

INVITATION TO BID

The City of Rochester, New Hampshire, will accept sealed bids for furnishing and installing a 200 KW diesel backup-up power generator at the Richardson Street Pump Station. Bids must be submitted in a sealed envelope plainly marked:

“Sealed Bid, RICHARDSON STREET PUMP STATION 200 KW GENERATOR SET #07-11

City of Rochester, New Hampshire

31 Wakefield St.

Rochester, NH 03867

Attn: Purchasing Agent

All bids must be received no later than August 24, 2006 at 3:00 PM. No late bids, telephone, faxed, or emailed bids will be accepted. The bid specifications, appendices and proposal forms may be obtained by visiting www.rochesternh.net, or emailing purchasing@rochesternh.net, or by contacting the Purchasing Agent at City Hall, 31 Wakefield Street, Rochester, NH 03867, (603) 335-7602. All bid questions must be submitted in writing (email preferred) to the Purchasing Agent. All bid proposals must be made on the bid proposal forms supplied, and the bid proposal forms must be fully completed when submitted. A mandatory walk through of the site will be held on August 15, 2006 at 9:00AM. All bidders will meet at the Richardson Street Station on The Corner of Richardson Street and Rt. 108.

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INSTRUCTION TO BIDDERS

PREPARATION OF BID PROPOSAL

1. The Bidder shall submit her/his proposal upon the forms furnished by the City (attached). The bidder shall specify a unit price, both in words and figures if requested, for each pay item for which a quantity is given. All words and figures shall be in ink or typed.
2. If a unit price or lump sum bid already entered by the bidder on the proposal form is to be altered it should be crossed out with ink, the new unit price or lump sum bid entered above or below it, and initialed by the bidder, also with ink. In case of discrepancy between the prices written in words and those written in figures, the prices written in words shall govern.
3. The bidder's proposal must be signed with ink by the individual, by one or more members of the partnership, by one or more members or officers of each firm representing a joint venture; by one or more officers of a corporation, or by an agent of the contractor legally qualified and acceptable to the owner. If the proposal is made by an individual, his name and post office address must be shown, by a partnership the name and post office address if each partnership member must be shown; as a joint venture, the name and post office address of each must be shown; by a corporation, the name of the corporation and its business address must be shown, together with the name of the state in which it is incorporated, and the names, titles, and business addresses of the President, Secretary, and Treasurer.
4. All questions shall be submitted in writing to the Purchasing Agent. The Purchasing Agent will then forward both the question and the City's response to the question to all prospective bidders.

IRREGULAR PROPOSALS

Bid proposals will be considered irregular and may be rejected for any of the following reasons:

1. If the proposal is on a form other than that furnished by the Owner or if the form is altered or any thereof is detached.
2. If there are unauthorized additions, conditional or alternate bids, or irregularities of any kind which may tend to make the proposal incomplete, indefinite or ambiguous as to its meaning.
3. If the bidder adds any provisions reserving the right to accept or reject an award, or to enter into a contract pursuant to an award.
4. If the proposal does not contain a unit price for each pay item listed, except in the case of authorized alternate pay items.

DELIVERY OF BID PROPOSALS

When sent by mail, the sealed proposal shall be addressed to the owner at the address and in the care of the official in whose office the bids are to be received. All proposals shall be filed prior to the time and at the place specified in the invitation for bids. Proposals received after the time for opening of the bids will be returned to the bidder, unopened. Faxed bid proposals are not acceptable.

WITHDRAWAL OF BID PROPOSALS

A bidder will be permitted to withdraw his proposal unopened after it has been deposited if such request is received in writing prior to the time specified for opening the proposals.

PUBLIC OPENING OF BID PROPOSALS

Proposals will be opened and read publicly at the time and place indicated in the invitation for bids. Bidders, their authorized agents, and other interested parties are invited to be present.

DISQUALIFICATION OF BIDDERS

Either of the following reason may be considered as being sufficient for the disqualification of a bidder and the rejection of his proposal of proposals:

1. Evidence of collusion among bidders.
2. Failure to supply complete information as requested by the bid specifications.

AWARD AND EXECUTION OF CONTRACT**CONSIDERATION OF PROPOSALS**

1. Bids will be made public at the time of opening and may be reviewed only after they have been properly recorded. In case of discrepancy between the prices written in words and those written figures, the prices written in words shall govern. In case of a discrepancy between the total shown in the proposal and that obtained by adding the products of the quantities of items and unit bid prices, the latter shall govern.
2. The right is reserved to reject any or all proposals, to waive technicalities or to advertise for new proposals, if in the judgment of the City, the best interest of the City of Rochester will be promoted thereby.

AWARD OF CONTRACT

If a contract is to be awarded, the award will be made to the lowest responsible and qualified bidder whose proposal complies with all the requirements prescribed as soon as practical after the bid opening. No bid shall be withdrawn for a period of (60) sixty days subsequent to the opening of bids without the consent of the City of Rochester. The successful bidder will be notified, by the form mailed to the address on his proposal, that his bid has been accepted and that he has been awarded the contract.

CANCELLATION OF AWARD

The City reserves the right to cancel the award of any contract at any time before the execution of such contract by all parties without any liability against the City.

BID EVALUATION

In addition to the bid amount, additional factors will be considered as an integral part of the bid evaluation process, including, but not limited to:

1. the bidder's ability, capacity, and skill to perform within the specified time limits
2. the bidder's experience, reputation, efficiency, judgment, and integrity
3. the quality, availability and adaptability of the supplies and materials sold
4. bidder's last performance
5. sufficiency of bidder's financial resources to fulfill the contract
6. bidder's ability to provide future maintenance and/or services

7. Other applicable factors as the City determines necessary of appropriate (such as compatibility with existing equipment.)

BONDING

1. The Contractor shall furnish, upon submission of the bid, a bid bond in the amount of five percent (5%) of the contract bid price.
2. The Contractor shall be required to furnish a one hundred percent (100%) performance bond of the contract bid price.
3. The Contractor shall be required to furnish a one hundred percent (100%) payment bond of the contract bid price.

CONDITIONS AT SITE

Bidders must visit the site and shall be responsible for having ascertained pertinent local conditions, such as: location, accessibility and general character of the site of the building. The character and extent of existing work within or adjacent to the site, and any other work being performed thereon at the time of the submission of his bid.

LAWS, PERMITS AND REGULATIONS

1. The Contractor shall obtain and pay for all licenses and permits as may be required of him by law, and shall pay for all fees and charges for connection to outside services, and use of property other than the site of the work for storage of materials or other purposes
2. The Contractor shall comply with all State and Local laws, ordinances, regulations and requirements applicable to work hereunder, including building code requirements. If the Contractor ascertains at any time that any requirement of this Contract is at variance with applicable laws, ordinances, regulations or building code requirements, he shall promptly notify the City of Rochester in writing.
3. The Contractor will comply with the Underground Utility Damage prevention System @ by notification to DIG SAFE SYSTEM of intent to excavate near or around any underground utility installations. The Contractor shall call 1-800-225-4977 at least seventy-two (72) hours in advance of starting any excavation. Saturdays, Sundays and legal holidays are not included in the computation of the required seventy-two (72) hour notice.

PROJECT COMPLETION/LIQUIDATED DAMAGES

1. In the event the Contractor fails to successfully execute the work by the completion date, the Owner shall assess the Contractor liquidated damages in the amount of \$200.00 for each calendar day beyond the specified completion date. Said liquidated damages shall be deducted from the contract Price prior to final payment of the Contractor.

CONTRACTOR'S AND SUBCONTRACTOR'S INSURANCE

1. The Contractor shall deliver at the time of execution of the Contract, certificates of all insurance required hereunder and shall be reviewed prior to approval by the City of Rochester. The certificates of insurance shall contain the description of the Project, and shall state that the companies issuing insurance will endeavor to mail to the City of Rochester ten (10) days notice of cancellation, alteration or material change of any listed policies. The Contractor shall keep in force the insurance required herein for the period of the Contract. At the request of the City of Rochester, the Contractor shall promptly make available a copy of any and all listed insurance policies. The requested insurance must be written by a Company licensed to do business in New Hampshire at the time the policy is issued.

2. The City of Rochester, NH shall be listed as additional insured on all the Certificates of Insurance.

1. The Contractor shall require each Subcontractor employed on the Project to maintain the coverage listed below unless the Contractor's insurance covers activities of the Subcontractor on the Project.
2. No operations under this Contract shall commence until certificates of insurance attesting to the below listed requirements have been filed with and approved by the Department of Public Buildings & Grounds, and the Contract approved by the City Manager.
 - a. Workmen's Compensation Insurance
Limit of Liability - \$100,000.00 per accident
 - b. Commercial General Liability
Limits of Liability
Bodily Injury: \$1,000,000.00 per occurrence, \$1,000,000.00 aggregate
Property Damage: \$500,000.00 per occurrence, \$500,000.00 aggregate
Combined Single Limit, Bodily Injury and Property Damage:
\$1,500,000.00 per occurrence, \$1,500,000.00 aggregate
 - c. Automobile Liability
Limits of Liability - \$500,000.00 per accident
3. The Contractor shall indemnify, defend, and save harmless the City of Rochester and its agents and employees from and against any suit, action or claim of loss or expenses because of bodily injury. Including death at any time resulting there from, sustained by any person or persons or on account of damage to property, including loss of use thereof, whether caused by or contributed to by said City of Rochester, its agents, employees or others.

ACCIDENT PROTECTIONS

1. It is a condition of this Contract, and shall be made a condition of each subcontract entered into pursuant to the Contract. That a Contractor and any Subcontractors shall not require any laborer or mechanic employed in the performance of the Contract to work in surroundings or under working conditions which are unsanitary hazardous or dangerous to health or safety. As determined by construction safety and health standards of the Occupational Safety and Health Administration, United States Department of Labor, which standards include, by reference, the established Federal Safety and Health regulations for Construction. These standards and regulations comprise Part 1910 and Part 1926 respectively of Title 29 of the Code of Federal Regulations and are set forth in the Federal Register. In the event any revisions in the Code of Federal Regulations are published, such revisions will be deemed to supersede the appropriate Part 1910 and Part 1926, and be effective as of the date set forth in the revised regulation.

SUBCONTRACTS

1. Nothing contained in the Specifications or Drawings shall be construed as creating any contractual relationship between any Subcontractor and the City of Rochester. The Division or Sections of the Specifications are not intended to control the Contractor in dividing the work among Subcontractors or to limit the work performed by any trade.
2. The Contractor shall be as fully responsible to the City of Rochester for the acts and omissions

of Subcontractors and of persons employed by him, as he is responsible for the acts and omissions of persons directly employed by him.

PROTECTION OF WORK AND PROPERTY

The Contractor shall, at all times, safely guard the City's property from injury or loss in connection with this Contract. He shall, at all times, safely guard and protect his own work and that of adjacent property from damage. All passageways, guard fences, lights and other facilities required for protection by State or Municipal laws, regulations and local conditions must be provided and maintained.

USE OF PREMISES AND REMOVAL OF DEBRIS

The Contractor expressly undertakes at his own expense:

1. To take every precaution against injuries to persons or damage to property;
2. To comply with the regulations governing the operations of premises which are occupied and to perform his Contract in such a manner as not to interrupt or interfere with the operation of the Institution;
3. To perform any work necessary to be performed after working hours or on Sunday or legal holidays without additional expense to the City, but only when requested to do so by the City;
4. To store his apparatus, materials, supplies and equipment in such orderly fashion at the site of the work as will not unduly interfere with the progress of his work or the work of any other Contractors;
5. Daily to clean up and legally dispose of (away from the site), all refuse, rubbish, scrap D-4 materials and debris caused by his operation. Including milk cartons, paper cups and food wrappings left by his employees, to the end that at all times the site of the work shall present a neat, orderly and workmanlike appearance;
6. All work shall be executed in a workmanlike manner by experienced mechanics in accordance with the most modern mechanical practice and shall represent a neat appearance when completed.

MATERIALS AND WORKMANSHIP

Unless otherwise specified, all materials and equipment incorporated into the work under the Contract shall be new. All workmanship shall be first class and by persons qualified in their respective trades.

Where the use of optional materials or construction method is approved, the requirements for workmanship, fabrication and installation indicated for the prime material or construction method shall apply wherever applicable. Required and necessary modifications and adjustments resulting from the substitution or use of an optional material or construction method shall be made at no additional cost to the City.

STANDARDS

1. Materials specified by reference to the number, symbol or title of a specific standard, such as a Commercial Standard, a Federal Specification, Department's Standard Specifications, a trade association standard or other similar standard. Shall comply with requirements in the latest revision thereof and any amendment or supplement thereto in effect on the date of advertisement, except as limited to type, class or grade or modified in such reference.
2. Reference in the Specifications to any article, device, product, material, fixture, form or type of construction by name, make or catalog number shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. In such cases the Contractor may, at his option, use any articles, device, product, material fixture, form or type of construction which, in the judgment of the City expressed in writing to all Bidders before opening of bids as an addendum, is an acceptable substitute to the specified.
3. Substitution During Bid Time: Whenever any particular brand or make of material or apparatus is called for in the Specifications, a Bidder's Proposal must be based upon such material or apparatus, or upon a brand or make which has been specifically approved as a substitution in an Addendum issued to all Bidders during the bidding time.
4. The intent is that the brand or make of material or apparatus which is called for herein establishes a standard of excellence which, in the opinion of the Consultant and Engineer, is necessary for this particular Project.
5. Substitution After Bid Opening: No substitutions will be considered after bids have been opened unless necessary due to strikes, lockouts, bankruptcy or discontinuance of manufacture, etceteras. In such cases, the Contractor shall apply to the City, in writing within ten (10) days of his realizing his inability to furnish the article specified, describing completely the substitution he desires to make.

EXTRAS

Except as otherwise herein provided, no charge for any extra work or material will be allowed unless the same has been ordered, in writing, by the Director of Public Works.

GUARANTEE OF WORK

1. Except as otherwise specified, all work shall be guaranteed by the Contractor against defects result in from the use of inferior materials, equipment or workmanship for one (1) year from the Date of Final Acceptance.
2. Make good any work or material, or the equipment and contents of said building or site disturbed in fulfilling any such guarantee.
3. In any case, wherein fulfilling the requirements of the Contract or of any guarantee, should the Contractor disturb any work guaranteed under another contract, the Contractor shall restore such disturbed work to a condition satisfactory to the Director of Public Works. And guarantee such restored work to the same extent as it was guaranteed under such other contracts.
4. If the Contractor, after notice, fails to proceed promptly to comply with the terms of the guarantee, the City of Rochester may have the defects corrected and the Contractor shall be liable for all expense incurred.
5. All special guarantees applicable to definite parts of the work that may be stipulated in the

Specifications or other papers forming a part of the Contract shall be subject to the terms of this paragraph during the first year of the life of such special guarantee.

DEFAULT AND TERMINATION OF CONTRACT

If the Contractor:

1. Fails to begin work under Contract within the time specified in the notice to proceed; or
2. Fails to perform the work with sufficient workmen and equipment, or with sufficient materials to assume prompt completion of said work; or
3. Performs the work unsuitably or neglects or refuses to remove materials or to perform a new such work as may be rejected as unacceptable and unsuitable; or
4. Discontinues the prosecution of the work; or
5. Fails to resume work, which has been discontinued, within a reasonable time after notice to do so; or
6. Becomes insolvent or has declared bankruptcy, or commits any act of bankruptcy or insolvency; or
7. Makes an assignment for the benefit of creditors; or
8. For any other causes whatsoever, fails to carry on the work in an acceptable manner the City of Rochester will give notice, in writing, to the Contractor for such delay, neglect, and default.

If the Contractor does not proceed in accordance with the Notice, then the City of Rochester will have full power and authority without violating the Contract to take the prosecution of the work out of the hands of the Contractor. The City of Rochester may enter into an agreement for the completion of said Contract according to the terms and conditions thereof, or use such other methods as in his opinion will be required for the completion of said Contract in an acceptable manner. All extra costs and charges incurred by the City of Rochester as a result of such delay, neglect or default, together with the cost of completing the work under the Contract will be deducted from any monies due or which may become due to said Contractor. If such expenses exceed the sum which would have been payable under the contract, then the Contractor shall be liable and shall pay to the City of Rochester the amount of such excess.

OBTAINING BID RESULTS

Bid results will be posted after 48 hours on the City of Rochester's web site: www.rochesternh.net or will be available by request via e-mail at the following address: purchasing@rochesternh.net

GENERAL REQUIREMENTS

GENERAL NOTES

1. Contractor will perform all work by competent, trained and properly equipped personnel in strict accordance with accepted construction practices and applicable industry standards.
2. Contractor will observe all published safety and accident prevention policies and practices relating to installation back-up power generators. All federal, state, and local codes shall be followed.
3. Contractor will dispose of all materials properly. Any material removal shall comply with state and local codes and requirements and shall be disposed of in a legal manner.
4. Employ safe entry practices, provide proper work access and staging within the work area following OSHA requirements.
5. Clean all debris from construction site and haul away to landfill.

INTENTION

1. It is the intention of this Specification to obtain a long-lived, reliable and well built product. The work will be inspected by the City, and only first-class materials and workmanship will be acceptable. Nonconforming materials or areas of substandard workmanship must be removed or corrected as directed by the City during the progress of the work. The solution to minor details or field conditions must be approved by the City prior to execution.

QUALIFICATIONS OF CONTRACTOR

1. The installation contractor shall be regularly engaged in the type of work specified herein, and shall be able to demonstrate at least five (5) years of experience with similar work prior to the date of receipt of bids.

CONTRACTOR'S RESPONSIBILITY

1. The contractor shall examine all documentation available regarding site conditions and expected. He/she shall be responsible for identifying and correction any problems in such design that might be detrimental to the installation of the generator set, and all such work shall be brought to the attention of the City.

SPECIAL REQUIREMENTS

1. The contractor will be required to coordinate with the City of Rochester for all excavation and other site work related matters.

SUBMITTALS

1. Submit materials in accordance with the Technical Specifications to the City of Rochester for approval before the installation of any work.

PRODUCT HANDLING

1. Materials shall be delivered materials with manufacturer's labels intact and legible, in sealed packages.
2. Materials shall be stored on raised platforms and shall be protected from the weather with coverings to prevent deterioration.

PRE-INSTALLATION CONFERENCE

1. Convene a pre-installation conference one-week prior to commencing work of this Section.
2. Require attendance of parties directly affecting work of this Section.
3. Review conditions of installation procedures and coordination required with related work.

WARRANTY

1. The installation workmanship shall be warranted for a period of one (1) year.
2. The contractor shall replace and install any material which fails due to the above causes within the warranty period at no cost to the Owner.

GENERAL WORKMANSHIP AND INSPECTION

1. The Contractor shall examine the areas and conditions under which work of this Section will be performed. He/she shall be responsible for identifying and correcting any defects detrimental to timely and proper completion of the work. All such work shall be brought to the attention of the City and be subject to the City's approval.

BID

Proposal of _____

(hereinafter called "BIDDER"), organized and existing under the laws of the State of

, doing business as _____

(Corporation, Partnership, Individual)

to the City of Rochester, New Hampshire (hereinafter called "OWNER").

In compliance with your Advertisement for Bids, BIDDER hereby proposes to perform all WORK for the construction of Richardson Street Pump Station 200 KW Generator Set in strict accordance with the CONTRACT DOCUMENTS, within the time set forth therein, and at the prices stated below.

By submission of this BID, each BIDDER certifies, and in the case of a joint BID each party thereto certifies as to his own organization, that this BID has been arrived at independently, without consultation, communication, or agreement as to any matter relating to the BID with any other BIDDER or with any competitor.

BIDDER hereby agrees to commence WORK under this contract on _____ as specified in the **NOTICE TO PROCEED** and to complete the PROJECT within:

30 calendar days for contract completion.

Liquidated damages will be in the amount of \$ 500.00 for each calendar day of delay from the date established for Contract Completion .

BIDDER acknowledges receipt of the following ADDENDUM:

The Bidder is requested to state below what works of a similar character to that included in the proposed contract he has done to give references that will enable the Owner to judge his experience, skill, and business standing.

All questions must be answered and the data given must be clear and comprehensive. This statement must be notarized. If necessary, add separate sheets.

1. Name of Bidder
2. Permanent Main Office address
3. When organized?
4. Where incorporated?
5. Is bidder registered with the Secretary of the State to do business in New Hampshire?
6. How many years have you engaged in the contracting business under your present firm name? Also state names and dates of previous firm names, if any.
7. Contracts on hand (Schedule these, showing gross amount of each contract and the approximate anticipated dates of completion.)
8. General character of work performed by your company
9. Have you ever failed to complete any work awarded you in the scheduled contract time, including approved time extensions? ___(Yes) ___(No).
If so, where and why?
10. Have you ever defaulted on a contract? ___(Yes) ___(No).
If so, where and why?
11. Have you ever had liquidated damages assessed on a contract? ___(Yes) ___(No).
12. List the more important contracts recently executed by your company, stating approximate cost for each, and the month and year completed.
13. List your major equipment available for this contract.
14. List your key personnel such as Project Superintendent and foreman available for this contract.
15. List any Sub-Contractors whom you would expect to use for the following (unless this work is to be done by your own organization):

- a. Civil Engineering_____
- b. Utility Installation_____
- c. Other work_____

16. With what banks do you business?

Do you grant the Engineer permission to contact this (these) institutions? ____(Yes) ____(No)

NOTE: Bidders may be required to furnish their latest financial statement as part of the award process.

Respectfully submitted:

Signature		
Title		Address

Date		

_____ Being duly sworn, deposes and says that he is
 _____ of _____
 (Name of Organization)

and that the answers to the foregoing questions and all statements contained therein are true and correct.

Sworn to before me this _____ day of _____, 20_____.

 Notary Public

My commission expires_____.

(Seal - If BID is by Corporation)

ATTEST_____

BID SCHEDULE

NOTE: BIDS shall include all fees.

Item No.	Approximate Quantity	Brief Description of Item With Unit Bid Price in Words	Unit Bid In Figures	Amount In Figures
1	LS	Mobilization/Demobilization		
		The Sum of _____		

		per Lump Sum		
2	1 LS	Furnish and Install 200 KW Generator Set with concrete foundation pad, complete		
		The Sum of _____		

		per Lump Sum		

TOTAL BID: Total of Items 1 through 2 above.

_____ (\$ _____)
 _____ (use figures)

 _____ (use words)

(Amounts are to be shown in both words and figures. In case of discrepancy, the amount shown in words will govern.)

The above unit prices shall include all labor, materials, bailing, shoring, removal, overhead, profit, insurance, etc., to cover the finished work of the several kinds called for.

Bidder understands that the Owner reserves the right to reject any or all bids and to waive any informalities in the bidding.

The bidder agrees that this bid shall be good and may not be withdrawn, for a period of **60** calendar days after the scheduled closing time for receiving bids.

Upon receipt of written notice of the acceptance of this bid, bidder will execute the formal contract attached within 10 days and deliver a Surety Bond or Bonds as required by the General Conditions. The bid security (certified check) attached in the sum of _____ (\$ _____) is to become the property of the Owner in the event the contract and bond are not executed within the time above set forth, as liquidated damages for the delay and additional expense to the Owner caused thereby.

The BIDDER must submit the following additional documents with the bid:

- a. Certified check
- b. Proposed Schedule to complete the Work, broken down on a weekly basis.

SUBMITTED on _____, 20 ____

If BIDDER is:

An Individual

By _____ (SEAL)
(Individual's Name)

doing business as _____

Business address: _____

Phone No.: _____

A Partnership

By _____ (SEAL)
(Firm Name)

Business address: _____

Phone No.: _____

A Corporation

By _____ (SEAL)
(Corporation Name)

By _____ (SEAL)
(Name of Person Authorized to Sign)

(SEAL - if BID is by a corporation)

Attest _____

SECTION G**NOTICE OF AWARD**

Dated _____, 20 ____

TO: _____
(BIDDER)ADDRESS: _____

OWNER'S PROJECT NO. _____

PROJECT _____

OWNER'S CONTRACT NO. _____

CONTRACT FOR _____ Richardson Street Pump Station 200 KW Generator Set _____

(Insert name of contract as it appears in the Bid Documents)

You are notified that your Bid dated _____, 20 ____ for the above Contract has been considered. You are the apparent successful bidder and have been awarded a contract for _____

Richardson Street Pump Station 200 KW Generator Set

(Indicate total Work, alternates or sections of Work awarded)

The Contract Price of your contract is _____ Dollars (\$_____).

_____ copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award. The same number of sets of the Drawings will be delivered separately or otherwise made available to you immediately.

You must comply with the following conditions precedent within ten days of receiving this Notice of Award.

1. You must deliver to the OWNER all of the fully executed counterparts of the Agreement including all the Contract Documents. This includes the sets of Drawings. Each of the Contract Documents must bear your signature on (the cover) (every) page.

2. You must deliver with the executed Agreement the Contract Security (Bonds) as specified in the Information for Bidders and General Conditions.

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3. (List other conditions precedent).

Failure to comply with these conditions within the time specified will entitle **OWNER** to consider your bid abandoned, to annul this Notice of Award and to declare your Bid Security forfeited.

Within ten days after receipt of acceptable performance BOND, payment BOND and agreement signed by the party to whom the Agreement was awarded, the **OWNER** will return to you one fully signed counterpart of the Agreement with the Contract Documents attached.

(OWNER)

By

(AUTHORIZED SIGNATURE)

(TITLE)

ACCEPTANCE OF NOTICE

Receipt of the above NOTICE OF AWARD is hereby acknowledged

By _____

the _____ day of _____, 20_____.

BY _____

Title _____

Copy to ENGINEER
(Use Certified Mail,
Return Receipt Requested)

AGREEMENT

THIS AGREEMENT, made this _____ day of _____ 20_____ by
and between _____, hereinafter called "**OWNER**"
(Name of Owner)
and _____ doing business as (an individual,) or (a
partnership,) or (a corporation) hereinafter called "**CONTRACTOR**".

WITNESSETH: That for and in consideration of the payments and agreements hereinafter mentioned:

1. The **CONTRACTOR** will commence and complete the construction of

Richardson Street Pump Station 200 KW Generator Set

(Project)

2. The **CONTRACTOR** will furnish all of the material, supplies, tools, equipment, labor and other services necessary for the construction and completion of the **PROJECT** described herein.

3. The **CONTRACTOR** will commence the work required by the **CONTRACT DOCUMENTS** within _____ calendar days after the date of the **NOTICE TO PROCEED unless the period for completion is extended otherwise by the CONTRACT DOCUMENTS.** Completion time for the project will be calculated as calendar days from the date specified in the **NOTICE TO PROCEED** as follows:

_____ calendar days for substantial completion.

_____ calendar days for contract completion.

Liquidated damages will be in the amount of \$ _____ for each calendar day of delay from the date established for _____.

4. The **CONTRACTOR** agrees to perform all of the **WORK** described in the **CONTRACT DOCUMENTS** and comply with the terms therein for the sum of \$ _____ or as shown in the **BID** schedule.

5. The term "**CONTRACT DOCUMENTS**" means and includes the following:

- (A) ADVERTISEMENT FOR BIDS
- (B) INFORMATION FOR BIDDERS
- (C) BID
- (D) BID BOND
- (E) AGREEMENT
- (F) GENERAL CONDITIONS
- (G) SUPPLEMENTAL GENERAL CONDITIONS
- (H) SPECIAL CONDITIONS
- (I) PAYMENT BOND
- (J) PERFORMANCE BOND
- (K) NOTICE OF AWARD
- (L) NOTICE TO PROCEED
- (M) CONTRACTORS AFFIDAVIT
- (N) CONTRACTORS RELEASE
- (O) CERTIFICATE OF SUBSTANTIAL COMPLETION

(P) CHANGE ORDER(S)

(Q) DRAWINGS prepared by _____
numbered _____ through _____, and dated _____, 20 ____.(R) SPECIFICATIONS prepared or issued by _____
_____ dated _____, 20 ____.

(S) ADDENDA:

No. _____, dated _____, 20

No. _____, dated _____, 20

No. _____, dated _____, 20

No. _____, dated _____, 20

No. _____, dated _____, 20

No. _____, dated _____, 20

6. The **OWNER** will pay to the **CONTRACTOR** in the manner and at such times as set forth in the General Conditions such amounts as required by the **CONTRACT DOCUMENTS**.

7. This Agreement shall be binding upon all parties hereto and their respective heirs, executors, administrators, successors, and assigns.

IN WITNESS WHEREOF, the parties hereto have executed, or caused to be executed by their duly authorized officials, this Agreement in _____ copies, each of which shall be deemed an original on the date first above written.

OWNER:

By _____

Name _____
(Please Type)

(SEAL)

ATTEST:

Name _____
(Please Type)

Title _____

CONTRACTOR:_____
By _____Name _____
(Please Type)Address _____

(SEAL)

ATTEST:

Name _____
(Please Type)**BID SECURITY**

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned, _____ as Principal, is hereby held and firmly bound unto City of Rochester as OWNER by a CERTIFIED CHECK in the penal sum of _____ for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this _____ day of _____, 20_____.

The Condition of the above obligation is such that whereas the Principal has submitted to City of Rochester a certain BID, attached hereto and hereby made a part hereof to enter into a contract in writing, for the Richardson Street Pump Station 200 KW Generator Set NOW, THEREFORE,

- (a) If said BID shall be rejected, or
- (b) If said BID shall be accepted and the Principal shall execute and deliver a contract in the Form of Contract attached hereto (Properly completed in accordance with said BID) and shall furnish a BOND for his faithful performance of said contract, and for the payment of all persons performing labor or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this

obligation shall be void, otherwise, the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Contractor for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Contractor hereby stipulates and agrees that the obligations of said Bid Security shall be in no way impaired or affected by any extension of the time within which the OWNER may accept such BID.

IN WITNESS WHEREOF, the Principal has hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Principal (L.S.)

By: _____

SECTION 02200EARTHWORKPART 1 - GENERAL1.1 DESCRIPTION

- A. The Work described by this Section consists of all earthwork encountered and necessary for construction of the project as indicated in the Contract Documents, and includes but is not limited to the following:
 - 1. Excavation
 - 2. Backfilling and Filling
 - 3. Compaction
 - 4. Embankment Construction
 - 5. Grading
 - 6. Providing soil material as necessary
 - 7. Disposal of excess suitable material and unsuitable materials
- B. Related Work Specified Elsewhere: (When Applicable)
 - 1. The use of explosives is specified in the Supplementary Conditions section of this Contract, and in Division 1.
 - 2. Traffic Regulation is specified in Division 1.
 - 3. Clearing and Grubbing, Dewatering, Filter Fabric, Temporary Erosion Control, Stripping and Stockpiling of Topsoil, Sheeting, Landscaping, and Paving are specified in the appropriate sections of this Division.
 - 4. Section 01400 - Quality Control.
 - 5. Pipe, fittings and valves are specified in Division 15 or 2.

1.2 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. All work shall be performed and completed in accordance with all local, state and federal regulations.
 - 2. The General Contractor shall secure all other necessary permits unless otherwise indicated from, and furnish proof of acceptance by, the municipal and state departments having jurisdiction and shall pay for all such permits, except as specifically stated elsewhere in the Contract Documents.
- B. Line and Grade:
 - 1. The Contractor shall establish the lines and grades in conformity with the Drawings and maintain same to properly perform the work.
- C. Testing Methods:
 - 1. Gradation Analysis: Where a gradation is specified the testing shall be in accordance with ASTM C-117-90 and ASTM C-136-93 (or latest revision).
 - 2. Compaction Control:
 - a) Unless otherwise indicated, wherever a percentage of compaction for back-fill is indicated or specified, it shall be the in-place density divided by the maximum density and multiplied by 100. The maximum density shall be

the density at optimum moisture as determined by ASTM Standard Methods of Test for Moisture-Density Relations of Soil Using 10-lb. Hammer and 18-in. Drop, Designation D-1557-91 (Modified Proctor), or latest revision, unless otherwise indicated.

- b) The in-place density shall be determined in accordance with ASTM Standard Method of Test for Density of Soil in Place by the Sand Cone method, Designation D 1556-90, (or latest revision) or Nuclear method Designation D2922.
- c) Wherever specifically indicated, maximum density at optimum moisture may be determined by ASTM Standard Methods of Test for Moisture Density Relations of Soils, ASTM D-698-91 (Standard Proctor).
- d) An Independent Testing Laboratory will be retained by the Owner to conduct all laboratory and field soil sampling and testing, and to observe earth work and foundation construction activities. Laboratory testing will consist of sieve analyses, natural water content determinations, and compaction tests. Field testing will consist of in-place field density tests and determination of water contents.

1.3 SUBMITTALS

- A. Collection of samples and testing of all materials for submittals shall be performed by the Independent Testing Laboratory and paid for by the Contractor until the materials are approved by the Owner or Engineer.
- B. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
- C. Submit test results (including gradation analysis) and source location for all borrow material to be used at least 10 working days prior to its use on the site. Contractor shall identify and provide access to borrow sites.
- D. Submit moisture density curve for each type of soil (on site or borrow material) to be used for embankment construction or fill beneath structures or pavement.

1.4 TESTS

The Independent Testing Laboratory shall conform to the following procedures and standards:

- A. Submit test results in accordance with the procedure specified in the General and Supplementary Conditions.
- B. All testing shall be performed by a qualified Independent Testing Laboratory acceptable to the Engineer and Contractor at the Owner's expense unless otherwise indicated (see Section 01400 - Quality Control).
- C. Field density tests on embankment materials shall be as follows:
 - 1. Tests shall be taken on every 200 cubic yards of embankment material.
- D. Paved Areas and Building Slab Sub grade: Make at least one field density test of sub grade for every 2,000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2,000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.
- E. Trenches: Field density test in trenches shall be taken at 75 linear foot intervals on every third lift.

- F. Foundation Wall Backfill: Take at least one (1) field density tests per lift per wall at locations and elevations as designated by the Engineer.
- G. In addition to the above tests the Independent Testing Laboratory will perform additional density tests at locations and times requested by the Engineer.
- H. Additional density testing will be required by the Engineer if the Engineer is not satisfied with the apparent results of the Contractor's compaction operation.
 - 1. If the test results fail to meet the requirements of these specifications, the Contractor shall undertake whatever action is necessary, at no additional cost to the Owner, to obtain the required compaction. The cost of retesting will be paid by Owner. The cost of retesting will be determined by Engineer and Owner will invoice Contractor for this cost. If unpaid after 60 days, the invoice amount for retesting will be deducted from the Contract Price. No allowance will be considered for delays in the performance of the work.
 - 2. If the test results pass and meet the requirements of these Specifications, the cost of the testing service will be borne by the Owner, but no allowance will be considered for delays in the performance of the work.

1.5 JOB CONDITIONS

A. Site Information:

- 1. Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings. It is expressly understood that Owner and Engineer will not be responsible for interpretations or conclusions drawn there from by the Contractor. Data are made available for the convenience of Contractor.
- 2. Additional test borings and other exploratory operations may be made by Contractor at no additional cost to Owner.

B. Existing Utilities and Structures:

- 1. The locations of utilities and structures shown on the Drawings are approximate as determined from physical evidence on or above the surface of the ground and from information supplied by the utilities. The Engineer in no way warrants that these locations are correct. It shall be the responsibility of the Contractor to determine the actual locations of any utilities or structures within the project area.

PART 2 - PRODUCTS

2.1 SOIL MATERIAL

- A. Select Fill: Shall consist of well graded granular material free of organic material, loam, wood, trash, snow, ice, frozen soil and other objectionable material and having no rocks with a maximum dimension of over 4 inches and meeting the following gradation requirements, except where it is used for pipe bedding in which case the maximum size shall be 2 inches.

<u>Sieve</u> <u>Designation</u>	<u>Percent by Weight</u> <u>Passing Square Mesh Sieve</u>
4 inch	100
3 inch	90-100

½ inch	25-90
No. 40	0-30
No. 200	0-5

- B. Sand: Shall be well graded durable material free of organic matter and conform to the following gradation requirements:

<u>Sieve Designation</u>	<u>Percent by Weight Passing Square Mesh Sieve</u>
3/8 inch	100
No. 4	95-100
No. 16	50-85
No. 50	10-30
No.100	2-10
No.200	0-5

Sand conforming to the requirement for fine aggregate in ASTM Standard Specifications for Concrete Aggregate, Designation C-33, will meet the above requirement.

2.2 CONCRETE

- A. If concrete is required for excess excavation, provide 3,000 psi concrete complying with requirements of Section 03300.

2.3 FILTER FABRIC

- A. If filter fabric is required, refer to Section 02260.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine the areas and conditions under which excavating, backfilling, filling, compaction and grading are to be performed and notify the Engineer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 EXCAVATION

A. General:

- Excavation consists of removal and disposal of all material encountered when establishing line and grade elevations required for execution of the work.
- The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and jointing the piping; shall furnish and place all sheeting, bracing, and supports; shall do all coffer damming, pumping, and draining; and shall render the bottom of the excavations firm, dry and acceptable in all respects.
- All excavation shall be classified as either earth or ledge.
 - Earth Excavation shall consist of the removal, hauling and disposal of all earth materials encountered during excavation including but not limited to

- native soil or fill, pavement (bituminous or concrete), existing sewers and manholes, ashes, loam, clay, swamp muck, debris, soft or disintegrated rock or hard pan which can be removed with a backhoe, or a combination of such materials, and boulders measuring less than one cubic yard.
- b) Ledge Excavation: Shall consist of the removal, hauling, and disposal of all ledge or rock encountered during excavation. "Ledge" and "rock" shall be defined as any natural compound, natural mixture that in the opinion of the Engineer can be removed from its existing position and state only by drilling and blasting, wedging, sledging, boring or breaking up with power operated tools. No boulder, ledge, slab, or other single piece of excavated material less than one cubic yard in total volume shall be considered to be rock unless, in the opinion of the Engineer it must be removed from its existing position by one of the methods mentioned above.
4. The Contractor shall not have any right of property in any materials taken from any excavation. Do not remove any such materials from the construction site without the approval of the Engineer. This provision shall in no way relieve the Contractor of his obligations to remove and dispose of any material determined by the Engineer to be unsuitable for backfilling. The Contractor shall dispose of unsuitable and excess material in accordance with the applicable sections of the Contract Documents.
- B. Additional Excavation: When excavation has reached required sub grade elevations, notify the Engineer and Resident Project Representative who will observe the conditions.
1. If material unsuitable for the structure or paved area or pipeline (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the Drawings and/or Specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted select fill, screened stone, crushed stone, or concrete as directed by the Engineer.
2. All excavated materials designated by the Engineer as unsuitable shall become the property of the Contractor and disposed of at locations in accordance with all State and local laws and the provisions of the Contract Documents.
- C. Unauthorized Excavation: Shall consist of removal of materials beyond indicated sub grade elevations or dimensions without specific authorization of Engineer. Unauthorized excavation, as well as remedial work required by the Engineer shall be at the Contractor's expense. Remedial work required is as follows:
1. Under footings, foundation bases, or retaining walls, fill unauthorized excavation with select fill or screened stone compacted to 95%. Provide 12" minimum select fill or screened stone directly under footings. Concrete fill may be used to bring elevations to proper position, when acceptable to Engineer.
2. If the bottom of a trench is excavated beyond the limits indicated, backfill the resulting void with thoroughly compacted screened stone, unless otherwise indicated.
3. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Engineer.
- D. Structural Excavation:

1. Shall consist of the removal, hauling, disposal, of all material encountered in the excavation to permit proper installation of structures.
 2. Excavations for structures shall be carried to the lines and sub grades shown on the Drawings.
 3. Excavate areas large enough to provide suitable room for building the structures.
 4. The extent of open excavation shall be controlled by prevailing conditions subject to any limits designated by the Engineer.
 5. Provide, install, and maintain sheeting and bracing as necessary to support the sides of the excavation and to prevent any movement of earth which could diminish the width of the excavation or otherwise injure the work, adjacent structures, or persons and property in accordance with all state and OSHA safety standards.
 6. Erect suitable fences around structure excavation and other dangerous locations created by the work, at no additional cost to the Owner.
 7. Exposed sub grade surfaces shall remain undisturbed, protected, and maintained as uniform, plane areas and shape to receive the foundation components of the structure.
 - a. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 - b. In excavating for footings and foundations, take care not to disturb bottom of excavation. Excavate by hand to final grade and trim bottoms to required lines and grades to leave solid base to receive the structure.
 - c. If a structure is to be constructed within the embankment, the fill shall first be brought to a minimum of 3 feet above the base of the footing. A suitable excavation shall then be made as though the fill were undisturbed earth.
- E. Trench Excavation: Shall consist of removal, hauling and disposal of all material encountered in the excavation to the widths and depths shown on the Drawings to permit proper installation of underground utilities.
1. Excavate trenches to the uniform width shown on the Drawings sufficiently wide to provide sufficient space for installation, backfilling, and compaction. Every effort should be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.
 2. Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation one foot above the top of the pipe.
 3. Grade bottoms of trenches as indicated for pipe and bedding to establish the indicated slopes and invert elevations, notching under pipe joints to provide solid bearing for the entire body of the pipe, where applicable.
 4. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least two feet above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.
 5. Unless otherwise specifically directed or permitted by the Engineer, begin excavation at the low end of sewer and storm lines and proceed upgrade.
 6. Perform excavation for force mains and water mains in a logical sequence.

7. The extent of open excavation shall be controlled by prevailing conditions subject to any limits prescribed by the Engineer.
 8. As the excavation progresses, install such shoring and bracing necessary to prevent caving and sliding and to meet the requirements of the state and OSHA safety standards, as outlined in the appropriate section of this Specification.
- F. Protection of Persons, Property and Utilities:
1. Barricade open excavations occurring as part of this work and post with warning lights in compliance with local and State regulations.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations. Exercise extreme caution and utilize sheeting, bracing, and whatever other precautionary measures that may be required.
 3. Rules and regulations governing the respective utilities shall be observed in execution of all work. Active utilities and structures shall be adequately protected from damage, and removed or relocated only as indicated or specified. Inactive and abandoned utilities encountered in excavation and grading operations shall be removed, plugged or capped only with written authorization of the utility owner. Report in writing to the Engineer, the locations of such abandoned utilities. Extreme care shall be taken when performing work in the vicinity of existing utility lines, utilizing hand excavation in such areas, as far as practicable.
 4. Repair, or have repaired, all damage to existing utilities, structures, lawns, other public and private property which results from construction operations, at no additional expense to the Owner, to the complete satisfaction of the Engineer, the utility, the property owner, and the Owner.
- G. Use of Explosives:
1. Do not bring explosives onto site or use in work without prior written permission from authorities having jurisdiction. Contractor is solely responsible for handling, storage, and use of explosive materials when their use is permitted.
 2. All blasting shall be performed in accordance with all pertinent provisions of the "Manual of Accident Prevention in Construction" of the Associated General Contractors of America, Inc.
- H. Stability of Excavations:
1. Slope sides of excavations to comply with all codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated.
 2. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
- I. Shoring and Bracing:
1. Provide materials for shoring and bracing, such as sheet piling, uprights, stringers and cross-braces, in good serviceable condition.
 2. Provide trench shoring and bracing to comply with local codes and authorities having jurisdiction. Refer to Specification Section 02156.
 3. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Install shoring and bracing as excavation progresses.
- J. Material Storage:

1. Stockpile excavated materials which are satisfactory for use on the work until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and protect with temporary seeding or other acceptable methods to control erosion.
 2. Locate and retain soil materials away from edge of excavations.
 3. Dispose of excess soil material and waste materials as herein specified.
- K. Dewatering:
1. To ensure proper conditions at all times during construction, the Contractor shall provide and maintain ample means and devices (including spare units kept ready for immediate use in case of breakdowns) with which to intercept and/or remove promptly and dispose properly of all water entering trenches and other excavations (including surface and subsurface waters).
 2. Excavations shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged. Refer to Specification Section 02401.
- L. Cold Weather Protection:
1. Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
 2. No frozen material shall be used as backfill or fill and no backfill shall be placed on frozen material.
- M. Separation of Surface Material:
1. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work.
 2. Prior to excavation, existing pavement shall be cut where in the opinion of the Engineer it is necessary to prevent damage to the remaining road surface.
 3. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.
 4. From areas within which excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed; or, if the Contractor prefers not to separate surface materials, he shall furnish, as directed, loam and topsoil at least equal in quantity and quality to that excavated.
- N. Dust Control:
1. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. Refer to Specification Section 01562.
 2. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control, the contractor shall furnish and spread the material, as directed.

3.3 BACKFILL AND FILL

A. General:

1. Backfilling shall consist of replacing material removed to permit installation of structures or utilities, as indicated in the Contract Documents.
2. Filling shall consist of placing material in areas to bring them up to grades indicated on the Drawings.
3. The Contractor shall provide and place all necessary backfill and fill material, in layers to the required grade elevations.

4. Backfill excavations as promptly as work permits, but not until completion of the following:
 - a. Acceptance by Engineer of construction below finish grade including, where applicable, damp proofing, waterproofing, and perimeter insulation.
 - b. Inspection, approval, and recording locations of underground utilities.
 - c. Removal of concrete formwork.
 - d. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Temporary sheet piling driven below bottom of structures shall be removed in manner to prevent settlement of the structure or utilities, or cut off and left in place if required.
 - e. Removal of trash and debris.
 - f. Permanent or temporary horizontal bracing is in place on horizontally supported walls.
 - g. Density testing having results meeting requirements specified herein.
5. In general, and unless otherwise indicated, material used for backfill of trenches and excavations around structures shall be suitable excavated material which was removed in the course of making the construction excavation. Unless otherwise specified or allowed by the Engineer the backfill and fill shall be placed in layers not to exceed 8 inches in thickness.
6. All fill and backfill under structures and pavement, and adjacent to structures, shall be compacted crushed stone or select fill as specified or as indicated on the Drawings. The fill and backfill materials shall be placed in layers not exceeding 8 inches in thickness.
7. All structures (including manholes) shall be placed on a 6-inch mat of screened stone unless otherwise indicated.
8. Suitable excavated material shall meet the following requirements:
 - a. Free from large clods, silt lumps or balls of clay.
 - b. Free from stones and rock fragments with larger than 12 inch max. dimension.
 - c. Free from organics, peat, etc.
 - d. Free from frozen material.
9. If sufficient suitable excavated material is not available from the excavations, and where indicated on the Drawings, the backfill material shall be select fill or common borrow, unless otherwise indicated, as required and as directed by the Engineer.
10. Do not backfill with, or on, frozen materials.
11. Remove, or otherwise treat as necessary, previously placed material that has frozen prior to placing backfill.
12. Do not mechanically or hand compact material that is, in the opinion of the Engineer, too wet.
13. Do not continue backfilling until the previously placed and new materials have dried sufficiently to permit proper compaction.
14. The nature of the backfill materials will govern the methods best suited for their placement and compaction. Compaction methods and required percent compaction is covered in Compaction section.

15. Before compaction, moisten or aerate each layer as necessary to provide a water content necessary to meet the required percentage of maximum dry density for each area classification specified.
 16. Do not allow large masses of backfill material to be dropped into the excavation in such a manner that may damage pipes and structures.
 17. Place material in a manner that will prevent stones and lumps from becoming nested.
 18. Completely fill all voids between stones with fine material.
 19. Do not place backfill on or against new concrete until it has attained sufficient strength to support loads without distortion, cracking, and other damage.
 20. Deposit backfill and fill material evenly on all sides of structures to avoid unequal soil pressures.
 21. Keep stones or rock fragments with a dimension greater than two inches at least one foot away from the pipe or structure during backfilling.
 22. Leave sheeting in place when damage is likely to result from its withdrawal.
 23. Completely fill voids left by the removal of sheeting with screened stone which is compacted thoroughly.
- B. Pipe Bedding, Initial Backfill and Trench Backfill
1. Place bedding and backfill in layers of uniform thickness specified herein, and as shown on the Drawings.
 2. Thoroughly compact each layer by means of a suitable vibrator or mechanical tamper.
 3. Install pipe bedding and initial backfill in layers of uniform thickness not greater than eight (8) inches.
 4. Deposit the remainder of the backfill in uniform layers not greater than eight inches.
 5. Provide underground sewer marking tape for the full length of sewer trenches as shown on the Drawings. Marking tape shall be SETON #210 SEW or equivalent.
 6. Where soft silt and clay soils are encountered the trench shall be excavated six inches below the normal bedding and backfilled with 6-inches of compacted sand.
 7. Backfill trenches with concrete where trench excavations pass within 18 inches of column or wall footings and which are carried below the bottom of such footings, or which pass under wall footings. Place concrete to the level of the bottom of adjacent footings.
 8. The following schedule gives the bedding requirements for various types of pipe. Distances refer to vertical thickness below the pipe.

BEDDING REQUIREMENTS

DI or Concrete Pipe 6 inches min. screened stone or select fill.

PVC or PE Pipe 6 inches min. screened stone.

9. The following schedule gives the initial backfill requirements for various types of pipes.

INITIAL BACKFILL REQUIREMENTS

DI or Concrete, Pipe	Screened stone or select fill 6 inches min. over top of pipe.
-------------------------	--

PVC or PE Pipe	6 inches min. screened stone over the top of the pipe.
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10. Special bedding and backfill requirements shown on the Drawings supersede requirements of this section.
 11. Where pipes or structures pass through or under the impervious core of the lagoon embankments, bedding and backfill material shall consist of the impervious embankment material. Extra care should be given to properly and thoroughly compact the bedding material around the pipe.
- C. Improper Backfill:
1. When excavation and trenches have been improperly backfilled, and when settlement occurs, reopen the excavation to the depth required, as directed by the Engineer.
 2. Refill and compact the excavation or trench with suitable material and restore the surface to the required grade and condition.
 3. Excavation, backfilling, and compacting work performed to correct improper backfilling shall be performed at no additional cost to the Owner.
- D. Ground Surface Preparation:
1. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, scarify or break-up sloped surface steeper than 1 vertical to 4 horizontal.
 2. When existing ground surface has a density less than that specified under "compaction" for the particular area classification, break up the ground surface, pulverize, moisture-condition to the optimum moisture content, and compact to required depth and percentage of maximum density.

3.4 COMPACTION:

A. General:

1. Control soil compaction during construction to provide not less than the minimum percentage of density specified for each area classification.

B. Percentage of Maximum Density Requirements:

1. Compact soil to not less than the following percentages of maximum dry density determined in accordance with ASTM D1557 as indicated.
 - a. Structures: Compact each layer of backfill or fill material below or adjacent to structures to at least 95% of maximum dry density (ASTM D1557).
 - b. Off Traveled Way Areas: Compact each layer of backfill or fill material to at least 90% of maximum dry density (ASTM D1557).
 - c. Walkways: Compact each layer of backfill or fill material to at least 93% of maximum dry density (ASTM D1557).
 - d. Roadways, Drives and Paved Areas: Compact each layer of fill, subbase material, and base material to at least 95% of maximum dry density (ASTM D1557).

- e. Pipes: Compact bedding material and each layer of backfill to at least 90% maximum dry density (ASTM D1557). Where backfilling with excavated material, compact to native field density.
 - f. Embankments: Compact each layer of embankment material to at least 95% of maximum dry density (ASTM D1557).
- C. Moisture Control:
- 1. Where sub grade or a layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of sub grade, or layer of soil material, in quantities controlled to prevent free water appearing on surface during or subsequent to compaction operations.
 - 2. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
 - 3. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory level.
- D. Embankment Compaction:
- 1. After each embankment layer has been spread to the required maximum 8-inch thickness and its moisture content has been adjusted as necessary, it shall be rolled with a sufficient number of passes to obtain the required compaction. One pass is defined as the required number of successive trips which by means of sufficient overlap will insure complete coverage and uniform compaction of an entire lift. Additional passes shall not be made until the previous pass has been completed.
 - 2. When any section of an embankment sinks or weaves excessively under the roller or under hauling units and other equipment, it will be evident that the required degree of compaction is not being obtained and that a reduction in the moisture content is required. If at any place or time such sinking and weaving produces surface cracks which, in the judgment of the Engineer are of such character, amount, or extent to indicate an unfavorable condition, he will recommend operations on that part of the embankment to be suspended until such time as it shall have become sufficiently stabilized. The ideal condition of the embankment is that attained when the entire embankment below the surface being rolled is so firm and hard as to show only the slightest weaving and deflection as the roller passes.
 - 3. If the moisture content is insufficient to obtain the required compaction, the rolling shall not proceed except with the written approval of the Engineer, and in that event, additional rolling shall be done to obtain the required compaction. If the moisture content is greater than the limit specified, the material of such water content may be removed and stockpiled for later use or the rolling shall be delayed until such time as the material has dried sufficiently so that the moisture content is within the specified limits. No adjustment in price will be made on account of any operation of the Contractor in removing and stockpiling, or in drying the materials or on account of delays occasioned thereby.
 - 4. If because of insufficient overlap, too much or too little water, or other cause attributable to defective work, the compaction obtained over any area is less than that required, the condition shall be remedied, and if additional rollings are ordered, they will be done at no cost to the Owner. If the material itself is unsatisfactory or if additional rolling or other means fails to produce satisfactory

results, the area in question shall be removed down to material of satisfactory density and the removal, replacement, and re-rolling shall be done by the Contractor, without additional compensation.

5. Material compaction by hand-operated equipment or power-driven tampers shall be spread in layers not more than 6 inches thick. The degree of compaction obtained by these tamping operations shall be equal in every respect to that secured by the rolling operation.
- E. Compaction Methods: The Contractor may select any method of compaction that is suitable to compact the material to the required density.
1. General: Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. All voids left by the removal of sheeting shall be completely backfilled with suitable materials and thoroughly compacted.
 2. Tamping or Rolling: If the material is to be compacted by tamping or rolling, the material shall be deposited and spread in uniform, parallel layers not exceeding the uncompacted thicknesses specified. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the excavation side slopes, as well as in all other portions of the fill area, is thoroughly compacted. When the excavation width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe or structure, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping or rolling, the rate at which backfilling material is deposited shall not exceed that permitted by the facilities for its spreading, leveling, and compacting as furnished by the Contractor.
- F. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

3.5 GRADING:

A. General:

1. Grading shall consist of that work necessary to bring all areas to the final grades.
2. Uniformly grade areas within limits of work requiring grading, including adjacent transition areas.
3. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Grading Outside Building Lines:

1. Grade areas adjacent to building to drain away from structures and to prevent ponding.
2. Grade surfaces to be free from irregular surface changes, and as follows:
 - a. Lawn or Unpaved Areas: Finish grade areas to receive topsoil to within not more than 1" above or below the required sub grade elevations.
 - b. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 1/2" above or below the required sub grade elevation.

- c. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 3/8" above or below the required sub grade elevation.
- C. Grading Surface of Fill Under Building Slabs:
 - 1. Grade surface to be smooth and even, free of voids, and compacted as specified, to the required elevation.
 - 2. Provide final grades within a tolerance of 1/2" when tested with a 10' straight edge.
- D. Compaction:
 - 1. After grading, compact sub grade surfaces to the depth and percentage of maximum density for each area classification.
- E. Protection of Graded Areas:
 - 1. Protect newly graded areas from traffic and erosion. Keep free of trash and debris.
 - 2. Repair and re-establish grades in settled, eroded, and rutted areas to specified tolerances.

3.6 BASE COURSE AND LEVELING COURSE

- A. General:
 - 1. Base course consists of placing the specified materials in layers to support a leveling course or paved surface, as indicated in the Drawings.
- B. Grade Control:
 - 1. During construction, maintain lines and grades including crown and cross-slope of base course and leveling course.
- C. Placing:
 - 1. Place base course on prepared sub base conforming to indicated cross-section and thickness. Maintain optimum moisture content for compacting base materials.
 - 2. Place leveling course on prepared base course, conforming to indicated cross-section and thickness. Maintain optimum moisture content for compaction.
- D. Shaping and Compacting:
 - 1. All layers of aggregate base course and leveling course shall be compacted to the required density immediately after placing. As soon as the compaction of any layer has been completed, the next layer shall be placed.
 - 2. The Contractor shall bear full responsibility for and make all necessary repairs to the base leveling courses and the sub grade until the full depth of the base leveling courses is placed and compacted. Repairs shall be made at no additional cost to the Owner.
 - 3. If the top of any layer of the aggregate base or leveling course becomes contaminated by degradation of the aggregate or addition of foreign materials, the contaminated material shall be removed and replaced with the specified material at the Contractor's expense.

END OF SECTION

SECTION 03346CONCRETE FINISHING, CURING AND REPAIRSPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Concrete Curing
- B. Concrete Finishing
- C. Concrete Repairs

1.2 RELATED SECTION

- A. Section 03300 - Cast-in-Place Concrete

1.3 REFERENCES

- A. ACI 301-96 - Standard Specifications for Structural Concrete
- B. ACI 302.1R-89 - Guide for Concrete Floor and Slab Construction
- C. ACI 305R-91 - Hot Weather Concreting
- D. ACI 306R-88 - Cold Weather Concreting
- E. ACI 308-92 - Standard Practice for Curing Concrete
- F. ACI 350R-89 - Environmental Engineering Concrete Structures
- G. ASTM C309-98a - Specification For Liquid Membrane - Forming Compounds for Curing Concrete

1.4 SUBMITTALS

- A. Submit product data and material safety data sheets for curing compounds, and repair materials.
- B. Submit procedures prior to concrete placements for cold weather protection, hot weather protection and curing methods.

1.5 ENVIRONMENTAL CONDITIONS

- A. Cold Weather and Hot Weather are defined when temperatures will fall below 40°F during the week following placement or will be above 90°F, respectively.

1.6 QUALITY ASSURANCE

- A. All curing, finishing and repair materials shall meet all Federal and State regulations pertaining to Volatile Organic Compounds (VOC) Compliance.
- B. Contractor performing flatwork finishing of concrete slabs shall provide at least one (1) flatwork finisher certified as an ACI Concrete Flatwork finisher.

PART 2 - PRODUCTS2.1 LIQUID CURING COMPOUND MATERIALS

- A. Curing and Sealing Compound; ASTM C309 Type 1 Class B. Application rate 200 square feet per gallon. Super Kurseal by A.H. Harris & Sons, Inc. Emulsion Kurseal 309 by A.H. Harris & Sons, Inc. or equivalent.
- B. Dissipating Resin Curing Compound: ASTM C309 type 1; Film must break down in two to four weeks. Application rate 200 square feet per gallon. Kurez-DR by Euclid Chemical Company, Emulsion Super KonKure 309 clear by A.H. Harris & Sons, Inc., or equivalent.
- C. Curing/Hardening Compound: Sodium Silicate Type. Application rate 200 square feet per gallon. Eucosil by Euclid Chemical Company, Super KurHard 309 by A.H. Harris & Sons, Inc., or equivalent.

2.2 FINISHING MATERIALS

- A. Bonding Admixture: Latex, non-rewettable type SBR Latex or Flex-con by Euclid Chemical, Daraweld C by W.R. Grace or equivalent.
- B. Grout Paint: mix 1 part Portland Cement, 1.5 part fine sand, 50:50 mixture of bonding admixture to consistency of thick paint.
- C. Patching Mortar: 1 part of a mixture of white and grey portland cement to 2.5 parts of damp loose sand. Cement type to match substrate.

2.3 REPAIR MATERIALS

- A. Epoxy Adhesive: Armatex 110 by Sika Corporation or equivalent.
- B. Repair Mortar: Polymer improved, cementitious, 2 component, trowel grade mortar equal to Concrete Coat by Euclid Chemical; Sikatop 122 by Sika Corp. or equivalent.

PART 3 - EXECUTION3.1 FINISHES

- A. Repair all holes and defects and allow to set prior to finishing concrete.
- B. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
- C. Finish concrete surfaces as scheduled.

3.2 FINISHING SLABS AND FLATWORK

- A. Screed to bring concrete surface to proper contour and elevation.
- B. Highway straightedge, bull float or darby float the concrete surface immediately after screeding.
- C. Allow bleed water to evaporate or remove.
- D. (STF) Steel Troweled Finish: Float the surface with magnesium or cast aluminum float or with a power finishing machine. Steel trowel surface immediately after floating to produce smooth surface. Steel trowel again after concrete has hardened enough so that mortar does not adhere to trowel edge. Ringing sound should be apparent when performing second troweling due to tilted, compacting motion.
- E. (WFF) Wood Float Finish: allow concrete to stiffen; float surface twice or more to a uniform sandy texture.

- F. (LBF) Light Broom Finish: wood float finish as in E above; while plastic draw a soft-bristled broom, over the concrete in long even strokes with downward pressure. Broom transverse to traffic or at right angles to the slope of the slab.
- G. Finish to receive concrete fill: do not bull float; remove water scum, laitance and loose aggregate from surface after concrete has started to harden with stiff bristle brush to partially expose coarse aggregate. Clean surface with brooms, water jets or air jets. Maintain wet for 12 hours immediately before placing fill concrete. As fill concrete is placed and just ahead of placement, broom in grout paint to the damp concrete surface. Do not allow grout paint to set prior to placement of concrete fill.
- H. Tolerances for trowel finished floors: ACI 302 class BX. 5/16 inch maximum deviation from 10 foot long straightedge placed anywhere on the surface.

3.3 FINISHING VERTICAL SURFACES

- A. (RFF) Rough Form Finish: Repair structural defects only and patch tie holes as specified in paragraph [3.8] - STRUCTURAL DEFECTS. Fins exceeding 1/4-in. in height to be removed by grinding and/or rubbing.
- B. (SFF) Smooth Form Finish: The concrete surface shall be of uniform color, texture and free of all irregularities. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the minimum. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Remove fins flush by grinding and/or rubbing. Repair surface and structural defects as specified in paragraph [3.7] - SURFACE DEFECTS and paragraph [3.8] - STRUCTURAL DEFECTS.

3.4 CURING

- A. Curing: Curing shall begin immediately following the initial set of concrete or after slab surface finishing has been completed and shall continue after form removal per Section 03300, 3.1.L. All concrete shall be cured to attain strength and durability by one of the following methods for a minimum of seven days after placement regardless of the ambient air temperature: See Schedule of Finishes and Curing Requirements - Section 03346, [3.6.]
 - 1. Ponding or continuous sprinkling. Intermittent wetting and drying is not an acceptable curing method.
 - 2. Application of absorptive mats of fabric kept continuously wet.
- B. Moisture loss from surfaces placed against wooden or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal, the concrete shall be cured by one of the methods described above, for the balance of time remaining as specified above.
- C. Cold Weather:
 - 1. Maintain concrete temperature between 50°F and 70°F for a minimum of seven days after placement, enclose and heat, insulate as required.
 - 2. Protect concrete from damage due to concentrated heat sources.
 - 3. Reapply curing compounds every two days during heating period.
 - 4. The maximum allowable temperature drop of the concrete surfaces during the first 24 hours after the end of the curing period shall not exceed 5°F in any 1 hour and shall not exceed the following total gradual temperature drop in the first 24 hours:

	Concrete Thickness
Less than 12 in.	12 to 36 in.
50 F	40 F

- D. Hot Weather: Concrete temperature shall not be greater than 90°F. Protect from loss of slump, flash set, plastic cracking and rapid evaporation of water.
- E. Place concrete quickly, shade from direct sun and protect from wind. Concrete shall be cured by one of the methods described in paragraph 3.[6.]A for seven days after placement.

3.5 SCHEDULE OF FINISHES AND CURING REQUIREMENTS

A. Provide finishes on concrete surfaces according to the following schedule:

<u>Location</u>	<u>Finish</u>	<u>Curing Requirements</u>
Exterior Exposed Walls to 6" below grade	SFF	Moist cure or apply two coats dissipating curing compound
Exterior unexposed walls	RFF	Moist cure or apply two coats curing and sealing compound.
Slab	LBF	Moist cure and apply two coats of slab sealer
Equipment Pads	WFF	

- NOTE: 1. Coordinate compatibility of curing compounds with damp proofing and waterproofing compounds.
2. When two (2) coats of materials are required as indicated above, second coat shall be applied perpendicular to the first coat.

3.6 SURFACE DEFECTS

- A. As soon as the forms have been stripped and the concrete surfaces exposed, repair all surface defects. Surface defects include all form tie holes, honeycombed areas and surface blemishes including air voids and bug holes with a nominal diameter or depth greater than ¼ inch, visible construction joints, fins, burs and other defects. All concrete repair work shall result in a concrete surface of uniform color and texture, and shall be free of all irregularities. Honeycombed and/or rat holes larger than 50 cubic inches are considered a structural defect.
- B. Cut out and remove honeycombed areas and rock pockets down to solid concrete, but in no case to a depth less than 1 inch, by means of hand chisels or pneumatic chipping hammers. Saw cut the edges perpendicular to the surface. No feather-edges shall be allowed.
- C. Remove all loose aggregate paste and debris and scrub clean; thoroughly wet area to be repaired; brush and scrub grout paint into the substrate of the area to be repaired.

- D. Apply a stiff consistency of patching mortar to the area with a trowel; apply prior to the set of grout paint (but after it has cast its water sheen): leave patched surface slightly higher than surrounding surface; do not finish for 1 hour minimum. Cure in same manner as adjacent concrete.
- E. Mix patching mortar using as little water as possible; allow to stand with frequent manipulation of trowel to achieve stiffest consistency; blend white and gray Portland cement to achieve color match with surrounding concrete.
- F. Form Tie Holes: After cleaned and thoroughly dampened, apply grout paint and fill tie holes solid with patching mortar.

3.7 STRUCTURAL DEFECTS

- A. Remove and replace or repair all structural defects. Structural defects include honeycombed areas and/or rat holes greater than 50 cubic inches, areas which cracking, spalling or other signs of deterioration are present or develop during the initial curing or thereafter until accepted by the Owner. The Contractor shall propose a specific repair method, suitable for the situation, and the Engineer will review the method prior to the repair.
- B. Cut out and remove defective concrete, honeycombed areas and rock pockets to sound concrete by means of hand chisels or pneumatic chipping hammers. Saw cut 1-inch minimum the edges perpendicular to the surfaces. If honeycomb exists around reinforcement, chip to provide a clear space at least 1 inch wide all around the reinforcement. Moisten surfaces and allow to dry until damp. Apply bonding agent. Apply a polymer-modified cement with 3/8 inch coarse aggregate. Cure as required by manufacturer.
- C. Random Cracks:
 - 1. Random shrinkage or structural cracks shall be repaired utilizing a low viscosity, 100% solids, two (2) component epoxy resin system. Remove all dust, debris or disintegrated material from crack or void by use of oil-free compressed air or vacuuming.
 - 2. Crack or void must be dry at time of application. Cracks saturated with oil or grease must be chipped out to unsaturated concrete. "Vee" out cracks in horizontal surfaces slightly.
 - 3. Where cracks extend through members and are accessible, seal bottom of crack which is to receive the epoxy. Apply epoxy in strict accordance with manufacturer's recommendations.
 - 4. Epoxy resin system shall be Sika chemical Corporation "Sikadur Hi-Mod LV", or equal.
 - 5. Patching of vertical wall or overhead cracks shall be accomplished in the same manner using a similar epoxy material of higher viscosity as recommended by the manufacturer.
- D. Spalls:
 - 1. All weakened, damaged or disintegrated concrete shall be removed to sound concrete. For defective areas involving only the surface and/or the finish of the concrete, reference Section 03346, Concrete Finishes, for Surface Defects.
 - 2. For spalled areas involving depths generally less than three (3) inches, utilize epoxy mortar for repair, Sika Chemical Corporation "Sikadur Lo-Mod LV Mortar" or equal.

3. For spalled areas involving depths generally in excess of three (3) inches, utilize an epoxy bonding compound and concrete grout. Bonding compound shall be Sika Chemical Corporation "Sikadur Hi Mod" bonding agent or equal.

3.8 PROTECTION

- A. Protect concrete from high and low temperatures for seven days.
- B. Protect against premature loads until the 28-day strength has been attained.

END OF SECTION

SECTION 03300CAST-IN-PLACE CONCRETEPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Formwork, shoring, bracing, and anchorage
- B. Concrete reinforcement and accessories
- C. Concrete

1.2 PRODUCTS INSTALLED BUT FURNISHED UNDER OTHER SECTIONS

- A. Anchor Bolts Section 13900, Storage Silo

1.3 RELATED SECTIONS

- A. Section 01340 - Submittals
- B. Section 01400 - Quality Control
- C. Section 03305 - Concrete Testing
- D. Section 03346 - Concrete Curing, Finishing and Repairs
- E. Section 07900 - Joint Sealers
- F. Section 13620 - Precast Concrete Building
- G. Section 16050 - Basic Materials and Methods

1.4 REFERENCES

- A. ACI 211.1-91 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
- B. ACI 301-96 - Standard Specifications for Structural Concrete
- C. ACI 302.1R-89 - Guide for Concrete Floor and Slab Construction
- D. ACI 304.2R-96 - Placing Concrete by Pumping Methods
- E. ACI 305R-91 - Hot Weather Concreting
- F. ACI 306R-88 - Cold Weather Concreting
- G. ACI 308-92 - Standard Practice for Curing Concrete
- H. ACI 309R-96 - Guide for Consolidation of Concrete
- I. ACI 318-99 - Building Code Requirements for Structural Concrete and Commentary
- J. ACI 347R-94 - Guide to Formwork for Concrete
- K. ASTM A82-97a - Specification for Steel Wire, Plain, for Concrete Reinforcement
- L. ASTM A615/A615M-00-Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
- M. ASTM A706/A706M-00-Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.
A775M-97 Bars
- N. ASTM C33-99a - Specification for Concrete Aggregates

- O. ASTM C94/C94M-00 - Specification for Ready Mixed Concrete
- P. ASTM C150-99a - Specification for Portland Cement
- Q. ASTM C260-00 - Specification for Air Entraining Admixtures for Concrete
- R. ASTM C309-98a - Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- S. ASTM C494-99a - Specification for Chemical Admixtures for Concrete
- T. Concrete Reinforcing Steel Institute - Manual of Standard Practice
- U. Concrete Reinforcing Steel Institute - Placing Reinforcing Bars

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301 and ACI 318 as modified here-in.
- B. Maintain copies of ACI 301 and ACI 318 on site.

1.6 SUBMITTALS

- A. Submit shop drawings for concrete reinforcement prior to fabrication, showing bar bends, details and placement.
- B. Submit Concrete Mix designs including past field performance test results.
- C. Submit sieve analysis and soundness tests for fine and coarse aggregates taken within the last three (3) months.
- D. Submit Cement Manufacturer's Certificates of conformance with ASTM C150 taken during the last 3 months.
- E. Submit product data and material safety data sheets for concrete admixtures.
- F. Submit product data and material safety data sheets for concrete accessories.
- G. Submit sample concrete mix delivery slip.
- H. Submit product data and material safety data sheets for form release agent.
- I. Submit product data and sample for form ties.

1.7 PRE-CONCRETE CONFERENCE

- A. Contractor shall hold meeting more than 14 days prior to submittal of concrete mixes to review concrete procedures. Engineer will attend.
- B. Meeting Minutes: Contractor shall record minutes of meeting and distribute to attending parties, within 5 days of meeting.
- C. Attendance: Contractor; concrete supplier; mix design laboratory; Independent Testing Laboratory; concrete subcontractor; admixture manufacturer; concrete pumping contractor.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Plywood: APA, B-B Plyform Class I exterior.
- B. Lumber: Southern pine, No. 2 grade or equal.
- C. Steel: Minimum 16 ga. sheet, well matched, tight fitting, stiffened to resist loads without excess deflection.
- D. Form Liner: Plywood conforming to PS-1, Grade B-B exterior (concrete form) not less than 1/4-inch thick.
- E. Form Ties: Factory fabricated assembly providing at least 1.5-inch break back dimension with at least a 1-inch diameter conical wood or plastic cones to leave a

uniform hole for patching. Single rod ties require a tightly fitted waterstop washer at the mid point. Multi rod ties do not require washers.

- F. Form release agent: non-staining colorless, compatible with finishes and non-toxic for potable water. CRETE-LEASE 727 Release Agent by Cresset Chemical Co., Super-X Emulsive by A.H. Harris & Sons, Inc. or equal.
- G. Conform to ACI 301 and ACI 347

2.2 REINFORCING STEEL

- A. Bars: ASTM A615 Grade 60; deformed new materials.
- B. Tie wire: ASTM A82, annealed.
- C. Bolsters, chairs and supports: plastic coated, stainless steel, or epoxy coated.

2.3 FABRICATION OF REINFORCING STEEL

- A. Conform to CRSI Code of Standard Practice-Fabrication.
- B. Cold bend bars.
- C. Bend bars around revolving collar of recommended size.

2.4 CONCRETE MATERIALS

- A. Portland cement: ASTM C150; Type II. Tricalcium Aluminate (C₃A) content in cement less than 8%. Cement shall be furnished from one source during the project.
- B. Aggregates:
 - 1. Fine aggregate shall consist of washed inert natural sand conforming to the requirements of ASTM Specification C-33, and the following requirements:

<u>Sieve</u>	<u>Percent Passing</u>
No. 4	95 to 100
8	80 to 100
16	50 to 85
30	24 to 60
50	5 to 30
100	0 to 10

Fineness Modulus 2.6 to 3.0

- 2. Coarse aggregate shall consist of a well graded crushed stone or a washed

gravel conforming to the requirements of ASTM Specification C-33.

- C. Water: potable from municipal water supply or equal.
- D. Admixtures: All from one common manufacturer.

2.5 ADMIXTURES

- A. Low Range Water Reducer: Pozzolith 122-N by Master Builders; WRDA with HYCOL by Grace Construction Products Division; or equal meeting ASTM C494 Type A
- B. High Range Water Reducer (superplasticiser): Rheobuild 1000 by Master Builders; Daracem 100 by W.R. Grace; or equal meeting ASTM C494 type F.
- C. Air entraining agent: Micro-Air by Master Builders, DAREX 11 AEA by Grace Construction Products; or equal meeting ASTM C260.
- D. Non-corrosive non-chloride accelerator: Pozzutec 20 by Master Builders; or equal meeting ASTM C494 type C or E.
- E. Not permitted: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions.

2.6 CONCRETE CLASS

- A. Reinforced concrete sections greater than 10" thick: Class B

2.7 CONCRETE

- A. Concrete proportioning shall conform to ACI 318, Chapter 5 except as modified below:

	Specified Strength	Coarse Aggregate	Min.- % Air	Min.- Max.	High Range	
					Max.	Max.
Water	Class	(f _c)	Size	±(1.5%)	Slump	Cem.Fac. W/C
Reducer						
B	4000 PSI	No. 67 (¾")	6	1-3	564-620	0.42 Yes

- B. The maximum slump as indicated in the above table will be as measured at the batch plant.
- C. Pumped Concrete: Conform to Chapter 4 - ACI 304.2
- D. High range water reducer shall be added on site to obtain 4" - 8" slump.
- E. No water shall to be added on site.
- F. Concrete shall be furnished from one source during the project.

2.8 SELECTION OF CONCRETE PROPORTIONS

- A. The Concrete producer shall select the concrete mix proportions on the basis of past field performance or the use of trial mixes. The changes in materials, and proportions within the population of background tests shall not have been more closely restricted than they will be for the proposed work. The test record shall represent only a single record of consecutive tests that span a period of not less than 45 calendar days. The concrete mix proportions shall produce an average strength at least as great as the required average strength (f_{cr}).
- B. Field Experience
 - 1. Concrete mix proportions shall be established on the basis of field test data with similar materials to be used for the project. Past field experience will be considered suitable if it consists of data from one group of at least 30 consecutive

compressive strength tests. To be acceptable, the test data shall be based on similar mix proportions to those for the project.

2. The Standard Deviation (s) shall be computed from such test data and the required average strength (f'_{cr}) to be used for the selection of the concrete proportions shall exceed the specified strength (f'_c) in accordance with the following formulae:
 - a. When the standard deviation (s) is less than 500 psi:

$$f'_{cr} = f'_c + 1.34s$$
 - b. When the standard deviation (s) is greater than or equal to 500 psi:

$$f'_{cr} = f'_c + 2.33s - 500$$
3. When a Concrete producer does not have test data meeting the requirements listed in Section 2.8.B.1, but does have data based on a single group of 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and modification factor indicated below. To be acceptable, the test data shall be based on similar mix proportions to those for the project.

<u>No. of tests</u>	<u>Modification factor for standard deviation</u>
15	1.16
20	1.08
25	1.03
30 or more	1.00

4. When a Concrete producer does not have test data meeting the requirements listed in Section 2.8.B.3, but does have data based on a two groups of consecutive tests totaling at least 30. To be acceptable, none of the two groups shall consist of less than 10 tests with similar mix proportions to those for the project. The group containing 15 or more test results which have different mix proportions from those for the project shall be within 1,000 psi of the specified strength. A standard deviation shall be established as the product of the calculated standard deviation based upon the group containing 15 or more test results and modification factor indicated above.
 5. Document that the calculated average strength for the proposed concrete proportions, using past field performance data for the proposed concrete proportions consisting of at least 10 consecutive test records, is at least greater than or equal to the required average strength (f'_{cr}). If the past field performance data consists of two groups of strength tests for two different mixes, plot the average strength versus the water cement ratio of the two mixes. Interpolate between the corresponding mixture proportions to determine the mixture proportions for the required average strength (f'_{cr}).
- C. Laboratory Trial Batches
1. When an acceptable record of field test results is not available, concrete proportions established from trial mixtures meeting the following restrictions shall be permitted:
 - a. Combination of materials shall be that for proposed work.
 - b. The required average compressive strength (f'_{cr}) shall be 4,600 PSI.
 - c. Trial mixtures having proportions and consistencies required for proposed work shall be made using at least three (3) different water-cementitious

- materials ratios which will be less than or equal to 0.42 and will produce a range of strengths encompassing the required average strength (f'_{cr}).
- d. The maximum cement factor as listed in Section 2.7.A shall not be exceeded.
 - e. Trial mixtures shall be designed to produce a slump within + or - 0.75 in. of maximum permitted, and for air entrained concrete, within + or - 0.5 percent of maximum air content.
 - f. For each water-cementitious materials ratio, at least three (3) test cylinders for each test age shall be made and cured in accordance with ASTM C 192. Cylinders shall be tested at 7, 21 and 28 days.
 - g. Maximum water-cementitious materials ratio for concrete to be used in proposed work shall be selected by the curve to produce the average strength required (f'_{cr}).
- D. Adjustments to Required Average Strength (f'_{cr}).
- 1. Adjustments in the Required Average Strength (f'_{cr}) may be made during the progress of the work on the following basis:
 - a. When a minimum of fifteen 28-day tests from this project are available, the average strength and standard deviation shall be computed. Should these determinations indicate an excessive compressive strength with a low standard deviation, the Engineer may allow modification of the concrete mix to achieve a lower average strength based upon a new standard deviation. In the event such determination should indicate a lower average strength or higher Standard Deviation than anticipated, the Engineer will require corrective measures to be taken immediately which may include one or more of the following but not limited to:
 - (1) An increase in the cementitious material
 - (2) Changes in mixture proportions
 - (3) Reductions in or better control of levels of slump supplied
 - (4) A reduction in the delivery time
 - (5) Closer control of air content.
 - (6) Decrease in the water-cement ratio.
 - (7) An improvement in the quality of the testing, including strict compliance with standard test procedures.
 - (8) To test the fifth cylinder immediately or at 56 days.

2.9 STORAGE OF MATERIALS

- A. Protect materials from ground and the elements.
- B. Maintain cement in dry condition.
- C. Store reinforcement on skids.
- D. Remove defective materials from site. Do not store on site.

PART 3 - EXECUTION3.1 FORMWORK

- A. Conform to ACI 301 and ACI 347
- B. Verify lines, levels and measurements before proceeding.
- C. Erect plumb and straight. Maintain rigid. Brace sufficiently.
- D. Allow no concrete leakage. Provide continuous, straight, smooth exposed surfaces.
- E. Treat forms with form release agent. Protect reinforcing from contact with form release agent.
- F. Earth forms not permitted.
- G. Camber formwork as necessary.
- H. Chamfer all exposed outside corners and edges 0.75-inch unless otherwise noted.
- I. Clean out inside of forms of all foreign materials prior to concrete placement.
- J. Maintain specified tolerances.
- K. Maintain forms and shores supporting the cast concrete for the time periods indicated:

- 1. Walls and Vertical Surfaces
(non-water retaining)

*36 Hours

- * These periods represent cumulative number of days or hours during which the temperature of the air surrounding the concrete is above 50°F and the concrete has been damp and no loss of moisture has occurred.

- L. Reshore as required.
- M. Form pressures increase with the use of concrete with High Range Water Reducers. Design forms accordingly.
- N. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form release agent as specified for new formwork.
- O. All concrete formwork, including reinforcing steel and embedment items, shall have a temperature greater than or equal to 35°F at the time of concrete placement.

3.2 REINFORCEMENT

- A. Conform to the CRSI Code of Standard Practice - Field Erection for surface condition, bending, spacing and placement tolerance.
- B. Weld no reinforcement unless no exceptions are taken by Engineer in writing.
- C. Splicing reinforcement: conform to ACI 318; welded wire fabric to be lapped 1½ courses or 12 inches; tie fabric at 24 inches on center maximum spacing.
- D. Provide bar supports: on grade use concrete brick; elsewhere use manufactured wire supports.
- E. Do not bend reinforcing partially embedded in the concrete.
- F. Field cutting of the reinforcement will not be allowed.

3.3 EMBEDDED ITEMS

- A. Coordinate installation of embedded items.
- B. Place anchor bolts.

3.4 PLACING CONCRETE

- A. Notify Engineer and Independent Testing Laboratory 24 hours minimum prior to each placement.
- B. Assure placement and proper location of all embedded items.
- C. Place no concrete on frozen ground.
- D. Place concrete from mixing truck to final location quickly and without segregation.
- E. Place concrete within 90 minutes of batching.
- F. Freefall: 4 feet maximum.
- G. Place continuously and against plastic concrete only.
- H. Do not place partially hardened concrete.
- I. Consolidate concrete by vibrating. Penetrate preceding lift 4 inches to blend layers. Do not use vibrator to move fresh concrete laterally. Insert vibrator at approximately 18-inch intervals. Consolidate concrete without segregation. Conform to ACI 309.
- J. Conform to ACI 306R for cold weather concreting when environmental conditions exist as defined in Section 03346.
 - 1. Temperature limitations on concrete when delivered to site:

		CONCRETE THICKNESS	
Item	Air Temperature	Less than 12 in.	12-36 in.
1	--	55 F	50 F
2	Above 30 F	60 F	55 F
3	0 to 30 F	65 F	60 F
4	Below 0 F	70 F	65 F

- K. Conform to ACI 305R for Hot Weather Concreting when environmental conditions exist as defined in Section 03346.
 - 1. Temperature of concrete placed shall not exceed 90°F.
- L. Provide concrete Delivery Slip prepared at batch plant with each truck load of concrete showing ticket number, date, truck number, mix strength, maximum stone size, weight of coarse aggregate, weight of fine aggregate, cement weight, volume of concrete, gallons of water added at plant, time water added at plant, quantities of all admixtures used and gallons of water withheld at the plant.
- M. High Range Water Reducing admixtures shall be used for all concrete to be pumped or with a specified water/cement ratio below 0.50. Maximum slump 8 inches with admixture.
- N. Use non-corrosive, non-chloride accelerator when placing concrete in air temperatures below 50°F.
- O. Thoroughly moisten sub grade materials prior to placing slabs on grade.
- P. Where shown on the drawings, apply epoxy adhesive to existing concrete to bond to new concrete.
- Q. Thoroughly clean the surface of the concrete at construction and control joints and remove laitance prior to placing adjoining concrete. Do not place concrete against the hardened side of a joint for at least 48 hours.
- R. Provide equipment pads and foundations, as shown on drawings. Set anchor bolts for equipment with templates at correct elevations using manufacturer's shop drawings reviewed by the engineer with no exceptions taken.

3.5 CORING OF HOLES

- A. Core drill holes where shown.
- B. Coring shall be performed with a non-impact rotary tool with diamond core drills, size shall be suitable for pipe conduit, sleeves or mechanical seals to be installed. All equipment shall conform to OSHA standards. Protect all existing equipment, utilities and critical areas against water or other damage caused by the drilling operation.
- C. No structural members shall be cut without no exceptions taken by the Engineer.

3.6 CUTTING OF HOLES

- A. Cutting shall be done with a concrete wall saw and diamond saw blades of proper size.
- B. Provide for control of slurry generated by sawing operation on both sides of wall.
- C. When cutting a reinforced concrete wall, the cutting shall be done so as not to damage the bond between the concrete and reinforcing steel left in structure.

3.7 DRILLING AND GROUT DOWELS

- A. Use rotary drills and cores (non-percussive) and drill holes into concrete to the depth indicated. Hole size shall be one inch (1 in.) larger in diameter than the dowel diameter unless otherwise noted.
 - 1. Drill holes may be offset 2 inches plus or minus from set locations, but shall not be drilled within six inches (6 in.) of the free edge of concrete
- B. Scour the dowel hole by thoroughly roughening the sides with a coarse, wire flue brush.
- C. Clean hole of dust and debris with a power vacuum.
- D. Fill hole with non-shrink grout; insert dowel with twisting motion; add grout as needed.
- E. Maintain dowel stationary until grout cures.

3.8 TOLERANCES

- A. Maximum allowable deviations from dimensions, elevations, slopes and positions as indicated.
 - 1. Variation from plumb:
 - a. In the lines and surfaces of columns, piers, walls, and in arises:
 - In any 10 ft. of length 1/4 in.
 - Maximum for the entire length 1 in.
 - b. For exposed corner of columns, control-joint grooves, and other conspicuous lines:
 - In any 20 ft. length 1/4 in.
 - Maximum for the entire length 1/2 in.
 - 2. Top elevation of columns, piers, walls and arises $\pm 1/4$ in.
 - 3. Variation of the linear building lines from established position in plan and related position of columns, walls, and partitions:
 - In any bay 1/2 in.
 - In any 20 ft. of length 1/2 in.
 - Maximum for the entire length 1 in.
 - 4. Variation of cross-sectional dimensions of columns and

beams and in the thickness of slabs and walls:

Minus 1/4 in.

Plus 1/2 in.

5. Footings*

a. Variations in dimensions in plan:

Minus 1/2 in.

Plus 2 in.

b. Misplacement or eccentricity:

2 percent of the footing width in the direction
of misplacement but not more than 2 in.

c. Thickness:

Decrease in specified thickness 5 percent

Increase in specified thickness No limit

d. Elevation of top $\pm 1/4$ in.

*Tolerances apply to concrete dimensions only, not to positioning
of vertical reinforcing steel, dowels, or embedded items.2

3.9 FAILURE TO MEET STRENGTH REQUIREMENTS

- A. The strength of the concrete in place will be considered substandard if any one of the following results occur:
 1. The arithmetic average of 28-day cylinder tests for any three (3) consecutive test results are less than the specified strength (f'_c).
 2. More than 10 percent of the 28-day cylinder tests have strengths less than the specified strength (f'_c).
 3. An individual compressive strength test result falls below the specified strength (f'_c) by more than 500 psi.
- B. Concrete which fails to meet the strength requirements as outlined above will be reviewed by the Engineer. The Engineer will determine whether the substandard concrete will be accepted, rejected or additional tests performed.
- C. When Substandard concrete as defined in Section 3.9 paragraphs A.1 and A.2 occurs, the Engineer will require corrective measures to be taken immediately, as listed in Section 2.8.D, in order to increase the average of subsequent strength tests.
- D. When substandard concrete as defined in Section 3.11 paragraph A.3 occurs the Engineer may require cores drilled in the area of question in accordance with Specification 03305 paragraph 3.2.B. If the core tests are inconclusive or impractical to obtain, load tests may be required and their results evaluated in accordance with ACI 318 Chapter 20. If the average of the three cores is less than 85% of the specified 28-day strength or if one core is less than 75% of the specified 28-day strength, then that portion of the structure shall be strengthened by a method proposed by the Contractor and no exceptions taken by the Engineer or replaced by the Contractor at no additional cost to the Owner.

3.10 DEFECTIVE CONCRETE

- A. Defective concrete is defined as concrete in place which does not conform to strength, shapes, alignments, appearances and/or elevation as shown on the drawings and/or presents faulty surface areas.
- B. Reinforcing steel size, quantity, strength, position, or arrangement at variance

with the Drawings will be considered defective.

- C. Concrete which differs from the required dimensions or locations in such a manner as to reduce the strength will be considered defective.
- D. Concrete surfaces not finished or cured in accordance with Section 03346 - Concrete Finishing, Curing, and Repairs shall be classified as defective concrete.
- E. Formed surfaces larger or smaller than dimensional tolerances specified in this Division may be rejected. If the Engineer permits the Contractor to correct the error, such correction shall be as directed and in such a manner as to maintain the strength, function and appearance of the structure.
- F. Concrete members cast in the wrong location may be rejected and shall be removed at no additional cost to the Owner if the strength, appearance or function of the structure is adversely affected.
- G. Inaccurately formed surfaces exposed to view may be rejected and shall be repaired or removed and replaced at no additional cost to the Owner.
- H. Concrete exposed to view with defects which adversely affect the appearance of the specified finish shall be repaired. If, in the opinion of the Engineer, the defects cannot be repaired, the concrete may be accepted or rejected in accordance with the decision of the Engineer.

3.11 PROTECTION FROM COLD

- A. Concrete structures shall be covered, insulated and heated as required to prevent frost penetration beneath the structures until acceptance by the Owner.

END OF SECTION

SECTION 03305CONCRETE TESTINGPART 1 - GENERAL1.1 SECTION INCLUDES

- A. Field testing of cast-in-place concrete.
- B. Plant inspection.

1.2 RELATED SECTIONS

- A. Section 03300 - Cast-In-Place Concrete
- B. Section 03346 - Concrete Finishing, Curing and Repairs

1.3 REFERENCES

- A. ASTM C31-98 - Practice For Making and Curing Concrete Test Specimens in the Field
- B. ASTM C39-99 - Test Method For Compressive Strength of Cylindrical Concrete Specimens
- C. ASTM C 42-99 - Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- D. ASTM C172-99 - Practice for Sampling Freshly Mixed Concrete
- E. ASTM C231-97b - Test Method For Air Content of Freshly Mixed Concrete by the Pressure Method
- F. ASTM E 329-98 - Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
- G. ACI 301-96 - Standard Specifications for Structural Concrete

1.4 QUALIFICATIONS

- A. Independent Testing Laboratory shall conform to concrete testing requirements of ASTM E329.
- B. Key personnel must be qualified and experienced in concrete quality assurance.
- C. Perform concrete field quality control testing with personnel certified as an ACI Concrete Field Testing Technician, Grade 1 according to the American Concrete Institute (ACI).

1.5 SUBMITTALS

- A. Owner shall submit Independent Testing Laboratory qualifications, for Engineer's and Contractor's review and acceptance.
- B. The Contractor shall be responsible for the submittals for review and acceptance by the Engineer at no additional cost to the Owner.
- C. Independent Testing Laboratory shall submit one copy each of all test reports to each of the following: Engineer, Resident Project Representative, Contractor and concrete supplier.

- D. Independent Testing Laboratory shall submit reports within 5 days of testing or inspection.
- E. Independent Testing Laboratory shall telephone the Engineer within 24 hours if tests indicate deficiencies.

PART 2 - PRODUCTS - not used

PART 3 - EXECUTION

3.1 CAST-IN-PLACE CONCRETE

- A. An Independent Testing Laboratory, selected and paid for by the Owner, shall test and sample concrete for strength, slump and air content as follows:
- B. Obtain 5 standard test cylinder samples (6" x 12") of each 100 cubic yards or less of each class of concrete placed in any one day.
- C. Test 2 cylinders at 7 days; 2 cylinders at 28 days. Hold one cylinder for later testing.
- D. Perform slump tests and air entrainment tests on each truck and at each sampling. Perform slump and air entrainment tests before addition of High Range Water Reducer and after addition of High Range Water Reducer.
- E. Sample concrete for testing at the discharge end of hose when concrete is pumped.
- F. Perform strength, slump, and air entrainment tests at other times when directed by the Engineer.
- G. Additional testing and sampling required as a result of deficient results or improper curing shall be paid for by Owner. The cost of resampling and retesting will be determined by Engineer, and Owner will invoice Contractor for this cost. If unpaid after 60 days, this invoice amount will be deducted from the Contract Price.
- H. Contractor shall provide and maintain an insulated, heated concrete cylinder curing box, 4 foot square minimum, with a min.-max. thermometer and maintain the temperature between 60°F and 80°F.
- I. Contractor shall provide access to the site at all times for the Independent Testing Laboratory Personnel.

3.2 ADDITIONAL TESTS

- A. Independent Testing Laboratory shall provide additional testing of in-place concrete as directed by Engineer due to non-compliance or considered substandard. Additional tests may consist of non-destructive testing, cores drilled from the area in question or load tests. Costs of additional testing will be paid by Owner. The cost of the additional testing will be determined by Engineer and Owner will invoice Contractor for that cost. If unpaid after 60 days, the invoice amount will be deducted from the Contract Price.
- B. When the concrete strength is substandard as defined in Specification 03300 Section 3.9 paragraph A, concrete core specimens shall be obtained and tested from the affected area.
 - 1. Field cured cylinders may be cast and tested by the independent testing laboratory at the request of the Contractor. The costs of these tests will be borne by the Contractor.
 - 2. Three (3) cores shall be taken for each sample in which the strength requirements were not met. The drilled cores shall be obtained and tested in

END OF SECTION

DIESEL-FIRED STANDBY POWER SYSTEMPART 1 - GENERAL1.1 DESCRIPTION

- A. Provide a complete standby power system as indicated in the Contract Documents. The system shall be a factory built, prototype tested, production tested, field tested, complete and operable emergency / standby electric generating system, including all devices and equipment specified herein, shown on the Drawings, and/or as required for the service. Materials and equipment shall be new and current, delivered to the site completely wired, tested, and ready for installation. This system shall include the following:
1. A diesel engine-driven electric plant to provide standby electric power.
 2. Engine-generator control console resiliently mounted on each generating set shall include complete engine start-stop control and monitoring system.
 3. Starting batteries with battery charger for each engine-generator set.
 4. Automatic load transfer controls to provide automatic starting and stopping of the electric plant and switching of the load.
 5. Mounted and loose accessories, control devices, and other equipment as specified herein and/or as shown on Drawings.
 6. Weatherproof, sound-attenuating enclosure. Maximum sound level of 77 dB(A) @ 23' under full load conditions.
 7. Such other components and accessories, parts, tests, documents, and services, as needed to meet the performance requirements of this specification.
 8. All necessary interconnecting wiring and connections to provide proper system operation. NOTE: Manufacturer of generator enclosure may opt to provide a separate 120V panel board for interior lighting, battery charger and receptacle branch circuits. Electrical Contractor to coordinate branch circuits and feeds with the type of service provided by the generator set enclosure manufacturer.
- B. This equipment, including engine-generator sets shall be manufactured by a single manufacturer who has been regularly engaged in the production of engine-generator sets for a minimum of ten years.
1. The electric generating system described herein, including these components shall be factory-built, factory-tested, and shipped by this single manufacturer, so there is one source of supply and responsibility for warranty, parts, and service. This manufacturer shall have a representative based within 300 miles who can provide factory trained servicemen on a 24-hour per day basis, required stock of replacement parts, and technical assistance.
 2. The responsibility for performance to this specification in its entirety cannot be split up among individual suppliers of components comprising the system, but must be assumed solely by the supplier of the system. The manufacturer shall furnish schematic and wiring diagrams for the engine-generator set(s).

3. All controls shall be the standard of the manufacturer, who is engaged in the manufacture of generators and has them available for sale on the open market. Control parts shall be identified by part numbers of this manufacturer and shall have second source listing where applicable. Control systems that are supplied by a sub-vendor or subcontractor of the vendor and not incorporated within the documentation drawings of the generator manufacturer are not acceptable.

1.2 QUALITY ASSURANCE

- A. The electric generating system must meet all requirements of NFPA 110 (Level 2) including design specifications, prototype tests, one-step full-load pickup, and installation acceptance.
- B. The performance of the electric plant shall be certified by the manufacturer verifying the electric plant's full power rating, stability and voltage and frequency regulation.
- C. The complete standby power system installation, start-up and operating instructions shall be performed under the supervision of a factory-trained engineer or representative of the system manufacturer.
- D. Acceptable Manufacturers:
 1. Electric Plant:
 - a. Caterpillar
 2. Automatic Load Transfer Controls:
 - a. Caterpillar
 3. Equipment as described herein is that as manufactured by Caterpillar and all equipment furnished shall be equal in every way to that specified herein, including quality, operation, and function.
 4. The equipment spacing, mounts, electrical wiring, ventilation equipment, fuel and exhaust components have all been sized and designed around the manufacturers listed. If alternate equipment is substituted, the contractor shall be responsible for changes in the facilities work, made necessary from installation of equipment other than Caterpillar, without additional cost to the Owner, and shall verify all work with the equipment manufacturer.
 - a. Any bidder wishing to use substitute equipment shall submit detailed data to the Engineer. Complete shop drawings, diagrams, and details shall be prepared specifically for this project. Standard and typical drawings will not be acceptable. Data for substitute equipment shall include complete information for the following:
 - 1) Plan drawing to verify that substitute equipment will fit into space allocated and allow for removal and service.
 - 2) Allowance for proper cooling and combustion air.
 - 3) To verify that all interconnecting wiring and piping is accounted for, provide complete interconnecting wiring diagrams and piping diagrams.
 - 4) Provide the results of engineering to show compliance with the requirements for "prototype testing".

- 5) Complete load study and load profile to show that the engine-generator set will not be overloaded during any phase of operation, including motor starting and steady-state load conditions.
 - 6) Specification information, factory literature, catalog sheets, etc., to show compliance with specifications.
 - 7) Deductions or additions to contract price for use of proposed substitute equipment.
 - 8) Complete list of deviations from these specifications.
 - 9) List of projects using similar equipment for the last 5 years.
- E. Service:
1. Replacement parts and competent service shall be available within the New England states.

1.3 SUBMITTALS TO THE ENGINEER

- A. Submit shop drawings per Section 16010. Provide complete shop drawings for each system and piece of equipment specified, including all auxiliary devices. Shop drawing submittals shall consist of a single soft cover binder with index tabs, and shall include:
1. Complete typewritten description of system operation(s), and ratings, including a listing of all auxiliary devices.
 2. Manufacturer's data sheets and detailed dimensioned drawings for all pieces of equipment and auxiliary devices.
 3. Complete interconnecting wiring diagrams, cross referenced with equipment designations indicated in the Contract Documents, indicating all required wiring between the electric plant control panel and all auxiliary devices
 4. Independent testing laboratory reports indicating the performance test results of the electric plants including power rating, stability and voltage and frequency regulation.
 5. Unless specified otherwise herein, all performance data and other information shall be as on the manufacturer's printed literature. Performance data shall be the result of test procedures in accordance with nationally recognized standards, plus such other procedures that are judged necessary by the manufacturer to insure maximum service reliability for emergency systems, and shall be available for inspection by the Engineer upon request.

1.4 TESTING

- A. The intent of this specification is to provide equipment of proven reliability and compatibility. Three separate series of tests shall be performed: Factory Prototype Model Tests, Factory Production Model Tests, and Field Tests.
1. Factory Prototype Model Tests: The electric generating system consisting of prime mover, generator, governor, coupling and all controls must have been tested as complete unit on representative engineering prototype model as required by NFPA 110. The tests, being potentially damaging to the equipment tested, must not be performed on equipment to be sold, but on separate prototype models as specified by NFPA 110 paragraph 3-2.1 thru 3-2.1.2 and their

accomplishment certified by means of documentation of the tests accompanying submittal data. These tests shall have included:

- a. Maximum power level (maximum kW).
 - b. Maximum motor starting capacity (maximum KVA) and voltage dip recovery within seven (7) cycles of applied load.
 - c. Structural soundness (Short-Circuit and Endurance Tests).
 - d. Torsi graph Analysis: The manufacturer of the engine-generator set shall verify that the engine-generator combination, as configured, is free from harmful torsional stresses. The analysis shall include correlation of empirical data from tests on a representative prototype unit. The empirical data must include spectrum analysis of the torsional transducer output within the critical speed range of the engine-generator set. Results of this analysis shall be made available to the specifier on request. Calculations based on engine and generator separately are not acceptable.
 - e. Engine-generator cooling and combustion air requirements.
 - f. Transient response and steady-state speed control and voltage regulation.
 - g. Generator temperature rise per NEMA MG1-22.40.
 - h. Harmonic analysis and voltage waveform deviation per MIL-STD-705B, method 601.4.
 - i. Three-phase short-circuit test for mechanical and electrical strength. With system operating at rated volts, amps, power factor, and speed, the generator terminals must be short circuited ten times on all three phases for a duration of thirty seconds. Engine-generator set must build up and perform normally without manual interventions of any kind such as resetting of circuit breakers or other tripping devices when the short circuit is removed.
 - j. Failure mode test for voltage regulator. With engine-generator set operating at no load, rated speed and voltage, the AC sensing circuit to the regulator must be disconnected for a period of at least one hour. The engine-generator set must be fully operative after the test, and without evidence of damage.
 - k. Endurance testing is required to detect and correct potential electrical and mechanical problems associated with typical operation.
 - l. Paralleling Test: For paralleling applications the manufacturer shall have performed and certified that the engine-generator set(s) can withstand 180° out-of-phase paralleling from full rated voltage and speed without sustaining any mechanical or electrical damage.
2. Factory Production Model Tests: Before shipment of the equipment, the engine-generator set(s) shall be tested under rated load and power factor for performance and proper functioning of control and interfacing. Testing at unity power factor only (resistance banks only) is not acceptable, since kW output is affected by the higher generator efficiency at unity power factor, and the KVAR for motor starting and regulation loads varies with power factor. Tests shall include:
- a. Single step load pickup per NFPA 110, paragraph 5-13.2.6.
 - b. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

A summary of these test results shall be submitted a minimum of one month before the date of substantial completion

3. Field Tests after Installation: After installation, the engine generator set shall be fully tested as specified herein.

1.5 WARRANTY

- A. The complete standby electric power system, including 1800 rpm engine-generator set and transfer switch equipped with set exerciser, and running time meter, shall be warranted for a period of five (5) years or fifteen hundred (1500) operating hours, whichever occurs first, from the date of Substantial Completion. Multiple warranties for individual components (engine, generator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. This warranty shall be detailed in available written documents. In the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General:
 1. This system shall include a Caterpillar engine-generator set rated for 200kW, 250KVA, at 0.8 PF, 60 Hz, three- phase, four-wire, 480/277 Volts on a continuous standby basis.
 2. The engine generator set shall be capable of starting the connected loads listed below:
 - a. Lighting Panel, Electric Heat, other miscellaneous loads.
 - b. Booster Pump No.1, 60HP, across the line starting.
 - c. Booster Pump No.2, 60HP, across the line starting.
 3. The engine-generator set shall be mounted on a heavy duty steel base to maintain proper alignment between components, and shall incorporate vibration isolators of the type and quantity as specified by the set manufacturer, whether mounted internally or externally to the set. The base shall be large enough to accommodate a weather-proof enclosure.
- B. Engine:
 1. Engine shall be 4-cycle industrial diesel-fired.
 2. Engine shall be certified by the engine manufacturer as capable of driving a generator yielding a kW rating as specified herein. Engine shall be capable of driving the generator of this rating on a continuous standby basis for the duration of normal utility source interruptions per SAE J1349 conditions.
 3. Fuel injection and valves shall not require adjustment while in service.
 4. Maximum ambient air temperature 104°F; derate 1% for every 10°F above 104°F.
 5. Engine equipment shall include the following:
 - a. An electric starter(s) as required by the manufacturer.

- b. Positive displacement, mechanical full pressure lubrication oil pump, full flow lubrication oil filters with replaceable elements and dipstick oil level indicator.
 - c. Fuel filter with replaceable element, and an engine driven, mechanical positive displacement fuel pump, all mounted on the engine. Replaceable dry element air cleaner.
 - d. Engine speed isochronous electronic governing system to control generator frequency within $\pm 0.25\%$ of rated frequency under steady state load conditions, and capable of parallel operation with load sharing controls.
 - e. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary alarms and engine shutdowns:
 - 1) Low coolant temperature alarm
 - 2) Low lubrication oil pressure alarm
 - 3) High coolant temperature alarm
 - 4) Low lubrication oil pressure shutdown
 - 5) High coolant temperature shutdown
 - 6) Overspeed shutdown
 - 7) Overcrank lockout
 - 8) Low coolant level shutdown
 - f. Engine starter battery charging alternator with solid-state voltage regulator.
 - g. Engine mounted thermostatically controlled water jacket heater(s) for each engine to aid in quick starting. Heater(s) shall be rated 120 Volts, single phase, 60 Hz.
6. Cooling System
- a. Engine shall be radiator-cooled by engine-mounted radiator system including belt-driven pusher fan, coolant pump, and thermostat temperature control. Performance of components shall be as required by set manufacturer.
 - b. Radiators shall be provided with a duct adapter flange permitting the attachment of air discharge duct directing the discharge of radiator air through the wall.
7. Engine Exhaust System:
- a. Exhaust muffler shall be provided of the size recommended by the generator set manufacturer. Muffler shall be of the critical type. Provide support for the muffler so its weight is not supported by the engine.
 - b. Stainless steel flexible exhaust connection shall be provided as required for connection between engine exhaust manifold and exhaust line, in compliance with applicable codes and regulations.
 - c. All components shall be properly sized to assure proper operation without excessive back pressure when installed as shown on drawings.
 - d. Exhaust line shall be insulated as required.
8. Fuel System:
- a. Provide sub-base fuel tank with level gauge. The 12-hour tank shall be new, unused, and shall not be galvanized. Tank shall be UL listed for secondary containment, dual wall, with rupture basin switch.
 - b. A low fuel supply sensing device shall be installed on the fuel c. The fuel tank shall be provided with a 2 inch exterior fill line with lockable cap,

and a 2 inch exterior vent line with approved vent cap. The locking cap shall be a minimum of 2 feet above the top of the tank.

C. Generator

1. Generator shall be single-bearing, 2/3rd pitch, self-aligning, four-pole, synchronous type, revolving field, with amortisseur windings, with direct drive centrifugal blower for proper cooling and minimum noise, with temperature compensated solid-state voltage regulator, with brushless PMG exciter system. No brushes will be allowed. Telephone influence factor less than 50 per NEMA MG1-22.43.
2. Generator shall be directly connected to engine flywheel housing and driven through a flexible coupling to insure permanent alignment; gear driven generators are not acceptable under this specification.
3. Insulation shall meet NEMA standards for Class H.
4. The maximum alternator temperature rise shall not exceed 125°C above ambient. Generator design shall prevent potentially damaging shaft currents.
5. The three-phase, broad range, reconnectible generator shall have 12 leads brought out to allow connection by user to obtain any of the available voltages for the unit.
6. Voltage regulator shall be solid-state design and shall function by controlling the exciter magnetic field between stator and rotor to provide no load to full load regulation of rated voltage within $\pm 1\%$ during steady-state conditions.
 - a. The engine-generator set and regulator must sustain at least 90% of no load voltage for ten (10) seconds with 250% of rated load at near zero power factor connected to its terminals.
 - b. The voltage regulator shall be insensitive to severe load induced wave shape distortion from SCR or thyristor circuits such as those used in battery charging (UPS) and motor speed control equipment.
 - c. A rheostat shall provide a minimum of $\pm 5\%$ voltage adjustment from rated value.
7. The generator, exciter, and voltage regulator shall be designed and manufactured by the engine-generator set manufacturer so that the characteristics shall be matched to the torque curve of the prime mover. This design allows the prime mover to use its fullest power producing capacity (without exceeding it or over compensating) at speeds lower than rated, to provide the fastest possible system recovery from transient speed dips. A system that routinely selects a linear-type (straight line) constant volts/hertz characteristic, without regard for the engine power and torque characteristics, will not meet this specification
8. PMG Exciter shall be three-phase, full-wave, rectified, with heavy-duty silicon diodes mounted on the common rotor shaft and sized for maximum motor starting loads.
9. Generator design shall be of the self-protecting type, as demonstrated by the prototype short-circuit test as described under "Testing" herein. All other generator performance criteria shall be equal to that of the specified equipment.

D. Engine-Generator Set Control:

1. The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions

for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The generator set mounted control shall include the following features and functions.

2. Control Switches
 - a. Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
 - b. EMERGENCY STOP switch. Switch shall be Red “mushroom-head” push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.
 - c. RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
 - d. PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.
3. Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:
 - a. Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.
 - b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.
 - c. Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.
4. Generator Set Alarm and Status Display
 - a. The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
 - low oil pressure (alarm)

- low oil pressure (shutdown)
- oil pressure sender failure (alarm)
- low coolant temperature (alarm)
- high coolant temperature (alarm)
- high coolant temperature (shutdown)
- engine temperature sender failure (alarm)
- low coolant level (alarm or shutdown—selectable)
- fail to crank (shutdown)
- fail to start/overcrank (shutdown)
- overspeed (shutdown)
- low DC voltage (alarm)
- high DC voltage (alarm)
- weak battery (alarm)
- low fuel-day tank (alarm)
- high AC voltage (shutdown)
- low AC voltage (shutdown)
- under frequency (shutdown)
- over current (warning)
- over current (shutdown)
- short circuit (shutdown)
- ground fault (alarm) (optional—when required by code or specified)
- over load (alarm)
- emergency stop (shutdown)

- b. Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

5. Engine Status Monitoring

- a. The following information shall be available from a digital status panel on the generator set control:

- engine oil pressure (psi or kPA)
- engine coolant temperature (degrees F or C)
- engine oil temperature (degrees F or C)
- engine speed (rpm)
- number of hours of operation (hours)
- number of start attempts
- battery voltage (DC volts)

- b. The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

6. Engine Control Functions

- a. The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

- b. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
 - c. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
 - d. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
 - e. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components and actual failure conditions.
7. Alternator Control Functions
- a. The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.
 - b. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
 - c. Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
 - d. Controls shall be provided to monitor the KW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

- e. An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
- f. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.
- g. When required by National Electrical Code or indicated on project drawings, the Control System shall include a ground fault monitoring relay. The relay shall be adjustable from 3.8-1200 amps, and include adjustable time delay of 0-10.0 seconds. The relay shall be for indication only, and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set, and provide relay that will function correctly in system as installed.

E. Auxiliary Equipment:

- 1. Starting Battery: Two (2) batteries shall be supplied for each engine and shall be mounted in a battery rack within the engine-generator set skid base. Batteries shall be 12 Volt, heavy duty, diesel starting lead-acid type.
- 2. Battery Charger(s): A voltage regulated battery charger shall be provided for each engine-generator set. Chargers shall be equipped with float, taper, and equalize charge settings.
Remote emergency stop station, break-glass type, for mounting outside enclosure housing the prime mover.
- 4. Remote Annunciator (NFPA 99/110, CSA 282) Provide a remote annunciator to meet the requirements of NFPA 110, Level 1. The annunciator shall provide remote annunciation as outlined below and shall incorporate ring-back capability so that after silencing the initial alarm, any subsequent alarms will sound the horn. Annunciator shall have the ability to be located up to 800 ft from the generator set. Provide the following individual light indications for protection and diagnostics:
 - a. Overcrank
 - b. Low coolant temperature
 - c. High coolant temperature warning
 - d. High coolant temperature shutdown
 - e. Low oil pressure warning
 - f. Low oil pressure shutdown
 - g. Overspeed
 - h. Low coolant level
 - i. EPS supplying load
 - j. Control switch not in auto
 - k. High battery voltage

- l. Low battery voltage
 - m. Battery charger AC failure
 - n. Emergency stop
 - o. Spare
 - p. Spare
5. Outdoor Weather-Protective Enclosure (Sound-Attenuated Level 2)
- a. Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet-metal shall be primed for corrosion protection and finish painted with the manufacturers standard color using a two step electro-coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:
 - Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils.
 - Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%.
 - Crosshatch adhesion, per ASTM D3359-93, 4B-5B.
 - Impact resistance, per ASTM D2794-93, 120-160 inch-pounds.
 - Salt Spray, per ASTM B117-90, 1000+hours
 - Humidity, per ASTM D2247-92, 1000+ hours
 - Water Soak, per ASTM D2247-92, 1000+ hours
 - b. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

F. Automatic Load Transfer Switch:

1. General: The transfer switch shall be designed, built, tested, furnished and warranted by the manufacturer of the engine-generator set to ensure one source of responsibility and equipment compatibility. A transfer switch manufactured by a different manufacturer may be equivalent providing the engine-generator and transfer switch is tested, furnished and warranted by the manufacturer of the engine-generator set.
2. An approved transfer switch manufacturer shall have been regularly engaged in the production of U.L. (Underwriters Laboratory) Standard 1008 Listed transfer switches. The transfer switch shall be documented, and have been offered for sale on the open market for a minimum of five (5) years. The manufacturer shall provide factory trained parts and service support through a factory authorized distributor that is regularly doing business in the area of the installation.
3. The manufacturer shall supply literature containing diagrams, parts lists and descriptions sufficient for the owner's personnel, or subcontract supplier to install, operate and perform normal maintenance on the equipment.
4. Testing: To provide proven reliability of the system, the transfer switch shall be completely tested as follows:
 - a. Representative production samples of the transfer switch supplied, shall be demonstrable, through tests, the ability to withstand at least 10,000

- mechanical operating cycles. An operating cycle shall consist of one (1) electrically operated transfer from normal to emergency and back to normal.
- b. During the development of the original transfer switching mechanism for this family of transfer switches, a prototype of the transfer switching mechanism shall have passed the environmental tests listed in Military Standard, Mil-Std-202E. These tests shall include Method 101D-Condition B, Salt Spray-Corrosion; Method 103B-Condition B, Humidity; Method 107D-Condition A, Thermal Shock; Method 110A Sand and Dust.
 - c. Transfer switch shall be U.L. Listed per Standard 1008. The minimum WCR (Withstand and Closing Current Ratings) shall meet the requirements of U.L. Standard 1008 and shall be obtained without contact welding. Where the line side over current protection is provided by circuit breakers at 480 Volts AC or less, the short circuit WCR shall be as follows:

<u>TRANSFER SWITCH CONTINUOUS CURRENT RATINGS</u>	<u>K & J/L* FUSES</u>	<u>WITHSTAND AND CLOSING RATINGS</u>
40A, 70A, 100A	125A/200A*	14,000A RMS
150A, 260A	400A/600A*	30,000A RMS
400A, 600A	1200A/1200A*	65,000A RMS

* Class J and L Fuses WCR = 200,000A RMS

- 1) The RMS (Root Mean Square) symmetrical fault current ratings shall be verified by UL-witnessed tests on representative test samples. All WCR tests shall be performed with the over current protective devices located external to the transfer switch. Tests conducted with over current protective devices internal to the transfer switch, in such a manner that the transfer switch interrupts the current rather than withstanding the current, are not acceptable under this definition of withstand.
 - 2) Where the line side over current protection is provided by current-limiting fuses, the fuses shall be UL Class RK1, RK5, J, or L (with the fuse sizes being no larger than the UL- listed maximum ratings or component recognition procedures for the transfer switches supplied). The transfer switch closing rating shall be suitable for 200,000A available fault current, as verified by UL witnessed tests on representative test samples.
- d. Provide testing as specified herein.
 5. Ratings: Transfer switch shall be UL Listed per Standard 1008 and shall be suitable for use on emergency and legally required standby systems in accordance with ANSI-C1 and NFPA-99, rated for total system load. These loads shall include motors, electric discharge lamps, resistive loads, and tungsten lamps as described in Section 1 of U.L. 1008 Standard.
 6. Transfer switch shall be 60 Hz, three phase, 3 pole with solid neutral, 480 volts, 400 amps. Equipment supplier shall verify that all ratings match with existing station electrical system prior to supplying transfer switch.

7. Transfer switch shall be rated to carry 100 percent of its rated current continuously when in an enclosure. Transfer switches which must be derated when installed in an enclosure (due to integral over current devices or any other reasons) do not meet this specification. Transfer switch shall be rated for continuous operation in ambient temperatures of -40° C (-40°F) to 67°C (142°F).
8. Construction: Transfer switch shall be over center operation, double-throw construction, positively electrically and mechanically interlocked by a simple mechanical beam to prevent simultaneous closing (for break before make operation), and mechanically held in both normal and emergency positions.
 - a. Transfer switch shall be quick-break, quick-make operation so that the speed of opening and closing is not controlled by an operator during manual operation. Transfer switch shall provide a center "Programmed Transition" position for manual switching.
 - b. Transfer switch shall be approved for manual operation under full load by integral mounted, permanently attached, high dielectric, manual operating handles. A manual operating handle, which is normally stored and must be installed for manual operation, does not meet this specification.
 - c. The electrical operating means shall be a direct-acting, constant force in both directions, bi-directional linear induction motor to provide minimum friction, straight-line switch action. Motor shall be attached directly to the switching mechanism without the use of gears, cams, or other complex mechanical linkage methods.
 - d. Transfer switch shall not contain any integral over current devices in the main power circuit, including molded case circuit breakers or fuses.
 - e. The transfer switch electrical actuator shall have an independent disconnect means to disable the electrical operation during manual switching.
 - f. Manual operating handle and controls (other than key- operated switches) shall be accessible to authorized personnel only by opening the key locking cabinet door. A transfer switch located on the outside of the cabinet does not meet this specification.
 - g. Unless noted or specified otherwise, transfer switch shall be mounted in a separate NEMA 1 cabinet enclosure with key-locking front door.
 - h. Maximum transfer time in either direction shall be six (6) cycles, except where the "Programmed Transition" feature is furnished.
 - i. Transfer switch shall have transparent protective cover to protect operating personnel during manual operation, and to allow an operator to visually determine that the main contacts are "Open" or "Closed".
 - j. The main switch contacts shall be of the no-maintenance type and high pressure silver cadmium oxide to resist burning and pitting for long life operation. All switches shall have arc chutes of heat absorbing material and metal leaves for positive extinguishing of arcs quickly and effectively; arc chutes shall have insulating covers to prevent interphase flashover.
 - k. Transfer switch shall have one (1) SPDT (Single Pole Double Throw), 480 Volt auxiliary switch on both the normal and emergency-sides, operated by the transfer switch. These auxiliary switches shall be factory wired to an easy access terminal block and may be used to monitor transfer switch position for controlling indicator lamps or other peripheral equipment.

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(sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities.

- a) Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance.
- b) Display source status, to indicate source is connected or not connected.
- c) Display load data, including 3-phase AC voltage, frequency, KW, KVA, and power factor. Voltage data for all phases shall be displayed on a single screen.
- d) The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
 - i. Set nominal voltage and frequency for the transfer switch.
 - ii. Adjust voltage and frequency sensor operation set points.
 - iii. Set up time clock functions.
 - iv. Set up load Sequence functions.
 - v. Enable or disable control functions in the transfer switch, including program transition.
 - vi. Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
- e) Display Real Time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
- f) Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
- g) Display information for other transfer switches in the system, including transfer switch name, real time load in KW on the transfer switch, current source condition, and current operating mode.
- h) Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.
 - b. Internal Controls
 - 1) The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide rms voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
 - 2) Transfer switch voltage sensors shall be closed differential type, providing source availability information to the control system based on the following functions:

- a) Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
 - b) Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
 - c) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for voltage imbalance.
 - d) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
 - e) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for phase rotation.
 - f) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).
 - g) Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.
- 3) All transfer switch sensing shall be configurable from a Windows 95, 98, or NT PC-based service tool, to allow setting of levels, and enabling or disabling of features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.
 - 4) The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature.
 - 5) The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cool-down) (adjustable in a range of 0-30 minutes).
 - 6) The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
 - 7) The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
 - 8) The transfer switch shall be provided with a battery charger for the generator set starting batteries. The battery charger shall be a float type charger rated 10 Amps. The battery charger shall include an ammeter for display of charging current and shall have fused AC inputs and DC outputs. The charger shall also include fault indications for high and low dc voltage, and supply power failed, and dry contacts

for external indication of these fault conditions. Supply power failed indication shall be displayed on the ATS control panel.

c. Control Interface

- 1) The transfer switch will provide an isolated relay contact for starting a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
- 2) Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 Amps, 250 VAC.

- G. Generator set shall be installed inside a weather-tight, sound attenuating enclosure specially designed to contain the generator and auxiliary equipment. Enclosure shall be equipped with adequate interior lighting and duplex 120V power[MJG1] receptacles. Refer to Specification Paragraphs 1.1 A and 2.1 E.5.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Site location of generator set enclosure and generator installation shall be made in complete accordance with manufacturer's recommendations.
- B. Install unit on concrete base to provide for servicing access and oil pan removal.
- C. Flexible connections shall be used on all connections to unit.
- D. Fill the engine cooling system with a solution of 50 percent ethylene glycol and water.
- E. Support muffler so that its weight is not supported by the engine. Exhaust pipe sizing shall be as required to maintain exhaust backpressure within the limits established by the generator set manufacturer.
- F. Bond steel base, generator and engine frames and all equipment enclosures to main ground electrodes.

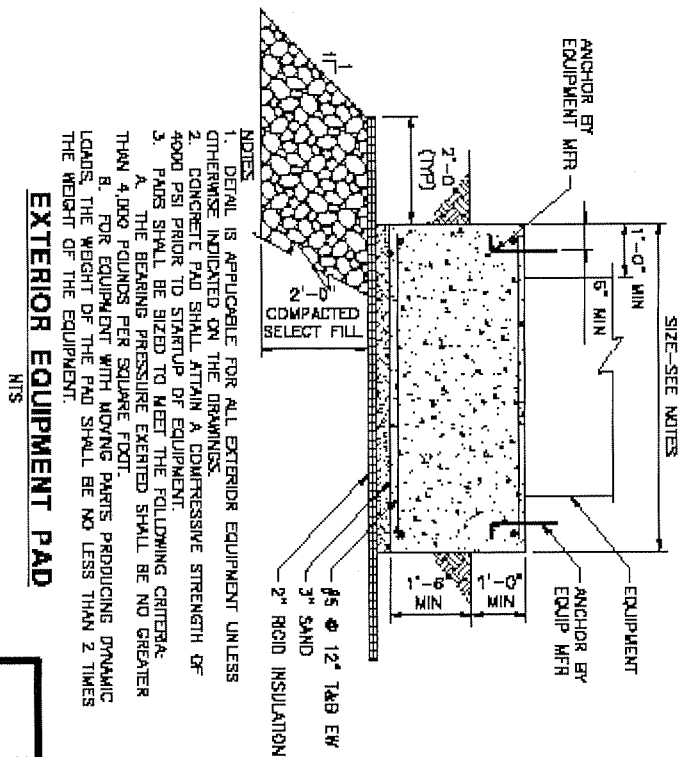
3.2 FIELD TESTS AFTER INSTALLATION


- A. The complete installation shall be initially started and checked out for operational compliance by factory-trained representative(s) of the engine-generator set(s) manufacturer. The engine lubrication oil as recommended by the manufacturer for operation under environmental conditions specified, shall be provided by the engine-generator set(s) supplier.
- B. Upon completion of initial start-up and system checkout, the supplier of the system shall perform a field test in the presence of the Contractor, Engineer and Owner's

operating personnel to demonstrate load carrying capability and voltage and frequency stability.

- C. The Contractor shall supply fuel for generator, water for pumps, and complete electrical system operating and functional in order to verify that generator will start the connected loads in the order specified.
- D. 100% Load shall consist of resistive load bank. Unity power factor is suitable for on-site testing, provided that rated load tests at power factor have been performed by the manufacturer prior to shipment.
 - 1. Records shall be maintained throughout the tests consisting of:
 - a. Time-of-day
 - b. Coolant temperature
 - c. Cranking time until prime mover starts and runs
 - d. Time required to come up to operating speed, voltage and frequency overshoot
 - e. Time required to achieve steady-state condition with all switches transferred to the emergency position
 - f. Voltage
 - g. Frequency
 - h. Current
 - i. Oil pressure
 - j. Ambient air temperature
 - k. Kilowatts
 - l. Power factor
 - m. Battery charger rate at 5 minute intervals for the first 15 minutes
 - 2. Data shall be recorded at 15 minute intervals throughout the test.
 - 3. Continue this load test for 2 hours per NFPA 110, observing and recording load changes and the resultant effect on voltage and frequency.
 - 4. Return normal power, record the time delay on retransfer for each switch (set for 15 minutes minimum) and the time delay on prime mover cool down period and shutdown.
 - 5. Upon completion of the above test, allow the prime mover to cool for 5 minutes. Then apply available building load via Automatic Transfer Switch. A power failure shall be initiated by opening all switches or breakers supplying the normal power to the building or facility. This load pickup shall be in one step immediately upon reaching rated RPM.
 - 6. During or after the tests, the Owner's operating personnel shall be fully instructed by the factory-trained representative in the operation and maintenance of this equipment.

END OF SECTION



CITY OF ROCHESTER, NH RICHARDSON STREET PUMP STATION 200 KW GENERATOR SET		FIELD NO: 10B00A DATE: JUNE 2008 SCALE: AS NOTED		PRINTED: 1
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