 40°C when operating at fully rated load continuously for either 15 minutes, or twice the stroking time, whichever is longer.

11. Disconnect Switches:

- a. Each actuator shall be furnished with a factory-mounted NEMA 4X, 3 pole disconnect switch, or non-automatic circuit breaker with a withstand rating equal to the available fault current as determined by the short circuit study specified in Section 16411.

12. Manufacturer and Product:

- a. Rotork
- b. AUMA

13. Spare Parts:

- a. Provide one spare fuse for each actuator furnished.
- b. Provide spare cover screws and seals.

2.3 VALVE POSITION SWITCH/INDICATORS

- A. Quarter-turn valves shall be furnished with a valve position switch/indicator and associated hardware where shown on the Drawings and specified herein.
- B. The valve position monitor shall consist of a NEMA 4X, engineered resin housing position indicator beacon mounted on the top of the housing in a clear, non-metallic cover. In the OPEN position, the beacon will display yellow quadrants; in the CLOSED position, the beacon will display black quadrants.
- C. The housing will enclose sealed proximity switch actuated by cams mounted on the extension stem which extends through the housing of the position monitor. Switch shall have SPDT Form C tungsten contacts and shall be hermetically sealed. The contacts shall be rated for 3 Amps at 120 VAC. The switch shall be rated for a temperature range of -20 F to 200 F and shall have an operational lift of 600,000 cycles and repeatability of 0.005 inches.
- D. Manufacturer:
 - 1. Westlok 9468 Series II Magnum Position Monitors.
 - 2. Or equal.

2.4 MANUAL VALVE OPERATORS

- A. Valves shall be equipped with an enclosed worm gear drive and handwheel operator.

- B. Enclosed worm gear operators shall have a gear ratio designed not to exceed 80 pounds pull to meet the required operator torque.
- C. Gears shall be permanently lubricated and totally enclosed.
- D. Operators shall be designed to hold the valve disc in any intermediate position without creeping or fluttering.
- E. Adjustable stops shall be provided to prevent overtravel in either position, to withstand a pull of 200 pounds.
- F. Stops shall be enclosed within the operator housing and be capable of absorbing the full operator torque with minimum safety factor of 5.
- G. Operators shall be equipped with a direct coupled indicator unless a position switch is to be furnished with the operator
- H. Valve operator shall be designed to fully close or fully open the valve with a maximum allowable torque of 80 pounds-feet. Valves shall open counter-clockwise and shall have a position indicator.
- I. Where indicated on the Contract Drawings, worm gear operators shall be furnished with position switch/indicators, mounting brackets, and hardware for Open/Close position indication.
- J. The housing will enclose sealed proximity switch actuated by cams mounted on the extension stem which extends through the housing of the position monitor. Switch shall have SPDT Form C contacts shall be rated for 3 Amps at 120 VAC. The switch shall be rated for a temperature range of -20 °F to 200 °F and shall have an operational life of 600,000 cycles and repeatability of 0.005- inches.
 - 1. Manufacturer:
 - 2. Provide manual operator by one of the following:
 - a. Rotork
 - b. AUMA

2.5 PAINTING

- A. Clean and prime coat exterior ferrous metal surfaces of equipment in the shop in accordance with the requirements of Section 09900, Painting.
- B. Coat machined, polished and non-ferrous surfaces including gears, bearing surfaces and similar unpainted surfaces with corrosion prevention compound which shall be maintained during storage and until equipment begins operation.
- C. Field painting is under Section 09900 Painting and Coating
- D. The Contractor shall certify, in writing, that the shop primer and coating system

is compatible with the finish coating system, in accordance with Section 09900, Painting.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all valves and appurtenances in accordance with manufacturer's instructions.
- B. Install all valves so that operating handwheels or wrenches may be conveniently turned from operating floor but without interfering with access, and as approved by Engineer.
- C. Unless otherwise approved install all valves plumb and level. Install valves free from distortion and strain caused by misaligned piping, equipment or other causes.

3.2 FIELD TESTS AND ADJUSTMENTS

- A. The Contractor shall provide the services of a factory-trained technician working for the supplier of automatically actuated valves to conduct field inspection and tests on each of the automatically actuated valves.
- B. The Electric Actuator Supplier (EAS) shall prepare and submit a test certificate for each of the automatically actuated valves on the letterhead of the supplier of the automatically actuated valves. Each test certificate shall be submitted prior to commencement of the field acceptance testing of the operation and control of the Chilled Water System.
- C. The test certificate for each valve shall include the following information:
 - 1. Confirmation that valve switch settings have been adjusted to provide positive contact closure at the valve actuator.
 - 2. Amperage draw readings for the valve taken at the actuator during travel from full -open to full-closed positions.
 - 3. Verification that all local pilot devices for the actuator, either mounted on the actuator, or located in a remote enclosure, provide local indication and control of the actuator.
 - 4. Verify that the valve functions correctly and meets the specified time and duty cycle requirements of the automatically actuated valves.
 - 5. Confirm that the valve, actuator, and internals, are in good working order.
- D. Field acceptance testing of the Chilled Water System for a particular area shall not commence until the valve test certificates have been received by the Engineer.

3.3 MANUFACTURERS SERVICE

- A. The Contractor shall provide the services of a factory-trained technician working for the supplier of automatically actuated valves to conduct field inspection and tests on each of the automatically actuated valves once installation of the electric actuators is complete and to ensure automatically actuated valves or gates interface properly with the Chilled Water System.
- B. The Contractor shall prepare and submit a test certificate for each of the automatically actuated valves on the letterhead of the supplier of the automatically actuated valves. Each test certificate shall be submitted prior to commencement of the field acceptance testing for the Chilled Water System.
- C. The test certificate for each valve shall include the following information:
 - 1. Confirmation that valve switch settings have been adjusted to provide positive contact closure at the valve actuator.
 - 2. Amperage draw readings for the valve taken at the actuator during travel from full -open to full-closed positions.
 - 3. Verification that all local pilot devices for the actuator, either mounted on the actuator, or located in a remote enclosure, provide local indication and control of the actuator.
- D. Field acceptance testing of the Chilled Water System for a particular area shall not commence until the valve test certificates have been received by the Engineer.
- E. The supplier of the automatically actuated valves shall include the cost of providing two eight-hour training sessions on the operation, maintenance, and repair of the automatically actuated valves services shall instruct DISTRICT'S personnel in operation, care and maintenance and supervise initial operation.

****END OF SECTION****

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SECTION 15140 – PIPE SUPPORTS

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide pipe supports, seismic restraints, hangers, guides, and anchors, as required by Section 01611 and 01600, as shown in the Drawings and specified herein, in accordance with the requirements of the Contract Documents.

1.2 RELATED SECTIONS

- A. Section 01600 – General Equipment Provisions
- B. Section 01611 – Seismic Design Criteria
- C. Section 05120 – Structural Steel
- D. Section 09900 – Painting and Coating
- E. Section 15080 – Piping Specialties

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. The following standards have been referenced in this Section:
 - 1. ANSI/ASME B31.1, Power Piping
 - 2. ASTM A123, Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

1.4 SUBMITTALS

- A. Shop drawings shall include the following information:
 - 1. Pipe supports, restraints, hangers, anchors, and guides
 - 2. Thermal expansion and related pipe stress analysis calculations for special supports and anchors.

1.5 QUALITY ASSURANCE

- A. The pipe supports shall be new and of current manufacture. No pipe support shall be purchased for use on the project prior to the return of approved shop drawings submitted by the Contractor pursuant to the provisions of Section 01300.
- B. The Contractor shall be responsible for the satisfactory serviceability of the pipe supports under the specified conditions.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Transport pipe supports with proper equipment to protect units from dirt and damage.
- B. Store units off ground and on firm surfaces. Protect units from damage and corrosion.

1.7 WARRANTY

- A. The Contractor shall obtain from the pipe support manufacturer a warranty for all components specified herein for one (1) year from the date of Substantial Completion.

PART 2 – PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Code Compliance: All piping systems and pipe connections to equipment shall be properly anchored and supported to prevent undue deflection, vibration, dislocation due to seismic events and line pressures, and stresses on piping, equipment, and structures. All supports, and parts thereof shall conform to the requirements of ANSI/ASME B31.1 - Power Piping, except as supplemented or modified below. Supports for plumbing piping shall be in accordance with the latest edition of the applicable plumbing code or local administration requirements.
- B. Structural Members: Wherever possible, pipes shall be supported from structural supports. Where it is necessary to fabricate frame structural supports, such supplementary supports shall be provided at no additional cost to the City. All supplementary supports shall be in accordance with the requirements of the building code and the American Institute of Steel Construction and shall be acceptable to the Engineer.
- C. Pipe Hangers: Pipe hangers shall be capable of supporting the pipe in all conditions of operation, allowing free expansion and contraction of the piping, and preventing excessive stress on equipment. All hangers shall have a means of vertical adjustment after erection. Hangers shall be designed to prevent becoming disengaged by any movement of the supported pipe. Hangers subject to shock, seismic disturbances, or thrust imposed by the actuation of safety valves, shall include additional support as necessary. All hanger rods shall be subject to tensile loading only.
- D. Hangers Subject to Horizontal Movements: At hanger locations where lateral or axial movement is anticipated, suitable linkage shall be provided to permit such movement. Where horizontal pipe movement is greater than 1/2-inch, or where the hanger rod deflection from the vertical is greater than 4 degrees from the cold to the ambient position of the pipe, the hanger rod and structural attachment shall be offset in such a manner that the rod is vertical in the cold position.

- E. Thermal Expansion: Where expansion and contraction of piping is expected, a sufficient number of expansion loops or joints shall be provided, together with the necessary rolling or sliding supports, anchors, guides, pivots, and restraints permitting the piping to expand and contract freely in all directions away from the anchored points. All components shall be structurally suitable to withstand all loads imposed as required in Section 01600 and 01611.
- F. Riser Supports: Where practical, risers shall be supported on each floor with riser clamps and lugs, independent of the connected horizontal piping.
- G. Freestanding Piping: Free-standing pipe connections to equipment such as chiller units shall be firmly attached to steel frames fabricated from angles, channels, or I-beams anchored to the floor slab with horizontal, welded steel angles and U-bolts or clamps securing the pipes.
- H. Materials of Construction:
 - 1. General: All pipe support assemblies, including framing, hardware, and anchors, shall be steel construction, galvanized after fabrication, unless otherwise indicated.
- I. Noise Reduction: To reduce transmission of noise in piping systems, all copper tubes in buildings and structures shall be wrapped with a 2-inch wide strip of rubber fabric or similar, suitable material at each pipe support, bracket, clip, or hanger.
- J. Insulation shields shall be utilized to protect the piping insulation at the point of support. The furnished and installed pipe supports shall be coordinated with the subcontractor that installs the insulation.

2.2 SUPPORT SPACING

- A. Supports for piping shall be spaced to prevent excessive sag, bending, and shear stresses in the piping, with special consideration given where components such as flanges and valves impose concentrated loads. Pipe support spacing shall not exceed the maximum spans in the tables below. For temperatures other than ambient temperatures and for other piping materials or wall thicknesses, the pipe support spacing shall be modified in accordance with the pipe manufacturer's recommendations. Vertical supports shall be provided to prevent the pipe from being overstressed from the combination of all loading effects.

- 1. Support Spacing for Schedule 40 and Schedule 80 Steel Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
1/2	6
3/4 and 1	8
1-1/4 to 2	10
3	12
4	14
6	17
8 and 10	19

12 and 14	23
16 and 18	25
20 and 22	30

2. Support Spacing for Copper Tubing:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u>
1/2 to 1-1/2	6
2 to 4	10
6 and greater	12

3. Support Spacing for Schedule 80 PVC Pipe:

<u>Nominal Pipe Diameter (inches)</u>	<u>Maximum Span (feet)</u> (at 100 degrees F)
1/2	4
3/4	4.5
1	5
1-1/4	5.5
1-1/2	5.75
2	6.25
3	7.5
4	8.25
6	10
8	11
10	12.25
12	13.25

2.3 MANUFACTURED SUPPORTS

- A. Stock Parts: Designs shall exemplify good engineering practice and use stock or production parts. Such parts shall be locally available, new, of best commercial quality, designed and rated for the intended purpose.
- B. Manufacturers, or approved equal:
 - 1. Unistrut
 - 2. Bergen-Paterson Pipesupport Corp., Woburn, MA
 - 3. Grinnell Corp., Exeter, PA

2.4 COATING

- A. Galvanizing: Unless otherwise indicated, all fabricated pipe supports other than stainless steel or non-ferrous supports shall be blast-cleaned after fabrication and hot-dip galvanized in accordance with ASTM A 123 - Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

- B. Other Coatings: Other than stainless steel or non-ferrous supports, all supports including galvanized supports, shall also receive protective coatings in accordance with the requirements of Section 09900.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: All pipe supports, seismic restraints, hangers, brackets, anchors, guides, and inserts shall be fabricated and installed in accordance with the manufacturer's printed instructions and ANSI/ASME B31.1 - Power Piping. All concrete inserts for pipe hangers and supports shall be coordinated with the formwork.
- B. Appearance: Pipe supports and hangers shall be positioned to produce an orderly, neat piping system. All hanger rods shall be vertical, without offsets. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting, as close to ceilings or roofs as possible, and without interference with other work.

3.2 FABRICATION

- A. Quality Control: Pipe hangers, supports, and seismic restraints shall be fabricated and installed by experienced welders and fitters, using the best welding procedures available. Fabricated supports shall be neat in appearance without sharp corners, burrs, and edges.

****END OF SECTION****

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SECTION 15410 - INSTALLATION OF PLUMBING PIPING

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall retain the services of a licensed Plumbing Subcontractor, who shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install a complete waste and vent piping system, including floor drains and a trap primer system.

1.2 RELATED SECTIONS

- A. Section 15053 - Ductile Iron Pipe
- B. Section 15054 - Cast Iron Pipe
- C. Section 15062 - Steel Pipe
- D. Section 15064 - Copper Pipe
- E. Section 15080 - Piping Specialties
- F. Section 15430 - Waste and Vent Piping Systems
- G. Section 15490 - Testing of Plumbing Piping Systems

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ANSI A21.6, Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids
 - 2. ANSI A21.11, Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
 - 3. ANSI A21.50, Thickness Design of Ductile-Iron Pipe
 - 4. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids
 - 5. ANSI A112.5.1, Cast Iron Soil Pipe and Fittings
 - 6. ANSI B16.12, Cast-Iron Threaded Drainage Fittings
 - 7. ANSI B125.2, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses

8. ASTM A 518, Corrosion-Resistant High-Silicon Cast Iron
9. ASTM C 564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings
10. ASTM D 1248, Polyethylene Plastics Molding and Extrusion Materials
11. ASTM D 1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
12. ASTM D 2466, Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
13. ASTM D 2467, Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
14. CISPI 301-78, Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary System
15. CISPI 310-78, Cast Iron Soil Pipe Institutes Patented Joint for Use in Connection with Hubless Cast Iron Sanitary System
16. FS HH-P-117, Federal Specification for Packing, Jute Twisted

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval detailed 1/4-inch scale layout drawings, showing materials and dimensions of piping system. See Sheet G-5 for applicable piping systems and submittal requirements in other Sections for additional required submittals.
- B. Product Data Sheets and Manufacturer's information: submit the manufacturer's specifications and product data sheets for the following:
 1. Plumbing piping and fittings
 2. Plumbing fixtures, specialties, and appurtenances
 3. Plumbing valves and accessories
 4. Supports, hangers, and restraints for plumbing piping.
 5. The Plumbing Subcontractor furnish and install reducers, couplings, and adapter connections between different pipe sizes and/or materials.

1.5 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:

- a. State and local Plumbing Code.
 - b. Uniform Plumbing Code.
- 2. Permits: Contractor shall obtain and pay for all required permits, fees and inspections by authorities having jurisdiction.
- B. Qualifications of the Plumbing Subcontractor:
 - 1. The Contractor shall provide the services of a single plumbing Subcontractor who shall assume unit responsibility for the work shown on the plumbing drawings and specified herein.
- C. Receipt and Review of Plumbing Submittals:
 - 1. No equipment submittals for plumbing equipment shall be reviewed until the qualifications of the plumbing Subcontractor, a current plumber license, and have been reviewed and approved.
 - 2. Delays and expenses associated with returned submittals under 1.2.C.1 above shall be the sole responsibility of the Contractor.

1.6 JOB CONDITIONS

- A. Sequencing: Obtain approval of Shop Drawings and layout drawings before installing any piping and placing concrete encasements.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials for piping system shall be specified under applicable Sections of Division 15, Mechanical.

PART 3 - EXECUTION

3.1 BEFORE INSTALLATION

- A. General: Thoroughly plan the installation of piping systems prior to placing concrete so that any inserts, openings, sleeves, supports and blocking will be correctly located.
- B. Defective Materials: Examine piping, fittings, valves, and accessories to be installed and reject those which are defective or in poor condition.
- C. Cleaning: Thoroughly clean all piping, fittings, valves and accessories.

3.2 INSTALLATION

- A. General:

1. Install all items as shown, specified, and as recommended by the manufacturer.
2. Request instructions from Engineer when there is a conflict between the manufacturer's recommendations and the Contract Documents.
3. Present conflicts between piping systems and equipment or structures to Engineer who will determine corrective measures to be taken.
4. Do not modify structures to facilitate installation of piping, unless specifically approved by Engineer.

B. Piping:

1. Install straight runs true to line and elevation.
2. Install vertical pipe truly plumb in all directions.
3. Install piping parallel or perpendicular to building walls. Piping at odd angles and 45-degree runs across corners will not be accepted, unless specifically shown.
4. Install small diameter piping generally as shown on the Contract Drawings, when specific locations and elevations are not indicated. Locate such piping as required to avoid ducts, equipment, beams, etc.
5. Unless otherwise approved by Engineer, provide temporary caps or plugs over all pipe openings at the end of each day's work, or when otherwise required or directed, to prevent foreign material from entering the piping systems.
6. Cutting: Cut pipe from measurements taken at site, not from Contract Drawings.

C. Joints:

1. General:
 - a. Make joints in accordance with the pipe manufacturer's recommendations and the supplemental specifications below.
 - b. Cut piping accurately and squarely and install without forcing or springing.
 - c. Ream out all pipes and tubing to full inside diameter after cutting.
 - d. Remove all cuttings and foreign matter from the inside of pipes and tubing before installation.
2. Threaded Joints: Use standard, right hand tapered full depth threads on steel piping and apply an approved joint compound, to the male threads

only, before installation. Leave not more than three pipe threads exposed at each connection.

3. Solder Joints:

- a. Ream or file pipe to remove burrs.
- b. Clean and polish contact surfaces of joints.
- c. Apply flux to both male and female ends.
- d. Insert end of tube into fittings full depth of socket.
- e. Heat joint evenly.
- f. Form continuous solder bead around entire circumference of joint.

4. Flanged Joints: Assemble any flanged joints with approved full-face gaskets and gasket compounds and draw up flange bolts evenly.

5. Plastic Pipe Joints: Make joints in plastic piping in accordance with the manufacturer's recommendations.

6. Welded Joints: ANSI B31.1 latest revision and requirements of the American Welding Society for pipe welding.

7. Flared Joints:

- a. Cut the tube to the required length.
- b. Remove all burrs.
- c. Slip the coupling nut and sleeve over the end of the tube.
- d. Clamp the tube in the flaring block so that the end of the tube is slightly above the face of the block.
- e. Place the yoke of the flaring tool on the block so that the beveled end of the compression cone is over the tube end.
- f. Turn the compression screw down firmly, forming the flare between the chamber in the flaring block and the beveled compression cone.
- g. Remove the flaring tool.
- h. Assemble the joint by placing the fitting squarely against the flare. Engage the coupling nut with the fitting threads. Tighten with two wrenches, one on the nut and one on the fitting.

D. Unions:

1. Install dielectric unions wherever dissimilar metals are connected, except for bronze or brass valves in ferrous piping.
2. Provide a union downstream of each valve with screwed connections.
3. Provide screwed or flanged unions as specified and to provide for ready dismantling of piping.

E. Eccentric Reducers: Use eccentric reducers where shown and where air or water pockets would otherwise occur in mains because of a reduction in pipe size.

- F. Valves and Accessories:
 - 1. Provide supports for large valves, flow meters and other heavy items as shown or otherwise required.
 - 2. Install floor stands as shown on the Contract Drawings and as recommended by the manufacturer.
 - 3. Provide lateral restraints for extension bonnets and extension stems as shown and as recommended by the manufacturer.

3.3 AFTER INSTALLATION

- A. Remove and replace any items which are found to be defective after installation.
- B. Repair damaged pipe as recommended by the manufacturer and approved by Engineer.
- C. Clean all debris out of piping systems.
- D. Maintain all piping, fittings, valves and accessories in clean undamaged condition.
- E. Inspections: The Contractor shall ensure that a representative or employee of the plumbing Subcontractor is present for all inspections provided by the Engineer.

****END OF SECTION****

SECTION 15430 - WASTE AND VENT PIPING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to furnish and install a complete waste and vent piping system, including floor drains and a trap primer system.

1.2 RELATED SECTIONS

- A. Section 15053 - Ductile Iron
- B. Section 15054 - Cast Iron
- C. Section 15062 - Steel Pipe
- D. Section 15064 - Copper Pipe
- E. Section 15080 - Pipe Specialties
- F. Section 15410 - Installation of Plumbing Piping
- G. Section 15490 - Testing of Plumbing Piping Systems

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ANSI A21.6, Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids
 - 2. ANSI A21.11, Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
 - 3. ANSI A21.50, Thickness Design of Ductile-Iron Pipe
 - 4. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids
 - 5. ANSI A112.5.1, Cast Iron Soil Pipe and Fittings
 - 6. ANSI B16.12, Cast-Iron Threaded Drainage Fittings
 - 7. ANSI B125.2, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses
 - 8. ASTM A 518, Corrosion-Resistant High-Silicon Cast Iron

9. ASTM C 564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings
10. ASTM D 1248, Polyethylene Plastics Molding and Extrusion Materials
11. CISPI 301-78, Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary System
12. FS HH-P-117, Federal Specification for Packing, Jute Twisted

1.4 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
 1. Manufacturers literature, specifications, and engineering data including, dimensions, size and material of the following:
 - a. Specifications and manufacturer's product literature of all pipe and fittings
 - b. Floor drains
 - c. Floor and open area cleanouts
 - d. Trap primers and appurtenances
 2. Drawings on a 1/4-inch minimum scale showing materials and dimensions of the complete waste and vent piping system, in plan and in section.

1.5 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
 - a. State and Local plumbing codes
 - b. Uniform Plumbing Code
 2. Permits: Contractor shall obtain and pay for all required permits, fees and inspections by all authorities having jurisdiction.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protection: Properly plug or cap the open ends of all pipes at the end of each day's work or other stopping point throughout construction. Equipment shall be tightly covered and protected against dirt, water and chemical or mechanical injury.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. All gravity waste and vent piping located in concrete slabs or underground as shown shall be Ductile Iron, Cast Iron and Carbon Steel as shown in the Plumbing Schedule 1 sheet of the Drawings.
- B. Drains and Cleanouts: Provide auxiliary inlet tapped for trap primer protection with removable threaded plugs on all floor drains. Provide auxiliary inlet tapped for
1. Floor Drain General Purpose:
 - a. Type: For areas with finished floors
 - b. Materials:
 - 1) Body: Enamel coated cast iron
 - 2) Collar: Enameled cast iron
 - 3) Strainer Head: Square nickel bronze grate with bronze body, heel proof grate, and vandal proof screws
 - c. Outlet Connection: 4-inch,
 - d. Product and Manufacturer: Provide one of the following:
 - 1) Jay R. Smith, Fig. 2270
 - 2) Zurn Industries, Fig Z520
 - 3) Or equal
 2. Cleanouts:
 - a. Floor and Open Area Cleanouts:
 - 1) Materials: Cast iron body and adjustable bronze top
 - 2) Outlet Connection: Standard spigot
 - 3) Accessories:
 - i) Flashing flange with flashing device and 1/4-inch diameter weep holes
 - ii) Round heavy-duty nickel bronze top
 - iii) Plug: Cast bronze taper thread plug
 - 4) Product and Manufacturer: Provide one of the following:
 - i) Jay R. Smith, Fig. 4021
 - ii) Zurn Industries, Fig. Z-1400
 - iii) Or equal
 3. Trap Primers:
 - a. Type: Automatic floor drain trap primer valve

- b. Connections: 1/2-inch inlet and 3/8-inch outlet
 - c. Accessories:
 - 1) Distribution units
 - 2) Vacuum breaker
 - d. Product and Manufacturer: Provide one of the following:
 - 1) Precision Plumbing Products, Inc. Fig. PO-500
 - 2) Or equal
4. Pipe Adapters
- a. Type: Cast Iron to PVC and PVC to Cast Iron
 - b. Connections: 6-inch and less inlet or outlet
 - c. Accessories: 316 Stainless steel bands
 - d. Product: FERNCO Series 1056 Adapters

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation of drains and cleanouts shall be in accordance with manufacturer's instructions and recommendations.
- B. Installation of piping shall be in accordance with Section 15410, Installation of Plumbing Piping.
- C. All waste and vent piping in chases shall pitch uniformly at a 1/8-inch (minimum) per foot grade, unless otherwise shown.
- D. Traps shall be furnished and installed where shown and as required by local building codes.
- E. Accessible cleanouts shall be furnished and installed as shown and as required by local building codes.
- F. Pipe adapters shall be provided for adapting PVC pipe to cast iron fittings.

3.2 FIELD QUALITY CONTROL

- A. Test piping in accordance with Section 15490 - Testing of Plumbing Piping Systems.

****END OF SECTION****

SECTION 15490 – TESTING OF PLUMBING PIPING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Contractor shall provide all tests necessary to demonstrate compliance with the Contract Documents, codes and regulations, which include water tests, air tests, and smoke tests as specified.

1.2 RELATED SECTIONS

- A. Section 15062 - Steel Pipe
- B. Section 15065 - Copper Pipe
- C. Section 15053 - Ductile Iron Pipe
- D. Section 15054 - Cast Iron Pipe
- E. Section 15080 - Pipe Specialties
- F. Section 15410 - Installation of Plumbing Piping
- G. Section 15430 - Waste and Vent Piping Systems

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified:
 - 1. ANSI A21.6, Cast-Iron Pipe Centrifugally Cast in Metal Molds, for Water or Other Liquids
 - 2. ANSI A21.11, Rubber Gasket Joints for Cast-Iron and Ductile-Iron Pressure Pipe and Fittings
 - 3. ANSI A21.50, Thickness Design of Ductile-Iron Pipe
 - 4. ANSI A21.51, Ductile-Iron Pipe, Centrifugally Cast, in Metal Molds or Sand-Lined Molds for Water or Other Liquids
 - 5. ANSI A112.5.1, Cast Iron Soil Pipe and Fittings
 - 6. ANSI B16.12, Cast-Iron Threaded Drainage Fittings
 - 7. ANSI B125.2, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses
 - 8. ASTM A 518, Corrosion-Resistant High-Silicon Cast Iron

9. ASTM C 564, Rubber Gaskets for Cast Iron Soil Pipe and Fittings
10. CISPI 301-78, Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary System
11. CISPI 310-78, Cast Iron Soil Pipe Institutes Patented Joint for Use in Connection with Hubless Cast Iron Sanitary System
12. FS HH-P-117, Federal Specification for Packing, Jute Twisted

1.4 SUBMITTALS

- A. Submit a complete written inspection report to the Engineer within 7 days following the scheduled date of the inspection.
- B. Submit a description of proposed testing methods, procedures, and apparatus to the Engineer for approval at least two weeks in advance of testing.
- C. Submit a test report for each test to the Engineer certifying the test pressure, duration of the test, and test performance of all installed piping.

1.5 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 1. Building Codes: Comply with applicable requirements of all governing authorities and the following codes:
 - a. State and local plumbing codes.
 - b. Uniform Plumbing Code.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide all necessary equipment and materials, including gages and pumps, to perform the testing operations.

PART 3 - EXECUTION

3.1 GENERAL

- A. Conduct water, air and smoke tests as required on all piping systems, as specified below.
- B. Conduct all tests in the presence of and in a manner approved by the Engineer and all state and local authorities having jurisdiction. Repeat test for these authorities if requested by them.

- C. Coordinate all required inspections of plumbing piping systems with the Engineer. Provide the Engineer with a minimum of three days' advanced notice of schedule inspection.
- D. Submit a complete written inspection report to the Engineer within 7 days following the scheduled date of the inspection.
- E. Repair and retest all lines which do not pass the tests as specified herein.
- F. Inspect all valves, joints, and specialties for tightness and for proper operation while under test pressure.

3.2 WATER TEST

- A. Drainage and Vent System Piping:
 1. Perform tests either on the entire system or on successive sections of the system.
 2. Tightly close all openings, except the highest opening, of the system or section to be tested.
 3. Fill the system or section with water to the point of overflow.
 4. Test with a head of at least 10 feet of water, except for the uppermost 10 feet of the system.
 5. Allow water to stand in the system for at least 15 minutes before inspecting.
 6. Inspect the system or section for leaks and repair any leaks found.
- B. Water Piping:
 1. Water piping shall be tested and proved tight under a pressure not less than 100 psi.
 2. Potable water shall be used for testing potable water systems.

3.3 AIR TEST

- A. Attach air compressor testing apparatus to any suitable opening after closing all other inlets and outlets. Force dehydrated, oil-less, compressed, dew point - 40F, air into system until there is a uniform gage pressure without the introduction of additional air. Below is a list of required gage pressures:
 1. Drainage and Vent Piping (substitute for water test) 5 psi for 15 minutes.

3.4 SMOKE TEST

- A. Finished Plumbing: Final test for gas and water tightness of the completed drainage and vent system:
1. Fill all traps with water.
 2. Introduce a pungent thick smoke, produced by one or more smoke machines, into the system.
 3. When the smoke appears at vent openings, close the system.
 4. Maintain a pressure in the system equivalent to a 1-inch water column for the period of the inspection.
 5. Inspect the system for leaks and repair any leaks found.

****END OF SECTION****

SECTION 16040 - ELECTRIC MOTORS

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide electric motors, accessories, and appurtenances, complete and operable, in accordance with the Contract Documents. The provisions of this Section apply to all electric motors.

1.2 RELATED SECTIONS

- A. The Work of the following Section applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 16050 - Basic Electrical Materials and Methods

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. ANSI/NEMA MG 1 - Motor and Generator
 - 2. ANSI/NEMA MG12.53 - Motor Testing
 - 3. ANSI/IEEE 112 - Standard Test Procedure for Polyphase Induction Motors and Generators
 - 4. IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery
 - 5. IEEE 841 - Recommended Practice for Chemical Industry Severe-Duty Squirrel Cage Induction Motors
 - 6. IEEE RP-841 - Recommended Practice for Chemical Industry Severe Duty Squirrel Cage Induction Motors

1.4 SUBMITTALS

- A. Shop Drawings and Catalog Data: Submit shop drawings and catalog data submittals in accordance with Section 01300 - Contractor Submittals.
- B. Motor Data: Complete motor data shall be submitted in the shop drawings for driven machinery. Motor data shall include:
 - 1. Machine name and specification number of driven machine.
 - 2. Name of the motor manufacturer.

3. Motor type or model and dimension drawing. Include motor weight.
 4. Nominal horsepower.
 5. NEMA design.
 6. Enclosure.
 7. Frame size.
 8. Winding insulation class and temperature rise class.
 9. Voltage, phase and frequency ratings.
 10. Service factor.
 11. Full load current at rated horsepower for application voltage.
 12. Full load speed.
 13. Guaranteed minimum full load efficiency. Also provide nominal efficiencies at 2 and 3/4 load.
 14. Type of thermal protection or overtemperature protection, if included.
 15. Wiring diagram for devices such as motor leak detection, temperature, or zero speed switches, as applicable.
 16. Bearing data, with recommended lubricants for relubricatable type bearings.
 17. If used with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery.
 18. Power factor at 2, 3/4 and full load.
 19. Recommended size for power factor correction capacitors to improve power factor to 0.95 (lagging) when operated at full load.
- C. Water Cooling: If water cooling is required for motor thrust bearings, the shop drawings shall indicate this requirement.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Identical Motors: Electric motors driving identical machines shall be identical.

- B. Maximum Motor Loading: Maximum motor loading shall in all cases be equal to nameplate horsepower rating or less, exclusive of service factor and as verified with the approved submittal data of the driven machinery.
- C. Minimum Motor Horsepower: All motors shall be sized to carry continuously all loads which may be imposed through their full range of operation. The motor horsepower shall be not less than the estimated minimum specified for each driven machine. If the estimated minimum horsepower specified is not adequate to satisfy the foregoing restrictions or any other requirements of these Specifications, the motor with the required horsepower shall be supplied at no additional cost to the Engineer. In addition, any changes caused by increase in motor horsepower shall be made by the Contractor at no additional cost to the Engineer; such changes may involve circuit breakers, magnetic starters, motor feeder conductors, conduit sizes, etc.
- D. Exempt Motors: Motors which are for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, part of domestic or commercial use apparatus may be excepted from these Specifications to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.2 DESIGN REQUIREMENTS

- A. General: All electric motors shall comply with ANSI/NEMA MG 1 - Motor and Generator.
- B. NEMA Design: Electric motors shall be NEMA Design B, (except as indicated in Equipment Specifications for motors controlled for variable speed operation and other special motors,) constant speed squirrel-cage induction motors having normal starting torque with low starting current. In no case shall starting torque or breakdown torque be less than the value in ANSI/NEMA MG 1. Motors shall be suitable for the starting method indicated on the Electrical Drawings.
- C. Motor Voltage Ratings: Motors shall have voltage ratings in accordance with the following, unless otherwise indicated:
 1. Motors below 2 hp shall be rated 115 V, single-phase, 60-Hz. Dual voltage motors rated 115/230 V, 115/208 V, or 120-240 V are acceptable, provided all leads are brought out to the conduit box.
 2. Motors 2 hp and larger shall be rated 230 V, or 460 V, 3-phase, 60-Hz, as required and as indicated. Dual voltage motors rated 230/460 V or 208/230/460 V are acceptable, provided all loads are brought out to the conduit box.
- D. Insulation: All three-phase motors shall be furnished with Class F insulation, rated to operate at a maximum ambient temperature of 104 degrees F and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42. Single phase motors

shall have Class F insulation with temperature rise not to exceed the insulation class.

- E. Motors in Nonhazardous Areas: Motors 50 hp or smaller located in nonhazardous areas shall be totally enclosed, fan cooled with a service factor of 1.15 unless otherwise indicated. Motors larger than 50 hp and up to 200 hp shall be the type indicated in the drawing schedules.
- F. Motors in Hazardous Areas: Motors for use in hazardous areas shall have enclosures suitable for the classification shown on the Drawings. Such motors shall be UL listed and stamped as such.
- G. Motors for Use Outdoors: Motors for 25 hp and larger for use outdoors shall have space heaters. Space heaters shall be 120 VAC.
- H. High Efficiency Motors:
 - 1. Motors with a nameplate rating of 1 hp and above shall be "high efficiency" units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Such motors shall have efficiencies determined by the test as set forth in ANSI/IEEE 112-Standard Test Procedure for Polyphase Induction Motors and Generators, Method B.
 - 2. Efficiency Index: Efficiency index, nominal efficiency, and minimum efficiency shall be defined in accordance with ANSI/NEMA MG 12.53 - Motor Testing; these values shall be stated in the shop drawing submittal.
 - 3. High efficiency motors shall conform to the guaranteed minimum, full-load efficiency requirement required by the Department of Energy (DOE) guidelines.
- I. Motors intended for use with variable frequency drives (VFDs) shall be compatible with the characteristics of the VFD. Motor nameplate shall specify inverter duty type motor. Motor insulation shall meet NEMA 1, Part 31. Provide factory installed rotor grounding ring and insulated bearings.
- J. All two-speed motors shall be of the two-winding type.

2.3 ACCESSORY REQUIREMENTS

- A. General: Horizontal motors 3 hp and larger, and all vertical motors, shall have split-type cast metal conduit boxes. Motors other than open drip-proof shall be gasketed. Motors less than 3 hp shall have the manufacturer's standard conduit boxes.
- B. Lifting Devices: All motors weighing 265 pounds or more shall have suitable lifting eyes for installation and removal.

- C. Special Requirements: Refer to individual equipment specifications for special requirements such as motor winding thermal protection, multispeed windings, etc.
- D. Grounding Lugs: Provide motor grounding lug suitable to terminate ground wire, sized as indicated on the Drawings.
- E. Nameplate: All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with NEMA Standard motor data, in conformance with NEMA MG-1-10.40.

2.4 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: All single-phase 120, 208, or 230 V motors shall have integral thermal overload protection or shall be inherently current limited.
- B. Thermostats: Winding thermostats where specifically indicated shall be snap action, bi-metallic, temperature-actuated switch. Thermostats shall be provided with one normally closed contact. The thermostat switch point shall be precalibrated by the manufacturer.

2.5 MOTOR BEARINGS

- A. General: Bearings shall conform with the provisions of Section 11000 - Equipment General Provisions, except as supplemented or modified by the requirements of this Specification.
- B. Bearing Life: All motors greater than 2 hp shall have bearings designed for a minimum rated L-10 life of 10 years or 100,000 hours, whichever comes first.
- C. Fractional Horsepower: Fractional horsepower through 2-hp motors shall be furnished with Lubricated-for-Life ball bearings.
- D. Horizontal Motors Over 2 Horsepower: Motors larger than 2 hp shall be furnished with relubricatable ball bearings.
- E. Vertical Motors Over 2 Horsepower: Vertical motors larger than 2 hp shall be furnished with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- F. Water Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve and, (where subject to freezing), insulation with heat tracing.

2.6 MANUFACTURERS

- A. The Contractor's designated equipment supplier shall have the responsibility to select and supply suitable electric motors for the driven equipment. The choice of motor manufacturer shall be subject to review by the Engineer. Such review will

consider the future availability of replacement parts and compatibility with driven equipment. Acceptable manufacturers include the following, or equal:

1. U.S. Motors.
2. Reliance Electric.
3. Louis Allis (Division of Magnetek, Inc.)
4. Marathon Electric Manufacturing Co.
5. Siemens Energy & Automation, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Motor installation shall be performed in accordance with the motor manufacturer's written recommendations and the written requirements of the manufacturer of the driven equipment.
- B. Electrical work involving connections, controls, switches, and disconnects, shall be as indicated in Division 16.
- C. Capacitors shall be connected to the output terminals of the motor starter. Motor overload elements shall be adjusted downwards to reflect the reduction in line current resulting from power factor correction.

3.2 FACTORY TESTING

- A. Motors rated 100 hp and larger shall be factory tested in conformance with ANSI/IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Test reports shall include heat run, performance, bearing (temperature, noise), locked rotor, speed torque, no-load saturation, surge, and megohmmeter/dielectric absorption ratio. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted.

3.3 FIELD TESTING

- A. The Contractor shall perform the following field tests:
 1. Inspect each motor installation for any deviation from rated voltage, phase or frequency; or improper installation.
 2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage.

3. Check winding and bearing temperature detectors and space heaters for functional operation.
4. Test for proper rotation before connection to the driven equipment.
5. Test insulation (megger test) of all new as well as reused motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

****END OF SECTION****

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SECTION 16050 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall provide electrical and appurtenant Work necessary for a complete and operable electrical system, in accordance with the Contract Documents.
- B. The Contractor shall make all field connections and terminations to all motors, switchgear, panels, control equipment and devices, instruments, and to all vendor-furnished packaged equipment. The requirements of this Section shall apply to all electrical items indicated in Division 16 unless otherwise indicated.
- C. The Contractor shall provide all materials and incidentals required to complete the electrical work. Typical materials which may be incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and all control wires required by vendor-furnished equipment to interconnect with other equipment all specifically indicated on the Contract Documents.
- D. All concrete work required for encasement, installation, or construction of the Work specified in Division 16 shall be 3000-psi concrete conforming to the applicable requirements of Section 03301-Cast-in-Place Concrete; provided, that the following exceptions and supplementary requirements shall apply:
 - 1. Consolidation of encasement concrete around duct banks shall be by hand puddling, and no mechanical vibration shall be permitted.
 - 2. A workability admixture shall be used in encasement concrete, which shall be a hydroxylated carboxylic acid type in liquid form. Admixtures containing calcium chloride shall not be used.
 - 3. Concrete for encasement of conduit or duct banks shall contain an integral red-oxide coloring pigment in the proportion of 8 pounds per cubic yard of concrete.

1.2 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 03300 - Cast-In-Place Concrete
 - 2. Section 05550 – Miscellaneous Metalwork
 - 3. Section 09900 - Painting and Coating

4. Section 13010 - Instrumentation and Controls General Requirements
5. Section 16950 - Electrical Tests

1.3 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

A. Codes and Standards:

1. NEC - National Electrical Code, latest edition

B. Government Standards:

1. FS W-C-596E/GEN(1) - Connector, Plug, Receptacle and Cable Outlet, Electrical Power
2. FS W-S-896E/GEN(1) - Switches, Toggle (Toggle and Lode), Flush Mounted (ac)
3. FS WW-C-563 - Electrical Metallic Tubing (EMT)
4. FS WW-C-581D, E - Conduit, Metal, Rigid, And Intermediate; And Coupling, Elbow, and Nipple, Electrical Conduit: Steel, Zinc Coated

C. Commercial Standards:

1. ANSI C80.1 - Zinc Coated, Rigid Steel Conduit, Specification for
2. ANSI C80.4 - Fittings for Rigid Metal Conduit and Electrical Metallic Tubing, Specifications for
3. ANSI/UL 467 - Grounding and Bonding Equipment, Safety Standard for
4. ASTM B3 - Soft or Annealed Copper Wire
5. ASTM B8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft
6. ASTM B33 - Specification for Timed Soft or Annealed Cooper Wire for Electrical Purposes
7. ICEA S-61-402 - Thermoplastic - Insulated Wire and Cable
8. ICEA S-66-524, NEMA WC7 - Cross-Linked, Thermosetting, Polyethylene Wire and Cable
9. ICEA S-68-516, NEMA WC8 - Ethylene Propylene Rubber Insulated Wire and Cable
10. NEMA 250 - Enclosures for Electrical Equipment (1,000 volts maximum)

11. NEMA PB-1 - Panelboards
 12. NEMA VE-1 - Ventilated Cable Tray
 13. UL 6 - Rigid Metal Electrical Conduit
 14. UL 44 - Rubber - Insulated Wire and Cable.
 15. UL 514 - Electrical Outlet Boxes and Fittings
 16. UL 886 - Electrical Outlet Boxes and Fittings for Use in Hazardous Locations
 17. UL 1072 - Medium Voltage Cable, Type MV-90
- D. All equipment furnished by the Contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated (UL), or of an independent testing laboratory acceptable to the local code-enforcement agency having jurisdiction.
- E. In addition to other regulatory requirements, the Work of this Section shall comply with the requirements of the current edition of the Standard Specifications for Public Works Construction (SSPWC) Subsection 209-1, together with the latest adopted editions of the Regional and City of San Diego Supplement Amendments.
- F. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the OSHA Safety and Health Standards (29CFR1910 and 29CFR1926, as applicable), State Building Standards, and applicable local codes and regulations.

1.4 SUBMITTALS

- A. Shop Drawings and Catalog Data: The Contractor shall submit shop drawings and catalog data submittals in accordance with Section 01300 - Submittals.
- B. Material Lists: The Contractor shall submit complete material lists for the Work of this Section. Such lists shall state the manufacturer and brand name of each item or class of material. The Contractor shall submit shop drawings for all grounding work not specifically indicated.
- C. Shop Drawing Content: Shop drawings are required for materials and equipment listed in other Sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
1. Front, side, rear elevations and top views with dimensional data.
 2. Location of conduit entrances and access plates.
 3. Component data.

4. Connection diagrams, terminal numbers, wire numbers, internal wiring diagrams, conductor size, and cable numbers.
 5. Method of anchoring, seismic requirement; weight.
 6. Types of materials and finish.
 7. Nameplates.
 8. Temperature limitations, as applicable.
 9. Voltage requirement, as applicable.
 10. Front and rear access requirements.
- D. Catalog Data: Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- E. Materials and Equipment Schedules: The Contractor shall furnish within 30 days, a complete list of all materials, equipment, apparatus, and fixtures proposed for use. The list shall include type, sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- F. Manuals: The Contractor shall furnish manuals as part of the shop drawing submittals under Section 1 specifications.
- G. Record Drawings: In addition to the record drawings as a part of the record drawing requirements specified in Section 1 specifications, the Contractor shall show depths and routing of all duct bank concealed below grade electrical installations.

1.5 QUALITY ASSURANCE

- A. Field Control of Location and Arrangement: The Drawings diagrammatically indicate the desired location and arrangement of outlets, conduit runs, equipment, and other items. The Contractor shall determine the exact locations in the field based on the physical size and arrangement of equipment, finished elevations, and other obstructions. Locations shown on the Drawings, however, shall be adhered to as closely as possible.
- B. Equipment Locations: All conduit and equipment shall be installed in a manner to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, such locations shall be obtained from the Engineer.

Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the OWNER.

- C. Workmanship: All materials and equipment shall be installed in accordance with printed recommendations of the manufacturer which have been reviewed by the Engineer. The installation shall be accomplished by workmen skilled in this type of work and installation shall be coordinated in the field with other trades so that interferences are avoided.
- D. Quality of Work: All Work, including installation, connection, calibration, testing, adjustment, and paint touchup, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
- E. Protection of Equipment and Materials: The Contractor shall furnish adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the Work and until acceptable by the Engineer.
- F. Protection: All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
- G. Damaged Materials and Equipment: The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the OWNER.
- H. Tests: The Contractor shall perform all tests required by the Engineer or other authorities having jurisdictions. All such tests shall be performed in the presence of the Engineer. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. The following testing shall be accomplished:
 - 1. Testing for the ground resistance value under "Grounding," below.
 - 2. Insulation resistance tests under "Wire and Cable," below.
 - 3. Operational testing of all equipment furnished and/or connected in other Sections of Division 16, including furnishing of support labor for testing.
- I. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted for review prior to final acceptance of the project.
- J. Any test failure shall be corrected in accordance with the industry practices and in a manner satisfactory to the Engineer.

1.6 PERMITS AND INSPECTION

- A. The Contractor shall obtain permits and pay for inspection fees as indicated in the Contract Documents.
- B. The Contractor shall pay for any service charges required by the utility company for connection and activation.

1.7 AREA DESIGNATIONS

- A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.
- B. General Purpose [Indoor] Locations: Electrical work installed in areas which are not otherwise specifically classified shall be "General Purpose. Workmanship and enclosures shall comply with the general requirements of these Specifications. Electrical enclosures shall be NEMA Type 1 unless otherwise specified or noted.
- C. Outdoor and Damp Locations: In outdoor locations, raceway shall be galvanized rigid PVC (polyvinyl chloride)-coated conduit; entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Raceway supports such as hanger rods, clamps, and brackets shall be stainless steel. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, and panel enclosures shall be NEMA Type NEMA 4X enclosure shall be 316 stainless steel. Switchboard and motor control centers shall be weatherproof NEMA Type 3R. Enclosures shall be mounted 1 inch from walls to provide an air space. Locations which are indoors and 2 feet below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations. "Damp locations" shall include pipe galleries, tunnels, and basements. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.
- D. Splash Locations: Areas shown as splash proof shall have electrical installations as described for "outdoor locations."
- E. Corrosive Locations: Corrosive locations shall have stainless steel threaded hardware; all other electrical hardware, fittings, and raceway systems shall be PVC-coated. Raceway supports such as hanger rods, clamps, and brackets shall be stainless steel. Electrical enclosures shall be NEMA Type 4X 316 stainless steel. Corrosive locations shall include below grade structures.
- F. Hazardous Locations: Areas shown as hazardous shall have electrical installations suitable for Class 1, Division 1 or 2 as indicated, Group B locations as required under OSHA Safety and Health Standards (29CFR) and National Fire Protection Association (NFPA) 820.

1.8 CLEANUP

- A. Cleaning of Materials and Equipment: All materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a nonflammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Paint touchup shall be applied to all scratches on panels and cabinets. Electrical cabinets or enclosures shall be vacuum cleaned before final acceptance.
- B. Cleaning of the Site: During the progress of the Work, the Contractor shall clean the premises and leave the premises and all portions of the site free of debris.

1.9 DEMOLITION AND RELATED WORK

- A. Demolition Work: The Contractor shall perform all electrical demolition work as indicated.
 - 1. Electrical equipment and components, terminal and relay cabinets, MCCs, shall be returned to the OWNER in an orderly fashion to a designated location on the site.
 - 2. Wire, conduit, junction boxes, fittings, supports and miscellaneous hardware removed as part of the demolition work shall not be reused and shall be returned to the OWNER.
 - 3. Wires and/or conduits that need to be extended shall be terminated in a new terminal box with terminal strips. Terminal box shall be properly sized by the Contractor. In outdoor installation, the terminal box shall be NEMA 4X 316 stainless steel. Wires and terminals shall be properly identified before disconnection and after reconnection.
 - 4. Wiring in conduits located in or under slabs shall be removed. The conduit shall be plugged level with the floor where practical. In other cases, the conduit shall be cut three inches below the finished floor and the area shall be resurfaced.
 - 5. Openings in walls and platforms created by the removal of conduit or electrical equipment shall be patched with materials similar to those in surrounding work areas or as required to provide proper sealed conditions as reviewed and accepted by the Engineer.
 - 6. Electrical demolition shall be as shown on the Drawings or as required by the Specifications.
 - 7. The Contractor shall exercise due care in the removal of the equipment made surplus by this project so as not to impair its resale value or reuse. The OWNER has the right to salvage any wire or other electrical equipment removed from the project.

B. Installation of New Equipment in Existing Structures:

1. Installation of certain new equipment and devices is required in existing structures. For this phase of the Work, the Contractor shall remove existing equipment or devices, install new equipment as indicated, remove existing conductors from existing raceways, and pull new conductors in existing raceways, reconnect existing conductors or furnish and install new conduit and wires.
2. The Contractor shall visit the site before bidding and carefully examine existing installation so that its proposal will reflect all the Work necessary to provide a complete installation so that the resulting installation will function as required. Include in the bid price all costs of labor and materials necessary to complete installations.

C. Installation of Temporary Equipment:

1. To facilitate continuous operation of existing equipment, temporary equipment shall be provided where indicated. The Contractor shall submit installation and connection details for review and acceptance. Temporary installations shall be provided at no additional cost to the OWNER.
2. All cables, conduits, and fittings used in temporary connections shall not be reused to install permanent connections. Salvaged items shall be returned to the OWNER.

D. Plant Monitoring Power and Control Shutdowns:

1. Existing plant operation shall be continued during this demolition process. The Contractor shall carefully examine all Work to be done in, on, or adjacent to existing equipment. Work shall be scheduled, subject to the OWNER's approval, to minimize required plant shutdown time. The Contractor shall submit a written request, including sequence and duration of activities to be performed during plant shutdown.
2. The Contractor shall perform all switching and safety tagging required for plant shutdown or to isolate existing equipment. In no case shall the Contractor begin any Work in, on, or adjacent to existing equipment without written authorization of the Engineer.

E. Modifications to Existing Electrical Facilities:

1. The Contractor shall provide all modifications or alterations to existing electrical facilities required to successfully install and integrate the new electrical equipment. All modifications to existing equipment, panels, or cabinets shall be made in a professional manner with all coatings repaired to match existing. Modifications to existing electrical facilities required for a complete and operating system shall be made at no additional cost to the OWNER. Extreme caution shall be exercised in digging trenches in order

not to damage existing underground utilities. Cost of repairs of damages caused during construction shall be the Contractor's responsibility.

2. The Contractor shall verify all available existing circuit breakers in lighting panels for their intended use as required by the Drawings. At no additional cost to the OWNER, the Contractor shall verify the available space in substation switchboards to integrate new power circuit breakers.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All equipment and materials shall be new, shall be listed by UL, and shall bear the UL label where UL requirements apply. All equipment and materials shall be the products of experienced and reputable manufacturers in the industry. Similar items in the project shall be products of the same manufacturer. All equipment and materials shall be of industrial grade and standard of construction; shall be of sturdy design and manufacture; and shall be capable of reliable, trouble-free service.

2.2 GROUNDING

- A. General: All components of the grounding electrode system shall be manufactured in accordance with UL 467 and shall conform to the applicable requirements of NEC Article 250.
- B. Grounding Cable: Grounding cable shall be copper. Bare copper wire shall be annealed, No. 8 AWG minimum, if not called out in the Drawings.
- C. Ground Rods: Ground rods shall conform to ANSI/UL 467 and shall be 3/4-inch diameter copper-clad steel, sectional type, joined by threaded copper alloy couplings.
 1. Grounding connectors shall be high-strength copper alloy suitable for direct burial.
 2. Wire connections shall be exothermic weld by Cadweld of Erico Products for underground installation, or Burndy Hyground System using irreversible compression-type connectors for exposed aboveground installation.
 3. Manufacturers of grounding materials shall be Copperweld, Blackburn, Burndy, or equal.

2.3 UNDERGROUND DUCTS AND MANHOLES

- A. General: Where an underground distribution system is required, it shall be comprised of multiple runs of single bore metallic and nonmetallic ducts, concrete encased, with steel reinforcing bars, with underground manholes and pullboxes. When nonmetallic ducts are required, they shall be rigid Schedule 40 PVC for concrete encasement.

1. Manholes and pullboxes shall be of precast concrete. Concrete construction shall be designed for traffic loading.
 - a. Covers shall be traffic type, except as shown otherwise. Manholes and pullbox covers designated as "HV" covers shall be identified as "High Voltage Electric," "P" shall be identified as "Secondary Electric," "C" as "Control" and "S" as "Signal." All covers shall be watertight after installation.
 - b. Manholes and pullboxes shall be equipped with pulling-in irons opposite and below each ductway entrance.
 - c. Manholes shall have concrete covers with 30-inch diameters lids. All covers and lids shall be bolted to cast-in-place frames with corrosion resistant hardware. Frames shall be factory-primed; covers shall be cast-iron and shall have pick holes.
 2. Manholes and pullboxes shall have cable supports so that each cable is supported at 3-foot intervals within the manhole or pullbox. Cable supports and racks shall be fastened with galvanized bolts and shall be fabricated of fiber glass or galvanized steel. Porcelain insulators for cable racks shall be provided.
 3. Manholes and pullboxes shall be Brooks, Quikset, U.S. Precast, or equal. Cast-iron covers shall be by U.S. Foundry, or equal.
- B. Concrete Envelope: The concrete envelope shall have a compression strength of 3000 psi in accordance with the requirements of Section 03301 - Cast-in-Place Concrete.

2.4 RACEWAYS

- A. General: Raceway shall be manufactured in accordance with UL and ANSI standards and shall bear UL label as applicable.
- B. Galvanized Rigid Steel (GRS) Conduit:
1. Rigid steel conduits and fittings shall be full weight, mild steel, hot-dip galvanized and zinc bichromate coated inside and outside after galvanizing.
 2. Rigid steel conduit shall be manufactured in accordance with UL Standard No. 6 and ANSI C80.1.
 3. Rigid steel conduit shall be manufactured by Triangle PWC, Republic Steel, or equal.
- C. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be Schedule 40 PVC.
1. Nonmetallic conduits and fittings shall be UL listed, sunlight-resistant, and rated for use with 90 degrees C conductors.

2. Nonmetallic conduits and fittings shall be manufactured by Carlon, Condux, or equal.
- D. Flexible Metallic Conduit: Flexible metallic conduit shall be fabricated from galvanized interlocked steel strip. Liquid-tight flexible metallic conduit shall have an extruded PVC covering over the flexible steel conduit. For conduit sizes 3/4 inch through 1-1/4 inches, flexible conduits shall have continuous built-in copper ground conductor. Flexible conduit shall be American Brass, Anaconda, Electroflex, or equal. Explosion-proof flexible conduits shall be used for Class I, Div. 1, Group C&D areas.
- E. PVC-Coated Raceway: PVC-coated raceway system shall conform to Federal Specification WW-C-581E, ANSI C80.1, and to UL specifications.
1. The zinc surfaces of the conduits and fittings shall remain intact and undisturbed on both the inside and the outside of the conduit through the preparation and application processing.
 2. A PVC coating shall be bonded to the galvanized outer surface of the conduit. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic.
 3. The thickness of the PVC coating shall be a minimum of 40 mils.
 4. A PVC jacketed coupling shall be furnished with each length of conduit. A PVC sleeve equal to the OD of the conduit shall extend 1-1/2 inches from each end of coupling.
 5. PVC-coated conduits shall be as manufactured by Robroy, Occidental (OCCAL), or equal.

2.5 WIRE AND CABLE

- A. General: All conductors, including ground conductors, shall be copper. Insulation shall bear UL label and the manufacturer's trademark, type, voltage and temperature rating, and conductor size. Wire and cable shall be products of American, Rome Cable, Okonite, Houston, or equal.
- B. Control Cables: All control cables shall be rated for 600 V and shall meet the following requirements:
1. Control wires shall consist of No. 14 gage stranded copper conductors and shall be XHHW rated for 90 degrees C at dry locations and 75 degrees C at wet locations.
 2. Control wires at panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.

3. Multiconductor control cable shall be rated at 600 V and shall consist of No. 14 gauge stranded copper conductors, individually insulated with a minimum of 20 mils of polyethylene, 10 mils full color coded PVC jacket over each insulated conductor, a polyester tape over assembly, and an overall PVC jacket. Multiconductor cable shall be identified by either ICEA color coding or ink imprinting. Multiconductor cables may be used in conduits or cable trays as required by the Drawings. Multipull taped control conductor assemblies may be used in conduits as approved by the Engineer.
 4. Multiconductor tray cable shall be rated 600 V, listed by UL as Type TC cable per Article 340 of the NEC. The individual conductors shall be UL listed as Type XHHW, with a sunlight-resistant overall jacket. The cables shall pass UL and IEEE-383 ribbon burner flame tests.
- C. Instrumentation Cables: Shielded instrumentation cables shall be rated at 300 V and shall comply with the following requirements:
1. Individual shielded cable shall consist of twisted 2 or 3 No. 16 gauge, stranded, color coded, tinned-coated copper in accordance with ASTM B 33 - Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes and B 8 - Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, and Soft. Color coding shall be black-clear, or black-red-clear.
 2. Insulation thickness shall be 32 mils of polyethylene, insulated with 2.3 mils 100% aluminum foil/polyester shield and No. 18 stranded tinned copper drain wire, all under a 32 mil PVC jacket. The shield shall be continuous and shall be grounded only at the receiving end, or as indicated.
 3. Multi-individual shielded pair or triad instrumentation cable shall consist of individual shielded and twisted pair copper conductors with an ethylene-propylene insulation, and No. 18 AWG tinned stranded copper drain wire, an overall aluminum mylar shield and an overall chloro-sulfonated polyethylene compound jacket. The cables shall be suitable for cable tray installation and shall be flame retardant.
 4. Thermocouple Extension: Extension cable shall be provided for the type of thermocouple circuit indicated. Conductors shall be 16 AWG, solid allow, with 15 mils of 90 degree C flame-retardant polyvinylchloride insulation, twisted and covered with 100% 2.35 mil aluminum polyester tape and a 20 AWG, 7-strand, tinned-copper drain wire and a 35 mil, flame-retardant PVC jacket overall. Cable shall be listed for cable tray installation.
- D. Building Wire and Cable: Building wires and cables shall be rated at 600 V and shall meet the following requirements:
1. Building wire shall be single conductor copper cable listed by UL as Type THHN/THWN rated 75 degrees C in wet locations and 90 degrees C in dry locations.

2. Building wire No. 8 AWG and larger shall be stranded; size No. 10 AWG and smaller shall be solid or stranded.
 3. No wire smaller than No. 12 AWG shall be used unless specifically indicated.
- E. Cable Terminations: Cable terminations shall be in accordance with the following:
1. Compression connectors shall be Burndy "Hi Lug", Thomas & Betts "Shure Stake", or equal. Threaded connectors shall be split bolt type of high strength copper alloy.
 2. Spring connectors (wire nuts) shall be 3M "Scotch Lok," "Ideal Wing Nuts", or equal.
 3. Preinsulated fork tongue lugs shall be "Thomas & Betts" RC Series, Burndy, or equal.
 4. General purpose insulating tape shall be Scotch No. 33, Plymouth "Slip-knot", or equal. High temperature tape shall be polyvinyl by Plymouth, 3M, or equal.
 5. Epoxy resin splicing kits shall be 3M Scotchcoat 82 Series, Burndy Hy Seal, or equal.

2.6 PULL AND JUNCTION BOXES

- A. General: Outlet, switch, pull and junction boxes for flush-mounting in general purpose locations shall be one-piece, galvanized, pressed steel. Ceiling boxes for flush-mounting in concrete shall be galvanized, pressed steel.
- B. Surface Mounted Boxes: Outlet, switch, pull and junction boxes where surface mounted in exposed locations shall be cast ferrous boxes with mounting lugs, zinc or cadmium plating, and enamel finish. Surface mounted boxes in concealed locations may be pressed steel.
- C. Corrosive Locations: Control station, pull and junction boxes, including covers, for installation in corrosive locations shall meet the NEMA 4X requirements and shall be stainless steel or fiber glass-reinforced polyester and shall be furnished with mounting lugs.
- D. Cast and Pressed Steel Boxes: All cast boxes and pressed steel boxes for flush mounting in concrete shall be fitted with cast, malleable box covers and gaskets. Covers for pressed steel boxes shall be one-piece pressed steel, cadmium plated, except that boxes for installation in plastered areas and finished rooms shall be stainless steel over plaster rings. Stainless steel plates shall be Sierra S-line, Hubbell, or equal. Cast boxes shall be as manufactured by Crouse-Hinds, Appleton, or equal.

- E. Floor Boxes: Floor boxes shall have checker plate covers such as O-Z/Gedney Type "YR," or equal. Surface boxes shall be O-Z/Gedney Type "YH," fully adjustable B2529 dual-level floor box by Hubbell, or equal.

2.7 CONDUIT FITTINGS

- A. General: Fittings shall comply with the same requirements as the raceway with which they will be used. Fittings having a volume less than 100 cubic inches for use with rigid steel conduit, shall be cast or malleable nonferrous metal. Such fittings larger than one inch shall be "mogul size." Fittings shall be of the gland ring compression type. Covers of fittings, unless in "dry" locations, shall be closed with gaskets. Surface-mounted cast fittings, housing wiring devices in outdoor and damp locations, shall have mounting lugs.
- B. Insulated Bushings: Insulated bushings shall be molded plastic or malleable iron with insulating ring, similar to O-Z Type A and B, equivalent types by Thomas & Betts, Steel City, Appleton, O-Z/Gedney, or equal.
- C. Insulated Grounding Bushings: Insulated grounding bushings shall be malleable iron with insulating ring and with ground lug, such as O-Z Type BL, equivalent types by T & B, Steel City, O-Z/Gedney, or equal.
- D. Erickson Couplings: Erickson couplings shall be used at all points of union between ends of rigid steel conduits which cannot be coupled. Running threads and threadless couplings shall not be used. Couplings shall be 3-piece type such as Appleton Type EC, equivalent types such as manufactured by T & B, Steel City, O-Z/Gedney, or equal.
- E. Liquid-Tight Fittings: Liquid-tight fittings shall be similar to Appleton Type ST, equivalent types such as manufactured by Crouse-Hinds, T & B, O-Z/Gedney, or equal. Fittings shall be PVC coated when used with PVC coated conduits.
- F. Hubs: Hubs for threaded attachment of steel conduit to sheet metal enclosures, where required, shall be similar to Appleton Type HUB, equivalent types such as manufactured by T & B, Myers Scrutite, or equal. Hubs located outdoors shall be 316 stainless steel.
- G. Transition Fittings: Transition fittings to mate steel to PVC conduit, and PVC access fitting, shall be as furnished or recommended by the manufacturer of the PVC conduit.
- H. Sealed Fittings: Sealing fittings are required in conduit runs entering corrosive areas and elsewhere as shown. Sealing fittings shall be Appleton Type EYS, O-Z Type FSK, or equal. Sealing compound shall not be poured in place until electrical installation has been otherwise accepted.
- I. Expansion Fittings: Expansion fittings shall be installed wherever a raceway crosses a structural expansion joint. Such fittings shall be expansion and deflection type and shall accommodate lateral and transverse movement. Fittings shall be O-Z/Gedney Type "DX," Crouse Hinds "XD," or equal. These fittings are required

in metallic and nonmetallic raceway installations. When the installation is in a nonmetallic run, a 3-foot length of rigid conduit shall be used to connect the nonmetallic conduit to the fitting.

2.8 WIRING DEVICES

A. General: All wiring devices shall be a product of a single manufacturer and shall conform to applicable NEMA Standards for UO series. Devices shall be as manufactured by Hubbell, Sierra, Pass & Seymour, or equal. General purpose duplex receptacles and toggle switch handles shall be brown everywhere except in finished rooms, where they shall be ivory. Special purpose receptacles shall have a body color as shown. Receptacles and switches shall conform to Federal Specifications W-C-596E and W-S-896E, respectively.

1. Receptacles:

- a. General purpose duplex receptacles shall be grounding type, 125-volt, ac, 20-amperes, NEMA Configuration 5-20R, such as Hubbell 5252, or equal.
- b. Convenience receptacles for installation in outdoor and corrosive areas shall be NEMA 5-20R configured and shall have stainless steel or nickel plated parts and plastic parts of melanine.
 - 1) Receptacles at outdoor locations shall be UL-approved for weatherproof locations with plug inserted. These shall be Crouse-Hinds, Hubbell, Pin and Sleeve Series, or equal.
 - 2) Receptacles at damp or dry locations shall be Crouse-Hinds DS 23G, Pyle National N-1, or equal.
 - 3) Receptacles at corrosive locations shall be Hubbell 52CM62 15 A, 53CM62 20 A, or equal.
- c. Ground fault interrupter (GFI) receptacles shall be NEMA 5-20R configured and shall mount in a standard outlet box. Units shall trip at 5 mA of ground current and shall comply with NEMA WD-1-1.10 and UL 943. GFI receptacles shall be capable of individual as well as "downstream" operation. GFI receptacles shall be Hubbell GF 5252, or equal.
- d. The 240-V duplex receptacles shall be 2-pole, 3-wire, grounding type, 250-VAC, 20-A, NEMA Configuration 6-20R, such as Hubbell 5462 gray, or equal.
- e. Single 30-A receptacles shall be 2-pole, 3-wire, grounding type, 125-VAC, 30-A, NEMA Configuration 5-30R, such as Hubbell 9308, or equal.
- f. All 480-V, 60-A, 3-phase receptacle outlets shall be 60-A, 3-wire, 4-pole, 600-V, weatherproof with spring door, such as Crouse-Hinds Catalog No. AREA 6424, Hubbell Hubbellock No. 26410 for receptacle and No. 26419 for plug, or equal. One matching plug shall be furnished loose.
- g. All 480-V, 30-A, 3-phase receptacle outlets shall be 30-A, 3-wire, 4-pole, 600-V, weatherproof with spring door such as Crouse-Hinds

Catalog No. AREA 3423, Bryant Cat. 7223FR, Russell Stoll No. JRFA6344, Hubbell No. 22CM427 for receptacle and No. 21CM4158 for plug, or equal. One matching plug shall be furnished loose.

2. Switches:

- a. Switches at outdoor locations shall be Crouse-Hinds DS 128, Mackworth Rees Style 3845, Joy Flexitite, or equal.
- b. Switches at damp locations shall be Mackworth Rees Style 3496, Joy Flexitite, or equal.
- c. Switches at dry locations shall be Crouse-Hinds DS 32G, Pyle National SCT-10k, or equal.
- d. Toggle switches shall conform to the following table, or equal:

<u>Hubbell No.</u>	<u>Bryant No.</u>	<u>Hubbell No.</u>	<u>Bryant No.</u>
Single Pole (ivory)	1221 (brown)	4901 (brown)	1221I (ivory) 4901I
Three Way	1223 4903	1223I 4903I	
Momentary	1556 4821	1556I 4821I	
Four Way	1224	1224I	

2.9 CABINETS AND ENCLOSURES

A. General: All electrical cabinets and enclosures housing control relays and terminal blocks shall be manufactured in accordance with NEMA Publications 250, UL Standards 50 and 508. All large enclosures shall have 3-point latch with door handle without additional external door latches.

- 1. Relay or control, and terminal cabinets shall be NEMA 4X 316 SST enclosures. Sizes shown on the Drawings are minimum. Provide sufficient terminal blocks to terminate 25% more conductors than are shown. Interiors of cabinets shall be finished white including internal back mounting plate.
- 2. Floor standing NEMA 12 construction shall have three-point latching mechanism operated by oil tight key-locking handle, and shall have gasketed overlapping doors. Steel construction shall be 12-gauge; construction for wall-mounted type shall be 14-gauge steel. Exterior finish shall be ANSI 61 light gray, or equal.
- 3. Floor standing NEMA 4X enclosures shall be Type 316 stainless steel, 12-gauge, with oil-resistant door gasket and shall have three-point latching mechanism operated by oil tight key-locking handle. Wall-mounted type construction shall be 14 gauge, Type 316 stainless steel.
- 4. Floor standing NEMA 4 construction shall be 12-gauge steel, with oil-resistant door gaskets and shall have three-point latching mechanism

operated by oil tight key-locking handle. Wall-mounted type construction shall be 14-gauge, with welded mounting plate.

- B. Wiring of Cabinets: Wiring of terminal cabinets, control or relay cabinets shall be accomplished with stranded copper conductor rated for 600 V and UL listed as Type MTW. Wires for annunciator and indication circuits shall be No. 16 AWG. All others shall be No. 14 AWG. Color coding shall be as specified elsewhere in this Section. Incoming wires to terminal or relay cabinets shall be terminated on a master set of terminal blocks. All wiring from the master terminals to internal components shall be factory-installed and shall be contained in 2-inch wide by 2-inch high plastic wireways having removable covers. Wiring to door-mounted devices shall be extra flexible and anchored to doors using wire anchors cemented in place. Exposed terminals of door-mounted devices shall be guarded to prevent accidental personnel contact with energized terminals.
- C. Terminal Blocks: All terminal block requirements shall be as manufactured by WAGO with cage clamp, Phoenix, or equal.
- D. Nameplates: Nameplate engraving shall be as shown or as directed by the Engineer. Characters shall be uniform block style not smaller than 1/8-inch. Nameplates shall be secured using cadmium plated steel or other corrosion resistant screws. Adhesive alone is not acceptable.
- E. Testing: Each relay or control and terminal cabinets shall be completed, assembled, wired, and tested at the factory. Test shall be in accordance with the latest UL and NEMA Standards. All cabinets shall bear UL label, as applicable.

2.10 DISCONNECT SWITCHES

- A. Disconnect Switches: Disconnect switches shall be externally operated with quick-make/quick-break mechanisms. The handle shall be interlocked with the switch cover by means of a defeatable interlock device. The switch shall be padlockable in the "off" position. Switches shall have nameplates stating manufacturer, rating, and catalog number. Heavy-duty switches shall have arc suppressors, pin hinges, and shall be horsepower rated at 600 V. All switches rated at 100 A or larger shall have auxiliary contact for remote status indication. Heavy-duty switches shall be provided for all motor circuits above 3 horsepower. In smaller motor circuits switches shall be general duty. Provide auxiliary switches where indicated.
- B. Ratings: Switch rating shall match the horsepower requirements of the load at the particular voltage if not otherwise shown.
- C. Enclosures: Switch enclosure shall be suitable for the location and shall be as manufactured by Square D, Eaton, or equal.

2.11 ELECTRICAL IDENTIFICATION

- A. Nameplates: Nameplates shall be fabricated from white-letter, black-face laminated plastic engraving stock, Formica type ES-1, or equal. Each shall be fastened securely, using fasteners of brass, cadmium plated steel, or stainless

steel, screwed into inserts or tapped holes, as required. Engraved characters shall be block style of adequate size to be read easily at a distance of 6 feet with no characters smaller than 1/8-inch high.

- B. Conductor and Equipment Identification: Conductor and equipment identification devices shall be either imprinted plastic-coated cloth marking devices such as manufactured by Brady, Thomas & Betts, or equal, or shall be heat-shrink plastic tubing, imprinted split-sleeve markers cemented in place, or equal.
- C. Identification Tape: Identification tape for protection of buried electrical installation shall be a 6-inch wide red polyethylene tape imprinted "CAUTION - ELECTRIC UTILITIES BELOW."

2.12 LIGHTING AND POWER PANELBOARDS

- A. General: Panelboards shall be dead front factory assembled. Panelboards shall comply with NEMA PB-1 as well as the provisions of UL 50 and 67. Panelboards used for service equipment shall be UL labeled for such use. Lighting panelboards shall be rated for 120/208-V 3-phase operation or 120/240-V for single phase operation as shown. Power panelboards shall be rated for 600 V, 3-phase operation.
 - 1. Interiors shall have solderless, anti-turn connectors and shall be constructed so that branch circuit breaker can be replaced without disturbing adjacent units or resorting to field drilling and tapping. Bus bars and connecting drops shall be copper. Neutral bar shall be full-sized and shall have one terminal screw for each branch circuit; main bus bar shall be full-sized for entire length. Spaces shown shall have cross connections for the maximum sized device that can be fitted.
 - 2. Panelboard box shall be galvanized code grade steel with knockouts, and shall have removable end walls. All boxes or panelboard enclosures shall have gray baked enamel finish.
- B. Lighting Panelboards:
 - 1. Cabinets for building panels shall be 20-inch wide minimum, with 4-inch minimum side gutters and 5-inch minimum top and bottom gutters. Panelboard trim shall be the same size as cabinet on surface-mounted panels and 3/4-inch larger all around than cabinet of flush-mounted panels. Doors in trim shall have typed circuit directory and pocket with protective clear plastic sheet. All trim and cabinets of surface-mounted panels in general purpose areas shall be phosphate treated, primed and finished with baked enamel, panels of flush mounted panels shall be finished to match surrounding wall color.
 - 2. The number of circuit breakers and the ampere ratings shall be in accordance with panel schedules. Main circuit breaker or main lugs only shall be provided as indicated. The panelboard circuit breakers shall be group mounted and shall be molded case with 3- or 2-pole main breakers

as required and branch circuit breakers with AIC as indicated. Circuit breakers shall be thermal/magnetic type.

3. Surface mounted cabinets and trim in wet and damp areas shall be galvanized. Panelboards in corrosive areas shall be housed in NEMA 4X, stainless steel cabinet. Provide control enclosures under common panel trim. All panelboard doors shall be keyed alike.

C. Power Panelboards:

1. Power panelboard shall be UL listed and suitable for use as service equipment with 6 circuits, or less or with main circuit breaker.
2. Short circuit current rating shall be 200,000 A maximum RMS symmetrical when equipped with a fusible main disconnect.
3. Cabinets for power panelboards with 225-amp mains shall be 35 inches wide, if the main bus is 800-amp, the box shall be 38 inches wide, 1200-amp mains require a 42-inch box. Minimum bottom and top gutters shall be 8-inch, minimum side gutter shall be 5-inch.

- D. Panelboards to Computers or Delicate Equipment: Panelboards supplying power to computer equipment or delicate instruments shall have voltage surge arresters mounted inside the panelboard and connected at the line side of the main circuit breaker. It shall be rated at 650 VAC phase to ground maximum and shall have an impulse sparkover voltage of 3200 V. Surge arresters shall be Square D Catalog No. J9200-9A for 3-phase system and J9200-10 for 1-phase system, Type DPA by Current Tech, or equal.

- E. Panelboards shall be as manufactured by Square D, Cutler-Hammer, Siemens, or equal.

2.13 CONTROL STATIONS

- A. General: Control stations shall comply with NEMA Standards ICS2-216. All control stations shall be industrial type, heavy duty, oil-tight, with legend plates.

- B. Requirements: Control stations shall be as follows:

1. Pushbutton Switch: Pushbutton switches shall be momentary type with round or square button plate. All emergency-stop pushbuttons shall have red button plates. Lock-out stop shall be momentary pushbutton with locking mechanism.
2. Selector Switches: Selector switches shall be rated 10 A at 600 V and shall be rotary type with number of position and poles as indicated.
3. Indicating Lights: Pilot lights shall be full-voltage, push to test type and with plastic color caps: red color for running, green for ready, and amber for failure status.

4. Control station enclosures shall be die cast aluminum, NEMA Type I in general purpose area and stainless steel, NEMA 4X in corrosive or outdoor or wet areas.
- C. Manufacturers: Manufacturers shall be Square D Class 9001, Allen-Bradley Bulletin 800, or equal.

PART 3 - EXECUTION

3.1 GROUNDING

- A. General: Grounding cable shall be sized in accordance with NEC Article 250 requirements when sizes are not indicated on the Drawings. The location of ground rods shall be as indicated. The length of rods forming an individual ground array shall be equal in length and shall be of the quantity required to obtain a ground resistance of no more than 5 ohms.
- B. Equipment Ground: Ground continuity throughout the facility shall be maintained by installing an electrically-continuous metallic raceway system, or a non-metallic raceway with a grounding conductor when non-metallic raceway is permitted in the Contract Documents.
1. Metallic raceway shall be installed with double lock nuts or hubs at enclosures. Nonmetallic raceway containing dc conductors operating at more than 50 V to ground, or any AC conductors, shall contain a copper grounding conductor either bare, or green if insulated. Such conductor shall be bonded to terminal and intermediate metallic enclosures.
 2. Metal equipment platforms which support any electrical equipment shall be bonded to the nearest ground bus or to the nearest switchgear ground bus. This grounding requirement is in addition to the raceway grounding required in the preceding paragraph herein.
- C. Grounding Electrode System: Install the grounding electrode system with all required components in accordance with NEC Article 250.
1. Connection to ground electrodes and ground conductors shall be exothermic welded where concealed and shall be bolted pressure type where exposed. Bolted connectors shall be assembled wrench-tight.
 2. Insulated grounding bushings shall be employed for all grounding connections to steel conduits in switchboards, in motor control centers, in pullboxes, and elsewhere where conduits do not terminate at a hub or a sheet metal enclosure. Where insulated bushings are required, they shall be installed in addition to double lock-nuts.
 3. Copper bonding jumpers shall be used to obtain a continuous metallic ground.

D. Shield Grounding:

1. Shielded power cable shall have its shield grounded at each termination in a manner recommended by the cable manufacturer.
2. Shielded instrumentation cable shall be grounded at one end only; this shall be at the Main Control Panel or otherwise at the "receiving" end of the signal carried by the cable, unless shop drawings indicate that the shield shall be grounded at both ends.
3. Termination of each shield drain wire shall be on its own terminal screw. All of these terminal screws in one rack shall be jumpered with No. 16 solid tinned bare copper wire; connection to ground shall be accomplished with a No. 12 green insulated conductor to the main ground bus.

3.2 UNDERGROUND DUCTS AND MANHOLES

A. Duct Bank Installation: The underground concrete encased duct bank shall be installed in accordance with the criteria below:

1. Duct shall be assembled using high impact nonmetallic spacers and saddles to provide conduits with vertical and horizontal separation. Plastic spacers shall be set every 5 feet.
2. The duct shall be laid on a grade line of at least 4 inches per 100 feet, sloping towards pullboxes or manholes. Duct shall be installed and pullbox and manhole depths adjusted so that the top of the concrete envelope is a minimum of 24 inches below grade.
3. Changes in direction of the duct envelope by more than 10 degrees horizontally or vertically shall be accomplished using bends with a minimum radius 24 times the duct diameter.
4. Couplings shall be staggered at least 6 inches vertically. Bottom of trench shall be of select backfill or sand. The duct array shall be anchored every 4 feet to prevent movement during placement of the concrete envelope.
5. Each bore of the completed duct bank shall be cleaned by drawing through it a standard flexible mandrel one foot long and 1/4-inch smaller than the nominal size of the duct through which the mandrel will be drawn. After passing of the mandrel, draw a wire brush and swab through.
6. A raceway, in the duct envelope, which does not require conductors, shall have a 1/8-inch polypropylene pull cord installed throughout the entire length of the raceway.

B. Duct Entrances: Duct entrances shall be grouted smooth; duct for primary and secondary cables shall be terminated with flush end bells. Sections of pre-fabricated manholes and pullboxes shall be assembled with waterproof mastic and

shall be set on a 6- inch bed of gravel as recommended by the manufacturer or as required by field conditions.

- C. Duct Bank Markers: Duct bank markers shall be installed every 200 feet along run of duct bank, at changes in horizontal direction of duct bank, and at ends of duct bank. Concrete markers, 6 by 6 inches square and one foot long, shall be set 2 inches above finish grade. The letter "D" and arrow set in the concrete shall be facing in the direction of the duct alignment.
- D. Wiring: Each duct bank shall contain a No. 4/0 bare stranded copper ground wire, continuous throughout the entire duct bank. End of ground wires shall be terminated at switchgear or MCC ground bus, or transformer ground lugs.
- E. Watertight Penetrations: Duct bank penetration through walls of manholes or pullboxes, and on building walls below grade shall be watertight.
- F. Trench Backfill: Trenches containing duct banks shall be filled with select backfill with no large rocks which could damage the duct.
- G. Concrete Encased Duct Banks: Concrete encased duct bank shall terminate at building foundations. When duct enters the building on a concrete slab on grade, duct shall not be encased, but shall transition to rigid steel PVC-coated conduits on all stub-ups.

3.3 RACEWAYS

- A. General: Raceways shall be installed as indicated, however, conduit routings shown are diagrammatic. Raceway systems shall be electrically and mechanically complete before conductors are installed. Bends and offsets shall be smooth and symmetrical, shall be accomplished with tools designed for the purpose intended. Factory elbows shall be used for all 3/4-inch conduit. Bends in larger sizes of metallic conduit shall be accomplished by field bending or by the use of factory elbows. All installations shall be in accordance with the latest edition of the NEC.
- B. Installation: Raceways shall be installed in accordance with the following schedule:
 - 1. Low Voltage Raceway (control, power, and data hi-way and communications):
 - a. Rigid Schedule 40 PVC shall be used for concrete encased duct on earth.
 - b. PVC-coated galvanized rigid steel raceways shall be used on exposed locations in corrosive areas and for all power feeders between variable frequency drives and their respective motors.
 - c. Galvanized rigid steel (GRS) shall be used on exposed installations in general purpose areas.
 - d. Electrical metallic (EMT) conduit shall be used in lighting and receptacle circuits on suspended ceilings or stud walls in general purpose areas.

- e. Rigid Schedule 40 PVC shall be used for conduits embedded in concrete slab on grade and above grade.
 - f. Rigid Schedule 40 PVC shall be used for area lighting circuits and may not be concrete encased.
 - g. Schedule 40 PVC shall be used for fiber optic data hi-way system concrete encased on grade.
 - h. Galvanized rigid steel (GRS) conduit shall be used for coaxial data hi-way cables for concrete encased on grade and exposed installations.
 - i. PVC-coated GRS shall be used in exposed installations in outdoor areas.
2. Analog Signal Raceways:
- a. Schedule 40 PVC conduits shall be used for concrete encased duct on earth.
 - b. PVC-coated GRS shall be used on exposed installations in corrosive areas.
 - c. Galvanized rigid steel conduits shall be used on exposed installations in general purpose areas.
 - d. PVC-coated GRS shall be used on exposed installations in outdoor areas.
3. Exposed Raceways:
- a. Conduits shall be rigidly supported with clamps, hangers, and Unistrut channels.
 - b. Intervals between supports shall be in accordance with the National Electric Code.
- C. Conduit Terminations: Empty conduit terminations not in manholes or pullboxes shall be plugged. Exposed raceway shall be installed perpendicular or parallel to buildings except where otherwise indicated. Conduit shall be terminated with flush couplings at exposed concrete surfaces. Conduit stubbed up for floor-standing equipment shall be placed in accordance with approved shop drawings. Metallic raceways installed below-grade or in outdoor locations and in concrete shall be made up with a conductive waterproof compound applied to threaded joints. Compound shall be Zinc Clads Primer Coatings No. B69A45, HTL-4 by Crouse-Hinds, Kopr Shield by Thomas & Betts, or equal.
- D. Conduit Installations:
- 1. Conduit may be cast integral with horizontal and vertical concrete slabs, providing one-inch clearance is maintained between conduit surface and concrete surface. If said clearance cannot be maintained, the conduit shall be installed exposed below elevated slabs; provided, that in the case of slabs on grade, conduit shall be installed below the slab. Maximum size of conduit that can be cast in slab shall be 1-1/2 inches.

2. Nonmetallic conduit may be cast integral with horizontal slabs with placement criteria stated above. Non-metallic conduit may be run beneath structures or slabs on grade, without concrete encasement. In these instances conduit shall be placed at least 12 inches below the bottom of the structure or slab. Nonmetallic conduit may be buried 24 inches minimum below grade, with a 3-inch concrete cover, in open areas or where otherwise not protected by concrete slab or structures. Top of concrete cover shall be colored red. Nonmetallic conduit shall be permitted only as required by the Specifications and in concealed locations as described above.
3. Where a run of concealed PVC conduit becomes exposed, a transition to rigid steel conduit is required. Such transition shall be accomplished by means of a factory elbow or a minimum 3-foot length of rigid steel conduit, either terminating at the exposed concrete surface with a flush coupling. Piercing of concrete walls by nonmetallic runs shall be accomplished by means of a short steel nipple terminating with flush couplings.
4. Flexible conduit shall be used at dry locations for the connection of equipment such as motors, transformers, instruments, valves, or pressure switches subject to vibration or movement during normal operation or servicing. Flexible conduit may be used in lengths required for the connection of recessed lighting fixtures; otherwise the maximum length of flexible conduit shall be 18 inches.
5. In other than dry locations, connections shall be made using flexible liquid-tight conduit. Equipment subject to vibration or movement which is normally provided with wiring leads, such as solenoid valves, shall be installed with a cast junction box for the make-up of connections. Flexible conduits shall be as manufactured by American Brass, Cablec, Electroflex, or equal.
6. Conduit penetrations on walls and concrete structures shall be performed in accordance with the following:
 - a. Seal all raceways entering structures at the first box or outlet with oakum or suitable plastic expandable compound to prevent the entrance into the structure of gases, liquids, or rodents.
 - b. Dry pack with nonshrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods indicated for underground penetrations.
 - c. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement, provide such device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with

one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.

- d. Where an underground raceway without concrete encasement enters a structure through a non-waterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device may be used in lieu of the sleeve.

- E. Cable Tray: Cable tray shall be installed straight and true and shall be supported with cable tray hangers and supports on 8 feet centers maximum. Tray hangers and brackets shall comply with the requirements of Section 05500 - Miscellaneous Metals. Cable tray shall be grounded as described in paragraph entitled, "Grounding," above.

3.4 WIRES AND CABLES

- A. General: Conductors shall not be pulled into raceway until:

- 1. Raceway system has been inspected and accepted by the Engineer.
- 2. Plastering and concrete have been completed in affected areas.
- 3. Raceway system has been freed of moisture and debris.

- B. Wire and Cables:

- 1. Conductors of No. 1 size and smaller shall be hand pulled. Larger conductors may be installed using power winches. Pulling tensions on the cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.
- 2. Wire in panels, cabinets, and gutters shall be neatly grouped using nylon tie straps and shall be fanned out to terminals.
- 3. Cables rated 2000 V and above shall be fireproofed for their entire exposed length in manholes and handholes, using 1-1/2-inch arc-proofing tape anchored by overwrapping with glass cloth tape such as 3M Co. No. 27, Scotch, Plymouth, or equal.

- C. Splices and Terminations:

- 1. The Contractor shall provide, install, and terminate the conductors required for power and controls to electrical equipment and to interconnect incoming annunciator, instrumentation terminal cabinets, and control and instrumentation equipment except where indicated elsewhere. There shall be no cable splices in underground manhole or pullboxes. If splices are

necessary, the cables shall be brought aboveground and terminated in a NEMA 4X, stainless steel terminal or splice cabinet on a concrete pad.

2. Two- and three-conductor shielded cables installed in conduit runs which exceed 2000 feet may be spliced in pullboxes. These cable runs shall have only one splice per conductor.
 3. Control conductors shall be spliced or terminated only at the locations indicated and only on terminal strips or terminal lugs of vendor furnished equipment. For the purposes of Division 16, "control conductors" are defined as conductors operating at 120 V or less in circuits that indicate equipment status or that control the electric energy delivered to a power consuming device.
 4. All 120/208-V and 480-V branch circuit conductors may be spliced in suitable fittings at locations determined by the Contractor. All cables rated above 2000 V shall be spliced or terminated only at equipment terminals shown.
 5. Solid conductors shall be terminated at equipment terminal screws with proper care that conductor is tightly wound around screw and does not protrude beyond screw head. Stranded conductors shall be terminated directly on equipment box lugs making sure that all conductor strands are confined within lug. Use forked-tongue lugs where equipment box lugs have not been provided.
 6. Splices in 600-V wire which are not pre-insulated shall be insulated with three layers of tape each half lapped except that splices in below grade pull boxes or in any box subject to flooding shall be made watertight using an epoxy resin splicing kit.
 7. Splices to motor leads in motor terminal boxes shall be wrapped with mastic material to form a mold and then shall be taped with a minimum of two layers of varnished cambric tape overtaped with a minimum of two layers of high temperature tape.
 8. Shielded power cable shall be terminated with pre-assembled stress cones in a manner approved by the cable manufacturer. Submit the proposed termination procedure as described for shop drawings.
 9. Control devices, such as solenoid operated valves, that are normally supplied with conductor pigtails, shall be terminated as described for control conductors.
- D. Cable Assembly and Testing: Cable assembly and testing shall comply with applicable requirements ICEA Publication No. S-68-516 and other relevant ICEA publications. Factory test results shall be submitted in accordance with Section 01300 - Submittals, prior to shipment of cable. The following tests shall be the minimum requirements:

1. High potential DC test shall be performed on all cables operating at more than 2000 V to ground.
 2. Insulation resistance shall be obtained and shall not be less than the value recommended by ICEA.
 3. All cables rated at 600 V shall be tested for insulation resistance between phases and from each Phase to a ground using a megohmmeter.
 4. All field testing mentioned above shall be done after cables are installed in the raceways.
 5. Field tests shall be performed by certified test organization acceptable to the cable manufacturer. Test results shall be submitted for review and acceptance.
 6. Cables failing in the said tests shall be replaced with a new cable or repaired. Such kind of repair methods shall be as recommended by the cable manufacturer and shall be performed by persons certified by the industry.
- E. Continuity Test: All control and instrumentation cables shall be tested for continuity, polarity, undesirable ground, and origination. Such tests shall be performed prior to placing all cables in service.

3.5 PULL AND JUNCTION BOXES

- A. Sizing: Pull and junction boxes shall be sized in accordance with the requirements of the NEC.
- B. Outlet Boxes: Outlet boxes shall be used as junction boxes wherever possible. Where separate pullboxes are required, they shall have screw covers.
- C. Requirements: Pullboxes shall be installed when conduit run contains more than three 90-degree bends and runs exceed 200 feet.

3.6 LIGHTING AND POWER DISTRIBUTION PANEL BOARDS

- A. The circuit description as indicated on the Record Drawings or Panel Schedule shall be typed on the circuit directory.
- B. Panel boards shall be tested for proper operation and function.

3.7 CABINETS AND ENCLOSURES

- A. Cabinets shall be set plumb at an elevation that will cause the maximum circuit breaker height to be less than 66 inches. Top edge of trim of adjacent panels shall be at the same height. Panels which are indicated as flush mounted shall be set so cabinet is flushed and serves as a "ground" for plaster application.

- B. All factory wire connections shall be made at shipping splits, and all field wiring and grounding connections shall be made after the assemblies are anchored.

3.8 CONCRETE HOUSEKEEPING

- A. Housekeeping Pads: Concrete housekeeping pads shall be provided for all floor standing electrical equipment. Housekeeping pads for all equipment, including future units, shall be 2 inches above surrounding finished floor or grade and 2 inches larger in both dimensions than the supported equipment, unless otherwise indicated.
- B. Housekeeping Curbs: Concrete housekeeping curb shall be provided for all conduit stub-up in indoor and outdoor locations, not concealed by equipment enclosures. Such curb shall be 3 inches above finished floor or grade.

3.9 EQUIPMENT ANCHORING

- A. Anchors: Freestanding or wall-hung equipment shall be anchored in place by methods that will meet seismic requirement in the area where project is located. Wall-mounted panels that weigh more than 500 pounds or which are within 18 inches of the floor shall be provided with fabricated steel support pedestal(s). Pedestals shall be of welded steel angle sections. If the supported equipment is a panel or cabinet and enclosed with removable side plates, it shall match supported equipment in physical appearance and dimensions. Transformers hung from 4-inch stud walls and weighing more than 300 pounds, shall have auxiliary floor supports.
- B. Leveling Channels: Leveling channels anchored to the concrete pad shall be provided for all switchgear and pad-mounted transformer installations.
- C. Anchoring Methods: Anchoring methods and leveling criteria specified in the printed recommendations of the equipment manufacturers are a part of the Work of this Contract. Such recommendations shall be submitted as required for shop drawings in Section 01300 - Submittals.

3.10 CABLE AND EQUIPMENT IDENTIFICATION

- A. General: The completed electrical installation shall be provided with adequate identification to facilitate proper control of circuits and equipment and to reduce maintenance effort.
- B. Cable: Assign each control and instrumentation wire and cable a unique identification number. Said numbers shall be assigned to all conductors having common terminals and shall be shown on all shop drawings. Identification numbers shall appear within 3 inches of conductor terminals. "Control" shall be defined as any conductor used for alarm, annunciator, or signal purposes:
 - 1. Multiconductor cable shall be assigned a number which shall be attached to the cable at intermediate pull boxes and at stub-up locations beneath free-standing equipment. It is expected that the cable number shall form a

part of the individual wire number. All individual control conductors and instrumentation cable shall be identified at pull points as described above. The instrumentation cable numbers shall incorporate the loop numbers indicated on the Drawings.

2. All 120/208-V system feeder cables and branch circuit conductors shall be color coded as follows: Phase A-black, Phase B-red, Phase C-blue, and Neutral-white. The 480/277-V system conductors shall be color coded as follows: Phase A-brown, Phase B-orange, Phase C-yellow, and Neutral-gray. Color coding tape shall be used where colored insulation is not available. Branch circuit switch shall be yellow. Insulated ground wire shall be green, and neutral shall be gray. Color coding and phasing shall be consistent throughout the site, but bars at panelboards, switchboards, and motor control centers shall be connected Phase A-B-C, top to bottom, or left to right, facing connecting lugs.
3. General purpose ac control cables shall be pink. General purpose dc control cables shall be blue.
4. All spare cables shall be terminated on terminal screws and shall be identified with a unique number as well as with destination.
5. Terminal strips shall be identified by imprinted, varnished, marker strips attached under the terminal strip.

C. Equipment: Equipment and devices shall be identified as follows:

1. Nameplates shall be provided for all panelboards, panels, starters, switches, and pushbutton stations. In addition to the name plates shown, control devices shall be equipped with standard collar-type legend plates.
2. Control devices within enclosures shall be identified similar to the paragraph above.
3. Three-phase receptacles shall be consistent with respect to phase connection of receptacle terminals. Errors in phasing shall be corrected at the bus, not at the receptacle.
4. Toggle switches which control loads out of sight of switch, and all multiswitch locations of more than two switches, shall have suitable inscribed finish plates.
5. Empty conduits shall be tagged at both ends to indicate the destination at the far end. Where it is not possible to tag the conduit, destination shall be identified by marking an adjacent surface.
6. Provide typewritten circuit directories for panelboards; circuit directory shall accurately reflect the outlets connected to each circuit.

7. Install identification tape directly above buried unprotected raceway; install tape 8 inches below grade and parallel with raceway to be protected. Identification tape is required for all buried raceway not under buildings or equipment pads except identification tape is not required for protection of street lighting raceway.

****END OF SECTION****

SECTION 16920 - MOTOR CONTROL CENTER

PART 1 - GENERAL

1.1 SCOPE

- A. This section describes requirements for adding new motor starters to existing Eaton motor control centers.

1.2 REFERENCE SPECIFICATIONS, CODE AND STANDARDS

- A. The MCC shall meet or exceed the requirements within the following standards for MCCs.
 - 1. NEMA ICS 18 - Industrial Control and Systems: Motor Control Centers
 - 2. UL 845 - UL Standard for Safety for Motor Control Centers.
 - 3. NOTE: UL 845 is a harmonized standard consisting of:
 - a. Underwriters Laboratories Inc. (UL) UL 845
 - b. Association of Standardization and Certification (ANCE) NMX-J-353-ANCE-2006
 - c. Canadian Standards Association (CSA) C22.2 No. 254-05
 - 4. NFPA 70 - National Electrical Code

1.3 DESIGN REQUIREMENTS

- A. Provide MCC based upon applicable NEMA and UL standards and in accordance with the detailed contract specifications and drawings.
- B. The manufacturer of the MCC shall also be the manufacturer of the across-the-line motor starters, across-the-line contactors, solid state reduced voltage starters, and variable frequency drives. The use of third party supply and assembly for these components in the motor control center is not acceptable and will be rejected.
- C. The contractor shall confirm motor full load amperage ratings and provide those to the MCC manufacturer to ensure proper sizing of motor branch circuit and overload protection.

1.4 PRE-MANUFACTURE SUBMITTALS

- A. Refer to Division 1 for submittal procedures
- B. Manufacturer Drawings
 - 1. Unit descriptions including starter sizes, circuit breaker frame sizes, circuit breaker continuous ampere ratings, pilot devices, etc.

2. Nameplate information
 3. Schematic wiring diagrams
 4. Manufacturer drawings shall be provided in PDF format.
- C. Product Data
1. Data sheets and publications on all major components including but not limited to the following:
 - a. Motor starters
 - b. Overload relays
 - c. Circuit breaker and fuse information including time current characteristics
 - d. Control power transformers
 - e. Pilot devices
 - f. Relays
- D. Specification Response
1. All clarifications and exceptions must be clearly identified.
- E. Installation Instructions
1. Provide a copy of the manufacturer's installation instructions which includes the following:
 - a. Receiving, Handling, and Storage instructions
 - b. General description for reading nameplate data, serial numbers, UL markings and short circuit ratings
 - c. Installation procedures including splicing procedures
 - d. Conduit and cable installation
 - e. Installing and removing plug-in units
 - f. Operation of operator handles and unit interlocks
 - g. Checklist before energizing
 - h. Procedure for energizing equipment
 - i. Maintenance procedures

1.5 FINAL SUBMITTALS

- A. Refer to Division 1 for procedure on submittal of final documentation.
- B. The contractor shall provide certification that the starters have been installed in accordance with the manufacturer's instructions and with local codes and standards which govern MCC installations.
- C. The contractor shall provide certification that all circuit breaker settings have been adjusted per field requirements.

- D. The contractor shall provide certification that all power fuses have been selected and installed per field requirements.
- E. The contractor shall provide certification that all solid state motor overload settings have adjusted per installed motor characteristics.
- F. The contractor shall provide certification that all settings for solid state devices such as reduced voltage solid state controllers and variable frequency drives have been adjusted per the specific application requirements.
- G. The contractor shall provide certification that any timing devices have been properly adjusted.
- H. Final Drawings
 - 1. The manufacturer shall provide final drawings reflecting the “As-Shipped” state of the documents previously submitted.
 - 2. Manufacturer drawings shall be provided in PDF format.
 - 3. Manufacturer drawings do not need to be stamped if a drawing schedule is provided which lists the drawing numbers, revision levels, and status of drawings (Preliminary, Approval, Final, etc)
 - 4. The contractor shall be responsible for making any changes to the “As-Shipped” drawings from the manufacturer to reflect any field modifications.
- I. Test reports indicating manufacturer's standard testing was performed.
- J. Maintenance Data
 - 1. Bucket installation instructions.
 - 2. Installation / Operation instructions for major components such as automatic transfer switch, circuit breakers, etc.
 - 3. Spare parts listing and pricing.
 - 4. Name and phone number for a local distributor who can provide spare parts.

1.6 DELIVERY, STORAGE AND HANDLING

- A. The contractor shall store the materials in a clean, dry and heated space.
- B. The contractor shall protect the units from dirt, water, construction debris and traffic.

- C. During storage the contractor shall connect internal space heaters (if specified) with temporary power.

1.7 WARRANTY

- A. The manufacturer shall provide their standard parts warranty for eighteen months from the date of shipment or twelve months from the date of being energized, whichever occurs first.
- B. The manufacturer shall confirm this warranty as part of the submittal.

1.8 REGULATORY REQUIREMENTS

- A. Contractor shall ensure that the installation conforms to the requirements of the latest edition of the NFPA 70 "National Electrical Code" and/or other applicable installation standards.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. The MCC enclosure rating shall be appropriate for the environment where the MCC is to be located.

1.10 SPARE MATERIALS

- A. Supplier shall review manufacturer's recommended spare parts list and discuss with Owner to determine requirements for spare parts
- B. Supplier to provide quotation for spare parts to Owner

1.11 WORK PAYMENT

- A. Payment for the Work in this section shall be included as part of the lump-sum or unit-price bid amount for which such Work is appurtenant thereto, including all Work and materials specified herein and as may be required to complete this portion of the Work.

PART 2 - MOTOR CONTROL CENTER SPECIFICATIONS

2.1 MANUFACTURERS

- A. Eaton to match existing.

2.2 RATINGS

- A. All MCC units shall have a full rated short circuit rating which meets or exceeds the available fault current as shown on the contract drawings.
 - 1. Use of series short circuit ratings shall only be permitted for panelboards; series short circuit ratings for other types of units is not acceptable.

- B. All circuit breakers used in the motor control center shall have full-rated short circuit interrupting ratings based on the applied MCC voltage.
 - 1. Slash rated short circuit interrupting ratings for circuit breakers are not acceptable except for branch circuit breakers in panelboards, and then only if the power system specified in the contract drawings is a Wye with a solidly grounded neutral.

2.3 UNIT INFORMATION

- A. The minimum compartment height shall be 6.0 inches and this shall be considered one-half space factor.
- B. NEMA Size 5 FVNR starters and below shall be provided as plug-in units.
- C. Plug-in units
 - 1. Plug-in units shall consist of unit assembly, unit support pan and unit door assembly.
 - 2. Units shall be supplied with removable doors. The unit doors shall be fastened to the structure so that the doors can be closed when the unit is removed.
 - 3. A unit support pan shall be provided for support and guiding units. Unit support pans shall remain in the structure when units are removed to provide isolation between units.
 - 4. A service position shall be provided for plug-in units which allows for the unit to be supported, but disengaged from the bus. The unit shall be capable of being padlocked in the service position. This position is to be used to isolate a unit from the bus to allow service to be performed on the connected load equipment.
- D. Power Stabs
 - 1. Unit stabs for engaging the power bus shall be tin plated copper and provided with stainless back-up springs to provide and maintain a high pressure 4-point connection to the vertical bus.
 - 2. Wiring from the unit disconnecting means to the plug-in stabs shall not be exposed on the rear of the unit. A separate isolated pathway shall be provided for each phase to minimize the possibility of unit fault conditions reaching the power bus system.
 - 3. The power cable termination at the plug-in stab shall be a maintenance-free crimp type connection.

E. Disconnect Handle

1. Plug-in units shall be provided with a heavy-duty, non-conductive, industrial duty, flange mounted handle mechanism for control of each disconnect switch or circuit breaker.
2. Use of rotary operators is not acceptable
3. The disconnect handle may pivot in the vertical or horizontal plane.
4. The on-off condition shall be indicated by the handle position, red and green color indicators with the words ON and OFF, and the international symbols 1 and O along with a pictorial indication of the handle position.
5. Handles shall be capable of being locked in the OFF position with up to three padlocks.
6. Plug-in units shall be provided with interlocks per NEMA and UL requirements.
Interlocks shall be provided for the following:
 - a. Prevention of unit insertion or withdrawal with the disconnect in the ON position
 - b. Prevention of the unit door from being opened when the disconnect is in the ON position
 - 1) A feature for intentionally defeating this interlock by qualified personnel shall be provided
 - c. Prevention of the disconnect switch from being moved to the ON position if the unit door is open
 - 1) A feature for intentionally defeating this interlock by qualified personnel shall be provided

F. Pilot Devices

1. Where specified, units shall be furnished with pushbuttons, selector switches or pilot lights as shown on the contract drawings. Pilot lights shall be push-to-test LED type.

G. Terminal Blocks

1. Control terminal blocks shall be provided on all contactor and starter units.
 - a. Control terminal blocks shall be a pull-apart design on all plug-in units for easy removal of the unit from the structure.

2. Control terminal blocks on non-plug-in contactor and starter units shall be fixed type.
3. Power terminal blocks shall be provided on all contactor and starter units, rated NEMA size 3 (100 A) and below which utilize vertically operated disconnects
 - a. Power terminal blocks shall be pull-apart for NEMA size 1 and 2 (30 A and 60 A contactors).
 - b. Power terminal blocks for NEMA size 3 starters (100 A contactors) shall be non-pull apart.
4. Terminal blocks shall not be located adjacent to or inside the vertical wireway.

H. Doors

1. Each unit shall be provided with a removable door mounted on removable pin type hinges.
2. The unit doors shall be capable of being opened at least 110 degrees.
3. The unit doors shall be removable from any location in the MCC without disturbing any other unit doors.
4. The unit door shall be fastened to the structure so it can be closed to cover the unit space when the unit is removed.
5. The unit doors shall be held closed with quarter-turn latches.
6. Unit door latches shall be provided with arc resistant latches to help keep the door latched in the event that an internal arcing fault occurs.

I. Motor Starter Disconnect

1. Electro-mechanical NEMA starters
 - a. The disconnecting means for the across the line starters shall be motor circuit protectors.
 - b. The unit short circuit rating shall be greater than or equal to the available fault current as shown on the contract drawings.
 - c. Units shall be supplied based upon the rules / requirements set forth in the UL 845, NEMA ICS-18, and NFPA 70.
 - d. Units shall be shipped at the motor circuit protector set at lowest setting per UL standards. The contractor shall adjust the units based upon the particular motor application.
 - e. The minimum frame size shall be 150 amps.
 - f. Provide one normally open and one normally closed circuit breaker auxiliary contact which follows the position of the circuit breaker main contacts for indication of "On" or "Off/Tripped."

2.4 COMBINATION NEMA RATED ACROSS THE LINE STARTERS

- A. Starters shall meet applicable NEMA and UL requirements.
- B. Starters shall be minimum NEMA Size 1
 - 1. Fractional NEMA sizes are not acceptable.
- C. Starters shall be provided with a 3-pole solid state overload relay.
- D. In addition to the hold-in contact, starters shall be provided with auxiliary contacts shown on the contract drawing wiring diagrams. The starter shall be capable of accommodating up to six contact in addition to the hold-in contact.
- E. Provide a control power transformer with a rated secondary voltage of 120V AC. The control power transformer shall be provided with primary and secondary fusing.
- F. Overload relays shall have an reset button located on the outside of the unit door.
- G. Provide a door mounted selector switch for Local-Off-In Computer operation. The Local Mode shall provide local control at the MCC unit door. In the In Computer Mode, control shall be provided through a remote contact.
- H. Provide door mounted 120V AC push-to-test pilot lights with LED lamps for status indication.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Contractor shall select and install fuses in fusible switches based upon field requirements.
- B. Contractor shall adjust circuit breaker settings based upon field requirements.
- C. Contractor shall adjust solid state overloads to match the installed motor characteristics.

****END OF SECTION****

SECTION 16950 - ELECTRICAL TESTS

PART 1 - GENERAL

1.1 SCOPE

- A. The Contractor shall test, commission and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.

1.2 GENERAL

- A. The Work of this Section includes furnishing the labor, equipment and power required to support the testing in other Divisions of these Specifications. Electrical testing herein, and functional testing of all power and controls not tested under Section 17010 - Instrumentation and Controls shall be completed before commencement of the 7-day test required in Section 01650 - Startup Requirements. This scope may require the Contractor to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers.

1.3 RELATED SECTIONS

- A. The Work of the following Sections applies to the Work of this Section. Other Sections, not referenced below, shall also apply to the extent required for proper performance of this Work.
 - 1. Section 01650 Startup Requirements
 - 2. Section 13010 Instrumentation and Controls General Requirements
 - 3. Section 16050 Basic Electrical Materials and Methods

1.4 CODES

- A. The Work of this Section shall comply with the current editions of the National Electrical Code as adopted by the City of San Diego.

1.5 STANDARDS

- A. Except as otherwise indicated, the current editions of the following apply to the Work of this Section:
 - 1. NETA - National Electrical Testing Association
 - 2. ICEA - Insulated Cable Engineers Association

1.6 TESTING

- A. The following test requirements are intended to supplement test and acceptance criteria that may be stated elsewhere.
1. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
 2. Cable Testing: 480-V circuits shall be tested for insulation resistance with a 1000-V megohm meter. Testing shall be done after the 480-V equipment is terminated. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected. Perform tests with all other equipment connected to the circuit. Test results shall be submitted and shall state equipment used and time of test.
 3. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Compartments and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
 - a. Visual and physical check of cables, busswork, circuit breakers, transformers, and connections associated with all new and modified equipment.
 - b. Circuit breakers with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or long-time overcurrent, shall be field adjusted by a representative of the circuit breaker Manufacturer. Time and pickup setting shall correspond to the recommendations of the Short Circuit Study. Setting shall be tabulated and proven for each circuit breaker in its installed position; test results shall be certified by the tester and transmitted to the CONSTRUCTION MANAGER.
 4. Complete ground testing of all grounding electrodes prior to operating the equipment. (See Section 16050 - Basic Electrical Materials and Methods. Use a three-point ground test.)
 5. Harmonic Measuring: Provide Harmonic measuring at locations listed below. The testing shall be done prior to construction and after construction. After construction testing shall be with each respective chiller operating. Test reports and instruments shall be in accordance with IEC Standard 61000-4-7 and 61000-4-30. Test instruments shall be Class A certified. Test reports shall address distortion results and compare them to IEEE-519 2014 limits. Testing shall be performed by a Third Party. The Third Party will be paid by the City under separate Agreement and coordinated by the Contractor.
 - a. USS 70 bus A MCB (with and without chiller running)
 - b. USS 70 buss B MCB (with and without chiller running)

- c. Each feeder breaker to Chiller skids (with chillers running)
- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the CONSTRUCTION MANAGER and after process control devices have been adjusted as accurately as possible. It is intended that the Contractor will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
- C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, and proper speed control.
- D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve Manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.
- E. Provide ground resistance tests in the presence of the construction manager and submit results. Use a ground resistance meggar "Earth" tester with a maximum of 0-50 scale. Use the full of potential method or the three-terminal method as described by Biddle or Neta.
- F. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, and air compressors.
- G. General: Carry out tests for individual items of materials and equipment indicated in other Sections.

1.7 COMMISSIONING

- A. Commissioning during the 7-day test as specified in Section 01660 - Testing, Adjusting, and Balancing of Systems, shall not be attempted until all subsystems have been found to operate satisfactorily; commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable. Simulation of process parameters will be considered only upon receipt of a written request.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

****END OF SECTION****

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SUPPLEMENTARY SPECIAL PROVISIONS
APPENDICES

APPENDIX A
NOTICE OF EXEMPTION

NOTICE OF EXEMPTION

(Check one or both)

TO: Recorder/County Clerk
P.O. Box 1750, MS A-33
1600 Pacific Hwy, Room 260
San Diego, CA 92101-2400

FROM: City of San Diego
Public Works Department
525 B Street, Suite 750, MS 908A
San Diego, CA 92101

Office of Planning and Research
1400 Tenth Street, Room 121
Sacramento, CA 95814

Project Name: Metropolitan Biosolids Center Cooling Water System Chiller Upgrade

Project No. / WBS No.: B-16165.02.06

Project Location-Specific: The project is located within the Metro Biosolids Center located at 5240 Convoy Street, San Diego, CA 92111 and is a part of the Miramar Landfill which is sited within the Miramar Marine Corps Air Station north of the Kearny Mesa Community Planning Area (Council District 6).

Project Location-City/County: San Diego/San Diego

Description of nature and purpose of the Project: The project involves the replacement of: two existing 370-ton chillers with three new 250-ton units; three existing primary water pumps with four new pumps; one existing control unit with a new programmable distributed control system unit; all existing valves and actuators with new units; and two secondary water pumps with new pumps. The scope also includes the replacement of all concrete slabs and pads within the existing chiller area to accommodate the new equipment.

Name of Public Agency Approving Project: City of San Diego

Name of Person or Agency Carrying Out Project: City of San Diego Public Works Department,
Contact: Jerry Jakubauskas; Phone: (619) 533-3755
525 B Street, Suite 750 (MS 908A), San Diego, CA

Exempt Status: (CHECK ONE)

- Ministerial (Sec. 21080(b)(1); 15268);
- Declared Emergency (Sec. 21080(b)(3); 15269(a));
- Emergency Project (Sec. 21080(b)(4); 15269 (b)(c))
- Categorical Exemption: 15301 (Existing Facilities) and 15302 (Replacement or Reconstruction)

Reasons why project is exempt: The City of San Diego conducted an environmental review which determined that the project meets the categorical exemption criteria set forth in CEQA State Guidelines, Section 15301 (Existing Facilities) which allows for restoration or rehabilitation of deteriorated or damaged structures, facilities, or mechanical equipment to meet current standards for public health and safety, and 15302 (Replacement or Reconstruction) which allows for the replacement or reconstruction of existing utility systems and/or facilities involving negligible or no expansion of capacity; and where the exceptions listed in Section 15300.2 would not apply.

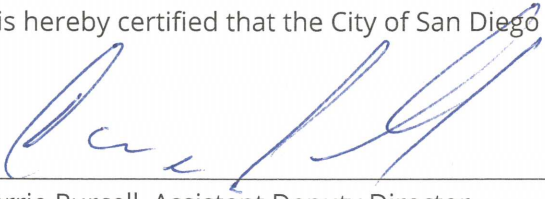
Lead Agency Contact Person: Jerry Jakubauskas

Telephone: (619) 533-3755

If filed by applicant:

1. Attach certified document of exemption finding.
2. Has a notice of exemption been filed by the public agency approving the project? Yes No

It is hereby certified that the City of San Diego has determined the above activity to be exempt from CEQA



Carrie Purcell, Assistant Deputy Director

August 24, 2018

Date

Check One:

Signed By Lead Agency

Signed by Applicant

Date Received for Filing with County Clerk or OPR:

APPENDIX B

NOT USED

APPENDIX C

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

MATERIALS TYPICALLY ACCEPTED BY CERTIFICATE OF COMPLIANCE

1. Soil amendment
2. Fiber mulch
3. PVC or PE pipe up to 16 inch diameter
4. Stabilizing emulsion
5. Lime
6. Preformed elastomeric joint seal
7. Plain and fabric reinforced elastomeric bearing pads
8. Steel reinforced elastomeric bearing pads
9. Waterstops (Special Condition)
10. Epoxy coated bar reinforcement
11. Plain and reinforcing steel
12. Structural steel
13. Structural timber and lumber
14. Treated timber and lumber
15. Lumber and timber
16. Aluminum pipe and aluminum pipe arch
17. Corrugated steel pipe and corrugated steel pipe arch
18. Structural metal plate pipe arches and pipe arches
19. Perforated steel pipe
20. Aluminum underdrain pipe
21. Aluminum or steel entrance tapers, pipe downdrains, reducers, coupling bands and slip joints
22. Metal target plates
23. Paint (traffic striping)
24. Conductors
25. Painting of electrical equipment
26. Electrical components
27. Engineering fabric
28. Portland Cement
29. PCC admixtures
30. Minor concrete, asphalt
31. Asphalt (oil)
32. Liquid asphalt emulsion
33. Epoxy

APPENDIX D

SAMPLE CITY INVOICE WITH CASHFLOW FORECAST

WBS #:	B18108
Date Submitted:	10/10/2018
NTP Date:	3/23/2018
Final Statement of WD Date:	5/23/2020
Contract #:	K-XX-XXXX-XXX-X
Contract Amount:	\$5,617,000

Construction Cash Flow Forecast
 "Sewer and Water Group Job 965 (W)"

Year	January	February	March	April	May	June	July	August	September	October	November	December
2018				15,000	25,000	52,000	52,000	100,000	10,000	100,000	100,000	100,000
2019	10,000	10,000	85,000	58,000	100,000	100,000	100,000	100,000	100,000	100,000	1,000,000	1,000,000
2020	100,000	100,000	100,000	1,000,000	1,000,000							
2021												
2022												
2023												
2024												
2025												

SAMPLE REFERENCE

APPENDIX E
LOCATION MAP

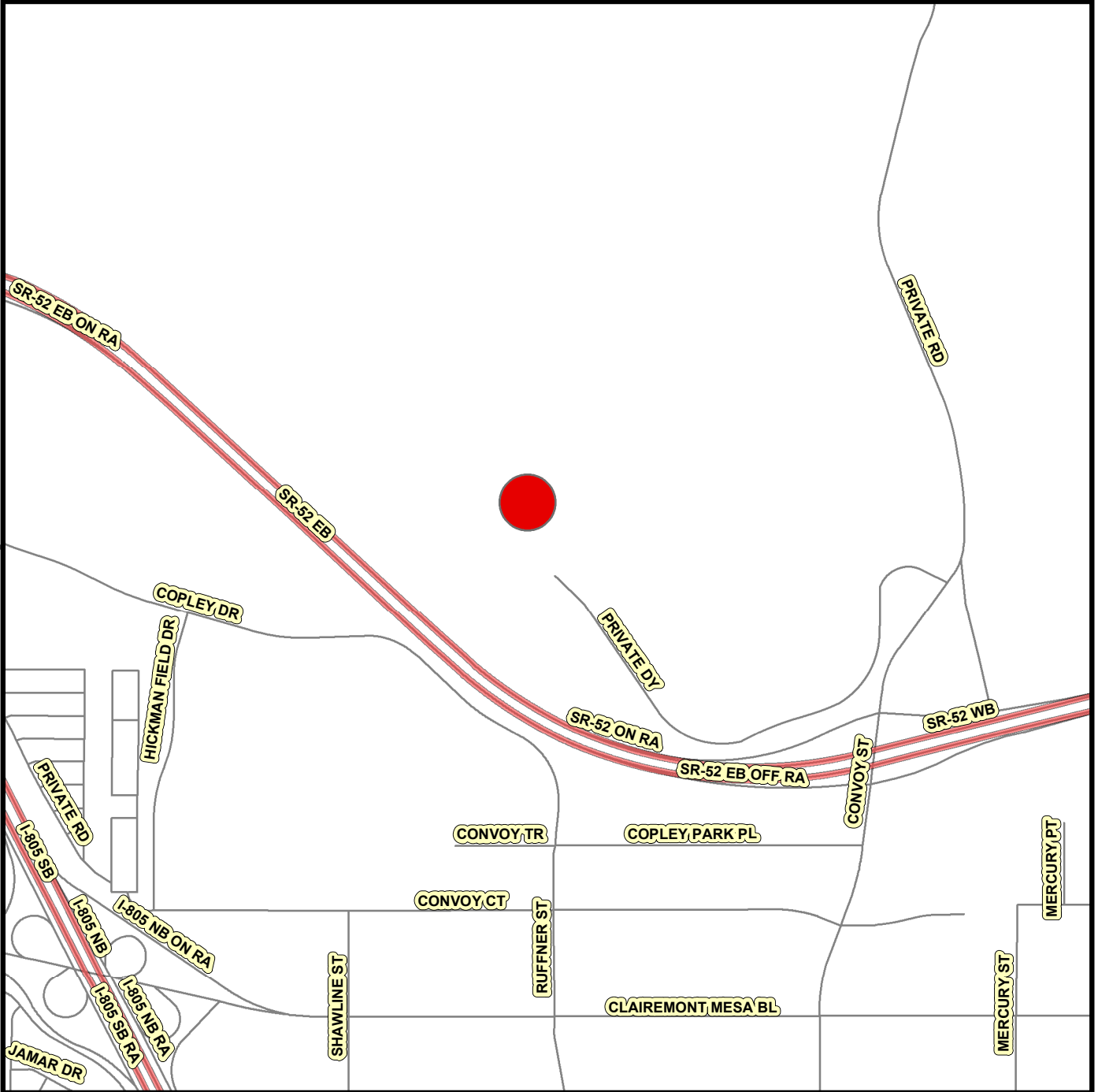
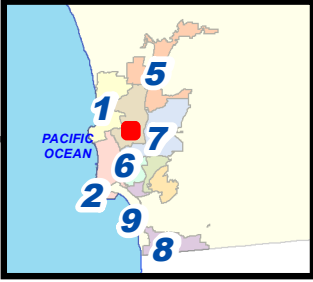
MBC Cooling Water System Chiller Upgrade

SENIOR ENGINEER
Alice Altres (OCA)
619-533-7405

PROJECT MANAGER
Idalmiro Manuel da Rosa
619-533-4629

PROJECT ENGINEER
Jorge Larriva
619-533-7405

FOR QUESTIONS ABOUT THIS PROJECT
Call: 619-533-4207
Email: engineering@sandiego.gov



 Project Location



THIS MAP/DATA IS PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Note: This product may contain information reproduced with permission granted by RAND MCNALLY & COMPANY to SanGIS. This map is copyrighted by RAND MCNALLY & COMPANY. It is unlawful to copy or reproduce all or any part thereof, whether for personal use or resale, without the prior, written permission of RAND MCNALLY & COMPANY.

APPENDIX F
HAZARDOUS WASTE LABEL AND FORMS

HAZARDOUS WASTE

STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY
AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OR THE CALIFORNIA DEPARTMENT OF HEALTH SERVICES

GENERATOR NAME _____
ADDRESS _____ 24 HR. PHONE () _____
CITY _____ STATE _____ ZIP _____
EPA ID NO. _____ MANIFEST DOCUMENT NO. _____
EPA WASTE NO. _____ CA WASTE NO. _____ ACCUMULATION START DATE _____ / /

CONTENTS, COMPOSITION _____
PROPER DOT SHIPPING NAME _____
TECHNICAL NAME (S) _____
UN/NA NO. WITH PREFIX _____

PHYSICAL STATE | HAZARDOUS PROPERTIES FLAMMABLE TOXIC
 SOLID LIQUID CORROSIVE REACTIVE OTHER _____

HANDLE WITH CARE!
CONTAINS HAZARDOUS OR TOXIC WASTES

INCIDENT/RELEASE ASSESSMENT FORM ¹

If you have an emergency, Call 911

Handlers of hazardous materials are required to report releases. The following is a tool to be used for assessing if a release is reportable. Additionally, a non-reportable release incident form is provided to document why a release is not reported (see back).

Questions for Incident Assessment:

	YES	NO
1. Was anyone killed or injured, or did they require medical care or admitted to a hospital for observation?	<input type="checkbox"/>	<input type="checkbox"/>
2. Did anyone, other than employees in the immediate area of the release, evacuate?	<input type="checkbox"/>	<input type="checkbox"/>
3. Did the release cause off-site damage to public or private property?	<input type="checkbox"/>	<input type="checkbox"/>
4. Is the release greater than or equal to a reportable quantity (RQ)?	<input type="checkbox"/>	<input type="checkbox"/>
5. Was there an uncontrolled or unpermitted release to the air?	<input type="checkbox"/>	<input type="checkbox"/>
6. Did an uncontrolled or unpermitted release escape secondary containment, or extend into any sewers, storm water conveyance systems, utility vaults and conduits, wetlands, waterways, public roads, or off site?	<input type="checkbox"/>	<input type="checkbox"/>
7. Will control, containment, decontamination, and/or clean up require the assistance of federal, state, county, or municipal response elements?	<input type="checkbox"/>	<input type="checkbox"/>
8. Was the release or threatened release involving an unknown material or contains an unknown hazardous constituent?	<input type="checkbox"/>	<input type="checkbox"/>
9. Is the incident a threatened release (a condition creating a substantial probability of harm that requires immediate action to prevent, reduce, or mitigate damages to persons, property, or the environment)?	<input type="checkbox"/>	<input type="checkbox"/>
10. Is there an increased potential for secondary effects including fire, explosion, line rupture, equipment failure, or other outcomes that may endanger or cause exposure to employees, the general public, or the environment?	<input type="checkbox"/>	<input type="checkbox"/>

If the answer is YES to any of the above questions – report the release to the California Office of Emergency Services at 800-852-7550 and the local CUPA daytime: (619) 338-2284, after hours: (858) 565-5255. Note: other state and federal agencies may require notification depending on the circumstances.

Call 911 in an emergency

If all answers are NO, complete a Non Reportable Release Incident Form (page 2 of 2) and keep readily available. Documenting why a “no” response was made to each question will serve useful in the event questions are asked in the future, and to justify not reporting to an outside regulatory agency.

If in doubt, report the release.

¹ This document is a guide for accessing when hazardous materials release reporting is required by Chapter 6.95 of the California Health and Safety Code. It does not replace good judgment, Chapter 6.95, or other state or federal release reporting requirements.

NON REPORTABLE RELEASE INCIDENT FORM

1. RELEASE AND RESPONSE DESCRIPTION

Incident # _____

Date/Time Discovered	Date/Time Discharge	Discharge Stopped <input type="checkbox"/> Yes <input type="checkbox"/> No
Incident Date / Time:		
Incident Business / Site Name:		
Incident Address:		
Other Locators (Bldg, Room, Oil Field, Lease, Well #, GIS)		
Please describe the incident and indicate specific causes and area affected. Photos Attached?: <input type="checkbox"/> Yes <input type="checkbox"/> No		
Indicate actions to be taken to prevent similar releases from occurring in the future.		

2. ADMINISTRATIVE INFORMATION

Supervisor in charge at time of incident:	Phone:
Contact Person:	Phone:

3. CHEMICAL INFORMATION

Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Chemical	Quantity <input type="checkbox"/> GAL <input type="checkbox"/> LBS <input type="checkbox"/> FT ³
Clean-Up Procedures & Timeline:	
Completed By:	Phone:
Print Name:	Title:

EMERGENCY RELEASE FOLLOW - UP NOTICE REPORTING FORM

A	BUSINESS NAME	FACILITY EMERGENCY CONTACT & PHONE NUMBER () -	
B	INCIDENT DATE MO DAY YR	TIME OES NOTIFIED (use 24 hr time)	OES CONTROL NO.
C	INCIDENT ADDRESS LOCATION	CITY / COMMUNITY	COUNTY ZIP
D	CHEMICAL OR TRADE NAME (print or type)		CAS Number
E	CHECK IF CHEMICAL IS LISTED IN 40 CFR 355, APPENDIX A <input type="checkbox"/>	CHECK IF RELEASE REQUIRES NOTIFICATION UNDER 42 U.S.C. Section 9603 (a) <input type="checkbox"/>	
F	PHYSICAL STATE CONTAINED <input type="checkbox"/> SOLID <input type="checkbox"/> LIQUID <input type="checkbox"/> GAS	PHYSICAL STATE RELEASED <input type="checkbox"/> SOLID <input type="checkbox"/> LIQUID <input type="checkbox"/> GAS	QUANTITY RELEASED
G	ENVIRONMENTAL CONTAMINATION <input type="checkbox"/> AIR <input type="checkbox"/> WATER <input type="checkbox"/> GROUND <input type="checkbox"/> OTHER	TIME OF RELEASE	DURATION OF RELEASE — DAYS — HOURS — MINUTES
H	ACTIONS TAKEN		
I	KNOWN OR ANTICIPATED HEALTH EFFECTS (Use the comments section for addition information) <input type="checkbox"/> ACUTE OR IMMEDIATE (explain) _____ <input type="checkbox"/> CHRONIC OR DELAYED (explain) _____ <input type="checkbox"/> NOTKNOWN (explain) _____		
J	ADVICE REGARDING MEDICAL ATTENTION NECESSARY FOR EXPOSED INDIVIDUALS		
K	COMMENTS (INDICATE SECTION (A - G) AND ITEM WITH COMMENTS OR ADDITIONAL INFORMATION)		
L	CERTIFICATION: I certify under penalty of law that I have personally examined and I am familiar with the information submitted and believe the submitted information is true, accurate, and complete. REPORTING FACILITY REPRESENTATIVE (print or type) _____ SIGNATURE OF REPORTING FACILITY REPRESENTATIVE _____ DATE: _____		

EMERGENCY RELEASE FOLLOW-UP NOTICE REPORTING FORM INSTRUCTIONS

GENERAL INFORMATION:

Chapter 6.95 of Division 20 of the California Health and Safety Code requires that written emergency release follow-up notices prepared pursuant to 42 U.S.C. § 11004, be submitted using this reporting form. Non-permitted releases of reportable quantities of Extremely Hazardous Substances (listed in 40 CFR 355, appendix A) or of chemicals that require release reporting under section 103(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 [42 U.S.C. § 9603(a)] must be reported on the form, as soon as practicable, but no later than 30 days, following a release. The written follow-up report is required in addition to the verbal notification.

BASIC INSTRUCTIONS:

- The form, when filled out, reports follow-up information required by 42 U.S.C § 11004. Ensure that all information requested by the form is provided as completely as possible.
- If the incident involves reportable releases of more than one chemical, prepare one report form for each chemical released.
- If the incident involves a series of separate releases of chemical(s) at different times, the releases should be reported on separate reporting forms.

SPECIFIC INSTRUCTIONS:

Block A: Enter the name of the business and the name and phone number of a contact person who can provide detailed facility information concerning the release.

Block B: Enter the date of the incident and the time that verbal notification was made to OES. The OES control number is provided to the caller by OES at the time verbal notification is made. Enter this control number in the space provided.

Block C: Provide information pertaining to the location where the release occurred. Include the street address, the city or community, the county and the zip code.

Block D: Provide information concerning the specific chemical that was released. Include the chemical or trade name and the Chemical Abstract Service (CAS) number. Check all categories that apply. Provide best available information on quantity, time and duration of the release.

Block E: Indicate all actions taken to respond to and contain the release as specified in 42 U.S.C. § 11004(c).

Block F: Check the categories that apply to the health effects that occurred or could result from the release. Provide an explanation or description of the effects in the space provided. Use Block H for additional comments/information if necessary to meet requirements specified in 42 U.S.C. § 11004(c).

Block G: Include information on the type of medical attention required for exposure to the chemical released. Indicate when and how this information was made available to individuals exposed and to medical personnel, if appropriate for the incident, as specified in 42 U.S.C. § 11004(c).

Block H: List any additional pertinent information.

Block I: Print or type the name of the facility representative submitting the report. Include the official signature and the date that the form was prepared.

MAIL THE COMPLETED REPORT TO:

**State Emergency Response Commission (SERC)
Attn: Section 304 Reports
Hazardous Materials Unit
3650 Schriever Avenue
Mather, CA 95655**

NOTE: Authority cited: Sections 25503, 25503.1 and 25507.1, Health and Safety Code. Reference: Sections 25503(b)(4), 25503.1, 25507.1, 25518 and 25520, Health and Safety Code.

ATTACHMENT F

RESERVED

ATTACHMENT G
CONTRACT AGREEMENT

CONTRACT AGREEMENT

CONSTRUCTION CONTRACT

This contract is made and entered into between THE CITY OF SAN DIEGO, a municipal corporation, herein called "City", and TechCom International, Corp. , herein called "Contractor" for construction of **MBC Cooling Water System Chiller Upgrade**; Bid No. **K-19-1802-DBB-3**; in the amount of two million nine hundred fifteen thousand seven hundred twenty-six dollars and eighty-three cents (\$2,915,726.83), which is comprised of the Base Bid.

IN CONSIDERATION of the payments to be made hereunder and the mutual undertakings of the parties hereto, City and Contractor agree as follows:

1. The following are incorporated into this contract as though fully set forth herein:
 - (a) The attached Faithful Performance and Payment Bonds.
 - (b) The attached Proposal included in the Bid documents by the Contractor.
 - (c) Reference Standards listed in the Instruction to Bidders and the Supplementary Special Provisions (SSP).
 - (d) Phased Funding Schedule Agreement.
 - (e) That certain documents entitled **MBC Cooling Water System Chiller Upgrade**, on file in the office of the Public Works Department as Document No. **B-16165**, as well as all matters referenced therein.
2. The Contractor shall perform and be bound by all the terms and conditions of this contract and in strict conformity therewith shall perform and complete in a good and workmanlike manner **MBC Cooling Water System Chiller Upgrade**, Bid Number **K-19-1802-DBB-3**, San Diego, California.
3. For such performances, the City shall pay to Contractor the amounts set forth at the times and in the manner and with such additions or deductions as are provided for in this contract, and the Contractor shall accept such payment in full satisfaction of all claims incident to such performances.
4. No claim or suit whatsoever shall be made or brought by Contractor against any officer, agent, or employee of the City for or on account of anything done or omitted to be done in connection with this contract, nor shall any such officer, agent, or employee be liable hereunder.
5. This contract is effective as of the date that the Mayor or designee signs the agreement.

CONTRACT AGREEMENT (continued)


IN WITNESS WHEREOF, this Agreement is signed by the City of San Diego, acting by and through its Mayor or designee, pursuant to Municipal Code §22.3102 authorizing such execution.

THE CITY OF SAN DIEGO

APPROVED AS TO FORM

Mara W. Elliott, City Attorney

By 

By 


Print Name: Stephen Samara
Principal Contract Specialist
Public Works Department

Print Name: Christine Leone
Deputy City Attorney

Date: 5/22/2018

Date: 5/23/19

CONTRACTOR

By 

Print Name: Bob Katebian

Title: President

Date: 4/11/2019

City of San Diego License No.: B2001010548

State Contractor's License No.: 824687

DEPARTMENT OF INDUSTRIAL RELATIONS (DIR) REGISTRATION NUMBER: 1000010140

CERTIFICATIONS AND FORMS

The Bidder, by submitting its electronic bid or proposal, agrees to and certifies under penalty of perjury under the laws of the State of California, that the certifications, forms and affidavits submitted as part of this submission are true and correct.

BIDDER'S GENERAL INFORMATION

To the City of San Diego:

Pursuant to "Notice Inviting Bids", specifications, and requirements on file with the City Clerk, and subject to all provisions of the Charter and Ordinances of the City of San Diego and applicable laws and regulations of the United States and the State of California, the undersigned hereby proposes to furnish to the City of San Diego, complete at the prices stated herein, the items or services hereinafter mentioned. The undersigned further warrants that this bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

The undersigned bidder(s) further warrants that bidder(s) has thoroughly examined and understands the entire Contract Documents (plans and specifications) and the Bidding Documents therefore, and that by submitting said Bidding Documents as its bid proposal, bidder(s) acknowledges and is bound by the entire Contract Documents, including any addenda issued thereto, as such Contract Documents incorporated by reference in the Bidding Documents.

**NON-COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID
UNDER 23 UNITED STATES CODE 112 AND PUBLIC CONTRACT CODE 7106**

State of California

County of San Diego

The bidder, being first duly sworn, deposes and says that he or she is authorized by the party making the foregoing bid that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

CONTRACTOR CERTIFICATION

DRUG-FREE WORKPLACE

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-17 regarding Drug-Free Workplace as outlined in the WHITEBOOK, Section 5-1.3, "Drug-Free Workplace", of the project specifications, and that;

This company_has in place a drug-free workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of subdivisions a) through c) of the policy as outlined.

CONTRACTOR CERTIFICATION

AMERICANS WITH DISABILITIES ACT (ADA) COMPLIANCE CERTIFICATION

I hereby certify that I am familiar with the requirements of San Diego City Council Policy No. 100-4 regarding the Americans With Disabilities Act (ADA) outlined in the WHITEBOOK, Section 5-1.2, "California Building Code, California Code of Regulations Title 24 and Americans with Disabilities Act", of the project specifications, and that:

This company has in place workplace program that complies with said policy. I further certify that each subcontract agreement for this project contains language which indicates the subcontractor's agreement to abide by the provisions of the policy as outlined.

CONTRACTOR CERTIFICATION

CONTRACTOR STANDARDS – PLEDGE OF COMPLIANCE

I declare under penalty of perjury that I am authorized to make this certification on behalf of the company submitting this bid/proposal, that as Contractor, I am familiar with the requirements of City of San Diego Municipal Code § 22.3004 regarding Contractor Standards as outlined in the WHITEBOOK, Section 5-1.4, "Contractor Standards and Pledge of Compliance", of the project specifications, and that Contractor has complied with those requirements.

I further certify that each of the Contractor's subcontractors has completed a Pledge of Compliance attesting under penalty of perjury of having complied with City of San Diego Municipal Code § 22.3004.

CONTRACTOR CERTIFICATION

EQUAL BENEFITS ORDINANCE CERTIFICATION

I declare under penalty of perjury that I am familiar with the requirements of and in compliance with the City of San Diego Municipal Code § 22.4300 regarding Equal Benefits Ordinance.

CONTRACTOR CERTIFICATION

EQUAL PAY ORDINANCE CERTIFICATION

Contractor shall comply with the Equal Pay Ordinance (EPO) codified in the San Diego Municipal Code (SDMC) at section 22.4801 through 22.4809, unless compliance is not required based on an exception listed in SDMC section 22.4804.

Contractor shall require all of its subcontractors to certify compliance with the EPO in their written subcontracts.

Contractor must post a notice informing its employees of their rights under the EPO in the workplace or job site.

By signing this Contract with the City of San Diego, Contractor acknowledges the EPO requirements and pledges ongoing compliance with the requirements of SDMC Division 48, section 22.4801 et seq., throughout the duration of this Contract.

AFFIDAVIT OF DISPOSAL

(To be submitted upon completion of Construction pursuant to the contracts Certificate of Completion)

WHEREAS, on the _____ DAY OF _____, 2_____ the undersigned entered into and executed a contract with the City of San Diego, a municipal corporation, for:

MBC Cooling Water System Chiller Upgrade

(Project Title)

as particularly described in said contract and identified as Bid No. **K-19-1802-DBB-3**; SAP No. (WBS/IO/CC) **B-16165**; and **WHEREAS**, the specification of said contract requires the Contractor to affirm that "all brush, trash, debris, and surplus materials resulting from this project have been disposed of in a legal manner"; and **WHEREAS**, said contract has been completed and all surplus materials disposed of:

NOW, THEREFORE, in consideration of the final payment by the City of San Diego to said Contractor under the terms of said contract, the undersigned Contractor, does hereby affirm that all surplus materials as described in said contract have been disposed of at the following location(s)

and that they have been disposed of according to all applicable laws and regulations.

Dated this _____ DAY OF _____, _____.

By: _____
Contractor

ATTEST:

State of _____ County of _____

On this _____ DAY OF _____, 2_____, before the undersigned, a Notary Public in and for said County and State, duly commissioned and sworn, personally appeared _____ known to me to be the _____ Contractor named in the foregoing Release, and whose name is subscribed thereto, and acknowledged to me that said Contractor executed the said Release.

Notary Public in and for said County and State

LIST OF SUBCONTRACTORS

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY *** SEE INSTRUCTIONS TO BIDDERS FOR FURTHER INFORMATION**

In accordance with the requirements of the "Subletting and Subcontracting Fair Practices Act", Section 4100, of the California Public Contract Code (PCC), the Bidder is to list below the name, address and license number of each Subcontractor who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement, in an amount of or in excess of 0.5% of the Contractor's total Bid. Failure to comply with this requirement may result in the Bid being rejected as non-responsive. The Contractor is to list only one Subcontractor for each portion of the Work. The Bidder's attention is directed to the Special Provisions; Section 3-2, "SELF-PERFORMANCE", which stipulates the percentage of the Work to be performed with the Bidder's own forces. The Bidder is to also list all SLBE, ELBE, DBE, DVBE, MBE, WBE, OBE, SDB, WoSB, HUBZone, and SDVOSB Subcontractors for which the Bidders are seeking recognition towards achieving any mandatory, voluntary, or both subcontracting participation percentages.

NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR	CONSTRUCTOR OR DESIGNER	DIR Registration Number	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK	DOLLAR VALUE OF SUBCONTRACT	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB [Ⓞ]	WHERE CERTIFIED [Ⓜ]	CHECK IF JOINT VENTURE PARTNERSHIP
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____								
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____								

- Ⓞ As appropriate, Bidder shall identify Subcontractor as one of the following and shall include a valid proof of certification (except for OBE, SLBE and ELBE):

Certified Minority Business Enterprise	MBE	Certified Woman Business Enterprise	WBE
Certified Disadvantaged Business Enterprise	DBE	Certified Disabled Veteran Business Enterprise	DVBE
Other Business Enterprise	OBE	Certified Emerging Local Business Enterprise	ELBE
Certified Small Local Business Enterprise	SLBE	Small Disadvantaged Business	SDB
Woman-Owned Small Business	WoSB	HUBZone Business	HUBZone
Service-Disabled Veteran Owned Small Business	SDVOSB		

- Ⓜ As appropriate, Bidder shall indicate if Subcontractor is certified by:

City of San Diego	CITY	State of California Department of Transportation	CALTRANS
California Public Utilities Commission	CPUC		
State of California's Department of General Services	CADoGS	City of Los Angeles	LA
State of California	CA	U.S. Small Business Administration	SBA

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

NAMED EQUIPMENT/MATERIAL SUPPLIER LIST

***** PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY *** TO BE SUBMITTED IN ELECTRONIC FORMAT ONLY *** SEE INSTRUCTIONS TO BIDDERS FOR FURTHER INFORMATION**

NAME, ADDRESS AND TELEPHONE NUMBER OF VENDOR/SUPPLIER	MATERIALS OR SUPPLIES	DIR Registration Number	DOLLAR VALUE OF MATERIAL OR SUPPLIES	SUPPLIER (Yes/No)	MANUFACTURER (Yes/No)	MBE, WBE, DBE, DVBE, OBE, ELBE, SLBE, SDB, WoSB, HUBZone, OR SDVOSB ^①	WHERE CERTIFIED ^②
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____							
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____							

- ① As appropriate, Bidder shall identify Vendor/Supplier as one of the following and shall include a valid proof of certification (except for OBE,SLBE and ELBE):
- | | | | |
|---|--------|--|---------|
| Certified Minority Business Enterprise | MBE | Certified Woman Business Enterprise | WBE |
| Certified Disadvantaged Business Enterprise | DBE | Certified Disabled Veteran Business Enterprise | DVBE |
| Other Business Enterprise | OBE | Certified Emerging Local Business Enterprise | ELBE |
| Certified Small Local Business Enterprise | SLBE | Small Disadvantaged Business | SDB |
| Woman-Owned Small Business | WoSB | HUBZone Business | HUBZone |
| Service-Disabled Veteran Owned Small Business | SDVOSB | | |
- ② As appropriate, Bidder shall indicate if Vendor/Supplier is certified by:
- | | | | |
|--|--------|--|----------|
| City of San Diego | CITY | State of California Department of Transportation | CALTRANS |
| California Public Utilities Commission | CPUC | | |
| State of California's Department of General Services | CADoGS | City of Los Angeles | LA |
| State of California | CA | U.S. Small Business Administration | SBA |

The Bidder will not receive any subcontracting participation percentages if the Bidder fails to submit the required proof of certification.

ELECTRONICALLY SUBMITTED FORMS

THE FOLLOWING FORMS MUST BE SUBMITTED IN PDF FORMAT WITH BID SUBMISSION

The following forms are to be completed by the bidder and submitted (uploaded) electronically with the bid in PlanetBids.

- A. BID BOND – See Instructions to Bidders, Bidders Guarantee of Good Faith (Bid Security) for further instructions**
- B. CONTRACTOR’S CERTIFICATION OF PENDING ACTIONS**
- C. MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM**
- D. SUBCONTRACTOR LISTING (OTHER THAN FIRST TIER)**

Bids will not be accepted until ALL the above-named forms are submitted as part of the bid submittal

BID BOND

**See Instructions to Bidders, Bidder Guarantee of Good Faith
(Bid Security)**

KNOW ALL MEN BY THESE PRESENTS,

That TechCom International Corporation dba Solar 2 Power as Principal, and Nationwide Mutual Insurance Company as Surety, are held and firmly bound unto The City of San Diego hereinafter called "OWNER," in the sum of **10% OF THE TOTAL BID AMOUNT** for the payment of which sum, well and truly to be made, we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, said Principal has submitted a Bid to said OWNER to perform the WORK required under the bidding schedule(s) of the OWNER's Contract Documents entitled

MBC Cooling Water System Chiller Upgrade (K-19-1802-DBB-3)

NOW THEREFORE, if said Principal is awarded a contract by said OWNER and, within the time and in the manner required in the "Notice Inviting Bids" enters into a written Agreement on the form of agreement bound with said Contract Documents, furnishes the required certificates of insurance, and furnishes the required Performance Bond and Payment Bond, then this obligation shall be null and void, otherwise it shall remain in full force and effect. In the event suit is brought upon this bond by said OWNER and OWNER prevails, said Surety shall pay all costs incurred by said OWNER in such suit, including a reasonable attorney's fee to be fixed by the court.

SIGNED AND SEALED, this 25th day of February, 2019

TechCom International Corporation
dba Solar 2 Power (SEAL)
(Principal)

Nationwide Mutual
Insurance Company (SEAL)
(Surety)

By: B. Katchurin
(Signature)

By: James W. Johnson
(Signature)
James W. Johnson, Attorney-In-Fact

(SEAL AND NOTARIAL ACKNOWLEDGEMENT OF SURETY)

CALIFORNIA ALL-PURPOSE ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

STATE OF CALIFORNIA

County of ORANGE }

On MARCH 6, 2019 before me, JENNIFER C. ANAYA, NOTARY PUBLIC, Notary Public,
Date Insert Name of Notary exactly as it appears on the official seal

personally appeared B. KATEBIAN

Name(s) of Signer(s)

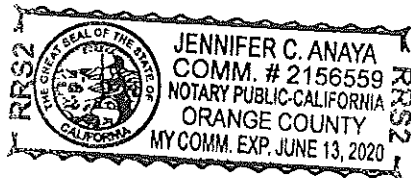
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

Witness my hand and official seal.

Signature

Signature of Notary Public JENNIFER C. ANAYA



Place Notary Seal Above

OPTIONAL

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of the form to another document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

RIGHT THUMBPRINT
OF SIGNER

Top of thumb here

Signer is Representing: _____

Signer's Name: _____

- Individual
- Corporate Officer — Title(s): _____
- Partner Limited General
- Attorney in Fact
- Trustee
- Guardian or Conservator
- Other: _____

RIGHT THUMBPRINT
OF SIGNER

Top of thumb here

Signer is Representing: _____

CALIFORNIA ALL-PURPOSE ACKNOWLEDGEMENT

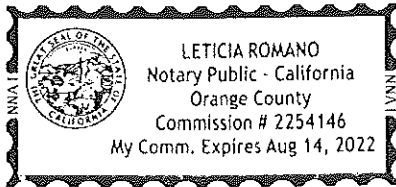
A Notary Public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California }
County of Orange }
FEB 25 2019

On _____, before me, Leticia Romano, Notary Public,
personally appeared James W. Johnson

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of State of California that the foregoing paragraph is true and correct.



PLACE NOTARY SEAL ABOVE

WITNESS my hand and official seal.

SIGNATURE Leticia Romano

Though the information below is not required by law, it may prove valuable to persons relying on the document and could prevent fraudulent removal and reattachment of this form to another document.

Description of attached document

Title or type of document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other than Named Above: _____

Power of Attorney

KNOW ALL MEN BY THESE PRESENTS THAT:

Nationwide Mutual Insurance Company, an Ohio corporation hereinafter referred to as the "Company" and does hereby make, constitute and appoint:
Erik K. Johansson, Melissa Lopez, James W. Johnson

each in their individual capacity, its true and lawful attorney-in-fact, with full power and authority to sign, seal, and execute on its behalf any and all bonds and undertakings, and other obligatory instruments of similar nature, in penalties not exceeding the sum of

UNLIMITED

and to bind the Company thereby, as fully and to the same extent as if such instruments were signed by the duly authorized officers of the Company; and all acts of said Attorney pursuant to the authority given are hereby ratified and confirmed.

This power of attorney is made and executed pursuant to and by authority of the following resolution duly adopted by the board of directors of the Company:

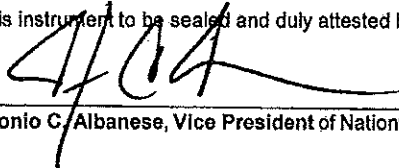
"RESOLVED, that the president, or any vice president be, and each hereby is, authorized and empowered to appoint attorneys-in-fact of the Company, and to authorize them to execute and deliver on behalf of the Company any and all bonds, forms, applications, memorandums, undertakings, recognizances, transfers, contracts of indemnity, policies, contracts guaranteeing the fidelity of persons holding positions of public or private trust, and other writings obligatory in nature that the business of the Company may require; and to modify or revoke, with or without cause, any such appointment or authority; provided, however, that the authority granted hereby shall in no way limit the authority of other duly authorized agents to sign and countersign any of said documents on behalf of the Company."

"RESOLVED FURTHER, that such attorneys-in-fact shall have full power and authority to execute and deliver any and all such documents and to bind the Company subject to the terms and limitations of the power of attorney issued to them, and to affix the seal of the Company thereto; provided, however, that said seal shall not be necessary for the validity of any such documents."

This power of attorney is signed and sealed under and by the following bylaws duly adopted by the board of directors of the Company.

Execution of Instruments. Any vice president, any assistant secretary or any assistant treasurer shall have the power and authority to sign or attest all approved documents, instruments, contracts, or other papers in connection with the operation of the business of the company in addition to the chairman of the board, the chief executive officer, president, treasurer or secretary; provided, however, the signature of any of them may be printed, engraved, or stamped on any approved document, contract, instrument, or other papers of the Company.

IN WITNESS WHEREOF, the Company has caused this instrument to be sealed and duly attested by the signature of its officer the 1st day of May, 2017.



Antonio C. Albanese, Vice President of Nationwide Mutual Insurance Company

ACKNOWLEDGMENT

STATE OF NEW YORK, COUNTY OF NEW YORK: ss

On this 1st day of May, 2017, before me came the above-named officer for the Company aforesaid, to me personally known to be the officer described in and who executed the preceding instrument, and he acknowledged the execution of the same, and being by me duly sworn, deposes and says, that he is the officer of the Company aforesaid, that the seal affixed hereto is the corporate seal of said Company, and the said corporate seal and his signature were duly affixed and subscribed to said instrument by the authority and direction of said Company.

BARRY T. BASSIS
Notary Public, State of New York
No. 02BA4656400
Qualified in New York County
Commission Expires April 30, 2019



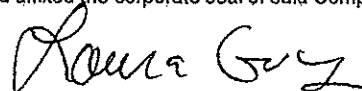
Notary Public
My Commission Expires
April 30, 2019

CERTIFICATE

I, Laura B. Guy, Assistant Secretary of the Company, do hereby certify that the foregoing is a full, true and correct copy of the original power of attorney issued by the Company; that the resolution included therein is a true and correct transcript from the minutes of the meetings of the boards of directors and the same has not been revoked or amended in any manner; that said Antonio C. Albanese was on the date of the execution of the foregoing power of attorney the duly elected officer of the Company, and the corporate seal and his signature as officer were duly affixed and subscribed to the said instrument by the authority of said board of directors; and the foregoing power of attorney is still in full force and effect.

IN WITNESS WHEREOF, I have hereunto subscribed my name as Assistant Secretary, and affixed the corporate seal of said Company this
_____ day of _____, 20

FEB 25 2019


Assistant Secretary

CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS

As part of its bid or proposal (Non-Price Proposal in the case of Design-Build contracts), the Bidder shall provide to the City a list of all instances within the past 10 years where a complaint was filed or pending against the Bidder in a legal or administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers, and a description of the status or resolution of that complaint, including any remedial action taken.

CHECK ONE BOX ONLY.

- The undersigned certifies that within the past 10 years the Bidder has NOT been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers.
- The undersigned certifies that within the past 10 years the Bidder has been the subject of a complaint or pending action in a legal administrative proceeding alleging that Bidder discriminated against its employees, subcontractors, vendors or suppliers. A description of the status or resolution of that complaint, including any remedial action taken and the applicable dates is as follows:

DATE OF CLAIM	LOCATION	DESCRIPTION OF CLAIM	LITIGATION (Y/N)	STATUS	RESOLUTION/REMEDIAL ACTION TAKEN

Contractor Name: TechCom International, Corp

Certified By Clare Katebian Title C.E.O.

Name

 Signature

Date 3/18/2019

USE ADDITIONAL FORMS AS NECESSARY

Mandatory Disclosure of Business Interests Form

BIDDER/PROPOSER INFORMATION

Legal Name TechCom International, Corp.	DBA Solar2Power
Street Address 440 Goddard, Irvine, CA 92618	City State Zip
Contact Person, Title Clare Katebian, C.E.O.	Phone Fax (949) 453-1900 x222 (949) 453-1902

Provide the name, identity, and precise nature of the interest* of all persons who are directly or indirectly involved** in this proposed transaction (SDMC § 21.0103).

* The precise nature of the interest includes:

- the percentage ownership interest in a party to the transaction,
- the percentage ownership interest in any firm, corporation, or partnership that will receive funds from the transaction,
- the value of any financial interest in the transaction,
- any contingent interest in the transaction and the value of such interest should the contingency be satisfied, and
- any philanthropic, scientific, artistic, or property interest in the transaction.

** Directly or indirectly involved means pursuing the transaction by:

- communicating or negotiating with City officers or employees,
- submitting or preparing applications, bids, proposals or other documents for purposes of contracting with the City, or
- directing or supervising the actions of persons engaged in the above activity.

Clare Katebian, C.E.O. TechCom International, Corp.

Name <u>Laguna Niguel, CA</u>	Title/Position
City and State of Residence <u>55% Owner of TechCom International,</u>	Employer (if different than Bidder/Proposer)
Interest in the transaction	

Bob Katebian, President, TechCom International, Corp.

Name <u>Laguna Niguel, CA</u>	Title/Position
City and State of Residence <u>45% Owner of TechCom International,</u>	Employer (if different than Bidder/Proposer)
Interest in the transaction	

* Use Additional Pages if Necessary *

Under penalty of perjury under the laws of the State of California, I certify that I am responsible for the completeness and accuracy of the responses contained herein, and that all information provided is true, full and complete to the best of my knowledge and belief. I agree to provide written notice to the Mayor or Designee within five (5) business days if, at any time, I learn that any portion of this Mandatory Disclosure of Business Interests Form requires an updated response. Failure to timely provide the Mayor or Designee with written notice is grounds for Contract termination.

Clare Katebian, C.E.O.		3-18-2019
Print Name, Title	Signature	Date

Failure to sign and submit this form with the bid/proposal shall make the bid/proposal non-responsive. In the case of an informal solicitation, the contract will not be awarded unless a signed and completed Mandatory Disclosure of Business Interests Form is submitted.

SUBCONTRACTOR LISTING
(OTHER THAN FIRST TIER)

Pursuant to California Senate Bill 96 and in accordance with the requirements of Labor Code sections 1771.1 and 1725.5, by submitting a bid or proposal to the City, Contractor is certifying that he or she has verified that all subcontractors used on this public work project are registered with the California Department of Industrial Relations (DIR). **The Bidder is to list below the name, address, license number, DIR registration number of any Subcontractor - regardless of tier - who will perform work, labor, render services or specially fabricate and install a portion [type] of the work or improvement pursuant to the contract. If none are known at this time, mark the table below with non-applicable (N/A).**

NAME, ADDRESS AND TELEPHONE NUMBER OF SUBCONTRACTOR	CONSTRUCTOR OR DESIGNER	DIR REGISTRATION NUMBER	SUBCONTRACTOR LICENSE NUMBER	TYPE OF WORK
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____	N/A			
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____				
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____				
Name: _____ Address: _____ City: _____ State: _____ Zip: _____ Phone: _____ Email: _____				

**** USE ADDITIONAL FORMS AS NECESSARY ****

City of San Diego

CITY CONTACT: Antoinette Sanfilippo, Contract Specialist, **Email:** Asanfilippo@sandiego.gov
Phone No. (619) 533-3439

ADDENDUM A



FOR

MBC COOLING WATER SYSTEM CHILLER UPGRADE

BID NO.:	<u>K-19-1802-DBB-3</u>
SAP NO. (WBS/IO/CC):	<u>B-16165</u>
CLIENT DEPARTMENT:	<u>2000</u>
COUNCIL DISTRICT:	<u>6</u>
PROJECT TYPE:	<u>BO</u>

BID DUE DATE:

2:00 PM
FEBRUARY 28, 2019

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps/index.shtml>

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. INSTRUCTIONS TO BIDDERS

1. To the Notice Inviting Bids **ADD** the following:

8. **PRE-BID SITE VISIT:** All those wishing to submit a bid are encouraged to visit the Work Site with the Engineer. The purpose of the Site visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Public Works Contracts at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid Site Visit is scheduled as follows:

Time: 11:00 A.M.
Date: February 14, 2019
Location: 5240 Convoy Street (Main Lobby)
San Diego, CA 92111

James Nagelvoort, Director
Public Works Department

Dated: *February 5, 2019*
San Diego, California

JN/RWB/cc

A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. ADDENDUM

1. To Addendum A, Section B, Notice Inviting Bids, **DELETE** in its entirety and **SUBSTITUTE** with the following:

11. PRE-BID SITE VISIT: All those wishing to submit a bid are encouraged to visit the Work Site with the Engineer. The purpose of the Site visit is to acquaint Bidders with the Site conditions. To request a sign language or oral interpreter for this visit, call the Public Works Contracts at (619) 533-3450 at least 5 Working Days prior to the meeting to ensure availability. The Pre-Bid Site Visit is scheduled as follows:

Time: 11:00 A.M.
Date: February 21, 2019
Location: Metro Biosolids Center (Main Lobby)
5240 Convoy Street
San Diego, CA 92111

James Nagelvoort, Director
Public Works Department

Dated: *February 12, 2019*
San Diego, California

JN/RWB/cc

City of San Diego

CITY CONTACT: Antoinette Sanfilippo, Contract Specialist, Email: ASanfilippo@sandiego.gov
Phone No. (619) 533-3439

ADDENDUM C



FOR

MBC COOLING WATER SYSTEM CHILLER UPGRADE

BID NO.: K-19-1802-DBB-3
SAP NO. (WBS/IO/CC): B-16165
CLIENT DEPARTMENT: 2000
COUNCIL DISTRICT: 6
PROJECT TYPE: BO

BID DUE DATE:

**2:00 PM
MARCH 19, 2019**

CITY OF SAN DIEGO'S ELECTRONIC BIDDING SITE, PLANETBIDS

<http://www.sandiego.gov/cip/bidopps/index.shtml>

ENGINEER OF WORK

The engineering Specifications and Special Provisions contained herein have been prepared by or under the direction of the following Registered Engineer:

Richard Howard Kennedy 3/5/19
1) Registered Engineer Date

Seal:



Brian Warner Vitelle 3/5/19
2) For City Engineer Date

Seal:



A. CHANGES TO CONTRACT DOCUMENTS

The following changes to the Contract Documents are hereby made effective as though originally issued with the bid package. Bidders are reminded that all previous requirements to this solicitation remain in full force and effect.

THE SUBMITTAL DATE FOR THIS PROJECT HAS BEEN **EXTENDED AS STATED ON THE COVER PAGE.**

B. BIDDER'S QUESTIONS

Q1. Sheet R-32A, General Structural Notes, B. Foundation Design is based on the Geotechnical report prepared by Geotechnical Consultants Inc. California. Project No.3678". Please provide this geotechnical report and all other geotechnical reports pertaining to this project.

A1. Attached is the geotechnical report.

Q2. Please provide existing and design grading plans for the new concrete slab.

A2. Grading is uniform around the new slab and should remain. Specific grade elevations of surrounding soils should not be necessary. The new slab replaces the existing with small addition on north side. Elevations of the new slab are shown on bid drawing 70-S-101A. A note on the bid drawing 70-S-101A will be added to signify that the surface of the new slab is to match existing sidewalks at locations of slab/sidewalk interfaces.

Q3. Which bid item will excavation and grading be paid?

A3. Excavation be considered part of Chiller Demolition, and that the grading be considered part of Structural Improvements.

Q4. Please provide existing structural sections for all concrete areas to be removed.

A4. See attached sections shown within a red box on the original as-build drawings.

Q5. A portion of the existing fence is to be removed. Is the fence required to be replaced and if so should the contractor use the existing fence material or will the city provide the required manufacturer?

A5. The removed fence will not be replaced, but rather the chiller area will be left open. A note will be added to bid drawing 70-D-3 indicating that removed portions of the fence are to be salvaged and stored on the plant site per direction from the City.

- Q6. Is the existing fence chain link or HSS, please provide As-builts or more specific details. Including a specification?
- A6. Refer to the response to the preceding bulleted item and the Sections 9, 10, &11 on 70-A-424, and 4/70-S-303 within the attachment.
- Q7. Please provide details and As-builts of Steel Canopy to be repaired and painted.
- A7. The details available are shown in Sections 70-A-301, and 8/70-A-424 within the attachment.
- Q8. Please provide the paint manufacturer and color required when repairing the steel canopy.
- A8. The paint type is unknown. The color is match existing per Note 11 on bid drawing 70-D-1.
- Q9. Please reference drawing 70-D-1 very top of the sheet note says "Demo existing fence and gate on North Side, Coordinate with engineer as where to store on-site". We cannot find anywhere in the drawings where it directs us to reinstall this fence & gate. Please confirm intent.
- A9. The fence will not be reinstalled, but rather stored on-site for potential future use by the City.
- Q10. Temp chillers and controls interface to process system. The existing system is primary secondary pumping with variable flow secondary. Is the temporary system to be variable flow or constant?
- A10. Refer to SECTION 01080 - WORK SEQUENCE AND TEMPORARY CHILLER SYSTEM, 1.4.C.2. Note the requirement:
- Integral to the temporary chiller shall be controls to monitor and maintain a set differential pressure between the suction and discharge of the secondary chilled water pump(s). Secondary chilled water pump speed shall be adjusted by means of VFD to maintain the differential pressure setpoint. The Contractor shall coordinate with plant operations staff, as they monitor the chilled water system differential pressure sensor through the existing STAFAs system, to establish an acceptable temporary system differential pressure setpoint."
- Secondary flows vary and so does primary flows depending on the number of chillers in operation.

Q11. There are to be two temporary chillers, are these to be lead lag, where one is always in standby?

A11. Refer to SECTION 01080 - WORK SEQUENCE AND TEMPORARY CHILLER SYSTEM 1.4.C.2. Note the requirement:

The Contractor's temporary chiller system shall operate under automatic control, including lag/lead of chillers and pumps and differential pressure setpoint, over the duration of the need for the temporary system. A pair of dry contacts with cabling shall provide a common trouble alarm to the City's DCS to alert City operations staff of the need for chiller system attention. Any programming of the City's DCS will be performed by the City.

Q12. If one of the temporary chillers is in standby what calls for the second unit to come on?

A12. Refer to SECTION 01080 - WORK SEQUENCE AND TEMPORARY CHILLER SYSTEM. This ultimately depends on the Contractor's control system for the temporary chillers. But if the priority chiller cannot provide for the cooling load the additional second chiller will have to be brought online to meet the cooling requirement.

Q13. Given the severe amount of liquidated damages associated with "inadvertent outages" that could potentially occur at any hour of the day/night, please provide the following:

- a. Does the City have staff at the facility 24/7 that will be able to contact and admit the Contractor into the facility to handle any such inadvertent outage?
- b. Does the City have an alarm system that can access remote devices such as smart phones if an inadvertent outage occurred?
- c. Would any such alarm system be available to the contractor in the case of an inadvertent outage?
- d. What personnel or systems are currently in place at the facility to timely handle inadvertent outages?
- e. Is it the intent of the City to cooperate with the Contractor to establish a protocol to timely respond to inadvertent outages without bidders having to include in its bids the cost of fulltime 24/7 personnel?

- A13. Answers for series questions in Q13:
- a. Yes.
 - b. No.
 - c. N/A.
 - d. The Instrumentation and Controls staff handles inadvertent outgages.
 - e. Yes.
- Q14. Will the temporary chiller system get a start or stop signal from the existing DCS to operate or are we to integrate the DCS to the temporary system?
- A14. Refer to SECTION 01080 - WORK SEQUENCE AND TEMPORARY CHILLER SYSTEM, 1.4.C.2:
- A pair of dry contacts with cabling shall provide a common trouble alarm to the City's DCS to alert City operations staff of the need for chiller system attention. Any programming of the City's DCS will be performed by the City.
- The Contractor operates the temporary chillers. The above is the only signal the City receives from the temporary chillers.
- Q15. Please identify which areas are hazardous and their specific classifications. .
- A15. There are no hazardous areas for this project.
- Q16. Please identify which areas are corrosive environments.
- A16. There are no corrosive environments for this project.
- Q17. General Note #10 on Drawing No. R-73A indicates there is a hazardous drawing available. Please issue this drawing.
- A17. This note does not apply and it will be removed by addendum on drawing number 40054-14-D.
- Q18. What is the manufacturer and AIC rating for existing board: 70MCC7002 CKT 5D?
- A18. A18. MCC is Eaton. Refer to Drawing 70-E-12A which indicates 65kaic.
- Q19. What is the manufacturer and AIC rating for existing panelboards: 70RPI and 70IPI?
- A19. Panels are Eaton – 10kaic.

- Q20. Note #3 Drawing No. 70-E-120D notes to re-use existing shower circuit for new shower flow switch. Please provide location of where we are to intercept, amperage size and location of existing panel.
- A20. Provide splice at the safety shower J-Box if necessary and new flexible conduit to connect to the new safety shower that is furnished with a new flow switch. Utilize the existing flow switch loop. The above text will be added to Drawing No. 70-E-102D as note as an addendum.
- Q21. On SECTION 01080 - 5 of 6 - Item 2 temporary chiller last paragraph. Contractor to be responsible for water treatment. Who is the existing water treatment company and contact person?
- A21. City of San Diego – Facility Maintenance Division staff
- Q22. The new chiller control system has to interface with existing process controls, who is the contact person to coordinate with?
- A22. All chiller water process controls, valves, and field instruments are new. The only existing process to interface with is the primary chiller water pump controls in the MCC.
Contact person is Instrumentation and Controls City Staff.
- Q23. We don't see a sequence of operation, can one be provided?
- A23. Sequence of operation for the Chillers is best define by the chiller manufacturer and control narratives are required in Section 11070, VARIABLE SPEED SCREW WATER CHILLERS, 1.4 SUBMITTALS.
- Q24. Are there any restrictions for the use of cranes due to proximity to Miramar Flight path?
- A24. Yes, height limit is as tall as the Area 86 building; need to contact the MCAS Miramar Control Tower.
- Q25. Are there any security badging requirements?
- A25. Yes, contractor staff must wear company badge at all time.
- Q26. The working hours of 7:00 AM to 3:00 PM have been stated, what are the holidays work is not allowed?
- A26. All City Holidays (New Year's Day, Martin Luther King, Jr. Day, Presidents' Day, Ceasar Chavez Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, Christmas Day)

Q27. Since the old chillers are to be removed, is there an asset documentation form to be filled out?

A27. Yes

Q28. Will there be an independent commissioning agent that we have to work with for scheduling?

A28. No

Q29. Is there a buy America only requirement?

A29. No

Q30. Spec section 11033 page 3 of 10 Pre approved VFD's:

VFD's shall be the same as manufacture as the motor control center.

MCC is Eaton, specs list Square-D, Allen Bradley Power Flex 753, Mitsubishi, and Toshiba as pre-approved along with Eaton.

Since MCC is Eaton does this mean only Eaton can be used and other preapproved cannot?

A30. This is general language which refers to new VFD's to be installed in the existing MCC only and does not apply to this scope since all the new VFD's are standalone outside of MCC. Manufacturers listed above are pre-approved.

Q31. Secondary pumps:

Schedule shows horizontal split case, specifications call for vertical split case, primary pumps are frame mount end suction, can secondary be of the same style.

A31. Secondary pumps shall be vertical split case.

Q32. The schedule calls for 1040 gpm, however the specifications have a secondary operating point of 1700 gpm, is there one point or two?

A32. The duty point is 1040 gpm @ 175 feet of TDH. The second operating point should fall on the selected pump's curve.

The PUMP SCHEDULE on Sheet 70-H-501A will be revised by addendum as follows:

Unit No. 70-P-04 and 70-P-05 – Replace the word HORIZONTAL with VERTICAL under the column heading TYPE and replace the FT.HD. from 180 to 175.

- Q33. Primary pumps:
Schedule shows two operating points, what controls this?
- A33. Similar situation to A32 above
- Q34. Are the pumps to be two speed dual winding or single?
- A34. Single speed.
- Q35. Starters need to be matched to pump winding.
- A35. Yes.
- Q36. Do you have any information regarding which areas are corrosive, as well as hazardous and their classifications? (Drawing No. R73A, General note #10 indicates there is a hazardous area drawing available.) This has a very significant impact on our installation.
- A36. This does not apply and will be removed by addendum.
- Q37. Who currently services the fire alarm system in place at the existing Chiller location?
- A37. The existing fire alarm is to be protected in-place.
- Q38. Sheet 70-D-1, referencing note 10, Is the existing alarm system to be removed a proprietary system?
- A38. The existing alarm, sound powered phone and PA speaker on the north fence will be relocated per 70-E-122A. Associated panels are located on the adjacent electrical room wall.
- Q39. Who will be responsible for Special Inspection and Materials Testing?
- A39. The City of San Diego shall employ and pay for the services of qualified inspection entities to perform specialty inspection services.
- Q40. There are no details as to the dimensions, heights, material types, etc. of a canopy that appears to cover portions of the Chiller Yard. Please provide these details.
- A40. The canopy protrudes from the building by about 5 feet. Materials include steel supports and sheet. Specific details are not available.
- Q41. What is the thickness of the Housekeeping Pad and its structural components – rebar, concrete strength, etc.
- A41. Refer to Drawings 70-S-101A, 70-S-401A, and Specification, SECTION 03300, CAST-IN-PLACE CONCRETE.

- Q42. Please provide a detail of how the existing fence posts are anchored to the existing footings such that the bidders can accurately estimate the cost to remove and reinstall the fence posts.
- A42. Details beyond what are shown on Drawings 70-D-4 and 70-S-401A, are not available.
- Q43. What are the load requirements on both Temporary Chillers for proper sizing of the temp cables?
- A43. This is a question for the general contractor to answer.
- Q44. Please provide name plate data on existing 70MCC7002. (to include manufacturer and mode)
- A44. The MCC is Eaton and rated for 65 kaic. Other nameplate data may be collected in the field by the contractor
- Q45. Please provide name plate data on existing panels 70IPI and 70RPI. (to include manufacturer and model)
- A45. The panels are Eaton and rated for 10 kaic. Other nameplate data may be collected in the field by the contractor
- Q46. Please confirm the third cable shown on drawing sheet 70-E-150A (note 8) is a temporary network cable.
- A46. Yes, this is a temporary cable to the PCM (DCS) for temporary chillers alarm, etc. The quantity of conductors to be determined during chiller submittal stage.
- Q47. Please clarify what is meant by HOC (hand off computer) and LOS (Lock-out stop push button) as called out on drawing sheet #70-E-102C.
- A47. The function is as stated above. The function is shown in the chill water pump schematics.
- Q48. Are the devices mentioned in #5 above furnished with equipment of supplied by electrical contractor?
- A48. Typically, by electrical subcontractor.
- Q49. Please clarify which party is responsible for the specification and procurement of all the instruments.
- A49. Procurement of all Instruments is as identified in the Contract Documents.

- Q50. Please reference drawing sheet # 70-E-122A. Please specify whether the conduit/s feeding these two devices are currently underground or overhead/exposed. If underground there is not a callout to intercept and reroute to new location. Please specify what location these devices need to be ran back to along with the conduit size, conductor quantity and type, and whether this is to be re-feed underground or overhead/exposed.
- A50. The conduit homeruns are underground to the paging panel in the electrical room. The relocated phone and speaker will be relocated with surface conduit to the paging panel. Assume communication cables. Conduit may be 1" C.
- Q51. Per drawings sheet # 70-E-140A, please specify to what on the chiller is the existing ground grid to be bonded to. Will this connection be exothermic or mechanical?
- A51. This depends on the chiller submittal. Assume a skid or local control panel POC. Assume exothermic.
- Q52. Are exterior junction boxes and disconnect required to be 4X or 3R?
- A52. 4X per specifications.
- Q53. Please confirm that all fencing, gates and posts will be removed on the north side.
- A53. See Drawing 70-D-1.
- Q54. In specification section 16040 Motors section 2.2 -G it indicates that all outdoor motors 25 HP and larger shall have a 120V space heater. No space heaters are indicated on plan drawings for P-4 and P-5.
- A54. Conduit plans and control diagrams 70-E-311A and 70-E-313A show motor space heaters.
- Q55. Within the specification section 16050 Basic Materials and Methods, section 1.1 -D it talks about concrete encasement. Which of the underground conduits being installed are to be concrete encased if any, or all, as suggested by 16050 section 2.3-A.
- A55. All underground conduits in the yard are integral to or under the new slab and do not require additional encasement.

- Q56. Within the specification section 16050 Basic Materials and Methods, section 1.7 B thru F, it talks about the different classifications of areas, however nowhere on the drawings dose it classify the area outdoors where the new chillers are to be installed. Please clarify if the work area is anything other than “outdoor/Damp. I.E. “Not Corrosive” Class-1 etc.
- A56. There are no classified or corrosive locations. All outdoor locations are ‘damp’.
- Q57. Please confirm if a shutdown of USS70 will be required to remove or install new wiring for the chillers. No access to USS70 above or below was available at the job walk.
- A57. USS70 is open to the below grade vault. Shutdown will not be required. However, arc flash PPE is required.
- Q58. Q60. Please confirm that temporary flexible power cables (Similar to those used with temporary generators) can be used to power the temporary chillers from USS70.
- A58. Yes.
- Q59. Can these cables lay on the ground, with the use of cable ramps “only in the areas of travel.” With all other areas just caution taped off.
- A59. Traffic and foot traffic areas at access doors must have cable ramps. Other methods may be proposed for review in other areas where the cables can be near outside walls. Methods must prevent trip hazards in the locations installed.
- Q60. After verification of the temp system operation. The specs state that the city will do shut down of existing equipment, isolation, and de-commissioning. Will the City also be recovering refrigerants and oil from the existing chillers?
- A60. No.
- Q61. Please describe the division of work with regard to Ethernet communication to the DCS 70-PCM-01).
- A61. The contractor shall run conduit between 70-PCM-03 and the CAC-3 controller and the two VFD’s as indicated. The CAT 6 cables shall be labeled and coiled by the contractor within 70-PCM-03 (DCS). The contractor shall procure and assign additional DCS hardware to the City for City installation in 70-PCM-03. Addendum 1 drawings lists the hardware to be procured by the contractor. The Ovation Ethernet Link

Card (ELC) is hard specified with no equal. The ELC card may be procured from Emerson.

Emerson Process Management
Power and Water Solutions 783 Palmyrita Ave, Suite D
Riverside, CA 92507
951-686-9880
Jeff Johnson 951-826-3229
Jeffrey.johnson@emerson.com

Q62. Our chiller supplier has informed us that the chiller sizing shown on page 50 of the solicitation document, based on the flow rates and temperatures is more than a 250 ton chiller unit can supply. If it is intended for each of the two temporary chillers to supply the required temperature and flow rates then the size of the unit will need to be larger (more expensive maybe 400 tons) or possibly three smaller units (250 ton) could supply the required flow/temperatures with a single unit loss. Can you verify the size (250 tons) and number (2) of temporary chillers specified is adequate for your needs including the redundancy the required to ensure that plant operations are not interrupted by the loss of a single chiller?

A62. There are two 250 ton temporary chillers. These are adequate for redundancy in a temporary configuration. The flowrate associated with a temporary chiller, on page 50 of the solicitation document, will be modified by an addendum.

The Landis & Staefa drawings L&S15 and L&S16 that were in the 70-Chiller CAC cabinet that is to be demolished are provided in the attached Drawings for reference information only.

C. SUPPLEMENTARY SPECIAL PROVISIONS

1. To Technicals, Section 01080 Work Sequence and Temporary Chiller System, Sub-section 1.4 Work Sequence and Constraints, Item C, Work Sequence, Sub-Item 2, page 50, **DELETE** in its entirety and **SUBSTITUTE** with the following:
 2. Provide a temporary chilled water closed system substituting for, and similar to, the existing consisting of one duty and one standby chiller, associated primary and secondary pumps and ancillary equipment, extended insulated and supported chilled water pipelines, and meeting the requirements below:

Capacity:	250 tons each
Design Supply Temperature:	42 °F
Design Return Temperature:	57 °F
Design Temperature Differential:	15 °F
Design Flow Rate:	450 - 650 gpm
Reclaimed or Potable Water:	City provides (See below)
System Control:	See below
Electrical Service:	See below
Term of Temporary Chiller Water:	15-days beyond acceptance
Maximum CW Outage:	Zero hrs (See below.)
Area of Installation:	As noted on the drawings
Operational Responsibility:	Contractor (See below.)
CW Corrosion Control:	Contractor (See below.)
Primary Pump Suction Pressure:	40 psig

2. To Appendices, **ADD** Appendix G, MBC Geotechnical Investigation with pages 15 through 178 of this addendum.
3. To Appendices, **ADD** Appendix H, Drawings L&S15, L&S16 with pages 179 through 181 of this addendum.

D. PLANS

1. To Drawing Numbers 40054-01-D, 40054-14-D, 40054-21-D, 40054-43-D, 40054-44-D, 40054-53-D, 40054-55-D, 40054-63-D, **DELETE** in their entirety and **REPLACE** with pages 182 through 189 of this Addendum.

James Nagelvoort, Director
Public Works Department

Dated: *March 7, 2019*
San Diego, California

JN/RWB/cc

APPENDIX G

MBC GEOTECHNICAL INVESTIGATION

Return to MBC Library

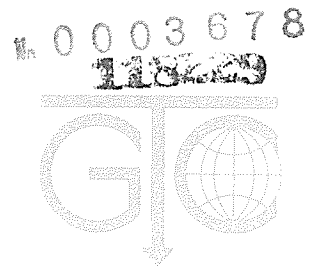
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Geotechnical Investigation
Proposed FIRP/NSPF Project
at Southwest Side of Miramar Landfill
City of San Diego, California

GEOTECHNICAL CONSULTANTS, INC.



GEOTECHNICAL CONSULTANTS, INC.

San Francisco • Santa Ana • Ventura, California

Geotechnical Investigation
Proposed FIRP/NSPF Project
at Southwest Side of Miramar Landfill
City of San Diego, California

For
Metcalf & Eddy, Inc.

April 12, 1994

S92022



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GEOPHYSICAL DATA

Geophysical Investigation, Proposed FIRP/NSPF, by Ryland Associates, Inc.

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-----------------------	--------------------------

INTRODUCTION

This report presents the results of our geotechnical investigation for design of the proposed Fiesta Island Replacement Project/Northern Sludge Processing Facility (FIRP/NSPF). The plant will be constructed by the Clean Water Program for Greater San Diego (CWP). The plant will be located within Miramar Naval Air Station on a 40-acre site north of State Highway Route 52 and west of Convoy Street (Figure 1 - Location Map).

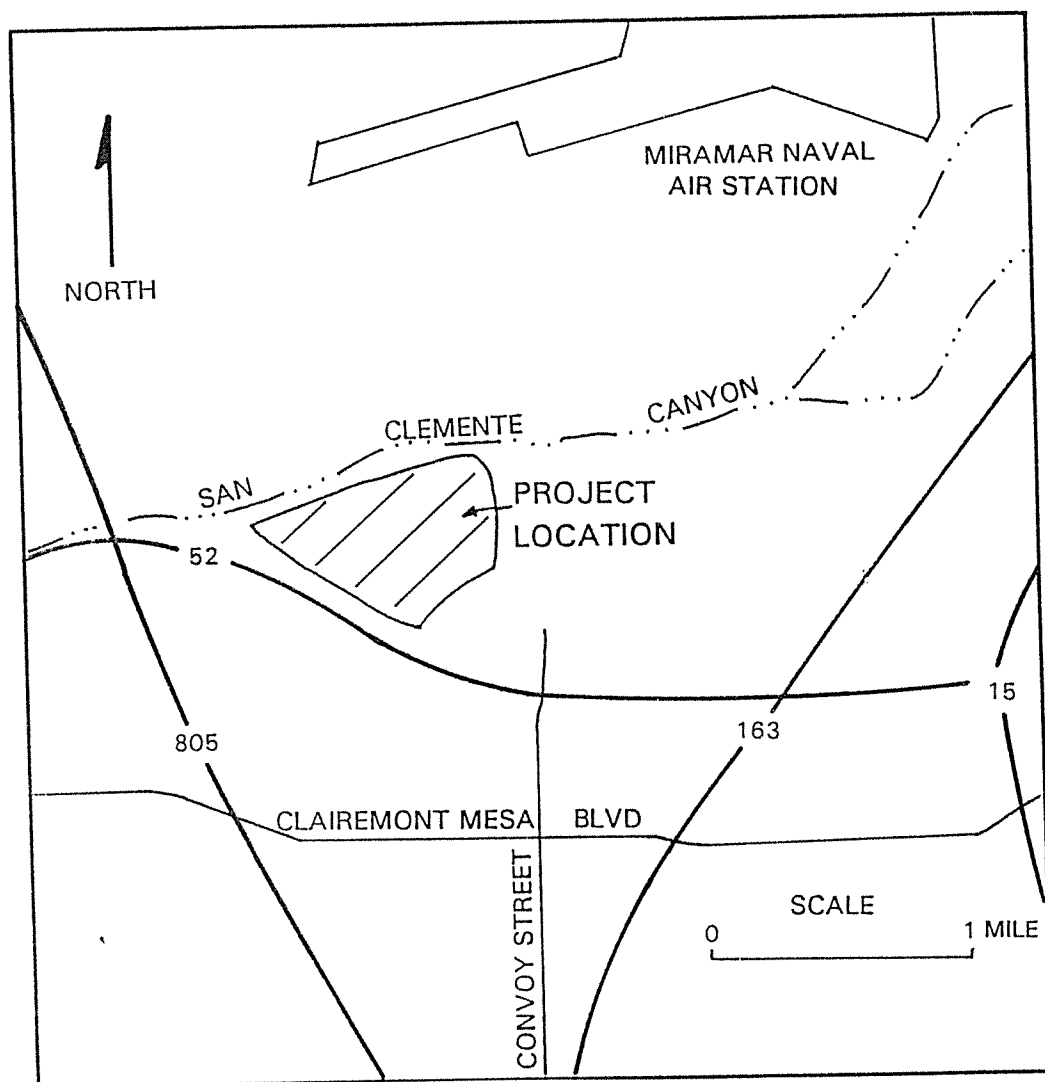
PROPOSED PROJECT

The FIRP/NSPF plant will process raw biosolids from the northern water reclamation plants and digested biosolids from the Point Loma Wastewater Treatment Plant. The FIRP/NSPF plant will include a wastewater pump station, a raw biosolids storage tank, thickeners, biosolids blending tank, digesters, digested biosolids storage tanks, biogas holding tank, waste gas burners, energy facility, maintenance yard, truck staging, washing and fueling area, dewatering facility, drying facility, administration building and parking area. In addition to the FIRP/NSPF plant, the overall site will be utilized by the Clean Water Program privatized Biosolids Processing Facilities and privatized Cogeneration Facility as well as the Waste Management Department (WMD) Material Recovery Facility, Co-Composting Facility and Paper Repulping Facility. Initial site development consists of rough grading for the Clean Water Program portion of the site, an access road, an at-grade intersection at Convoy Street, culverts, and relocation of onsite pipelines.

Site grading will be performed such that most of the CWP facilities will have pad grade elevations between 408 and 412 feet; future WMD facilities will be built at approximate elevation 420 feet. Predominantly cut, with minor fill, grading is required to achieve the desired pad elevations and will generate approximately 1.1

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**FIGURE 1
LOCATION MAP**



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million cubic yards of excess earth materials which will be exported from the site. Excavations of about 20 to 35 feet below finish grade will be required for basements and the pipe gallery.

WORK PERFORMED

The scope of work for this project was discussed with Metcalf & Eddy and formalized in our letter dated August 19, 1993. Work performed included the following:

1. Published and in-house file data were reviewed and analyzed to assist our planning of a subsurface exploration program.
2. Geologic field reconnaissance was performed at the site as part of subsurface exploration. A total of 40 small diameter hollow stem auger and air rotary borings were drilled, logged and sampled to depths ranging from 10 to 85 feet below ground surface. Location of the borings are shown on Plates 1.1 and 1.2 - Geotechnical Map. Undisturbed drive samples and bulk samples were collected from all borings and submitted to the laboratory for visual classification and testing. Within the drill holes, standard penetration testing was completed at selected depth intervals.
3. Representative samples of the earth materials encountered during exploration were tested to determine their strength properties and other engineering characteristics. Tests included moisture content, dry density, Atterberg limits, grain-size distribution, sand equivalent, expansion index, direct shear, compaction and other testing deemed

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appropriate based on exploration findings. In addition, five R-value tests were also conducted.

4. Geophysical exploration, consisting of four seismic lines, was conducted to evaluate the rippability characteristics of the bedrock. Seismic refraction, magnetometry and electromagnetic methods were used to identify the limit of landfill and cover thickness along the access road.
5. Literature review data, exploration findings and the results of laboratory testing were analyzed in order to prepare geotechnical recommendations for project design. Specific items covered include recommended bearing values, lateral earth pressures, temporary and permanent slope inclinations, seismic design considerations and pavement design criteria. The geotechnical aspects for design of the access road over landfill are also addressed.
6. At the conclusion of the study, this report was prepared summarizing our findings, conclusions and recommendations. Geologic findings were plotted on a 100-scale site grading plan along with other pertinent geotechnical data. Five geologic cross-sections were prepared to graphically depict subsurface conditions. Appended to the report is a complete set of drill hole logs and laboratory test data. Results of the geophysical exploration are also appended to this report.

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FINDINGS

SITE CONDITIONS

The proposed site, consisting of approximately 40 acres, is located on Clairemont Mesa south of San Clemente Canyon within the southern boundary of Miramar Naval Air Station. San Clemente Canyon forms the northern margin of the site, Highway 52 forms the southern boundary, with the western and eastern limits defined by northerly draining tributaries of San Clemente Canyon. A portion of the City of San Diego South Miramar Landfill lies along the southeast margin of the site and underlies the proposed access road from Station 12 to 32 (Plate 1.2).

The upper surface of Clairemont Mesa is relatively flat although a local topographic high (approximate elevation 450 feet) forms a north-south trending ridge across the project site. Slopes and drainages descend gently from the ridge to the west, north, and east to approximate elevation 400 feet. The mesa boundaries along the canyons are irregular, V-shaped gullies, with steep slopes and locally steep scarps formed by resistant bedrock layers of Lindavista sandstone and Stadium conglomerate.

Vegetation on the site consists of a light to moderate growth of chaparral-type vegetation including a variety of grasses and shrubs. The canyon slopes are densely covered by thick brush and scattered trees. A local topographic depression within the north to south striking ridge is interpreted to be created by erosion and drainage.

Access over the site is by unimproved dirt roads. Numerous roads and motorcycle trails cross the site. Two high-pressure petroleum fuel pipelines cross the site from the north to the south (see Plate 1.1) and the surface of the site is covered with scattered debris consisting of car parts, concrete debris and household trash.

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GEOLOGIC SETTING

The site is located along the western margin of the Peninsular Range Geomorphic Province. Within this province, the southern California batholith of Jurassic and Lower Cretaceous geologic age intruded (and metamorphosed) the Santiago Peak Volcanics. The gabbroic-granitic rock of the batholith and the andesitic volcanic rock comprise the basement complex upon which the thin shelf of late Cretaceous, Eocene, and post Eocene age sediments lie unconformably. The Eocene sedimentary rocks in the area of the site were deposited within the San Diego embayment (Kennedy, 1975). These sediments are comprised of an alternating sequence of transgressive and regressive deposits forming two major groups, classified as the La Jolla Group and the overlying Poway Group. The upper unit of the La Jolla Group is the Friars Formation which crops out in the lower exposures of San Clemente Canyon. Outcrops of the Stadium Conglomerate (Poway Group) occur along the canyon scarps bordering the north, northeasterly and northwesterly sides of the site. Subsurface exploration identified fine grained sandstone of the Mission Valley Formation overlying Stadium Conglomerate in the central and western portions of the site. Unconformably overlying the Eocene rock sequence is the Lindavista Formation of Pleistocene age. The Lindavista Formation, Mission Valley Formation and the Stadium Conglomerate immediately underlie the site. These bedrock units are poorly indurated, moderately consolidated, friable material.

The Stadium Conglomerate of late Eocene age is the lower unit of the Poway Group. This unit is a nonmarine deltaic sediment characterized by the presence of Poway "type" clasts. Poway clasts are composed of up to 80 percent weakly metamorphosed rhyolitic to dacitic volcanic and volcanoclastic rocks and up to 20 percent quartzite. The clasts are up to 1.5 feet in size, generally subrounded and are enveloped by a silty sand to clayey sand matrix. The Stadium Conglomerate is permeable, resistant to weathering, and varies in thickness from approximately 40

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feet on the east to less than 10 feet where the Mission Valley Formation overlies it on the west side of the site. The Stadium Conglomerate lies conformably upon the Friars Formation and is overlain by the Mission Valley Formation. Contacts dip gently to the southwest.

The Lindavista Formation consists of marine to nonmarine interbedded sandstone and conglomerate with a ferruginous cement. The ferruginous cement gives the Lindavista Formation its distinctive coloration and resistant nature. The Lindavista Formation forms an irregular angular unconformable surface upon the Stadium Conglomerate and Mission Valley Formation. The contact strikes approximately north 10 degrees west, dipping approximately two degrees to the southwest. The project site is dominated by a north to south striking barrier beach ridge composed of up to fifty feet of locally cemented sand that is medium to coarse grained. Fine gravel sized concretionary hematite pellets have eroded from the sandstone and cover the ground surface.

No faults were observed during the geologic reconnaissance conducted on the site. Pre-Pleistocene normal faults are mapped to the west in San Clemente Canyon. These fault exposures reportedly show no offset of the Pleistocene age Lindavista Formation (Kennedy, 1975).

EARTH MATERIALS

Artificial Fill (af). Fill was encountered along the proposed access road in Drill Holes 1 and 3. Fill materials are predominantly dense silty sand and gravel with minor clay and measure more than 15 feet thick in DH-1 and 5 feet thick in DH-3. Artificial fill covers the closed landfills where surface exposures reveal gravel and sand material will underlie the proposed access road over the closed landfill. Artificial fill will only be encountered along the access road alignment.

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Landfill (lf). Landfill debris underlies the proposed access road from Station 12 to 32 and is located immediately southeast of the proposed operations building (Plates 1.1 and 1.2). Exploration of the landfill was performed by non-intrusive geophysical methods, including seismic refraction, electromagnetics and magnetometry. Geophysics was able to ascertain the horizontal limits of trash but unable to estimate the thickness of waste or the soil cover. Relative thickness of the soil cap was investigated by electromagnetics and identified possible thin (less than 5 feet?) cover at Stations 17, 24 and 29 along the access road. Landfill debris consisting of paper, wood, glass and rubber with layers of soil was encountered in DH-2 drilled near the flow line of the existing drainage channel. Landfill waste extends to a depth of 31 feet below approximately 7 feet of soil cover in DH-2.

Colluvium (Qc). Colluvium on the site consists of a one to eight foot thick surface layer of loose to dense Silty Sand (SM), Sandy Clay (CL) and Sandy Silt (ML). This colluvial soil is developed on the Lindavista Formation on gentle slopes flanking the north trending sandstone ridge passing through the center of the site; virtually no colluvium is present on the sandstone ridge. Locally, accumulations of hematite concretionary pellets may constitute up to five percent of the soil. Colluvium will be removed during site grading.

Lindavista Formation (Qln). The Lindavista Formation observed at the site is composed of cemented, distinctly red colored, locally cemented sandstone, gravelly sandstone, silty sandstone and conglomerate. Backhoe exploration (GTC, 1987) exposed root development along vertical and horizontal fractures that have left clay alteration holes around root holes. The upper portion of the Lindavista Formation was readily excavated with a backhoe, but the presence of a hematite "hardpan" three to four feet below the surface was very difficult to penetrate. Deep exploration of the moderately consolidated, locally cemented sandstone and conglomerate required rotary and percussion hammer drilling.

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The Lindavista Formation is exposed at the surface across the entire site and ranges in thickness from 15 to 60 feet (Plate 2). Rough grading to approximate elevation 405 will terminate in dense sand and gravel deposits with poor resistance to erosion and a low expansion potential. Both the north facing cut slope on the south side of the site and the cut slope on the north side will expose dense, friable sandstone.

Mission Valley Formation (Tmv). Light gray to white sandstone beneath the Lindavista Formation is correlated with the Mission Valley Formation. The sandstone is generally fine grained, with minor silt and clay, and friable. Thin layers of siltstone and claystone occur locally in the Mission Valley Formation, which is conformable and gradational with the underlying Stadium Conglomerate.

The Mission Valley sandstone occurs 15 to 50 feet below existing ground surface and will not be encountered by rough grading or exposed in permanent cut slopes. Thickness ranges from zero on the east side of the site to a maximum of approximately 35 feet near the middle of the site (Plate 2). Excavation for the westerly part of the pipe gallery will encounter Mission Valley sandstone.

Stadium Conglomerate (Tst). The Stadium Conglomerate underlying the site is composed of gray to brown, dry to damp, dense, poorly indurated cobble conglomerate with Silty Sand and Clayey Sand matrix. The Stadium Conglomerate is difficult to excavate and may contain up to 80 percent cobbles formed of very hard volcanic rock measuring from three to 16 inches in diameter.

Stadium Conglomerate lies approximately 20 feet below existing grade on the east side of the site and nearly 70 feet deep near the middle where it is overlain by thick sections of the Mission Valley and Lindavista formations. Stadium Conglomerate will not be encountered during rough grading but will directly underlie deep structures on the east side of the site.

S92022-9

Friars Formation (Tf). Gray to brown siltstone, claystone and sandstone of the Friars Formation underlie the Stadium Conglomerate at approximate elevation 354 to 364 as measured in DH-9, 10, 11, 15 and 23, suggesting a southwest dipping contact. Strata of the Friars Formation are generally fine grained although minor gravel occurs in sandstone beds. The Friars Formation is not exposed at the site and will not be encountered in the deepest excavations extending to elevation 378 feet.

GROUNDWATER

Groundwater was observed during exploration in Drill Holes 2, 18 and 21 at depths of 40, 30 and 50 feet, respectively. These groundwater levels reflect local perched water conditions in sandstone. The site is more than 250 feet above the regional groundwater table as measured in nearby landfill monitoring wells (Ninyo & Moore, 1991). Locally, the site is bordered by a small reservoir to the north in San Clemente Canyon and surface water was observed in the northerly-draining tributary canyon forming the eastern boundary of the site. Heavy rainfall and poor surface drainage resulted in ponding of surface water which was observed during surface reconnaissance in April, 1993.

FAULTS AND SEISMICITY

Historically, seismic activity in the San Diego coastal area has been relatively quiet when compared to other parts of southern California. However, recent research has identified active and potentially active faults onshore and offshore of San Diego, which are believed to be capable of generating damaging earthquakes.

The northwest trending Rose Canyon fault zone, considered to be an extension of the Newport-Inglewood fault zone, passes through La Jolla, north and east of Mt. Soledad and through downtown San Diego. Until recently, no direct evidence of Holocene rupture of the Rose Canyon fault had been reported. Results

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of trenching and age dating on a trace of the Rose Canyon fault in north Mission Bay documented multiple Holocene earthquakes (Lindvall et al., 1990). Holocene rupture has also been documented in downtown San Diego (Shlemon, 1989). These studies prompted the California Division of Mines and Geology to recommend that two segments of the Rose Canyon fault be zoned as active and be included within an Alquist-Priolo Special Studies Zone (Treiman, 1990). The northern segment is considered active and is located between the coastline at La Jolla and Mission Bay, lying approximately four miles southwest of the project site.

Several northwest trending faults exist offshore in the California Continental Borderland. A complex system of subparallel faults belonging to the Coronado Bank fault zone is located offshore approximately 15 miles west of the site (Greene and Kennedy, 1987). This fault zone is considered part of the Palos Verdes fault zone which extends from Santa Monica southward (Kennedy et al., 1980). Although activity of this fault zone is not thoroughly understood, Quaternary sediments have been displaced within a few feet of the sea floor by many of the faults, and offshore earthquake epicenters are associated with the zone (Kennedy et al., 1980).

The San Clemente fault zone is located offshore approximately 46 miles west of the site. Activity on this fault zone is demonstrated by offset of late Quaternary sediments and by numerous recent earthquakes with epicenters along the fault trend (Legg and others, 1989).

Major active faults at greater distances from the site include the Elsinore, San Jacinto, and San Andreas faults. The distance to selected active faults, estimated maximum credible earthquake (MCE) events on these faults, and estimated peak ground acceleration (PGA) at the site due to maximum credible events are given in Table 1 - Active Fault Criteria. During our subsurface exploration, no evidence was

S92022-11

found to suggest that any active or potentially active faults traverse or trend toward the site.

**TABLE 1
ACTIVE FAULT CRITERIA**

Fault	Distance to Site (miles)	Maximum Credible Magnitude^a	Peak Ground Acceleration (g)^b
Rose Canyon	4	7.0	0.46
Coronado Banks	15	7.0	0.20
Elsinore	35	7.5	0.09
San Clemente	46	7.5	0.06
San Jacinto	56	7.5	0.04
San Andreas	84	8.0	0.03

^a Maximum credible earthquake (Blake, 1991a)

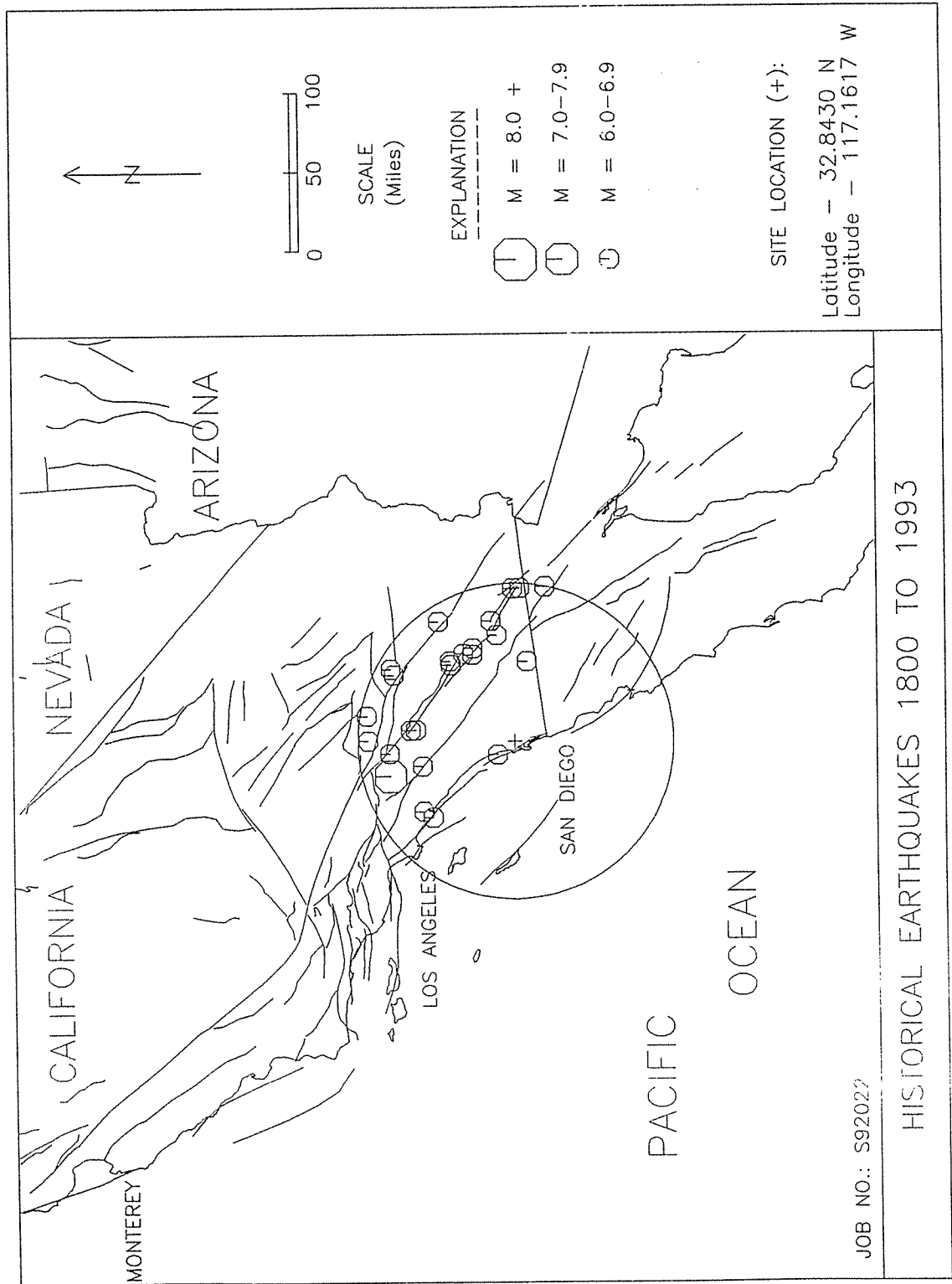
^b Values of PGA are calculated using empirical attenuation relationships by Joyner and Boore (1988) for the maximum credible event.

Figure 2 - Historic Earthquakes, 1800 to 1993 shows the location of earthquake epicenters with a magnitude 6.0 and greater within a radius of 100 miles of the project site. This figure was prepared using the computer program EQSearch (Blake, 1991b).

S92022-12



FIGURE 2
HISTORIC EARTHQUAKES, 1800 TO 1993



S92022-13

CONCLUSIONS AND RECOMMENDATIONS

1.0 GENERAL

Based on our literature research, surface geologic mapping, subsurface exploration, laboratory testing and analyses of data, it is our opinion that the subject site is suitable, from a geotechnical standpoint, for development of the proposed facilities. The following recommendations are presented as guidelines for use in preparing project plans and specifications.

2.0 GROUNDWATER

Forty borings were drilled during our subsurface investigation. Groundwater was encountered in Drill Holes 2, 18 and 21 at depths ranging from 30 to 50 feet, corresponding to elevations of 300 to 406 feet. This water is believed to be perched groundwater as the regional groundwater table is at least 200 feet below the planned grades. Based on these findings and our understanding of hydrogeologic conditions within the study area, the groundwater present would be only at nuisance levels.

3.0 SEISMIC DESIGN CONSIDERATIONS

3.1 Maximum Credible Earthquake. Because of its size and proximity to the project, a maximum credible earthquake on the Rose Canyon fault would generate the highest earthquake loads on the proposed facilities. A maximum credible earthquake is usually only considered in the design of critical structures such as nuclear power plants, dams and hospitals and is normally not considered as the design earthquake for a sludge processing facility. However, it is often desirable to use the maximum credible earthquake to evaluate the behavior of a structure should it ever become exposed to such forces. The maximum credible earthquake may thus be considered as a "collapse threshold

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force level" where the structure is allowed to yield beyond elastic deformations. A maximum credible earthquake occurring on the Rose Canyon fault, at its closest point to the site, would generate a peak horizontal ground acceleration at the site of approximately 0.46g. The effective or repeatable horizontal ground acceleration for this event would be on the order of 0.31g.

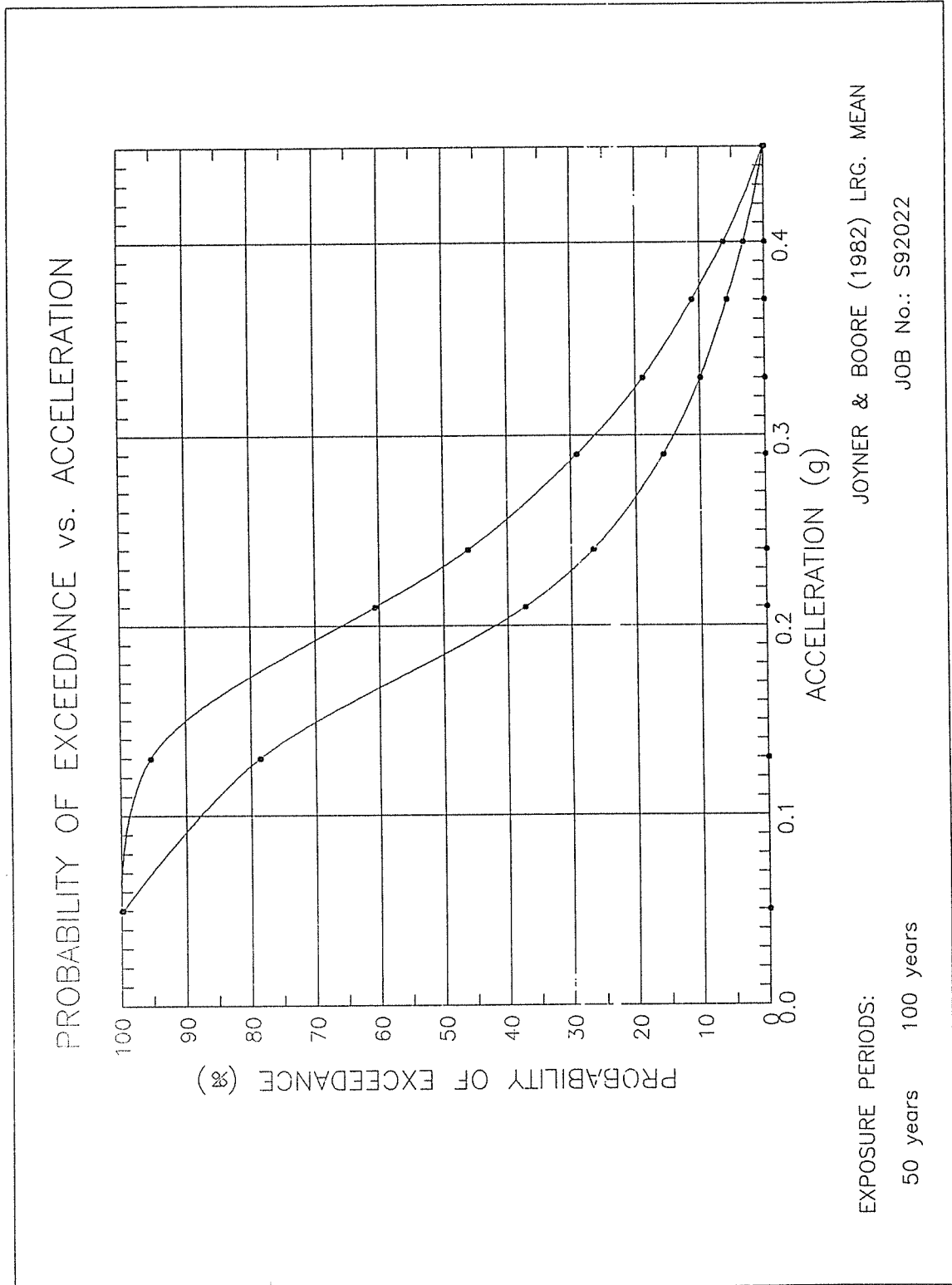
3.2 Design Earthquake. The design earthquake for the sludge processing facility should be based on an earthquake of a specified value that has a reasonable probability of occurrence during the expected service life of the structures. Structures should be able to behave elastically and without serious damage during the design level earthquake.

A probabilistic seismic hazard analysis performed for the site using the computer program FRISK89 (Blake, 1991c) and attenuation relationship of Joyner and Boore (1988) calculated that peak horizontal ground accelerations of 0.19g and 0.33g, respectively, would have 50 and 10 percent probability of exceedance in 50 years. These would increase to about 0.24g and 0.38g for the same probabilities over a 100-year period. The range of calculated probabilities for periods of 50 and 100 years are graphically shown on Figure 3 - Probability of Exceedance vs. Acceleration.

Based on the Structural Design Guidelines, Appendix D, Chapter D3 (CWP, 1992), all seismic forces and design should be performed using the ground acceleration for a 100-year design life with a probability of exceedance of 50 percent. All structures should be checked against collapse using the ground acceleration for 100-year design life with a probability of exceedance of 10 percent. In accordance with these guidelines, a horizontal ground acceleration of 0.24g can be chosen for the design of the structures, but should be checked against collapse for horizontal ground acceleration of 0.38g.

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**FIGURE 3
PROBABILITY OF EXCEEDANCE VS. ACCELERATION**



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Elastic response spectra for a 100 year design life with a probability of exceedance of 50 percent and 10 percent are shown on Figure 4 - Elastic Response Spectra. The response spectra using both mean and mean plus one standard deviation are shown in the figure.

3.3 Liquefaction. Liquefaction potential usually exists for loose to medium dense, sandy soil layers with a shallow water table and with low overburden pressure. Under the influence of seismic shaking such layers may partially or completely lose strength, causing loss of bearing capacity. Due to the relatively high density of the soils encountered and the depth of groundwater in excess of 200 feet below the planned grade level, we do not consider liquefaction to present a geologic hazard at the site.

3.4 Ground Rupture. Since there is no indication that an active fault crosses the site or trends toward the site, the likelihood of on-site ground rupture is considered remote.

4.0 EARTHWORK

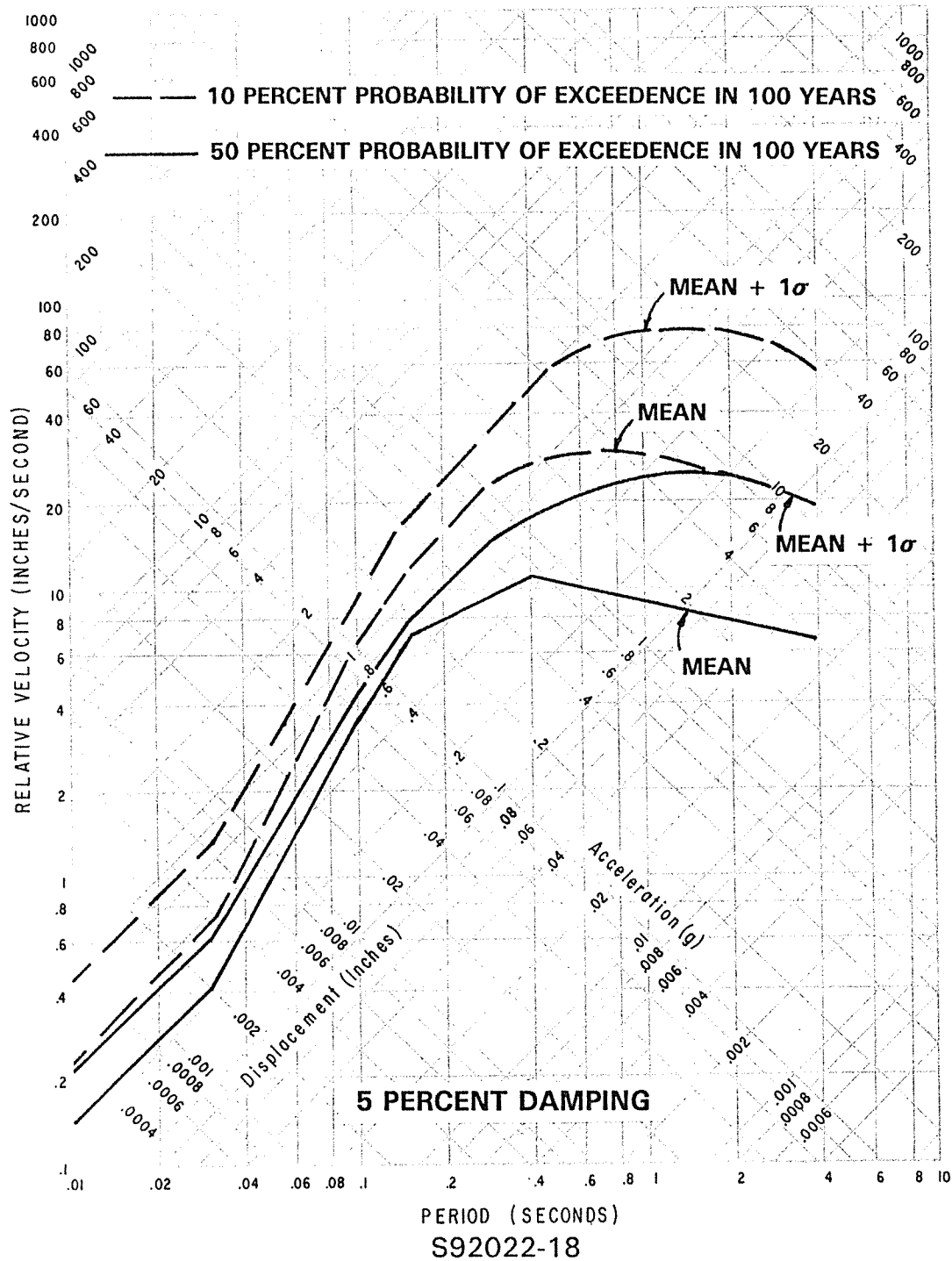
4.1 Site Preparation. Prior to grading, all vegetation, stockpiled debris, existing fill berms and loose surface soils should be stripped from the site and removed to an approved stockpile or disposal location. Additionally, safety measures should be taken to avoid the existing fuel lines and exposure to gases from the landfill.

4.2 Excavations.

Rippability. As shown on the preliminary site grading plan, excavations up to 55 feet deep will be required at the site. It is anticipated that all of the proposed excavations will be confined to the Lindavista Formation, Mission Valley Formation and Stadium Conglomerate. Much of the Lindavista

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**FIGURE 4
ELASTIC RESPONSE SPECTRA**



Formation unit is readily excavatable, however well-cemented stratum may require moderate to heavy pre-ripping. Excavations that extend into the underlying Stadium Conglomerate will encounter very hard gravel and cobbles up to 16 inches in diameter. The results of the seismic refraction survey performed for this investigation are presented in Appendix B. Based on these results we anticipate that the majority of excavation can be completed using standard grading equipment without blasting; although local heavy ripping (single shank D-9) or possibly even blasting may be required where cemented sandstone or conglomerate lenses are encountered.

Temporary Slopes. Temporary excavations up to 30 feet in height within the Lindavista, Mission Valley and Stadium Conglomerate formations should be stable at inclinations of 3/4:1 (horizontal:vertical). We recommend that all cut slopes and excavations be geologically mapped by a geologist of Geotechnical Consultants, Inc. during grading, to confirm anticipated geologic conditions.

As a general guideline, construction procedures and design of shoring should comply with the Occupational Safety and Health Administration (OSHA) current regulations pertaining to excavations. During construction, care should be taken to trim loose rocks and cobbles from the face of cut slopes and excavation sidewalls and, if necessary, provide protection from falling rocks.

Permanent Cut Slopes. Permanent, unsupported cut slopes greater than five feet in height are confined to the north-facing slope dividing the CWP and WMD facilities and a small, 15-foot high south-facing slope on the north side of the site. Using available geologic data, the north-facing slope will expose bedding planes having an apparent dip favorably oriented into the slope and will not pose an instability problem. The south-facing slope should expose thick bedded to massive sandstone that will be grossly stable.

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On a strength of materials basis, cut slopes within the formational material up to the maximum proposed height of approximately 45 feet will have a factor of safety above 1.5 (static) and above 1.1 (seismic loading) at inclinations of 1 1/2:1, or flatter. A 6-foot wide bench with gunite drain should be constructed approximately 30 feet above the proposed rough grade elevation of 405 feet.

Setback from Natural Slopes. The canyon slopes that border the northerly side of the property are subject to some form of long-term erosional regression. Although the level of detail in this study is not adequate to accurately quantify the extent of slope migration, we recommend for planning purposes that all structures be sited at least 15 feet back from the brow of this existing natural slope. To minimize the erosion potential, the slope should be provided with appropriate surface drainage features. Berms should be provided at the top of the slopes and drainage should be directed to suitable drainage devices such that surface run-off to the slope face is minimized.

4.3 Compacted Fill Placements.

Engineered Fill. Earth materials generated during site grading can be placed and compacted as engineered fill. Engineered fill may be used wherever it is not necessary to specify structural fill (see Structural Fill below). Engineered fill should be inorganic, have a low expansion potential (Expansion Index <50), and generally not contain rocks or cobbles larger than 6 inches in greatest dimension. Oversize materials greater than 6 inches in maximum dimension shall not be placed within 10 feet vertically of finish grade or within 2 feet of utilities or underground construction or as recommended by the geotechnical consultant. Placement operations should be such that nesting of oversized material does not occur and such that oversized material is completely surrounded by compacted or densified fill. Following site preparation work

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as described in Section 4.1, areas to receive fill that are flatter than 5:1 should be scarified to a depth of at least six inches, water conditioned and compacted to at least 90 percent relative compaction. The site may then be brought to design grade with engineered fill. Compaction tests should be performed in accordance with ASTM D1557-91, Methods A, B, or C, whichever is applicable. For the soil containing more than 30 percent particles retained on a 3/4-inch sieve, compaction tests should be performed in accordance with AASHTO T-180-86.

Where fill is placed against a natural or excavated slope steeper than 5:1, the existing slope should be horizontally benched to key the fill into the existing slope and a base key should be constructed at the toe of the fill. The toe key should be fully embedded at least two feet into competent bedrock. The fill should then be benched horizontally into the existing slope as shown on Figure 5 - Sidehill Fill. The final gradient of the fill slopes should be made no steeper than 2:1.

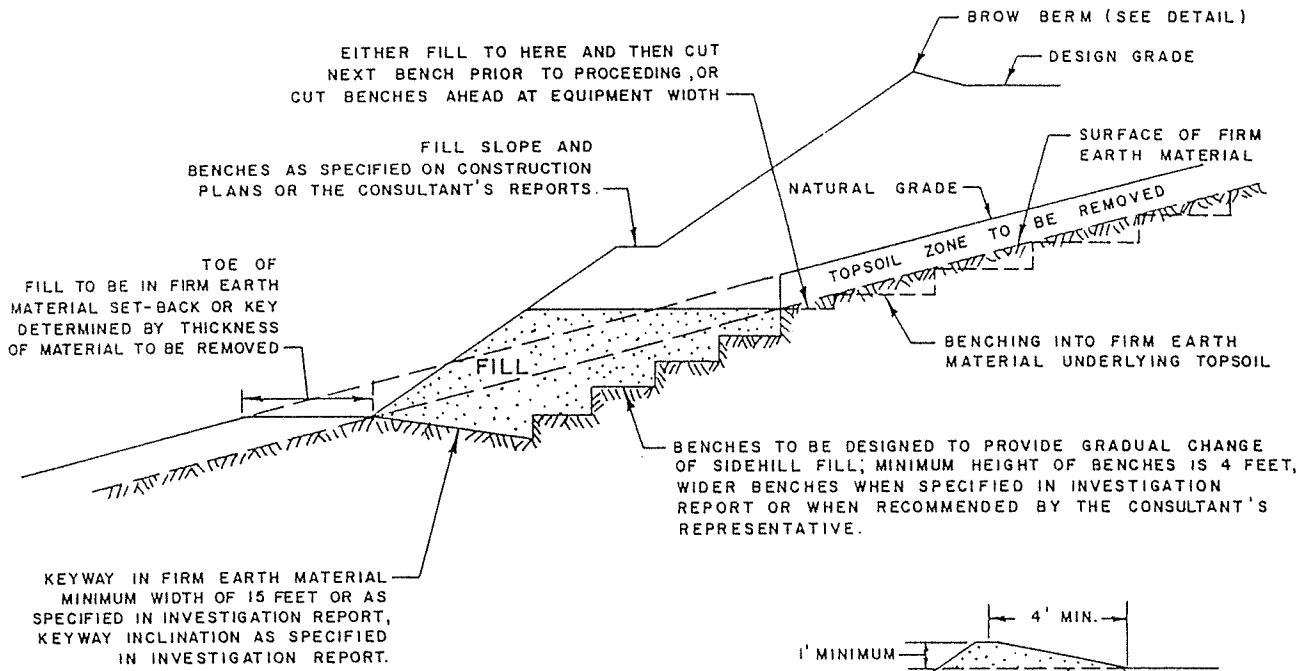
Engineered fill should be placed in layers not exceeding 8 inches in loose thickness, water conditioned, and compacted to a minimum of 90 percent relative compaction. The upper 6 inches of all pavement subgrades should be compacted to a minimum of 95 percent. A sample of the proposed fill material should be tested at the time of grading to evaluate the water content and dry density at which it should be placed.

Structural Fill. Where fill will support project slabs-on-grade or foundations, the fill should be select structural fill. Select structural fill should be inorganic, have a minimum sand equivalent of 20 and expansion index of less than 20, and should conform to the gradation shown in Table 2.

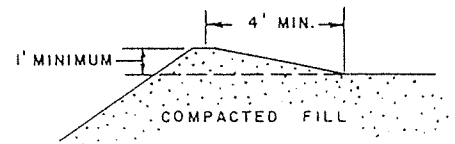
Structural fill should be placed in layers not exceeding 8 inches in loose thickness, water conditioned to between optimum and 4 percent above

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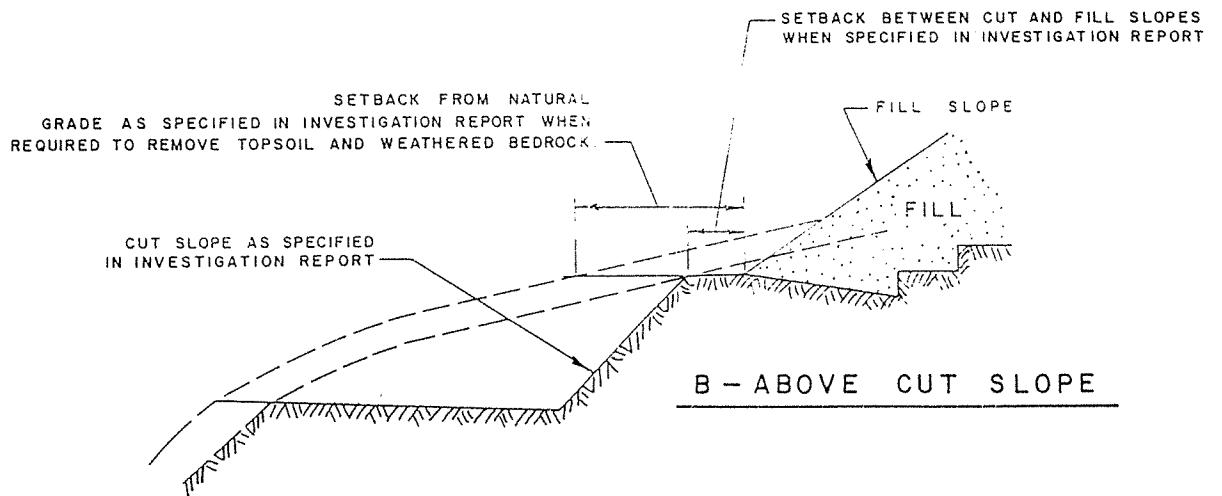
**FIGURE 5
SIDEHILL FILL**



A - ABOVE NATURAL SLOPE



BROW BERM DETAIL



B - ABOVE CUT SLOPE

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**TABLE 2
STRUCTURAL FILL GRADATION REQUIREMENTS**

SIEVE SIZE	PERCENT PASSING
3 inch	100
3/4 inch	80 - 100
No. 4	35 - 100
No. 30	20 - 100
No.200	0 - 30

the optimum value, and compacted to a minimum of 95 percent relative compaction (ASTM D1557-91) beneath all building or retaining wall foundations within the limits established by inclined planes sloping 1:1 out and down from lines one foot beyond the perimeter of the bottom of the foundation.

A minimum relative compaction of 95 percent should be achieved for structural fill underlying slabs-on-grade to a depth of 4 feet below the bottom of the slab. Below a depth of 4 feet, structural fill underlying slabs-on-grade should be compacted to a minimum relative compaction of 90 percent.

To provide a level and uniform surface for the proposed building slabs-on-grade that expose native bedrock materials, the slab subgrade should be over-excavated a minimum of 6 inches below the bottom of the slab. The approved over-excavated surface should then be scarified to a depth of 6 inches, conditioned with water to achieve a soil water content between optimum and 4 percent above optimum, and compacted to a minimum relative compaction of 90 percent based on ASTM Test D1557-91. The slab subgrade can then be brought to final grade with structural fill meeting the requirements previously given.

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Cut/Fill Transition Areas. To minimize the potential of differential settlement, the cut portion of the structure foot print in the cut/fill transition areas should be overexcavated to a minimum of 2 feet below finish grade and replaced with structural fill. The horizontal limits of this overexcavation should extend to a minimum of 2 feet beyond the structure footprint.

- 4.4 Surface Drainage.** Final grades should be planned to prevent ponding and to direct water away from building foundations and walls, peripheral slabs and walkways, and edges of pavements. Roof drainage systems should likewise be planned to direct rainwater away from building foundations. Collected surface drainage should not be discharged onto unprotected slopes but should instead be directed toward suitable collection and discharge facilities.

Graded permanent slopes should be protected by planting suitable erosion resisting vegetation as soon as possible after construction.

5.0 FOUNDATION DESIGN

The proposed facilities may be supported on continuous or column spread footings bearing on undisturbed Lindavista, Mission Valley and Stadium Conglomerate formations or select structural fill compacted as described in Section 4.3. Spread footings supported on undisturbed natural formation material may be designed to support dead plus normal live loads using an allowable soil bearing pressure of 5,000 pounds per square foot (psf). This value may be increased by 1,000 psf for each additional foot of embedment below a depth of 24 inches to a maximum of 8,000 psf. Footings supported over structural fill can be designed for an allowable bearing pressure of 4,000 psf, with no increase allowed for added embedment depth. Spread footing foundations should be embedded a minimum of 24 inches below rough pad

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grade or adjacent finished grade, whichever is lower. Continuous footings should be at least 24 inches wide, except for light, single-story structures where a footing width of 12 inches may be used.

The allowable foundation pressures presented above may be increased by one-third when considering short-term wind or seismic loads.

To minimize potential differential settlements between foundations supported by bedrock and foundations supported by structural fill, the total thickness of fill underlying project foundations should not exceed 5 feet.

Total long-term settlements should be less than one inch using the foundation recommendations presented above. Maximum differential settlement between adjacent columns should be no more than 1/2 inch. The majority of settlement should occur during construction as the loads are applied.

6.0 CONCRETE SLABS-ON-GRADE

Concrete slabs-on-grade should be constructed on compacted structural fill which has been prepared as described in Section 4.3. A modulus of subgrade reaction (K_v) equal to 200 pounds per cubic inch (pci) can be assumed. To control slab distress due to differential settlement, it is suggested that slabs that are underlain by more than 5 feet of compacted structural fill be isolated from building elements supported on native subgrade.

Where it is desirable to minimize the possibility of floor dampness, slabs should be constructed on a minimum 5-inch thick layer of capillary break material covered with a high quality impermeable membrane vapor barrier. The capillary break material should be free-draining, clean gravel or rock such as No. 4 by 3/4-inch pea gravel or permeable aggregate complying with Caltrans Standard Specifications, Section 68, Class 1, Type B. In addition a protective

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2-inch thick cover of granular material such as sand or capillary break material should be provided over the vapor barrier.

If dampness of the concrete slabs is not objectionable, the slabs may be constructed directly on the water-conditioned and compacted structural fill subgrade.

7.0 LATERAL LOADS

7.1 **General.** Recommended design parameters for retaining walls and structure walls subjected to lateral loads are presented in Table 3 - Recommended Geotechnical Design Values for Retaining Walls. The recommended lateral soil pressures presented in Table 3 are expressed as equivalent fluid pressures and are presented for level backfill conditions. The equivalent fluid pressure should be applied to a vertical plane extending vertically upward from the base of the heel of the wall to the ground surface above the heel.

**TABLE 3
RECOMMENDED GEOTECHNICAL DESIGN VALUES FOR RETAINING WALLS**

Active soil pressures level slope* (pcf):	32
At-rest soil pressures level slope* (pcf):	55
Passive soil pressure for level toe conditions* (pcf):	350
Coefficient of horizontal friction between wall base and underlying soil (ultimate):	0.40
Total soil unit weight (pcf):	130

* given as equivalent fluid pressure

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Active earth pressures apply where the top of the wall is unrestrained so that the top of the wall is free to yield about 0.2 percent of the wall height from rotation of the wall about its base. At-rest conditions should be used where the wall is restrained so that deflections of this magnitude cannot occur or where such deflections are not desirable.

Lateral earth pressures given in Table 3 assume the backfill is drained, lightly compacted, and not subject to traffic or surcharge loads imposed on the backfill side of the wall within a horizontal distance equal to the height of the wall. Where surcharge loads occur, an additional uniform lateral pressure of 0.25 times the value of the surcharge load for unrestrained walls, and 0.40 times the value of the surcharge load for restrained walls should be applied to the back of the wall. If drainage can not be provided over the full height/length of the wall, additional lateral force due to partially saturated backfill (having a higher unit weight) behind the wall should be taken into consideration for design of wall portion retaining the undrained zone. For undrained backfill, the equivalent fluid pressures of 36 pcf for active level conditions and 60 pcf for at-rest level conditions may be used.

Passive resistance contributed by the upper two feet of soil should be ignored unless the soil is confined and protected by a concrete slab or well-drained pavement. Passive pressure and friction resistance are used to compute lateral soil resistance developed against lateral structural movement. In combining the total lateral resistance, either the passive pressure or the friction of resistance should be reduced by 50 percent.

7.2 Seismic Design. In addition to the active and at-rest pressures, retaining walls should be designed to consider additional earth pressures due to earthquake loading. Dynamic lateral earth pressures may be calculated using equivalent fluid pressures of 25 pcf for level backfill slopes. The dynamic

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pressures should be applied to the back of the wall as an inverted triangular distribution. This pressure value assumes that the wall will yield sufficiently for active soil conditions to develop. Under the combined effect of static and dynamic loads, a factor of safety of 1.2 is acceptable for calculating overall stability.

- 7.3 **Backfill Compaction and Drainage.** Wall backfill should consist of a non-expansive, inorganic soil. Native granular material are suitable to use as backfill for the walls. Compaction of the backfill in a confined wedge behind the wall can cause the horizontal earth pressures to exceed the active or at-rest values given in Table 3. Care should be taken during construction to avoid overstressing the wall from the use of heavy compaction equipment. Where compaction requirements for backfill specify relative compaction of 95 percent or greater (such as for structural fill beneath footings and within 4 feet of the bottom of slabs-on-grade), the wall should be designed to resist an additional horizontal compaction surcharge. The compaction surcharge imposed by heavily compacted soils should be applied as a uniform 100 psf pressure to the back of the wall.

A drainage system should be constructed on the backfill side of all retaining walls. It is recommended that the drain consist of clean, coarse gravel or rock that is completely separated from the surrounding soil by an appropriate engineering filter fabric. To minimize infiltration, the top of the permeable backfill should be capped with concrete, pavement, or a minimum of 18 inches of compacted fine-grained soil. The wall drainage system should be drained using a perforated drain pipe placed "holes down" near the bottom of the section of drainage material. The drain pipe should discharge by gravity to a suitable outlet. Cleanouts should be incorporated into the drainage pipe design.

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8.0 PROPOSED BOX CULVERT

The proposed access road crosses a northwest trending canyon and drainage channel east of the project site. At the proposed crossing the canyon measures 60 feet deep. The channel area at the bottom of the canyon is 40 to 60 feet wide, supports a dense growth of brush and trees, and carries runoff from the surrounding South Miramar Landfills and Highway 52 north to San Clemente Canyon. The proposed crossing consists of a concrete box culvert measuring 32 feet wide, 12 feet high and 165 feet long for drainage and an earth embankment fill up to 35 feet high to support the access road across the canyon.

Subsurface exploration for the proposed culvert consisted of one boring, DH-2, located at the east edge of the existing channel (Plate 1). Drill hole 2 intercepted 7 feet of soil cover over landfill waste extending to a depth of 31 feet (elevation 309 feet), where siltstone bedrock was encountered. Although the lateral and vertical extent of landfill throughout the proposed culvert is not known, the waste will not provide adequate support for the box culvert or embankment fill. Landfill, soil cover, vegetation and alluvium should be removed until firm bedrock is encountered. These removals should extend at a 1:1 projection down and out from the bottom of the box culvert and from the proposed toe of the embankment fill between Stations 30 and 31. It should be noted that landfill waste removal will likely expose more waste, particularly on the east side of the channel, with uncertain physical characteristics and strength parameters. Minimum depth of excavation is estimated to be 30 feet. All excavation, including design of temporary slopes in waste, should be performed in accordance with Cal-OSHA guidelines.

In order to protect workers during removal of landfill waste, health and safety precautions should be undertaken to minimize exposure to harmful

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landfill gases. Handling and disposal of excavated waste should be in accordance with a health and safety/work plan prepared by an industrial hygienist.

The bottom of the removal excavation should be inspected by an engineering geologist to confirm bedrock conditions prior to backfilling. Backfill should consist of engineered fill until the proposed culvert subgrade is reached. Subdrains should be used beneath the engineered fill in the drainage channel. The embankment fill can be constructed with 2:1 slopes following the general guidelines for erosion control, key preparation and compaction discussed under Section 4.3 - Compacted Fill Placements.

As an alternate to complete removal of the landfill waste, the box culvert could be supported on caissons or driven piles. This option requires penetrating the base of the landfill with borings and permanent installation of columns that may act as conduits for downward migration of landfill derived contamination. Any plan to breach the landfill bottom should be approved by the appropriate regulatory agencies.

Alternatives to the proposed box culvert and embankment fill include a bridge or a revised alignment that bypasses the deep canyon which is underlain by landfill. At the proposed crossing a bridge could span the landfill in the channel with the westerly abutment founded on bedrock. The easterly bridge abutment would have to penetrate an unknown thickness of landfill to reach bedrock for foundation support. Alternate access road alignments should be selected where drainage channel crossings don't involve deep landfill waste removal in the culvert area that may extend into the landfill proper.

Additional subsurface exploration is required to adequately characterize the site conditions and landfill limits to provide recommendations for support of the proposed box culvert or bridge. It is anticipated that landfill debris may

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be present along the subject drainage channel between the proposed crossing and Highway 52. Consequently, additional subsurface exploration should not be undertaken until the location and type of crossing is fully considered.

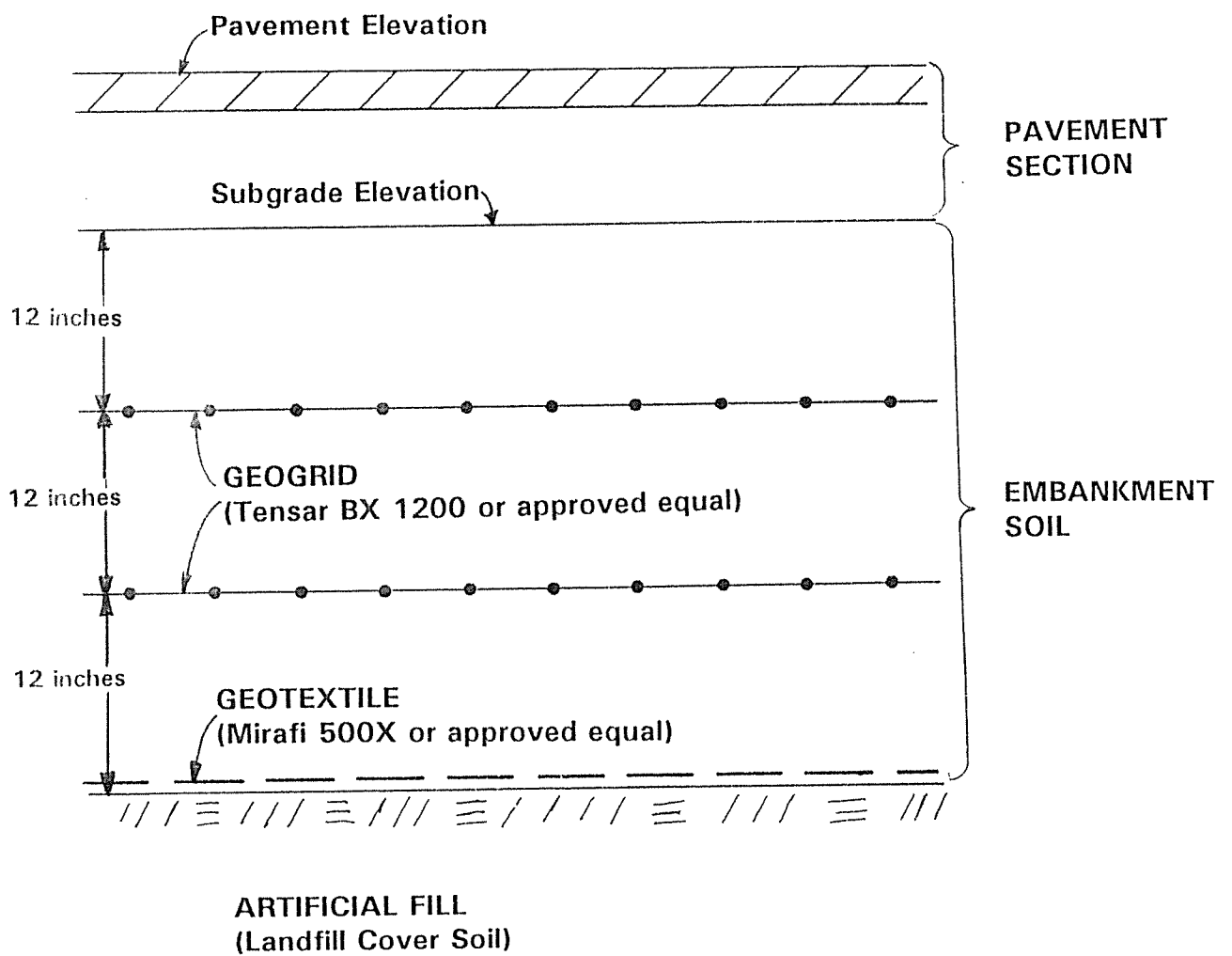
9.0 PROPOSED ACCESS ROAD

An access road measuring approximately 3000 lineal feet is proposed for vehicular traffic coming to the plant facilities. Except in the canyon area (Station 24+50 to 33+50) minor cut and fill grading are proposed for the roadway. In the area of existing landfill, 3 to 5 feet of fill is proposed which is likely to provide improved support for the roadway. Exploration in the proposed access road area was performed by non-intrusive geophysical methods including seismic refraction, electromagnetics and magnetometry. Based on this study, landfill debris underlies the proposed access road from Station 12 to 32. Landfill materials are highly compressible under loads and the likelihood of long-term decomposition of the organic material in the landfill combine for unpredictable settlement of the roadway.

From a practical standpoint and in order to minimize differential settlement, a system of geogrid with high strength geotextile requiring a minimal amount of overexcavation may be considered. This may be cost effective, provided that the owner is willing to accept a limited amount of risk consisting of future maintenance of the roadway section. For preliminary design, Figure 6 - Subgrade Stabilization Using Geosynthetics could be used. Consideration should also be given to preloading the roadway and keeping the access road unpaved until construction is completed. The final geogrid reinforced zone should be designed by a geogrid designer (i.e. Tensar Earth Technologies, Inc., Mirafi, Inc. or The Reinforced Earth Company). We further recommend that

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**FIGURE 6
SUBGRADE STABILIZATION USING GEOSYNTHETICS**



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survey/settlement monuments be installed along the existing roadway and be monitored frequently.

10.0 PAVEMENT DESIGN

The site soils were evaluated for pavement support by performing R-Value tests on five representative samples. The test results indicated subgrade support strength with R-Values ranging from 31 to 53. Based on these results, we recommend that on-site pavements be designed for an R-Value of 30 for subgrade soils.

11.0 LANDFILL GAS

The presence, concentration or chemical character of landfill gas near the FIRP/NSPF site was not evaluated during this geotechnical investigation. The potential for landfill gas to migrate through porous granular bedrock to structures with deep basements or human occupancy should be considered. Near-term plans by the City of San Diego to extract and recover landfill gas may create a positive gas flow away from the subject site and provide adequate safeguards.

12.0 CONSTRUCTION OBSERVATION

On-site grading and earthwork should be observed and, where necessary, tested by our firm to verify compliance with our recommendations. All site preparation work and foundation excavations should also be observed to compare the generalized site conditions assumed in this report with those found on the site at the time of construction.

We recommend that Geotechnical Consultants, Inc. be given the opportunity to review the geotechnical aspects of project plans and specifica-

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tions prior to construction to verify that the intent of our recommendations is incorporated into the final design.

13.0 CLOSURE

The conclusions and recommendations presented in this report are professional opinions based on the project data described in this report. A review by this office of any foundation, excavation, and/or grading plans and specifications or other work product that rely on the content of this report, together with the opportunity to make supplemental recommendations is considered an integral part of this study and a condition of the recommendations presented herein. Should the project change from that described in this report, we should be given the opportunity to review our recommendations in light of those changes.

Subsurface exploration of any site is confined to selected locations and conditions may, and often do, vary between and around these locations. Should varied conditions come to light during project development, additional exploration, testing, and recommendations may be required.

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The findings and professional opinions presented in this report are presented within the limits prescribed by the client, in accordance with generally accepted professional engineering and geologic practices. There is no other warranty, either express or implied.

Respectfully submitted,
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SG/JET/jwf

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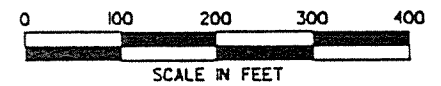
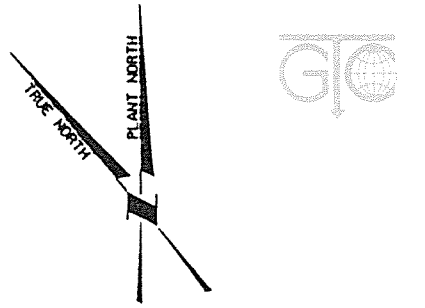
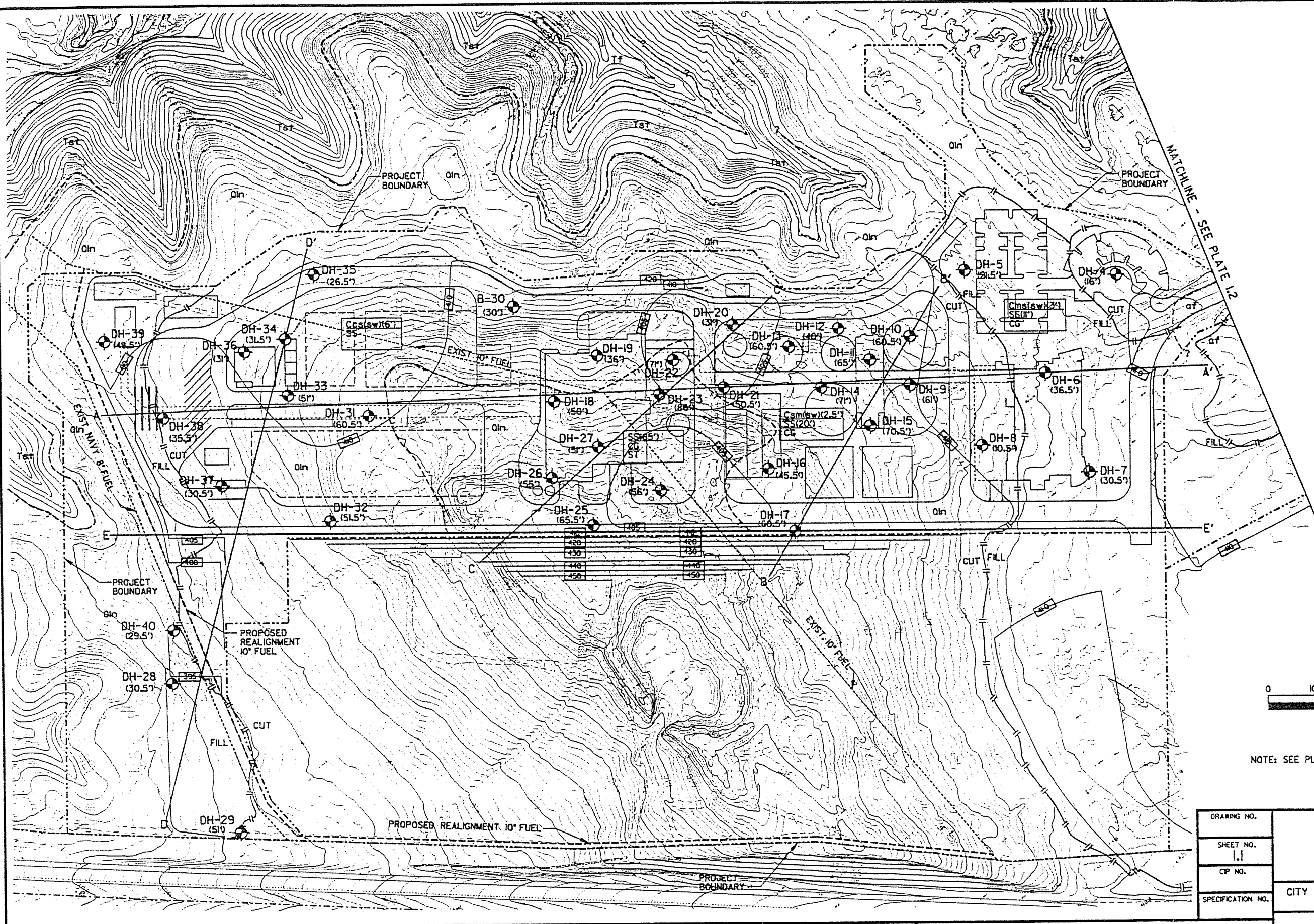
Ziony, J.I., and Buchanan, J.M., 1972, Preliminary Report on Recency of Faulting in the Greater San Diego Area, California: U.S. Geological Survey Open-File Report, 16 p.

Ziony, J.I., 1973, Recency of Faulting in the Greater San Diego Area, California, in Ross, A., and Dowlen, R.J., eds., Studies on the Geology and Geologic Hazards of the Greater San Diego Area, California: San Diego Association of Geologists Guidebook, p. 68.

Ziony, J.I., Wentworth, C.M., Buchanan - Banks, J.M., and Wagner, H.S., 1974, Preliminary Map Showing Recency of Faulting in Coastal Southern California: U.S. Geological Survey Miscellaneous Field Studies Map MF-585.

S92022-40

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NOTE: SEE PLATE L3 FOR GEOLOGIC LEGEND

WARNING
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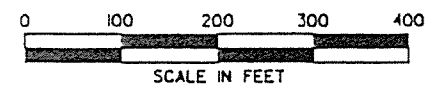
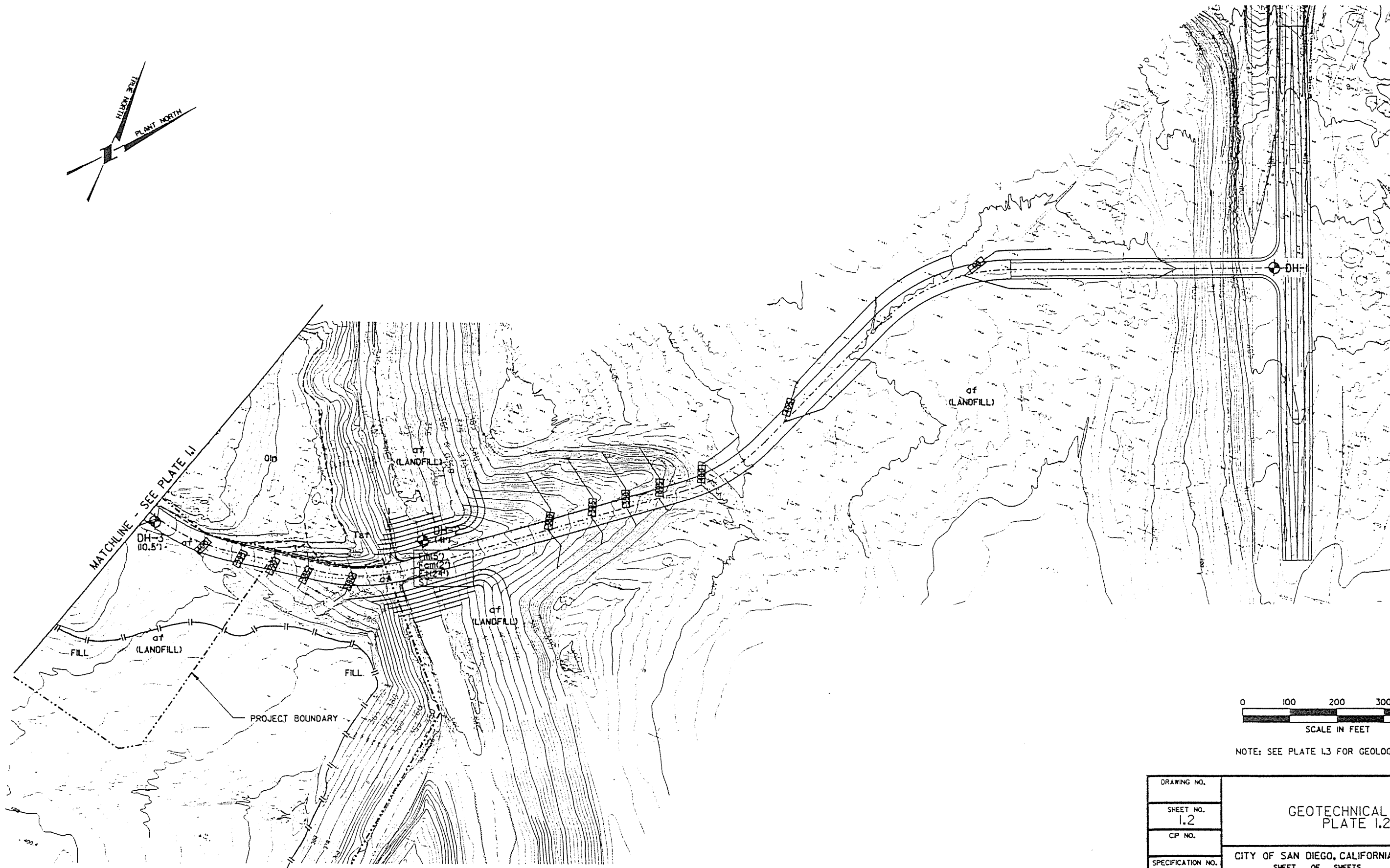
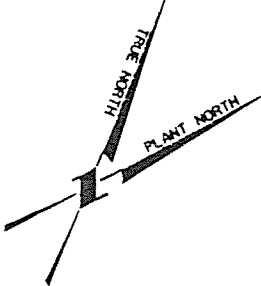
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 SCALE: HORIZONTAL _____ VERTICAL _____

METROPOLITAN WASTEWATER DEPARTMENT
 City of San Diego



DRAWING STATUS										
NO.	DATE	REQ.	REVISION	DESCRIPTION	DRAWN	CKD	APD	PE	EM	DA/OC

DRAWING NO.	GEOTECHNICAL MAP	
SHEET NO.	PLATE I.I	
CIP NO.		
SPECIFICATION NO.	CITY OF SAN DIEGO, CALIFORNIA	WATER W.O. _____
	SHEET OF SHEETS	SEWER W.O. _____
	APRIL 1994	
	CWP DIRECTOR	DEPUTY DIRECTOR
	DESCRIPTION	BY
	APPROVED	DATE
	FILED	
	DESIGN ENGINEER	
	CONTROL CERTIFICATION	
	LAMBERT COORDINATES	
CONTRACTOR	DATE STARTED	
INSPECTOR	DATE COMPLETED	
		27319-0



NOTE: SEE PLATE 1.3 FOR GEOLOGIC LEGEND

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DRAWING NO.	GEOTECHNICAL MAP PLATE 1.2 CITY OF SAN DIEGO, CALIFORNIA SHEET OF SHEETS	WATER
SHEET NO. 1.2		SEWER
CIP NO.		W.O.
SPECIFICATION NO.		

WARNING
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GEOTECHNICAL CONSULTANTS, INC.

SCALE	HORIZONTAL
	VERTICAL

METROPOLITAN WASTEWATER DEPARTMENT
 City of San Diego



DRAWING STATUS							
NO.	DATE	REQ.	REVISION DESCRIPTION	DRAWN	CKD	APD	PE

CWP DIRECTOR				DATE				DEPUTY DIRECTOR			
DESCRIPTION	BY	APPROVED	DATE	FILMED							
DESIGN ENGINEER											
CONTROL CERTIFICATION											
LAMBERT COORDINATES											
CONTRACTOR INSPECTOR				DATE STARTED				DATE COMPLETED			
27319-0											

40003563



LEGEND

SYMBOLS	DESCRIPTION
	BUILDING
	PROPOSED FUTURE BUILDING
	ESTIMATED BOUNDARY OF RESISTANT SANDSTONE OUTCROP
	APPROXIMATE GEOLOGIC CONTACT, QUERIED WHERE UNCERTAIN
	APPROXIMATE STRIKE AND DIP OF CONTACT
	EXPLORATORY DRILL HOLE, DRILL HOLE NUMBER, (DEPTH OF BORING)
	LINE OF GEOLOGIC CROSS SECTION (PLATE 2)
	PROPOSED ROUGH GRADING ELEVATION
	PROPOSED DAYLIGHT LINE

ROCK UNITS

MAP SYMBOL	DESCRIPTION
af	ARTIFICIAL FILL: TRASH AND DEBRIS, LANDFILL WASTE, HETEROGENEOUS MIXTURES OF SAND, SILT AND CLAY, ARTIFICIALLY COMPACTED EARTH MATERIALS.
qc	COLLUVIUM: UNCONSOLIDATED SLOPEWASH DEPOSITS OF SAND, SILT AND GRAVEL. FORMS 1 TO 3 FOOT THICK LAYER ON GENTLE SLOPES. NOT MAPPED.
qin	LINDAVISTA FORMATION: SANDSTONE AND CONGLOMERATE - RED TO RED-BROWN, FRIABLE, LOCALLY FORMS RESISTANT OUTCROPS, MEDIUM TO COARSE COBBLE CONGLOMERATE.
Tmv	MISSION VALLEY FORMATION: SANDSTONE - WHITE TO GRAY, FRIABLE TO MODERATELY INDURATED, SOFT, MICACEOUS (DOES NOT OUTCROP ON SITE, OBSERVED IN EXPLORATORY DRILLING).
Tst	STADIUM-CONGLOMERATE: CONGLOMERATE - GRAY TO BROWN, MEDIUM TO COARSE COBBLE CONGLOMERATE WITH FINE TO COARSE GRAINED CLAYEY SAND MATRIX.
Tf	FRIARS FORMATION: SILTSTONE - YELLOW-GRAY, MODERATELY INDURATED, INTERBEDS OF CLAYSTONE (DOES NOT OUTCROP ON SITE, OBSERVED IN EXPLORATORY DRILLING).

ENGINEERING GEOLOGY, DRILL HOLE STRATIGRAPHY

UNCONSOLIDATED SEDIMENTS GENERAL SYMBOL = Ab(c)(7')	BEDROCK GENERAL SYMBOL = AA(13')
A = GENETIC SYMBOL	AA = BEDROCK SYMBOL
F = FILL	SS = SANDSTONE
A = ALLUVIUM	ST = SILTSTONE
C = COLLUVIUM	CG = CONGLOMERATE
b = LITHOLOGIC SYMBOL	(13') = THICKNESS IN FEET
s = SAND	
m = SILT	
c = CLAY	
g = GRAVEL	
k = COBBLES	
† = TRASH	
(c) = QUALIFIER SYMBOL	
(u) = UNCOMPACTED	
(e) = ENGINEERED	
(te) = TERRACE	
(sw) = SLOPE WASH	
(7') = THICKNESS IN FEET	

EXAMPLE
 Cms(sw)(3') 3 FEET OF COLLUVIUM, SOLPE WASH IN NATURE,
 SS(7') CONSISTING OF SANDY SILT, OVERLIES 7 FEET
 cg(5') OF SANDSTONE AND 5 FEET CONGLOMERATE.
 *SOURCE: KEATON, 1984

- NOTES:
- ADDITIONAL GEOLOGIC INFORMATION PRESENTED ON PLATE 2.
 - APPROXIMATE GEOLOGIC CONTACT BASED ON SURFICIAL RECONNAISSANCE AND EXPLORATORY DRILLING.

DRAWING NO.	GEOLOGIC LEGEND		WATER W.O.
SHEET NO.	1.3		SEWER W.O.
CIP NO.	CITY OF SAN DIEGO, CALIFORNIA		
SPECIFICATION NO.	SHEET OF SHEETS		
APRIL 1994			
CIP DIRECTOR	DATE	DEPUTY DIRECTOR	
DESIGNER	BY	APPROVED	DATE
CONTROL	DATE	FILED	
CONTRACTOR	DATE STARTED	LAMBERT COORDINATES	
INSPECTOR	DATE COMPLETED	27319-	-0

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WARNING

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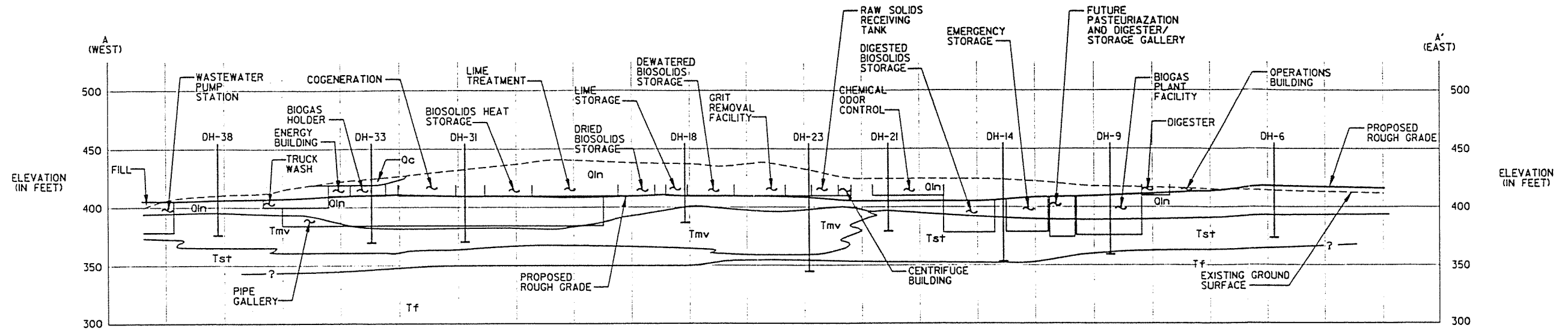
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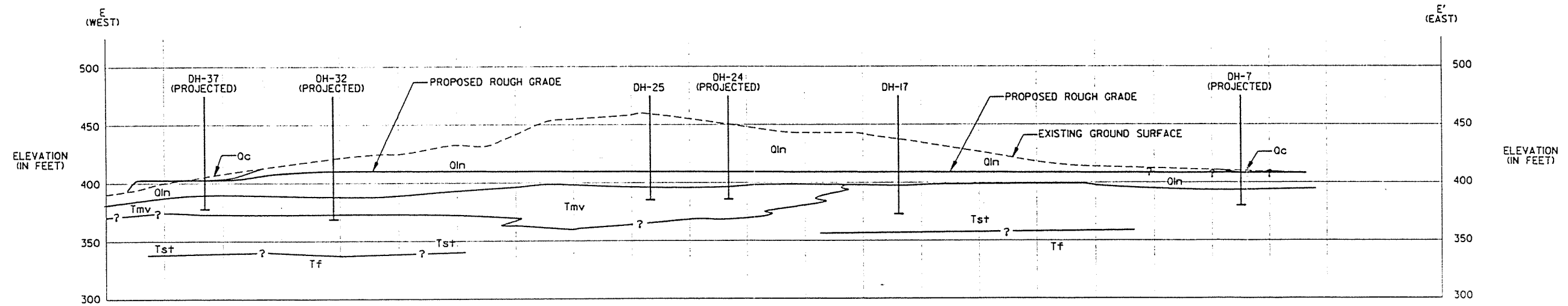
VERTICAL

METROPOLITAN WASTEWATER DEPARTMENT
 City of San Diego

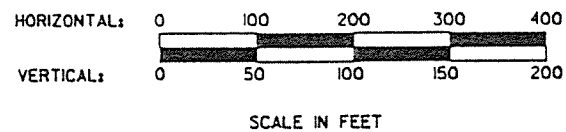
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NO.	DATE	REQ.	REVISION	DESCRIPTION	DRAWN	CKD	APD



GEOLOGIC CROSS SECTION
PIPE GALLERY



GEOLOGIC CROSS SECTION
SOUTH PLANT ACCESS ROAD



LEGEND

- af ARTIFICIAL FILL
- oc COLLUVIUM
- olin LINDAVISTA FORMATION
- Tmv MISSION VALLEY FORMATION
- Tst STADIUM CONGLOMERATE
- Tf FRIARS FORMATION

DRAWING NO.	GEOLOGICAL CROSS SECTIONS PLATE 2.1	CITY OF SAN DIEGO, CALIFORNIA SHEET OF SHEETS	WATER W.G. _____ SEWER W.G. _____
SHEET NO. 2.1			
CIP NO.			
SPECIFICATION NO.			

APRIL 1994		CIP DIRECTOR	DATE	DEPUTY DIRECTOR
DESCRIPTION	BY	APPROVED	DATE	FILED
CONTRACTOR INSPECTOR				
DATE STARTED				
DATE COMPLETED				
				27319-0

DRAWING STATUS									
NO.	DATE	REQ.	REVISION DESCRIPTION	DRAWN	CKD	APD	PE	EM	DA/OC

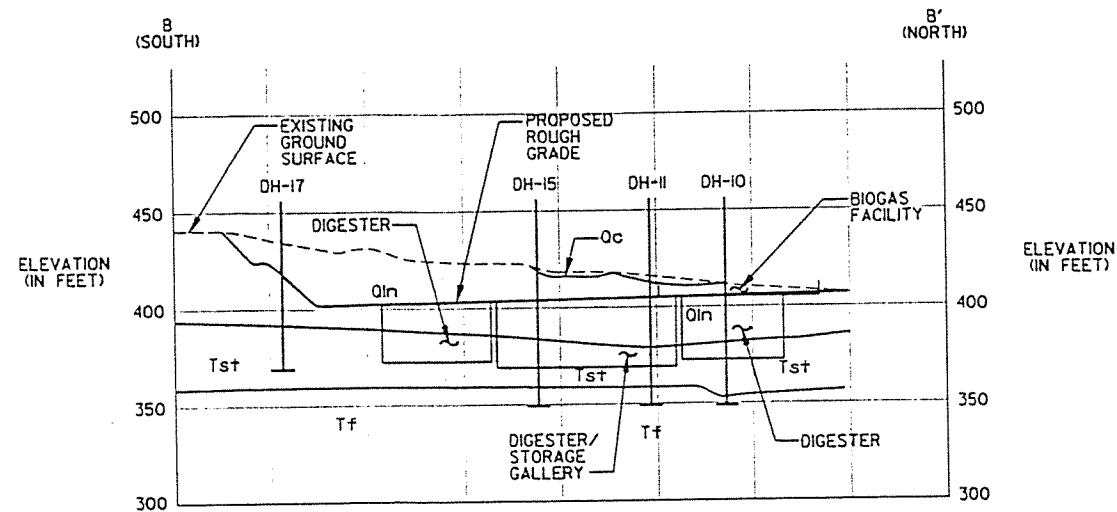
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WARNING
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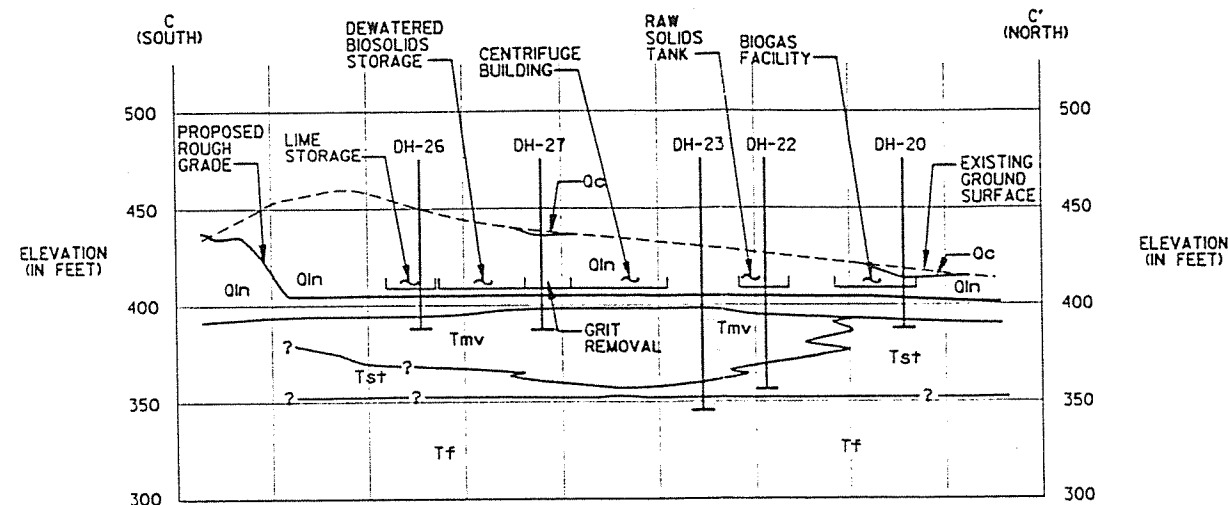
GTC
GEOTECHNICAL CONSULTANTS, INC.

SCALE: HORIZONTAL _____ VERTICAL _____

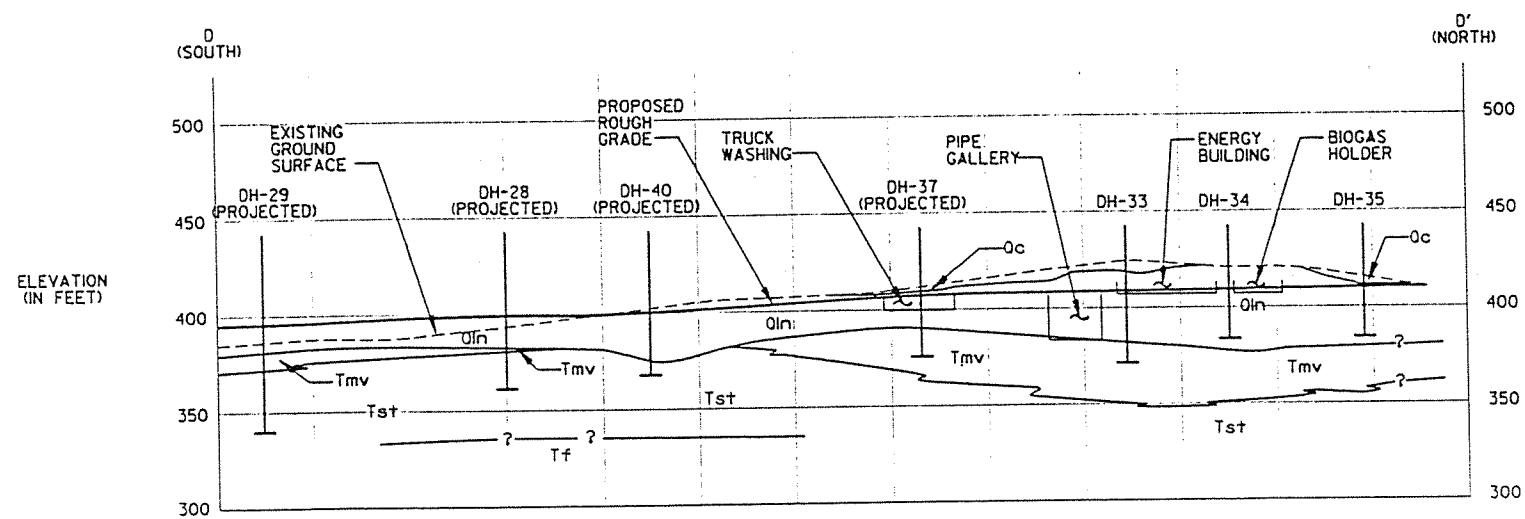
METROPOLITAN WASTEWATER DEPARTMENT
City of San Diego



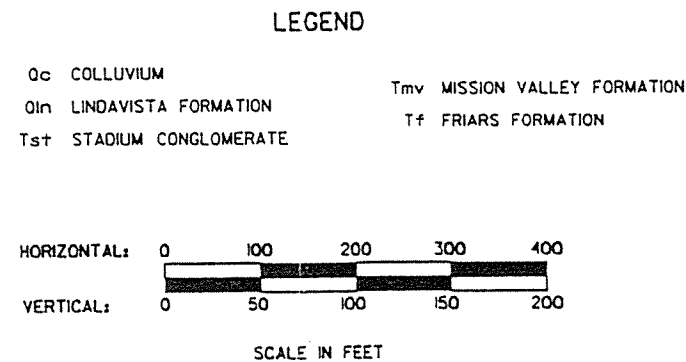
GEOLOGIC CROSS SECTION
DIGESTER AREA



GEOLOGIC CROSS SECTION
DEWATERED BIOSOLIDS BUILDINGS



GEOLOGIC CROSS SECTION
ENERGY BUILDING-UTILITY CORRIDOR



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 METCALF & EDDY CAD PLOT BY 111

WARNING
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GEOTECHNICAL CONSULTANTS, INC.
 SCALE HORIZONTAL 1" = 100'
 VERTICAL 1" = 20'

METROPOLITAN WASTEWATER DEPARTMENT
 City of San Diego



DRAWING STATUS						
NO.	DATE	REQ.	REVISION DESCRIPTION	DRAWN	CKD	APD

DRAWING NO.	GEOTECHNICAL CROSS SECTIONS	
SHEET NO.	2.2	
CIP NO.		
SPECIFICATION NO.		
CITY OF SAN DIEGO, CALIFORNIA		
SHEET OF SHEETS		
APRIL 1994		
CWP DIRECTOR	DATE	DEPUTY DIRECTOR
DESIGNER	BY	DESIGN ENGINEER
		CONTROL CERTIFICATION
		LAMBERT COORDINATES
CONTRACTOR	DATE STARTED	
INSPECTOR	DATE COMPLETED	27319-0



APPENDIX A
SUPPORTING GEOTECHINCAL DATA

S92022

**APPENDIX A
SUPPORTING GEOTECHNICAL DATA**

EXPLORATION

Exploration for the proposed FIRP/NSPF consisted of drilling, logging and sampling 40 borings to depths ranging from 10 to 85 feet below ground surface. Drill Holes 1 through 40 were drilled between August 25 and September 15, 1993 using hollow stem auger drilling and air rotary rigs.

Relatively undisturbed drive samples were obtained at selected depth intervals using a 3-inch O.D., 2.5-inch I.D. split barrel sampler with 6-inch long brass liners. In addition, disturbed samples were obtained using a standard penetration test sampler, and large bulk samples of representative earth materials were collected from the cutting returns. Soil samples were visually classified according to the Unified Soil Classification System. Exploration findings and sample locations are shown on Plates A-1.1 through A-1.40 - Log of Drill Hole. A Legend to Logs is presented on Plate A-2.

Surface reconnaissance was conducted at the project site concurrent with drilling exploration. Our findings and approximate boring locations are shown on Plate 1.1 - Boring Plan. Location of the borings and the elevation of the ground surface at each location were surveyed by Dye Surveying, Inc. and provided to us.

Geophysical exploration consisting of seismic refraction, magnetometry and electromagnetic methods were used to evaluate the rippability characteristics of the bedrock formations and to identify the limit of landfill along the proposed access road. The results of the geophysical exploration are presented in Appendix C.

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LABORATORY TESTING

MOISTURE AND DENSITY TESTS

The moisture content and dry density of undisturbed samples obtained during the drilling program were determined prior to additional testing. The moisture content was determined in accordance with Standard Test Method ASTM D2216 and was considered to represent the moisture content of the entire sample to determine the sample's dry density. The test results are presented on the drill hole logs.

DIRECT SHEAR TESTS

Consolidated-undrained direct shear tests were performed on seven samples of the bedrock formations to determine their shear strength characteristics. Prior to testing, the specimen weight and height were measured and recorded. The minimum specimen diameter-to-thickness ratio was 2 to 1. The desired normal load was applied pneumatically to the specimen. The loaded sample was then flooded and allowed to saturate and come to equilibrium. A shear force was then applied through a motor and gear system at a constant rate of deflection. Shearing and normal displacements produced by the shear loads were recorded during the test. The moisture content and dry density were determined before the test and after failure of the specimen. The test was conducted in accordance with Standard Test Method ASTM D3080. The test results are presented on Plates A-3.1 through A-3.7.

CONSOLIDATION TESTS

A consolidation test was performed on one sample of alluvium/colluvium to evaluate their compressibility under the anticipated loads. Each specimen was trimmed and fitted into a consolidation ring. The test was performed by placing the prepared specimen on the testing apparatus, applying an initial load, then flooding the

S92022 A-2

sample with water. The sample was allowed to saturate and come to equilibrium. Additional loads were applied in increments through a pneumatic system. The tests were performed in accordance with Standard Test Method for One-Dimensional Consolidation Properties of Soils. The test results are presented on Plate A-4.

GRAIN-SIZE DISTRIBUTION TESTS

Grain-size distribution tests were conducted on several soil samples. The tests were performed in accordance with Standard Test Method ASTM D422. The test results are presented on Plates A-5.1 through A-5.12.

COMPACTION TESTS

Four compaction tests were performed on representative samples of the earth materials encountered during exploration. Tests were performed in accordance with Standard Test Method ASTM D1557. The test results are appended following Plate A-7 and are summarized as follows:

Sample Location	Optimum Moisture (%)	Maximum Dry Density (pcf)
DH-4 @ 0 to 5 feet	8	132
DH-8 @ 5 to 10 feet	10.5	126
DH-25 @ 43 to 48 feet	8.5	131
DH-38 @ 0 to 5 feet	7.5	133

ATTERBERG LIMITS

Liquid limits and plastic limits were determined for eight representative samples of the earth materials encountered during exploration. Tests were performed

S92022 A-3



in accordance with Standard Test Method ASTM D4318. The results of these tests are presented on the drill hole logs and Plates A-6.1 and A-6.2.

R-VALUE TESTS

Resistance (R) value tests were performed on five representative samples of the earth materials expected to be present at pavement subgrade. Testing was performed in accordance with California Test Method 301. The results of these tests are appended following Plate A-7 - and are summarized as follows:

Sample Location	R-Value
DH-3 @ 0 to 5 feet	32 (by exudation)
DH-4 @ 0 to 5 feet	48 (by exudation)
DH-8 @ 5 to 10 feet	31 (by exudation)
DH-25 @ 43 to 48 feet	49 (by exudation)
DH-38 @ 0 to 5 feet	53 (by exudation)

SAND EQUIVALENT TESTS

Sand equivalent tests were performed on sixteen representative samples of earth materials encountered during exploration. The tests were performed in accordance with Standard Test Method 217 (California Department of Transportation). The test results are presented on Plate A-7.

EXPANSION INDEX TESTS

The expansion potential of selected materials was evaluated by the Expansion Index Test, U.B.C. Standard No. 29-2. Specimens are molded under a given compactive energy to approximately the optimum moisture content and

S92022 A-4



approximately 50 percent saturation or approximately 90 percent relative compaction. The prepared 1-inch thick by 4-inch diameter specimens are loaded to an equivalent 144 psf surcharge and are inundated with tap water until volumetric equilibrium is reached. The test results are presented on Plate A-7.

S92022 A-5

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Hollow Stem Auger, 6-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 1
 DRILLING DATE: August 26, 1993
 ELEVATION: 410 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	ATTERBERG LIMITS			UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
									MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10		136				[Hatched pattern]	"ARTIFICIAL FILL (af)" SANDY CLAY (CH) dark brown, moist, stiff, roots.						
		90	9			[Dotted pattern]	"ARTIFICIAL FILL (af)" POORLY GRADED SAND (SP) tan to orange-brown, damp, very dense, medium grained sand, local pockets of Sandy Clay (CH).	101	16	67	24		GS
		142	7			[Vertical lines pattern]	"ARTIFICIAL FILL (af)" SILTY SAND (SM) tan to orange-brown, damp, very dense, medium grained sand, abundant mica, artificial layering.						
		110/6				[Hatched pattern]	"ARTIFICIAL FILL (af)" GRAVELLY SANDY CLAY (CH) dark brown, dry to moist, fine to coarse gravel, angular to subangular, medium grained sand, not homogeneous. Increasing coarse gravel.						
20							Becoming Sandy Clayey Gravel (GW-GC) dark brown, moist clay, fine to coarse gravel, angular to subangular. Bottom of drill hole at 15 feet. No groundwater encountered. Hole backfilled.						
30													
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 2
 DRILLING DATE: August 27, 1993
 ELEVATION: 340 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
32						[Hatched pattern]	"ARTIFICIAL FILL (af)" SILT (ML) dark gray, dry, medium stiff.						
23						[Diagonal lines]	"ARTIFICIAL FILL (af)" SILTY CLAY (CL) green to dark gray, moist, very stiff, local gravel.		20	41	20		
10						[Vertical lines]	"ARTIFICIAL FILL (af)" LANDFILL DEBRIS, paper, roots, glass fragments, strong trash odor.						
35						[Vertical lines]							
20						[Vertical lines]	Layers of Silt (ML) dark gray, moist, stiff.						
29						[Vertical lines]	Paper, roots, glass fragments, rubber (tire), strong trash odor.	94	24				C
30						[Vertical lines]							
28						[Vertical lines]							
87						[Vertical lines]	"FRIARS FORMATION (Tf)" SILTSTONE (R) medium gray, damp, stiff, moderate amount of Fe oxide, horizontal layering.	102	22	49	40		
40		90/11				[Vertical lines]	Sandstone layer (R) medium gray, wet, medium dense, medium grained sand (3-inch thick). 40 1/2 feet: Becoming Sandy Siltstone, dark gray, damp, hard.		21				GS
50						[Vertical lines]	Bottom of drill hole at 41 feet. Groundwater encountered at 40 1/2 feet. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Hollow Stem Auger, 6-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 3
 DRILLING DATE: August 25, 1993
 ELEVATION: 407 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
94	X	94				[Symbol: Dotted pattern]	"ARTIFICIAL FILL (af)" SILTY SAND (SM) brick red, dry, very dense, friable, medium grained sand, disturbed soil (burrows). Hard drilling at 5 feet.							GS,R
73	X	73				[Symbol: Dotted pattern]	"LINDAVISTA FORMATION (Gln)" SANDSTONE (R) brick red, damp, very dense, friable, abundant mica. Cobbles, 2 to 4-inch, subrounded.							
10	100/4	100/4				[Symbol: Dotted pattern]	Bottom of drill hole at 10 1/2 feet. No groundwater encountered. Hole backfilled.							

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 4
 DRILLING DATE: August 27, 1993
 ELEVATION: 415 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
							"COLLUVIUM (Gc)" SANDY SILT (ML) brick red, dry, very stiff, fine grained sand.						
		85/8					"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) brick red, damp, very dense, fine grained sand, angular coarse gravel.						CP,R
		100/5					Brick red, damp, very dense, medium grained sand, angular to subrounded coarse gravel, volcanic.						
10		90/8					Very coarse gravel and cobbles.		5				SE
		80/8											
20							Bottom of drill hole at 16 feet. No groundwater encountered. Hole backfilled.						
30													
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 5
 DRILLING DATE: August 28, 1993
 ELEVATION: 410 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
78/11						[Symbol: Fine sand]	"COLLUVIUM (Gc)" SILTY SAND (SM) brick red, dry to moist, very dense, medium grained sand.						6S
80/2						[Symbol: Gravelly sandstone]	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, very dense, medium grained sand, coarse gravel, angular to subangular, volcanic. Hard drilling, cobbles.						
57						[Symbol: Sandstone]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, very dense, medium grained sand.						
100/3						[Symbol: Conglomerate]	"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) red-gray, dense, hard drilling from 14 1/2 to 21 feet, unable to sample at 15 feet.						
							Bottom of drill hole at 21 1/2 feet. No groundwater encountered. Hole backfilled.						
30													
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 6
 DRILLING DATE: August 27, 1993
 ELEVATION: 410 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS	
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)			
80/6						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) orange-red to brick red, dry to damp, dense, medium grained sand, hematite cement, moderately indurated.	89	7					
85/7														
10 67/9						[Dotted pattern]	Minor Fe concretion pellets, local coarse gravel and biotite flakes.							
						[Circular pattern]	"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) medium brown, damp, very dense, medium grained sand, coarse gravel, angular to subrounded gravel, up to 3-inches, local cobbles, volcanic. Hard drilling, unable to sample at 15 and 20 feet.							
20						[Circular pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) medium brown, damp, very dense, medium grained sand, abundant cobbles, volcanic. (switch to air hammer, drill from 20 to 24 1/2 feet, switch back to tricone rock bit at 24 1/2 feet). Added water during drilling to bring up cuttings.	4						
100/8														
30						[Circular pattern]	"MISSION VALLEY FORMATION (Tm)/STADIUM CONGLOMERATE (Tst)" SANDSTONE (R) white-gray, moist, dense, medium grained sand, abundant Fe oxide and biotite flakes. "STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, very dense, subangular to subrounded, abundant cobbles, volcanic.							
150/5							Bottom of drill hole at 38 1/2 feet. No groundwater encountered. Hole backfilled.							
40														
50														

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Hollow Stem Auger, 8-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 7
 DRILLING DATE: August 25, 1993
 ELEVATION: 409 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
0-10	203/12	148/12					"COLLUVIUM (Gc)" SILTY SAND (SM) brown, dry, loose to firm. "LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, very dense, friable, fine to medium grained sand, minor biotite. Hard drilling at 3 1/2 feet.	120	9				
10-20	100/3	250/6					Moist, fine grained sand, abundant biotite. "LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, moist, very dense, medium grained sand, locally cemented. "LINDAVISTA FORMATION (Qln)" SANDSTONE (R) tan, moist, very dense, friable, abundant biotite, hard drilling at 11 1/2 feet and 13 1/2 feet, layers of gravel. Dry sand.						GS
20-30	54	150/7					"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) dark brown, moist, dense, abundant coarse gravel and cobbles, subangular to subrounded. Unable to sample at 20 feet, hard drilling. Unable to sample at 25 feet, hard drilling, cobbles.						
30-40							"MISSION VALLEY FORMATION (Tmv)/STADIUM CONGLOMERATE (Tst)" SILTSTONE (R) white-gray, dense, abundant biotite and Fe oxide, local Mn oxide, horizontal layering. Hard drilling at 28 feet.	122	9				
40-50							SANDSTONE (R) white-gray, moist, very dense, medium grained sand, abundant biotite, moderate Fe oxide. Bottom of drill hole at 30 1/2 feet. No groundwater encountered. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 8
 DRILLING DATE: September 3, 1993
 ELEVATION: 414 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
44		44				/ / / /	"COLLUVIUM (Gc)" SANDY CLAY (CL) medium brown, moist, stiff, fine to medium grained sand.		12	46	15		
141		141				"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, dense, medium grained sand. Minor fine to coarse gravel.						CP,R
10		91/7				X X X X		95	11				
20							Bottom of drill hole at 10 1/2 feet. No groundwater encountered. Hole backfilled.						
30													
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 9
 DRILLING DATE: September 8, 1993
 ELEVATION: 418 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10		100/6				[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, dry to damp, very dense, medium grained sand. Local fine to coarse gravel, subangular. Becomes damp to moist, abundant mica.	93	8				DS
20						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, very dense, medium grained sand, coarse gravel, angular to subrounded. Increasing gravel, hard drilling, unable to sample at 20 feet. Sloughing at 25 feet. Minor clay.						
30		150/2				[Circular pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray to brown, damp, very dense, fine to coarse gravel, subangular to subrounded, medium brown clayey sand matrix.						
40		100/4				[Circular pattern]							
50		100/6				[Circular pattern]	Conglomerate, tan, moist, coarse to very coarse gravel, subrounded, with sand and clay matrix.		17	31	21		GS

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 9
 DRILLING DATE: September 8, 1993
 ELEVATION: 418 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
		200/9					"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray-brown, damp, dense, with silt clay matrix.						
		100/9					"FRIARS FORMATION (Tf)" SILTY SANDSTONE (R) gray-white, damp, very dense, medium grained sand, local Fe oxide, abundant biotite.						
65							"FRIARS FORMATION (Tf)" GRAVELLY SANDSTONE (R) medium brown, damp, very dense, fine to medium grained sand, coarse gravel, subrounded, local Fe oxide.						
							Bottom of drill hole at 61 feet. No groundwater encountered. Hole backfilled.						
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 10
 DRILLING DATE: September 7, 1993
 ELEVATION: 414 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
8.5	I65/11					[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, dry, very dense, medium grained sand. Minor coarse gravel, subangular.						GS,SE
10	I50/3					[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp to moist, very dense, medium grained sand, minor clay, coarse gravel, subangular to subrounded.						
15	I50/3					[Dotted pattern]							
20	I100/3					[Circular pattern]	"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) gray to brown, dry to damp, very dense, fine to coarse grained, subangular to subrounded, brick red sand matrix. Hard drilling and sampling.						
25	I100/3					[Circular pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray to brown, dry to damp, dense, coarse to very coarse gravel and cobbles, subrounded, medium brown clayey sand matrix.						
30	I100/3					[Circular pattern]							
35	I100/8					[Circular pattern]							GS
40	I100/2					[Circular pattern]							
45						[Circular pattern]	Hard drilling, unable to sample at 45 feet.						
50	I100/4					[Circular pattern]							

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 10
 DRILLING DATE: September 7, 1993
 ELEVATION: 414 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
		100/8					"FRIARS FORMATION (T1)" SILTY SANDSTONE (R) gray-white to tan, damp, very dense, fine grained sand, abundant Fe oxide and biotite specks.						
		100/6					Becomes medium grained sand.	102	12				DS
65							Bottom of drill hole at 60 1/2 feet. No groundwater encountered. Hole backfilled.						
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 6-inch

LOGGED BY: Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 11
 DRILLING DATE: September 9, 1993
 ELEVATION: 419 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
							"COLLUVIUM (Gc)" SILTY SAND (SM) brown, damp, medium dense.						
	50/4												
	60/4						"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-gray, damp, dense, fine to medium grained sand, minor silt.						
10	65/6						Gravel and cobbles, red-brown.	80	14				
	68/3						Silty sand, red-brown, damp, fine grained.						
20	70/4												
	70/6						"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) red-brown, damp, dense, fine to coarse grained sand.						GS,SE
30	65						Gravel/silty sand, gray-green matrix, damp, fine to coarse grained sand, minor amount Iron oxide staining.						
	85						"STADIUM CONGLOMERATE (Tst)" SANDSTONE (R) with gravel layers, gray, damp, medium dense, minor clay.						
40	70						"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, dry to damp, dense, sandy silt matrix, fine to coarse grained, trace cobble size material.						GS
	70/5						Becoming gray-green, fine to medium grained, trace amounts of Iron oxide staining/stringers.						
50	71/5												

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 6-inch

LOGGED BY: Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 11
 DRILLING DATE: September 9, 1993
 ELEVATION: 419 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)			
70/6						[Stippled pattern]	"FRIARS FORMATION (T1)" SANDSTONE (R) gray, damp, dense, fine to medium grained, moderate amount silt, trace amount of indurated siltstone, gray-green. Moderate Iron oxide staining.	100	13				DS	
75/4														
65	60/6						Sandstone/Siltstone, gray, damp, dense, Iron oxide staining common, minor amounts of gravel. Bottom of drill hole at 65 1/2 feet. No groundwater encountered. Hole backfilled.							
75														
85														
95														
105														

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Hollow Stem Auger, 8-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 12
 DRILLING DATE: August 25, 1993
 ELEVATION: 417 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
0-10	68/10					[Symbol: Fine to medium grained sand]	"COLLUVIUM (Gcd)" SILTY SAND (SM) brick red, dry, very dense, fine to medium grained sand, local hematite concretions, subrounded to rounded (1/4- to 1/2-inch), minor roots.						
10-20	100/6					[Symbol: Sandstone]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, very dense, medium grained sand. Layer of very coarse gravel, volcanic, subrounded. Moist, abundant mica flakes, coarse gravel, volcanic, subrounded.	100	7				
20-30	147					[Symbol: Gravelly sandstone]	Trace of hematite concretion pellets, 1/4- to 1/2-inch, subrounded to rounded. "LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, moist, very dense, medium grained sand, minor clay, coarse gravel, angular to subangular. Becoming conglomerate, very hard drilling from 20 to 35 feet.						
30-40	132/9					[Symbol: Conglomerate]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) brown, damp, dense, abundant gravel and cobbles, hard drilling. Trip out, change drill bit.						
40-50	200/4					[Symbol: Refusal]	Bottom of drill hole at 40 feet, refusal at 40 feet. No groundwater encountered. Hole backfilled.						
50-60	200/4												

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 13
 DRILLING DATE: September 9 and 10, 1993
 ELEVATION: 421 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10	100/9						"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, dense, medium grained sand, friable, well indurated. Minor silt. Local fine to medium size gravel, subangular.						
20	100/4						"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, dense, friable, coarse gravel, subangular to subrounded. Becomes gray-white at 25 1/2 feet, abundant Fe oxide stringers.	III	5				
30	100/8						"MISSION VALLEY FORMATION (Tmv)" SILTY SANDSTONE (R) gray-light brown, damp, dense, subhorizontal layer, abundant Fe oxide stringers. Local coarse gravel, subrounded.						GS
40	100/5						"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, dense, fine to coarse gravel, subangular to subrounded, sandy clay matrix, medium brown, medium grained sand, high plasticity. Hard drilling, unable to sample at 40 feet.						GS
50	100/8												

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 13
 DRILLING DATE: September 9 and 10, 1993
 ELEVATION: 421 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
		100/5					"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, dense, very hard drilling, sandy clay matrix.						
		100/2					Bottom of drill hole at 60 1/2 feet. No groundwater encountered. Hole backfilled.						
65													
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S02022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 14
 DRILLING DATE: August 29 and September 2, 1993
 ELEVATION: 425 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
100/3							"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, dense, medium grained sand, well indurated, hematite cement.						
92/10							"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, very dense, medium grained sand, friable, abundant mica flakes.						
10	95/9						Becomes damp to moist.	105	7				
83/9													
20	82						Minor clay, minor fine to coarse gravel, subangular to subrounded.						
150/8									9				
30	85						"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) orange-brown, damp to moist, very dense, medium grained sand, fine to coarse gravel, subrounded, volcanic gravel.						65
40	125/9						"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) brown, damp, very dense, coarse gravel, subrounded, volcanic, medium grained sand.						
							Clayey Sand matrix, medium brown, very dense, medium grained sand.						
50	100/3												

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 14
 DRILLING DATE: August 29 and September 2, 1993
 ELEVATION: 425 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
65		100/10					<p>"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, dense, abundant cobbles, hard drilling, unable to sample at 55 feet.</p> <p>Sloughing at 60 feet. Clayey Sandstone interbed from 60 to 60 1/2 feet, medium brown, stiff, medium grained sand.</p> <p>Silty Sandstone interbed at 66 feet, white-tan, moist, very dense, medium grained sand, local Fe oxide.</p>	124	9				GS	
75							<p>Bottom of drill hole at 71 feet. No groundwater encountered. Hole backfilled.</p>							
85														
95														
105														

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 15
 DRILLING DATE: August 28, 1993
 ELEVATION: 424 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
		61/9				[Diagonal Hatching]	"COLLUVIUM (Gc)" SANDY CLAY (CL) medium brown, dry, dense, fine grained sand, minor fine gravel.						
10		73				[Dotted Pattern]	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, dense to very dense, medium grained sand.						
		78/11				[Dotted Pattern]		101	7				
20		78/11				[Dotted Pattern]	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, very dense, medium grained sand, coarse gravel, subangular to subrounded, volcanic. Increasing coarse gravel, minor clay.						GS,SE
		80/6				[Dotted Pattern]							
30		150/3				[Circular Pattern]	"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) brown, damp, very dense, medium grained sand, angular to subrounded coarse gravel, volcanic cobbles.		5				
		150/6				[Circular Pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, very dense, subangular to subrounded gravel, cobbles, silty sand matrix.						GS
40		90/10				[Circular Pattern]							GS
50		128/11				[Circular Pattern]							

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 15
 DRILLING DATE: August 28, 1993
 ELEVATION: 424 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
		100/6					"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) with Silty Sand matrix, gray, damp, very dense.						
		122					"FRIARS FORMATION (Tf)" SILTSTONE (R) gray-white, damp, dense, abundant biotite, moderate Fe oxide, local lenses of Silty Sand (SM) white, fine grained.	107	16				
65		130/11					"FRIARS FORMATION (Tf)" SANDY CLAYSTONE (R) medium brown, moist, dense, fine to medium grained sand, coarse gravel, subrounded, volcanic.	125	17				
		100/3					Bottom of drill hole at 70 1/2 feet. No groundwater encountered. Hole backfilled.						
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 18
 DRILLING DATE: September 3, 1993
 ELEVATION: 437 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
42						[Hatched pattern]	"COLLUVIUM (Qc)" SANDY CLAY (CL) medium to dark brown, dry, stiff, low plasticity, minor fine grained sand.						
87						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, dense, medium grained sand. Clayey Sandstone, brick red, damp, dense.	106	7				GS
85						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, very dense, medium grained sand, minor to moderate amount of silt. Abundant biotite flecks.						
86						[Dotted pattern]							
125/6						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, very dense, medium grained sand, fine to coarse gravel, subangular to subrounded. Minor clay.	105	6				GS
125/6						[Dotted pattern]							
150/6						[Dotted pattern]							
100/6						[Dotted pattern]							
50							Bottom of drill hole at 45 1/2 feet. No groundwater encountered. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 17
 DRILLING DATE: September 17, 1993
 ELEVATION: 435 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, dry to damp, dense, medium grained sand, friable, moderately indurated, abundant mica.						
10		80				[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, dense, medium grained sand, friable, slightly indurated.						
20		100/10				[Dotted pattern]	Becomes moderately indurated.	99	8				
30		85/9				[Dotted pattern]	Local coarse gravel, subrounded.						SE
						[Dotted pattern]	Becomes fine grained.						
40		95/11				[Dotted pattern]							
						[Dotted pattern]							
						[Dotted pattern]							
						[Dotted pattern]							
40		78/9				[Dotted pattern]							
						[Dotted pattern]							
						[Dotted pattern]							
40		100/1				[Circular pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, very dense, fine to coarse gravel, subangular to subrounded, sandy to silty sand matrix.						
						[Circular pattern]	Hard drilling.						
						[Circular pattern]	Sandy Clay matrix, medium brown.						GS,SE
						[Circular pattern]							
50		100/4				[Circular pattern]							
						[Circular pattern]							
						[Circular pattern]							
50		100/5				[Circular pattern]							

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 17
 DRILLING DATE: September 17, 1993
 ELEVATION: 435 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
							"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, very dense, abundant gravel and cobbles, hard drilling, unable to sample.						
65		100/3					"STADIUM CONGLOMERATE (Tst)/FRIARS FORMATION (Tf)" SILTY SANDSTONE (R) gray-white, damp, dense, friable, medium grained sand, abundant biotite. Bottom of drill hole at 60 1/2 feet. No groundwater encountered. Hole backfilled.						
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 18
 DRILLING DATE: September 15, 1993
 ELEVATION: 436 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10		100/8				[Stippled pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, dry, dense, friable, medium grained sand.						
20		100/10				[Stippled pattern]	Silty Sandstone (R) brick red, damp, friable, medium grained sand. Becomes damp to moist.	114	12				SE
30		100/9				[Stippled pattern]	Clayey Sandstone (R) brick red, wet, dense, medium grained sand, local coarse gravel, angular to subangular. Becomes moist. Bore wall sloughing.		18	27	15		
40						[Stippled pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp, dense, friable, fine to medium grained sand.						
50						[Stippled pattern]	Bottom of drill hole at 50 feet. Groundwater encountered at 30 1/2 feet. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 19
 DRILLING DATE: September 15, 1993
 ELEVATION: 427 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10		31					"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, dry to damp, medium dense, sand is fine to medium grained, minor silt.						
20		55					Silty Sandstone (R) red-brown, damp, dense, fine to medium grained, some patchy light brown-gray mottlings.						GS
							Local interbedded gravel.						
							Micaceous stringers, local interbedded gravel.						
30		37/8					"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine grained, micaceous, Iron oxide staining.						GS
							Gray to gray-green.						
40							Bottom of drill hole at 38 feet. No groundwater encountered. Hole backfilled.						
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 20
 DRILLING DATE: September 9, 1993
 ELEVATION: 420 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
33		85/9				[Diagonal hatching pattern]	"COLLUVIUM (Qc)" SANDY CLAY (CL) dark brown, dry to damp, very stiff, fine grained sand, medium plasticity, 64 percent fines.						EX
10		90/11				[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brown to brick red, damp, very dense, medium grained sand, Fe oxide stains locally.						
20		100/10				[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, very dense, medium grained sand, local coarse gravel, subrounded. Increase in coarse gravel at 17 feet. Local coarse gravel, subangular to subrounded. Becomes tan, Fe oxide stringers locally.						SE
30		100/7				[Large circle pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, very dense, coarse gravel, subangular to subrounded, sandy clay matrix, medium brown, stiff.						SE
40		85/9					Bottom of drill hole at 31 feet. No groundwater encountered. Hole backfilled.						
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 21
 DRILLING DATE: September 10, 1993
 ELEVATION: 429 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
						/ / / / /	"COLLUVIUM (Gc)" SANDY CLAY/CLAYEY SAND (CH/SC) brick red, dry to damp, medium grained sand, high plasticity.						
		24				"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, damp, medium dense, sand is fine to medium grained.						
10						Very dense.						
						Medium grained sand, abundant mica, 21 percent fines.						
						/ / / / /		102	9			EX	
						/ / / / /	"LINDAVISTA FORMATION (Qln)" SILTY SAND (SM) brick red, damp, very dense, medium grained sand.						
						"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, very dense, medium grained sand, fine to coarse subangular.						
20		85/10				Sloughing at 29 feet.						
						Minor clay.						
						"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) gray, damp, very dense, coarse gravel, subangular to subrounded, brick red sand, medium grained.						
						"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, very dense, coarse gravel, subrounded, clayey sand matrix, medium brown, medium grained sand.						
						Sloughing at 45 feet.						
												
						"STADIUM CONGLOMERATE (Tst)" SANDSTONE (R) gray-white, moist, dense, friable, abundant Fe oxide stringers. Becoming wet at 50 feet, flowing sand and water.						65
						Bottom of drill hole at 50 1/2 feet. Groundwater encountered at 50 feet. Hole backfilled.						
50		100/4										
												
60												

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 5-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 22
 DRILLING DATE: September 9, 1993
 ELEVATION: 428 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION		DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
											LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
26							"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, medium dense, fine grained.							
25							Common Iron oxide staining.							GS
10														
70							Dark red-brown, damp, dense, fine to medium grained.	103	16					
20														
							No recovery due to cobbles.							
30		80/4					Silty Sandstone, red-brown, minor gray, fine grained, scattered gravel-cobble size material.	95	24					DS
51							"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine to medium grained.							
40		75/10					Layer of Sandy Siltstone, gray, damp, dense.							
90							Fine grained, scattered gravel.	108	13					
50							Trace Iron oxide staining.							

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 5-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 22
 DRILLING DATE: September 9, 1993
 ELEVATION: 428 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
50							"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine grained, Iron oxide staining.						
80							Siltstone/Sandstone (R) gray to gray-green, minor brown, damp, dense, fine grained, trace pebble size material.						
65		80/5					"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, Iron oxide staining, damp, very dense, fine to medium grained sand matrix.						
65							Gray, damp, dense, fine to medium grained.						
75							Bottom of drill hole at 71 feet. No groundwater encountered. Hole backfilled.						
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 23
 DRILLING DATE: September 10, 1993
 ELEVATION: 433 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
28							"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, medium dense, fine grained, minor silt.						
10													
70							Dense, fine grained.						
20													
60							Fine to medium grained, local increased amounts in clay size fraction and induration.						
30							Fine grained, trace amounts coarse gravel.		10				
74							Layer of gravel, 12-inch.						
40							"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine grained, micaceous, faint laminae, moderate amount of silt.						
57							Micaceous, trace Iron oxide stringers.						
50							Fine to medium grained, Iron oxide staining.						
50							Fine grained, trace Iron oxide.	94	12				
							Silt, dark brown, trace gravel.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 23
 DRILLING DATE: September 10, 1993
 ELEVATION: 433 feet
 DATUM: Plate 1



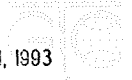
DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
73						[Dotted pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine grained, micaceous, moderate amount of silt, some Iron oxide local, thin gravel layer.						
75						[Dotted pattern]	Interbedded gray shale, minor gravel.						
65		80/10				[Dotted pattern]							
64						[Dotted pattern]	Silty Sandstone (R) gray, damp, dense, fine grained.						
75		73				[Circular pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, dense, silty sand matrix.						
80						[Horizontal line pattern]	"FRIARS FORMATION (Tf)" SILTSTONE (R) gray, damp, dense, some Iron oxide.						
85		85				[Vertical line pattern]	Gravel-sand-silt layer, gray-brown, fine to coarse grained.						
95							Bottom of drill hole at 86 feet. No groundwater encountered. Hole backfilled.						
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: G. Zilinsky, Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 24
 DRILLING DATE: September 10 and 11, 1993
 ELEVATION: 445 feet
 DATUM: Plate I



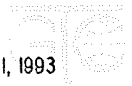
DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
20		20					"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) red-brown, damp, medium dense, fine grained sand.						
10		66					Light to dark gray, iron staining, dense, fine grained.						
		90/6					Sandstone (R) brick red, moderately indurated, friable, medium grained sand.	89	10				
20		65/6											
		100/8					Silty Sandstone (R) brick red, dry to damp, dense, moderately indurated, friable, medium grained sand.						
30		100/8					Moderate amount mica specks.	98	8				
		100/9											
40		100/7					"LINDAVISTA FORMATION (Qln)" SILTSTONE (R) brick red to brown, damp, dense, abundant mica, minor coarse gravel.						
		100/7					Local fine to coarse gravel, subrounded.						
50		94					"MISSION VALLEY FORMATION (Tmv)" SILTY SANDSTONE (R) gray-white, damp, dense, friable, fine to medium grained sand, abundant biotite.	115	13				

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: G. Zilinsky, Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 24
 DRILLING DATE: September 10 and 11, 1993
 ELEVATION: 445 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
58							"MISSION VALLEY FORMATION (Tmv)" SILTY SANDSTONE (R) gray-white, damp, dense. Bottom of drill hole at 58 feet. No groundwater encountered. Hole backfilled.						
65													
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 25
 DRILLING DATE: September 11, 1993
 ELEVATION: 453 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
0 - 10	44/6						"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, dry, dense, moderately indurated, friable, medium grained sand. Becoming damp.						
10 - 20	100/6						Moderate amount of clay, locally.	102	9				
20 - 30	100/6												
30 - 40	100/8												
40 - 45	100/7							92	6				
45 - 50	100/8												
50 - 55	100/9						"LINDAVISTA FORMATION (Qln)" CLAYEY SANDSTONE (R) brick red, damp to moist, dense, friable, medium grained sand, abundant mica, local coarse gravel, subangular to subrounded.						CP,R
55 - 60	100/5						"LINDAVISTA FORMATION (Qln)" SANDY SILTSTONE (R) brown to red-brown, damp, dense, slightly fissile, abundant mica.	98	10				

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Hammer, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 25
 DRILLING DATE: September 11, 1993
 ELEVATION: 453 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
100/5						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, dense, friable, medium grained sand, local fine to coarse gravel, subangular to subrounded.						
100/7						[Dotted pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp, dense, moderately indurated, friable, fine grained sand, abundant biotite.		6				
65	100/5						Bottom of drill hole at 65 1/2 feet. No groundwater encountered. Hole backfilled.						
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 4 3/4-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 26
 DRILLING DATE: September 15, 1993
 ELEVATION: 445 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10		78/11					"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) dark red-brown, damp, medium dense. Dense, fine to medium grained.						
20		90/9					Moist.	109	9				GS,SE
30		56					Silty Sandstone, red-brown, damp, dense, fine to medium grained, becoming lighter in color, local cobble layer.						
40		70					Cobble-Sandstone layer, red-brown, damp, dense, fine to medium grained.						
50		75/6					"LINDAVISTA FORMATION (Qln)" CONGLOMERATE (R) red-brown, damp, dense, medium to coarse grained gravel, cobbles.	102	4				gs
							"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp to moist, dense, fine to medium grained.						
60							Bottom of drill hole at 55 feet. No groundwater encountered. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSFP
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 4 3/4-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 27
 DRILLING DATE: September 15, 1993
 ELEVATION: 440 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
30						[Symbol: Dotted pattern]	"COLLUVIUM (Gc)" SILTY SAND (SM) red-brown, dry, loose.						
10						[Symbol: Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, dense, fine to medium grained. Dark red-brown.						
50						[Symbol: Dotted pattern]	Silty Sandstone (R) dark red-brown, moist, dense, fine to medium grained, becoming lighter in color with scattered gray mottling.						
50						[Symbol: Dotted pattern]	Dark-light red-brown, damp, dense, locally well cemented.						
53						[Symbol: Dotted pattern]	Red-brown with patchy gray color.						
81/11						[Symbol: Dotted pattern]	Silty Sandstone (R) red-brown, damp, dense, fine to medium grained.	105	11			GS	
85/11						[Symbol: Dotted pattern]	Becoming lighter in color, scattered cobble size material.						
99						[Symbol: Dotted pattern]	Moist, scattered cobbles and gravel.						
86						[Symbol: Dotted pattern]	Silty Sandstone/Conglomerate layer, red-brown, moist, dense, fine to coarse grained, micaceous.	92	10			DS,GS	
81						[Symbol: Dotted pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine to medium grained, micaceous, faint Iron oxide staining.						
78/10						[Symbol: Dotted pattern]	Fine grained, micaceous.						
							Bottom of drill hole at 51 feet. No groundwater encountered. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 4 3/4-inch

LOGGED BY: G. Ziilnsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 28
 DRILLING DATE: September 14, 1993
 ELEVATION: 389 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
54/4						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown/gray, damp, dense, fine to medium grained, Iron oxide staining, locally dense cobble and gravel.						
22						[Dotted pattern]	Gravelly Sandstone (R) matrix is brown, damp, medium dense, fine to coarse grained.						
10	50					[Dotted pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) tan, damp, medium dense, fine to medium grained.						
68						[Dotted pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) brown, damp, dense, fine to coarse grained sand, silty clay, sand matrix.	92	11				GS, SE
20	53					[Dotted pattern]	Sand matrix is light brown, damp, dense, fine to coarse grained. No sample recovery. Cobble, dense.						
80/9						[Dotted pattern]	Light brown to yellow-brown, damp, dense, fine to coarse grained.	99	7				
30	28					[Dotted pattern]	Gravel-sand-silt layer, light brown to yellow-brown, damp, medium dense, fine to coarse grained.						GS
							Bottom of drill hole at 31 feet. No groundwater encountered. Hole backfilled.						
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary/Air Hammer, 5-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 29
 DRILLING DATE: September 14, 1993
 ELEVATION: 392 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
84		50/2				[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, dense, fine to medium grained. Red-brown, damp, dense, fine grained.						SE
10		50/4				[Dotted pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) light brown, damp, dense, medium to coarse grained.						
		60/4				[Dotted pattern with circles]	"MISSION VALLEY FORMATION (Tmv)" CONGLOMERATE (R) light brown, damp, dense, medium to coarse grained, trace Fe oxide. Interbedded sandstone and conglomerate, light brown, damp, dense, medium to coarse grained.						GS
20		50/5				[Dotted pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine grained, micaceous, Iron oxide stringers.						
30		55				[Dotted pattern with circles]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray-brown, dry to damp, dense. Light brown, fine to medium grained. Fine to coarse grained, trace Iron oxide staining.						GS
40		50/4				[Dotted pattern with circles]							
50		57				[Dotted pattern with circles]							
							Bottom of drill hole at 51 feet. No groundwater encountered. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 4 3/4-inch

LOGGED BY: G. Zilinsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 30
 DRILLING DATE: September 14, 1993
 ELEVATION: 417 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
91						[Symbol: Diagonal lines]	"COLLUVIUM (Qc)" SILTY SAND (SM) red-brown and gray, damp, dense, fine to medium grained.						
42						[Symbol: Diagonal lines]	Red-brown, some gray.						
50						[Symbol: X's]	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) dark red-brown, damp, dense, fine to medium grained.						GS
87						[Symbol: Diagonal lines]	Minor gravel.						
78						[Symbol: Diagonal lines]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, damp, dense, fine grained, micaceous, interbedded laminated siltstone, trace Iron oxide.						
110						[Symbol: Dotted]	Local cobble layers, scattered Iron oxide.	101	15				
75						[Symbol: Diagonal lines]							
31						[Symbol: Dotted]	Bottom of drill hole at 31 feet. No groundwater encountered. Hole backfilled.						
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 31
 DRILLING DATE: September 14, 1993
 ELEVATION: 433 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10		100/5					"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, dry, dense, friable, medium grained sand. Becoming damp.	94	9				SE
20		90/10					"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, dense, friable, medium grained sand.						
30		100/8					"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, dense, friable, fine to coarse gravel, angular to subangular, moderate amount of silt. Local cobbles.		7				
40		85/11					"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) red-brown, damp, dense, friable, medium grained sand, local Fe oxide and biotite specks.						
40		60					"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red to red-brown, damp, dense, friable, medium grained sand, fine to coarse gravel, angular to subrounded.		4				GS
50		78					"LINDAVISTA FORMATION (Qln)" CLAYEY SANDSTONE (R) red-brown, damp, dense, medium grained sand, subhorizontal layering, Fe oxide along layering.						
50		100/10					"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp, dense, friable, medium grained sand, local Fe oxide and biotite flakes, minor clay.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 31
 DRILLING DATE: September 14, 1993
 ELEVATION: 433 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	ATTERBERG LIMITS			UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
									MOISTURE CONTENT (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
55	85					[Dotted pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray, moist, dense.		20				
65							Bottom of drill hole at 60 1/2 feet. No groundwater encountered. Hole backfilled.						
75													
85													
95													
105													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 32
 DRILLING DATE: September 14, 1993
 ELEVATION: 424 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
75/9						[Stippled pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) orange-brown to red-brown, dry, dense, moderately indurated, friable, medium grained sand, moderate silt, minor clay. Becoming damp.						GS, SE
100/9						[Stippled pattern]	Friable, medium grained sand, increasing silt. Minor coarse gravel.						GS
100/8						[Stippled pattern]	Abundant mica specks.	85	7				DS
90						[Stippled pattern]	Becomes fine grained sand, local coarse gravel, angular to subangular.						
90/11						[Horizontal lines pattern]	"LINDAVISTA FORMATION (Qln)" SILTSTONE (R) light orange-brown, damp, dense, abundant mica, minor fine gravel, angular.						
85						[Stippled pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) light orange-brown, damp, dense, friable, medium grained sand, minor clay.						
82						[Stippled pattern]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp, dense, sand is fine to medium grained.						
100/4						[Stippled pattern]	"MISSION VALLEY FORMATION (Tmv)" GRAVELLY SANDSTONE (R) light brown to medium brown, damp, dense, medium grained sand, fine to coarse gravel, subangular to subrounded.						
90/9						[Stippled pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, dense, coarse to very coarse gravel, subrounded, local cobbles.						
60						[Stippled pattern]	Bottom of drill hole at 51 1/2 feet. No groundwater encountered. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSFP
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 33
 DRILLING DATE: September 13, 1993
 ELEVATION: 423 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
							"COLLUVIUM (Gc)" SANDY CLAY (CL) dark brown, dry to moist, firm, medium grained sand.						
10		95/9					"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp to moist, dense, friable, slightly indurated, medium grained sand, local Fe oxide. Brick red, damp.	110	13				EX
20		100/10					Silty Sandstone (R) brick red, damp, dense, friable, fine grained sand, abundant mica.						GS
							"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, dense, friable, medium grained sand, fine to coarse gravel, angular.						
		100					"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, dense, friable, slightly indurated, fine to medium grained sand.						
30		100/8					"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) red-brown to brick red, locally gray-white, moist, dense, medium grained sand, coarse gravel, angular to subrounded, minor clay.	96	9				DS
							"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) red-brown to brick red, locally gray-white, moist, dense, medium grained sand, coarse gravel, angular to subrounded, minor clay.						
		80/11					"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) red-brown to brick red, locally gray-white, moist, dense, medium grained sand, coarse gravel, angular to subrounded, minor clay.	80	13				
40		60					"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp to moist, dense, minor coarse gravel. Silty Sandstone, damp, friable, medium grained sand, local Fe oxide stringers.						
							"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp to moist, dense, minor coarse gravel. Silty Sandstone, damp, friable, medium grained sand, local Fe oxide stringers.						
		100/10					"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp to moist, dense, minor coarse gravel. Silty Sandstone, damp, friable, medium grained sand, local Fe oxide stringers.						
50		125/11					Becoming Sandy Claystone (R) medium brown, high plasticity, medium grained sand, local coarse gravel, subrounded, local Fe oxide. Bottom of drill hole at 51 feet. No groundwater encountered. Hole backfilled.			11			
60													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 34
 DRILLING DATE: September 12, 1993
 ELEVATION: 420 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVAINE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
10	100/10					[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) brick red, dry to damp, dense, slightly indurated, friable, medium grained sand.	97	8				
						[Dotted pattern]	Silty Sandstone (R) brick red, damp, dense, friable, medium grained sand.						
20	100/6					[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) brick red, damp, dense, friable, medium grained sand, fine to coarse gravel, subangular.						
						[Dotted pattern]	Local cobbles, subrounded.						
	95/11					[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp to moist, dense, friable, medium grained sand, abundant biotite.		6				
	100/9					[Dotted pattern]	Becoming conglomerate, red-brown, damp, dense, friable, medium grained sand, coarse gravel.						
30	75/9					[Dotted pattern]	Bottom of drill hole at 31 1/2 feet. No groundwater encountered. Hole backfilled.						
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 35
 DRILLING DATE: September 12, 1993
 ELEVATION: 416 feet
 DATUM: Plate 1



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
150/4						[Symbol: Small dots]	"COLLUVIUM (Qc)" GRAVELLY SAND (SP) dark brown, dry, very dense, fine to medium grained sand, fine to coarse gravel, angular to subangular, minor silt.						
100/3						[Symbol: Small dots]	"LINDAVISTA FORMATION (Qln)" Sandstone, red-brown, damp, very dense, medium grained sand, coarse gravel, subangular to subrounded. Becomes brick red at 8 feet. Sample at 10 feet - no recovery.						
100/4						[Symbol: Small dots]	Local cobbles, subrounded. Sandstone, brick red, dry to damp, friable, minor fine gravel.		3				
140						[Symbol: Small dots]	Silty Sandstone, very fine grained sand, moderate amount of silt.						GS
65						[Symbol: Small dots]							
30							Bottom of drill hole at 26 1/2 feet. No groundwater encountered. Hole backfilled.						
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 36
 DRILLING DATE: September 12, 1993
 ELEVATION: 418 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
100/2						[Dotted pattern]	"COLLUVIUM (Gc)" POORLY GRADED SAND (SP) red-brown, dry, dense, very fine grained sand.						
90						[Diagonal lines]	"COLLUVIUM (Gc)" SANDY CLAY (CH) medium brown, damp, stiff, medium grained sand, mottling of soil.						GS
95/9						[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) brick red, damp, dense, friable, medium grained sand. Sandstone, light brown, dry to damp, friable. Brick red, very fine grained sand.	96	3				
80						[Dotted pattern]	Silty Sandstone, fine grained sand, local coarse gravel, subangular to subrounded.						
65						[Dotted pattern]							
150/8						[Dotted pattern]	Conglomerate, medium brown to red-brown, dense, medium grained sand, coarse to very coarse gravel, subrounded.	107	8				
							Bottom of drill hole at 31 feet. No groundwater encountered. Hole backfilled.						
40													
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 37
 DRILLING DATE: September 14, 1993
 ELEVATION: 410 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
73		73			0.5		"COLLUVIUM (Qc)" SANDY CLAY (CL) medium brown, dry, dense, medium grained sand, medium to high plasticity.						
100/10		100/10			0.9		"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) medium brown, damp, dense, medium grained sand, local Fe oxide. Becomes brown-orange, minor fine to coarse gravel.						
10		80/10			0.9		Siltstone, interbed, medium brown, 2" layers.						
20		85			0.8		"MISSION VALLEY FORMATION (Tmv)" SILTY SANDSTONE (R) gray-white, damp, dense, friable, fine to medium grained sand, abundant biotite, minor clay.	13	44	19		GS	
		90/10			0.7		"MISSION VALLEY FORMATION (Tmv)" SILTSTONE (R) light purple-red, damp, dense, medium plasticity.						
30		100/8			0.8		"MISSION VALLEY FORMATION (Tmv)" CLAYEY SANDSTONE (R) gray-white, damp, dense, medium grained sand, abundant biotite.						
40							Bottom of drill hole at 31 1/2 feet. No groundwater encountered. Hole backfilled.						
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 38
 DRILLING DATE: September 12, 1993
 ELEVATION: 409 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
100/4						[Symbol: Diagonal lines]	"LINDAVISTA FORMATION (Qln)" GRAVELLY SANDSTONE (R) red-brown, dry to damp, dense, fine grained sand, fine gravel, angular to subangular.						CP,R
100/6						[Symbol: Dotted]							
100/9						[Symbol: Diagonal lines]	Silty Sandstone, yellow-brown, damp, very fine grained sand.						
78/9						[Symbol: Diagonal lines]							
75/10						[Symbol: Dotted]	"MISSION VALLEY FORMATION (Tmv)" SANDSTONE (R) gray-white, damp to moist, dense, medium grained sand, well cemented siltstone interbed, pale yellow to tan. Local Fe oxide stringers.	107	12				
75/8						[Symbol: Diagonal lines]	Gravelly Claystone, interbed from 25 to 25 1/2 feet, medium brown, moist, very stiff, high plasticity.						
85/11						[Symbol: Diagonal lines]	28 feet: Gravelly Sandstone, gray-white, friable, coarse gravel, subangular to subrounded. Local claystone, medium brown, moist, fine grained sand.						
100/5						[Symbol: Dotted]	Local cobbles.	127	11				
40							Bottom of drill hole at 35 1/2 feet. No groundwater encountered. Hole backfilled.						
50													

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: Y. Van
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 39
 DRILLING DATE: September 13, 1993
 ELEVATION: 407 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
						•••••	"COLLUVIUM (Gc)" SANDY GRAVEL (GW) gray, dry, very dense, fine to coarse gravel, angular, medium grained sand.						
10		100/5 85/10				•••••	"LINDAVISTA FORMATION (Qln)" SILTY SANDSTONE (R) red-brown, damp, dense, friable, medium grained sand. Clayey Sandstone interbed from 8 to 9 feet, moderately indurated. Gravelly Sandstone, tan, friable, fine to coarse gravel, angular, local cobbles.						
20		75/11				•••••	Clayey Sandstone, tan, moist, medium grained sand, minor coarse gravel, local Fe oxide stringers. Conglomerate, light brown to tan, medium grained sand, fine to coarse gravel, angular, local cobbles. Hard drilling, unable to sample at 20 feet.	96	15	36	22		GS
30						•••••	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) gray, damp, very dense, coarse to very coarse gravel, subrounded, local cobbles. Hard drilling, unable to sample at 30 feet.						
40		100/5				•••••	Very slow drilling, grinding through conglomerate. Grab sample of cuttings, cobbles and gravel.						GS
50		100/5				•••••	Bottom of drill hole at 49 1/2 feet. No groundwater encountered. Hole backfilled.						

LOG OF DRILL HOLE

JOB NO.: S92022
 PROJECT: FIRP/NSPF
 LOCATION: San Diego
 DRILLING METHOD: Air Rotary, 5-inch

LOGGED BY: G. Ziilnsky
 CHECKED BY: J. Thurber

DRILL HOLE NO.: 40
 DRILLING DATE: September 15, 1993
 ELEVATION: 396 feet
 DATUM: Plate I



DEPTH (FEET)	SAMPLE	BLOW COUNT	TORVANE SHEAR STRENGTH (PSF)	POCKET PENETROMETER COMP. STRENGTH (TSF)	PHOTOVAC TIP READING (PPM)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS		UNCONFINED SHEAR STRENGTH (PSF)	ADDITIONAL TESTS
										LIQUID LIMIT (%)	PLASTIC LIMIT (%)		
7.0	70/10				0.6	[Dotted pattern]	"LINDAVISTA FORMATION (Qln)" SANDSTONE (R) red-brown, damp, dense, fine to medium grained, local cobbles.						
9.0	76/9				0.9	[Dotted pattern]	Abundant cobbles and gravel locally.						
18.0	50/3				0.8	[Dotted pattern]	Brown to red-brown, fine to coarse grained sand, abundant cobbles and gravel, gray-green silty sand matrix.						
20.0	50/4				0.5	[Dotted pattern]							
29.5	50/6				0.6	[Dotted pattern]	"STADIUM CONGLOMERATE (Tst)" CONGLOMERATE (R) light brown, damp, dense, fine to coarse grained sand, Iron oxide. No recovery, dense cobbles and gravel.						GS
30.0						[Dotted pattern]	Gravel and cobbles, light brown, disturbed sample, fine to coarse grained.						
29.5						[Dotted pattern]	Bottom of drill hole at 29 1/2 feet. No groundwater encountered. Hole backfilled.						



UNIFIED SOIL CLASSIFICATION SYSTEM

	MAJOR DIVISION	GROUP SYMBOL	DESCRIPTION	GRAPHIC LOG
COARSE GRAINED SOILS Over 50% By Weight Coarser Than No.200 Sieve Size	GRAVELLY SOILS OVER 50% OF COARSE FRACTION LARGER THAN NO.4 SIEVE SIZE	CLEAN GRAVELLY SOILS LITTLE OR NO FINES	GW WELL GRADED GRAVELS OR GRAVEL - SAND MIXTURES	
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GP POORLY GRADED GRAVELS OR GRAVEL - SAND MIXTURES	
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GM SILTY GRAVELS OR GRAVEL - SAND - SILT MIXTURES	
		GRAVELLY SOILS WITH FINES OVER 12% FINES	GC CLAYEY GRAVELS OR GRAVEL - SAND - CLAY MIXTURES	
	SANDY SOILS OVER 50% OF COARSE FRACTION SMALLER THAN NO.4 SIEVE SIZE	CLEAN SANDY SOILS LITTLE OR NO FINES	SW WELL GRADED SANDS OR GRAVELLY SANDS	
		CLEAN SANDY SOILS LITTLE OR NO FINES	SP POORLY GRADED SANDS OR GRAVELLY SANDS	
		SANDY SOILS WITH FINES OVER 12% FINES	SM SILTY SANDS OR SAND - SILT MIXTURES	
		SANDY SOILS WITH FINES OVER 12% FINES	SC CLAYEY SANDS OR SAND - CLAY MIXTURES	
FINE GRAINED SOILS Over 50% By Weight Finer Than No.200 Sieve Size	SILTY AND CLAYEY SOILS LIQUID LIMIT LESS THAN 50	ML INORGANIC SILTS, VERY FINE SANDS, SILTY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY		
		CL INORGANIC CLAYS, GRAVELLY, SANDY, SILTY, OR LEAN CLAYS, OF LOW TO MEDIUM PLASTICITY		
		OL ORGANIC CLAYS OR ORGANIC SILTS OF LOW PLASTICITY		
	SILTY AND CLAYEY SOILS LIQUID LIMIT GREATER THAN 50	MH INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS		
		CH INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS		
		OH ORGANIC CLAYS OR ORGANIC SILTS OF MEDIUM TO HIGH PLASTICITY		
HIGHLY ORGANIC SOILS	Pt PEAT OR OTHER HIGHLY ORGANIC SOIL, ORGANIC CONTENT GREATER THAN 60%			
		TRASH FILL - LANDFILL REFUSE (NOT A PART OF UNIFIED SOIL CLASSIFICATION SYSTEM)		

SAMPLE TYPES:

- UNDISTURBED SLEEVE
- DISTURBED
- UNSUCCESSFUL ATTEMPT
- STANDARD PENETRATION

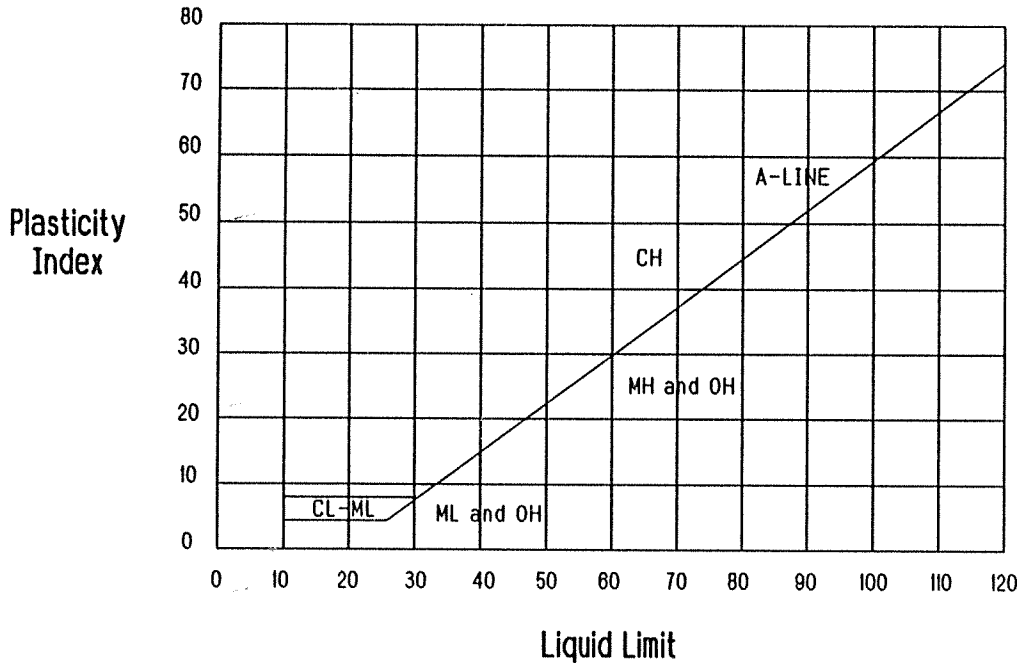
CAVING:

- LIGHT CAVING
- HEAVY CAVING

WATER LEVEL:



PLASTICITY CHART – Used for Classification of Fine Grained Soils



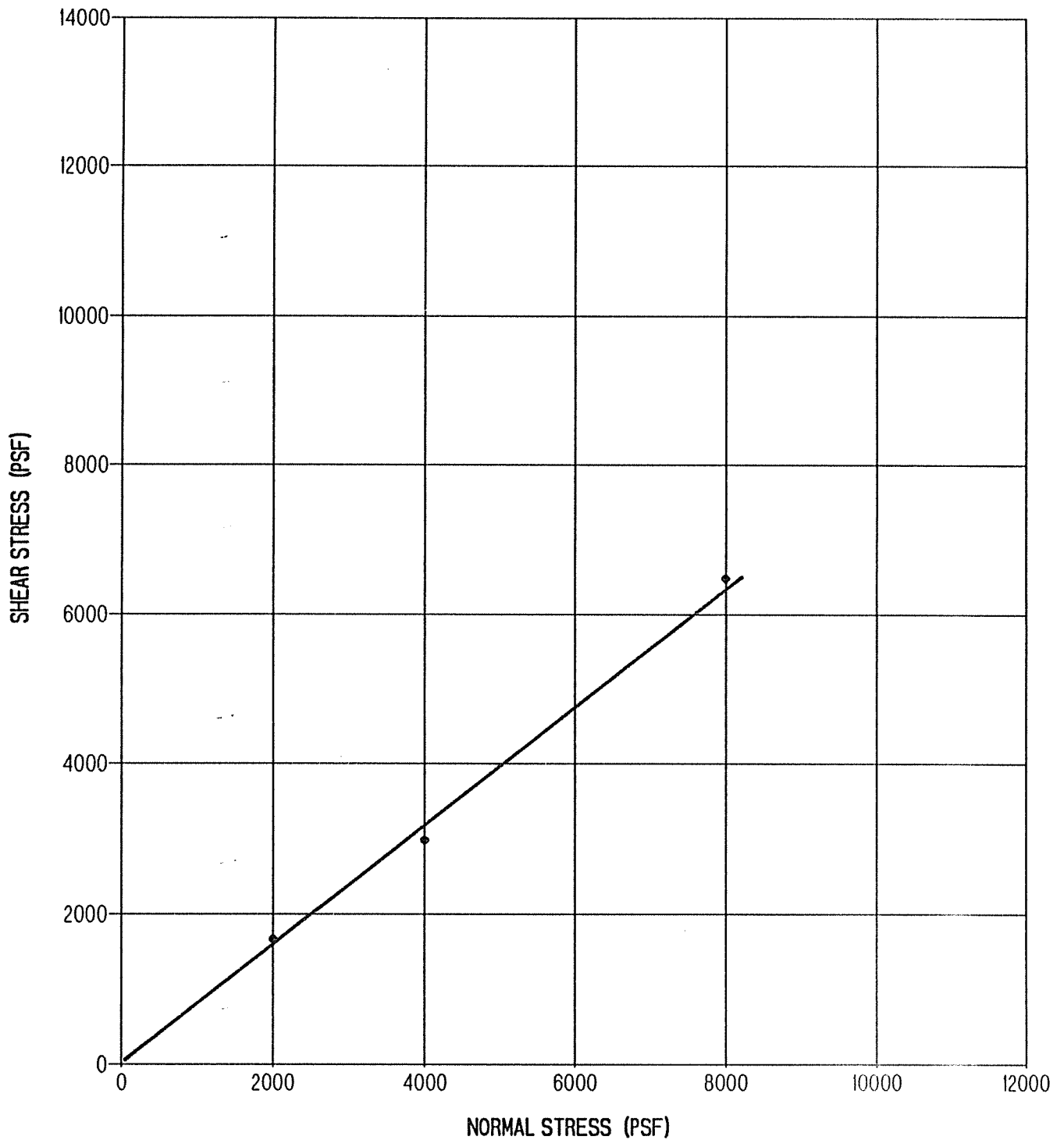
BLOW COUNT – The number of blows required to drive the sampler the last 12 inches of an 18-inch drive. When the sampler is not advanced the last 12 inches, i.e. 100 blows in 9 inches, the notation is 100/9. Symbols designating various hammer weights, drop heights, and sampling methods are shown below. A number not enclosed by one of the following symbols indicates a Standard Penetration Test (SPT) using a 140-pound hammer and 30-inch drop height.

No. of Blows	Driving Weight (pounds)	Drop Height (inches)	Sampling Method
()	_____	_____	_____
[]	_____	_____	_____
{ }	_____	_____	_____
< >	_____	_____	_____

ADDITIONAL TESTS –

C : Consolidation	pH : Hydrogen Ion Concentration	SP : Specific Gravity
CL : Chloride	PM : Permeability	SU : Sulphate
CP : Compaction	RS : Resistivity	TD : Triaxial Compression, Drained
DS : Direct Shear	RV : R-Value	TDy: Triaxial Compression, Dynamic
EX : Expansion	S : Swell	TU : Triaxial Compression, Undrained
GS : Grain Size Distribution	SP : Sand Equivalent	

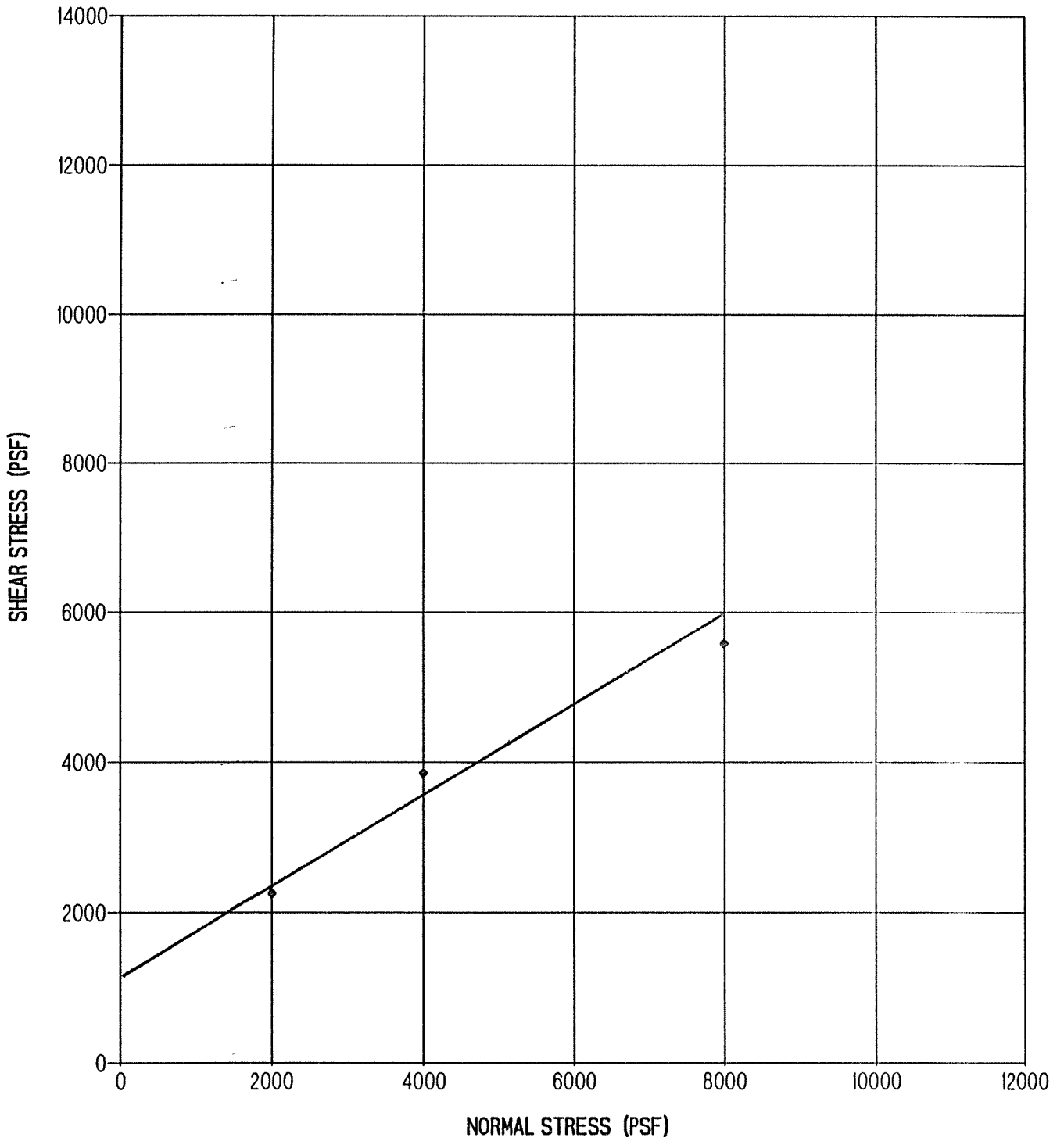
DIRECT SHEAR TEST



DRILL HOLE NO.: 9	DEPTH (FEET): 15	MOISTURE CONTENT (%): 8
DRY UNIT WEIGHT (PCF): 93	FRICTION ANGLE (DEGREES): 37	COHESION (PSF): 0
DESCRIPTION: Silty Sand (SM)red-brown, dense, slightly cemented		



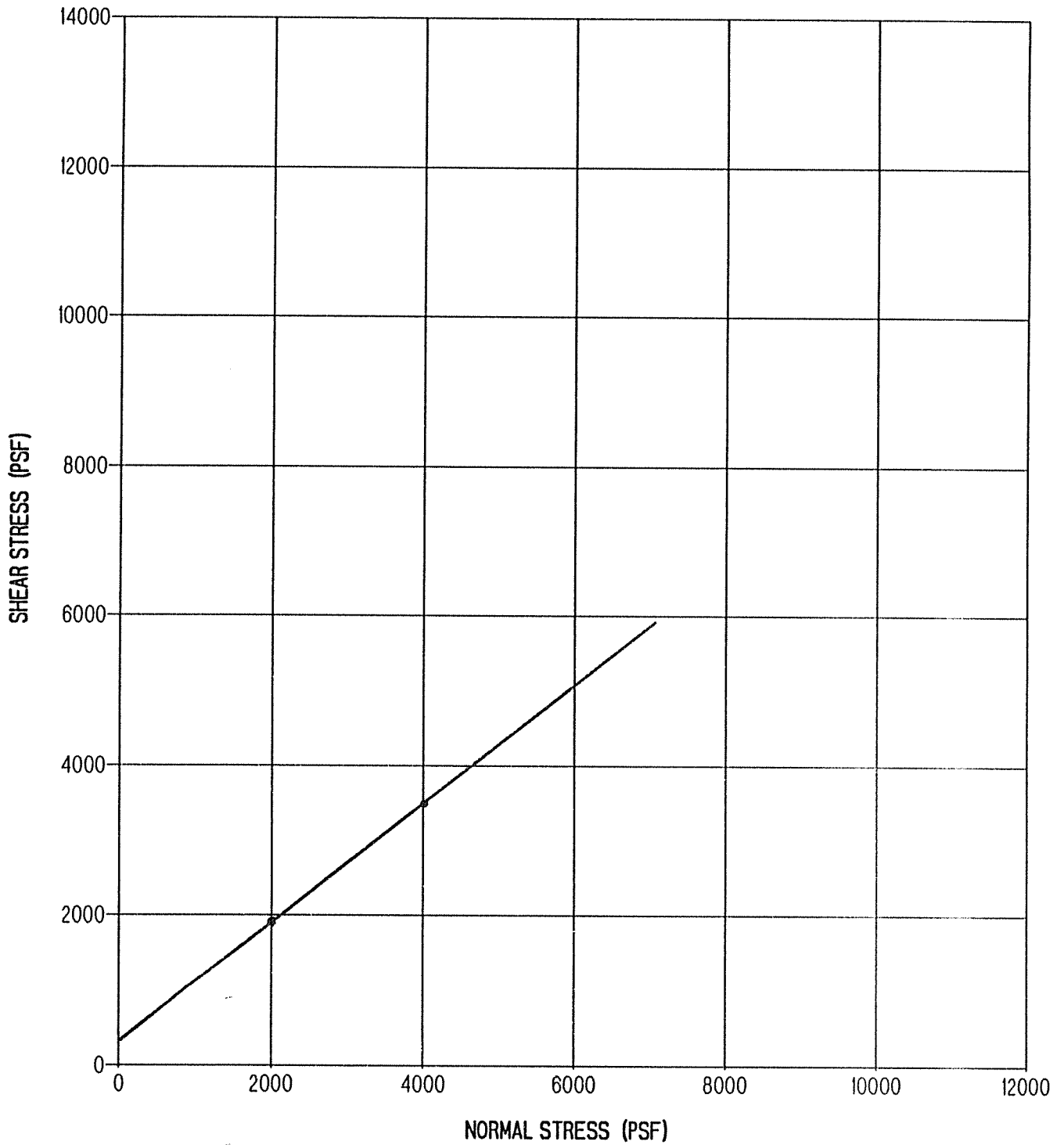
DIRECT SHEAR TEST



DRILL HOLE NO.: 10	DEPTH (FEET): 60	MOISTURE CONTENT (%): 12
DRY UNIT WEIGHT (PCF): 102	FRICTION ANGLE (DEGREES): 31	COHESION (PSF): 1100
DESCRIPTION: Silty Sand/Sandy Silt (SM-ML) green-gray, dense.		



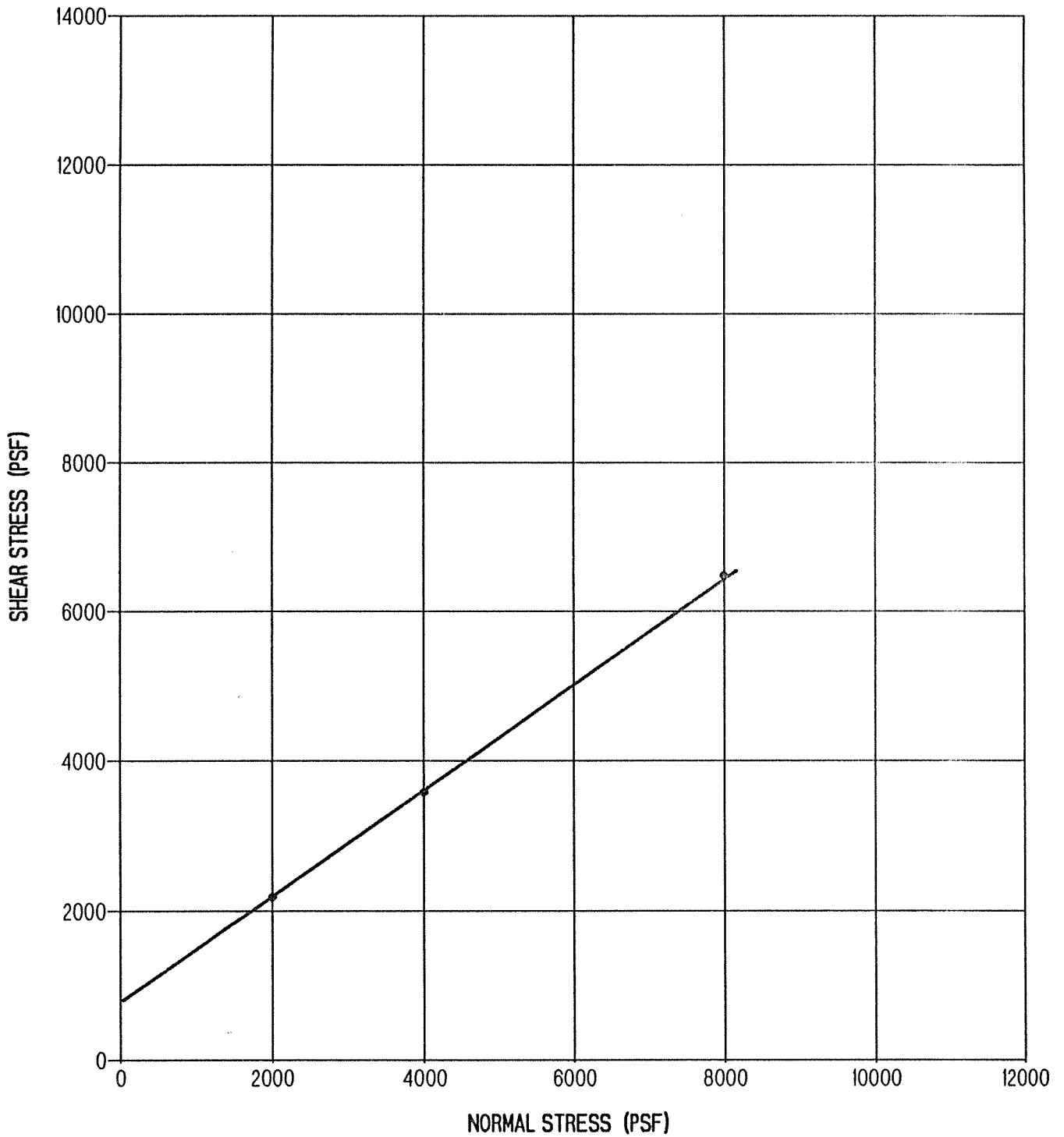
DIRECT SHEAR TEST



DRILL HOLE NO.: II	DEPTH (FEET): 55	MOISTURE CONTENT (%): 13
DRY UNIT WEIGHT (PCF): 100	FRICTION ANGLE (DEGREES): 39	COHESION (PSF): 300
DESCRIPTION: Sandy Clay/Clayey Sand (SC-CL) green-gray, dense.		



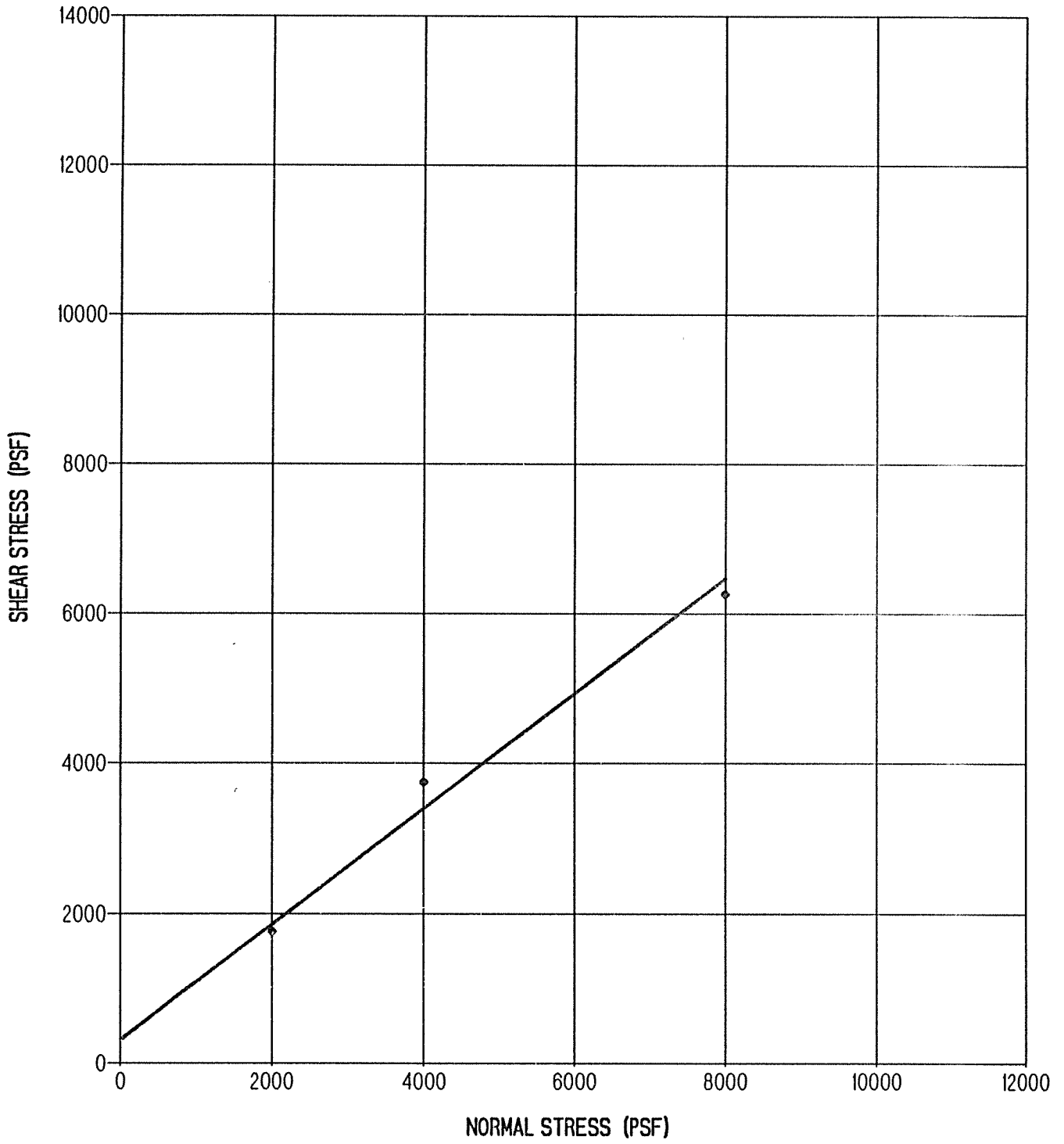
DIRECT SHEAR TEST



DRILL HOLE NO.: 22	DEPTH (FEET): 30	MOISTURE CONTENT (%): 24
DRY UNIT WEIGHT (PCF): 95	FRICTION ANGLE (DEGREES): 35	COHESION (PSF): 800
DESCRIPTION: Silty Sand (SM) red-brown, soft, micaceous.		



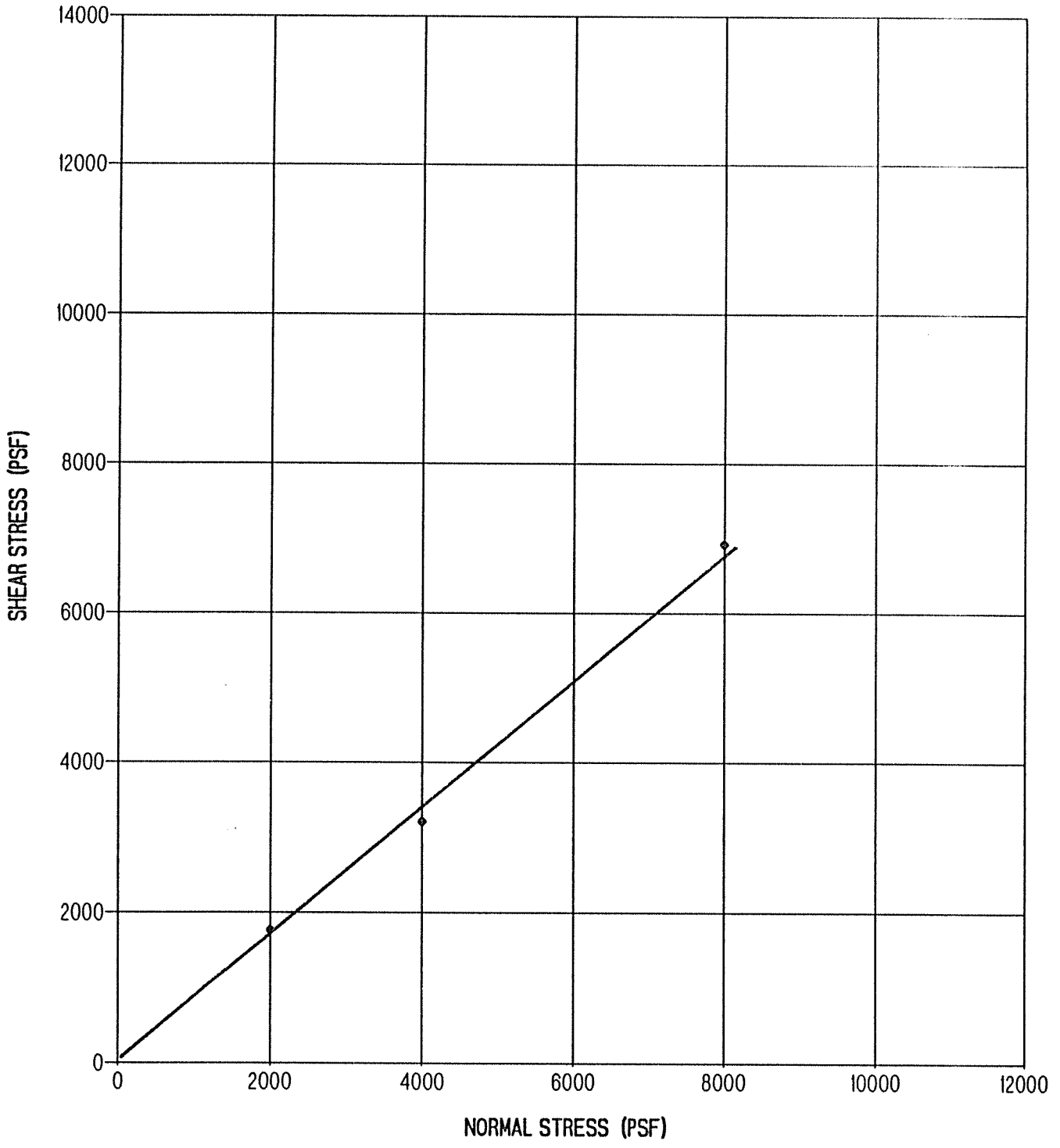
DIRECT SHEAR TEST



DRILL HOLE NO.: 27	DEPTH (FEET): 40	MOISTURE CONTENT (%): 10
DRY UNIT WEIGHT (PCF): 92	FRICTION ANGLE (DEGREES): 39	COHESION (PSF): 300
DESCRIPTION: Silty Sand (SM) red-brown, dense, micaceous.		



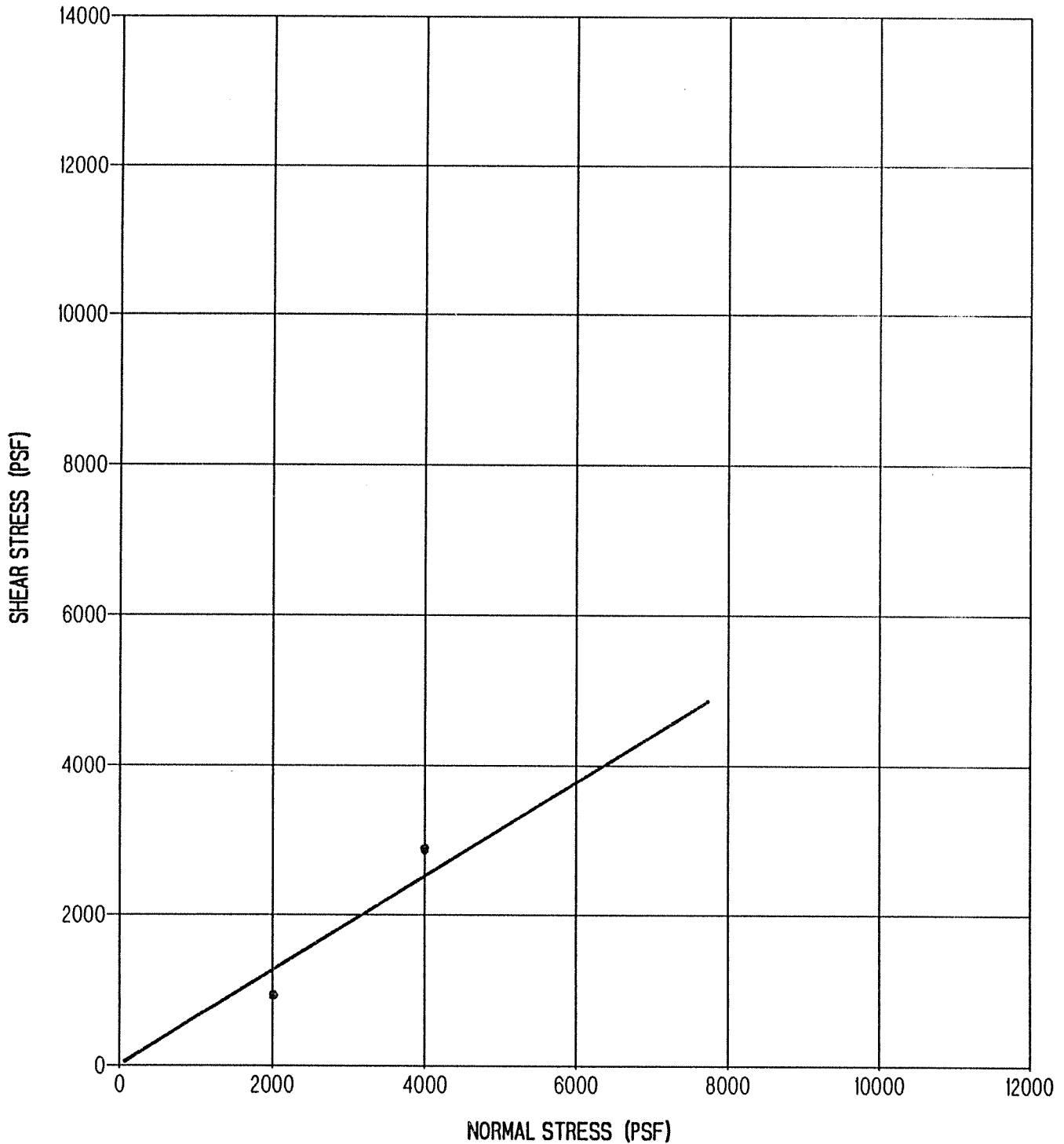
DIRECT SHEAR TEST



DRILL HOLE NO.: 32	DEPTH (FEET): 20	MOISTURE CONTENT (%): 7
DRY UNIT WEIGHT (PCF): 85	FRICTION ANGLE (DEGREES): 40	COHESION (PSF): 0
DESCRIPTION: Silty Sand (SM) red-brown, dense, micaceous.		



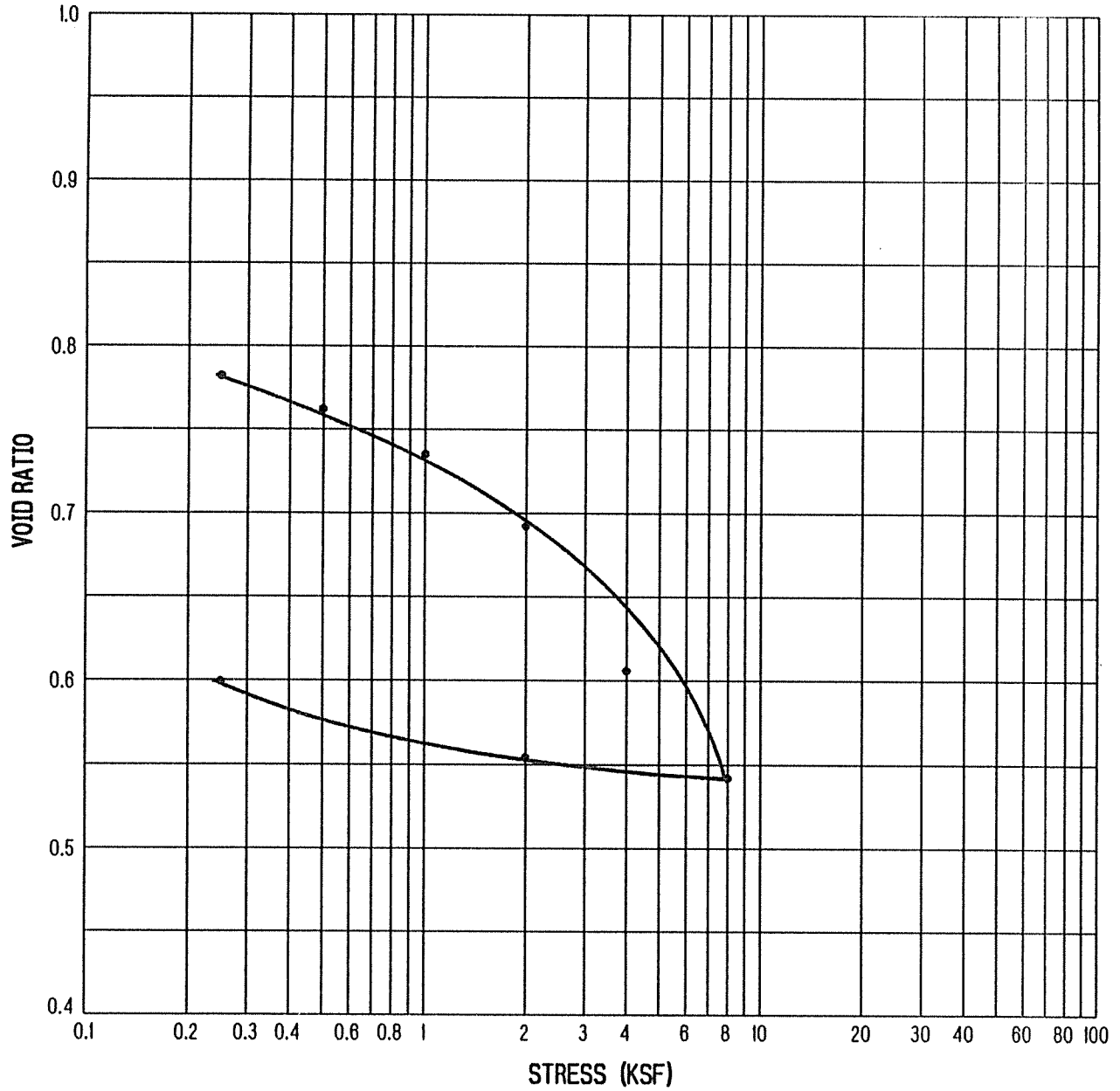
DIRECT SHEAR TEST



DRILL HOLE NO.: 33	DEPTH (FEET): 30	MOISTURE CONTENT (%): 9
DRY UNIT WEIGHT (PCF): 96	FRICTION ANGLE (DEGREES): 32	COHESION (PSF): 0
DESCRIPTION: Silty Sand (SM) mottled orange-brown and gray.		



CONSOLIDATION TEST

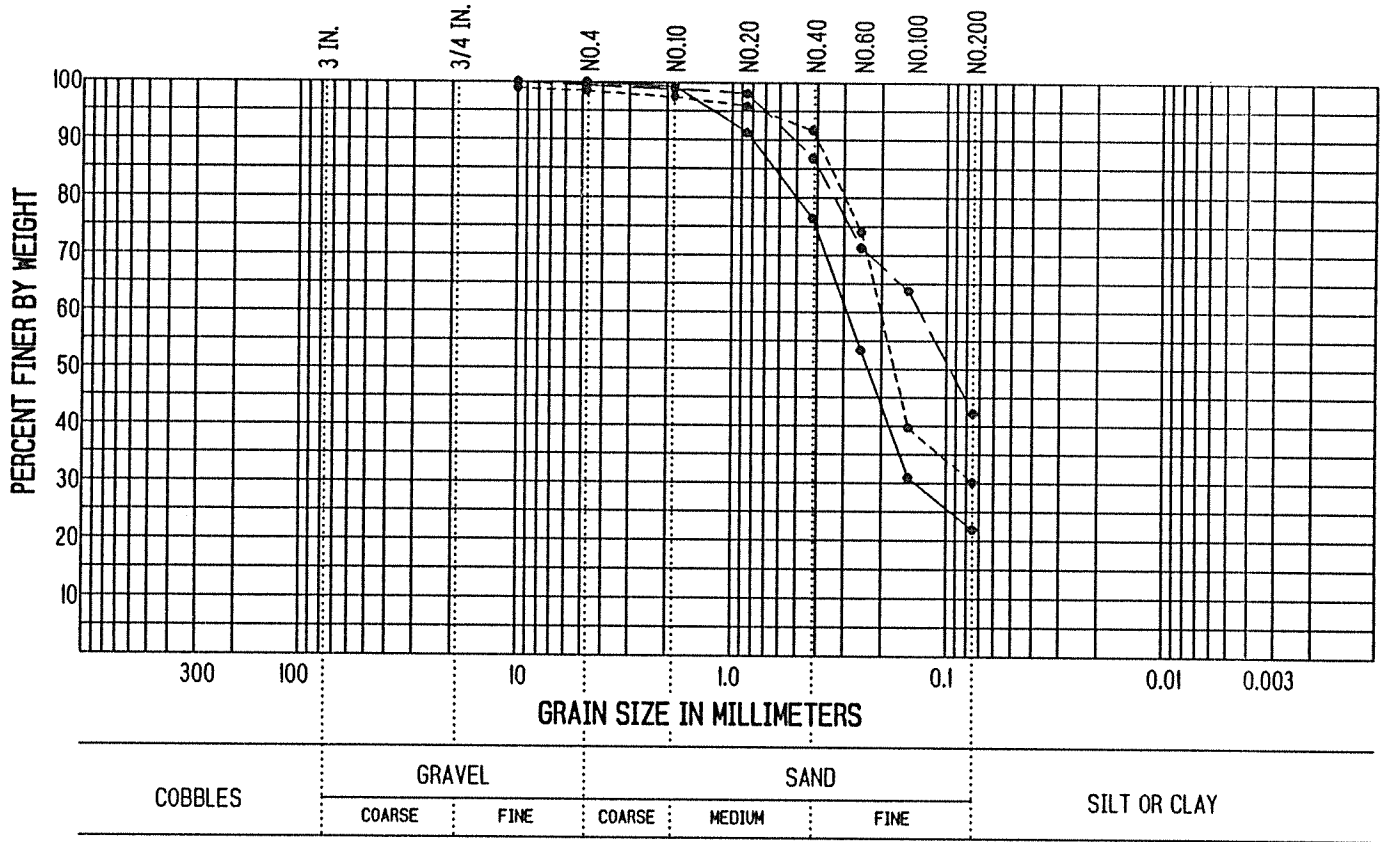


DRILL HOLE NO.: 2	DEPTH (FEET): 25
INITIAL MOISTURE CONTENT (%): 24	FINAL MOISTURE CONTENT (%): 20
INITIAL VOID RATIO: 0.796	FINAL VOID RATIO: 0.559
INITIAL SATURATION: 81	FINAL SATURATION: 91
INITIAL DRY UNIT WEIGHT (PCF): 94	FINAL DRY UNIT WEIGHT (PCF): 105
DESCRIPTION: Landfill debris	



GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE



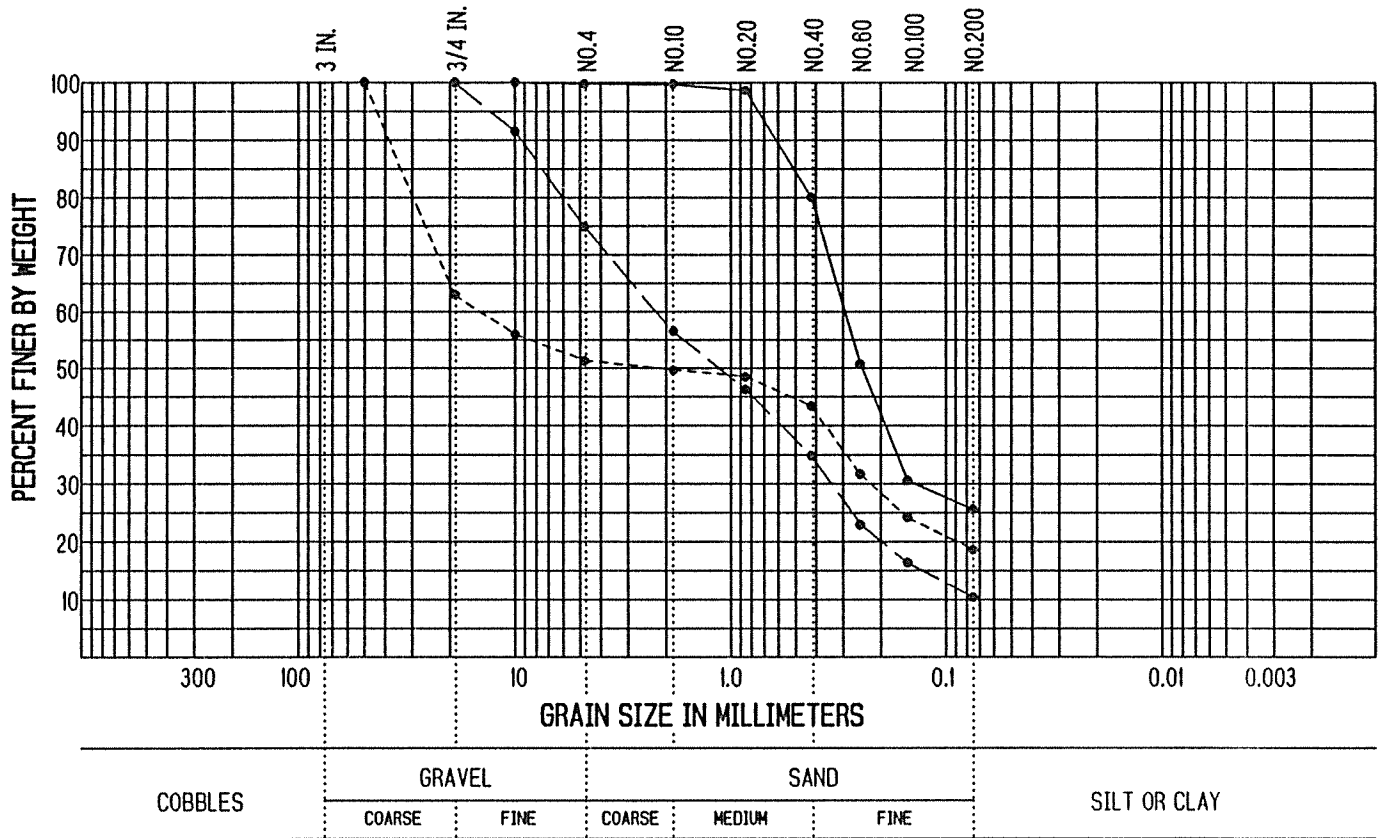
PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	1	5	SM
- - - -	2	40	SM
- - - - -	3	2.5	SM
.....			



GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE



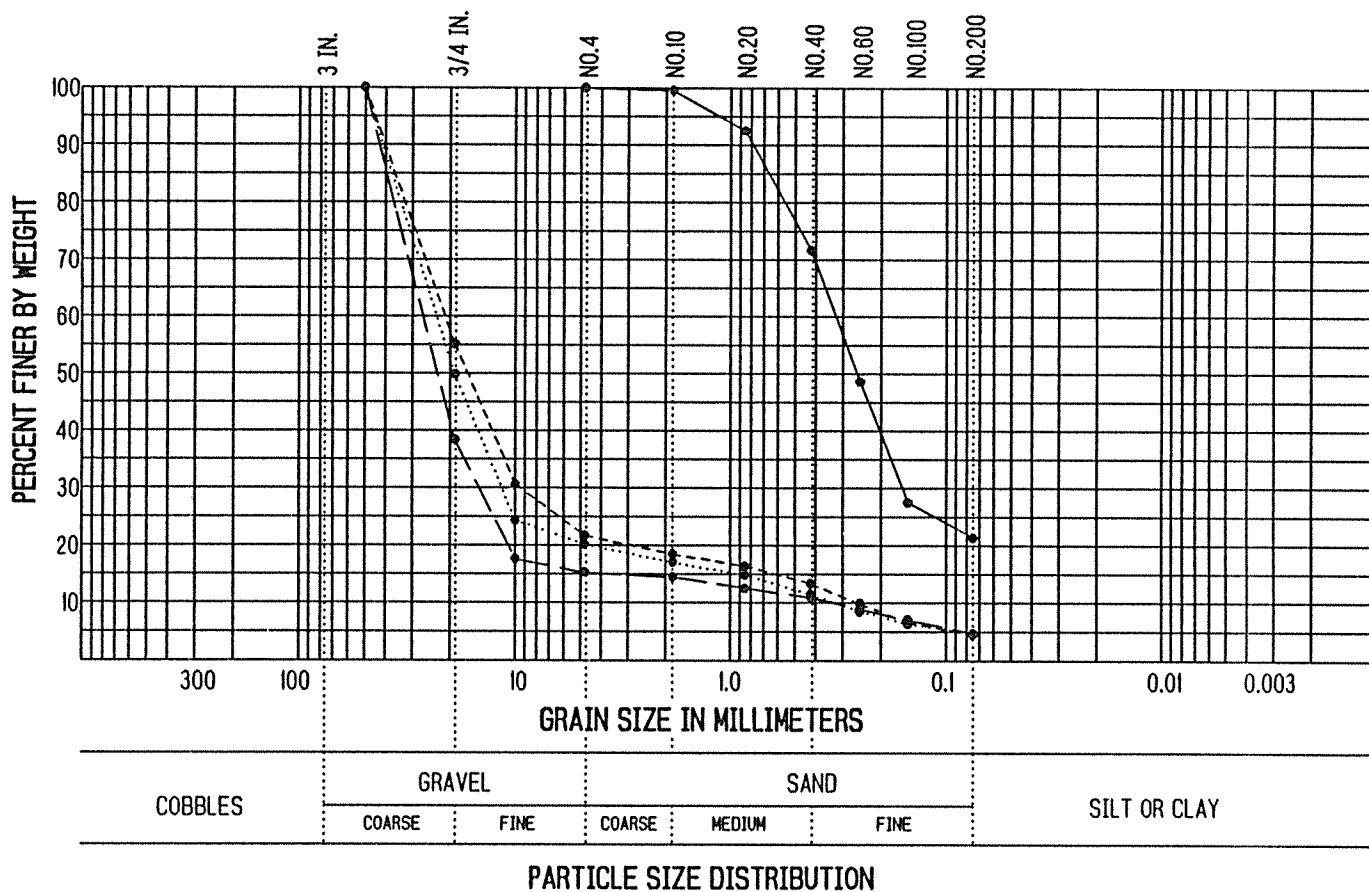
PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	5	2	SM
- - - -	7	9.5	SW-SM
- - - - -	9	50	SM
.....			



GRAIN-SIZE DISTRIBUTION

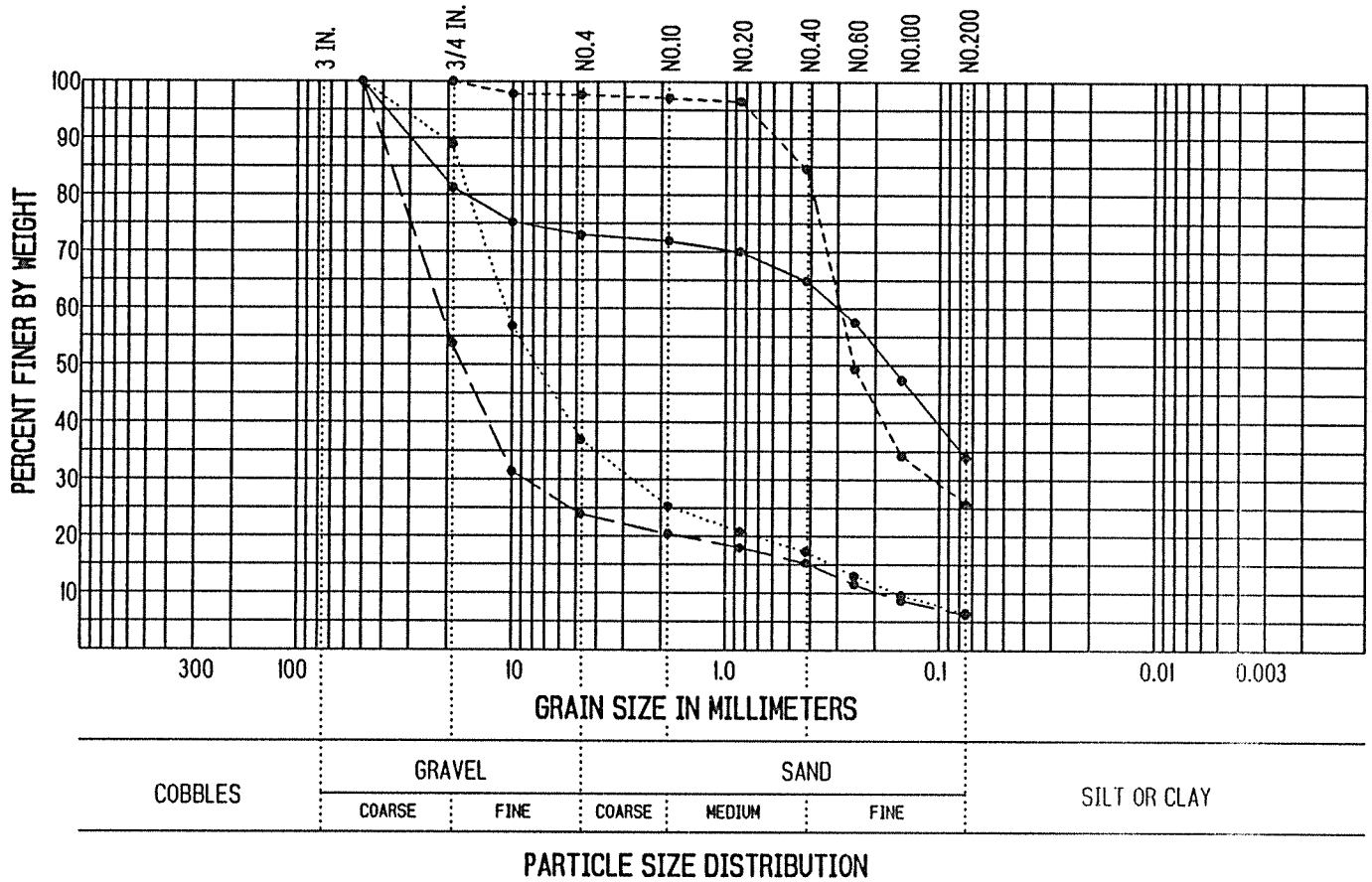
U.S. STANDARD SIEVE SIZE



LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	10	5	SM
-----	10	35	GP
-----	11	25	GP
.....	11	40	GP

GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE

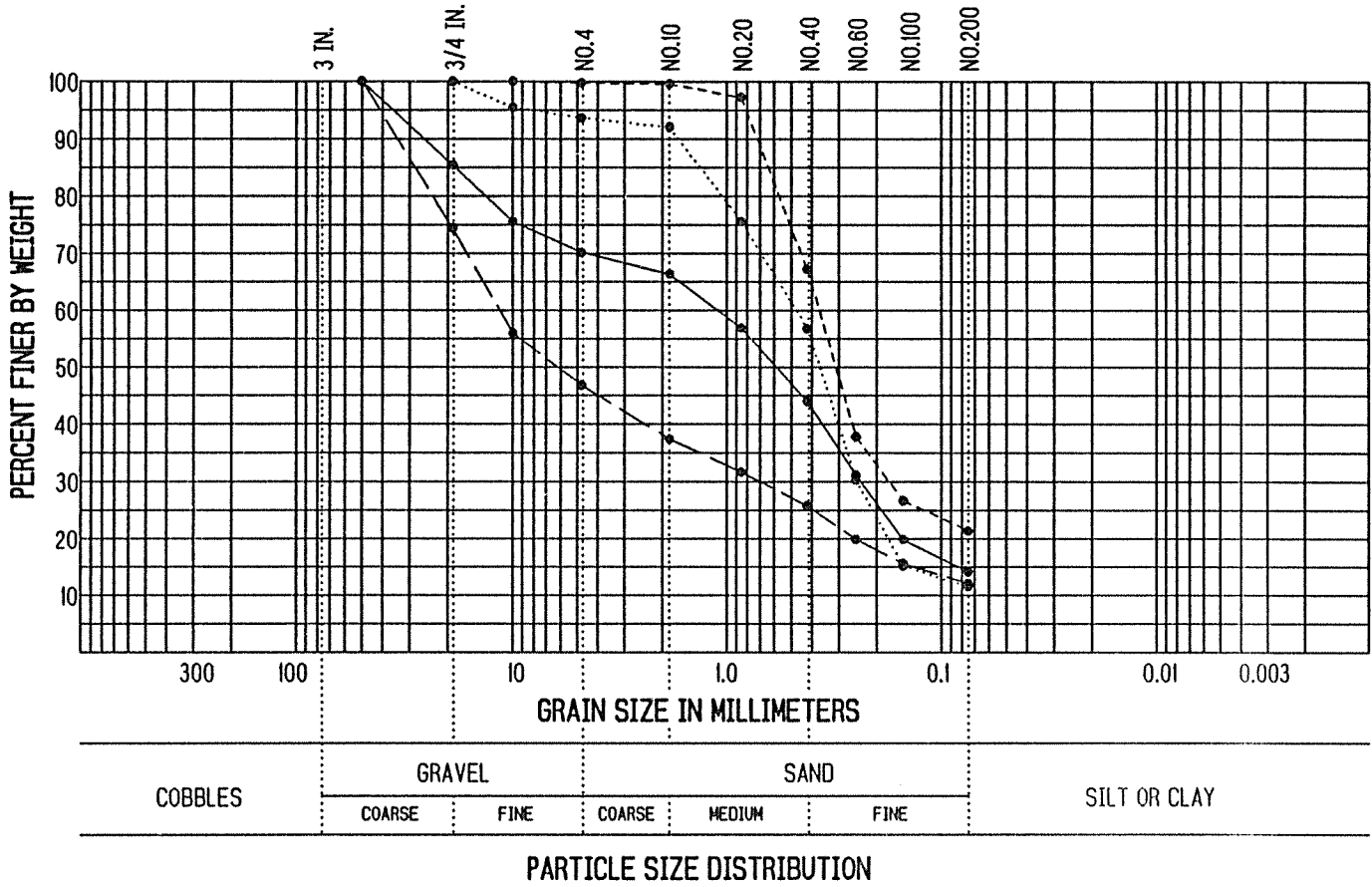


LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	13	30	SM
-----	13	47	GP
-----	14	30	SM
.....	14	59.5	GP-GM



GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE

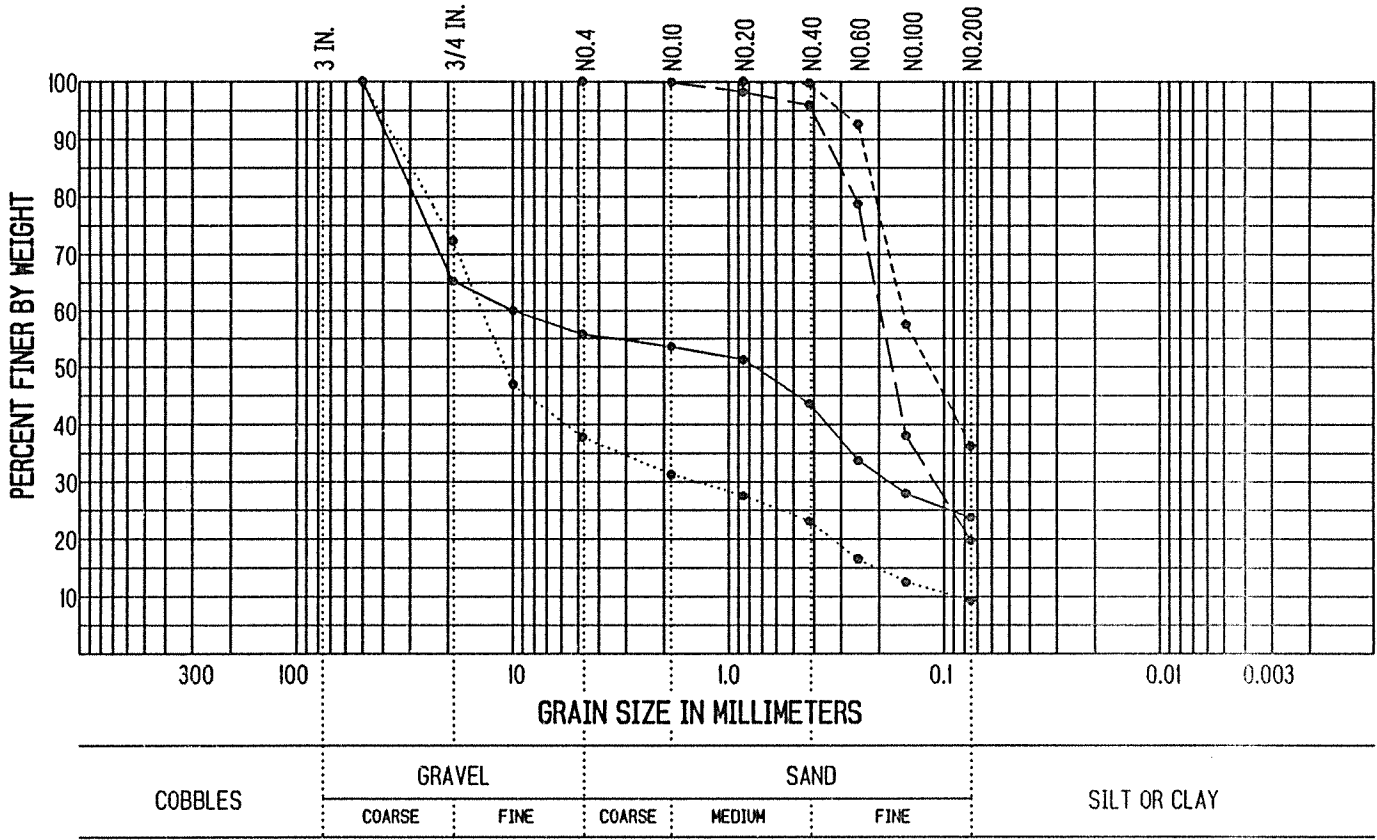


LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	15	20	SM
- - - -	15	35	GM
- - - -	16	15	SM
.....	16	30	SM



GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE



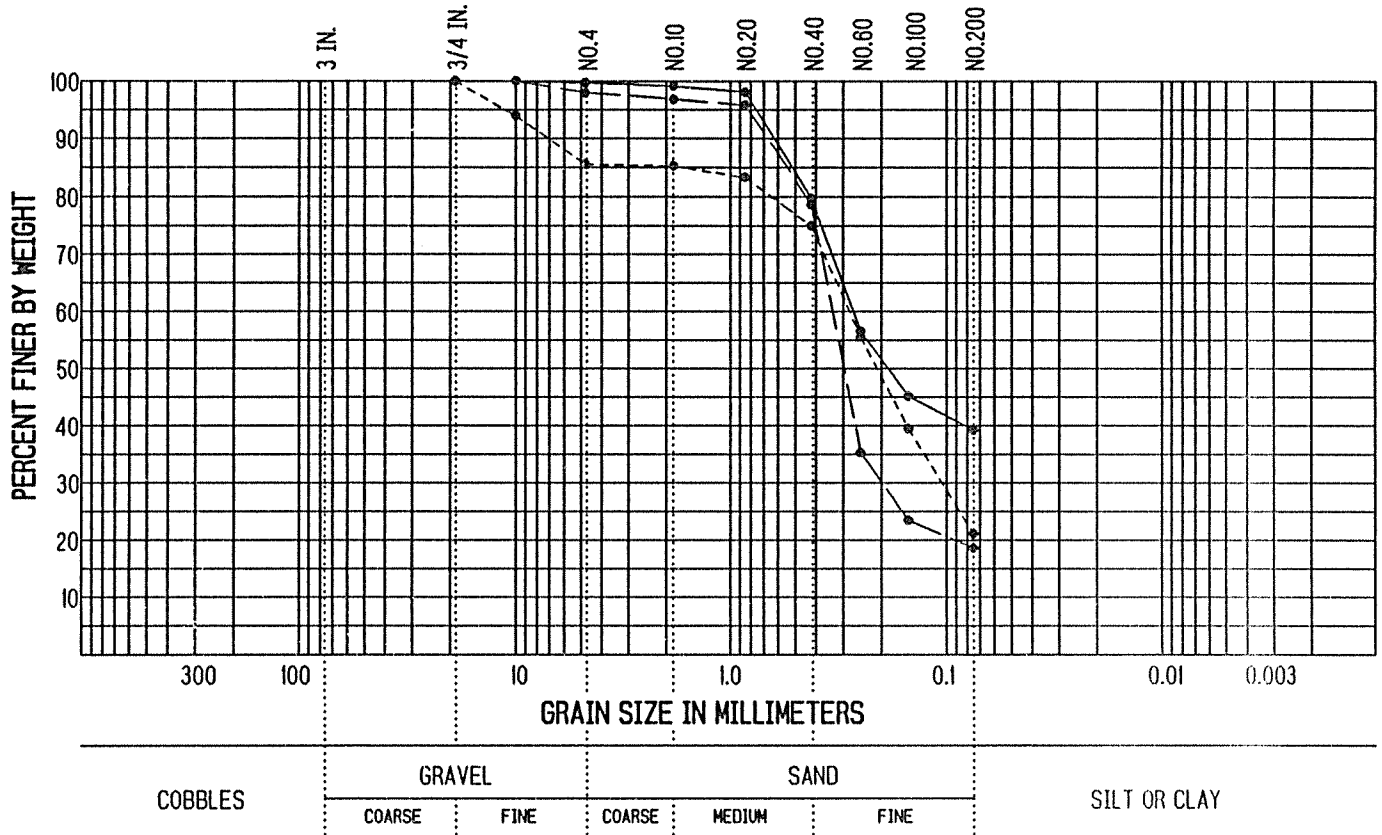
PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	17	45	GM
-----	19	20	SM
-----	19	30	SM
.....	21	50	GP-GM



GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE

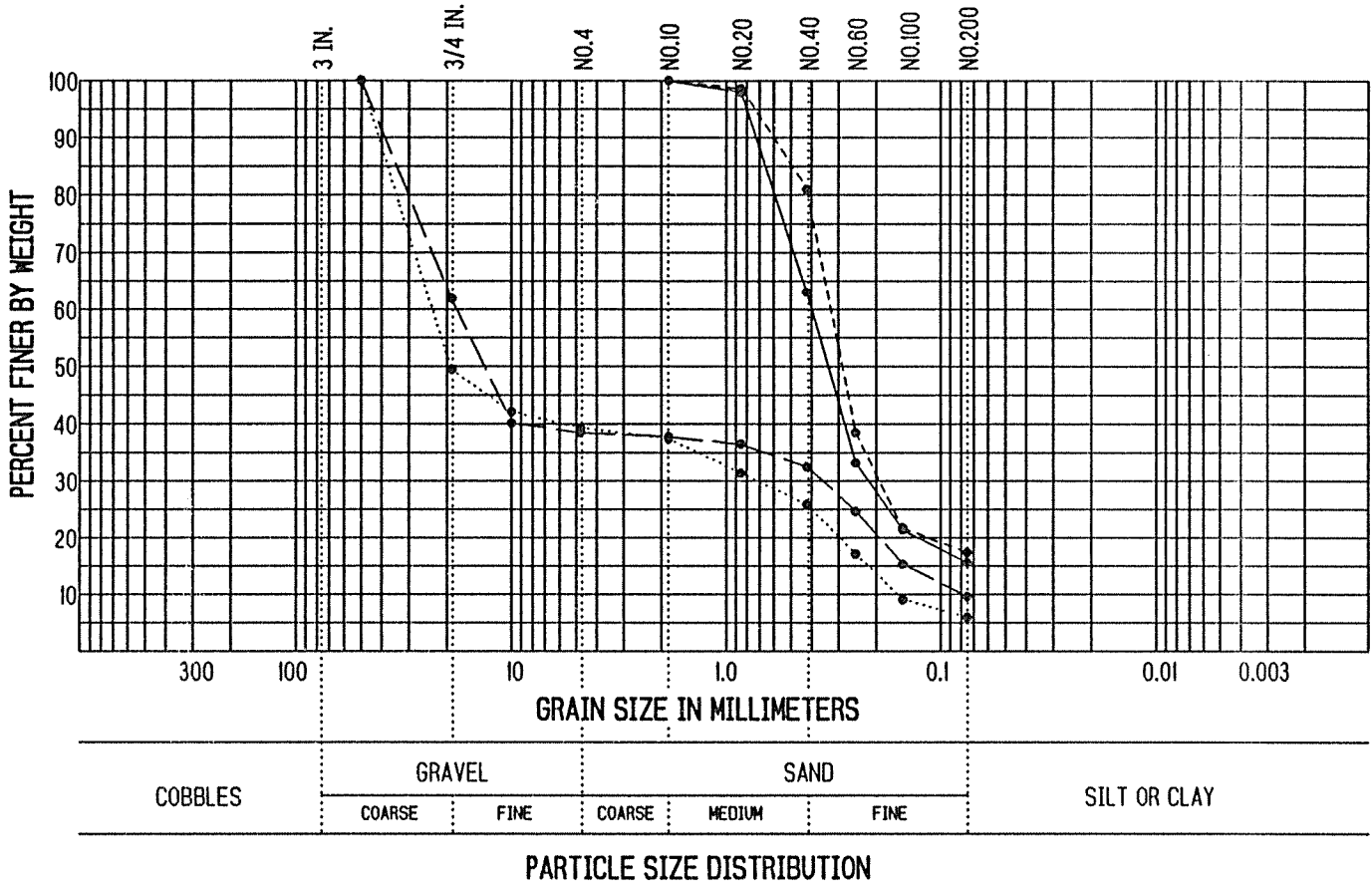


PARTICLE SIZE DISTRIBUTION

LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	22	5	SC
— — —	23	5	SM
-----	25	55	SM
.....			

GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE

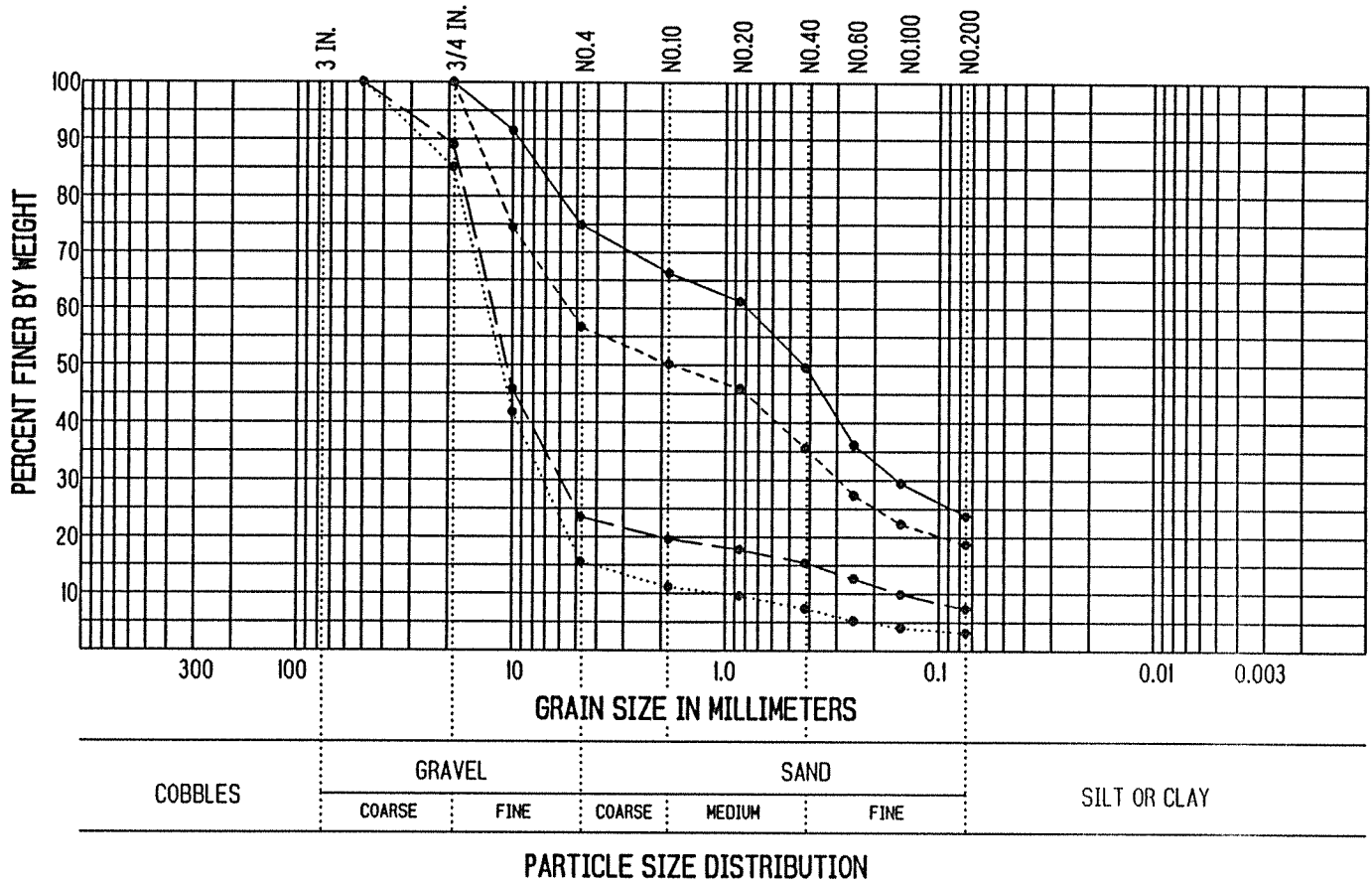


LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	26	20	SM
-----	26	50	GP-GM
-----	27	25	SM
.....	27	40	GP-GM

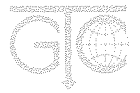


GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE

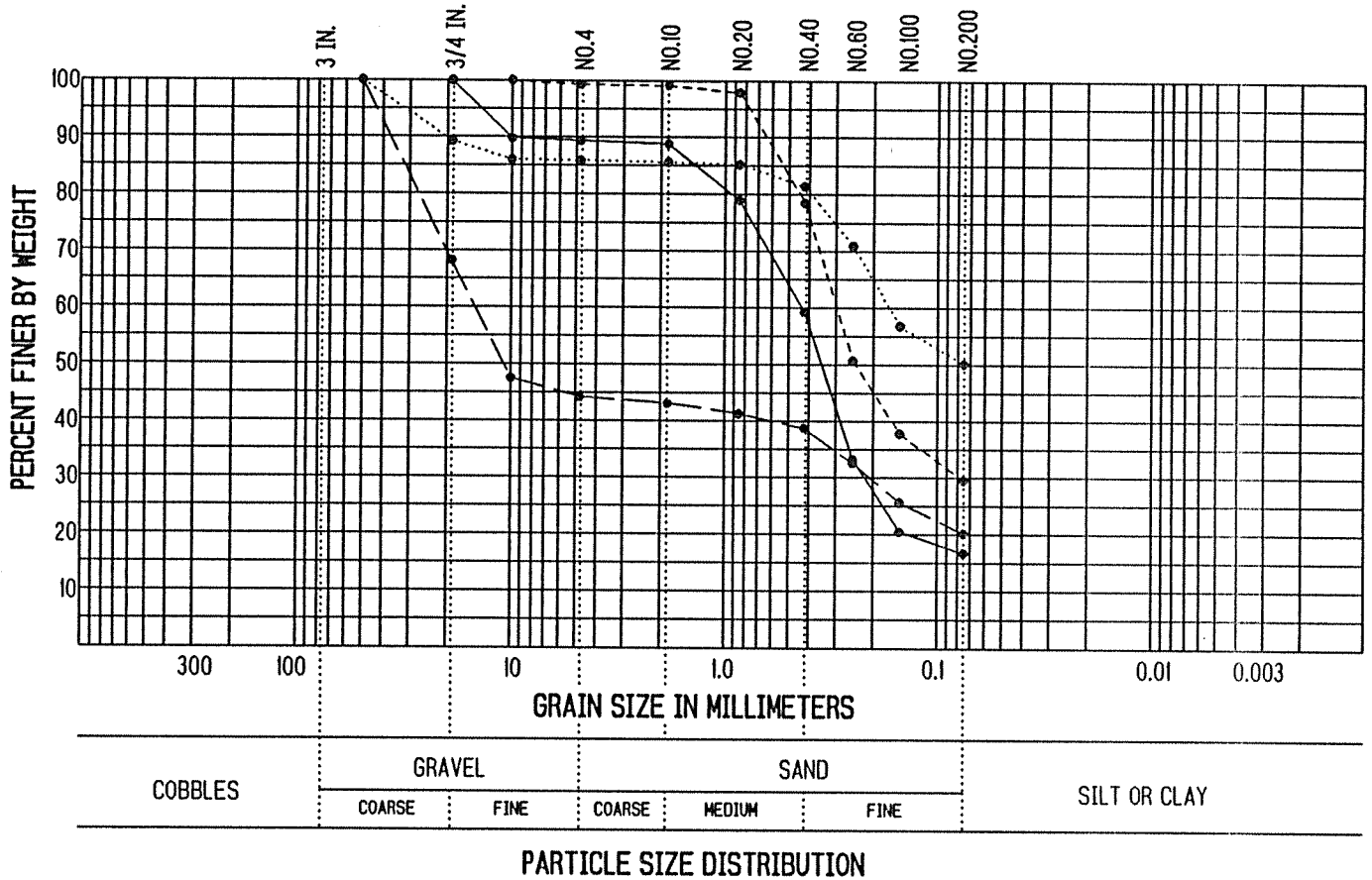


LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	28	10	SM
- - - -	28	30	GP
- - - -	29	15	SM
.....	29	30	GP



GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE

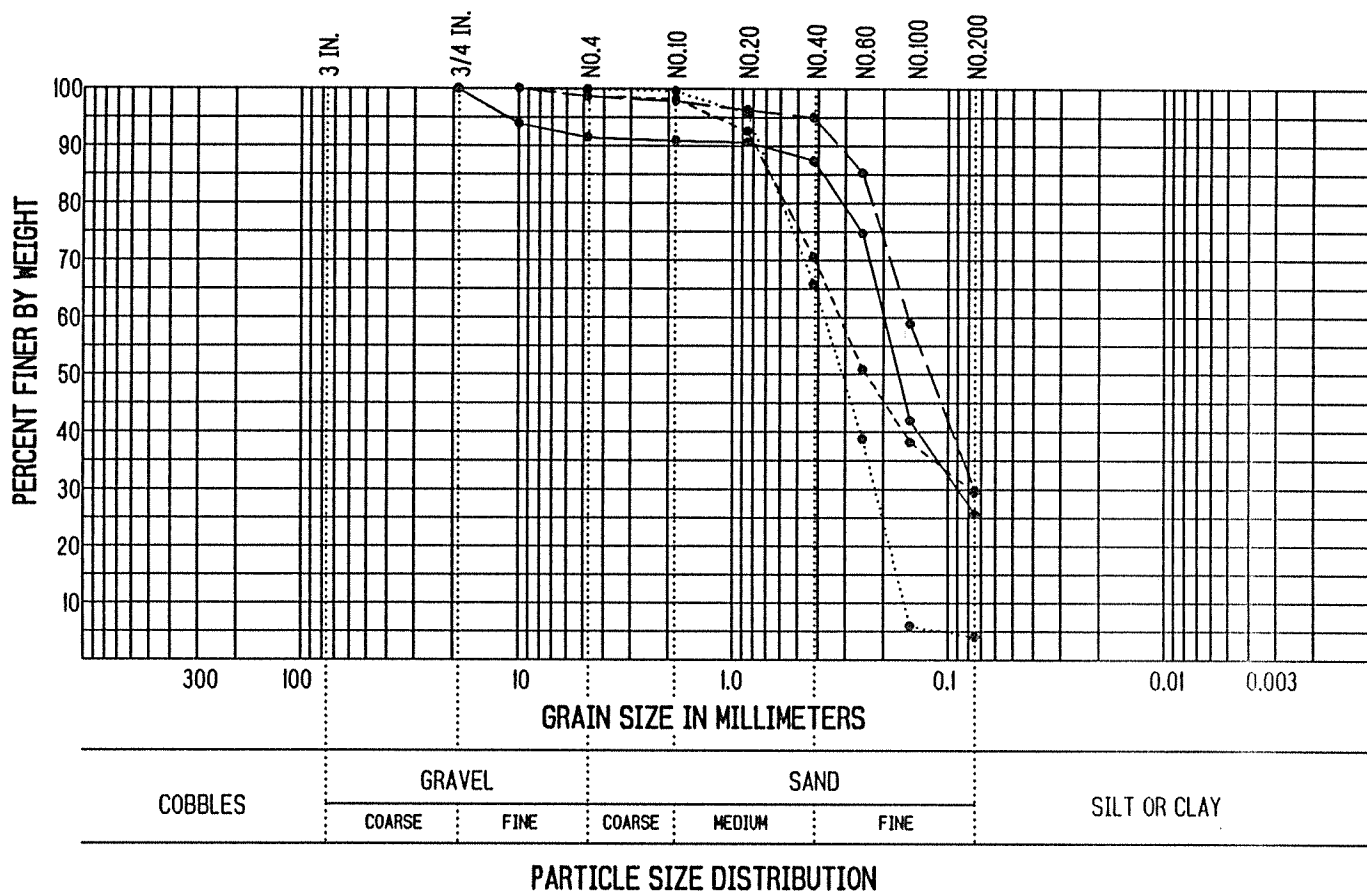


LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	30	10	SM
-----	31	40	GM
-----	32	5	SM
.....	32	15	ML-CL

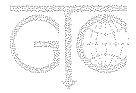


GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE

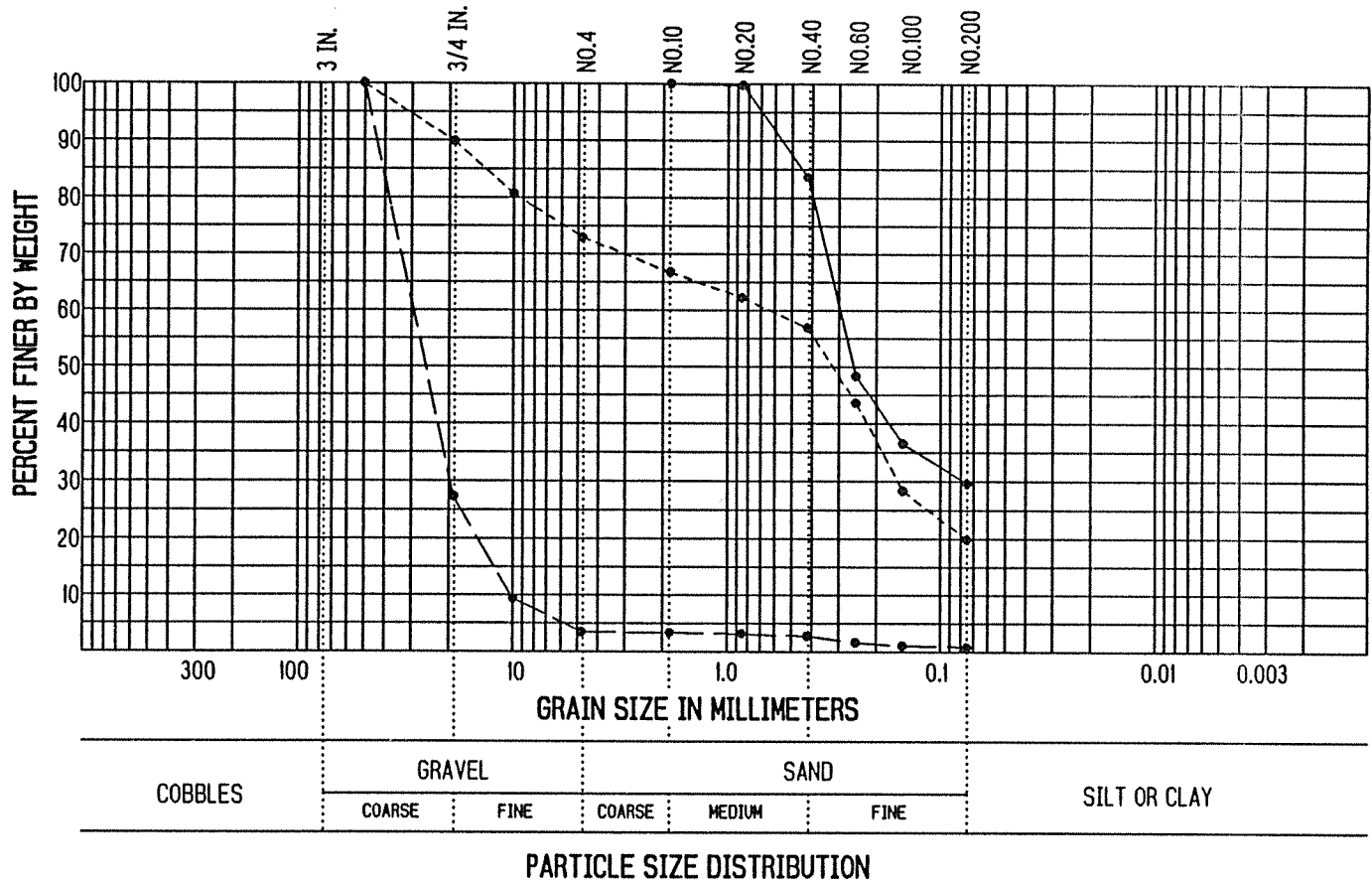


LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	33	20	SM
-----	35	20	SM
-----	36	10	SM
.....	37	20	SP



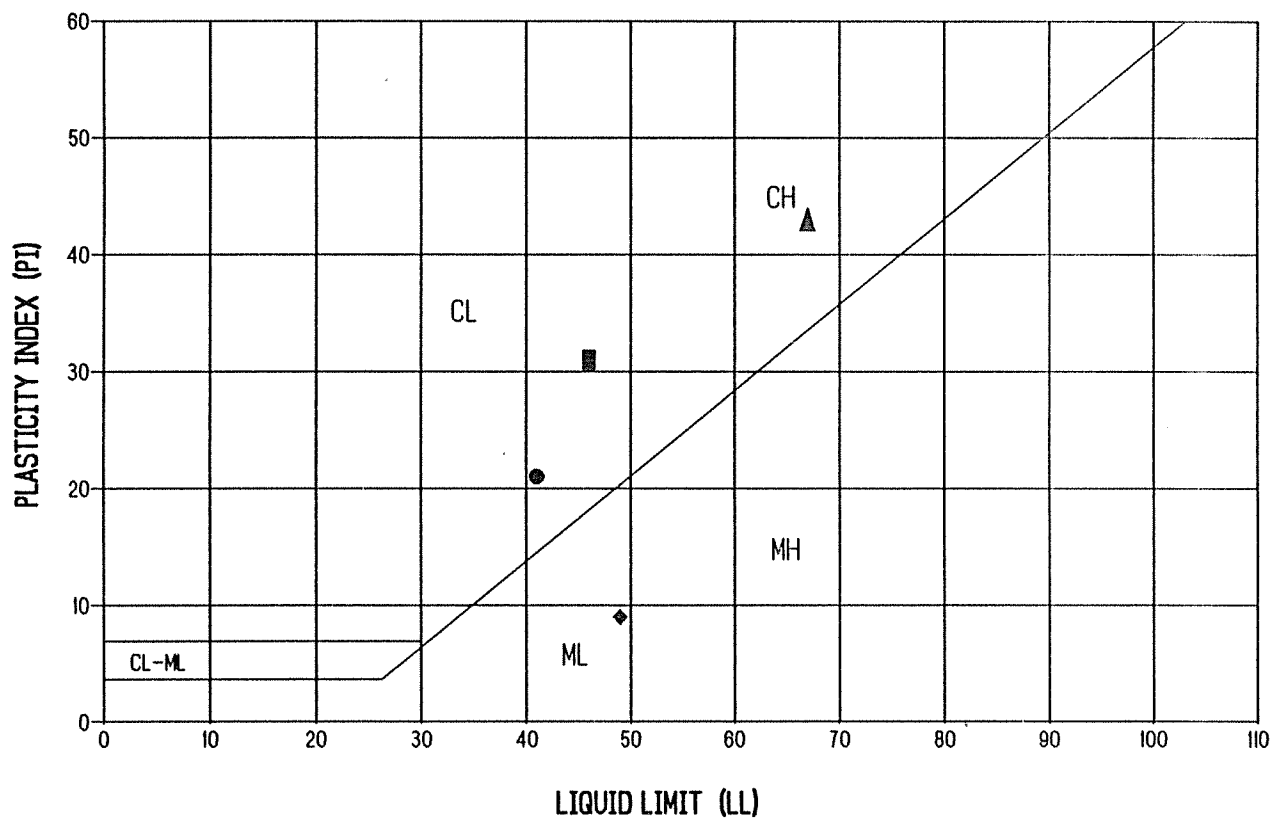
GRAIN-SIZE DISTRIBUTION

U.S. STANDARD SIEVE SIZE



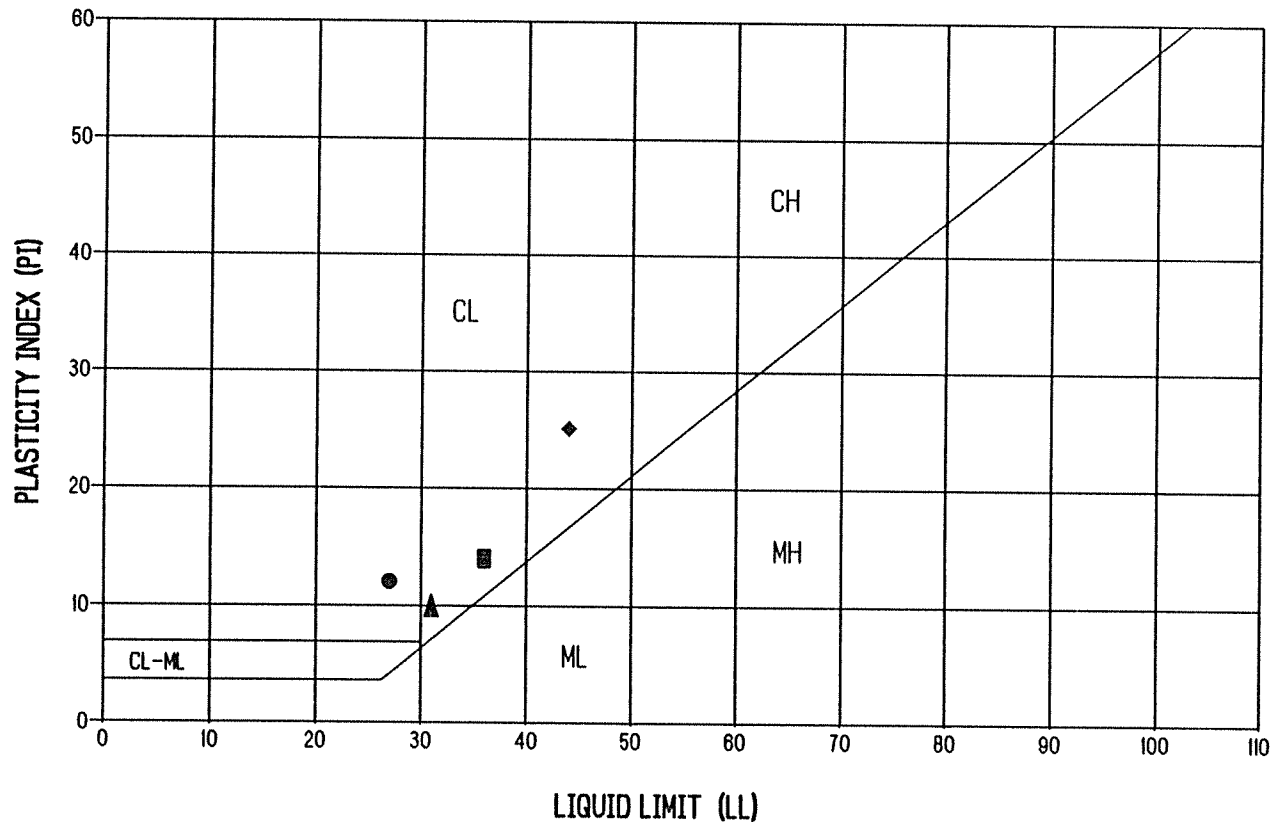
LINE SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	CLASSIFICATION
————	39	15	SM
-----	39	35	GP
-----	40	20	SM
.....			

ATTERBERG LIMITS



SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	NATURAL WATER CONTENT (%)	LL	PL	PI	CLASSIFICATION
▲	1	2	16	67	24	43	CH
●	2	5	20	41	20	21	CL
◆	2	35		49	40	9	ML
■	8	2	12	46	15	31	CL

ATTERBERG LIMITS



SYMBOL	DRILL HOLE NO.	DEPTH (FEET)	NATURAL WATER CONTENT (%)	LL	PL	PI	CLASSIFICATION
▲	9	50	17	31	21	10	CL
●	18	30	18	27	15	12	CL
◆	37	20	13	44	19	25	CL
■	39	15		36	22	14	CL



SAND EQUIVALENT TEST RESULTS

<u>Sample Location</u>	<u>Sand Equivalent</u>
DH-4 @ 10 feet	26
DH-10 @ 5 feet	28
DH-11 @ 25 feet	4
DH-15 @ 20 feet	25
DH-15 @ 40 feet	23
DH-17 @ 30 feet	22
DH-17 @ 45 feet	10
DH-18 @ 10 feet	27
DH-20 @ 20 feet	25
DH-20 @ 30 feet	15
DH-20 @ 35 feet	28
DH-26 @ 20 feet	25
DH-28 @ 10 feet	8
DH-29 @ 2 feet	12
DH-31 @ 10 feet	25
DH-32 @ 5 feet	20

EXPANSION INDEX TEST RESULTS

<u>Sample Location</u>	<u>Expansion Index</u>	<u>Expansive Classification</u>
DH-21 @ 20 feet	0	None
DH-20 @ 2 feet	88	Medium
DH-33 @ 10 feet	0	None

PLATE A-7



APPENDIX B
GEOPHYSICAL DATA

S92022

GEOPHYSICAL INVESTIGATION
Proposed FIRP/NSPF
Miramar, California

RYLAND ASSOCIATES, INC.

Project Number 93-143-04

September 20, 1993
Revised February 12, 1994

Prepared for
Geotechnical Consultants, Inc.
Santa Ana, California

INTRODUCTION

The proposed FIRP/NSPF is located south and west of the existing Miramar landfill.

Geophysical investigations were conducted to address three aspects at the pre-design stage:

- I Rippability of the rock at the facility site
- II Landfill boundaries at the ends of the access road
- III Nature of the fill cap and other properties along
the access road

The report will be presented in three separate sections.

Subsequent to the initial submittal of the report in September, 1993, it was reviewed by various organizations and returned in February, 1994. Drill hole logs were provided and the report was generally revised.

I RIPPABILITY SURVEY

Four seismic refraction lines were conducted in the area of the proposed FIRP/NSPF in Miramar, California. The subject area is underlain by conglomerate and sandstone of the Linda Vista Formation and Stadium Conglomerate, weathered bedrock, and soil. The rock has locally variable cementation which introduces some uncertainty to the interpretation. The purpose of this investigation was to determine the seismic velocities in areas of the proposed cut and determine ease of excavation (rippability). The locations were selected to be representative of the area to be excavated. Maximum cuts will be on the order of 40-50 feet, although the average in the

western portion of the site appears to be on the order of twenty feet.

A total of 3300 feet of refraction line was surveyed. Field work was conducted in August, 1993. The locations of the lines are shown on the attached site plan (Plates B-1 and B-2). Elevation control was estimated from field notes and site topographic maps.

METHODOLOGY

The seismic refraction method makes use of the time required for a seismic (acoustic) wave to travel various distances to calculate the subsurface configuration of the surveyed area.

In this series of surveys ground-motion sensitive transducers (geophones) were placed at intervals of 25 feet along the survey lines. The lengths of the Lines were:

Line SL-1	900 ft
SL-2	1800
SL-3	300
SL-4	300

Seismic energy was initiated into the lines by means of repeated sledge hammer impacts. The small ground motion generated is converted into an electric current by the geophones and then amplified and displayed by the seismograph. For this investigation a Bison 9024 seismograph was used. This device has the ability to "build-up" or stack the small signals generated by several of these small impacts into a larger-amplitude, readable signal. The arrival times of the seismic wave at each geophone and the time of impact are recorded by the seismograph and

presented on paper records, and may be stored into memory for future data enhancement.

Impacts were made at each end, at the centers, and sometimes at points beyond the ends of the lines. Horizontal shortening due to topography was accommodated although the lines are extrapolated to their full lengths on the cross sections and maps.

By plotting the delay time of arrivals versus distance and by various algebraic manipulations the depth and configuration may be measured. The ray tracing method was used primarily in interpretation; in complex areas this was supplemented by inspection. The data reduction was computer-assisted using the program SIPT2.

OBSERVATIONS AND GEOLOGIC INTERPRETATIONS

The seismic refraction method produces a series of data from which an interpretation is made. The interpretation is generally not unique and may differ from actuality in some instances. The lines were tied to proposed boring locations and the boring data was used to constrain the interpretations during the report revision. The drill hole data may be used to correlate with the seismic data in two ways. The first is a comparison between the lithologic and material property stratigraphy and the seismic stratigraphy. This could modify the depths and configurations of the subsurface layers; minor variations are to be expected. A discussion of this type of correlation is provided after each line description; the drill hole locations are shown on Figures 1 and 2. The second type of correlation is between the general lithology and material properties

with observed seismic velocities; this is discussed in the Rippability Conclusions section.

In general this site is characterized by three subsurface layers with lateral variations in a complex configuration affected by erosion and weathering.

Surficial velocities in relatively weathered, looser and broken materials are around 850-1400 ft/sec. This includes soil, colluvium, and loose or weathered bedrock.

Denser material including less weathered, softer, and less cemented bedrock, exhibits velocities of 3200-5000 ft/sec. Harder bedrock has velocities in excess of 4500 ft/sec with some values approaching 8000-10,000 ft/sec. Some of the intermediate velocity material and perhaps some of the lower velocity material contains isolated, hard cemented facies, surrounded by looser and more weathered material. Although this configuration may generate an average, lower velocity the cemented zones themselves may contain internally high velocities (perhaps in excess of 6000 ft/sec). Outcrops of particularly hard material were observed near the highpoint of the site.

Sources of Error

Unusual phenomena such as intermediate velocity thin layers (blind zones) or lower velocity layers beneath higher velocity layers (hidden zones) may cause interpretive error. Based on the correlation of drill hole data (primarily blowcounts) with the seismic data, it is likely that lower velocity material may underlie higher velocity material in several areas.

Seismic waves do not travel only vertically. The depths given could also, in some instances, be lateral distances to a higher velocity material. That is, cross-section depths may not always be vertical.

Some rocks may have anisotropic behavior; that is higher velocity in some directions than in others; those velocities measured may not always be fastest.

Extreme topographic relief of the surface or a refractor can introduce errors in depth and velocity calculations.

When conducting surveys directly on a bedrock surface the generation and detection of a head wave (first arrival compressional wave) may sometimes be difficult and the first arrival noted may be a later waveform.

Sometimes hard rock in a matrix of soft rock will yield rather average velocities and local areas may be much harder than as indicated, and localized blasting could be required.

There will often be an increase in excavation difficulty as a seismic interface is approached and the calculated interface may represent the average depth of transition rather than the top.

Line Descriptions

The seismic lines were located in areas representative of expected cuts. Interpretive seismic sections are attached (Figures 1-2).

Line SL-1 (Figure 1) was surveyed along a northwest trending ridge in the west central portion of the property. The most prominent topographic feature was the sharp erosional ridge southeast of station 600. Here the iron stained sandstone appeared to be more cemented and formed outcrops; it was also observed at the surface north of the scarp. The velocities along this line were the highest on the site. Soil and loose surficial material had velocities from 1000-1320 ft/sec and attained depths of 5-15 feet. This was underlain by primarily beach derived, cemented sandstone with corresponding velocities of 4100-5000 ft/sec. These velocities may belie the actual rippability. Very high velocity bedrock (7000-10,000 ft/sec) is postulated at depths of more than 20 feet although it is not clearly defined everywhere along the line. The highest ridge appears to be underlain directly by material with a velocity of 5000 ft/sec which may correspond to much of the cemented sands.

Three drill holes (DH-25, 31, and 34) were located near Line SL-1. DH-34 showed approximately the same blow counts at all depths. The major transition from 4100 to 7000 ft/sec correlates with the lithologic change from sandstone to gravelly sandstone, both in the Linda Vista Formation. DH-31 shows the transition from 4550 to 10,000 ft/sec to be at the top of the Mission Valley Formation and an associated increase in blow counts. DH-25 shows little correlation although the dashed contact between the 5000 to 8000 ft/sec transition is moved

somewhat higher to match the increase of blow counts.

Line SL-2 (Figure 2) was conducted east to west across most of the property. In gross configuration it is similar to Line SL-1 with three subsurface layers present. The surface layer is no more than ten feet thick and has a velocity of 850-1250 ft/sec. The second layer of bedrock shows velocities of 4000-5050 ft/sec. It is relatively thin in the first half of the line (15-25 feet) but deepens to the west. The third layer has velocities from 4500-6300 ft/sec, generally somewhat less to the west. The velocities of the second and third layer in the western portion of the line are very similar and their separation is not complete.

A number of drill holes are located along or near SL-2 (DH-6, 9, 14, 21, 23, 31, and 33). DH-6 shows a dramatic increase in blowcounts within the Stadium Conglomerate at a depth of around 35 feet; this correlates with the transition between the velocities of 5050 to 6000 ft/sec, only a minimal contrast. DH-9 shows a similar correlation as DH-6 with the Stadium Conglomerate and higher blowcounts. DH-14 shows the 4060 to 6320 ft/sec transition to correlate with a hard layer at the top of the gravelly sandstone member of the Lindavista Formation. DH-21 is similar to DH-14 and the seismic contact is correlated with the gravelly sandstone member of the Lindavista Formation with a corresponding increase of blowcounts. DH-23 shows little correlation although there may be some with gravel layers within the Lindavista Formation. DH-18 has rather continuous blowcounts with depth. The rather vague transition between 4000 to 5000 ft/sec appears to correlate with ground water and an increase in gravel content. DH-31 is off the line but a possible higher velocity layer (7000? ft/sec) may be correlated with the top of

the Mission Valley Formation. DH-33 shows only a minor velocity contrast but this may correlate with the gravelly sandstone member of the Lindavista Formation.

Lines SL-3 and SL-4 (Figure 1) were surveyed up northeasterly facing ridge slopes. Line 3 shows three layers with a maximum velocity of 4620 ft/sec. Line SL-4 is grossly similar but shows a higher velocity (5930 ft/sec) at depths in excess of 20 feet. Lines SL-3 and SL-4 correlate with their crossings of Line SL-1.

Drill Holes 20 and 21 are near Line SL-3. The colluvium is mapped but no other transitions are noted. DH-21 shows a transition between velocities of 3195 and 4620 ft/sec at an increase in blowcounts associated with the top of the gravelly sandstone member of the Lindavista fm.

Drill Holes 23 and 27 are near Line SL-4. DH-23 shows a velocity transition to be associated with the top of the Mission Valley Formation, although blowcounts are not high. DH-27 shows this same transition to be associated with a change in blowcounts within the Lindavista Formation.

RIPPABILITY CONCLUSIONS

General Rippability

The determination of rippability is an imprecise science. Standard references such as those of the Caterpillar Company have attempted to correlate rippability with compressional seismic wave velocity; all of these studies are empirical in nature. In addition to the seismic velocities other factors contribute to the actual rippability. These include: fracture density and spacing, thickness of beds, type of equipment used, material type, skill and experience of equipment operator, and geologic configuration of the material to be moved. Thus any formulation of a rippability chart must, by necessity be very generalized. The following correlation can often be applied:

0-2500 ft/sec	Readily rippable
2500-3500	Rippable with Little Difficulty
3500-5000	Rippable with Considerable Difficulty
5000-8000	Rippable with Great Difficulty Blasting may be Required
8000-	Blasting generally required

Small areas of high velocity rocks, less than 10-30 feet wide, such as knobs or resistant lenses, may go undetected in this survey. Seismic velocity may gradually increase as the hard rock is approached and excavation difficulty may increase significantly before the actual horizon is reached.

Rippability is best determined on a site to site basis using seismic velocities as a guide for field testing ease of excavation at various locations throughout the site. The seismic data applies to the immediate vicinity of the line only.

Site Rippability

Weathered, in place, bedrock was observed along the higher areas of the property. The velocities observed (mostly around 4000-5000 ft/sec) may appear low considering its difficulty in drilling, or these average velocities may be somewhat misleading.

It is probable that various hard facies consisting of cemented facies may be encountered throughout the excavation. These may require local blasting or may be difficult to remove.

However, the typical velocities of the average weathered bedrock were less than 6000 ft/sec. Based on standard tables and the typical values, little general blasting would appear necessary. However, in regional areas of unfractured, highly cemented sandstone exhibiting seismic velocities as low as 4500 ft/sec, general blasting has been required.

The experience of previous excavations in the site area, particularly for landfill construction, should be investigated. Test excavations with equipment of the size expected for use in the actual project would provide substantial correlations.

Correlation of Seismic Rippability with Drill Hole Data

Based on an analysis of the Line Descriptions section a few generalizations arise:

1. Transitions into higher seismic velocities with depth are commonly correlated with lithologic transitions or changes in material properties as measured by blowcounts.
2. The most common lithologic horizons correlating with seismic velocity transitions are those associated with the gravelly sandstone member of the Lindavista fm, the Stadium Conglomerate, and to a lesser extent the Mission Valley fm. In most cases these are associated with an increase in blowcounts. A similar transition observed in seismic velocities may be related to one lithologic/material property transition at one location along a seismic line and to another type of transition a few hundred feet away.
3. There is not a good, direct correlation between blowcounts and seismic velocities. In some cases high blowcounts (i.e. 100/5) may correlate with velocities of 4000 ft/sec; in others it may be 7000 ft/sec. This relationship may develop where the high blow counts are caused by hard cobbles, which are not representative of the bedrock density.
4. Although gravel and conglomerate lithologies generally correlate with higher seismic velocities this comparison is ill-defined and may also be a function of lateral variations in cementation or other factors.
5. Based on the drill hole data, both the Blind Zone and the Hidden Zone problems (see Sources of Error section) may be operative at this site.

II LANDFILL BOUNDARY

The perimeter of the existing landfill was not well documented and, after the unexpected discovery of trash in Drill Hole 2, its location became more important. The location of this perimeter was attempted in three ways: common offset seismic refraction, magnetometry, and electromagnetic. The principal locations of investigation were at opposite ends of the proposed access road.

METHODOLOGY

Seismic

The seismic refraction method is discussed in Section I. The common offset methods measures the arrival time of the seismic wave with a specified distance (here 100 feet) between the source and receiver. This is often very sensitive to lateral changes of material.

Magnetic

The magnetic method used a Geometrics G-816 proton precession magnetometer to measure the change of the earth's magnetic field from place to place. The magnetometer will respond to ferrous metal and the percent content of magnetic minerals within rock. It was thought that the trash would contain some iron content and represent a contrast.

Electromagnetic

The electromagnetic methods was used to measure lateral (and to some extent vertical) changes of conductivity within the landfill. The Geonics EM-31 unit was used for this investigation. It contains an internal tuned EM transmitter which induces an electromagnetic field within the upper earth. The modification of this field is measured by the receiver and is proportional to the conductivity (1/resistivity) of the subsurface material. Maximum penetration for conductivity measurement is generally considered 18 feet (6m). The conductivity measurement may be influenced by subsurface metal.

OBSERVATIONS AND GEOLOGIC INTERPRETATIONS

The common offset seismic data are shown on Figure 5 and the magnetic data on Figures 6 and 7. The electromagnetic data are shown on Figure 8, although only the first and last portions of that data are germane for discussion of landfill boundaries.

The common offset seismic refraction lines were surveyed to determine the west and east landfill boundaries along the access road (Plate B-2, Figure 5). The common offset seismic data show a clear time increase/velocity decrease near station 75-100 (east line) and 100-125 (West line); these correspond to actual road stations 1200-1225 and 3110-3135 respectively. This would be consistent with an increasing thickness of lower velocity subsurface material. The common offset anomaly near station 200 on the western data is probably based on topography going uphill to the east. The western common offset data were measured for two phases of the seismic

waveform; both are shown on Figure 5.

The magnetic data from Line M1 (Figure 6), surveyed near the east side of the FIRP/NSPF site (Plate B-1) do not show only a gradual increase (60 gammas) of field, with no abrupt anomaly over the suspected trash boundary. This suggests that the landfill is not present within the vicinity of Line M1, or that the magnetic method may not always be a good indicator of landfill boundaries. Line M2 (Figure 7) was conducted near Drill Hole 2 and shows a distinct difference starting near station 200 (actual road station 3160). There are additional perturbations due to surface metal in the area; this may account for the large positive anomaly near the creek and then the expected lower values to the east.

Line M3 (Figure 7) was surveyed at the eastern margin of the access road. Here a large decrease is noted past station 75 (corresponding to actual road station number 1200). Alternatively, in both Lines M2 and M3 the large anomalies mentioned above may represent large dipolar anomalies corresponding to the margin edge effects of the landfills; in this case the centers of their exact locations would differ slightly from those indicated above.

The electromagnetic data (Figure 8) show very large anomalies near road station 1225 both in the vertical (deeper) and horizontal (more shallow) readings. This represents an abrupt change from lower conductivities to the east to higher conductivities to the west. On the western end of the line, there is reduction of conductivity starting near road station 2950 with conductivity dropping to a low near road station 3050 and starting up again at road station 3100; the bottom

of the creek is at approximately 3060.

BOUNDARY CONCLUSIONS

Based on these three methods and the boring data from Drill Hole 2, the gross landfill edge appears to be around stations 1200-1225 on the east end of the access road. The westerly location is more diffuse but is probably around station 3125-3150 on the west end. These stations are where the geophysical anomalies are located; the actual edges may be gradual rather than abrupt and the precise locations may be difficult to determine. The landfill does continue west of Drill Hole 2.

III LANDFILL INVESTIGATION

An access road is to be built over the existing landfill to the proposed site. Borings were not allowed along this alignment due to possible subsurface gasses. The seismic refraction and electromagnetic methods were used to investigate the area.

METHODOLOGY

The seismic method was discussed in Section I. Figures 3 and 4 show the interpretive section for these data (SL-5).

The electromagnetic method was discussed in Section II. For this access road, measurements were taken at 25 foot intervals. A vertical and a horizontal coil orientation measurement were taken at each station. As noted above, in the vertical position, the maximum penetration for conductivity measurements is around 18 feet (6m). In the horizontal position the corresponding conductivity depths approximate 9 feet (3m). Since the range of fill cap thickness is from 5-20 feet, it was thought that the corresponding values from these two readings and from their ratio might provide some information regarding the thickness of the fill cap. Figure 8 shows the conductivity in millimhos/m (corresponding to 1000/ohm-m resistivity) for the vertical (deeper) and horizontal (more shallow) measurements and their ratio ($V/H \times 100$).

Calibration measurements were also made on known fill and bedrock. The conglomerate bedrock

at the west end of the line has considerably higher conductivity than the sandstone at the eastern end.

OBSERVATIONS AND GEOLOGIC INTERPRETATIONS

A simple seismic refraction investigation was conducted across the landfill. As noted in the Sources of Error section above, one problem inherent to the seismic refraction method is having a higher velocity layer over a lower velocity layer. Here, depth to bedrock cannot be accurately measured nor are any subsurface configurations definite. Also, with a heterogenous landfill, the lateral changes may be so great as to obscure any information. In some cases, data may be interpreted with some success, but this is very doubtful without any "ground truth" such as boring data. Therefore, Seismic Line 5 (Figures 3 and 4) was conducted, and provides some information, but do not rely on the depths or configurations presented. However, they may be, in some way, a function of actual subsurface conditions.

The electromagnetic data show many things; the possible boundaries of the landfill are discussed in Section II. The zones of higher conductivity presumably reflect a nearer-surface conductive horizon, which could be interpreted as trash. If both the vertical and horizontal measurements are high (possibly low ratio), then presumably the trash would be very near the surface. If the vertical is high but not the horizontal (ratio high), then the trash should be taken as somewhat nearer the surface than normal but not as much as in the first case. As with any geophysical

method, this assumes a rather uniform site. That is, the anomalies noted may also have been due to more conductive fill or surface trash mixed with fill; the following discussion should be considered as a possible model, but not the only possible origin of the anomalies. Again, some actual subsurface boring data would calibrate this method.

The highest conductivities are observed near road stations 2275-2450 and from approximately road stations 2775 to 2950; a smaller anomaly is observed near station 1700. In the first instance the V/H ratio is very high and in the latter it is very low. This suggests very high conductivity at the first anomaly (2275-2450) both at the surface and deep, very possibly indicating very shallow trash or more conductive backfill, but probably not immediately at the surface. In the second case (2775-2950), the trash may come very near the surface as there is minimal difference between the vertical and horizontal readings. At one measurement location, the horizontal reading is actually lower than the vertical; this could also be related to an accumulation of near surface conductive material, including metal or water, in the creek bottom. The smaller anomaly near road station 1700 is also associated with a high ratio, indicating near-surface trash. Other, smaller anomalies (1500, 2550, etc.) could also be postulated.

LANDFILL CONCLUSIONS

Without some "ground truth" in the form of borings or probes, the subsurface nature of the landfill will be very difficult to access.

Based on the seismic refraction lines, the trash may thicken west of station 250 (road station 1375). A possible bedrock high, with corresponding higher velocity may be present near station 1250. The fill cap appears to thicken considerably going down the road where it may reach up to 50 feet in thickness. However, there is considerable complexity here.

Based on the electromagnetic data, there may be shallow conductive trash (and/or thin soil cover layer) near road station 2900 and very shallow trash near road stations 1700 and 2400.

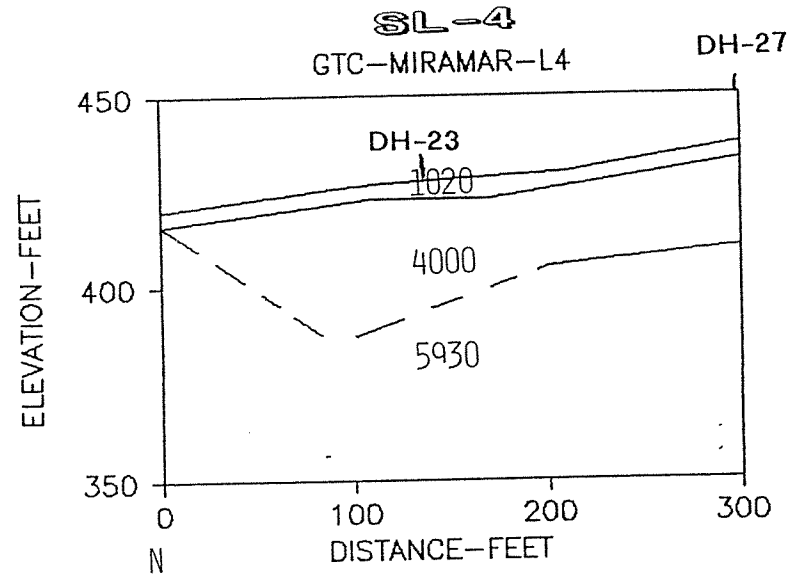
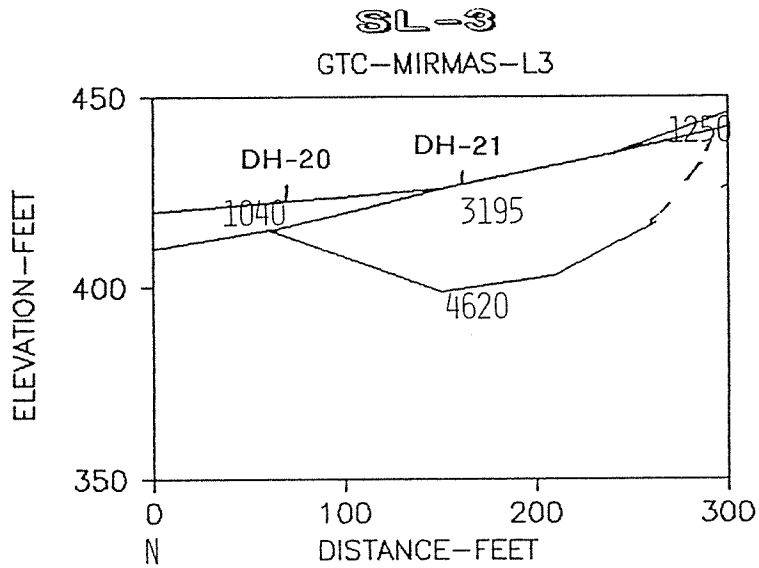
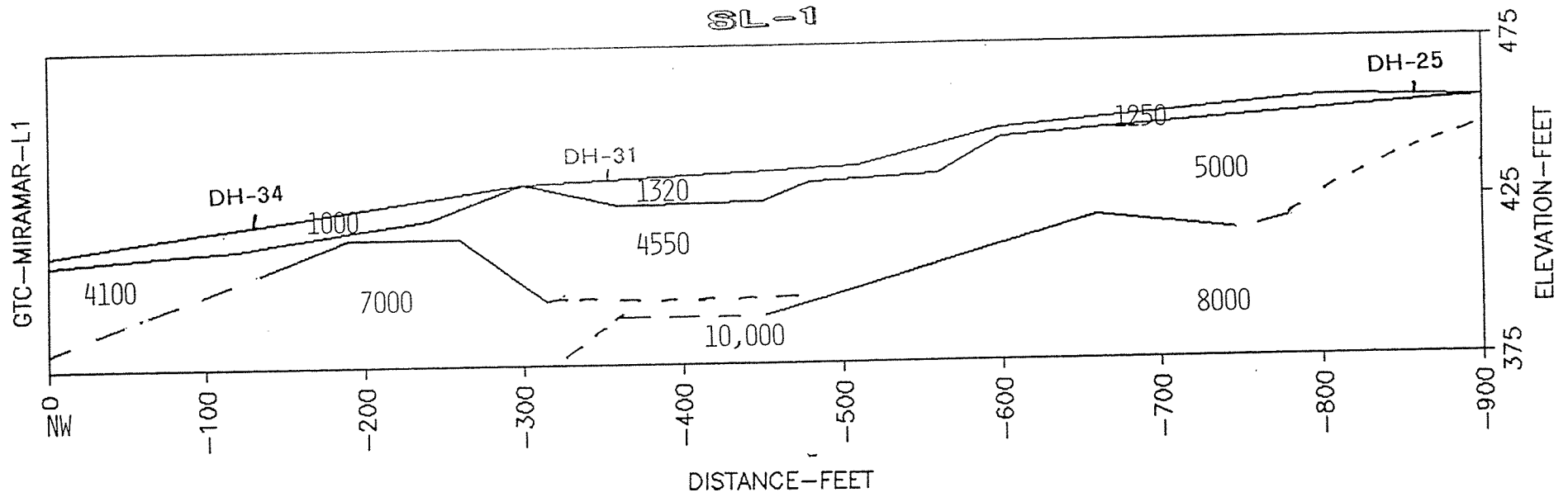


FIGURE 1

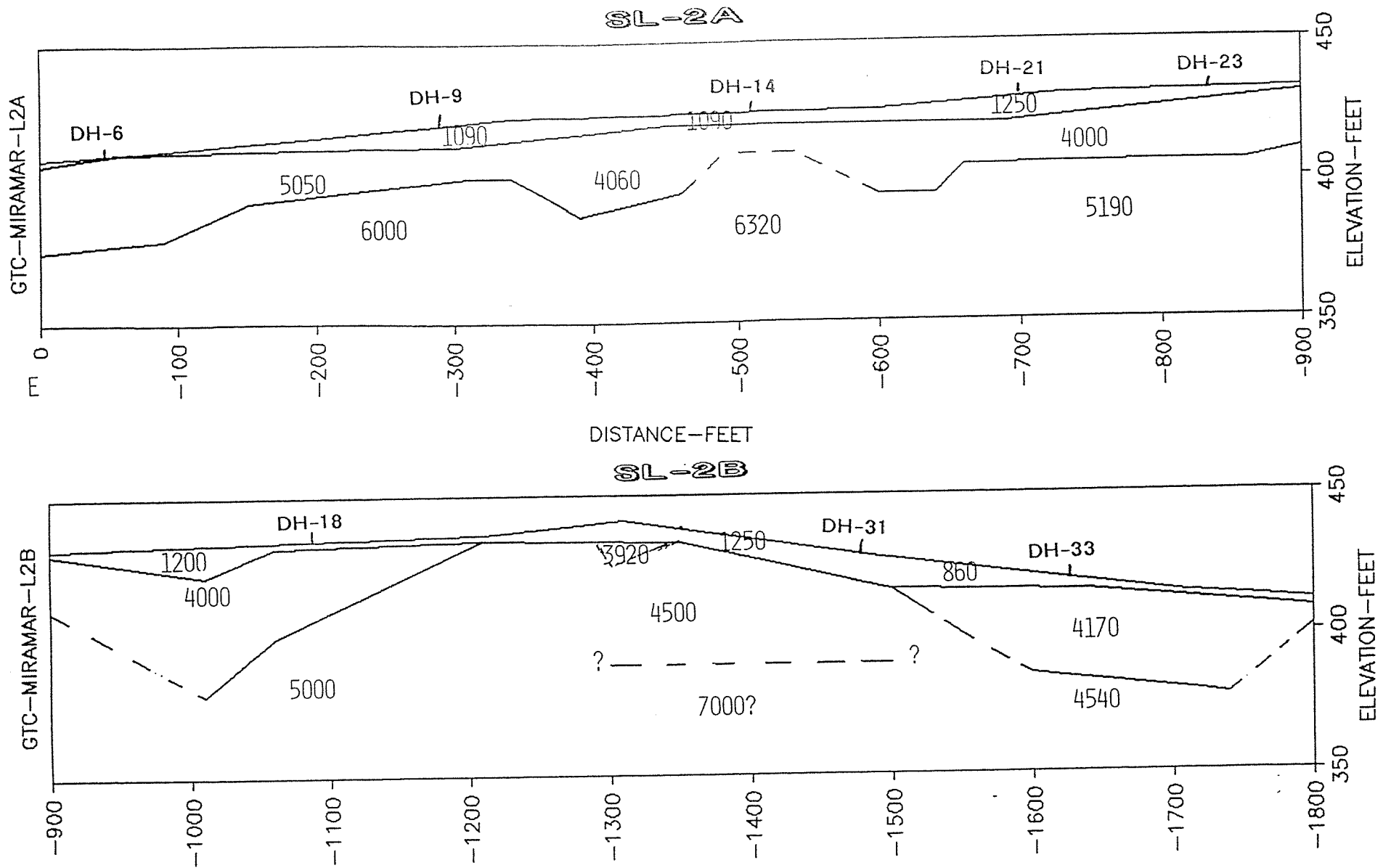


FIGURE 2

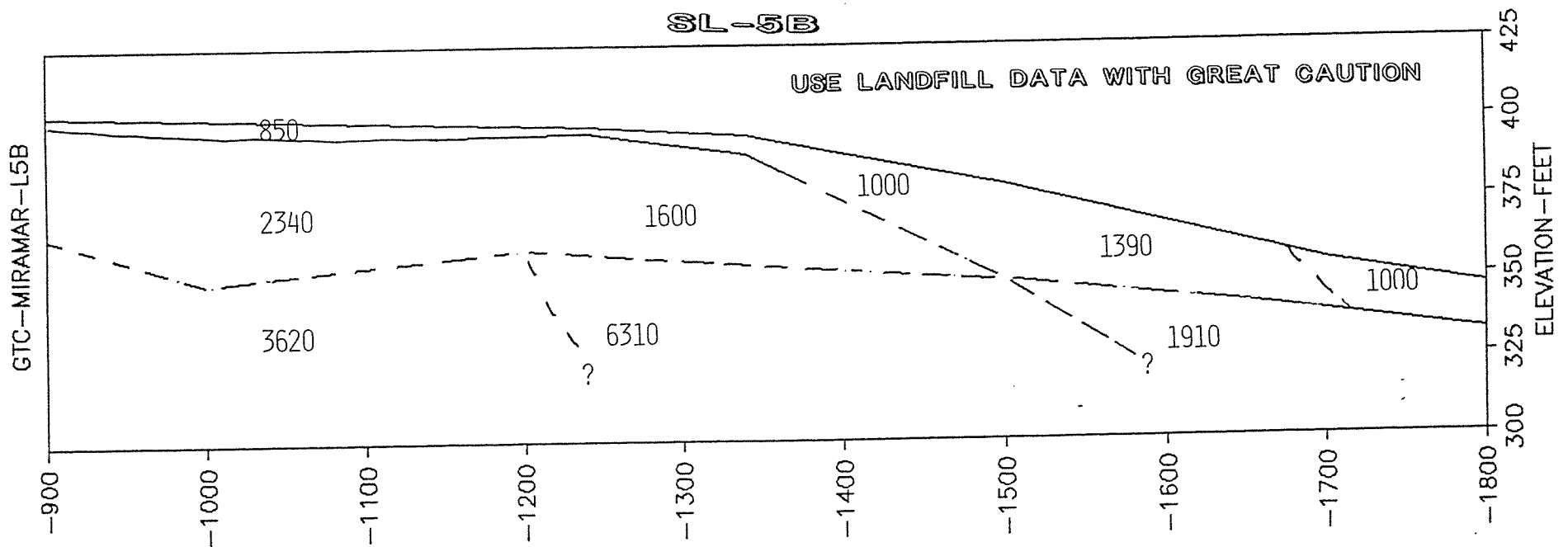
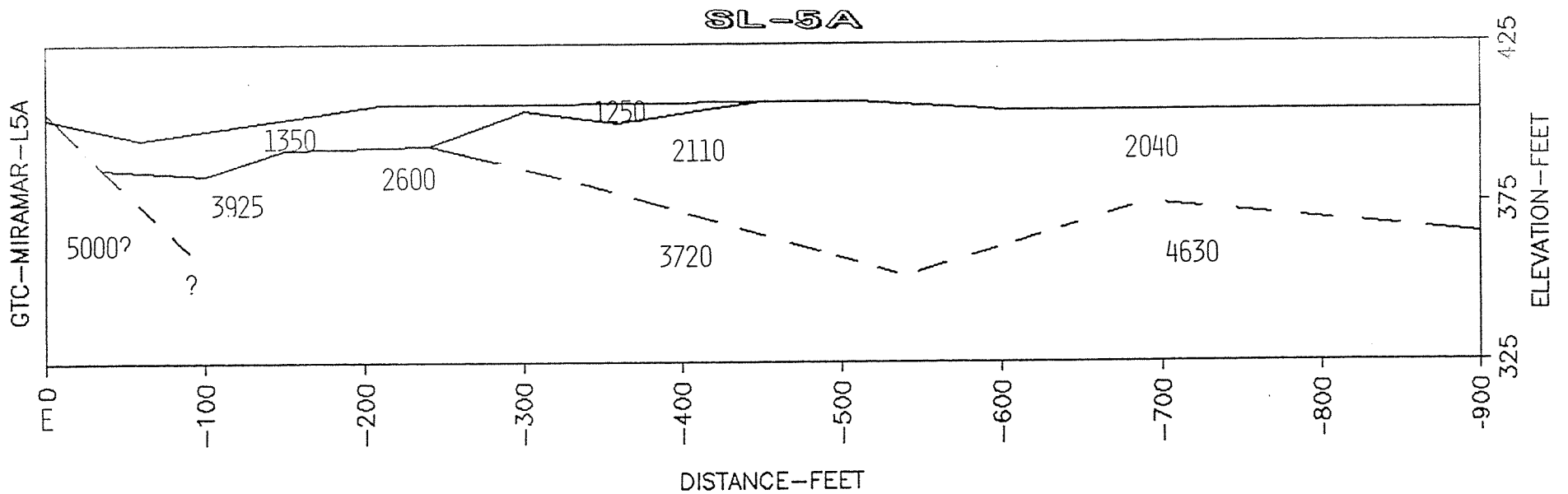


FIGURE 3

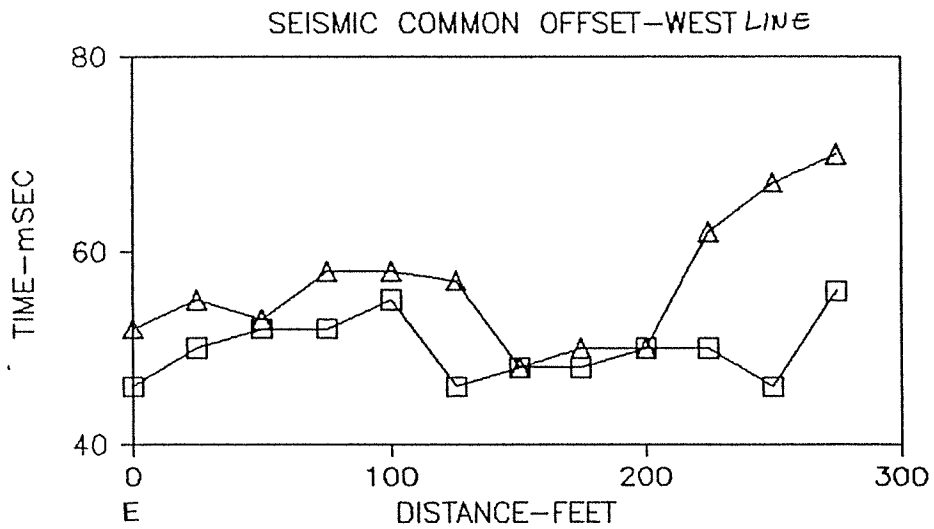
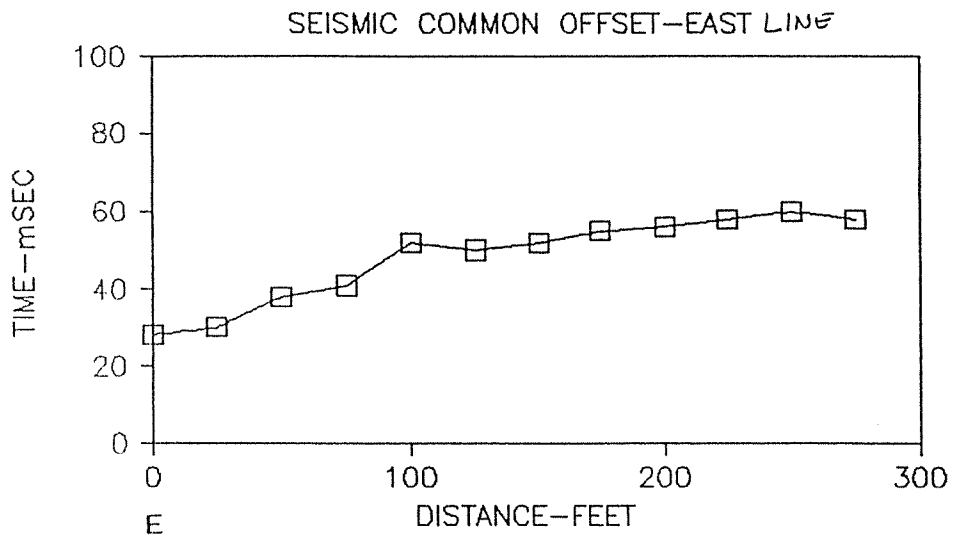


FIGURE 5

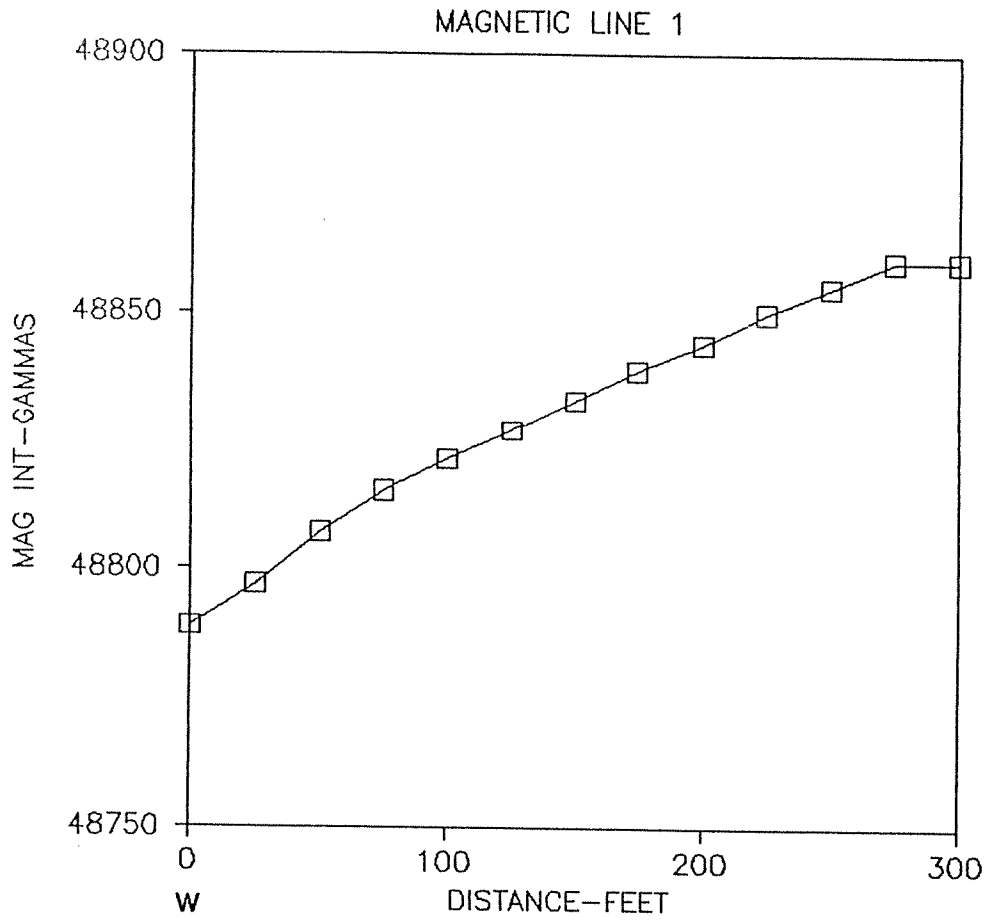


FIGURE 6

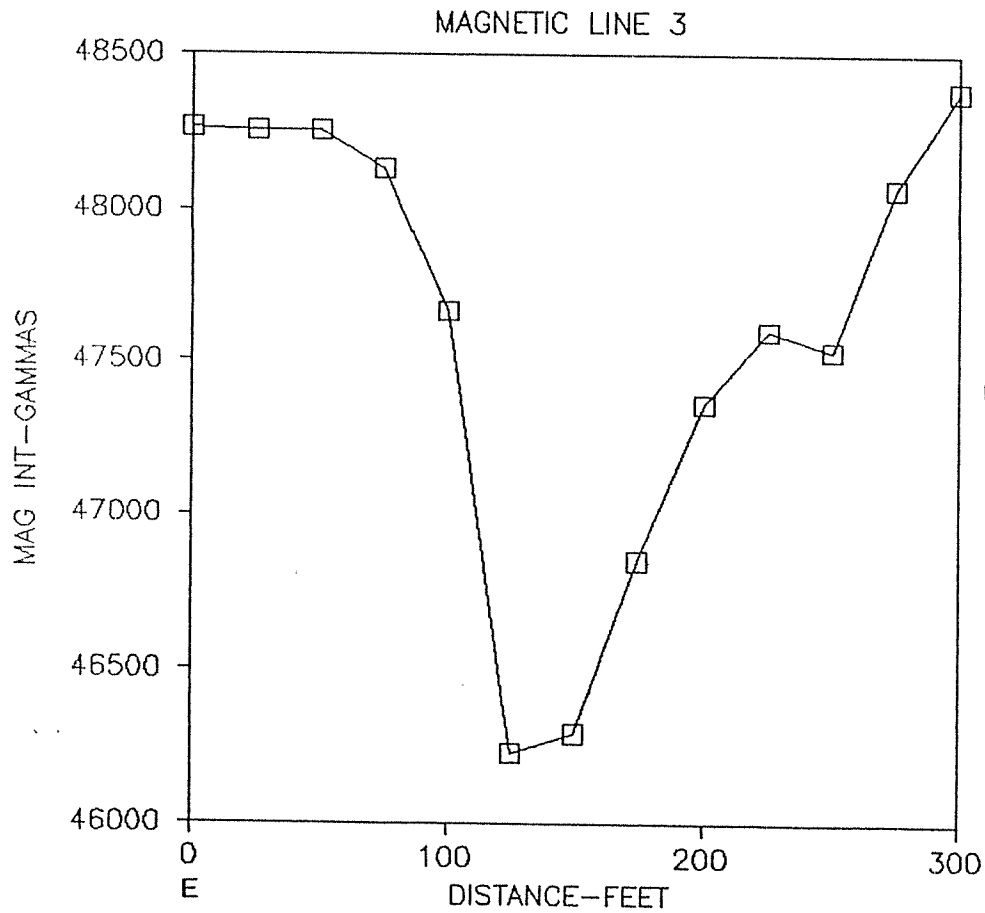
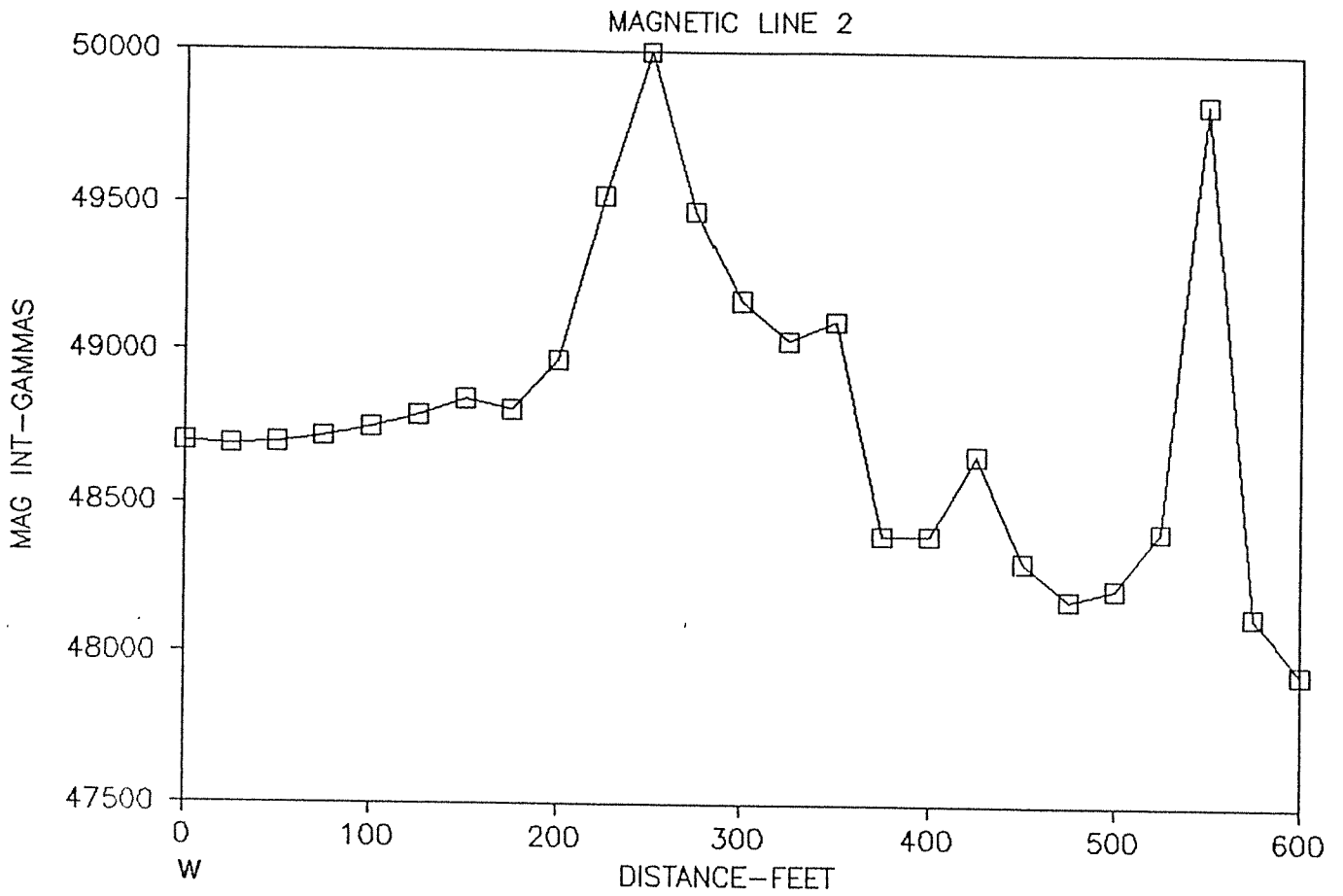


FIGURE 7

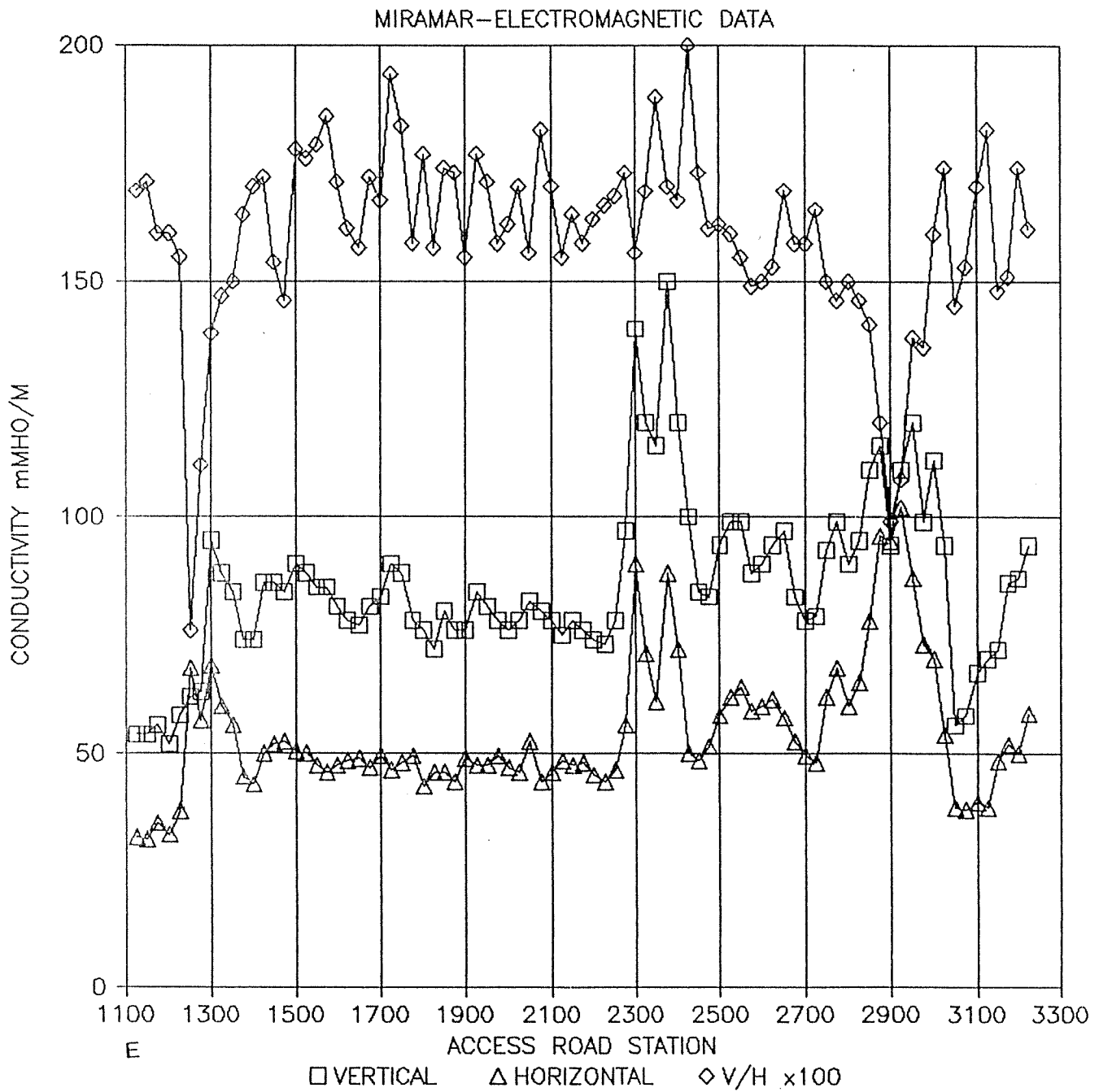
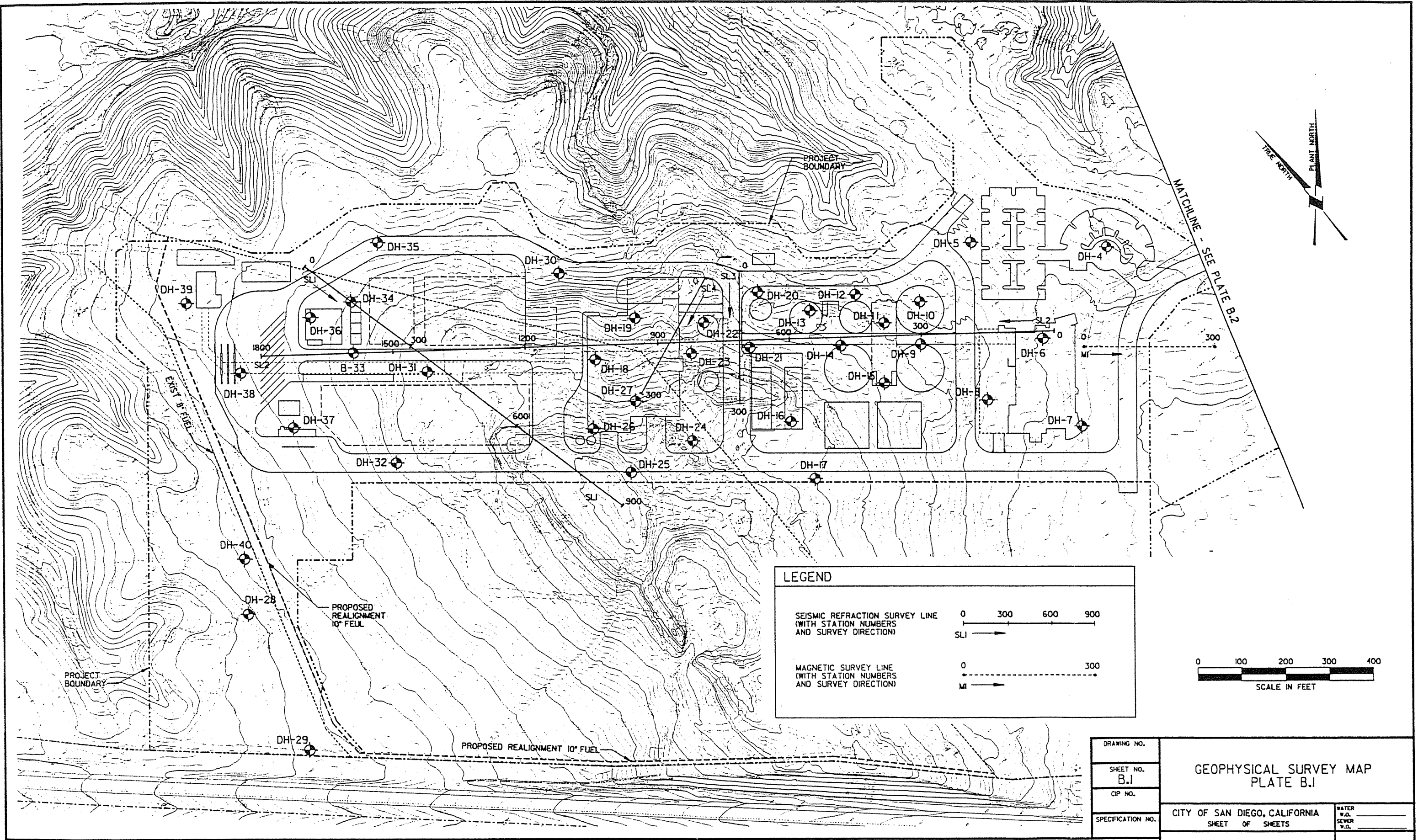


FIGURE 8

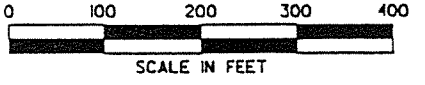
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 METCALF & EDDY CAD PLOT BY 111



LEGEND

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 SLI → 0 300 600 900

MAGNETIC SURVEY LINE (WITH STATION NUMBERS AND SURVEY DIRECTION)
 MI → 0 300



DRAWING NO.	GEOPHYSICAL SURVEY MAP				CITY OF SAN DIEGO, CALIFORNIA		WATER
SHEET NO.	B.1				SHEET OF SHEETS		W.O.
CIP NO.							SEWER
SPECIFICATION NO.							W.O.
CIP DIRECTOR		DATE		DEPUTY DIRECTOR			
DESCRIPTION		BY	APPROVED	DATE	FILED	DESIGN ENGINEER	
						CONTROL CERTIFICATION	
						LAMBERT COORDINATES	
CONTRACTOR		DATE STARTED		DATE COMPLETED		27319-0	

WARNING

IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

0 1/2 1

SCALE

HORIZONTAL

VERTICAL

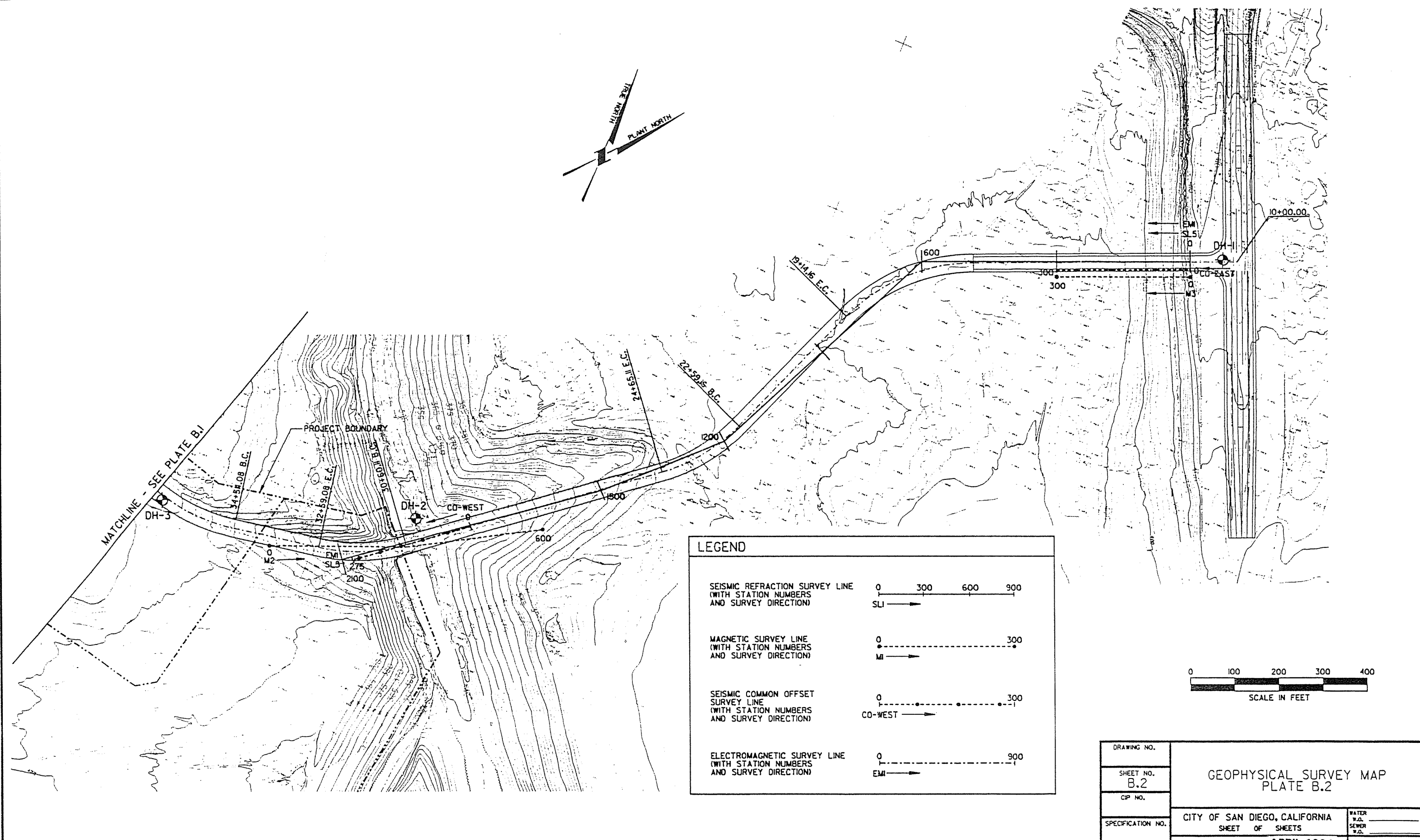
METROPOLITAN WASTEWATER DEPARTMENT
 City of San Diego



DRAWING STATUS

NO.	DATE	REQ.	REVISION DESCRIPTION	DRAWN	CKD	APD	PE	EM	DA/OC
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2	10-06-93		RELOCATED B-4, B-40						

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 METCALF & EDDY CAD PLOT BY 111



LEGEND

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 SLI → 0 300 600 900

MAGNETIC SURVEY LINE (WITH STATION NUMBERS AND SURVEY DIRECTION)
 MI → 0 300

SEISMIC COMMON OFFSET SURVEY LINE (WITH STATION NUMBERS AND SURVEY DIRECTION)
 CO-WEST → 0 300

ELECTROMAGNETIC SURVEY LINE (WITH STATION NUMBERS AND SURVEY DIRECTION)
 EMI → 0 900

DRAWING NO.	GEOPHYSICAL SURVEY MAP	
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CIP NO.	PLATE B.2	
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	SHEET OF SHEETS	SEWER W.O. _____
	APRIL 1994	
	CWP DIRECTOR	DATE
	DESCRIPTION	BY
	APPROVED	DATE
	FILED	DEPUTY DIRECTOR
		DESIGN ENGINEER
		CONTROL CERTIFICATION
		LAMBERT COORDINATES
CONTRACTOR	DATE STARTED	27319-
INSPECTOR	DATE COMPLETED	-0

WARNING

0 1/2 1

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SCALE

HORIZONTAL

VERTICAL

METROPOLITAN WASTEWATER DEPARTMENT
 City of San Diego



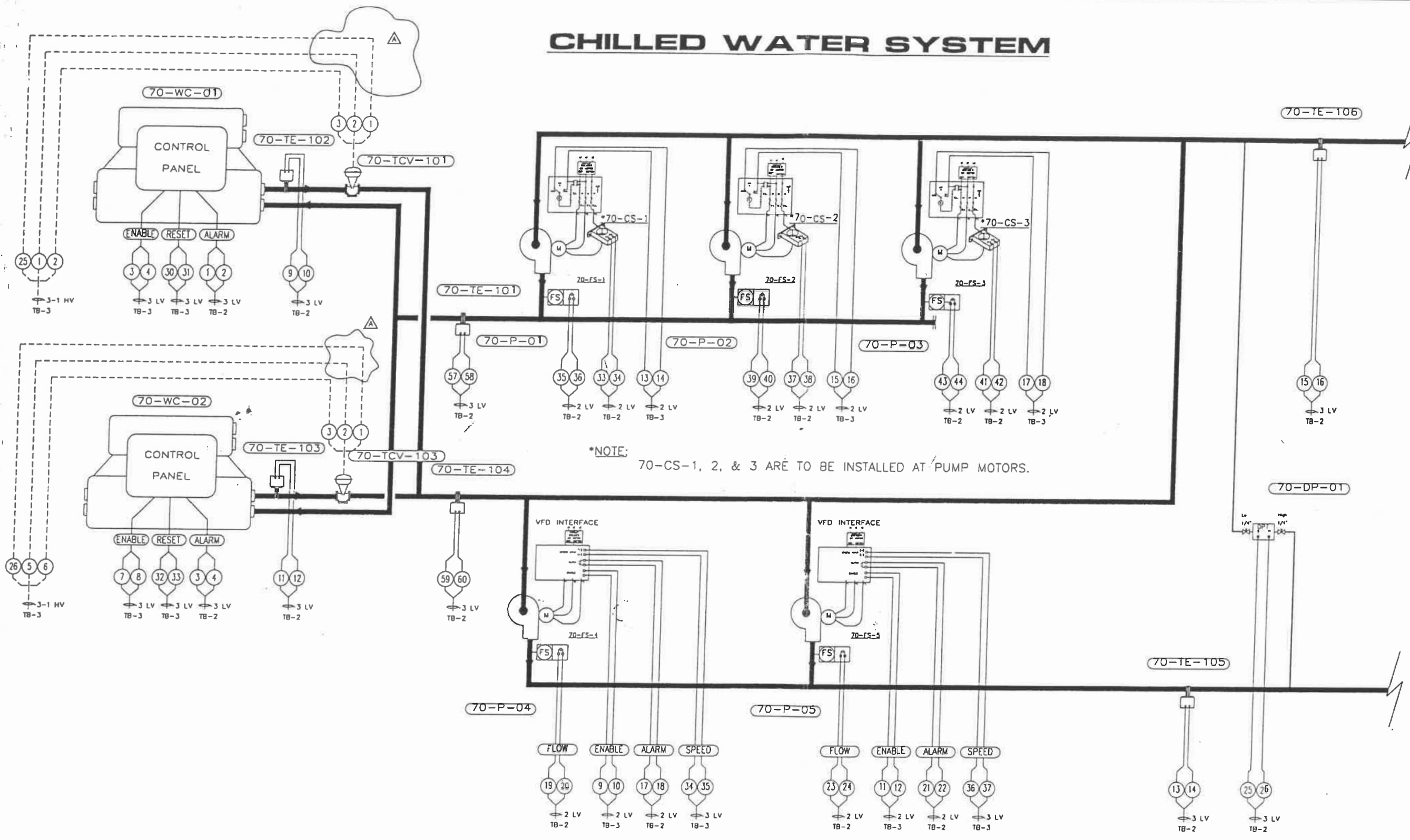
DRAWING STATUS

NO.	DATE	REQ.	REVISION	DESCRIPTION	DRAWN	CKD	APD	PE	EM	DA/OC

APPENDIX H

DRAWINGS L&S15 and L&S16

CHILLED WATER SYSTEM

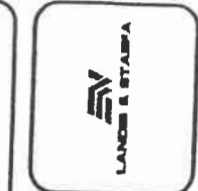


*NOTE: 70-CS-1, 2, & 3 ARE TO BE INSTALLED AT PUMP MOTORS.

WIRING TABLE	
	INDICATES PANEL TERMINAL STRIP TERMINATION
---	LINE VOLTAGE WIRING
	WIRING FROM FIELD DEVICES TO CONTROL PANEL
LV	INDICATES LOW VOLTAGE WIRING

MINIMUM WIRING REQUIREMENTS	
	1 = 14 AWG THIN
	2 = 16 AWG THIN
	3 = 18 AWG 2 WIRE SHIELDED/TWISTED CABLE
	4 = 18 AWG 4 WIRE SHIELDED/TWISTED CABLE
	5 = 18 AWG 6 WIRE SHIELDED/TWISTED CABLE
	6 =
DO NOT RUN LINE VOLTAGE WIRING IN THE SAME CONDUIT WITH LOW VOLTAGE WIRING.	

BILL OF MATERIAL				
TAG #	PART #	DESCRIPTION	MFG	QTY.
70-DP-01	PT-500	PRESSURE TRANSDUCER	TRIAD	1
70-TE-101/106	TE211Z-A-2-B-1-E-4	TEMPERATURE SENSOR	MAMAC	6
70-CS-1/3	225	CURRENT SWITCH	NK	3
70-FS-1/5	FS4-3	FLOW SWITCH	ITT	5
CR-1/2	G4B1121	CONTROL RELAY	OMRON	2
70-TCV 101,103	B1061352	ISOLATION VALVE	CENTERLINE	2



MARK	REVISD	BY	DESCRIPTION
	12/31/96	Wm.B	RESUBMITAL
	3/24/97	J.F.	RESUBMITAL
	4/28/97	J.F.	VALVE POWER

Landis & Staefa, Inc.
9835 Carroll Center Rd., #100
San Diego, CA 92126
619.693-8711

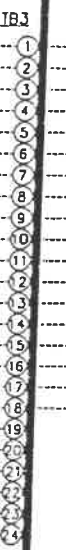
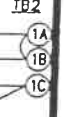
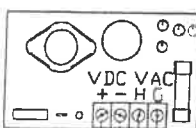
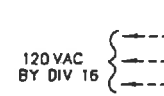
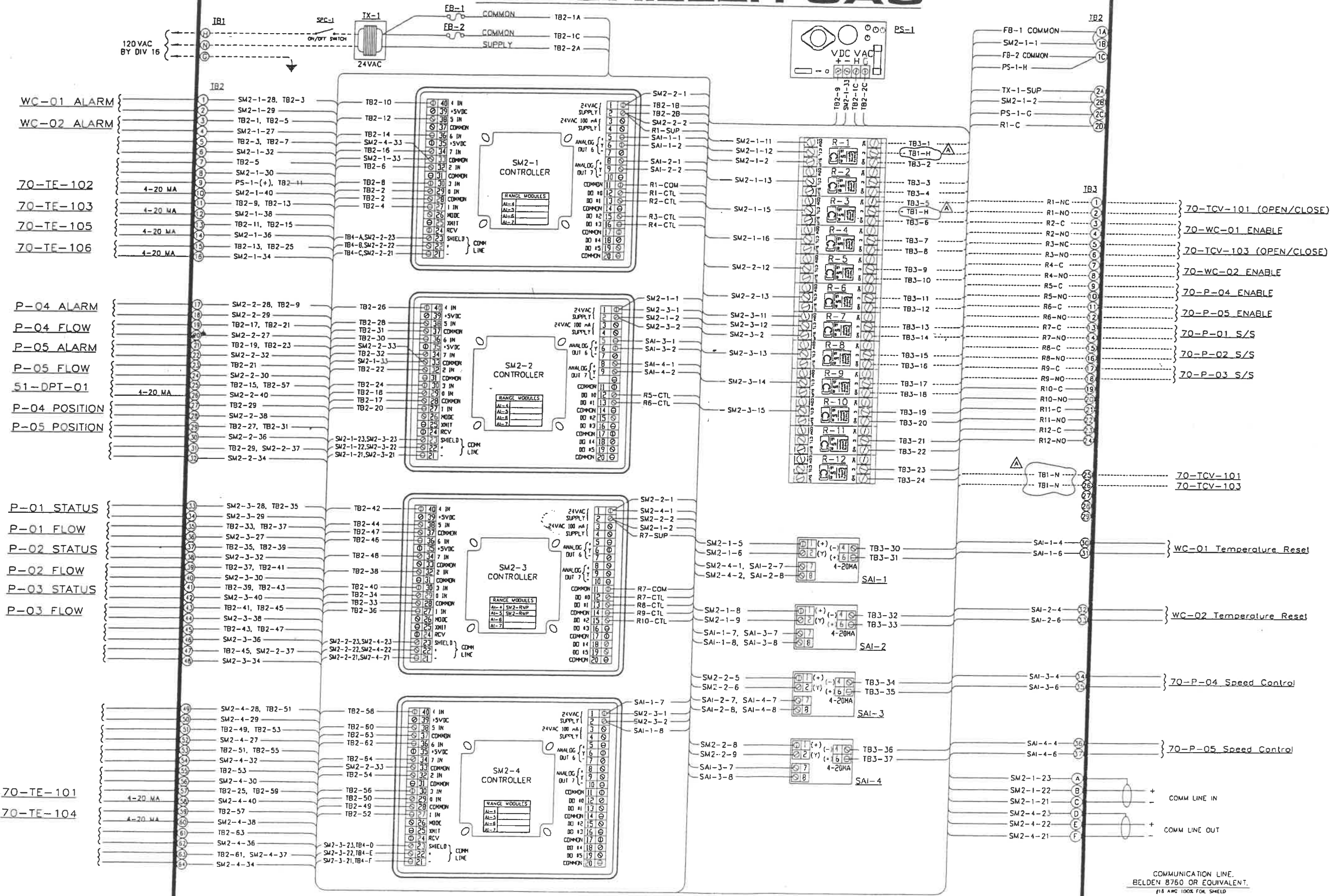


SHEET TITLE: 70/94 COVER & TITLE SHEET
PROJECT TITLE: NORTHERN SLUDGE PROCESSING FACILITY ENERGY BUILDING WASTEWATER PUMP STATION

BUILDING: 70-ENERGY
ENGINEER: T. DALL
DRAWN BY: D. DZIKONSKI
DATE: 06/16/96
SCALE: N.T.S.
L&S PROJECT NUMBER: 611-H-8225
ACAD FILENAME: ENERGY_15.DWG

70-CHILLER CAC

PANEL



- WC-01 ALARM
- WC-02 ALARM
- 70-TE-102
- 70-TE-103
- 70-TE-105
- 70-TE-106
- P-04 ALARM
- P-04 FLOW
- P-05 ALARM
- P-05 FLOW
- 51-DPT-01
- P-04 POSITION
- P-05 POSITION
- P-01 STATUS
- P-01 FLOW
- P-02 STATUS
- P-02 FLOW
- P-03 STATUS
- P-03 FLOW
- 70-TE-101
- 70-TE-104

- 70-TCV-101 (OPEN/CLOSE)
- 70-WC-01 ENABLE
- 70-TCV-103 (OPEN/CLOSE)
- 70-WC-02 ENABLE
- 70-P-04 ENABLE
- 70-P-05 ENABLE
- 70-P-01 S/S
- 70-P-02 S/S
- 70-P-03 S/S
- 70-TCV-101
- 70-TCV-103

- WC-01 Temperature Reset
- WC-02 Temperature Reset
- 70-P-04 Speed Control
- 70-P-05 Speed Control

COMMUNICATION LINE.
BELDEN 8750 OR EQUIVALENT.
#18 AWG 100K OHM SHIELD



MARK	REVISED	BY	DESCRIPTION
	12/31/96	Wm.B	RESUBMITAL
	3/24/97	J.F.	RESUBMITAL
	4/28/97	J.F.	VALVE POWER

Landis & Staefa, Inc.
9835 Carroll Center Rd., #100
San Diego, CA 92126
619.693-8711



SHEET TITLE:
70-CHILLER CAC PANEL DIAGRAM
PROJECT TITLE:
NORTHERN SLUDGE PROCESSING FACILITY
ENERGY BUILDING
WASTEWATER PUMP STATION

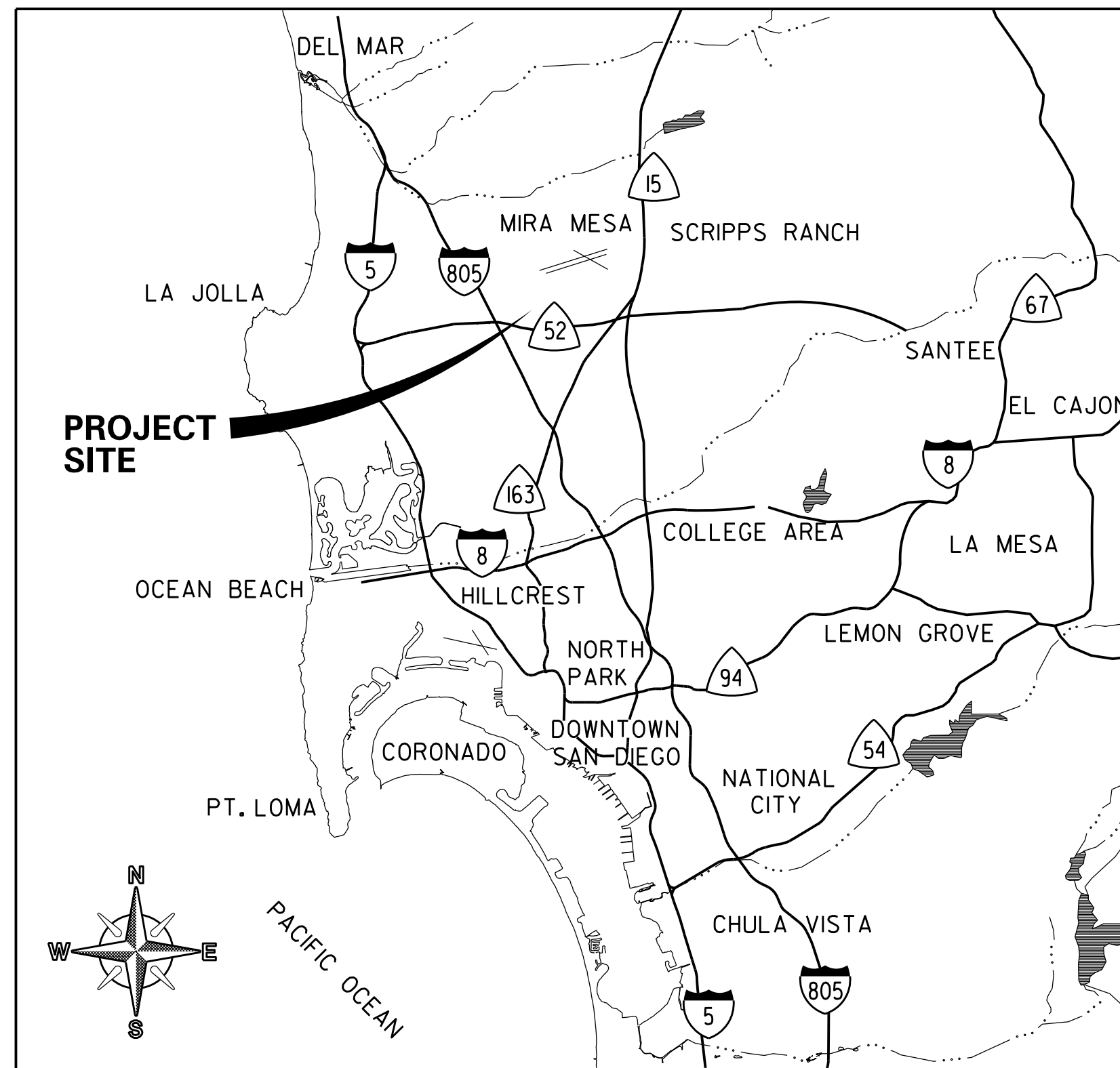
BUILDING
70-ENERGY
ENGINEER
T. BALL
DRAWN BY
D. DZIKONSKI
DATE
08/11/96
SCALE
N.T.S.
L&S PROJECT NUMBER
611-H-6226
ACAD FILENAME
ENERGY_16.DWG

CONTRACT DRAWINGS FOR City of San Diego

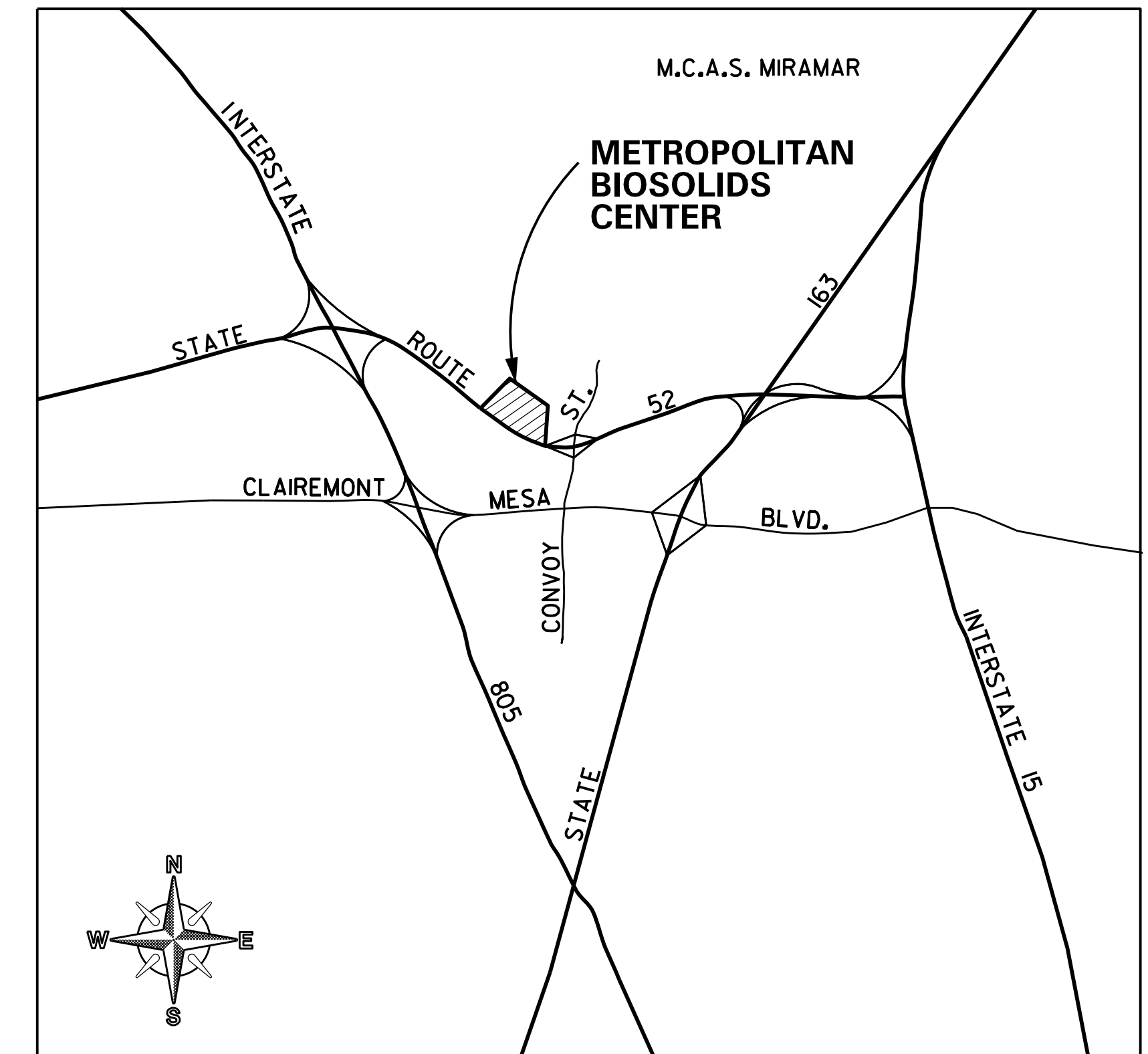
METROPOLITAN BIOSOLIDS CENTER

COOLING WATER SYSTEM CHILLER UPGRADE

DECEMBER 2018



VICINITY MAP
NOT TO SCALE



LOCATION MAP
NOT TO SCALE

DECLARATION OF RESPONSIBLE CHARGE

* I HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS PROJECT THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THE PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE AND THAT THE DESIGN IS CONSISTENT WITH CURRENT STANDARDS. I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE CITY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.

Richard H. Kennedy
RICHARD H. KENNEDY 12-13-18
DATE

T-1

PLANS FOR THE CONSTRUCTION OF
METROPOLITAN BIOSOLIDS CENTER
COOLING WATER SYSTEM CHILLER UPGRADE
TITLE SHEET

CONSTRUCTION CHANGE / ADDENDUM			
CHANGE	DATE	AFFECTED OR ADDED SHEET NUMBERS	APPROVAL NO.
C	3/01/2019	14, 21, 43, 44, 53, 55, 63	

WARNING
0 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

The City of
SAN DIEGO Public Works

CONSULTANT

14271 Danielson Street
Poway, California 92064
T 858.413.2400 F 858.413.2440
www.iecorporation.com

SPEC. NO. 1802

CONTRACTOR
INSPECTOR

CITY OF SAN DIEGO, CALIFORNIA
PUBLIC WORKS DEPARTMENT
SHEET 1 OF 70 SHEETS

APPROVED: *Brian Vitelle*
FOR CITY ENGINEER
BRIAN VITELLE
PRINT DCG NAME
RCE# C73039
DATE 12/13/2018

WBS B-16165

SUBMITTED BY: IDALMIRO DA ROSA
PROJECT MANAGER

CHECKED BY: JORGE LARRIVA
PROJECT ENGINEER

DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	REC			

246-1719
CCS27 COORDINATE

1886444-6280407
CCS83 COORDINATE

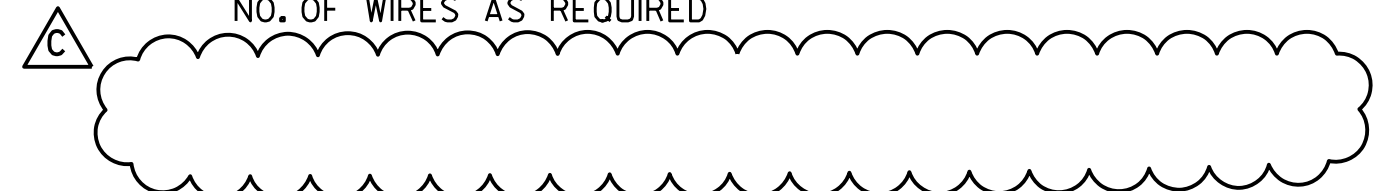
40054-01-D

DATE STARTED
DATE COMPLETED

MBC COOLING WATER SYSTEM CHILLER UPGRADE

GENERAL NOTES

1. ALL CONDUIT AND EQUIPMENT SHALL BE INSTALLED AND GROUNDED IN ACCORDANCE WITH THE LATEST EDITION OF THE NATIONAL ELECTRICAL CODE AND APPLICABLE LOCAL CODES. GROUND WATER PIPES, IN EACH FACILITY OR BUILDING WITH GROUND CLAMPS THAT ARE CONNECTED TO THE GROUNDING SYSTEM IN EACH FACILITY OR EACH BUILDING. BONDING JUMPERS, CONDUIT CLAMPS AND POINTS OF ATTACHMENT ARE NOT SHOWN ON DRAWINGS. SIZE BONDING JUMPERS IN ACCORDANCE WITH TABLE 250-94 OF THE NATIONAL ELECTRICAL CODE. THE POINTS OF ATTACHMENT OF THE GROUND CLAMPS SHALL BE IN ACCESSIBLE LOCATIONS.
2. CONDUIT INSTALLATIONS ARE SHOWN DIAGRAMMATICALLY ONLY AND SHALL BE INSTALLED IN A MANNER TO PREVENT CONFLICTS WITH EQUIPMENT AND STRUCTURAL CONDITIONS. EXPOSED CONDUITS SHALL BE INSTALLED PARALLEL TO BEAMS AND WALLS. COORDINATE EXACT LOCATIONS WITH OTHER TRADES.
3. CONDUITS SHALL BE TERMINATED SO AS TO PERMIT NEAT CONNECTIONS TO MOTORS AND OTHER EQUIPMENT
4. NO CONDUIT SMALLER THAN 3/4" PIPE SIZE NOR WIRE SMALLER THAN NO. 12 A.W.G. SHALL BE USED UNLESS OTHERWISE NOTED.
5. THE WIRING DIAGRAMS, QUANTITY AND SIZE OF WIRES AND CONDUIT REPRESENT A SUGGESTED ARRANGEMENT BASED UPON SELECTED STANDARD COMPONENTS OF ELECTRICAL EQUIPMENT. MODIFICATIONS ACCEPTABLE TO THE ENGINEER MAY BE MADE BY THE CONTRACTOR TO ACCOMMODATE EQUIPMENT ACTUALLY PURCHASED. THE BASIC SEQUENCE AND METHOD OF CONTROL MUST BE MAINTAINED AS INDICATED ON THE DRAWINGS AND/OR SPECIFICATIONS.
6. SWITCHES SHALL BE MOUNTED 4'-6" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED. RECEPTACLES SHALL BE MOUNTED 4'-0" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED, EXCEPT RECEPTACLES IN OFFICES OR AREAS WITH SUSPENDED CEILINGS SHALL BE MOUNTED 1'-6" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED.
7. ALL SURFACE MOUNTED PANELS AND PANELBOARDS ON THE INSIDE OF THE EXTERIOR WALLS SHALL BE MOUNTED SO AS TO MAINTAIN A 1/4" AIR SPACE BETWEEN THE ENCLOSURE AND THE WALL.
8. FOR EXPLANATION OF INSTRUMENTATION SYMBOLS SHOWN ON ELECTRICAL DRAWINGS, SEE INSTRUMENTATION LEGEND.
9. CONDUIT AND WIRE (NOT SHOWN) FOR THE HVAC CONTROL EQUIPMENT AND MISCELLANEOUS DEVICES SHALL BE FURNISHED AND INSTALLED UNDER DIVISION II AND 15 OF SPECIFICATIONS AND SHALL BE:
 - A. 3/4" (MIN.) RIGID GALVANIZED STEEL CONDUIT
 - B. NO. 14 CU. WIRE SEE SPECS.
 NO. OF WIRES AS REQUIRED
11. ALL CONDUIT RUNS AND CABLE TRAYS CROSSING EXPANSION JOINTS SHALL HAVE EXPANSION OR EXPANSION AND DEFLECTION TYPE FITTINGS AS REQUIRED. FOR EXACT LOCATIONS OF EXPANSION JOINTS SEE STRUCTURAL DRAWINGS.
12. ALL MOTOR STARTER CONTROL TRANSFORMERS SHALL BE SIZED TO PROVIDE SUFFICIENT VOLT-AMPERE CAPACITY FOR OPERATING ALL ELECTRICAL DEVICES ASSOCIATED WITH CONTROL OF THE MOTOR; IN ADDITION TO THE STARTER COIL, IT SHALL INCLUDE RELAYS, TIMERS, MOTOR HEATERS, INDICATING LIGHTS, ETC.
13. DUCTLINE CONDUIT SIZES ARE GIVEN IN THE DUCTLINE SECTIONS. WHERE THE SAME CONDUIT NUMBER IS USED BOTH IN THE DUCTLINE AND IN A BUILDING, THE CONDUIT SIZE GIVEN IN THE CONDUIT SCHEDULE APPLIES TO THE CONDUIT IN THE BUILDING ONLY.
14. LIQUID-TIGHT FLEXIBLE METAL CONDUIT SHALL BE USED FOR FINAL CONNECTIONS TO ALL EQUIPMENT SUBJECT TO VIBRATION INCLUDING MOTORS, TRANSFORMERS, INSTRUMENTS AND VALVES.
15. FOR ROOF PENETRATIONS DETAIL SEE ARCHITECTURAL DRAWINGS.
16. CONDUITS IN DUCT BANKS OR EMBEDDED FOR FIRE ALARM, DATA HIGHWAY, (PCM) SIGNAL AND MOTOR FEEDERS FROM ADJUSTABLE SPEED DRIVES SHALL BE PVC COATED RIGID STEEL CONDUIT.



MBC COOLING WATER SYSTEM CHILLER UPGRADE

R-73A

PLANS FOR THE CONSTRUCTION OF
METROPOLITAN BIOSOLIDS CENTER
COOLING WATER SYSTEM CHILLER UPGRADE

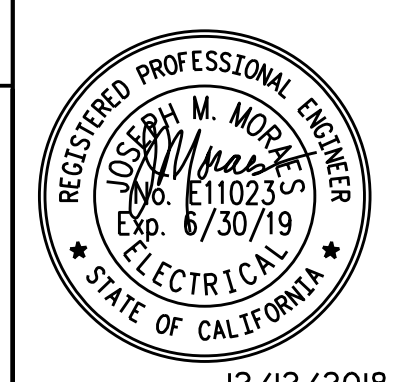
GENERAL
ELECTRICAL NOTES

CITY OF SAN DIEGO, CALIFORNIA PUBLIC WORKS DEPARTMENT SHEET 14 OF 70 SHEETS		WBS B-16165
APPROVED: <i>Brian Vitelle</i> FOR CITY ENGINEER BRIAN VITELLE PRINT DCE NAME	DATE 12/13/2018 C73039 RCE#	SUBMITTED BY IDALMIRO DA ROSA PROJECT MANAGER
DESCRIPTION	BY	APPROVED
ORIGINAL	MPA	
ADDENDUM C	MPA	<i>Brian Vitelle</i>
		DATE
		3/4/19
		FILMED
		246-1719 CCS27 COORDINATE
		1886444-6280407 CCS83 COORDINATE
CONTRACTOR	INSPECTOR	DATE STARTED
		DATE COMPLETED
		40054-14 -D

CONSULTANT

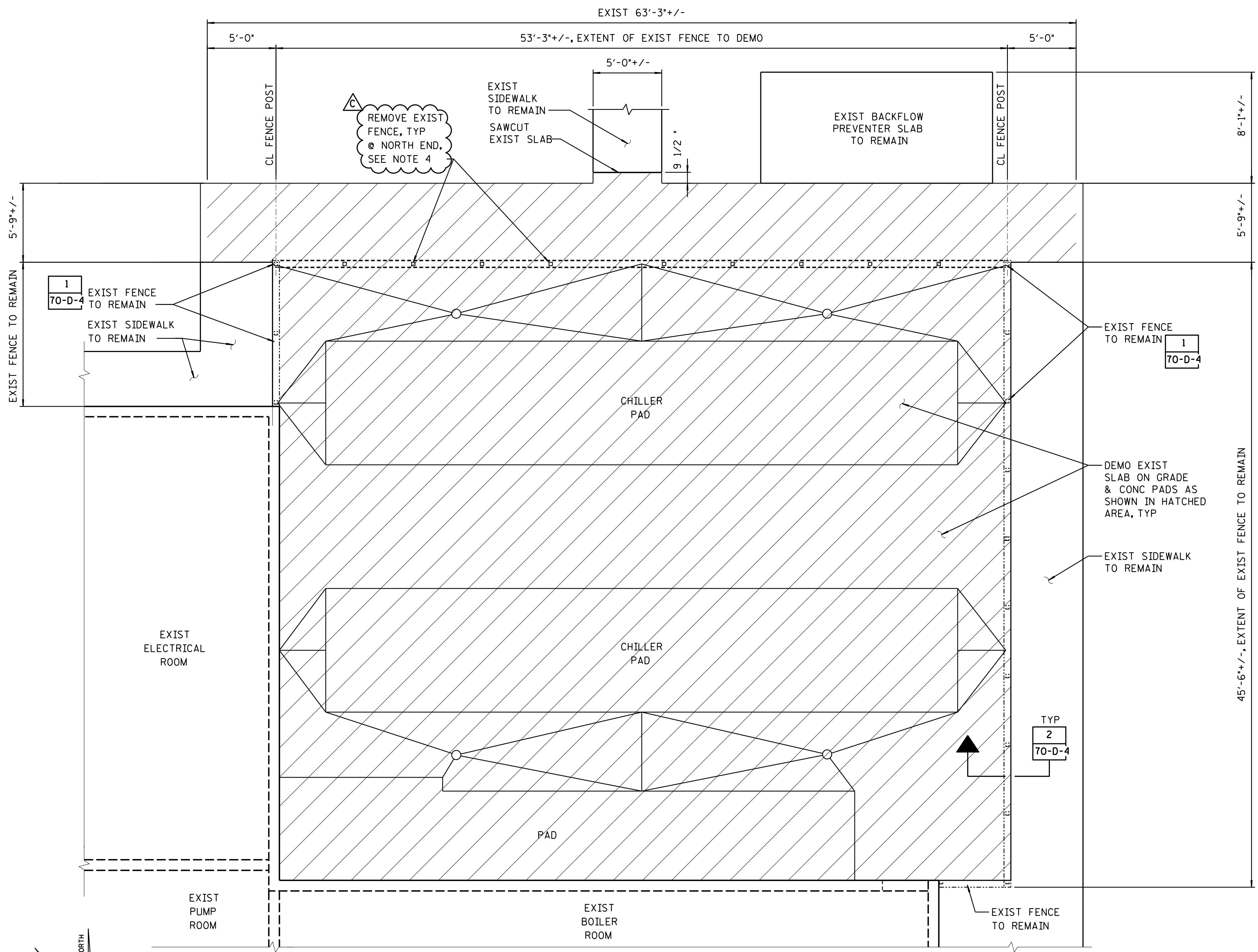
MPA

MORAES / PHAM & ASSOCIATES
2131 Palomar Airport Rd. #120
Carlsbad, CA 92011



REMOVE NOTE 10

ADDENDUM C



- NOTES:**
- SEE DRAWING R-31A FOR STRUCTURAL ABBREVIATIONS.
 - SEE DRAWING R-32A FOR STRUCTURAL GENERAL NOTES.
 - CONTRACTOR SHALL VERIFY ALL EXISTING DIMENSIONS AND CONDITIONS PRIOR TO STARTING WORK.
 - REMOVED PORTIONS OF THE FENCE ARE TO BE SALVAGED AND STORED ON THE PLANT SITE PER DIRECTION FROM THE CITY.

70-D-3

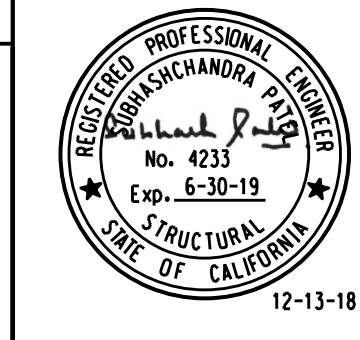
**PLANS FOR THE CONSTRUCTION OF
METROPOLITAN BIOSOLIDS CENTER
COOLING WATER SYSTEM CHILLER UPGRADE
DEMOLITION**

STRUCTURAL CHILLER AREA PLAN

CITY OF SAN DIEGO, CALIFORNIA PUBLIC WORKS DEPARTMENT SHEET 21 OF 70 SHEETS		WBS <u>B-16165</u>
APPROVED: <i>[Signature]</i> FOR CITY ENGINEER BRIAN VITELLE PRINT DOC NAME	DATE <u>12/13/2018</u> PROJECT MANAGER IDALMIRO DA ROSA	RCE# <u>C73039</u> PROJECT ENGINEER JORGE LARRIVA
DESCRIPTION	BY	APPROVED
ORIGINAL	B&P	DATE
ADDENDUM C	B&P <i>[Signature]</i>	FILMED
		DATE COMPLETED
		DATE STARTED
		DATE COMPLETED

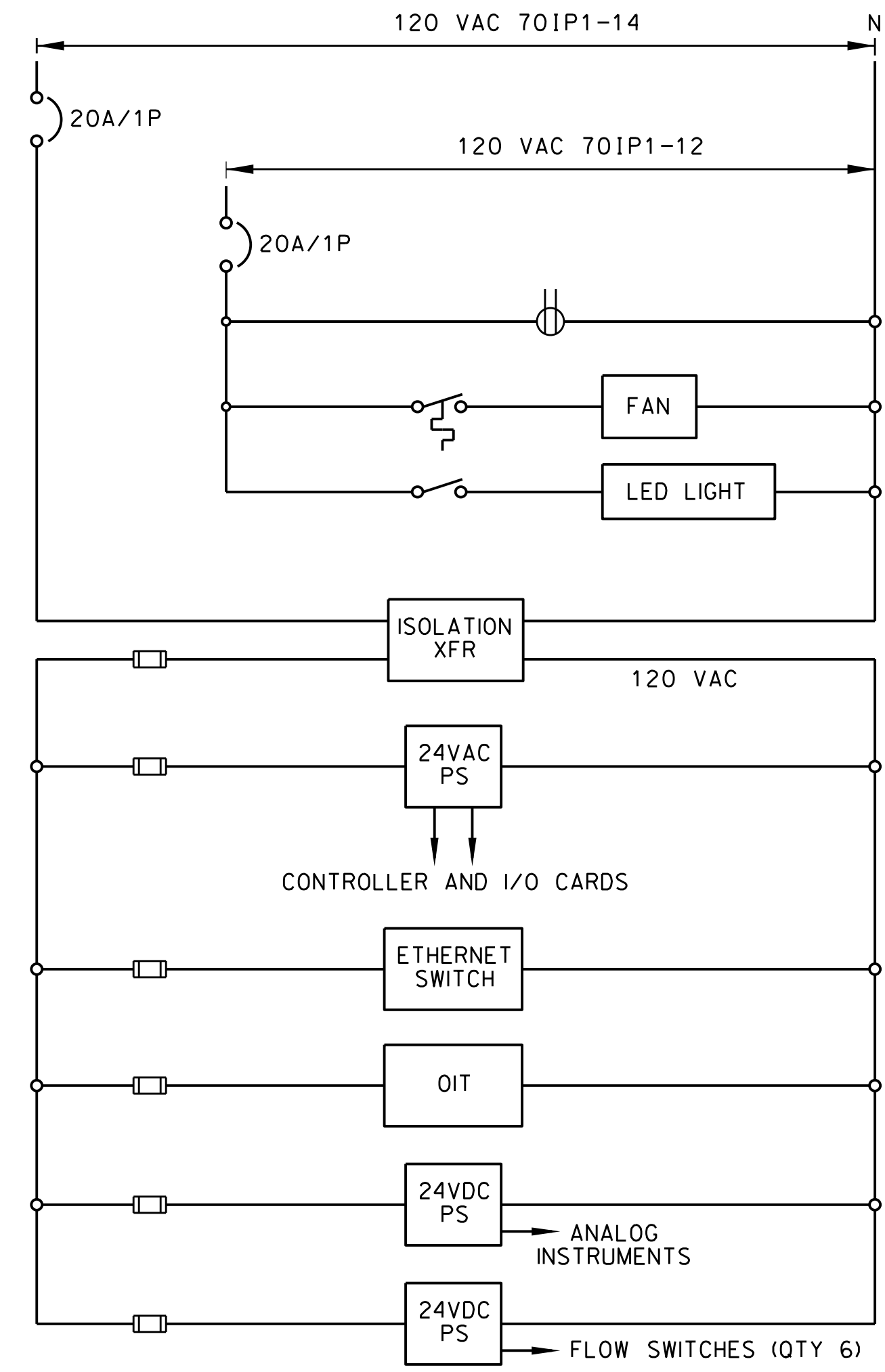
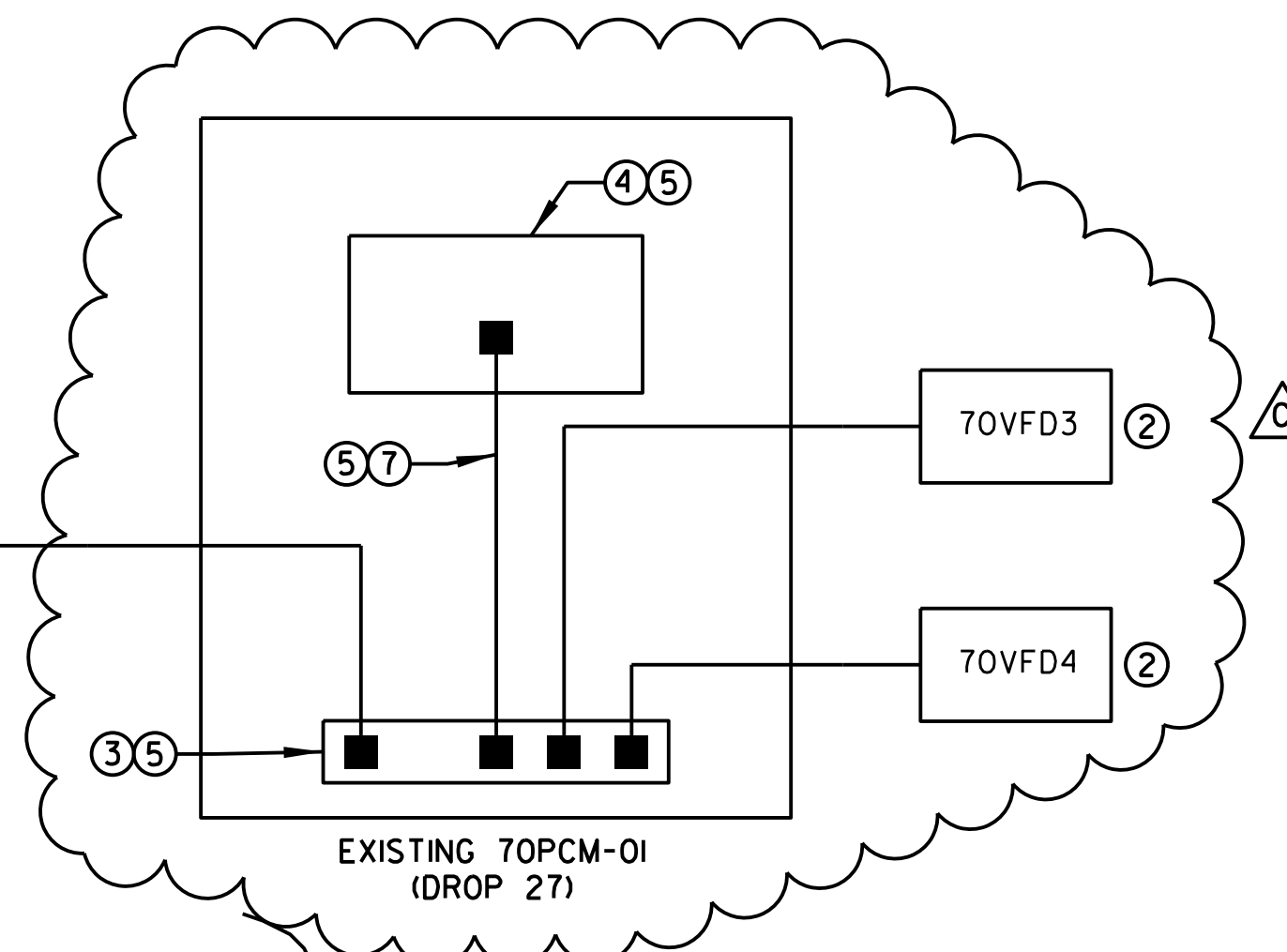
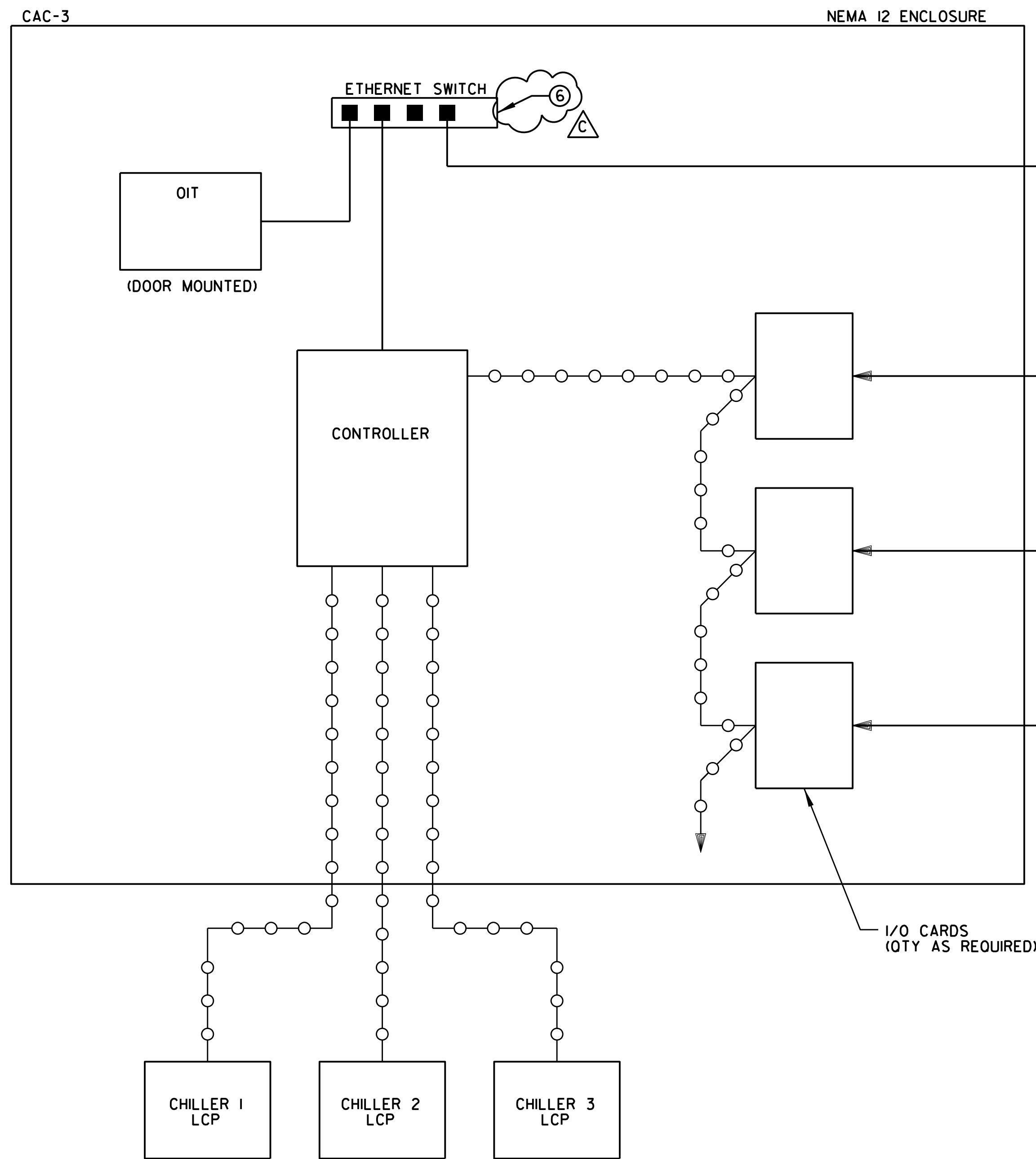
CONSULTANT

Beyaz & Patel Inc.
10920 VIA FRONTERA, STE 210
SAN DIEGO, CALIFORNIA 92127
(858) 451-0374
www.beyazpatel.com

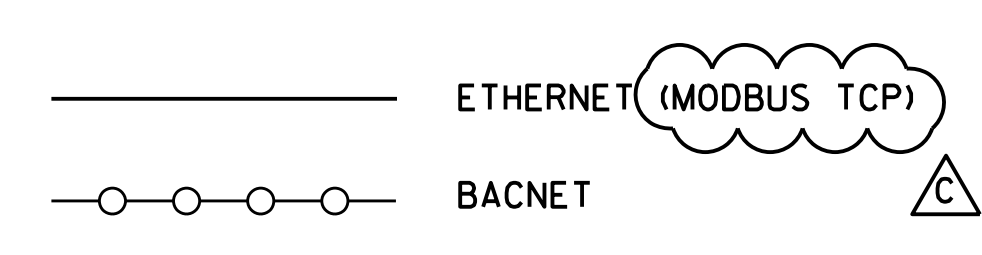


ADD NOTE 4

ADDENDUM C



CAC-3 POWER DIAGRAM
NTS



CAC-3 (CHILLED WATER SYSTEM CUSTOM APPLICATION CONTROLLER) COMMUNICATION BLOCK DIAGRAM
NTS

- NOTES:**
- ① ALL ETHERNET COMMUNICATIONS SHALL BE MODBUS TCP.
 - ② VFD TO 70PCM-O1 COMMUNICATIONS LINKS FOR POWER MONITOR ONLY (NO CONTROL).
 - ③ FIELD LAN ROUTER. PROVIDE CISCO 2901 WITH EHWIC 8 PORT MODULE, OR APPROVED EQUAL.
 - ④ OVATION ETHERNET LINK CONTROLLER (ELC) MODULE; EMOD 5X00419G02, NO EQUAL. MODBUS MASTER LICENSES FOR ELC, PROTOCOL ANALYZER SOFTWARE FOR ELC, AND CONFIGURATOR SOFTWARE LICENSE FOR ELC.
 - ⑤ HARDWARE AND SOFTWARE LICENSES TO BE PROVIDED BY CONTRACTOR AND INSTALLED BY CITY.
 - ⑥ CAC-3 ETHERNET SWITCH IN IT'S OWN SUBNET. CAC-3 IP ADDRESS WILL BE DEFINED BY COMNET (CITY).
 - ⑦ PROVIDE CAT6 CABLE WITH 90 DEGREE (RIGHT ANGLE) CONNECTOR ON ONE END ONLY.

70-H-306E

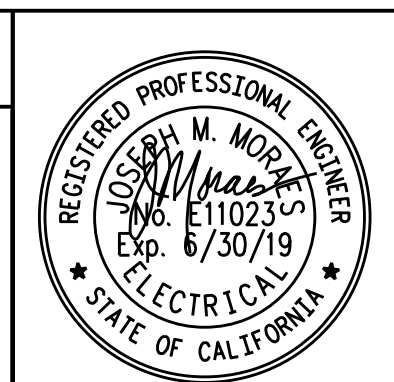
PLANS FOR THE CONSTRUCTION OF METROPOLITAN BIOSOLIDS CENTER COOLING WATER SYSTEM CHILLER UPGRADE

CAC-3 COMMUNICATION DIAGRAMS

CONSULTANT

M/A

MORAES / PHAM & ASSOCIATES
2131 Palomar Airport Rd. #120
Carlsbad, CA 92011



12/12/2018

CITY OF SAN DIEGO, CALIFORNIA PUBLIC WORKS DEPARTMENT SHEET 43 OF 70 SHEETS		WBS B-16165		
APPROVED: <i>Brian Vitelle</i> FOR CITY ENGINEER BRIAN VITELLE PRINT DCE NAME	DATE: 12/13/2018 C73039 RCE#	SUBMITTED BY: IDALMIRO DA ROSA PROJECT MANAGER CHECKED BY: JORGE LARRIVA PROJECT ENGINEER		
DESCRIPTION	BY	APPROVED	DATE	FILMED
ORIGINAL	MPA			
ADDENDUM C	MPA	<i>Brian Vitelle</i>	3/4/19	
		1886444-6280407 CCS27 COORDINATE		
		40054-43-D CCS83 COORDINATE		
CONTRACTOR		DATE STARTED		
INSPECTOR		DATE COMPLETED		

PUMPS

UNIT NO.	MANUFACTURER & MODEL NO.	SERVICE	LOCATION	TYPE	G.P.M.	FT. HD.	MIN. EFF. %	N.P.S.H. (FT.)	MOTOR DATA				OPER. WT. (LBS.)	SPEC. SECTION	REMARKS
									R.P.M.	H.P.	V./PH./HZ.	TYPE			
70-P-01	BELL & GOSSETT e-15104BD	PRIMARY CW	BLDG. 70 CHILLER YARD	FRAME MOUNT END SUCTION	450/650	45/37	81	8	1750	10	460/3/60	TEFC	400	11071	
70-P-02	BELL & GOSSETT e-15104BD	PRIMARY CW	BLDG. 70 CHILLER YARD	FRAME MOUNT END SUCTION	450/650	45/37	81	8	1750	10	460/3/60	TEFC	400	11071	
70-P-03	BELL & GOSSETT e-15104BD	PRIMARY CW	BLDG. 70 CHILLER YARD	FRAME MOUNT END SUCTION	450/650	45/37	81	8	1750	10	460/3/60	TEFC	400	11071	
70-P-20	BELL & GOSSETT e-15104BD	PRIMARY CW	BLDG. 70 CHILLER YARD	FRAME MOUNT END SUCTION	450/650	45/37	81	8	1750	10	460/3/60	TEFC	400	11071	
70-P-04	BELL & GOSSETT VSC 4X6X17-1/2A	SECONDARY CW	BLDG. 70 CHILLER YARD	VERTICAL SPLIT CASE	1040	175	74	12	1780	75	460/3/60	TEFC	1100	11072	VARIABLE FREQUENCY DRIVE CONTROL
70-P-05	BELL & GOSSETT VSC 4X6X17-1/2A	SECONDARY CW	BLDG. 70 CHILLER YARD	VERTICAL SPLIT CASE	1040	175	74	12	1780	75	460/3/60	TEFC	1100	11072	VARIABLE FREQUENCY DRIVE CONTROL



AIR COOLED CHILLERS

UNIT NO.	MANUFACTURER & MODEL NO.	LOCATION	CAPACITY (TONS OF REFR.)	AMBIENT AIR TEMP. (°F.)	CHILLED WATER				ELECTRICAL				RATED COOLING EFFICIENCY (AHR/HEER)	TOTAL UNIT POWER (KW)	OPER. WT. (LBS.)	SPEC. SECTION	REMARKS
					G.P.M.	E.W.T. (°F.)	L.W.T. (°F.)	P.D. (FT.HD.)	M.C.A. 1 2	M.O.P. 1 2	TYPE OF START	VOLTAGE V. / PH. / HZ					
70-WC-01	NOTE 1	BLDG. 70 CHILLER YARD	250	95.0	450/650	57.0	42.0	7.2	455 455	600 600	FULL VOLTAGE	460/3/60	10.99	261.4	18,000	11070	
70-WC-02	NOTE 1	BLDG. 70 CHILLER YARD	250	95.0	450/650	57.0	42.0	7.2	455 455	600 600	FULL VOLTAGE	460/3/60	10.99	261.4	18,000	11070	
70-WC-03	NOTE 1	BLDG. 70 CHILLER YARD	250	95.0	450/650	57.0	42.0	7.2	455 455	600 600	FULL VOLTAGE	460/3/60	10.99	261.4	18,000	11070	

NOTE 1: THIS COLUMN TO BE COMPLETED AS PART OF AS-BUILTS BY THE CONTRACTOR

EXPANSION TANKS

UNIT NO.	MANUFACTURER & MODEL NO.	LOCATION	SERVICE	CAPACITY (GALS.)		SIZE DIAMETER x HT. (IN.)	OPER. WT. (LBS.)	SPEC. SECTION	REMARKS
				TANK	ACCEPTANCE				
70-ET-01	BELL & GOSSETT B-300	BLDG. 70 CHILLER YARD	CW	80	80	24x51	1000	11075	

AIR SEPARATORS

UNIT NO.	MANUFACTURER & MODEL NO.	LOCATION	SERVICE	CAPACITY (G.P.M.)	SIZE DIA. x HT. (IN.)	OPER. WT. (LBS.)	SPEC. SECTION	REMARKS
70-AS-01	BELL & GOSSETT ROLAIRTROL RL-8F	BLDG. 70 CHILLER YARD	CW	1900	24x54	420	11075	

70-H-501A

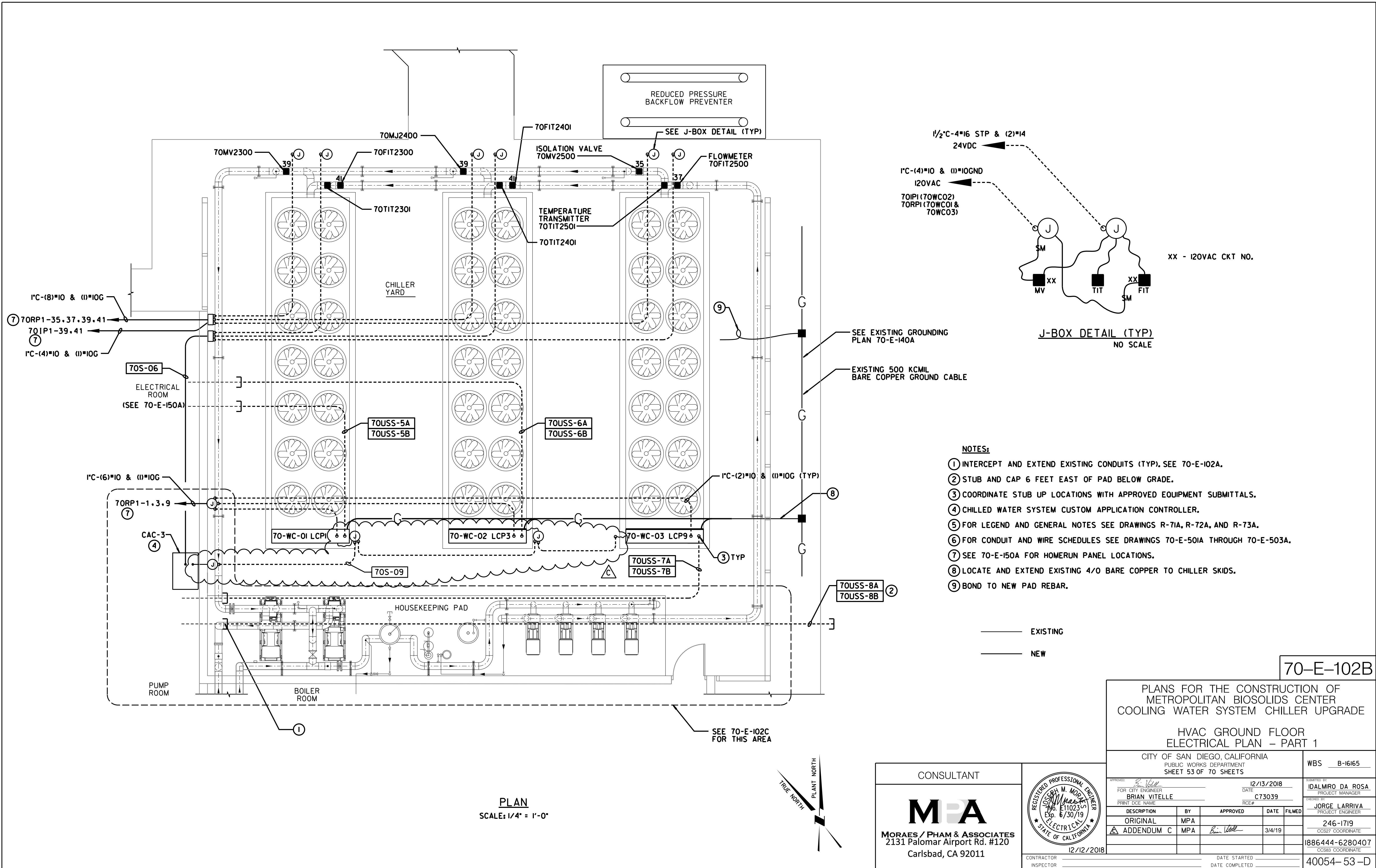
PLANS FOR THE CONSTRUCTION OF METROPOLITAN BIOSOLIDS CENTER COOLING WATER SYSTEM CHILLER UPGRADE

HVAC SCHEDULE - 1

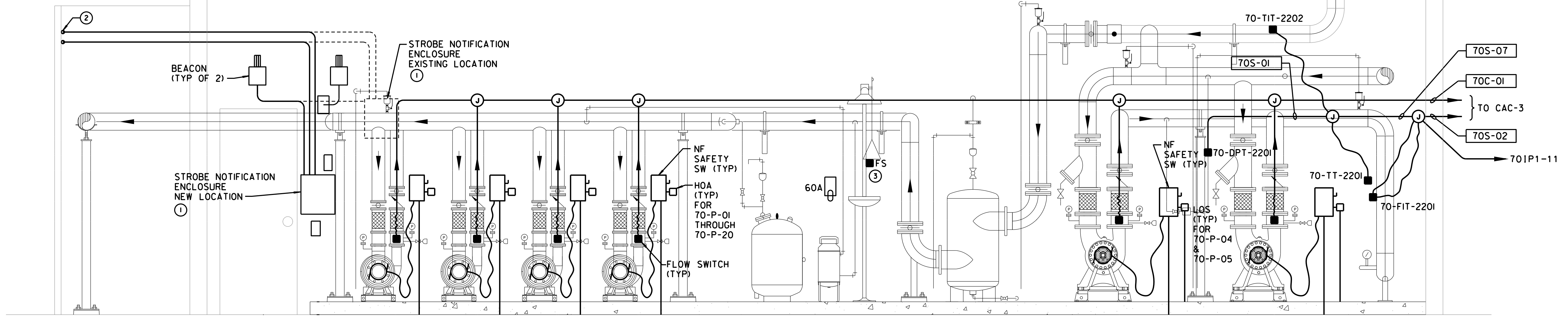
CONSULTANT		CITY OF SAN DIEGO, CALIFORNIA PUBLIC WORKS DEPARTMENT SHEET 44 OF 70 SHEETS		WBS B-16165	
 14271 Danielson Street Poway, California 92064 T 858.413.2400 F 858.413.2440 www.iecorporation.com				APPROVED: <i>Brian Vitelle</i> FOR CITY ENGINEER: BRIAN VITELLE DATE: 12/13/2018 RCE#: C73039	
SUBMITTED BY: IDALMIRO DA ROSA PROJECT MANAGER		CHECKED BY: JORGE LARRIVA PROJECT ENGINEER		DATE STARTED: _____ DATE COMPLETED: _____	
DESCRIPTION: ORIGINAL BY: IEC APPROVED: <i>Brian Vitelle</i> DATE: 3/4/19 FILMED: _____		246-1719 CCS27 COORDINATE		1886444-6280407 CCS83 COORDINATE	
ADDENDUM C BY: IEC DATE: _____		40054-44-D		40054-44-D	

REVIS PUMP TABLE

ADDENDUM C



CHILLER
YARD



SECTION
SCALE: 1/2" = 1'-0"

1
70-E-102C

— EXISTING
— NEW
— RELOCATE

- NOTES:**
- ① RELOCATE ENCLOSURE & INTERCEPT, RE=ALIGN CONDUITS.
 - ② FROM FENCE MOUNT PAGING JUNCTION BOX.
 - ③ PROVIDE SPLICE AT THE SAFETY SHOWER J-BOX IF NECESSARY AND 5' OF NEW FLEX CONDUIT TO NEW SAFETY SHOWER THAT IS FURNISHED WITH NEW FLOW SWITCH.

70-E-102D

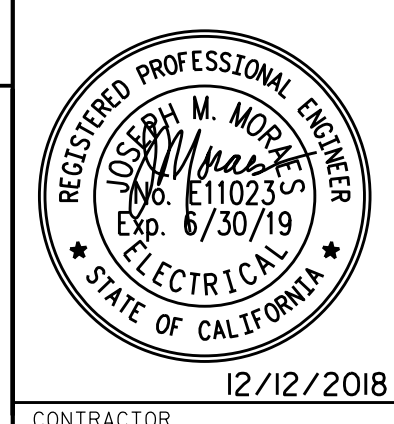
PLANS FOR THE CONSTRUCTION OF
METROPOLITAN BIOSOLIDS CENTER
COOLING WATER SYSTEM CHILLER UPGRADE

ELECTRICAL SECTION

CONSULTANT

MPA

MORAES / PHAM & ASSOCIATES
2131 Palomar Airport Rd. #120
Carlsbad, CA 92011



CITY OF SAN DIEGO, CALIFORNIA PUBLIC WORKS DEPARTMENT SHEET 55 OF 70 SHEETS		WBS B-16165
APPROVED FOR CITY ENGINEER BRIAN VITELLE PRINT DCE NAME	DATE 12/13/2018 C73039 RCE#	SUBMITTED BY IDALMIRO DA ROSA PROJECT MANAGER
DESCRIPTION	BY	APPROVED
ORIGINAL	MPA	
ADDENDUM C	MPA	3/4/19
DATE STARTED		DATE FILMED
DATE COMPLETED		DATE COMPLETED
1886444-6280407 CCS83 COORDINATE		246-1719 CCS27 COORDINATE
40054-55-D		

REPLACE NOTE 3

ADDENDUM C

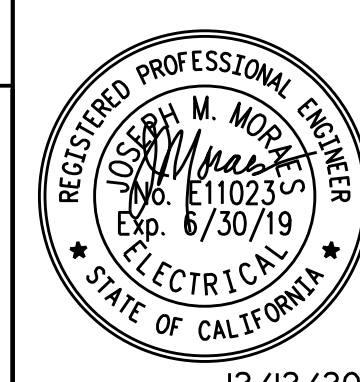
CONDUIT AND WIRE SCHEDULE							CONDUIT AND WIRE SCHEDULE						
CABLE/ RACEWAY NUMBER	CONDUIT SIZE	WIRING		FROM	TO	REMARKS	CABLE/ RACEWAY NUMBER	CONDUIT SIZE	WIRING		FROM	TO	REMARKS
		QUANTITY	SIZE						QUANTITY	SIZE			
70MCC7001-1A	3	3	350 KCM	70MCC7001	70MCC7002	POWER GROUND	70MCC7002-1	1 1/4	3 1	10 10	70MCC7002	70-P-02	POWER GROUND CONTROL
70MCC7001-1B	3	3	350 KCM	70MCC7001	70MCC7002	POWER GROUND	70MCC7002-2	1 1/4	9 3	14 6	70MCC7002	70-P-07	POWER GROUND CONTROL
70MCC7001-2	1	3	12	70MCC7001	70-AHU-01	POWER GROUND	70MCC7002-3	1 1/4	1 9	10 14	70MCC7002	70-AHU-02	POWER (TWO SPEED) GROUND CONTROL
70MCC7001-3	1 1/4	8 3	14 10	70MCC7001	70-P-01	CONTROL POWER GROUND CONTROL	70MCC7002-4	1	6 1	12 12	70MCC7002	70-B-02	POWER (TWO SPEED) GROUND CONTROL
70MCC7001-4	1 1/4	1 9	10 14	70MCC7001	70-P-06	POWER GROUND CONTROL	70MCC7002-5	1 1/2	3 1 9	4 8 14	70MCC7002	70-P-13	POWER GROUND CONTROL
70MCC7001-5	1	3	12	70MCC7001	70-AD-01	POWER GROUND	70MCC7002-6	1	3 1	12 12	70MCC7002	70-AD-02	POWER GROUND
70MCC7001-6	1	3	6	70MCC7001	70-B-01	POWER GROUND	70MCC7002-7A	1	3 1	6 10	70MCC7002	70XIPI	POWER GROUND
70MCC7001-7	2 1/2	3	4/0	70MCC7001	SIDP2	POWER GROUND	70MCC7002-7B	2	3 1	1 1	70XIPI	70IPI	POWER NEUTRAL GROUND
70MCC7001-8	1	3	10	70MCC7001	70-P-12	POWER GROUND CONTROL	70MCC7002-8A	3	3 1	500 KCM 3	70MCC7002	70XVFD2	POWER GROUND
70MCC7001-9A	3	3	500 KCM	70MCC7001	70XVFDI	POWER GROUND	70MCC7002-8B	3	3 1	500 KCM 3	70MCC7002	70FVFD2	POWER GROUND
70MCC7001-9B	3	3	500 KCM	70XVFDI	70FVFDI	POWER GROUND	70MCC7002-8C	3	3 1	500 KCM 3	70MCC7002	70VFD2	POWER GROUND
70MCC7001-9C	3	3	500 KCM	70XVFDI	70VFDI	POWER GROUND	70MCC7002-8D	3	3 1	500 KCM 3	70MCC7002	70VFD2	POWER GROUND
70MCC7001-9D	3	3	500 KCM	70VFDI	70-P-11	POWER GROUND	70MCC7002-8E	1	13	14	70VFD2	70-P-10	CONTROL
70MCC7001-9E	1	13	14	70VFDI	70-P-11	CONTROL	70MCC7002-9	2	3 1	1/0 6	70MCC7002	70DP2	POWER GROUND
70MCC7001-10	2 1/2	66 14 14 14 10	14	70MCC7001	70PCM01	CONTROL & INDICATION 70-AHU-01 70-P-01 70-P-06 70-P-12 SPARE	70MCC7002-10	2 1/2	66 14 14 14 14 10	14	70MCC7002	70PCM01	CONTROL & INDICATION 70-P-13 70-AHU-02 70-P-07 70-P-02 SPARE
70C-01	1	24	#14	CAC-3	FLOW SWITCHES	CONTROL	70MCC7002-11	1 1/4	3 1 9	10 10 14	70MCC002	70-P-20	POWER GROUND CONTROL
70C-02	1	5	#14	CAC-3	70VFD3	CONTROL & GROUND	-	-	-	-	-	-	-
70C-03	1	5	#14	CAC-3	70VFD4	CONTROL & GROUND	-	-	-	-	-	-	-
70C-04	1	2	#14	CAC-3	70MCC7001	CONTROL & GROUND	-	-	-	-	-	-	-
70C-05	1	6	#14	CAC-3	70MCC7002	CONTROL & GROUND	-	-	-	-	-	-	-
70C-06	1	2	#14	CAC-3	70MCC7003	CONTROL & GROUND	-	-	-	-	-	-	-
70C-07	1	4	#14	CAC-3	70MCC7001	CONTROL	-	-	-	-	-	-	-
70C-08	1	12	#14	CAC-3	70MCC7002	CONTROL	-	-	-	-	-	-	-
70C-09	1	6	#14	CAC-3	70MCC7003	CONTROL	-	-	-	-	-	-	-
70C-10	-	-	-	-	-	-	-	-	-	-	-	-	-
70S-01	1	1	#16 STP	J-BOX	70DPIT-220I	SIGNAL	-	-	-	-	-	-	-
70S-02	1	4	#16 STP	CAC-3	70FIT-220I J-BOX	SIGNAL	-	-	-	-	-	-	-
70S-03	1	2	#16 STP	CAC-3	70VFD3	SIGNAL	-	-	-	-	-	-	-
70S-04	1	2	#14	-	-	CONTROL	-	-	-	-	-	-	-
70S-05	1	2	#16 STP	CAC-3	70VFD3	SIGNAL	-	-	-	-	-	-	-
70S-06	1	2	#14	-	-	CONTROL	-	-	-	-	-	-	-
70S-07	1	1	CAT6	CAC-3	70PCM-01	SIGNAL	-	-	-	-	-	-	-
70S-08	2	12	#16 STP	CAC-3	J-BOX	SIGNAL	-	-	-	-	-	-	-
70S-09	1	6	#14	-	-	CONTROL	-	-	-	-	-	-	-
70S-10	1	3	#16 STP	J-BOX	J-BOX	SIGNAL	-	-	-	-	-	-	-
70S-11	1	2	CAT6	J-BOX	70PCM-01	SIGNAL	-	-	-	-	-	-	-
70S-12	1	1	#22 STP	CAC-3	70-WC-01-01/02/03 LCP'S	SIGNAL (BELDEN 350IA)	-	-	-	-	-	-	-

70-E-502A

— EXISTING
— NEW

PLANS FOR THE CONSTRUCTION OF
METROPOLITAN BIOSOLIDS CENTER
COOLING WATER SYSTEM CHILLER UPGRADE
CONDUIT & WIRE SCHEDULE
SHEET 2

CONSULTANT
M P A
MORAES / PHAM & ASSOCIATES
2131 Palomar Airport Rd. #120
Carlsbad, CA 92011



CITY OF SAN DIEGO, CALIFORNIA PUBLIC WORKS DEPARTMENT SHEET 63 OF 70 SHEETS		WBS B-16165
APPROVED: <i>Brian Vitelle</i> FOR CITY ENGINEER BRIAN VITELLE PRINT DCE NAME	DATE: 12/13/2018 RCE# C73039	SUBMITTED BY: IDALMIRO DA ROSA PROJECT MANAGER CHECKED BY: JORGE LARRIVA PROJECT ENGINEER
DESCRIPTION	BY	APPROVED
ORIGINAL	MPA	
ADDENDUM C	MPA	<i>Brian Vitelle</i>
		DATE: 3/4/19
		FILMED
		246-1719 CCS27 COORDINATE
		1886444-6280407 CCS83 COORDINATE
CONTRACTOR	DATE STARTED	DATE COMPLETED
INSPECTOR		
		40054-63-D

Bid Results

Bidder Details

Vendor Name TechCom International
Address 11 Redondo
 Laguna Niguel, CA 92677
 United States
Respondee B Whittle
Respondee Title Vice President
Phone 949-453-1900 Ext. 223
Email b.whittle@tci-corp.com
Vendor Type CAU,FEM,PQUAL,DBE,WBE
License # 824687
CADIR

Bid Detail

Bid Format Electronic
Submitted March 19, 2019 1:50:11 PM (Pacific)
Delivery Method
Bid Responsive
Bid Status Submitted
Confirmation # 168529
Ranking 0

Respondee Comment

Buyer Comment

Attachments

File Title	File Name	File Type
Contractors Certification of Pending Actions	Contractors Certification of Pending Actions.pdf	CONTRACTOR'S CERTIFICATION OF PENDING ACTIONS
Mandatory Disclosure of Business Interest	Mandatory Disclosure of Business Interest.pdf	MANDATORY DISCLOSURE OF BUSINESS INTERESTS FORM
Subcontractor Listing (Other than First Tier)	Subcontractor Listing (Other than First Tier).pdf	SUBCONTRACTOR LISTING (OTHER THAN FIRST TIER)
Bid Bond	Bid Bond(1).pdf	Bid Bond

Line Items

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
Main Bid						
1	Bonds (Payment and Performance)					
	524126	LS	1	\$41,170.05	\$41,170.05	
2	WPCP Development					
	541330	LS	1	\$3,397.50	\$3,397.50	
3	WPCP Implementation					
	238910	LS	1	\$46,576.50	\$46,576.50	

Bid Results

Type	Item Code	UOM	Qty	Unit Price	Line Total	Comment
4	Mobilization					
	237110	LS	1	\$77,597.50	\$77,597.50	
5	Building Permits (EOC Type I)					
	236220	AL	1	\$30,000.00	\$30,000.00	
6	Field Orders (EOC Type II)					
		AL	1	\$185,000.00	\$185,000.00	
7	Temporary Chiller Construction					
	238220	LS	1	\$302,511.58	\$302,511.58	
8	Chiller Demolition					
	238910	LS	1	\$114,222.00	\$114,222.00	
9	Structural Improvements - Concrete Pad					
	238110	LS	1	\$271,972.07	\$271,972.07	
10	Mechanical Improvements					
	238220	LS	1	\$1,264,344.47	\$1,264,344.47	
11	Plumbing					
	238220	LS	1	\$199,387.50	\$199,387.50	
12	Electrical Improvements					
	238210	LS	1	\$222,085.83	\$222,085.83	
13	Instrumentation and Controls Improvements					
	238210	LS	1	\$157,461.83	\$157,461.83	
Subtotal					\$2,915,726.83	
Total					\$2,915,726.83	

Subcontractors

Name & Address	Description	License Num	CADIR	Amount	Type
Rosenbach Company Inc. 1870 Joe Crosson Dr. Suite 200 El Cajon, CA 92020 United States	Demolition	842271	1000002519	\$85,600.00	ELBE
Alvarez And Shaw, Inc 13080 Hwy 8 Business el cajon, CA 92021 United States	Concrete Work	986171	1000052129	\$131,554.00	LAT,MALE,ELBE,DB E,MBE,CADIR,SDB
Baker Electric, Inc. 1298 Pacific Oaks Pl. Escondido, CA 92029 United States	Electrical	161756	1000000466	\$165,919.00	PQUAL,CADIR
San Diego Mechanical & Energy Inc. 7568 Trade St. San Diego, CA 92121 United States	Mechanical and I&C	997083	1000008266	\$560,692.00	CAU,MALE,CADIR

Line Totals (Unit Price * Quantity)								
Item Num	Section	Item Code	Description	Reference	Unit of Measure	Quantity	TechCom International - Unit Price	TechCom International - Line Total
1	Main Bid	524126	Bonds (Payment and Performance)	1-7.2.1	LS	1	\$41,170.05	\$41,170.05
2	Main Bid	541330	WPCP Development	1001-4.2	LS	1	\$3,397.50	\$3,397.50
3	Main Bid	238910	WPCP Implementation	1001-4.2	LS	1	\$46,576.50	\$46,576.50
4	Main Bid	237110	Mobilization	7-3.4.1	LS	1	\$77,597.50	\$77,597.50
5	Main Bid	236220	Building Permits (EOC Type I)	2-2.3	AL	1	\$30,000.00	\$30,000.00
6	Main Bid		Field Orders (EOC Type II)	7-3.9	AL	1	\$185,000.00	\$185,000.00
7	Main Bid	238220	Temporary Chiller Construction	7-3.1	LS	1	\$302,511.58	\$302,511.58
8	Main Bid	238910	Chiller Demolition	7-3.1	LS	1	\$114,222.00	\$114,222.00
9	Main Bid	238110	Structural Improvements - Concrete Pad	7-3.1	LS	1	\$271,972.07	\$271,972.07
10	Main Bid	238220	Mechanical Improvements	7-3.1	LS	1	\$1,264,344.47	\$1,264,344.47
11	Main Bid	238220	Plumbing	7-3.1	LS	1	\$199,387.50	\$199,387.50
12	Main Bid	238210	Electrical Improvements	7-3.1	LS	1	\$222,085.83	\$222,085.83
13	Main Bid	238210	Instrumentation and Controls Improvements	7-3.1	LS	1	\$157,461.83	\$157,461.83
							Subtotal	\$2,915,726.83
							Total	\$2,915,726.83