3C35

NOTICE:

Bids to be opened at 2:00 P.M.
SEP 20 1983 at the Office of
Officer in Charge of Construction
Jacksonville, North Carolina Area
Building 1005, Marine Corps Base
Camp Lejeune, North Carolina 28542

CONTRACT N62470-83-B-5840

NAVFAC SPECIFICATION
NO. 05-83-5840

REPLACE AUXILIARY ENGINE, BUILDING AS-110

at the

MARINE CORPS AIR STATION (HELICOPTER), NEW RIVER,

JACKSONVILLE, NORTH CAROLINA

Review & Return to MSC SS

DESIGN BY:

J. H. Fitch, P.E.

and

A. E. Young, P.E.

APPROVED BY:

E. L. Rouse, P.E.
Director, Design Branch

R. E. Carlson, CDR, CEC, U. S. Navy
for Commander, Naval Facilities Engineering Command

BOD 20 Sep 83

CONTENTS

SECTION 00101
BIDDING INFORMATION

1. CONTENTS: This Invitation for Bids, IFB NO.N62470-83-5840, consists of the following documents:

(a) Bid Instruction Documents
  (i) Invitation for Bids (Standard Form 20, January 1961 Ed.)
  (ii) Bidding Information
  (iii) Instructions to Bidders, dated March 1979
(b) Bid Submittal Documents
  (i) Bid Form (Standard Form 21, December 1965 Ed.)
  (ii) Representations and Certifications, Standard Form 19-B, June 1976 Ed. (REV 1980 AUG), including Appendix "A", dated August 1980
  (iii) Bid Guaranty (Standard Form 24, June 1964 Ed.) (See Instructions to Bidders)
(c) Contract Documents
  (i) Construction Contract (Standard Form 23, Jan 1961 Ed.)
  (ii) Performance Bond (Standard Form 25, June 1967 Ed.)
  (iii) Payment Bond (Standard Form 25A, June 1964 Ed.)
  (iv) Labor Standards Provisions, dated November 1979)
  (v) General Provisions dated March 1981 (Rev 12/81)
    a. Clause 43. ACCIDENT PREVENTION (1977 Jun): Change the date of the Corps of Engineers Manual, EM 385-1-1, from "1 June 1977" to "1 April 1981"
    b. Clause 63. VALUE ENGINEERING INCENTIVE (1977 AUG): Delete this clause and substitute the following therefore:

"63. VALUE ENGINEERING INCENTIVE--CONSTRUCTION (1980 DEC):

(a) Applicability. This clause applies to any Contractor developed, prepared, and submitted Value Engineering Change Proposal (VECP).

(b) Definitions.

(1) "Contractor's development and implementation costs" means those costs incurred on a VECP Government acceptance and those costs the Contractor incurs specifically to make the changes required by Government acceptance of a VECP.

(2) "Government costs" means those agency costs that result directly from developing and implementing the VECP and any net increases in the cost of testing, operations, maintenance, and logistic support. They do not include the normal administrative costs of processing the VECP.

(3) "Instant contract savings" means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs (including subcontractors' development and implementation costs). (See paragraph (g).)

(4) "Value Engineerng Change Proposal (VECP) means a proposal that:

(i) requires a change to this, the instant contract, to implement; and

(ii) results in reducing the contract price or estimated cost without impairing essential functions or characteristics, provided that it does not involve a change in deliverable end-item quantities only.

(c) VECP preparation. As a minimum, the Contractor shall include the information described in (1) through (6) in each VECP. If the proposed change affects contractually required configuration management procedures, the instructions in the procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

(1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for both the affected portions of the existing contract requirement and the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (g). The Contractor shall also include a description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and supports costs.

(4) A projection of any effects the proposed change would have on collateral costs to the agency.

(5) A statement of the time by which a contract modifiction accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(6) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) Submissions.

(1) The Contractor shall submit VECPs to the Resident Engineer at the worksite, with a copy to the Contracting Officer. The Contracting Officer shall notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required because of extenuating circumstances, the Contractor shall be notified within the 45-day period and provided the reason for the delay and the expected date of the Contracting Officer's decision. VECPs shall be processed expeditiously; however, the Government shall not be liable for any delay in acting upon a VECP.

(2) If the VECP is not accepted, the Contracting Officer shall provide the Contractor written notification fully explaining the reasons for rejection. The Contractor may withdraw, in whole or in part, any VECP not accepted by the Government within the period specified in the VECP. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

(e) Acceptance. Any VECP may be accepted in whole or in part by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The Contracting Officer's decision to accept all or part of any VECP shall be final and not subject to the Disputes clause.

(f) Sharing.

(1) Rates. The Contractor's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by 55 percent for fixed-price contracts and 25 percent for cost-reimbursement contracts.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to:

(i) accept the VECP;

(ii) reduce the contract price or estimated cost by the amount of instant contract savings; and

(iii) provide the Contractor's share of savings by adding the amount calculated in (f)(1) to the Contract price or fee.

(g) Subcontracts. The Contractor shall include appropriate VE clauses in any subcontract of $50,000 or more and may include them in subcontracts of lesser value. To compute any adjustment in the contract price under paragraoh (f), the Contractor's VECP development and implementation costs shall include any subcontractor's development and implementation costs that clearly result from the VECP, but shall exclude any VE incentive payments to subcontractors. The Contractor may choose any arrangement for subcontractor VE incentive payments, provided that these payments are not made from the Government's share of the savings resulting from the VECP.

(h) Data. The Contractor may restrict the Govenment's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering Incentive--Construction clause of Contract_____, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a VECP submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations."

If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data."

c. Clause 97. AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (1978 SEP): Change the date of this clause to "(1982 FEB)".

(vi) NAVFAC Specification No. 05-83-5840

(vii) Drawings identified in Section 01011 of the specifications

(viii) Wage Determination Decision No. NC81-1201 for Building Construction

2. BIDS:

2.1 Instructions to Bidders: Instructions to Bidders and Invitation for Bids, Standard Form 20, January 1961 edition, shall be observed in the preparation of bids. Bidders shall affix their names and return addresses in the upper left corner of bid envelope. Envelopes containing bids must be sealed.

2.2 Bid Guaranty: For bids of $25,000 or greater, a bid guaranty will be required as stipulated in the Instructons to Bidders.

2.3 Items of Bids: Bids shall be submitted in duplicate on Standard Form 21, Bid Form, and shall be accompanied by Standard Form 19B, Representations and Certifications, with Appendix "A" and by Bid Guaranty, all in accordance with the Bid Instruction Documents listed in paragraph 1(a) hereinbefore upon the following item:

BASE BID: Price for the entire work, complete in accordance with the drawings and specifications.

2.4 TELEGRAPHIC MODIFICATIONS OF BIDS in accordance with the instructions to bidders may be made. Two signed copies of the telegram in a sealed envelope marked "Copies of telegraphic modification of bid for Replace Auxiliary Engine, Specification No. 05-83-5840", should be forwarded immediately to the office to which written bids were submitted.

2.5 TELEGRAPHIC MODIFICATIONS OR WITHDRAWAL OF BIDS will be considered as specified herein. TELEPHONIC RECEIPT OF TELEGRAPHIC MODIFICATIONS OR WITHDRAWAL OF BIDS WILL NOT QUALIFY THE TELEGRAM AS TIMELY. The telegram must be received at the place specified for receipt of bids prior to the exact time set for receipt of bids.

2.6 HAND DELIVERED BIDS: All hand delivered bids must be deposited with personnel in the Contract Branch, Room No. 26, Building 1005, Marine Corps Base, Camp Lejeune, North Carolina 28542, prior to the time and date set for bid opening. Any bids submitted by hand after the time set for receipt will not be accepted.

3. PRE-BID SITE VISITATION: To inspect the site of the work prior to bid opening, prior appointment must be made with the Officer in Charge of Construction, Jacksonville, North Carolina Area, telephone 919-451-2581. Bidders are urged and expected to inspect the site where the services are to be performed and to satisfy themselves as to all general and local conditions that may affect the cost of performance of the contract to the extent such information is reasonably obtainable. In no event will a failure to inspect the site constitute grounds for withdrawal of a bid after opening or for a claim after award of the contract.

4. CONTROLLED MATERIALS DATA: The Contracting Officer will issue a DO-C2 priority rating for procurement of critical materials. See General Provision entitled "PRIORITIES, ALLOCATIONS AND ALLOTMENTS".

5. INQUIRIES:

5.1 Plans and Specifications: Questions regarding the plans and specifications occurring prior to bid opening shall be presented to the Public Works Design Division, Building 1005, Marine Corps Base, Camp Lejeune, North Carolina 28542, telephone 919-451-5507. Questions requiring interpretation of drawings and specifications must be submitted at least ten days before bid opening. Interpretations or modifications to specifications made as a result of questions will be made by amendment only, and unless so done, all bidders should base their bids on the plans and specifications as issued.

5.2 Bidding Procedures: All questions concerning the bidding procedures shall be presented to OICC-ROICC Contract Branch, Room 26, Building 1005, Marine Corps Base, Camp Lejeune, North Carolina, telephone 919-451-2581.

6. AVAILABILITY OF SPECIFICATIONS, STANDARDS AND DESCRIPTIONS (1977 JUN): Specifications, standards and descriptions cited in this solicitation are available as indicated below:

a. Unclassified Federal, Military and Other Specifications and Standards (Excluding Commercial), and Data Item Descriptions: Submit request on DD Form 1425 (Specifications and Standards Requisition) to:

Commanding Officer
U. S. Naval Publications and Forms Center
5801 Tabor Avenue, Philadelphia, Pennsylvania 19120

The Acquisition Management Systems and Data Requirements Control List: DOD Directive 5000.19L, Volume II, may be ordered on the DD Form 1425. The Department of Defense Index of Specifications and Standards (DODISS) may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. When requesting a specification or standard, the request shall indicate the title, number, date and any applicable amendment thereto by number and date. When requesting a data item description, the request shall cite the solicitation. When DD Form 1425 is not available, the request may be submitted in letter form, giving the same information as listed above, and the solicitation or contract number involved. Such request may also be made to the activity by TELEX No. 834295, Western Union No. 710-670-1685, or telephone 215-697-3321 in case of urgency.

b. Commercial Specifications, Standards and Descriptions: These specifications, standards and descriptions are not available from Government sources. They may be obtained from the publishers.

c. Availability for Examination of Specifications, Standards, Plans, Drawings, and other Pertinent Documents: The specifications, standards, plans, drawings, and other pertinent documents cited in this solicitation may be examined at the following location:

Public Works Division
Specifications and Estimates Section
Building 1005, Marine Corps Base
Camp Lejeune, North Carolina

7. RECOVERED MATERIAL: The Contractor certifies by signing this bid/proposal/quotation that recovered materials as defined in DAR 1-2500.4 will be used as required by the applicable publications.

8. REFERENCE TO AMENDMENTS: Each bidder shall refer in his bid to all amendments to this specification; failure to do so may consititute an informality in the bid.

9. CERTIFICATE OF CURRENT COST OR PRICING DATA: (This paragraph applies to negotiated contracts of $500,000 or more, except where the price is based on adequate competition, and to change orders of $500,000 or more, to any contract.) The Contractor shall submit to the Contracting Officer a certificate in the form set forth below as soon as practicable after agreement is reached on the contract price:

This is to certify that, to the best of my knowledge and belief, cost or pricing data defined in DAR 3-807.1(a)(1) submitted, either actually or by specific identification in writing (see DAR 3-807.3(a)) to the Contracting Officer or his representative in support of _____*
are accurate, complete, and current as of _____**
day month year

This certification includes the cost or pricing data supporting any advance agreement(s) and forward pricing rate agreements between the offeror and the Government which are part of the proposal.

Firm_____
Name_____
Title_____

_____***
Date of Execution

*Describe the proposal, quotation, request for price adjustment or other submission involved, giving appropriate identifying number (e.g. RFP No. _____).

**The effective date shall be the date when price negotiations were concluded and the contract price was agreed to. The responsibility of the Contractor is not limited by the personal knowledge of the Contractor's negotiator if the Contractor had information reasonably available at the time of agreement, showing that the negotiated price is not based on accurate, complete and current data.

***This date should be as close as practicable to the date when the price negotiations were concluded and the contract price was agreed to.

END OF SECTION

SECTION 01011
GENERAL PARAGRAPHS

1. GENERAL INTENTION: It is the declared and acknowledged intention and meaning to provide and secure replacement of auxiliary engine, complete and ready for use. This is a fixed-price contract awarded on a lump sum basis.

2. GENERAL DESCRIPTION: The work includes a 300 kW auxiliary generator set, diesel engine driven, with fiberglass fuel tank, fuel system, non-automatic transfer switches, piping and duct banks, a concrete pad and incidental related work.

3. LOCATION: The work shall be located at the Marine Corps Air Station (Helicopter), New River, Jacksonville, North Carolina, approximately as shown. The exact location will be indicated by the Contracting Officer. "Contracting Officer" and "Officer in Charge of Construction (OICC)" are used interchangeably in this specification and have the same meaning.

4. COMMENCEMENT, PROSECUTION AND COMPLETION OF WORK: The Contractor will be required to commence work under the contract 15 calendar days after the date of receipt of Notice of Award, to prosecute said work diligently, and to complete the entire work ready for use within 180 calendar days. The time stated for completion shall include final cleanup of the premises. The contract completion date will be computed starting 15 calendar days after the date of Notice of Award. This 15-day period is to allow for mailing of the notice of Award and the Contractor's submission of required bonds.

5. LIQUIDATED DAMAGES: In case of failure on the part of the Contractor to complete the work within the time fixed in the contract or any extensions thereof, the Contractor shall pay to the Government as liquidated damages pursuant to General Provisions clauses entitled "Termination for Default - Damages for Delay - Time Extensions', and "Damages for Delay - Defense Materials System and Priorities" the sum of $35 for each day of delay.

6. DRAWINGS ACCOMPANYING SPECIFICATIONS: The following drawings accompany this specification and are a part thereof. Drawings are the property of the Government and shall not be used for any purpose other than that contemplated by the specification.

NAVFAC DWG. NO.	TITLE
4089130	Location & Vicinity Maps; Legend & General Notes
4089131	Electrical Plan
4089132	Details
4089133	Sequence of Operation

7. NORTH CAROLINA SALES AND USE TAX IS REQUIRED. See section entitled "Additional General Paragraphs".

8. SCHEDULING THE WORK:

8.1 General Scheduling Requirements: Notwithstanding the requirements of clause entitled "Progress Charts and Requirements for Overtime Work" of the General Provisions, immediately after award the Contractor shall meet with the

Contracting Officer and present a schedule of work, prepared in accordance with said clause, for review by the Contracting Officer. The schedule will be reviewed at this meeting and will be retained by the Contracting Officer for final review and approval.

8.2 Work Outside Regular Hours: If the Contractor desires to carry on work outside regular hours or on Saturdays, Sundays, or holidays, he shall submit application to the Contracting Officer, but shall allow ample time to enable the Government to make satisfactory arrangements for inspecting the work in progress. At night he shall light the different parts of the work in an approved manner. All utility cutovers shall be made after normal working hours or on weekends. Anticipated costs shall be included in the bid. Regular working hours are 7:45 A.M. to 4:15 P.M., Monday through Friday, excluding holidays.

9. SAFETY PROGRAM: The Contractor shall implement a safety program conforming to the requirements of Federal, State and local laws, rules and regulations. The program shall include, but is not limited to, the following:

a. "Occupational Safety and Health Standards" which can be examined at the office of the Contracting Officer or be ordered from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402.

b. Department of the Army, Corps of Engineers "General Safety Requirements" which may be examined at the office where bids are being received or may be purchased from the Superintendent of Documents, U. S. Government Printing Office.

c. General Provisions clause entitled "Accident Prevention".

d. NFPA 241-1975, Safeguarding Building Construction and Demolition Operations, which may be examined in the Design Branch, Public Works Division, Building 1005, Marine Corps Base, Camp Lejeune, or may be purchased from the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210

10. FACTORY INSPECTION of material and equipment for which tests at the place of manufacture are required in referenced publications will be waived if notarized copies of factory reports are furnished that show compliance with the specification requirements. Factory inspection will be required only where specified herein or in the technical sections of this specification. The Government reserves the right to charge to the Contractor any additional cost of Government inspection and tests when materials and equipment are not ready at the time inspection and tests are required by the Contractor.

11. TRAILER OR STORAGE BUILDINGS will be permitted on the job site, where space is available, subject to the approval of the Contracting Officer. The trailers or buildings shall be suitably painted and kept in a good state of repair. Failure of the Contractor to maintain his trailers or storage buildings in good condition will be considered sufficient reason to require their removal from the job site.

12. WRITTEN GUARANTIES AND GUARANTOR'S LOCAL REPRESENTATIVE: Prior to completion of the contract, the Contractor shall obtain and furnish to the Contracting Officer's designated representative, written guarantees for all equipment and/or appliances furnished under the contract. The Contractor shall furnish with each guarantee the name, address and telephone number of the guarantor's representative nearest to the location where the equipment and/or appliances are installed, who, upon request of the using service's representative, will honor the guarantee during the guaranty period and will provide the services prescribed by the terms of the guarantee. At the time of installation, the Contractor shall tag each item of warranted equipment with a durable oil and water resistant tag approved by the Contracting Officer. Leave the date of acceptance and inspector's signature blank until the project is accepted for beneficial occupancy. The tag shall show the following information:

EQUIPMENT WARRANTY TAG

Type of Equipment_____

Accepted Date_____

Warranted Until_____

Under Contract No. N62470-

Inspector's Signature_____

STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

13. MATERIALS AND EQUIPMENT TO BE SALVAGED: Clause entitled "Salvage Materials and Equipment" of the General Provisions is hereby deleted. Except where specifically specified otherwise herein, all existing materials and equipment which are required to be removed or disconnected to perform the work, but are not indicated or specified for use in the new work, shall become the property of the Contractor and shall be removed from Government property.

14. AS-BUILT RECORD OF MATERIALS USED IN BUILDINGS: A record of materials used, in accordance with clause entitled "As-Built Record of Materials Used in Buildings" of the General Provisions is not required.

15. FORWARDING OF SAMPLES AND SUBMITTALS: Notwithstanding the requirements of clause entitled "Shop Drawings' of the General Provisions, the quantity of submittals required shall be as specified hereinafter.

16. SUBMITTAL OF PROOF OF QUALIFICATIONS AND EXPERIENCE: Where qualifications or experience requirements are set forth in the specifications with respect to equipment and equipment installers, written proof of such qualifications or experience must be provided within 45 calendar days after contract award, and before placing any order for such equipment or before dispatching equipment installers to the project site.

END OF SECTION

SECTION 01012. ADDITIONAL GENERAL PARAGRAPHS

1. UTILITIES:

1.1 Government-Furnished Utilities: The Government will furnish water and electricity from the nearest available outlet free of charge for pursuance of work under this contract. If the nearest available outlet cannot be utilized by the Contractor because of improper voltage, insufficient current, improper pressure, incompatible connectors, etc., it shall be the responsibility of the Contractor to provide temporary utilities as required.

1.2 Energy and Utilities Conservation: The Contractor shall carefully conserve utilities furnished without charge. The Contractor, at his own expense and in a manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines and remove the same prior to final acceptance of the construction. (DAR 7-603.30)

1.3 Operation of Station Utilities: The Contractor shall not operate nor disturb the setting of any control devices in the Base utilities system, including water, sewer, electrical and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer, giving reasonable advance notice, when such operation is required.

1.4 Location of Underground Utilities: Where existing piping, utilities, and underground obstructions of any type are indicated in locations to be traversed by new piping, ducts, and other work provided hereunder, and are not indicated or specified to be removed, the elevations of the existing utilities and obstructions shall be determined before the new work is laid closer than the nearest manhole or other structure at which an adjustment in grade could be made. For any additional work required by reason of conflict between the new and existing work, an adjustment in contract price will be made in accordance with General Provisions clause entitled "Differing Site Conditions (1968 FEB)." The Base Telephone Officer, telephone 451-2531, will show the Contractor approximate locations of all buried telephone and fire alarm cables after receiving 10 days notice. The locations of underground utilities shown is only approximate and the information is incomplete.

2. CHANGED CONDITIONS: Wherever changed conditions as defined in General Provisions clause entitled "Differing Site Conditions (1968 FEB)" are encountered, and wherever conditions exposed during the course of the work necessitate a change from quantities indicated or specified as either estimated quantities or as a basis for bids, whether or not provisions for a change in price for such variation is specified, the Contracting Officer must be notified in writing and written directions to do so must be obtained before quantities stated in the contract documents are exceeded.

3. SUBCONTRACTORS AND PERSONNEL: Promptly after the award of the contract, the Contractor shall submit to the Contracting Officer, in triplicate, a list of his subcontractors and the work each is to perform. On this form shall appear the names of the key personnel of the Contractor and subcontractors, together with their home addresses and telephone numbers, for use in event of emergency. From time to time as changes occur and additional information becomes available, the Contractor shall amplify, correct, and change the information contained in previous lists.

4. PRINTS FURNISHED TO CONTRACTOR: Six copies of the project specifications, and six sets of the drawings accompanying the specifications, will be furnished the Contractor. Additional sets of the specifications and drawings can be obtained, if required, by application to the Contracting Officer, provided that the need therefor is justified to the satisfaction of the Contracting Officer.

5. SCHEDULE OF PRICES: The original and seven copies of the Schedule of Prices shall be submitted to the Contracting Officer for approval. Payments will not be made until the Schedule of Prices has been submitted and approved.

6. CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT: Requests for payment in accordance with the terms of the contract shall consist of:

a. Contractor's Invoice on Form NAVFAC 10-7300/30(4/68), which shall show, in summary form, the basis for arriving at the amount of the invoice

b. Contractor's Monthly Estimate for Voucher (5ND GEN 5265/1)

c. Affidavit to Accompany Invoice (5ND LANTDIV 4-4235/4)(Rev 1/68)

Forms will be furnished by the Contracting Officer. Monthly invoices and supporting forms for work performed through the 15th of the month shall be submitted to the Contracting Officer by the 20th of the month in the following quantities:

a. Contractor's Invoice - Original and five copies

b. Contractor's Monthly Estimate for Voucher - Original and two copies

c. Affidavit - Original

7. OPTIONAL REQUIREMENTS: Where a choice of materials or methods is permitted herein, the Contractor will be given the right to exercise the option unless stated specifically otherwise.

8. QUARANTINE FOR IMPORTED FIRE ANT (CLNC 2/82): All of Onslow, Jones and Carteret Counties and portions of Duplin and Craven Counties have been declared a generally infested area by the United States Department of Agriculture for the imported fire ant. Compliance with the quarantine regulations established by this authority as set forth in USDA Quarantine No. 81 dated 9 October 1970, and USDA Publication 301.81-2A of 23 July 1976, is required for operations hereunder

8.1 The quarantine applies to materials originating from Camp Lejeune and the Marine Corps Air Station (Helicopter), New River, which are to be transported outside the Onslow County or adjacent suppression areas.

8.2 Certification is required for the following articles, and they shall not be moved from the reservation to any point outside the Onslow County and adjacent designated areas unless accompanied by a valid inspection certificate issued by an officer of the Plant Protection and Quarantine Program, USDA:

(1) Bulk soil

(2) Used mechanized soil-moving equipment

(3) Any other products, articles, or means of conveyance if it is determined by an inspector that they present a hazard of spread of the imported fire ant and the person in possession thereof has been so notified.

8.3 Authorization for movement of equipment outside the imported fire ant regulated area shall be obtained from USDA, APHIS, PPQ, Rural Route 6, Box 53, Wilmington, NC 28504; telephone (919) 343-4667. Requests for inspection shall be made at least two days in advance of the date of movement to permit arrangements for the services of authorized inspectors. The equipment shall be prepared and assembled so that it may be readily inspected. All soil on or attached to equipment, supplies and materials shall be removed by washing with water and/or such other means as necessary to accomplish complete removal. Resulting spoil shall be wasted as directed.

9. EMERGENCY MEDICAL CARE: Only emergency medical care is available at Camp Lejeune Government facilities for Contractor employees who suffer on-the-job injury or disease. Emergency care will be rendered at the prevailing rates established in BUMEDINST 6320.4 series. Reimbursement shall be made by the Contractor to the Naval Regional Medical Center Collection Agent upon receipt of a monthly statement.

10. PROPRIETARY NAMES: Names indicated for colors, textures and patterns of materials are for the purpose of color, texture and pattern selection only. Other manufacturer's materials are acceptable provided they closely approximate colors, textures and patterns indicated and provided they conform to all other requirements.

11. NORTH CAROLINA STATE AND LOCAL SALES AND USE TAX (1977 JAN):

(a) As used throughout this clause, the term "materials" means building materials, supplies, fixtures and equipment which become a part of or are annexed to any building or structure erected, altered, or repaired under this contract.

(b) If this is a fixed-price contract as defined in the Defense Acquisition Regulation, the contract price includes the North Carolina state and local sales and use taxes to be paid with respect to materials, notwithstanding any other provision of this contract. If this is a cost-reimbursement type contract as defined in such regulation, any North Carolina state and local sales and use taxes paid by the Contractor with respect to materials shall constitute an allowable cost under this contract.

(c) At the time specified in paragraph (d) below:

(i) The Contractor shall furnish the Contracting Officer certified statements setting forth the cost of the materials purchased from each vendor and the amount of North Carolina state and local sales and use taxes paid thereon. In the event the Contractor makes several purchases from the same vendor, such certified statement shall indicate the invoice numbers, the

inclusive dates of the invoices, the total amount of the invoices and the North Carolina state and local sales and use taxes paid thereon by the Contractor. Any local sales or use taxes included in the Contractor's statements must be shown separately fromthe state sales or use tax. The Contractor shall furnish such additional information as the Commissioner of Revenue of the State of North Carolina may require to substantiate a refund claim for sales or use taxes.

(ii) The Contractor shall obtain and furnish to the Contracting Officer similar certified statements by its subcontractors.

(d) If this contract is completed before the next October 1, the certified statements to be furnished pursuant to paragraph (c) above shall be submitted within 60 days after completion. If this contract is not completed before the next October 1, such certified statements shall be submitted on or before the 30th day of November of each year and shall cover taxes paid during the twelve-month period which ended the preceding September 30.

(e) The certified statements to be furnished prusuant to paragraph (c) above shall be in the following form:

I hereby certify that during the period _____ to _____, (name of Contractor or subcontractor) paid North Carolina state and local sales and use taxes aggregating $_____(state) and $_____ (local) with respect to building materials, supplies, fixtures and equipment which have become a part of or annexed to a building or structure erected, altered or repaired by (name of Contractor) for the United States of America, and that the vendors from whom the property was purchased, the dates and numbers of the invoices covering the purchases, the total amount of the invoices of each vendor, the North Carolina state and local sales and use taxes paid thereon, shown separately, and the cost of property withdrawn from warehouse stock and North Carolina state and local sales or use taxes paid thereon are as set forth in the attachments hereto.

12. AS-BUILT DRAWINGS: During the progress of the work, one full-size print of each of the drawings accompanying this specification shall be neatly and clearly marked in red to show all variations between the construction actually provided and that indicated or specified in the contract documents. The as-built drawings shall be kept up-to-date at the work site at all times during the contract, and shall be available for inspection by the Contracting Officer upon request. The Contractor shall also mark the drawings to indicate the exact location of any underground utility lines discovered in the course of the work. Where a choice of materials and/or methods is permitted herein, and where variations in the scope or character of the work indicated or specified are permitted either by award on bidding items specified for that purpose or by subsequent change to the contract, the as-builit drawings shall define the construction actually provided. The representation of such variations shall conform to standard drafting practice and shall include such supplementary notes, legends, and details as may be necessary for legibility and clear portrayal of the as-built construction; the marked prints shall be subject to approval of the Contracting Officer before acceptance. Upon completion of the work, the completed as-built drawings shall be presented to the Contracting Officer.

*** END OF SECTION ***

SECTION 01401
QUALITY CONTROL

1. APPLICABLE PUBLICATION: The following publication is a part of this specification to the extent referenced. The publication is referred to by basic designation only in the text.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

ASTM E329-77 Standard Recommended Practices for Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

2. QUALITY CONTROL of this contract will be administered under the General Provisions Clause entitled "Contractor Inspection System".

3. DEFINITIONS:

3.1 Factory Tests: Tests made on various products and component parts prior to shipment to the job site, including but not limited to such items as transformers, boilers, air conditioning equipment, electrical equipment, and precast concrete.

3.2 Field Tests: Tests or analyses made at, or in the vicinity of, the job site in connection with the actual construction.

3.3 Product: The term "product" includes the plural thereof and mean a type or a category of manufactured goods, construction, installations and natural and processed materials or those associated services whose characterization, classification or functional performance determination is specified by standards.

3.4 Person: The term "person" means associations, companies, corporations, educational institutions, firms, government agencies at the Federal, State and Local level, partnerships, and societies, as well as divisions thereof, and individuals.

3.5 Testing Laboratory: The term "testing laboratory" means any "person", as defined above, whose functions include testing, analyzing, or inspecting "products", as defined above, and/or evaluating the designs or specifications of such "products", according to the requirements of applicable standards.

3.6 Certified Test Reports: Reports of tests signed by a qualified professional attesting that the test results reported are accurate and that items tested either meet or fail to meet the stated minimum requirements. These test reports include those performed by Factory Mutual, Underwriters' Laboratories, Inc., and others.

3.7 Certified Inspection Reports: Reports signed by approved inspectors attesting that the items inspected meet the specification requirements other than any exceptions included in the report.

3.8 Manufacturer's Certificate of Conformance or Compliance: A certificate signed by an authorized manufacturer's official attesting that the material or equipment delivered meets the specification requirements.

4. SUBMITTALS shall be prepared in accordance with this specification and the General Provisions and submitted to the Contracting Officer for approval. Each submittal shall be accompanied with a cover letter signed by the Contractor. Each item proposed to be incorporated into the contract shall be clearly marked and identified in the submittals, and shall be cross-referenced to the contract drawings and specifications so as to identify clearly the use for which it is intended. Each sheet of submittal shall be stamped with the Contractor's certification stamp. Data submitted in a bound volume or on one sheet printed on two sides, may be stamped on the front of the first sheet only. The Contractor's certification stamp shall be worded as follows:

"It is hereby certified that the (equipment)(materials) shown and marked in this submittal is that propsed to be incorporated into Contract Number_____, is in compliance with the contract drawings and specifications, can be installed in the allocated spaces, and is submitted for Government approval. Certified by _____ Date_____"

The person signing the certification shall be one designated in writing by the Contractor as having that authority. The signature shall be in original ink. Stamped signatures are not acceptable.

4.1 Submittal Status Logs: The Contractor shall maintain at the job site an up-to-date submittal status log showing the status of all submittals required by the contract. A sample format of an acceptable log is attached at the end of this section. While the use of this sample format is not required, any other format must contain the same information as shown on the sample.

4.2 Samples, Shop Drawings, Manufacturer's Data, Certifications and Data Required of the Contractor: Specification MIL-D-1000 shall be used as a guide and its use is encouraged, for all drawings and data submitted by the Contractor. Conformance to the provisions of Specification MIL-D-1000 is not mandatory for maps, sketches, presentation drawings, perspectives, renderings, and all other drawings not requiring Naval Facilities Engineering Command drawing numbers. Before starting the fabrication or installation of any of this work, the Contractor shall submit to the Contracting Officer for and receive approval of, in accordance with the General Provisions, such drawings as may be required, including all items specified in the applicable paragraphs of the technical sections of this specification. Seven copies of all submittals to be approved by the Contracting Officer shall be forwarded

4.3 Identification: All catalog cuts, shop drawings, samples and other data submitted for approval shall specifically identify the specification paragraph or contract drawing by number where each item submitted is required to be provided. All submittals shall be clearly marked in ink to indicate the specific item(s) submitted for approval. Samples shall be clearly labeled with strong tags, firmly affixed, or indelible markings to identify the contract number, contracctor, manufacturer, and item name.

4.4 Certified Test Reports: Before delivery of materials and equipment, four certified copies of the reports of all tsts listed in the technical sections and referenced publications shall be submitted and approved. The testing shall have been performed in a laboratory meeting the requirements

specified herein. The tests shall have been performed within three years of submittal of the reports for approval. Test reports shall be accompanied by certificates from the manufacturer certifying that the material and equipment proposed to be supplied is of the same type, quality, manufacture, and make as that tested.

4.5 Manufacturer's Certificates of Conformance or Compliance: Manufacturer's certification furnished by the Contractor on items of materials and equipment incorporated into the work will be accepted only when this method will assure full compliance with the provisions of the contrct, as determined by the Contracting Officer. Preprinted certifications will not be accaeptablle. All certifications shall be in the original. The original of all manufacturer's certifications shall name the appropriate item of equipment or material, specification, standard, or other document specified as controlling the quality of that item and shall have attached thereto certified copies of test reports upon which the certifications are based. All certificates shall be signed by the manufacturer's official authorized to sign certificates of conformance or compliance.

4.6 Laboratory Reports shall cite the contract requirements, the test or analysis procedures used, the actual tst results, and include a statement that the item tested or analyzed conforms or fails to conform to the specification requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters "CONFORMS" or "DOES NOT CONFORM" to the specification requirements as the case may be. All test reports shall be signed by the representative of the testing laboratory authorized to sign certified test reports. The Contractor shall arrange for immediate and direct delivery of the signed original of all reports, certifications, and other documentation to the Contracting Officer.

4.7 Tabulation of Tests: In addition to the General Provisions requirements for CQC test reports, prior to final payment the Contractor shall obtain from each laboratory a tabulation of all tests it has performed in connection with the construction contract, including conforming or nonconforming, and repeated test results. The tabulations shall be certified as complete, and signed by the authorized representative of the laboratory, and shall be delivered to the Contracting Officer.

5. QUALITY CONTROL REQUIREMENTS: In accordance with the General Provisions Clause entitled "Contractor Inspection System", the Contractor shall inspect and test all work under the contract and maintain records of the inspections and tests. Approvals, except those required for field installations,, field applications, and field tests, shall be obtained before delivery of materials and equipment to the project site. Surveillance of the inspection system will be performed by the Contracting Officer.

5.1 Factory Tests: Unless otherwise specified, the Contractor will arrange for factory tests when they are required under the contract.

5.2 Factory Inspection: Unless otherwise specified, the Contractor will arrange for factory inspection when required under the contract.

5.3 Field Inspections and Tests by the Contractor: The Contracctor shall furnish all equipment, instruments, qualified personnel, and facilities necessary to inspect all work and perform all tests required by the contract. All inspections and tests performed and test results received each day shall be included in the Daily Report to Inspector.

5.4 Approval of Testing Laboratories: All laboratory work under this contract shall be performed by a laboratory approved by the Government, whether the laboratory is employed by the Contractor or is owned and operated by the Contractor. The basis of approval includes the following:

a. Testing laboratores performing work in connection with concrete, steel, and bituminous materials shall comply with ASTM E329, except that the Contracting Officer will perform the function of paragraphs 3.4 and 3.5 therein in the absence of other Government approval.

b. Testing laboratories performing work not in connection with concrete, steel, or bituminous materials shall comply with sections 3 and 4 of ASTM E329, except that the Contracting Officer will perform the functions of paragraphs 3.4 and 3.5 therein in the absence of other Government approval.

5.5 Repeated Tests and Inspections: The Contractor shall repeat tests and inspections after each correction made to nonconforming materials and workmanship until tests and inspections indicate the materials, equipment, and workmanship conform to the contract requirements. The retesting and reinspections shall be performed at no additional cost to the Government.

5.6 Daily Report to Inspector: The Daily Report to Inspector Form NAVFAC 4330/34 shall be submitted to the Contracting Officer by 10:00 A.M. on the working day following the day the work was performed.

SUBMITTAL STATUS LOG

"SEE INSTRUCTIONS ON REVERSE BEFORE FILLING IN"

PAGE______ OF______

CONTRACT NUMBER	SHORT TITLE	LOCATION	CONTRACTOR

SUBMITT'L/ TRANSMITT'L NO.	DESCRIPTION OF ITEMS	SPECIFICATION SECTION REQUIRING SUBMITTAL	SUBMITTAL REQUIRES							CONTRACTOR ACTION		DATE FORWARDED FROM ROICC	ROICC ACTION		DATE			REMARKS
			SHOP DWGS.	CATALOG DATA	SAMPLE	CERTIFICATION	TEST DATA	CONTRACTOR APPV'D	GOV'T APPROVED	INSERT ACTION CODE	DATE OF ACTION		INSERT ACTION CODE	DATE OF ACTION	RECEIVED FROM ROICC	MAT'L/EQUIP RECEIVED ON SITE	APPROVED BY CONTRACTOR	
(a)	(b)	(c)	(d)					(e)		(f)		(g)	(h)		(i)	(j)	(k)	

INSTRUCTIONS

1. This form may be used by the Contractor for listing all material submittals that require action by either the Contractor or the Government.

2. Columns (a) through (e) should be completed by the Contractor and must include all submissions that are required by the specifications.

3. As submittals are received and processed, the remaining columns are to be complted by the Contracctor.

4. In those instances where the Contractor has approved the submittal under his contraact responsibility, there may be a dual Action Code under column (f); e.g., "A/E", indicating approved as submitted and forwarded to the OICC for record purposes.

5. In column (f) for those items requiring OICC action (Action Code "D"), the reason for forwarding to the OICC should be entered in the "Remarks" column; e.g., gov't approval required; waiver requested because of variance, substitution, etc..

6. Where no Government action is required, (for Contractor review/approval items), there need be no entry in columns (h) and (i).

7. Column (j) is completed when material or equipment is deliverd to the project. Column (k) is completed only afteer verifiation that the delivered item is that represented by the approval submittal.

ACTION CODE: To be used when completing columns (f) and (h)

A. Approved as submitted

B. Approved as noted

C. Disapproved

D. Forwarded to OICC for action

E. Forwarded to OICCC for record purposes

END OF SECTION

SECTION 01560
ENVIRONMENTAL PROTECTION

PART 1. GENERAL

1.1 ENVIRONMENTAL PROTECTION PLAN: The Contractor may be responsible for the preparation and submission of an Environmental Protection Plan. After the contract is awarded, but prior to the commencement of the work, the Contractor shall meet with the Contracting Officer, or his representative, and discuss the proposed Environmental Protection Plan. The meeting shall develop mutual understanding relative to details of environmental protection, including required reports and measures to be taken should the Contractor fail to provide adequate protection in an adequate and timely manner. Not more than 14 days after the meeting, the Contractor shall submit for approval his proposed Environmental Protection Plan, if so required.

1.2 GENERAL REQUIREMENTS: The Contractor shall provide and maintain environmental protection during the life of the contract as defined herein. The Contractor's operations shall comply with all Federal, State and Local regulations pertaining to water, air, solid waste, and noise pollution.

2. PRODUCTS

2.1 DEFINITIONS OF POLLUTANTS:

2.1.1 Non-Hazardous Wastes: Solid or liquid substances that are to be discarded by the Contractor and that normally do not constitute a hazard to man or to the environment. This includes, but is not limited to, paper, metal (other than toxic metals such as lead and mercury), masonry, wood, brick, stone, asphaltic concrete, plastics, rubber, rubbish and concrete.

2.1.2 Hazardous Wastes: Solid and liquid substances that are to be discarded by the Contractor and that constitute a significant active or potential hazard to man and/or to the remainder of the environment. This includes, but is not limited to asbestos, glass, lead, mercury, pesticides, herbicides, other toxic chemicals and waste, liquid petroleum products, human excrement, garbage, sediment and radioactive materials.

2.1.3 Protection of Natural Resources: It is intended that the natural resources within the limits of permanent work performed under this contract be preserved in their existing condition or be restored to an equivalent or improved condition upon completion of the work. The Contractor shall confine his construction activities to areas defined by the work schedule, plans, and specifications.

3. EXECUTION

3.1 CONTROL AND DISPOSAL OF HAZARDOUS AND NON-HAZARDOUS WASTES:

3.1.1 Non-hanzardous wastes, except rubble, shall be picked up and disposed of daily or placed in containers which are emptied on a weekly schedule. All handling and disposal shall be so conducted as to prevent contamination of the site and other areas. The Contractor shall transport all such waste off the Base, unless he desires to use the Base Sanitary Landfill or rubble disposal areas.

3.1.2 If transporting any material off Government property, the Contractor shall provide the Contracting Officer a copy of State and/or local permit which reflects the responsible agency's approval of the disposal area and proposed waste disposal methods.

3.1.3 Rubble such as masonry, stone, concrete without reinforcing steel, and brick may be deposited as directed on the Base. Upon completion, the work and disposal area shall be left clean and natural looking. All signs of temporary construction and activities incidental to construction of the required permanent work in place shall be obliterated.

3.1.4 Optional use of Base Landfill shall require compliance with Landfill rules. Such rules do not allow accepting recyclable metals nor reusable wood or lumber over six feet in length.

3.2 HAZARDOUS WASTES:

3.2.1 Garbage Disposal: The Contractor shall transport any garbage to the Base Sanitary Landfill. However, the preparation, cooking and disposing of food are strictly prohibited on the project site.

3.2.2 Liquid wastes shall be stored in corrosion-resistant containers, removed from the project site, and disposed of not less frequently than monthly unless directed otherwise. Disposal of liquid waste shall be in accordance with Federal, State and Local regulations. Fueling and lubricating of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spills and evaporation. For oil and hazardous material spills which may be large enough to violate Federal, State and Local regulations, the Contracting Officer shall be notified immediately. The Base Sanitary Landfill will not accept liquid wastes nor empty drums.

3.2.3 Asbestos disposal in the Base Sanitary Landfill will be mandatory when friable asbestos is encountered. If such asbestos is encountered, provisions for handling or disposal shall comply with the applicable section of this specification; if not specified, such requirements shall be as directed.

SECTION 02050
DEMOLITION AND REMOVAL

PART 1 - GENERAL

1.1 SUBMITTALS: Submit proposed demolition and removal procedures to the Contracting Officer for approval before work is started. Procedures shall provide for coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation, and sequence of operations.

1.2 REQUIREMENTS: The work includes demolition or removal of all construction indicated or specified. All materials resulting from demolition work, except as indicated or specified otherwise, shall become the property of the Contractor and shall be removed from the limits of Government property. Remove rubbish and debris from the station daily, unless otherwise directed; do not allow accumulations inside or outside the building. Store materials which cannot be removed daily in areas specified by the Contracting Officer.

1.3 DUST CONTROL: Take appropriate action to check the spread of dust to occupied portions of the building and to avoid the creation of a nuisance in the surrounding area. Do not use water if it results in hazardous or objectionable conditions, such as ice, flooding or pollution. Comply with all dust regulations imposed by local air pollution agencies.

1.4 PROTECTION:

1.4.1 Buildings: Protect existing work that is to remain in place, that is to be reused, or that is to remain the property of the Government by temporary covers, shoring, bracing, and supports. Repair items damaged during performance of the work or replace with new. Do not overload structural elements. Provide new supports or reinforcement for existing construction weakened by demolition or removal work.

1.4.2 Weather Protection: Protect building interior and all materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and approved temporary covering of exposed areas. Temporary coverings shall be attended, as necessary, to insure effectiveness and to prevent displacement.

1.4.3 Personnel: Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning any such work.

PART 2 - EXECUTION

2.1 EXISTING FACILITIES TO BE REMOVED:

2.1.1 Utilities:

2.1.1.1 Utility Services: Disconnections of utility services and related meters and equipment are included under Section 16402, "Interior Wiring System".

2.1.2 Paving and Slabs: Remove concrete and asphaltic concrete paving and slabs including aggregate base to a depth of 2 feet below existing adjacent grade.

2.1.3 Masonry: Remove masonry carefully so as to prevent damage to surfaces to remain.

2.1.4 Concrete: Where concrete work is to be removed, saw concrete along straight lines to a depth of not less than 2 inches. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. The remainder of the concrete shall be broken out, provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, it shall be ground smooth or the saw cut shall be made entirely through the concrete.

2.2 DISPOSITION OF MATERIAL:

2.2.1 Title to Materials: Title to all materials and equipment to be removed, except as specified otherwise, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition or loss of, or damage to, such property after notice to proceed. Materials and equipment shall not be viewed by prospective purchasers or sold on the site.

2.3 CLEANUP:

2.3.1 Debris and Rubbish: Remove and transport debris and rubbish in a manner that will prevent spillage on streets or adjacent areas. Clean up spillage from streets and adjacent areas. Other applicable requirements are included under Section 01560, "Environmental Protection".

2.3.2 Regulations: Comply with Federal, State, and Local hauling and disposal regulations.

*** END OF SECTION ***

SECTION 03302
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

U. S. DEPARTMENT OF COMMERCE PRODUCT STANDARD (PS):

1-74	Construction and Industrial Plywood

AMERICAN CONCRETE INSTITUTE (ACI):

211.1-77	Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete
301-72 (R 1975)	Specifications for Structural Concrete for Buildings
315-74 (R 1978)	Manual of Standard Practice for Detailing Reinforced Concrete Structures
318-77 & 77C Suppl.	Building Code Requirements for Reinforced Concrete
347-78	Recommended Practice for Concrete Formwork

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

A 185-79	Welded Steel Wire Fabric for Concrete Reinforcement
A 615-79	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
C 31-69 (R 1975)	Making and Curing Concrete Test Specimens in the Field
C 33-79	Concrete Aggregates
C 39-72 (R 1979)	Compressive Strength of Cylindrical Concrete Specimens
C 94-80	Ready-Mixed Concrete
C 143-78	Slump of Portland Cement Concrete
C 150-80	Portland Cement
C 171-69 (R 1975)	Sheet Materials for Curing Concrete
C 172-71 (R 1977)	Sampling Fresh Concrete
C 231-78	Air Content for Freshly Mixed Concrete by the Pressure Method
C 260-77	Air-Entraining Admixtures for Concrete
C 309-74	Liquid Membrane-Forming Compounds for Curing Concrete
D 98-77a	Calcium Chloride
D 1190-74 (R 1980)	Concrete Joint Sealer, Hot Poured Elastic Type
D 1751-73 (R 1978)	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
D 1752-67 (R 1978)	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
D 1850-74 (R 1979)	Concrete Joint Sealer, Cold-Application Type

1.2 SUBMITTALS:

1.2.1 Shop Drawings: Submit shop drawings for reinforcing steel, prepared in accordance with ACI 315. Indicate bending diagrams, assembly diagrams, splicing and laps of rods, and shapes, dimensions and details of bar reinforcing and accessories. Do not use scaled dimensions from structural drawings to determine lengths of reinforcing rods.

1.2.2 Contractor Mix Design: Submit a mix design for each type of concrete, including a complete list of materials including admixtures and the applicable reference specifications, and copies of test reports showing that the mix has been successfully used to produce concrete with the properties specified.

1.2.3 Certification: Submit one copy of the delivery ticket for each load of ready-mixed concrete, showing all information required by ASTM C 94.

1.2.4 Catalog Data: Submit manufacturers' recommendations for the items listed below. Clearly mark data to indicate which type, size, or item is proposed. Data shall be sufficient to show conformance to specified requirements.

a. Joint Filler
b. Joint Sealer
c. Reinforcement

1.3 DELIVERY: Do not deliver concrete until forms, reinforcement, and embedded items are in place and ready for concrete to be placed.

1.4 STORAGE: Store reinforcement in a manner that will avoid excessive rusting or coating with grease, oil, dirt, and other objectionable materials. Store in separate piles or racks so as to avoid confusion or loss of identification after bundles are broken.

PART 2 - PRODUCTS

2.1 CONCRETE:

2.1.1 Contractor Furnished Mix Design: Design concrete mix in accordance with ACI 211.1 Slump shall be between two inches and four inches. The concrete shall have a 28-day compressive strength of 3000 pounds per square inch.

2.1.2 Air-Entrained Concrete: Provide for all concrete exposed to the weather. Accomplish air-entrainment by using an air-entraining admixture, not air-entraining cement. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve the admixture in a portion of the mixing water and add to the mix in the drum in a manner that will ensure uniform distribution of the agent throughout the batch. The air content of freshly mixed air-entrained concrete shall be as follows:

Maximum aggregate size	Amount of air (percent volume of concrete)
1-1/2 inch	between 4 and 5-1/2
1 inch	between 4 and 6
3/4 inch	between 5 and 7
1/2 inch	between 6 and 8
3/8 inch	between 7 and 9

2.2 MATERIALS:

2.2.1 Cement: ASTM C 150, Type I or II for all concrete. All cement for exposed concrete surfaces shall be of the same manufacture.

2.2.2 Water: Water, including free moisture and water in the aggregates, shall be fresh, clean, and potable.

2.2.3 Aggregates: ASTM C 33, size no. 467 except as modified herein. Obtain all aggregates for exposed concrete surfaces from one source. Aggregates shall be free from any substance which may be deleteriously reactive with the alkalies in the cement.

2.2.4 Admixtures:

2.2.4.1 Air-entraining: ASTM C 260, for all air-entrained concrete.

2.2.4.2 Accelerating: ASTM D 98, Type I or Type II. Use only when approved.

2.2.5 Materials for Forms: Wood, plywood, steel, or other suitable material. Wood forms, for surfaces exposed to view in the finished structure, shall be boards or plywood. Dress boards to a uniform thickness, evenly match, and provide boards free from loose knots, holes, and other defects. Plywood shall be B-B concrete form panels conforming to PS-1. Surfaces of steel forms shall be free from irregularities, dents, and sags.

2.2.6 Reinforcement:

2.2.6.1 Reinforcing Bars: ASTM A 615, Grade 40. All bars shall be deformed.

2.2.6.2 Welded Wire Fabric: ASTM A 185, 6 by 6 - W2.9 by W2.9, unless otherwise indicated.

2.2.7 Materials for Curing Concrete:

2.2.7.1 Impervious Sheeting: Waterproof paper, polyethylene sheeting, or polyethylene coated burlap conforming to ASTM C 171.

2.2.7.2 Liquid Membrane-forming Compound: ASTM C 309, white-pigmented, Type 2, free of paraffin or petroleum.

2.2.7.3 Liquid Chemical Compound: A suitable sealer-hardener designed for sealing and hardening in addition to curing of the concrete, applied by the method and at the rate recommended by the manufacturer. It shall not reduce the adhesion of tile, paint, roofing, waterproofing, or other material to be applied to the concrete. The chemical compound shall be free of petroleum resins or waxes.

2.2.8 Joint Sealing Materials: ASTM D 1190 or ASTM D 1850 inside buildings; ASTM D 1190 outside of buildings.

2.2.9 Preformed Joint Filler: ASTM D 1751 or ASTM D 1752.

2.2.10 Vapor Barrier Material: Polyethylene sheeting of not less than 6-mil nominal thickness.

PART 3 - EXECUTION

3.1 FORMS:

3.1.1 General: Provide forms for all concrete not indicated or specified otherwise. Set forms true to line and grade and maintain so as to insure completed work within the allowable tolerances specified, and make mortar-tight. Construct forms so that they can be removed without damaging the concrete. Chamfer all exposed joints, edges, and external corners of concrete 3/4 inch unless otherwise indicated. Concrete for fuel storage tank may be placed in excavations without forms. The dimensions of excavations in earth shall be not less than 2 inches outside of the concrete lines indicated.

3.1.2 Coating: Before placing the concrete, coat the contact surfaces of forms with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer. Do not use mineral oil on forms for surfaces which are to be painted.

3.1.3 Tolerances and Variations: Set and maintain concrete forms to ensure that after removal of the forms no portion of the concrete work will exceed any of the tolerances specified in ACI 347.

3.2 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS:

3.2.1 General: Provide all bars, wire fabric, and other reinforcing materials as indicated or specified, together with all necessary wire ties, supports, and other devices necessary to install and secure the reinforcement properly. All reinforcement, when placed, shall be free from rust, scale, oil, grease, clay, and other coating, and foreign substances that would reduce or destroy the bond. Rusting of reinforcement shall not be a basis of rejection, provided that the rusting has not reduced the effective cross sectional area of the reinforcement, and provided that loose rust shall be removed prior to placing. Where cover over reinforcing steel is not indicated, it shall be in accordance with ACI 318.

3.2.2 Vapor Barrier: Provide beneath the entire concrete slab. Use the greatest widths and lengths practicable so as to eliminate joints wherever possible. Where joints are necessary, lap not less than 6 inches and seal with approved adhesive. Torn, punctured, or damaged vapor barrier material shall be removed and replaced as directed, prior to the placing of concrete. Place concrete in such a manner as to preclude damage to the vapor barrier material.

3.2.3 Placing: Place reinforcement accurately and secure in place on suitable chairs, spacers, or metal hangers. On the ground, use concrete or other non-corrodible material for supporting reinforcement.

3.2.4 Splicing: Conform to ACI 318, except as otherwise indicated or specified. Where splices in addition to those indicated are necessary, they shall be approved prior to their use. Do not make splices at points of maximum stress. Make splices in welded wire fabric so that the overlap is not less than the spacing of the cross wires.

3.2.5 Setting Miscellaneous Material: Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before the concrete is placed. Plumb anchor bolts, check for location and elevation, and secure rigidly in position. Fill voids in sleeves temporarily with readily removable material to prevent the entry of concrete into the voids.

3.2.6 Expansion Joints and Cleavage Joints: Make joints 1/2-inch wide except as indicated otherwise. Fill expansion joints not exposed to weather completely, and fill joints exposed to weather to a depth of one inch from the surface, with preformed joint material. Clean the one-inch deep space above the preformed material after the concrete has been cured and, when dry, fill flush with joint sealing material. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint.

3.3 MEASURING, MIXING, TRANSPORTING, AND PLACING CONCRETE: In accordance with ACI 301, Chapters 7 & 8, except as modified herein.

3.3.1 Measuring: Make moisture, volumetric, and air determinations at intervals specified herein under testing requirements. Allowable tolerances for measuring cement and water shall be one percent; for aggregates, 2 percent; and for admixtures, 3 percent.

3.3.2 Mixing: Machine mix all concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Introduce all mixing water in the drum before one-fourth of the mixing time has elapsed. The time elapsing between the introduction of the mixing water to the cement and aggregates or the cement to the aggregates and the start of placing of the concrete in final position in the forms shall not exceed 60 minutes if the the air temperature is less than 85 degrees Fahrenheit, and 45 minutes if the air temperature is equal or greater than 85 degrees F. On arrival at the job site, no addition of water will be allowed other than that required initially to adjust to the specified slump. Such an addition must not exceed the limits of the specified maximum water-cement ratio.

3.3.3 Conveying: Convey concrete from the mixer to the forms as rapidly as practicable and so as not to cause segregation or loss of ingredients. Deposit concrete as close as practicable to its final position in the forms. At any point in the conveying, the free vertical drop of the concrete shall not exceed 3 feet. Clean conveying equipment thoroughly before each run. Do not use aluminum pipe or chutes. Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Remove any concrete which has segregated in conveying and dispose of as directed.

3.3.4 Placing: Do not place concrete when weather conditions prevent proper placement and consolidation. Do not place concrete in uncovered areas during periods of precipitation. Do not place concrete in water. Prepare subgrades of earth or other material properly and, if necessary, cover with heavy building paper or other suitable material to prevent the concrete from becoming contaminated. Dampen porous subgrades as required to prevent water of hydration from being absorbed into the subgrade. Clean forms of dirt, construction debris, water, snow, and ice. Place concrete in one continuous operation except where construction joints are provided. Place concrete in areas bounded by construction joints in one continuous operation. Remove water which accumulates on the surface of the concrete during placing by absorption with porous materials in a manner that prevents removal of cement.

3.3.5 Vibration: Compact all concrete, with the exception of concrete slabs 4 inches or less in depth, with high frequency, internal, mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straight edge. Vibrators shall be designed to operate with vibratory element submerged in the concrete, and shall have a frequency of not less than 6,000 impulses per minute when submerged.

3.3.6 Cold Weather: Except with authorization, do not place concrete when the ambient temperature is below 40 degrees F or when the concrete is likely to be subjected to freezing temperatures within 24 hours. When so authorized, if concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that the temperature of the concrete when deposited shall be between 65 and 80 degrees F. Methods of heating materials are subject to approval of the Contracting Officer. Do not heat mixing water above 165 degrees F. Remove lumps of frozen material and ice from the aggregates before placing aggregates in the mixer. When specifically approved by the Contracting Officer, the Contractor may add, not more than 2 pounds of Type I or not more than one pound, 10 ounces of Type II calcium chloride, ASTM D 98, per bag of cement. Dissolve the admixture in a portion of the mixing water and add to the mix at the drum in a manner that will ensure uniform distribution of the agent throughout the batch.

3.3.7 Hot Weather: Cool ingredients before mixing so as to prevent rapid drying of newly placed concrete. When the ambient temperature is more than 90 degrees F, the temperature of the concrete as placed shall not exceed 90 degrees F; shade the fresh concrete as soon as possible after placing; and start curing as soon as the surface of the fresh concrete is sufficiently hard to permit curing without damage to the concrete.

3.4 SURFACE FINISHES (EXCEPT DIESEL ENGINE - GENERATOR CONCRETE PAD FINISHES):

3.4.1 Defects: Repair all formed surfaces by patching minor honeycombed or otherwise defective areas with cement mortar of the same composition as that used in the concrete. Patch concrete as soon as the forms are removed. Concrete with honeycombing or other defects which affect the structural strength of the member, will be rejected, or the defects corrected as directed by the Contracting Officer.

3.4.2 Standard Finish: Provide standard finish for exposed concrete not indicated or specified otherwise. The surface of the concrete shall not vary more than 1/4 inch when measured from a five-foot template. Exposed surfaces shall be uniform in appearance.

3.4.2.1 Against Forms: Remove fins and other projections and level abrupt irregularities. Fill surface pits having a dimension greater than 1/8 inch with cement mortar as specified.

3.4.2.2 Not Against Forms: Finish surfaces not otherwise specified with wood floats to even surfaces.

3.5 DIESEL ENGINE - GENERATOR CONCRETE PAD FINISHES:

3.5.1 General: Do not place dry cement directly upon the new concrete surface to absorb excess moisture.

3.5.2 Finishing: Place, consolidate and immediately strike off concrete to bring the top surface of the slab to proper contour, grade, and elevation. Immediately darby or bull float the surface with wooden tools so as to correct any uneveness. Complete striking-off and darbying before bleed water appears on the surface of the freshly-placed concrete. Permit the concrete to attain a set sufficient for floating and sufficient to support the weight of the finisher and equipment. If the bleed water has not disappeared by the time floating of the surface is to start, drag the excess water off using a rubber hose. Do not use dry cement to absorb bleed water.

3.5.2.1 Troweled Finish: First, provide a floated finish. When slab has attained a proper set, hand- or machine-trowel to a smooth, hard, dense finish, level within 1/8 inch in 10 feet.

3.5.2.2 Sealer-hardener Finish: Provide trowelled finish and then apply liquid chemical compound as specified herein.

3.6 CURING AND PROTECTION:

3.6.1 General Requirements: Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use impervious-sheeting curing, liquid chemical or liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. Begin curing immediately following the removal of forms. Maintain the temperature of the air next to the concrete at not less than 40 degrees F for the full curing periods.

3.6.2 Impervious-Sheeting Curing: Wet the entire exposed surface thoroughly with a fine spray of water and then cover with impervious sheeting. Lay sheets directly on the concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than the concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets if torn or otherwise damaged during curing. The sheeting shall remain on the concrete surface to be cured for not less than 7 days.

3.6.3 Liquid Membrane-Forming Compound Curing: Seal or cover all joint openings prior to application of the curing compound to prevent the curing compound from entering the joint. Compound shall remain on the concrete for 7 days before sealer or covering is removed and joint sealing material is placed in the joints.

3.6.3.1 Application: Apply the compound immediately after the surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. The total coverage for the two coats shall be between 150 and 200 square feet per gallon of undiluted compound. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat of the compound immediately to areas where the film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after the curing compound has been applied in the same manner.

3.6.3.2 Protection of Treated Surfaces: Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from foot and vehicular traffic and other sources of abrasion for not less than 72 hours. Maintain continuity of the coating for the entire curing period and repair damage to the coating during this period immediately.

3.6.4 Liquid Chemical Compound Curing: Provide for surfaces for which a sealer-hardener finish is specified, and, at the Contractor's option, provide in lieu of liquid membrane-forming compound curing for other surfaces. The application of the compound shall conform to the

requirements for liquid membrane-forming compound curing except as specified otherwise herein. Sealing or covering of joints and openings in which joint sealer is to be applied will not be required. The coverage and number of applications shall be in accordance with the recommendations of the manufacturer of the compound.

3.6.5 Curing Periods: Cure not less than 10 days for concrete exposed to the weather and not less than 7 days for all other concrete.

3.6.6 Removal of Forms: Remove forms in a manner which will prevent damage to the concrete. Do not remove forms without approval, nor sooner than 24 hours after placement of concrete.

3.7 SAMPLING AND TESTING:

3.7.1 Sampling: Collect samples of fresh concrete in accordance with ASTM C 172 during each working day as required to perform all tests specified herein. Make test specimens in accordance with ASTM C 31.

3.7.2 Testing:

3.7.2.1 Consistency Tests: Determine slump in accordance with ASTM C 143. Take samples for slump determination from the concrete while it is being placed. Perform tests at the beginning of a concrete placement operation and at subsequent intervals to insure that the specification requirements are met. In addition, perform tests each time test cylinders are made.

3.7.2.2 Compressive Tests: Determine compressive strength in accordance with ASTM C 39. Make four test specimens for each set of tests. Test two specimens at 7 days, and the other two at 28 days. The strength of the concrete will be considered satisfactory if the average of the 28-day test results equals or exceeds the specified 28-day compressive strength, and no individual strength test is less than the required 28-day compressive strength by more than 300 pounds per square inch. Frequency of compressive tests on concrete cylinders shall be not less than four test cylinders for each day for each class of concrete placed that day. If the foregoing criteria is not met, core samples shall be taken and tested at the Contractor's expense. In such event, three core samples for each cylinder test indicating defective concrete shall be taken for further testing. Sampling, testing, and evaluation of drilled cores shall be in accordance with ACI 318, Part 3, Chapter 4. Concrete which is determined to be defective based on the strength acceptance criteria therein shall be removed and replaced with acceptable concrete.

3.7.2.3 Air Content: Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C 231 on samples taken during placing of the concrete in the forms.

END OF SECTION

SECTION 09809
PROTECTION OF BURIED STEEL PIPING
AND STEEL BULKHEAD TIE RODS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL SPECIFICATION (FED. SPEC.):

L-T-1512A Tape, Pressure Sensitive Adhesive, Pipe Wrapping

MILITARY SPECIFICATION (MIL. SPEC.):

MIL-I-631D & Am 5 Insulation, Electrical, Synthetic-Resin Composition, Nonrigid

1.2 DESCRIPTION OF WORK: The work includes protection of buried steel piping by field applied tape wrapping system or a factory applied coating system with field or factory applied tape wrapping at joints and damaged areas of coatings.

1.3 SUBMITTALS:

1.3.1 Manufacturer's Certificates of Conformance or Compliance:

a. Polyvinylchloride-butyl rubber laminated tape
b. Pressure sensitive organic plastic tape

1.3.2 Manufacturer's Catalog Data:

a. Polyethylene-butyl adhesive coating system
b. Electrical flaw detector

1.3.3 Manufacturer's Installation Instructions:

a. Polyvinylchloride-butyl rubber laminated tape

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION:

2.1.1 Tape Wrapping System: Polyvinylchloride-butyl rubber laminated tape with adhesive primer, or pressure sensitive organic plastic tape with 0.010-inch plus or minus 0.001-inch thickness for use on couplings and fittings and 0.020-inch plus or minus 0.001-inch thickness for straight runs of pipe conforming to Fed. Spec. L-T-1512, Tables I and II for puncture resistance and Mil. Spec. MIL-I-631, Class I for fungus resistance except that the fungus rating shall lie between 0 and 1 for all specimens.

PART 3 - EXECUTION

3.1 INSTALLATION:

3.1.1 Tape Wrapping System:

3.1.1.1 Surface Preparation: The surfaces shall be clean, dry, and grease-free. Wire brush weld beads and remove weld spatters. Remove heavy rust or mill scale with a wire brush.

3.1.1.2 Application: Kraft paper-protected material shall have paper removed before placing in final position. Reinforce wrapping at sling points with roofing felt or other approved heavy shielding material or handle with nylon or canvas slings. Apply polyvinylchloride-butyl rubber laminated tape or pressure sensitive organic plastic tape and its adhesive primer by a single machine operation.

3.1.1.2.1 Pipe: Spirally wrap the straight runs in one layer, lapping the tape as it is applied. The overlap shall conform to the recommendations of the tape manufacturer. When an outerwrap is used, the overlap of the outerwrap shall bridge the joints of the tape. Apply at each end of straight runs a double wrap of one full width of tape at right angles to the axis in such a manner as to seal the ends of the spiral wrapping.

3.1.1.2.2 Pipe Joints and Couplings, and Damaged Areas of Coatings: Clean joint areas, which are to be taped, of burrs and rust. Smooth down or cut away damaged coating if not firmly bonded to the pipe. Spirally wrap with a two-layer wrapping system, overlapping the coating surface at least 3 inches. Initially stretch tape sufficiently to conform to the surface to which it is applied, using one layer half-lapped for tape 2 inches or less in width, or one layer lapped at least one inch for tape more than 2 inches wide. Apply a second layer lapped as above, with tension as it comes off the roll and press to conform to the shape of the component.

3.2 FIELD INSPECTION AND TESTING:

3.2.1 Field Inspection: Examine material surface preparation and application procedures performed in the field.

3.2.2 Field Test: Test the protective system for holes, voids, cracks, and other visually undetectable damage that may occur during handling and installation. Test with an electrical flaw-detector of an approved type in accordance with the printed instructions of the detector manufacturer. Repair areas where arcing occurs.

*** END OF SECTION ***

SECTION 10440
CONTROL PANEL SIGNS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL SPECIFICATIONS (FED. SPEC.):

FF-B-575C	Bolts, Hexagon and Square
FF-S-85C(1)	Screws, Cap, Slotted and Hexagon-Head
FF-S-92B(1)	Screws, Machine: Slotted, Cross-Recessed or Hexagon Head
TT-P-86G	Paint, Red-Lead Base, Ready-Mixed
TT-P-645	Primer, Paint, Zinc-Chromate, Alkyd Type
TT-P-664C(2)	Primer Coating, Synthetic, Rust-Inhibiting, Lacquer-Resisting
TT-V-51F	Varnish; asphalt

MILITARY SPECIFICATIONS (MIL. SPEC.):

MIL-C-18480	Coating Compound, Bituminous, Solvent, Coal Tar Base
MIL-M-43719A(1)	Marking Materials and Markers, Adhesive, Elastomeric, Pigmented; General Specification for

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

A 123-78	Zinc (Hot-Galvanized) Coatings on Produca
A 153-78	Zinc-Coating (Hot Dip) on Iron and Steel Hardware

1.2 SUBMITTALS:

1.2.1 Shop Drawings: Submit complete shop drawings, catalog cuts, templates, and erection and installation details, as appropriate, for all items listed below. Indicate dimensions, construction details, reinforcement, anchorage, and installation with relation to the building construction.

a. Control Panel with Signs
b. Sign mounting

PART 2 - PRODUCTS

2.1 CONFORMANCE TO REQUIREMENTS: Products shall conform to the requirements specified for the particular item; and where these requirements are not specified in detail, the materials shall be suitable for the intended usage of the item. The materials listed below shall conform to the respective specifications and other requirements as designated below:

2.1.1 Bolts and Nuts: Fed. Spec. FF-B-575, as applicable.

2.1.2 Screws: Fed. Spec. FF-S-85 and Fed. Spec. FF-S-92, as best suited for the use intended.

2.1.3 Vinyl: Vinyl sheeting for die-cut graphics shall have a minimum 0.003 inch film thickness and shall conform to Mil. Spec. MIL-M-43719.

2.2 FABRICATION AND MANUFACTURE:

2.2.1 Workmanship: Verify all measurements and take all field measurements necessary before fabrication. Provide materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Provide all screws or bolts and other items necessary for completion of the work. Form signs to shape and size, with sharp lines and angles and true curves. Drill or punch holes for bolts and screws in alignment in both signs and control panel. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish. Exposed fastenings shall harmonize with the material to which fastenings are applied. Conceal fastenings where practicable. Galvanize in accordance with ASTM A 123 or ASTM A 153, as applicable where practicable. Execute and finish work in accordance with approved drawings, cuts, details, and samples.

2.2.2 Dissimilar Materials: Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, protect the surfaces with a coat of bituminous paint conforming to Mil. Spec. MIL-C-18480 or to Fed. Spec. TT-V-51 or a coat of zinc-chromate primer conforming to Fed. Spec. TT-P-645 or Fed. Spec. TT-P-664 to prevent galvanic or corrosive action.

2.2.3 Pressure Sensitive Letters: Provide thermal cut vinyl letters. Ensure that all edges and corners of finished letterforms and graphics are true and clean. Do not use letterforms and graphics with rounded positive or negative corners, nicked, cut, or ragged edges.

a. Typeface: Helvetica medium
b. Size: 3/4-inch
c. Color: Black

2.3 MESSAGES: See schedule on drawings for message content. The entire "sequence of operation" and the title "sequence of operation" shall be placed in the upper right hand corner of the engine-generator control panel and separately the identifying titles shown on the "engine-generator control panel" drawing shall be provided.

2.4 MECHANICAL FASTENERS: Provide countersunk mounting holes in plaques and sufficient mounting screws.

PART 3 - EXECUTION

3.1 INSPECTION: Inspect condition of locations and surfaces on which signs will be installed. Do not proceed with installation until defects or errors which would result in poor installation have been corrected.

3.2 INSTALLATION: Install signs at locations shown on drawings. Ensure that signs are installed plumb and true, at the locations indicated, and by method shown or specified.

3.2.1 Anchorage: Provide anchorage where necessary for fastening signs securely in place. Machine or carriage bolts shall be used for steel.

3.3 SHOP PAINTING: Give all sufaces of miscellaneous metal work, except non-ferrous metal, corrosion resisting steel, and zinc-coated work, one coat of Type 1 red-lead paint conforming to Fed. Spec. TT-P-86, or zinc-chromate primer conforming to Fed. Spec. TT-P-645, or give an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Upon completion of work, thoroughly recoat all damaged surfaces and replace any damaged letters.

3.4 PROTECTION: Wrap finished work with paper, polyethylene film, or strippable waterproof tape for shipment and storage and protect from damage during installation.

3.5 ADJUST AND CLEAN: Repair any damage to signs incurred during installation. Replace signs which cannot be repaired to new condition.

END OF SECTION

SECTION 15011
MECHANICAL GENERAL REQUIREMENTS

1. APPLICATION: This section applies to all sections of Division 15, except as specified otherwise in each individual section.

2. SUBMITTALS: Submit shop drawings, manufacturers data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable Federal, Military, industry and technical society publication references, and other information necessary to establish contract compliance of each item the Contractor proposes to furnish.

2.1 Shop Drawings: Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include floor plans, sectional views, wiring diagrams, installation details of equipment; and equipment spaces identifying and indicating proposed location, layout and arrangement of items of equipment, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinted installation. Wiring diagrams shall identify circuit terminals, and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance and replacement of operating equipment devices. If equipment is disapproved, drawings shall be revised to show acceptable equipment and resubmitted.

2.2 Manufacturer's Data: Submittals for each manufactured item shall be manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

2.3 Publication Compliance: Where equipment or materials are specified to conform to industry and technical society publications of organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters' Laboratories, Inc. (UL), proof of such compliance shall be submitted. The label or listing by the specified organization will be acceptable evidence of compliance. Submit a certificate from an independent testing organization adequately equipped and competent to perform such services, and approved by the Contracting Officer, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publication.

2.4 Certified Test Reports: Referenced publications' testing requirements for materials will be waived provided the manufacturer's original certificates are submitted stating that previously manufactured materials have been tested by approved laboratories, that such materials meet testing requirements specified, and that the materials furnished for this project are of the same type, quality, manufacture, and make as that tested. Copies of the test reports need not be submitted except as specifically requested by the Contracting Officer.

2.5 Certificates of Compliance: Submit certification attesting that materials and equipment to be furnished for this project comply with the requirements of this specification and of the reference publications. Pre-printed certifications will not be acceptable; certifications shall be the manufacturer's original. The certification shall not contain statements that could be interpreted to imply that the product does not meet all requirements specified, such as "as good as"; achieve the same end use and results as materials formulated in accordance with the referenced publications"; "equal or exceed the service and performance of the specified material". The certification shall simply state that the product conform to the requirements specified.

3. OPERATION AND MAINTENANCE MANUAL: Furnish an operation and maintenance manual for each item of equipment. Furnish three copies of the manual bound in hardback binders or an approved equivalent. Furnish one complete manual prior to the time that equipment tests are performed, and furnish the remaining manuals before the contract is completed. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL," the name and location of the equipment or the building, the name of the Contractor, and the contract number. The manual shall include the names, addresses, and telephone numbers of each subcontractor installing equipment, and of the local representatives for each item of equipment. The manual shall have a table of contents and be assembled to conform to the table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include: wiring and control diagrams with data to explain detailed operation and control of each item of equipment; a control sequence describing start-up, operation and shut-down; description of the function of each principal item of equipment; the procedure for starting; the procedure for operating; shut-down instructions; installation instructions; maintenance instructions; lubrication schedule including type, grade temperature range, and frequency; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list. The parts lists for equipment shall indicate the sources of supply, recommended spare parts, and the service organization which is reasonably convenient to the project site. The manual shall be complete in all respects for equipment, controls, accessories, and associated appurtenances provided.

4. POSTED OPERATING INSTRUCTIONS: Furnish approved operating instructions for each principal item of equipment for the use of the operation and maintenance personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal item of equipment. Operating instructions shall be printed or engraved, and shall be framed under glass or in approved laminated plastic and posted where directed by the Contracting Officer. Operating instructions shall be attached to or posted adjacent to each principal item of equipment including start-up, proper adjustment, operating, lubrication, shut-down, safety precautions, procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each item of equipment. Operating instructions exposed to the weather shall be made of weather-resisting materials or shall be suitably enclosed to be weather protected. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

5. INSTRUCTION TO GOVERNMENT PERSONNEL: Furnish the services of competent instructors to give full instruction to the Government personnel in the adjustment, operation and maintenance, including pertinent safety requirements, of each item of equipment and each system. Each instructor shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of mandays (8 hours) of instruction furnished shall be as specified in each individual section.

6. DELIVERY AND STORAGE: Properly store, adequately protect and carefully handle equipment and materials to prevent damage before and during installation. Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations. Damaged or defective items shall have new undamaged item substituted for the damaged or defective items.

7. CATALOGED PRODUCTS: Materials and equipment shall be cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall duplicate items that have been in satisfactory commercial or industrial use for two years prior to bid opening. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the items need not be the products of the same manufacturer. Each item of equipment shall have the manufacturer's name, address, model number and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

8. VERIFICATION OF DIMENSIONS: Coordinate the proper relation of the work to the building structure and to the work of all trades. Visit the premises and become familiar with the dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

9. MANUFACTURER'S RECOMMENDATIONS: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Contracting Officer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

10. ELECTRICAL REQUIREMENTS: Furnish motors, controllers, contactors. and disconnects with their respective pieces of equipment except controllers indicated as part of the motor control centers shall be provided under Section 16402, "Interior Wiring System." Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16402. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors shall have a maximum of 120-volt control circuits. When motors and equipment furnished are larger than

sizes indicated, the cost of additional electrical service and related work shall be included under the section that specified that motor or equipment. Power wiring and conduit for field installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, and conduit and wiring connecting such centers, assemblies or other power sources to equipment shall be provided under and conform to the requirements of Section 16402.

END OF SECTION

SECTION 15611
FUEL OIL HANDLING SYSTEM

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL SPECIFICATION (FED. SPEC.):

WW-P-521G	Pipe Fittings, Flange Fittings and Flanges, Steel and Malleable Iron, (Threaded and Butt Welded), 150 Pound

MILITARY SPECIFICATIONS (MIL. SPEC.):

MIL-V-18434B	Valves, Gate, Globe, and Angle, Steel
MIL-P-23236 & Am 5	Paint Coating Systems, Steel Ship Tank Fuel and Salt Water Ballast
MIL-C-24176A	Cement, Epoxy, Metal Repair and Hull Smoothing

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI):

B16.3-77	Malleable Iron Threaded Fittings, Class 150 and 300
B16.5-77	Steel Pipe Flanges, and Flanged Fittings Including Ratings for Class 150, 300, 400, 600, 900, 1500 and 2500
B16.9-78	Factory-Made Wrought Steel Buttwelding Fittings
B16.11-80	Forged Steel Fittings, Socket-Welding and Threaded
B16.39-77	Malleable Iron Threaded Pipe Unions Class 150, 250, 300
B31.1-80	Power Piping
B31.4-79	Liquid Petroleum Transportation Piping Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME):

ASME Boiler and Pressure Code:	Section VIII - Pressure Vessels - 1977 Section IX - Welding Qualifications - 1978

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

A 120-80	Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, For Ordinary Use

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

NFPA 31-78	Installation of Oil Burning Equipment

STEEL STRUCTURES PAINTING COUNCIL (SSPC):

SSPC-Paint 9-64	No. 9 White (or Colored) Vinyl Paint

1.2 GENERAL DESCRIPTION: This section includes all fuel oil piping, and related auxiliary equipment for a fuel oil handling system. General requirements include those specified in Section 15011, "Mechanical General Requirements."

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

2.1.1 Steel Piping:

2.1.1.1 Pipe: ASTM A 120 Schedule 80, black steel, electric-resistance welded.

2.1.1.2 Threaded and Socket-Welding Fittings: ANSI B16.11 forged steel.

2.1.1.3 Threaded Fittings: ANSI B16.3, black malleable iron.

2.1.1.4 Butt-Welding Fittings: ANSI B16.9, 150 lb. Backing rings shall conform to ANSI B31.4 and be compatible with materials being welded.

2.1.1.5 Flanges and Flange Fittings: ANSI B16.5 steel flanges or convoluted steel flanges which meet the criteria of ASME Code Section VIII. Flange faces shall have integral grooves of rectangular cross section which afford containment for self-energizing gasket material.

2.1.2 Vent Piping: Zinc-coated steel conforming to ASTM A 120 standard weight, with zinc-coated malleable iron fittings conforming to Fed. Spec. WW-P-521.

2.1.3 Valves:

2.1.3.1 Steel Gate Valves: Mil. Spec. MIL-V-18434, Type I, oil service, Class 150.

2.1.4 Piping Accessories:

2.1.4.1 Flexible Hose: Flexible metal hose, corrugated type with braided wire sheath covering, close-pitch annular corrugations, rated for a working pressure of at least 125 psig, 8-inch minimum live length, flanged end connections, UL listed for flammable liquid service. Metal for hose and braided wire sheath shall be stainless steel, any type of ASTM 300 series.

2.1.4.2 Unions: ANSI B16.39, 150 lb and 250 lb.

2.1.4.3 Welding Filler Metal: ANSI B31.4 and compatible with the materials to be welded.

2.1.4.4 Gaskets: Provide composition asbestos gaskets for all flanged and bolted connections.

2.1.5 Protective Coating Systems for Buried Steel Piping:

2.1.5.1 Piping and Fittings: Protective coatings shall conform to the requirements of Section 09809, "Protection of Buried Steel Piping and Steel Bulkhead Tie Rods."

2.1.5.2 Protective Coating Systems: All protective coating systems, including FRP coated steel tanks, shall be inspected with a 10,000 volt holiday tester just prior to placement in ground and any holidays revealed shall be promptly repaired to a condition as good as the rest of the system.

2.1.6 Protection for Aboveground Steel Pipe and Steel Tanks: Protect all aboveground steel pipe and tanks against atmospheric corrosion by a prime coat, inorganic, zinc-rich primer in accordance with Mil. Spec. MIL-P-23236, Type I, Class 3, bond or tie coat in accordance with specifications of manufacturer of prime coat and 2 finish coats of vinyl paint in accordance with SSPC - Paint 9. Prior to internal coating as described above, unsealed lap seams shall be sealed with epoxy cement in accordance with Mil. Spec. MIL-C-24176, Type II. Inaccessible voids shall be filled with epoxy cement prior to application of the coating.

PART 3 - EXECUTION

3.1 INSTALLATION:

3.1.1 General Installation Requirements for Oil Piping: Install piping in out-of-the way locations, in a manner that will minimize cutting of beams, girders, columns, or load-bearing members. Piping shall be free from traps and shall drain toward tank and equipment. Installation of oil piping and equipment in buildings shall conform to NFPA 31, except as indicated or specified herein. Feed line to equipment shall have a gate valve located near tank.

3.1.2 Pipe Sleeves: Provide pipe sleeves where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be steel pipe. Sleeves in partitions shall be zinc-coated sheet steel having a nominal weight of not less than 0.906 pound per square foot. Space between pipe, tubing, or insulation and the sleeve shall be not less than 1/4 inch. Hold sleeves securely in proper position and location before and during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, partitions, or slabs. Extend sleeves in floor slabs 1/2 inch above finished floor. Firmly pack space between the pipe or tubing and sleeve with oakum, and calk on both ends of sleeve with elastic cement.

3.1.3 Steel Piping: Steel piping shall be socket-welded.

3.1.4 Welding:

3.1.4.1 Welding Procedure Specifications: Before any welding is performed, the Contractor shall submit to the Contracting Officer three copies of his welding procedure specification for all metals included in work, together with proof of its qualifications as outlined in ANSI B31.1.

3.1.4.2 Performance Qualification Record: Before any welder or operator shall perform any welding the Contractor shall also submit to the Contracting Officer three copies of the Welder's Performance Qualification Record in accordance with ANSI B31.1 showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition the Contractor shall also submit each welder's assigned number, letter, or symbol which shall be used to identify the work of the welder and which shall be affixed immediately upon completion of the weld. Welders making defective welds after passing a qualification test shall be given a requalification test and upon failing to pass the test shall not be permitted to work this contract.

3.1.4.3 Previous Qualifications: Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without requalification subject to the approval of the Contracting Officer and provided that all the conditions specified in ANSI B31.1 are met before a procedure can be used.

3.1.4.4 Welding of Piping: Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and cleaning of pipe shall be in accordance with ANSI B31.1.

3.1.4.5 Quality of Welds: Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ANSI B31.1.

3.1.4.6 Arc Welding and Gas Welding: In accordance with ASME Boiler and Pressure Vessel Codes Section IX.

3.1.5 Unions and Flanges: Place unions and flanges where necessary to permit easy disconnection of piping and apparatus. Each connection having a screw end valve shall have a union. In long lines inside buildings, place unions and flanges not farther apart than 100 feet, except in pipe lines of welded construction. Unions and flanges shall be as specified.

3.1.6 Valves: Install valves in positions accessible for operation and repair. Install check valve and a gate valve on suction line of each fuel oil storage tank.

3.2 FIELD TESTS:

3.2.1 Tests: Prior to application of test pressure, remove or valve off piping components which may be damaged by test and install a currently calibrated test gage in the system. Maintain test pressure for at least one hour. In the event of leakage, locate and repair leak and repeat test.

3.2.1.1 Piping Test: Before backfilling of pipe trenches, perform hydrostatic test of fuel oil piping with No. 2 fuel-oil at 1-1/2 times system pressure or 100 psig whichever is greater.

*** END OF SECTION ***

SECTION 16011
ELECTRICAL GENERAL REQUIREMENTS

1. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designaton only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

70-1981 National Electric Code (NEC)

2. APPLICATION: This section applies to all sections of this project except as specified otherwise in the individual sections. All electrical work shall conform to NFPA 70.

3. DELIVERY AND STORAGE: Equipment and materials shall be properly stored, adequately protected, and carefully handled to prevent damage before and during installation. Equipment and materials shall be handled, stored, and protected in accordance with the manufacturer's recommendations and as approved by the Contracting Officer. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Plastic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored and handled carefully to avoid damage to the outer covering of insulation and damage from moisture and weather. Damaged or defective items, in the opinion of the Contracting Officer, shall be replaced at no cost to the Government.

4. CATALOGED PRODUCTS: Materials and equipment shall be essentially the cataloged products of manufacturers regularly engaged in production of such materials or equipment and shall be manufacturer's latest design that complies with the specification requirements. Materials and equipment shall essentially duplicate items that have been in satisfactory commercial or industrial use at least two years prior to bid opening. Where two units of the same class of equipment are required, these units shall be products of a single manufacturer; however, the component parts of the systems need not be the product of the same manufacturer. Each item of equipment shall have the manufacturer's name and address, and the model and serial number on the nameplate securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable. Nameplate for electrical apparatus shall conform to NEMA standards.

5. VERIFICATION OF DIMENSIONS: The Contractor shall be responsibale for the coordination and proper relation of his work to the building structure and to the work of all trades. The Contractor shall visit the premises and thoroughly familiarize himself with all dimensions in the field, and to advise the Contracting Officer of any discrepancy before performing any work.

6. MANUFACTURER'S RECOMMENDATIONS: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Contracting Officer prior to installation. Installatin of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

SECTION 16208
DIESEL ENGINE-GENERATOR SET

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL SPECIFICATIONS (FED. SPEC.):

W-B-133C	Battery, Storage (Lead Acid, Industrial Portable Service)
W-C-375B	Circuit Breaker, Molded Case, Branch Circuit and Service
VV-F-800C	Fuel Oil, Diesel

MILITARY SPECIFICATIONS (MIL. SPEC.):

MIL-I-16165D	Interference Shielding, Engine Electrical Systems
MIL-T-52777A	Tanks, Storage, Underground, Glass Fiber Reinforced Plastic

MILITARY STANDARD (MIL. STD.):

MIL-STD-461A	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference

AMERICAN NATIONAL STANDARD INSTITUTE, INC. (ANSI):

B15.1-72	Safety Standard for Mechanical Power Transmissions Apparatus
C39.1-81	Requirements for Electrical Analog Indicating Instruments
C50.10-77	General Requirement for Synchronous Machines

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, (ASME):

PTC26-62	Speed-Governing Systems for Internal Combustion Engine-Generator Units

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

B 8-81	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft
B 33-74	Tinned Soft or Annealed Copper Wire for Electrical Purposes
B 189-74	Lead-Coated and Lead-Alloy-Coated Soft Copper Wire for Electrical Purposes

DIESEL ENGINE MANUFACTURERS ASSOCIATION (DEMA):

(Sixth Edition 1972)	Standard Practices for Stationary Diesel and Gas Engines

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE):

126-59	Recommended Specification for Speed Governing of Internal Combustion Engine-Generator Units

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA):

S-19-81 (Fifth Ed.) & Rev. 9	Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
S-61-402 (Third Ed.) & Rev. 3	Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
S-66-524 Interim Standard No. 1	Cross-Linked-Thermosetting-Polyethylene-Insulated Wire & Cable for the Transmission & Distribution of Electrical Energy & Rev. 8

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA):

ICS 1-1978 (R 1980)	General Standards for Industrial Controls & Systems
ICS 2-1978 (R 1980)	Industrial Control Devices, Controllers & Assemblies
ICS 3-1978 (R 1979)	Industrial Systems
ICS 4-1977 (R 1978)	Terminal Blocks for Industrial Control Equipment & Systems
ICS 6-1978 (R 1980)	Enclosures for Industrial Controls and Systems
MG1-1978 (R 1980)	Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

30-1977	Flammable and Combustible Liquids Code
70-1981	National Electrical Code

UNDERWRITERS LABORATORIES, INC. (UL):

142-1972	Steel Aboveground Tanks for Flammable and Combustible Liquids
1008-1977 (R 1980)	Automatic Transfer Switches
1236-1978 (R 1980)	Electric Battery Chargers

1.2 RELATED WORK SPECIFIED IN OTHER SECTIONS: Section 16011 "Electrical General Requirements" applies to this section except as specified otherwise.

1.3 DESCRIPTION: Provide one diesel electric generating unit with accessories, auxiliary equipment, and associated work as specified.

1.4 QUALITY ASSURANCE: Provisions of Division 1, apply.

1.4.1 Operating Experience Requirements: Engines installed shall meet all of the operating experience requirements listed below:

a. Only electric generation service is considered as equivalent experience. Engines driving pumps or compressors or in marine propulsion or railroad service are not acceptable.

b. Only experience on the same engine model is acceptable. Engine model is considered to be a given series or class of identical bore and stroke and of the same type of engine, such as in-line or Vee. In-line and Vee engines with identical bore and stroke are considered as two separate models of engines.

c. Only experience at the identical rotative speed as that which is offered is acceptable.

d. Only experience at the identical or higher brake mean effective pressure as that which is offered is acceptable.

e. Only experience with fuel oil is acceptable.

1.5 SUBMITTALS: Furnish certificate(s) within 30 days after award certifying that not less than two engines of identical number of cylinders and cylinder size, identical rotative speed, and identical or higher BMEP, and of the same basic configuration (in-line or Vee) as the engine to be furnished, shall have driven generators which have produced in satisfactory operation not less than 1,000 kW hours of electricity for each kW of generator nameplate capability within a 2-year period. Certificate(s) shall include:

a. A list of at least two engine installations meeting the experience requirements set forth in paragraph entitled "Operating Experience Requirements."

b. Owner and location of each such installation.

c. Date of initial operation of each such installation.

d. Number of kW hours produced per kW of generator rated capability of each installation.

e. Horsepower rating, kW rating, and rotative speed of each unit.

f. Brake mean effective pressure rating of each engine.

g. Design characteristics of each unit, such as bore and stroke, number of cylinders, and configuration (in-line or Vee).

1.5.1 Manufacturer's Data:

a. Diesel engine driven electric generator set

b. Valves

c. Fuel oil day tank

d. Fuel line strainers

e. Engine muffler

1.5.2 Shop Drawings and Calculations: Submit for diesel generating unit and auxiliary equipment, including the following:

a. Certified outline, general arrangement (setting plan), and anchor bolt details. Drawings shall show the total weight and center of gravity of the assembled equipment on the mounting skid.

b. General arrangement drawings showing location of all auxiliary equipment in relation to the diesel generating unit.

c. Piping schematics for fuel oil, lubricating oil, jacket water and cooling water integral with diesel engine.

d. BMEP Calculations

e. Battery sizes and cranking time calculations

f. Critical speed calculations

g. Drawings for the transfer switch, including certified outline, electrical ratings, general arrangement, and detail drawings.

h. Electrical elements, schematics and wiring diagrams, including details of the safety shutdown systems and main generator circuit breaker trip system.

1.5.3 Certified Test Reports:

a. Diesel Engine Shop Tests

b. Generator Shop Tests

c. Diesel Engine Driven Electric Generator Set Shop Tests

d. Automatic Transfer Switch

1.5.4 Manuals: Provide 2 sets of operation and maintenance manuals for equipment. Identification symbols for all replaceable parts and assemblies shall be included. Information in manuals shall be comprehensive and specific.

1.6 SAFETY REQUIREMENTS: Comply with ANSI B15.1.

PART 2 - PRODUCTS

2.1 MATERIALS:

2.1.1 Standard Commerical Product: Generator set shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product with any added features needed to comply with the requirements. Additional or better features which are not specifically prohibited by this specification, but which are a part of the manufacturer's standard commercial product shall be included in the generator set being furnished. Standard commercial product is a product which has been or will be sold on the commercial market through advertisements or manufacturer's catalogs, or brochures, and represents the latest production model(s).

2.1.2 Materials and Equipment: Furnish new materials of high quality which will give long life and reliable operation. Equipment shall not have been in prior service except as required by factory tests. Workmanship shall be of highest quality in every detail.

2.2 DIESEL-ELECTRIC GENERATOR SET AND AUXILIARY EQUIPMENT: Each generator set shall consist of a diesel engine connected to an alternating current generator with brushless excitation system mounted on a steel subbase and provided with all necessary accessories, auxiliaries, and control equipment resulting in a complete self-contained unit capable of operation. Set shall be housed in a weatherproof enclosure for installation outdoors. Generator set must be capable of providing full rated power within 10 seconds after failure of normal power.

2.2.1 Equipment Rating and Capability: Diesel-electric generating set shall have a net continuous rating of 300 kW at 0.8 power factor. Both the engine and generator of the generator set shall be capable of satisfactorily carrying a load 10 percent in excess of the net continuous rated generating capacity at 0.8 power factor for a period of 2 continuous hours out of any 24 consecutive hours. Gross kW rating of each diesel generating set shall be not more than the figure obtained by multiplying the delivered shaft horsepower rating of the engine by 0.746 and by the overall efficiency of the generator at the corresponding load. Overall efficiency of the generator shall allow for power required to operate the exciter, including power consumed in losses and in windage and friction for generator and rotating exciter. Rated net capacity of each generating set is defined as gross electrical power output of generator minus total electrical power requirements of electric motor driven engine accessories normally constituting part of "engine assembly," as defined in DEMA publication "Standard Practices for Stationary Diesel and Gas Engines." All auxiliary equipment furnished shall be designed for continuous duty at 110 percent of rated net capacity of generating set.

2.2.2 Critical Speeds: Each complete diesel-electric generating set shall be free of critical speeds of either a major or minor order that will endanger satisfactory operation of the set. Satisfactory operation will be considered endangered if torsional vibration stresses exceed 5,000 psi within 10 percent above or below rated engine speed. Submit copies of a summary of computations of critical speeds to the Contracting Officer.

2.3 DESIGN AND CONSTRUCTION: Rotating or reciprocating parts, or other parts that may present a hazard to operating personnel shall be isolated or shielded to minimize danger. Design characteristics shall limit operating temperatures at critical points of maximum wear at full-load operating conditions.

2.4 DIESEL ENGINE AND ACCESSORIES: Engine shall be 2-cycle or 4-cycle, naturally aspirated, turbocharged, turbocharged-intercooled, vertical in-line or vertical "V" type. Design and construct engine so as to eliminate undue heating, vibration, and wear. Engine shall be capable of burning diesel fuel oil conforming to Fed. Spec. VV-F-800, Grade DF-2. Limiting characteristics of engine shall be as follows:

a. Maximum brake mean effective pressure, psi

Engine Duty	Naturally Aspirated	Turbocharged Without Intercooler	Turbocharged With Intercooler
		2-cycle engines	
Continuous	85	95	105
		4-cycle engines	
Continuous	90	120	160

b. Maximum engine speed, rmp

2-cycle engines	1,800
4-cycle engines	1,800

c. Maximum piston speed, rpm

2-cycle engines	1,725
4-cycle engines	1,950

d. Number of Cylinders: Minimum - 6; Maximum - 12.

Base rating of each engine on plant site elevation of 20 feet above mean sea level and an atmospheric temperature of 100 degrees Fahrenheit. Offer engine only at speeds and ratings not higher than those for which they have been designed, which fulfill requirements specified in paragraph entitled "Operating Experience Requirements."

2.4.1 General Construction: Engine shall be constructed adequately to withstand sudden changes from no load to rated load, and to preserve alignment of integral components under all conditions of operation. Engine shall be neat in appearance and shall permit easy access to various parts for maintenance purposes. The crankshaft shall incorporate drilled passages for pressure lubrication of bearings, and the journals shall be hardened or chromium plated to provide a hard shock-resistant surface with ductile core. Crankshaft and connecting rod bearings shall be the replaceable precision sleeve type. Cylinders shall be provided

with replaceable liners. The piston rings shall be constructed of a heat-resisting alloy steel or chromium plated cast iron. Camshafts shall be gear or chain driven, and shall have higher wear resistance at cams and journals. Timing marks shall be clearly indicated on the crankshaft and gears. Valves shall operate in removable stem guides and seat inserts. The fly-wheel shall be balanced, and shall be capable of being rotated 50 percent above the maximum rated engine rotative speed without danger of breaking or exploding. Flywheel housing shall be provided with a drain hole at the lowest point. Means for turning the crankshaft manually shall be provided.

2.4.2 Assembly: Completely factory assemble each engine. Mount turbocharger, intercooler if provided, and all piping integral with the engine, on the engine.

2.4.3 Engine Speed Governing System: Governing system shall be suitable for controlling the speed of the generator set within the requirements specified herein without intermediate adjustment and shall maintain the specified stability without hunting or cycling.

2.4.3.1 Speed (Frequency) Governing System: Set shall have an engine speed (frequency) governing system conforming to IEEE 126, Section II. Engine speed governing system shall be adjusted to meet the performance requirements of IEEE 126, Section II, when tested in accordance with ASME PTC26.

2.4.4 Overspeed Shutdown Device: The overspeed shutdown device shall be entirely independent of the engine speed governing system and shall consist of solid state overspeed device positive engaged so that engine speed shall not exceed 110 percent of synchronous speed, and shall react to shutoff the engine's air or fuel supply and trip the set output circuit breaker. The overspeed device shall require manual resetting after emergency tripping.

2.4.5 Engine Fuel System: The engine shall be provided with all necessary equipment including piping, fittings, valves, fuel transfer pump to pump fuel from underground tank, filters (throw-away-type), strainers, day tank, and appurtenances. A mechanical fuel injection system shall be employed. Injection pumps shall be driven in a positive manner from cam or drive shaft. Injection pumps and injection valves shall be of a type not requiring adjustment in service and shall be capable of quick replacement in a few minutes by ordinary mechanics without special diesel experience. A pump for priming the fuel system shall be provided to facilitate easy starting. Internal parts forming the high-pressure portion of the fuel system shall have wear-resistant surfaces where relative movement between surfaces exists.

2.4.5.1 Day Tank: A day tank shall be provided with the generator set. The day tank shall meet all applicable requirements of NFPA 30 and UL 142, and shall include hangers, brackets, fittings, vents, and other accessories required for installation. Storage capacity of the tank shall be adequate for operation of the generator set at rated load for at least 8 hours.

2.4.5.2 Fuel Transfer Pump: A fuel transfer pump shall be provided for use in conjunction with the day tank and shall operate on 208 volts, single phase circuit. The fuel transfer pump shall be a UL approved submersible pump designed for flamable liquid service for the specified diameter of the fiberglass fuel storage tank and with a 3 foot burial depth. Suction line shall be provided the pump shall be capable of delivering not less than three times the maximum fuel consumption of the engine in gallons per hour of fuel conforming to Fed. Spec. VV-F-800, Grade DF-2, at a temperature of 0 degrees F (-17.8 degrees C), against a total dynamic head of 20 psi and a suction lift of 10 feet. The fuel transfer pump shall be automatically controlled by a float switch in the day tank. The motor controller shall conform to NEMA ICS 2 and have a press to test switch. The fuel transfer-day tank system shall also have a positive shutoff so that when the day tank is full, no fuel can flow into the day tank even though the external fuel supply system is pressurized.

2.4.5.3 Fuel Storage Tank: Underground storage tank shall be UL labeled Fiberglass, 2000 gallon capacity, with fittings as shown on plans. Refer to Mil. Spec. MIL-T-52777A for tank specifications and installation instructions.

2.4.5.3.1 Loading Conditions - External hydrostatic pressure. Buried in ground with 3 feet of overburden over the top of tank. The hole fully flooded and a safety factor of 3:1 against bucking. Surface load when installed according to manufacturer's installation instruction, tank will withstand surface H-20 axle loads. Tank shall withstand 5 psi air pressure test with 5 to 1 safety factor. Test prior to installation since this design conditions is to test for leakage. Tanks shall be designed to support accessory equipment such as drop tube, etc., when installed according to manufacturer's recommendations and limitations.

2.4.5.3.1.1 The tank shall be vented as tanks are designed for operation at atmospheric pressure only.

2.4.5.3.1.2 Tanks shall be capable of storing liquids with specific gravity up to 1.1.

2.4.5.3.1.3 Maximum temperature: Tanks shall be capable of storing liquids up to a maintained temperature of 150 degrees Fahrenheit, at the tank interior surface.

2.4.5.3.1.4 Tanks shall be chemically inert to petroleum products.

2.4.5.3.1.5 Dimensional Requirements:

a. Nominal capacity of tank shall be 2000 gallons.
b. Nominal outside diameter of tanks shall be 6 feet.
c. Approximate overall length of tanks shall be 11 feet.

2.4.5.3.2 Accessories:

a. Anchor Straps: Provide fiberglass-reinforced plastic anchor straps for each tank shown. Number and location of straps shall be as specified by manufacturer. Each strap shall be capable of withstanding the tensile load for tank diameter as shown: 6 feet in diameter - 18,000 pounds. Straps shall be standard as supplied by tank manufacturer.

b. Certification Plate: Underwriters' Laboratory label shall be permanently affixed to each tank.

c. Fill and Overflow Tubes shall be fiberglass-reinforced plastic. Tubes shall be factory installed, 4 inches diameter, and shall include a 6 inch steel fitting with a double tapped reducer bushing to 4 inch diameter. Location: refer to drawings for location. Tubes shall be standard items as manufactured and installed by tank manufacturer.

d. Fittings-Threaded-NPT:

(1) All threaded fittings on UL labeled tanks shall be of a material of construction consistent with the requirements of the UL label. All fittings to be supplied with cast iron plugs.

(2) All standard threaded fittings are 4 inches in diameter and shall be half couplings. Reducers are to be used for smaller sizes as indicated.

(3) Thread Standards - All threaded fittings shall have machine tolerances in accordance with the ANSI standard for each fitting size.

(4) Strength: NPT fittings will withstand a minimum of 150 foot-pounds of torque and 1,000 foot-pounds of bending, both with 2:1 factor of safety.

(5) Location: Refer to drawings for location.

e. Lifting Lugs: Provide lifting lugs on tank. Lugs shall be capable of withstanding weight of tank with safety factor of 3:1.

f. Pressure Vacuum Vent shall have an aluminum body and a 40 mesh brass screen. Vent shall be open type and direct vapors upward in accordance with NFPA Code 30. Vent shall have an 8 ounce pressure setting and a half-ounce vacuum setting. Maximum flow pressure drop shall be 28 ounce square inch at 2000 SCFH.

2.4.6 Engine Lubricating Oil System: Provide with a full pressure lubricating system arranged to distribute oil to all moving parts of the engine and to cool the pistons. System shall include an engine-driven positive displacement pump, pressure regulating valves, oil filter, oil pressure indicator, crankcase ventilator for four cycle engines and the

necessary piping and fittings. The pump shall have ample capacity to circulate the lubricating oil required for engine lubrication, and to cool the pistons. All necessary stop, check, pressure relief, and pressure control valves shall be provided.

2.4.6.1 Lubricating Oil Filters: Shall be the full-flow type (throw-away-type) and shall be capable of filtering the full rate of oil flow of the oil pump at maximum engine speed. Means shall be provided to insure delivery of lubricating oil to vital wearing surfaces regardless of the condition of the filter. Additionally, the filter must provide a means of automatically bypassing filter if it should become flow-restricting.

2.4.6.2 Lubricating Oil Coolers: Provide to maintain the lubricating oil within the temperature limits recommended by the manufacturer. Oil cooler shall utilize the engine jacket cooling water from the radiator as the cooling medium. Temperature rise of the jacket water across the lubricating oil cooler shall be limited so that the temperature of the water leaving the lubricating oil cooler will be not higher than the optimum temperature as recommended by the engine manufacturer for jacket water to the engine. Cooler shall be either the shell and tube single or multipass design, or shall be built in as an integral part of the engine cooling radiator. The core shall be constructed of copperbase alloys. The cooler shall be designed for jacket water to pass through the tubes. The temperature of the oil to the engine shall be maintained at a reasonably constant value. Thermostats used in the oil cooler shall be of the non-adjustable type and factory set at the temperature as recommended by the manufacturer. Where temperature of the oil in the cooler is regulated by controlling the jacket water temperature, the system design shall assure proper oil temperature under operating conditions.

2.4.7 Engine Cooling System: The radiator fan shall direct the air flow from the engine outward through the radiator, with horizontal air discharge. The fan shall be driven directly from the engine crankshaft or through V-belt drive. The radiator shall have sufficient capacity to dissipate not less than the total British Thermal Units per hour rejected by the engine to the cooling system at 110 percent rated load in 100 degrees F ambient, and against a static restriction of 0.5 inches of water as may be imposed by louvers, ductwork, etc. Cooling section shall have a tube and fin type core which shall consist of copper or copper base alloy tubes with nonferrous fins. The radiator shall be protected by a strong grille or metal bar guard on the exterior, and the fan shielded with a metal canopy. Filler caps shall be designed for pressure relief prior to removal. A thermostatic control valve shall be installed in the jacket water system of the engine to maintain the water system temperature of the engine. The thermostatic valve shall be the standard modulating type utilizing self-contained thermostats. The valve shall be capable of passing the water flow as determined by the manufacturer without excessive pressure drop across the valve. The valve shall be provided with one or more interchangeable thermostatic elements. The

elements shall be non-adjustable type and the operating temperature shall be set at the temperature recommended by the engine manufacturer. The valve shall be designed so that in event of the thermostatic element failure, water will be able to flow through the engine. Engine shall be delivered with adequate anti-freeze for protection at -20 degrees Fahrenheit.

2.4.8 Engine Exhaust System: Provide a complete exhaust system including exhaust flexible connection and residential type silencer.

2.4.9 Engine Air Induction System: The air induction system shall be equipped with heavy duty dry type air cleaners of adequate capacity to effectively remove the dirt and abrasives from the combustion air to the engine. When the engine air intake noise level is above the audible mechanical noise level of the engine, a combination filter-silencer or a separate silencer shall be provided. For two-stroke engines an air intake shut-off shall be provided which shall be operated by the engine over-speed shut-down device.

2.4.9.1 Scavenging air blowers for two stroke cycle engines shall be built integrally with and driven directly from the engine.

2.4.9.2 Turbocharger shall be a combination centrifugal blower driven by an exhaust gas turbine, with the air blower directly connected to the intake air manifold. Systems that require cooling of the intake air below ambient air temperature ahead of the turbocharger or scavenger air blower will not be acceptable. They may be lubricated from the engine pressure lubrication system or as recommended by the manufacturer. All necessary supports and connections shall be provided.

2.4.9.3 Intercooler: Tubular heat exchangers will be accepted only if available jacket water can be used as the cooling medium. Supplementary water cooling equipment is not acceptable. When intercooling is included, provide and install on the engine all necessary intercooling equipment including valves, controls and integral piping.

2.4.10 Cranking System: NEMA ICS 1 and NEMA ICS 2. An electric cranking system shall be furnished, capable of rotating the engine at a speed sufficient for rapid starting in an ambient temperature of 20 degrees F. The system shall be arranged to permit starting of the engine automatically upon signal from the remote control panel.

2.4.10.1 Cranking: The electric cranking system shall utilize direct current (dc) electrical circuit energized by storage batteries. The cranking motor shall be of the heavy duty type with adequate capacity to crank the engine continuously to start the engine in an ambient temperature of 20 degrees F. The drive mechanism for engaging the starting motor with the engine flywheel shall be designed to inherently engage and release without binding. When the engine starts, a "stop cranking" switch which is engine speed actuated shall cause disengagement of the starting gearing and the shut-down of the starting motor.

Starting shall be automatic. Automatic cranking panel shall crank the engine for 15 seconds cranking and 15 seconds off for three consecutive cycles before locking out the starting circuitry, sounding an alarm and illuminating an "overcrank" indicating light which shall remain lighted until it is manually reset.

2.4.10.2 Starting Aids: A jacket water heating system shall be provided to insure starting. The heater shall be thermostatically controlled at the temperature recommended by the engine manufacturer. Heat system shall be electric and designed to operate on 8 kW maximum, 277 volt, 60 Hertz, single phase, A.C. power supply. Power leads shall be brought to a junction box which shall provide fusing for the heater. The junction box shall be mounted on the engine base.

2.4.10.3 Storage Battery: The engine cranking battery shall be S.A.E. Type "D," diesel engine starting type and of sufficient size and capacity in a fully charged condition to start the engine-generator six consecutive times. Batteries shall comply with Fed. Spec. W-B-133.

2.4.10.4 Battery Charger: The battery charger shall be enclosed, wall-mounted, automatic, dual rate, solid-state, constant voltage type having a.c. voltage compensation, d.c. voltage regulation and current limiting. The charger shall employ transistor controlled magnetic amplifier circuits to provide continuous taper charging. Charger shall have two ranges, float and equalize, with 0-24 hour equalizer time, d.c. cranking disconnect relay, silicon diode full-wave rectifiers, automatic surge suppressors, d.c. ammeter, d.c. voltmeter and fused inputs and outputs. Charger shall have a continuous rated output of not less than 10 amps. Battery charger shall conform to UL 1236. Charger shall be designed to operate on 277 volt, 60 Hertz, single phase, A.C. power supply.

2.4.11 Safety Shutdown Controls and Alarms: Control shall be provided that will function to immediately shut off delivery of fuel to the engine cylinders, when actuated by a condition of low lubricating oil pressure, high water temperature, overspeed or low water level. The values at which the controls for low lubricating oil pressure and high water temperature are actuated shall be as recommended by the manufacturer, and the overspeed governor shall be set to actuate at the value specified herein. The low lubricating oil pressure shutdown control shall be provided with a means to make it inoperative during the period of low oil pressure when the engine is started. Each shutdown shall initiate its individual light and sound an alarm within the cranking panel, and shall require manual reset to release each indicating light. Normal start-up and shut-down shall not actuate the manual reset indicator system.

2.4.12 Radio-Interference Suppression: The diesel engines shall comply with MIL-I-16165 relative to radiated radio interference. Generators and other devices capable of producing radio interference shall comply with MIL-STD-461 relative to radiated and conducted radio interference.

2.5 GENERATORS AND EXCITATION SYSTEMS:

2.5.1 Generators: The generator for each unit shall be 480 volts, three-phase, 60-hertz, 0.80 power-factor alternating-current type with revolving field. The speed of the generator shall be that of the engine. The generator shall be capable of carrying continuously a 0.80 power factor load equal to the gross kilowatt rating of the diesel generating unit, and to carry a 0.80 power factor load ten percent in excess of the gross kilowatt rating of the diesel generating unit for 2 continuous hours out of any period of 24 consecutive hours at normal voltage and with a temperature rise of not more than 80 degrees C as measured by resistance based on 40 degrees C ambient temperature. Enclosures shall be the general-purpose open type with ventilating openings covered with removable screens having a mesh not larger than 1/2-inch. The generator shall conform to ANSI C50.10, ANSI C50.12, and to NEMA MG-1. The generator shall have form-wound coils and Class B insulation. The stator winding shall be arranged for "wye" connection with both line and neutral leads of each of the three-phase windings brought out of the bottom of the generator frame, and the neutral grounded. The generator and flywheel shall have sufficient flywheel effect to meet the requirements of regulation and operation as specified. The rotor shall have continuous or interconnected amortisseur windings. Parallel operation shall be as specified in the paragraph: Parallel Operation. The generator for rotor shall be mounted on an extended shaft which shall be coupled rigidly to the engine crankshaft. Impellers shall be mounted on the rotor for cooling the generator. The rotor shall be capable of safe operation at a speed 25 percent in excess of its rated synchronous speed. The generator armature, field, and ground leads shall have clamp- or crimp-type lugs or connectors for electrical connections. Terminal markings shall conform to NEMA MG-1.

2.5.2 Excitation and Voltage Regulation System: The excitation system shall be the integral brushless-type consisting of a rotating a.c. exciter and rectifier diode assembly together with a static type voltage regulating system and including surge protection and the required accessories. The system shall serve as an individual excitation and regulation system for the generator specified herein and there is no requirement for parallel operation with other exciters. The excitation system shall have a continuous current rating of not less than the generator excitation current required when the generator operates at 105 percent rated voltage under the condition of continuous rating requiring maximum field current. The voltage rating of the system shall be as required to match the generator field requirements. The excitation system response ratio shall be not less than 0.5 and the ceiling voltage shall be not less than 120 percent of rated voltage.

2.5.2.1 Exciter: The exciter shall be a rotating a.c. generator having a rotating armature on the rotor spider and a stationary field on the stator frame. The exciter insulation shall be Class B and the temperature rise shall not exceed 70 degrees C when measured by resistance based on a 40 degree C ambient temperature.

2.5.2.2 Rectifiers shall be full-wave silicon diode type, with each diode protected by individual fuses. The rectifiers shall be mounted on the rotating part of the exciter to convert a.c. exciter output to d.c. for the main generator excitation. Connections shall be provided between the exciter, rectifiers, and generator field without use of brushes or slip rings.

2.5.2.3 Voltage Regulator: The voltage regulator shall be a completely solid state type for control of generator voltage by control of the exciter field. The regulator shall be suitable for mounting in the generator switchgear. The regulator shall control the generator exciter field as required to maintain a constant and stable generator output voltage within plus or minus 1/4 of one percent of nominal for all steady state loads from no load to full load including a five percent variation in frequency and the effects of field heating. The regulator shall be designed for single-phase voltage sensing. The regulator shall have internal sensing transformers to allow the sensing voltage to be reconnected at 120, 208, 240, 416, 480, and 600 VAC. Electromagnetic interference suppression shall be an integral part of the regulator. Thermal protection for power semi-conductors, inherent over-voltage protection and fuse protection shall be provided internally in the regulator. No electrolytic capacitors, vacuum tubes, or electromechanical relays shall be used in the voltage regulator. A voltage regulator power supply transformer of adequate capacity for the regulator furnished shall be furnished for mounting in the generator switchgear. The regulator shall have provisions for switching to manual control to allow the generator voltage to be controlled either manually or automatically. The following regulator components shall be mounted on the front of the generator switchgear:

a. Voltage adjusting rheostat.

b. Manual voltage control with adjusting rheostat and manual automatic-off transfer switch.

c. Field flashing pushbutton.

2.5.2.4 Engine-Generator Instruments and Controls: NEMA ICS 1, 2, 3, 4, and 6.

2.5.2.5 Engine Instruments: Include the following as minimum components:

a. Lubricating Oil Pressure Gauge: Indicating dial type, utilizing a Bourdon tube for confining the pressure medium. The Bourdon tube shall be seamless and made of phosphor bronze. Gauge shall be accurate to within 2 percent of full scale reading. Gauge subject to rapid pressure surges shall be properly suppressed.

b. Coolant Temperature Indicators: Indicating dial type. Capillary tubing shall be covered with a protective casing throughout its entire length and reinforced with an additional casing at the connection to the bulb or socket. The temperature indicator shall be accurate to within 2 percent of full scale reading.

c. Running Time Meter: Totalize engine running time to 9999.9 hours total.

2.5.2.6 Generator controls and instruments, NEMA ICS 1, 2, 3, and 4 shall include the components listed below. Instruments shall comply with ANSI C39.1.

a. Voltmeter and Ammeter: Semiflush mounted direct indicating type, not less than 3-1/2-inch nominal round or square, 180 degree arc, with accuracy of two percent of full scale.

b. Frequency Meter: Dial type.

c. Control Switches: Voltage and ampere ratings suitable for the intended use. Contacts shall be rated in accordance with NEMA Standards ICS 2-125 A600.

d. Generator Output Circuit Breaker: Shall comply with Fed. Spec. W-C-375. Molded case type, trip-free, and shall be mounted to allow operation from outside the control panel. Frame size shall be adequate for generator amperage when operating at stand-by rating, and an adjustable trip shall be provided. Lugs shall be provided for electrical connections.

e. Voltage adjustment rheostat.

f. Panel lights and control switch.

g. Alarm indicating panel.

2.6 BASE ASSEMBLY AND ENCLOSURE: NEMA ICS 6.

2.6.1 Engine-Generator: Shall be mounted on a fabricated steel skid base suitable for supporting, transporting, and skidding engine and generator without damage to equipment or alignment.

2.6.2 Vibration Isolators: Shall be provided to isolate the engine-generator set from the concrete pad. At least four isolators as recommended by the isolator manufacturer are required. The isolators shall be manufactured by a firm specializing in this product, and the unit shall be specifically listed for this application and have a maximum deflection of one inch.

2.7 TREATMENT AND PAINTING: All parts including engine subject to high temperature shall be treated and painted in accordance with manufacturer's standards. The generator and all associated electrical equipment shall be thoroughly cleaned and treated prior to painting. Color shall be manufacturer's standard.

2.8 NON-AUTOMATIC TRANSFER SWITCH: UL 1008.

2.8.1 Non-Automatic Transfer Switch: Provide non-automatic transfer switch and associated isolation and by-pass switch with the number of poles, amperage, voltage, and withstand ratings as shown. Transfer switch shall be listed per UL 1008 as a recognized component for emergency systems and rated for all classes of loads when installed in an unventilated enclosure. Electrical operation shall be accomplished by a non-fused momentarily energized solenoid direct operating mechanism or stored energy operator. Mechanical locking in each direction shall be provided. Main pole structures shall be designed so that fault currents result in increased main contact pressure. An overload or short circuit shall not cause the switch to go to a neutral position. Main contacts shall be designed for non-automatic transfer switch service. Inspection and replacement of all main and separate arcing contacts moving and stationary, shall be possible from the front of the switch without any disassembly of operating linkages or power conductors.

2.8.2 Accessories: A separately mounted unitized control module shall include:

a. Normal - Alternate "Selector Switch"

b. Phase voltage relay supervision of three phases of the normal source 65 to 70 percent drop-out (D.O.) and 92 to 95 percent pick-up (P.U.) to detect "brown-out" conditions.

c. Voltage/frequency lockout relay (90 percent P.U., nominal) to prevent premature transfer.

d. Amber pilot light to indicate alternate source available.

e. Imposed neutral position for transferring motor loads.

f. Engine starting control contacts (one-N.C. and one-N.O.).

g. Auxiliary pilot contacts rated 10 amperes at 480 Vac (one closed on "N" (normal) and one closed on "E" (emergency).

h. The switch shall have full rated neutral transfer contacts driven by the main contact shaft.

i. Provide adjustable time delay, 5 to 15 minutes, on shutdown of engine-generator after retransfer of the load to "normal."

j. Pilot lights to indicate source to which the load is connected.

k. Pilot lights to indicate which source is available.

2.9 WIRE AND CABLE: Provide all wire and cable required for a complete electrical system as shown.

2.9.1 Conductors: Shall be as specified by American Wire Gage (AWG). Unless otherwise indicated or specified, conductors shall be copper. Copper shall be soft annealed coated type per ASTM B 33 or ASTM B 189. Size, type, use, and location for all circuits shall be as shown on the "Circuit Schedule" on the drawings. Wire and cable sizes indicated are for copper. Power cables No. 12 and smaller may be solid or 7-strand. Power cables No. 10 and larger shall be Class B stranding per ASTM B 8 (copper). Multiple-conductor control cables shall be either 7-strand or 19-strand. Thermocouple extension wires shall be solid.

2.9.2 Insulation: As designated on the drawings, conforming to the following:

a. Multiple-Conductor Control Cables: Insulate for 600-volt service. Provide cables with necessary fillers and binder tape. Color-Code individual conductors in accordance with ICEA, Method 1. Multiple-conductor control cables shall be one of the following constructions:

(1) Each conductor shall have 47 mils of Type RHW synthetic rubber insulation plus 15 mils of neoprene followed by an overall neoprene jacket. Insulation shall conform to ICEA S-19-81.

(2) Each conductor shall have 20 mils of polyethylene plus 10 mils of polyvinylchloride insulation followed by overall polyvinylchloride jacket. Insulation and jacket materials shall conform to ICEA S-61-402.

(3) Each conductor shall have 30 mils of cross-linked polyethylene insulation followed by an overall neoprene or polyvinylchloride jacket. Insulation and jacket materials shall conform to ICEA S-66-524 and ICEA S-61-402.

2.10 ENGINE-GENERATOR CONTROL PANEL: Provide as indicated on drawings.

PART 3 - EXECUTION

3.1 INSTALLATION: Installation shall conform to the requirements of the NFPA 70. Muffler and fuel connections shall be made under the Mechanical sections of this contract.

3.2 DIESEL ENGINE-GENERATOR: Install diesel generating unit on a concrete foundation as indicated. Provide vibration isolators to isolate vibrations from the diesel generating unit to the foundation, and install insolators in accordance with diesel-generator manufacturer's instructions.

3.3 TESTING: Perform the following tests on the generator set system provided. The Contracting Officer shall be given 10 working days notice prior to each test. The Contractor shall provide all test equipment and personnel and submit written copies of all test results.

3.3.1 Factory Tests: The engine-generator shall be subject to the manufacturer's standard run-in and conditioning tests. Following the run-in tests, test the engine-generator set at rated speed and voltage for 8 hours of continuous operation with 2 hours each at 50, 75, 100, and 110 percent of rated load, consecutively, 0.8 power factor. Determine generator frequency, phase current and voltage and record at 15-minute intervals. Run tests on the voltage regulator to determine the variation in terminal voltage under conditions of constant load, and under conditions of abrupt load changes to determine the maximum voltage change during the surging period and the time required as specified in paragraph entitled "Voltage Regulator."

3.3.1.1 Speed Governing Test: Engine speed governing system shall be tested in accordance with ASME PTC26.

3.3.1.2 Test for Radio-Interference Suppression: Test shall be conducted in accordance with Mil. Spec. MIL-I-16165 and MIL-STD-461. All testing equipment, instruments, personnel for making the tests, the test location, which shall be reasonably free from radiated and conducted interference, and other necessary facilities shall be furnished by the Contractor. Tests for radio-interference suppression will not be required for items that are physically and electrically identical to those that have previously met the requirements of the above specifications.

3.3.2 Field Tests and Inspections: The Contractor shall perform all field tests and trial operations, and conduct all field inspections except final field inspection. The Contractor shall provide all labor, equipment, and incidentals including but not limited to water, fuel, and lubricants required for tests. The Contracting Officer will witness all field tests and trial operations, and conduct final field inspections. The Contractor shall give the Contracting Officer ample notice of the dates and times scheduled for tests, trial operations, and inspections which require the presence of the Contracting Officer. All deficiencies found shall be rectified and work affected by such deficiencies shall be completely retested at the Contractor's expense. A qualified factory representative shall assist the Contractor with the field check-out, start-up, and test. Field tests shall include the following:

a. Demonstrate proper operation of all systems.

b. Simulate power failure and demonstrate complete automatic start, load, unload, by-pass, and stop sequence.

c. Conduct 3-hour load run utilizing Contractor-furnished portable load banks as follows:

(1) 1/2 load--One Hour
(2) Full load--2 Hours

END OF SECTION

SECTION 16402
INTERIOR WIRING SYSTEMS

PART 1 - GENERAL

1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

FEDERAL SPECIFICATION (FED. SPEC.):

W-C-375B	Circuit Breaker, Molded Case, Branch-Circuit and Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI):

C2-1981	National Electrical Safety Code
C80.1-1977	Specification for Rigid Steel Conduit, Zinc-coated
C80.3-1977	Specification for Electrical Metallic Tubing, Zinc-coated

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):

B 1-70 (R 1976)	Hard-Drawn Copper Wire
B 8-77	Concentric-Lay-Stranded Copper Conductor, Hard, Medium-Hard, or Soft

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA):

ICS6-1978 (Rev. 1-80)	Enclosures for Industrial Controls and Systems
KS1-1975	Enclosed Switches
ST20-1972 (R 1978)	Dry-Type Transformers for General Applications
WD1-1979 (Rev. 1-79)	General Purpose Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA):

70-1981	National Electrical Code (NEC)

UNDERWRITERS' LABORATORIES, INC. (UL):

1-1979 (Mar 80)	Flexible Metal Conduit
50-1980	Cabinets and Boxes
67-1979 (Dec 80)	Panelboards
83-1980	Thermoplastic-Insulated Wires and Cables
467-1972 (May 79)	Grounding and Bonding Equipment
486A-1980	Wire Connectors and Soldering Lugs for Use with Copper Conductors

486B-1978 (Feb 81)	Wire Connectors for Use with Aluminum Conductors
510-1976 (Jun 80)	Insulating Tape
514-1979 (Apr 80)	Outlet Boxes and Fittings
854-1979 (Nov 80)	Service-Entrance Cables
869-1977 (Nov 80)	Service Equipment
943-1972 (Jan 77)	Ground-Fault Circuit Interrupters
1242-1977 (Draft)	Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS: Section 16011, "Electrical General Requirements," applies to this section with additions and modifications specified herein. In each of the standards referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Interpret reference in these standards to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer.

1.2.1 Electrical Characteristics: Electrical characteristics for this project shall be 208 or 480 volts secondary as indicated, three phase, four wire, wye connected. Final connections to the power distribution system at the existing transformers shall be made by the Contractor as directed by the Contracting Officer.

1.3 SUBMITTALS:

1.3.1 Manufacturer's Data:

a. Circuit Breakers
b. Switches
c. Intermediate Metal Conduit
d. Conduit Supports
e. Fuses

1.3.2 Shop Drawings:

a. Transformers
b. Wireway

1.3.3 Certificates of Conformance or Compliance:

a. Conduit (except plastic and IMC)
b. Ground Rods
c. Outlet and Junction Boxes
d. Insulating Tapes
e. Conduit Fittings
f. Conductors

1.4 TRANSFORMER TESTS AND TEST REPORTS: Perform tests classified as "routine" per NEMA ST20 on each transformer and submit the results for approval in report form. Submittal shall also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT: All materials, equipment, and devices shall, as a minimum, meet the requirements of UL where UL Standards are established for those items and the requirements of NFPA-70. All items shall be new unless specified or indicated otherwise.

2.1.1 Coordination: Coordinate new equipment (fuses, circuit breakers, relays, and other equipment) with existing station equipment. The Contracting Officer will provide the necessary information on existing equipment when requested.

2.1.2 Conduit and Fittings:

2.1.2.1 Rigid Steel Conduit (Zinc-coated): ANSI C80.1

2.1.2.2 Intermediate Metal Conduit (IMC): UL 1242, zinc-coated steel only

2.1.2.3 Electrical Metallic Tubing (EMT): ANSI C80.3

2.1.2.4 Flexible Metal Conduit: UL 1, zinc-coated steel only

2.1.2.5 Fittings for Metal Conduit, Electrical Metallic Tubing, and Flexible Metal Conduit: Ul 514. All ferrous fittings shall be cadmium- or zinc-coated per UL 514.

2.1.2.5.1 Fittings for rigid metal conduit and IMC shall be threaded type. Split couplings are not acceptable.

2.1.2.5.2 Fittings for electrical metallic tubing (EMT) shall be the compression type.

2.1.3 Cabinets, Junction Boxes, and Pull Boxes (With Volume Greater than 100 Cubic Inches): UL 50, hot-dip zinc-coated if of sheet steel. Weatherproof construction where indicated.

2.1.4 Wires and Cables: Wires and cables shall meet the applicable requirements of NFPA 70 and UL for the type of insulation, jacket, and conductor specified or indicated. Unless indicated or specified otherwise, conductor sizes are based on copper. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. Wires and cables manufactured more than twelve months prior to date of delivery to the site shall not be used.

2.1.4.1 Color coding is required for all service, feeder, branch, control, and signalling circuit conductors. For conductors No. 6 AWG and smaller, color coding shall be by factory applied color impregnated insulation. Cable ties, tape, or heat shrink sleeves shall be used on conductors No. 4 AWG and larger. Color shall be white for neutrals and green for grounding conductors. The color of the ungrounded conductors in different voltage systems shall be as follows:

a. 120/208 volt, 3-phase: black, red, and blue

b. 277/480 volt, 3-phase: brown, orange, and yellow

All ungrounded conductors of the same color shall be connected to the same ungrounded feeder conductor.

2.1.4.2 Conductor sizes are expressed in American Wire Gage (AWG) or in circular mils. Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal-ciruits - No. 14 AWG; for Class 2 low-energy remote control and signal-circuits - No. 16 AWG.

2.1.4.3 Power and Lighting Conductors: UL 83, type THW or THWN.

2.1.4.4 Service Entrance and Underground Secondary Conductors: UL 854, type USE, single conductor, rated 600 volts. Cable shall be suitable for direct burial in earth or for installation in conduit.

2.1.4.5 Grounding and Bonding Conductors: ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller; ASTM B 8, class B, stranded bare copper wire for sizes No. 6 AWG and larger. [Grounding and bonding conductors shall be insulated type where indicated or specified.]

2.1.4.6 Flexible Connections: Connections to movable equipment shall be flexible metal conduit with the number of conductors indicated.

2.1.5 Splices and Termination Components: UL 486A and UL 486B, as applicable for wire connectors, and UL 510 for insulating tapes. Connectors for wires No. 10 and smaller shall be insulated pressure-type or wirenut-type. Provide solderless terminal lugs on stranded conductors.

2.1.6 Switches:

2.1.6.1 Disconnect Switches: NEMA KS1, general duty nonfused, single throw, quick-make quick-break, 240 volts, and the number of poles indicted. Provide switches in NEMA 3R enclosure per NEMA ICS6. Switches serving as motor-disconnect means shall be horsepower rated.

2.1.7 Panelboards: UL 67 and UL 50, as applicable. Panelboards for use as service disconnecting means shall additionally conform to UL 869. Panelboards shall be circuit breaker equipped. Design complete panelboard assembly so that any individual breaker can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as a means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for the future installation of a breaker sized as indicated.

2.1.7.1 Panelboard Buses: Provide copper bus bars supported on bases independent of the circuit breakers. Design main buses and back pans so that breakers may be changed without machining, drilling, or tapping. Provide an insulated neutral bus in each panel for connection of circuit neutral conductors. Provide a separate ground bus marked with a green stripe along its front and bonded to the steel cabinet for connecting grounding conductors.

2.1.7.2 Circuit Breakers: Fed. Spec. W-C-375 ambient-compensated thermal magnetic type with interrupting capacity as indicated. Design breakers to accept copper, copper-clad, and aluminum conductors. Plug-in circuit breakers are not acceptable.

2.1.7.2.1 Multipole Breakers: Provide common-trip type with a single operating handle. Design breakers so that an overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C respectively.

2.1.8 Transformers: NEMA ST20, general purpose, dry-type, self cooled, ventilated. Provide transformers in a NEMA 3R enclosure. Transformer shall have 220 degrees C insulation system with a temperature rise not exceeding 150 degrees C under full rated load in a maximum ambient of 40 degrees C. Transformer shall be capable of carrying continuously 115 percent of the nameplate KVA without exceeding the insulation rating.

2.1.9 Grounding and Bonding Equipment: UL 467

2.1.9.1 Equipment Grounds: Provide a green-colored equipment grounding conductor which shall be separate from the electrical system neutral conductor. Provide equipment ground conductors in branch circuits serving convenience outlets, receptacles, portable and permanently installed electrical appliances, equipment, apparatus, and other miscellaneous metal-enclosing bodies including light switch boxes normally within contact of personnel.

2.1.9.2 Ground Rods: Copperweld type, 3/4 inch in diameter and 10 feet long unless otherwise indicated.

2.1.9.3 Hazardous Locations: Electrical materials, equipment, and devices for installation in hazardous locations as defined by NFPA 70 shall be specifically approved by Underwriters Laboratories or Factory Mutual for the particular "Class," "Division," and "Group" of hazardous location involved. The boundaries and classifications of hazardous locations shall be as indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

3.1.1 General Requirements: Electrical installations shall conform to the requirements of ANSI C2 and NFPA 70 and to the requirements specified herein. Measure mounting heights specified or indicated to the center of the device or outlet.

3.1.2 Hazardous Locations: Perform work in hazardous locations as defined by NFPA 70 in strict accordance with the NEC for the particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by NFPA 70.

3.1.3 Wiring Methods: Wiring method shall be insulated conductors installed in conduit, except where specifically indicated or specified otherwise, or required by NFPA 70 to be installed otherwise. Conduit shall be rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT) except where specified or indicated otherwise.

3.1.3.1 Aluminum Conduit: Do not install underground or encase in concrete.

3.1.3.2 Electrical Metallic Tubing: Do not install underground, encase in concrete, use in areas where subject to severe physical damage, or use in outdoor work.

3.1.3.3 Underground Conduit and Conduit In or Under Slabs: Rigid steel or steel IMC. The conduit shall be field coated with a coal tar base conforming to MIL-C-18480, 30 mils thick and encased in a minimum of 3 inches of concrete.

3.1.3.4 Service Entrance Conduit: Rigid steel or IMC from the service equipment to the outdoor transformer or substation and not less than 24-inches below grade.

3.1.4 Conduit Installation: Keep conduit at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Support Conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine or wood screws. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. The load applied to fasteners shall not exceed one-fourth of the proof test load. Fasteners attached to concrete ceiling shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4-inch in concrete joints shall not cut the main reinforcing bars. Fill holes that are not used. In partitions of light steel construction, use sheet- metal screws. In suspended-ceiling construction, run conduit above the ceiling and fasten only lighting system branch circuit conduits to the ceiling supports. Spring steel fasteners may be used for lighting branch circuit conduit supports in suspended ceiling in dry locations.

3.1.4.2 Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with a hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of all obstructions.

3.1.4.3 Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least a single locknut and bushing. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Install bushings on the ends of conduits and provide insulating type where required by NFPA 70.

3.1.4.4 Stub-Ups: Provide conduits stubbed up through concrete floor for connection to free-standing equipment with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above the floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.5 Flexible connections of short length shall be provided for equipment subject to vibration, noise transmission, or movement and for all motors. Liquid-tight flexible conduit shall be used in wet locations. A separate ground conductor shall be provided across flexible connections.

3.1.5 Boxes, Outlets, and Supports: Provide boxes in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, in hazardous areas, and when installed exposed up to 7 feet above interior floors and walkways. Boxes in other locations shall be sheet steel. Each box shall have the volume required by the NEC for the number of conductors enclosed in the box. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type fastener not more than 24 inches from the box. When penetrating reinforced-concrete members, avoid cutting any reinforcing steel.

3.1.5.1 Boxes for use with raceway systems shall not be less than 1-1/2 inches deep except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be not less than 4 inches square except that 4 by 2 inch boxes may be used where only one raceway enters the outlet.

3.1.5.2 Pull Boxes: Construct of not less than the minimum size required by the NEC of code-gage aluminum or galvanized sheet steel except where cast-metal boxes are required in locations specified above. Furnish boxes with screw-fastened covers. Where several feeders pass through a common pull box, tag the feeders to indicate clearly the electrical characteristics, circuit number, and panel designation.

3.1.6 Mounting Heights: Mount panelboards, transfer and disconnect switches so the height of the top operating handle will not exceed 78 inches from the floor. Mount receptacles and other devices as indicated.

3.1.7 Conductor Identification: Provide conductor identification within each enclosure where a tap, splice, or termination is made. Make identification with color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat-shrink type sleeves. Identify control circuit terminations.

3.1.8 Splices: Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller with an insulated pressure type connector. Make splices in conductors No. 8 AWG and larger with a solderless connector and cover with an insulation material equivalent to the conductor insulation.

3.1.9 Grounding and Bonding: In accordance with NFPA 70. Ground all exposed non-current-carrying metallic parts of electrical equipment and metallic raceway systems. Where ground fault protection is employed, take care that the connection of ground and neutral does not interfere with the correct operation of the fault protection.

3.1.9.1 Equipment Grounds: Equipment grounds shall be solid and continuous from a connection at earth to panelboards. Make ground connections at panelboards, outlets, equipment, and apparatus in an approved and permanent manner.

3.1.9.2 Resistance: The maximum resistance to ground of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Where the resistance obtained with ground rod exceeds 25 ohms, provide additional ground rods not less than 6 feet on centers.

3.1.10 Equipment Connections: Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications, but shall be provided under Section: 16208.

3.1.11 Reworking Existing System: All work shall conform to applicable requirements of this Division of the Specifications. Remove or de-energize existing electrical equipment, conduit, conductors, etc., not in use after reworking the existing system, as indicated. Keep equipment not scheduled for replacement in operation at all times. Schedule work to be renovated, changed, or modified so as not to interfere with normal operation.

3.1.12 Repair of Existing Work: Layout the work carefully in advance. Where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, do this work carefully. Repair any damage to buildings, piping, or equipment by skilled mechanics of the trades involved.

3.2 FIELD TESTS: As an exception to requirements that may be stated elsewhere in the contract, the Contracting Officer shall be given 10 working days notice prior to each test.

3.2.1 Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 Test on 600-Volt Wiring: Test all 600-volt wiring to verify that no short circuits or accidental grounds exist. Tests shall be made using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance.

3.2.3 Grounding System Test: Test the grounding system to assure continuity and that the resistance to ground is not excessive. Test each ground rod for resistance to ground. Make resistance measurements in normally dry weather, not less than 48 hours after rainfall, and with the ground rod under test isolated from other grounds. Submit written results of each test to the Contracting Officer and indicate the location of the rod as well as the resistance and soil conditions at the time the measurements were made.

END OF SECTION

SUPERSEDEAS DECISION

STATE: NORTH CAROLINA
COUNTIES: BRUNSWICK, CARTERET, COLUMBUS, CRAVEN, DUPLIN, JONES, LENOIR, NEW HANOVER, ONSLOW, PAMLICO, AND PENDER
DECISION NUMBER: NC81-1201 DATE: DATE OF PUBLICATION
Supersedes Decisions Number NC81-1181, dated January 23, 1981, 46 FR 7745; NC81-1182, dated January 23, 1981, 46 FR 7744; Number NC81-1147, dated December 30, 1980, 45 FR 86200.
DESCRIPTION OF WORK: BUILDING CONSTRUCTION PROJECTS (does not include single family homes and apartments up to and including four stories).

	Basic Hr. Rate	FRINGE BENEFITS PAYMENTS			
		H&W	Pensions	Vacation	Edu and/or Appr. Tr.
Asbestos Workers	$7.26				
Bricklayers	7.10				
Carpenters	6.02				
Cement Masons	5.68				
Drywell Mechanics	7.00				
Electricians	6.22				
Electronic Technicians	4.50				
Glaziers	5.38				
Ironworkers	6.66				
Laborers:					
Laborers - General	3.78				
Pipe Layers	4.94				
Millworkers	9.45				
Painters	5.00				
Plasters	6.00				
Plumbers & Pipefitters	6.52				
Roofers	5.91				
Sheet Metal Workers	6.38				
Soft Floor Layers	7.00				
Sprinkler Fitters	7.95				
Tile Setters	6.00				
Truck Drivers	3.90				
Welders - Rate for Craft					
Power Equipment Operators:					
Asphalt Raker	4.27				
Backhoe	5.32				
Bulldozer	5.25				
Crance	6.80				
Distributor	4.70				
Fork Lift	6.50				
Front End Loader	4.50				
Motor Grader	5.36				
Paver - Screed	4.25				
Roller	5.00				
Scraper - Pan	4.60				
Tractor	5.00				

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clause (29 CFR, 5.5(a)(1)(ii)).