TITLE II DESIGN DOCUMENT FOR THE 881 HILLSIDE REMEDIAL ACTION

VOLUME I

PREPARED FOR

ROCKWELL INTERNATIONAL
NORTH AMERICAN SPACE OPERATIONS
ROCKY FLATS PLANT

AUGUST 1988

PREPARED BY

ENGINEERING-SCIENCE, INC.
Denver, Colorado

IN CONJUNCTION WITH

THE RALPH M. PARSONS COMPANY
Pasadena, California

ES ENGINEERING-SCIENCE

TITLE II DESIGN DOCUMENT
FOR THE
881 HILLSIDE REMEDIAL ACTION
ROCKY FLATS PLANT
GOLDEN, COLORADO

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AUGUST 30,1988

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By R. B. Hoffman

Date 7-9-90

FORWARD

This report represents work performed by Engineering-Science, Inc. in conjunction with the Ralph M. Parsons Company under Basic Ordering Agreement BA 55713HJ, Task Order BA98614 HJ for Rockwell International, North American Space Operations, Rocky Flats Plant.

This report represents the Title II Design Document for the Building 881 Hillside Remedial Action.

TABLE OF CONTENTS

SECTION 1
INTRODUCTION

1.1 SCOPE

This Title II Report provides the plans and specification for construction of facilities to implement the Building 881 Hillside Remedial Action Plan. This report expands upon information developed in the Title I, Preliminary Design Basis Document for the 881 Remedial Action Plan, dated 16 June 1988. The scope of the Title II report covers the design development of contract drawings and specifications, purchase specification for government furnished equipment, component checkout (cc) and system operations (so) test procedures, and a quality acceptance criteria checklist. A detailed cost estimate is included under separate cover.

1.2 PURPOSE OF PROJECT

The primary objective of the Building 881 Hillside Remedial Action Plan (Project) is to isolate, collect, treat and re-inject ground water contaminated with a variety of volatile organic compounds. A conceptual design for the project has been developed as a result of Remedial Investigation/Feasibility Study (RI/FS) procedures. A Health Risk Assessment performed in conjuction with the RI/FS concluded that a small but identifiable health risk to the public would occur in the future if no remedial action was performed at the site. Implementation of the recommended remedial action will eliminate the future risk and result in the removal of the contaminants identified as contributing to the risk.

Preliminary process design and selection was performed as a part of the RI/FS and subsequently verified through independent treatability studies initiated by Rockwell and performed by a manufacturer of the selected system. The selected process for treatment of the volatile organics is an ultraviolet light (UV)/hydrogen peroxide (H_2O_2) system and is discussed in detail in the referenced RI/FS.

The Title I report included preliminary design of a french drain ground water interceptor system, sumps and sump pumps, installation and equipping of interceptor well 1-88, influent piping, modification of exising building 830 to accomodate the treatment unit, erection of a combination storage tank/secondary containment pad, storage tanks for the influent and effluent, and an effluent re-injection system.

This Title II report completes the design of the remedial facilities and presents drawings and specifications suitable for bidding by qualified contractors.

1.3 LOCATION OF WORK

The location of this work is the 881 Hillside area. This area lies immediately south and east of the Building 881 near the perimeter of the plant site. The UV/hydrogen peroxide treatment unit will be located within Building 830 which formerly housed the Building 881 Isolated Power System. The storage tanks and tank pad will be located adjacent to Building 830 as an extension of the existing loading dock. The french drain ground water collection system and the re-injection trench will be located several hundred feet south of Building 881 on the hillside. The floor elevation of Building 830 is approximately 5,978.5 feet above mean sea level. The french drain and re-injection are approximately 60 to 85 feet lower in elevation.

1.4 DESIGN CRITERIA

The Title II Design Document conforms to all preliminary requirements as stated in the Preliminary Design Basis Document dated 16, June 1988, RI/FS Volume I dated 1 March 1988, and the Design Criteria for Remedial Action 881 Hillside, Volume 3 dated 31 May 1988. Modification to the preliminary design were made during final design. Those changes are discussed below. The design information contained in this document represents requirements as described in Volumes 1 and 2 of the Design Criteria Manual for the Rocky Flats Plant.

1.5 WORK INCLUDED

A new and functional ground water collection, treatment and re-injection system is provided. The treatment process is housed in Building 830 which has been modified to accommodate the unit. Work covered in the construction documents inlcude:

(a) Approximately 1,800 linear feet of french drain ground water interceptor trench;

(b) Two french drain collection wells and dual well pumps to pump the collected ground water to the influent storage tanks;

(c) A collection well and dual well pumps to collect drainage from the Building 881 foundation footing drain;

(d) A new interceptor well, 1-88, approximately 12 inches in diameter with a 6-inch casing and approximately 40 feet in depth equipped with a submersible well pump;

(e) Piping to connect the facilities described in items (a) through (d) above to the influent storage tanks;

(f) Four tanks located in a reinforced concrete pad and secondary containment structure. Two of the tanks shall be used as influent storage tanks and two shall normally be used for effluent storage. Provisions have been made to use all four tanks for effluent storage;

(g) Influent pumping to the treatment unit from the storage tanks;

(h) UV/hydrogen peroxide pre-engineered treatment system complete with control unit;

(i) Modifications as required to Building 830 to house the treatment unit, hydrogen peroxide feed unit and a small utility area of approximately 144 square feet;

(j) Effluent piping to deliver the treated water to the infiltration gallery; and

(k) A ground water infiltration gallery downgradient of the french drain system.

1.6 COMPONENT CHECKOUT AND SYSTEMS OPERATING TEST PROCEDURES

Component checkout (CC) test procedures have been defined for each item of work. These requirements appear in a "Field Quality Control" paragraph in the Part 3 - Execution section of each technical specification section. Detailed systems operating (SO) test procedures have been prepared for the new collection, treatment and re-injection system as a part of this final design effort. The Contractor's responsibilities and building operations responsibilities during system operating tests are clearly defined in the technical specifications.

1.7 REGULATORY COMPLIANCE

The contract specifications for construction are consistent with Federal Statutes, Regulations and Interpretative Rules; and specifically reference the Contractor's responsbilities to partcipate in components of the Remedial Action Process, as described in Superfund Remedial Design and Remedial Action Guidance, OSWER Directive 9355.0-4A, June 1986. Upon completion of construction the Contractor shall be required to participate in required activities including: the Prefinal Construction Conference, the Prefinal Inspection and Final Inspection and Certification.

The Buyer shall provide a full time onsite inspector with expertise in federal construction projects and proceedings.

BASIS FOR DESIGN

1.8 GENERAL

1.8.1 Design Documents

The documents listed below form the basis for the Facilities Engineering design of the Building 881 Remedial Action Plan:

(a) Design Criteria Manual, Volumes 1 and 2, Rocky Flats Plant.

(b) Design Criteria for Remedial Action 881 Hillside, Rocky Flats Plant, Volume 3.

(c) Feasibility Study Report for High Priority Sites, (881 Hillside Area) Volume I.

(d) Preliminary Design Basis Document for the 881 Hillside Remedial Action, Engineering-Science, Inc.

(e) Rocky Flats Plant Standards Manual, Volumes I, II, and III.

1.8.2 Quality Assurance

This design incorporates applicable regulatory requirements and design basis for structures, modifications, additions, systems and components such that they are correctly translated into specifications, drawings, procedures and instructions. The following are those attributes included in the design:

(1) Facilitate inspectability of equipment during fabrication, shipping, construction, testing, operation and maintenance modes;

(b) Performance and acceptance criteria;

(c) Monitoring instrumentation and control requirements including instruments, controls, and alarms required for operating, testing and maintenance of the facility and process equipment;

(d) Accomodations for equipment handling, protection, storage, and shipping;

(e) Optimization of maintainability/serviceability of equipment;

(f) Specify material requirements including such items as compatibility, electrical insulation properties, protective coating and corrosion resistance;

(g) Material traceability through drawing and/or specification callouts, and;

(h) Personnel safety, and protection of economic investment.

The Quality Acceptance Criteria Checklist is included as Section 5 of this document.

1.8.3 Design Requirements/Codes and Standards

All facilities are designed and sized for operation at the site elevation of approximately 6,000 feet above mean sea level. Facilities design has considered the impact of committing the use of existing Building 830 to the Building 881 Remedial Action Plan and its impact on future site utilization.

The facilities have been designed with regard to the following codes and standards as they apply:

(a) ACI - American Concrete Institute

(b) AISC - American Institute of Steel Construction

(c) ANSI - American National Standards Institute

(d) ASTM - American Society for Testing and Materials

(e) AWS - American Welding Society

(f) AWWA - American Water Works Association

(g) IEEE - Institute of Electrical and Electronics Engineers

(h) IPCEA - Insulated Power Cable Engineers Association

(i) ISA - Instrument Society of America

(j) NEC - National Electric Code

(k) NEMA - National Electrical Manufacturers Assoc.

(l) OSHA - Occupational Safety & Health Act of 1970

(m) UBC - Uniform Building Code

(n) UPC - Uniform Plumbing Code

(o) U/L - Underwriters Laboratory

1.8.4 Special Considerations

1. Contamination Control. The Contractor has been instructed that all excavated materials shall be handled in such a manner to minimize contaminant dispersion via aeolian dispersion or leaching. No excavated materials will be transported or stored downgradient of the proposed french drain. He is instructed to place it as a surface fill in the area of known contamination. Prior to excavation, soils will be wetted to a moisture content exceeding optimum moisture as defined by Standard Proctor Compaction Testing, ASTM D-698. In general, during handling, the excavated materials will be thoroughly wetted but will not contain moisture to the extent which would interfere with the Contractor's handling equipment. Excavated materials in stockpiles will be immediately stabilized by covering or other approved means immediately upon conclusion of work at that particular stockpile. During final placement of waste excavated material the surface will be stabilized by compaction and such covering as may be necessary so

that aeolian dispersion is minimized. No earthwork will be permitted during periods in which the wind velocity exceeds 30 mph. Long-term erosion protection will be provided by seeding and irrigation as required or other means approved by the Buyer. Irrigation will not begin until after the french drain and treatment unit are functional. Earthwork operations will be planned and conducted in a manner to promote maximum handling efficiency. Materials will be immediately placed and compacted after initial excavation where practicable.

The concrete base supporting the influent storage tanks has been designed to provide secondary containment with a capacity greater than the volume of one tank.

Any excavated materials, as determined by the Buyer's Health Physics representative (Radiation Monitor) exceeding the criteria for placement as fill will be immediately segregated from other uncontaminated materials and placed in containers provided by the Buyer. The Buyer shall arrange for removal and disposal of these containers.

2. Safety Requirements. The Contractor is instructed to conform to Chapter 1 of DOE Order 5480.1, "Environmental Protection, Safety, and Health Protection Standards" and National Fire Protection Association (NFPA) No 241, "Safeguarding Building Construction and Demolition Operations". All visitors and construction personnel are required to adhere to all regulations and receive indoctrinations which pertain to them.

3. Safeguards and Security. Construction of these facilities will be performed in compliance with the established Rocky Flats Plant Security Program. Most of this project is not located in a secured area. Unless the successful bidder can provide "Q" cleared personnel to perform all work within the 881 Security Area, the

Buyer shall provide Guard Escorts during all operations within the 881 Security Area.

The Contractor will obtain an approved "Land Use Request" for access control prior to entry into the buffer zone in accordance with HSE 20.01.

4. Health, Safety, and Environment. The Contractor is required to adhere to the procedures established in the Rocky Flats Plant Health, Safety, and Environment (HS&E) Manual, and the Plant Policy Manual where applicable. In particular, the Contractor is required to adhere to Plant Policy HMS 3-050, which requires that all personnel allowed on the plant site participate in applicable radiation exposure measurement programs. All personnel working on the project are required to be fully briefed on HS&E rules and regulations that must be followed on the project and are required to attend all applicable safety training indoctrinations.

   The Specifications explicitly reference appropriate worker health and safety standards.

   The Specifications include a site safety plan, in accordance with HSE 24.01.

   A full time Radiation Monitor will be provided by the Buyer during all excavation.

5. Operation Interruptions. The Contractor is required to perform all service and utility disconnects and tie-ins during normal working hours, insofar as it is practicable. The Contractor is required to schedule disconnects and tie-ins to minimize downtime and interruptions to other facilities, and is required to schedule all work with Buyer prior to the start of work.

1.9 REMOVALS

The following removals are detailed in the Drawings and Specifications in support of implementation of the Building 881 Hillside Remedial Action Plan:

(a) The entire floor, including equipment mounting pads, will be removed in Building 830 in order to facilitate installation of new facilities. A new floor and equipment pads will be constructed.

(b) Abandoned wires and cables in existing conduit runs in Building 830 will be removed in order to facilitate installation of new cables and wires into conduits to support electrical requirements.

1.10 PROCESS DESIGN

The treatment process has previously been selected as UV/Hydrogen Peroxide. Rockwell has confirmed this process as appropriate for the destruction of volatile organics contained in the contaminated ground water. Two manufacturers will be asked to submit bids under a Government Furnished Equipment (GFE) specification and the equipment selected will be installed by the Contractor. The GFE specification is the subject of Section 3 of this document.

1.11 CIVIL DESIGN

1.11.1 General

The civil engineering design encompassed the construction of the french drain system, the infiltration gallery, collection well 1-88, and interconnecting pipelines in addition to minor earthwork at the site. The following sections provide clarification of these items.

Finished grades will be as close as practicable to the existing.

All buried pipes and utilities shall be protected from future mechanical damage by buried warning tapes.

Final plans and specifications require the installation of physical surface monuments at significant points along all buried structures. They shall include: end points, points of curvature, tangent points, and the location of branches.

Final plans and specifications include compaction specifications for all fill materials including waste fill, drain rock, pipe bedding, and filters.

All surfaces within the required excavation limits will be cleared and grubbed. The top 12" of soil will be stripped and stockpiled uphill of the proposed french drain in an area not proposed for fill placement. This topsoil shall be used for reclamation of surface areas within the zone of expected ground water and soil contamination (upgradient of the french drain).

1.11.2 French Drain

The french drain shall be excavated so that it penetrates at least 2' of continuous (uninterrupted by permeable members) claystone bedrock. Permeable bedrock members encountered in the french drain excavation shall not be considered in determination of the design depth. The downstream face of the drain and exposed bedrock surfaces shall be lined with an impermeable synthetic membrane. The impermeable membrane shall be designed to prevent communication between exposed bedrock members and to limit flow beyond the drain during periods of high discharge or if mechanical failure of the pump system is experienced. Slush grouting of the exposed bedrock surfaces shall be preformed if it is determined during construction that faults exist in the bedrock members. A 6" diameter perforated drainpipe shall be installed at or near the bottom of the drain. The drainpipe and upstream face of the drain shall be protected with a geotextile filter, as appropriate. A collection sump shall be provided at the low point of the drain. The design depth of the sump

was selected to provide sufficient storage to produce pumping cycles compatible with the mechanical equipment selected.

1.11.3 Well 1-88

Well 1-88 shall be approximately 20 feet deep. The well hole shall be logged during drilling by an experienced engineering geologist or geotechnical engineer to document the lithology. The well shall be at least 36" in diameter to impermeable bedrock and 16" in diameter for an additional 5 feet. It shall be cased for its full length with 12" diameter stainless steel well casing, capped at the bottom and provided with surface sanitary seals and completion details. The well shall have a screened interval extending between the bottom of the pitless adaptor and the bedrock surface. The well shall be grouted for its entire length below top of bedrock with neat cement grout containing additives to prevent shrinkage.

1.11.4 Infiltration Gallery

The infiltration gallery has been designed to re-inject treated ground water into the shallow aquifer immediately downgradient from the french drain system. The gallery will generally consist of an excavated trench, lined with a porous geotextile and backfilled with drain rock. Within the drain rock a 6" perforated drainpipe will be installed. The total length of the infiltration gallery was based upon the need to re-inject all of the ground water potentially extracted from the french drain system and therefore is as long as the french drain system with an appropriate factor of safety involved to account for system and soil variances. The system consists of a multiple pipes network.

1.11.5 Collection Sumps

Collection sumps are located on the french drain system and the Building 881 foundation footing drain system. The sumps shall consist of pre-cast concrete sumps suitable for

installation of dual submersible pumps and shall have hinged lids with locking hasp.

1.12 ARCHITECTURAL DESIGN

The UV/hydrogen peroxide treatment system will be housed in existing Building 830. This building was previously used to house the Building 881 Isolated Power System. A sheltered storage area was subsequently erected adjacent to this facility to store gas bottles. The facility is now used as a storage shed and all previous mechanical equipment has been removed. As directed, the existing building was assumed to meet all existing design codes and standards for roof, floor and seismic loading and appropriate wind loads. The existing floor and equipment mounting pads will be removed. The new floor and equipment mounting pads have been designed for anticipated loads.

Remodeling consists of building an office/utility facility at one end of the existing building. This room will have an approximate area of 144 square feet and will be insulated and heated. The remainder of the building will house the treatment unit and hydrogen peroxide feed unit. The office/utility area will include a utility sink, an electric unit heater, a ventilator, and emergency eye wash/shower and a work bench and storage shelves. A new door and window will be installed into the treatment area and a new door will be installed to the exterior. The double door entrance to the existing building will be retained as the main entrance to the treatment area. The office/utility space will have insulated walls and ceiling with an R factor of 11. Cold water will be supplied to the laboratory space and electrical outlets will be supplied as appropriate. A sump shall be provided in the treatment area with pump discharge directed to one of the contaminated water influent tanks. Drainage from the utility sink facility will be routed to the nearest sanitary sewer. The safety shower/eye wash station has been designed in accordance with Rocky Flats Plant Standard SMU 101 and HSE 7.04.

1.12.1 Utility and Equipment Supports

Supports and anchorages for items such as pipes and electrical conduits and equipment are provided as required. All

supports are designed for the appropriate dead and live loads.

1.12.2 Finishes

Existing exterior building finishes and interior finishes in the treatment plant area will not be altered as a part of this work. Areas damaged by construction activities will be repaired in like and kind materials and finish. The new office/utility walls will consist of steel stud construction finished with 5/8 inch wall board sealed and primed and given two coats of an appropriate interior finish with color to be selected by Building Operations. Interior cabinetry will be given two coats of an appropriate white enamel paint. Metal, i.e. doors, shall be cleaned, primed and given two coats of paint consistent with environment and use. The floor of the laboratory area will be finished with floor tile.

1.13 STRUCTURAL DESIGN

Structural design elements of the work involve primarily the tank storage pad and secondary containment structure. The tank storage pad consists of spread footing foundations and pad to distribute overall loading within design guidelines as prescribed by the geotechnical design report. The pad will support four 15,000 gallon tanks. The pad will have side walls to act as a secondary containment for the contents of one tank. The design is consistent with current practice and standards.

Concrete reinforcement is designed and will be placed in accordance with Chapter 7 of ACI Standard 318. Reinforcement bars conform to American Society for Testing and Materials (ASTM) A-615.

1.14 MECHANICAL DESIGN

1.14.1 General

Mechanical design will include storage tanks, the treatment facility specification, hydrogen peroxide feed system specification (as a part of the GFE), the french drain sumps,

Building 881 foundation footing sump, well 1-88 and influent transfer pumps to the treatment unit.

1.14.2 Storage Tanks

Four tanks will be provided near the treatment unit. Two tanks shall be influent storage tanks and two shall provide effluent storage. The use of insulation on immersion heaters for these tanks has been included to prevent freezing. Horizontal ASME welded steel tanks have been selected and sized at 15,000 gallons each (9 feet in diameter by approximately 32 feet shell length.).

1.14.3 Treatment Plant and Hydrogen Peroxide Feed System

Refer to Section 3 for the Specification of these items.

1.14.4 Well 1-88

Well 1-88 will be provided with a submersible well pump of approximately 1/3 HP with a approximate 1" diameter riser pipe. The well shall be provided with a "pitless adapter" and the installation shall provide for replacement or servicing of the pump and motor. The pump selected is capable of delivering the total well capacity to the influent storage tanks.

1.14.5 Sump Pumps

The french drain collection sump shall be provided with two submersible sump pumps, each with sufficient capacity to deliver the entire discharge of the french drain to the treatment unit. The pumps will have level switches set so that one pump functions as a backup unit. Pumps will be equipped with fittings so that they may be removed for servicing or replacement without entering the sump.

The Building 881 foundation drain collection sump shall be mechanically equipped similar to the french drain collection sump.

All collection structures shall be equipped with totalizing flow meters with surface readouts mounted above the ground surface.

1.14.6 Influent Transfer Pumps

The influent tanks and piping is equipped with two floor mounted end suction centrifugal transfer pumps designed to transfer contaminated influent from the storage tanks to the treatment unit. The pumps are controlled from the treatment unit control panel and set so that one pump functions as a standby.

1.14.7 Building 830 HVAC

Building 830 HVAC system is designed to provide two zones compatible with the occupancies of both rooms. The treatment unit room is designed in accordance with the recommendations of the treatment equipment manufacturer. The office/utility space is insulated separately from other interior space. The office/utility room will maintain a minimum temperature of 69°F with a ventilating fan for summer use.

The treatment unit bay wi not be heated. Ventilation is provided by the existing ventilation louvers located above the existing double door entry.

1.15 PIPING

1.15.1 General

Piping covered under this section includes influent piping from the sumps to the influent storage tanks, piping to and from the storage tanks, piping from the effluent storage tank to the infiltration gallery and process and utility piping interior to Building 830.

1.15.2 Influent Piping

All below grade piping installed outside the known area of contamination (approximately 500 feet upgradient of the french drain) used to convey contaminated water to the

influent storage tanks is double wall containment pipe. Each collection sump (not including the Building 830 sump) is equipped with a check valve, a manual shutoff valve and a frost proof hydrant installed within five feet of the facility to allow sampling. In addition each sump in the collection system is equipped with a totalizing flow meter with above ground readout/indication on the sump pump control panel.

1.15.3 Transfer Piping

Transfer piping to and from the storage tank area and the treatment facility is single wall PVC solvent welded pipe below grade. Above grade pipe is galvanized steel which is heat traced to prevent freezing.

1.15.4 Effluent Piping

Piping from the treated effluent storage tank to the infiltration gallery is single wall below grade PVC pipe sized to accomodate expected peak flow. Above grade pipe is galvanized steel.

1.15.5 Utility Piping

Utility piping internal to Building 830 is sized to accommodate required flows. Below grade utility water piping is galvanized steel with a shutoff located inside the laboratory area. All utility water piping located within Building 830 is copper with soldered joints. Utility piping from the sump and drains to the influent tank is PVC.

1.16 ELECTRICAL

1.16.1 General

An electrical power supply system design is provided for the new treatment facility and the sump and well pumps. All electrical equipment is suitable for operation at 6,000 feet elevation. All electric installation meets current (latest edition) National Electric Code (NEC). New power lines are

installed to supply power to Building 830. New conduits are run in an orderly manner and grouped in banks wherever possible. Conduit is steel with appropriate fittings and connections.

1.16.2 Power Sources

Power for the new treatment unit will be obtained from within Building 881, designation SWGR81-2. New conduit will be run from this panel to Building 830. An existing conduit and cables currently provide power to the Building 830 lighting panel and appears to be adequate for building utility lighting and power receptacles. This system will remain in service.

Power for collection stations will be provided through buried cables from Building 830.

1.16.3 Motors

All motors are rated at 6,000 feet above mean sea level and are provided with an insulation Class B or F. Motors have a minimum rated service factor of 1.15 and are selected based upon intended use and type of service. Motors smaller than 1 HP are furnished with lubricated for life bearings. Motors used with pumps are provided as an integral assembly with the pump under a single supplier responsbility. Compatibility of pumps and motors are the responsibility of the single supplier.

1.16.4 Lighting and Receptacles

Power for lighting and receptacles will be provided as described in Section 2.9.2. Existing flourescent lighting in Building 830 will be rearranged and removed as required to support the treatment plant installation and the new laboratory area. Likewise, existing receptacles will be rearranged or removed to accomodate new facilities. Receptacles are equipped with ground fault interrupters.

1.16.5 Grounding

A grounding conductor will be pulled through all conduits per Rocky Flats Standard SE-103, "Electrical Wiring". The new treatment system will be grounded to the existing Building 830 grounding system.

1.16.6 Wiring and Identification

Wiring will be in accordance with Rocky Flats Standard SE-103, "Electrical Wiring". Electrical systems will be identified in accordance with Rocky Flats Standard SE-104, "Identification of Electrical Systems". Wire markers will be provided at the ends and intermediate pull boxes and junction boxes of each single conductor; multiconductor cable jacket and each individual conductor; shielded cable jacket; and multicable jacket and each individual cable. Each wire marking will be unique and of a developed system which may be carried throughout the entire building facility.

1.17 ALARMS AND INSTRUMENTATION

1.17.1 General

Instruments are industrial grade equipment from established manufacturers; state of the art type instruments are provided. Selection of instruments was based on maintainability, provisions for field calibration, flexible operating characteristics, and materials of construction.

In general, high level alarms are provided on all tanks and malfunction alarms are provided for all pumps.

1.17.2 Treatment Plant Control Panel UCP-1

The UV/hydrogen peroxide treatment unit is provided with a Unit Control Panel which provides for complete operation and control of the treatment plant functions in accordance with the manufacurers requirements and includes: high temperature alarms and shutoffs for the reactor vessel and lamp drive unit, temperature gauges for the reactor vessel and lamp

drive unit, high pressure shutoff and alarm for the reactor vessel and pressure gauge for the reactor vessel, a lamp drive moisture indicator and shutoff, a low flow indicator and shutoff, high and low water level (from probes in the influent tanks) alarm and shutoff, a high water level alarm and shutoff (from a probe in the effluent tank), integrated transfer pump control and hydrogen peroxide feed unit control, run time indicator, instantaneous and totalizing flow indicator, amperage and on/off switches for each lamp or banks of lamps, an adjustable flow control valve, and a solenoid shut-off valve. UCP-1 is also equipped with a tank selector switch indicating which influent tank is being used (manually selected by the operator) and connecting the appropriate probes to the alarm and shutoff circuits. Refer to Section 3 for unit specifications.

1.17.3 Hydrogen Peroxide Unit Control Panel UCP-2

The hydrogen peroxide feed control unit is operated and controlled from the treatment plant unit control panel, UCP-1. Individual on/off/auto switches are provided for each metering pump. In the auto mode, control will be from UCP-1. Refer to Section 3 for equipment specifications.

1.17.4 Building 830 Control Panel MCC-1

The main control center for Building 830 will include a main power switch and switches for UCP-1 and UCP-2 in addition to switches for the transfer pumps, office unit heater and fan motor and Building 830 sump pumps.

1.17.5 Sump Pump Control Panels

Each collection sump pump shall be equipped with an above ground control panel with an on/off/auto switch. Also included in the remote control panel will be the flow totalizer. Collection sump pumps will be configured to be selectable between active and standby. The active pump shall be controlled by level sensors, with a low water shutoff and

a high water on. The control panel will be housed in a NEMA 3R weather tight enclosure.

1.17.6 Well 1-88 Control Panel

The control panel for well 1-88 shall be similar to that described for the sump pumps in Section 2.10.5, except that only one submersible pump will be installed and hence no active/standby switching is necessary. Pump operation shall be controlled by a low water shutoff and a high water on probe installed in the well casing.

1.17.7 Building 830 Sump Pumps

The sump in Building 830 shall be controlled similar to those described in Section 2.10.5 except that the control panel shall be mounted in conjunction with MCC-1 in Building 830 and no flow indication will be provided.

1.17.8 Tank Level Indication and Pump Alarm Panel MCP-1

The two influent storage tanks shall be equipped with both high and low water level probes. The probes shall provide a high and low water signal to MCP-1 and UCP-1 respectively, and, depending upon which tank is selected at UCP-1, shall provide a low water (unit shutoff) signal at UCP-1 or a high water (alarm) signal at MCP-1. The effluent tanks will be equipped with a high water probe to be connected to UCP-1 and MCP-1 and shall provide a high effluent level alarm and signal equipment shutdown. Additionally, a conductive strip level element and level indicator will be provided for each tank with the indicators mounted on MCP-1. Sump and well pump malfunction will be sent via buried cable to MCP-1 with indicators signaling the location of the alarm. All alarm signals will activate an automatic rotary type telephone dialer to alert the appropriate personnel of the alarm condition.

1.18 FIRE PROTECTION

Fire protection for Building 830 and the laboratory area is provided by installation of two 25 pound dry chemical type extinguishers, wall mounted, in the treatment unit area and in the laboratory area.

All mandoors are provided with illuminated exit signs in accordance with Rocky Flats Plant Standard SE-204.

The building is non-combustible construction throughout and will normally be unoccupied. Combustible contents, other than minimal necessary files and records, shall not be maintained within the building.

SECTION 2
TECHNICAL SPECIFICATIONS

TABLE OF CONTENTS

08210 Wood Doors

08500 Metal Windows

08700 Hardware and Specialties

08800 Glazing

Division 9: Finishes

09250 Gypsum Drywall

09650 Resilient Flooring

09900 Painting

Division IO: Specialties

10210 Wall Louvers

Division 11: Equipment

11605 Utility Room Furniture

Division 15: Mechanical

15050 Equipment Installation

15060 Piping and Appurtenances

15099 Process Valves

15140 Pumps

15175 Tanks

15180 Insulation

15400 Plumbing

15800 Heating and Ventilating

Division 16: Electrical

16010 Electrical

165050 Basic Materials and Methods

16140 Wiring Devices

16150 Electrical Power Equipment

16160 Panelboards

16450 Grounding

16460 Transformers

16492 Underground Electrical Service

16510 Lighting Fixtures

16600 Special Systems

16700 Heat Tracing

Division 17: Process Instrumentation, Controls and Monitoring

17000 Process Instrumentation and Control System

17220 Leak Detection System

17550 Automatic Telephone Dialer

Division 19: Special Construction

19000 Extraction Well 1-88

SECTION 01100
SPECIAL CONTRACT REQUIREMENTS

01101 LOCATION OF WORK

The work covered by this contract will be performed at the Rocky Flats Plant, near Denver, Colorado. (See Location Map and Area Plot Plan as shown on the drawings.) This facility is one which is owned by the Government and operated on behalf of the DOE by Rockwell International.

01102 SCOPE OF WORK, PERFORMANCE OF WORK BY CONTRACTOR

This contract covers the furnishing of all plant, labor, equipment, supplies, and materials and performing all work in strict accordance with the terms of the contract.

The Contractor shall perform on the site and with his own organization work equivalent to at least 20 percent of the total dollar amount of work to be performed under the contract. If during the progress of the work hereunder, the Contractor requests a reduction in such percentage and the Buyer determines that it would be to the Buyer's advantage, he may, in writing, authorize a reduction.

01103 CONTRACT DRAWINGS AND SPECIFICATIONS

The Contractor will be furnished, without charge, 10 sets of specifications and half-sized drawings, one full-size set, and one full-size reproducible. The drawings which constitute a part of the contract documents are as indexed at the end of these specifications.

01104 ABBREVIATIONS

Abbreviations contained in various sections of the specifications refer to the following organizations, societies, associations, standards, publications, terms, etc.

AASHTO	American Association of State Highway and Transportation Officials.
ACI	American Concrete Institute.
AGA	American Gas Association.
AGMA	American Gear Manufacturers Association.
AIMA	Acoustical and Insulating Materials Association.
AISC	American Institute of Steel Construction, Inc.
AISI	American Iron and Steel Institute.
AMCA	Air Moving and Conditioning Association, Inc.
ANSI	American National Standards Institute.
APA	American Plywood Association.
API	American Petroleum Institute.
ASCE	American Society of Civil Engineers.

ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers.
ASME	American Society of Mechanical Engineers.
ASTM	American Society for Testing and Materials.
AWI	Architectural Woodwork Institute.
AWPB	American Wood Preservers Bureau.
AWPI	American Wood Preservers Institute.
AWS	American Welding Society.
AWWA	American Water Works Association.
CBM	Certified Ballast Manufacturers.
CLFMI	Chain Link Fencing Manufacturers Institute.
CRSI	Concrete Reinforcing Steel Institute.
CS	Commercial Standard, US Department of Commerce.
ETL	Electrical Testing Laboratories.
Fed Spec	Federal Specification.
HI	Hydraulics Institute.
ICBO	International Conference of Building Officials.
IEEE	Institute of Electrical and Electronic Engineers.
IPCEA	Insulated Power Cable Engineers Association.
MIL-	Military Specification (leading symbol).
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry.
NAPF	National Association of Plastic Fabricators.
NEC	National Electric Code.
NEMA	National Electrical Manufacturers Association.
NFPA	National Fire Protection Association.
NSF	National Sanitation Foundation.
NWMA	National Woodwork Manufacturers Association.
OFCI	Owner-Furnished Contractor-Installed.
OFCR	Owner-Furnished Contractor-Relocated.
OSHA	Occupational Safety and Health Administration, U.S. Department of Labor, as defined in the General Conditions.
PCA	Portland Cement Association.
PDI	Plumbing and Drainage Institute.
PS	Product Standard, U.S. Department of Commerce.
SDI	Steel Deck Institute.
SJI	Steel Joist Institute.
SMACNA	Sheet Metal and Air-Conditioning Contractors. National Association.
SPR	Simplified Practice Recommendations, U.S. Department of Commerce.
UBC	Uniform Building Code.
UL	Underwriters' Laboratories, Inc.
WCLIB	West Coast Lumber Inspection Bureau.
WIC	Woodwork Institute of California.
WWPA	Western Wood Products Association.

01105 SECURITY MEASURES

a. The Contractor shall furnish to the Buyer a letter listing all Contractor organizations; any deviations from the normal workday or workweek at the Rocky Flats Plant; names, dates of

birth, height, color of eyes and hair, and citizenship status of Contractor and Subcontractor personnel who require access to specified construction areas. Access will be granted for the period of performance of work. The Buyer shall be notified of the termination of employment of individuals submitted for access. The Buyer reserves the right to exclude from the worksite any employee as deemed appropriate. Access to the plant site will not be granted to persons who are not citizens of the United States of America.

b. The Buyer shall issue each Contractor individual security badges (passes) and parking permits for access to the plant. All badges and parking permits are accountable property of the U.S. Government and must be returned to the designated guard gate at the end of each day. Failure of the Contractor to return all badges and parking permits could result in a delay of contract closing.

c. The work under this contract will be performed in security areas and employees will be subject to security controls required by the DOE. Contractor employees who possess a DOE personnel security clearance will be permitted access to the security areas under special controls. The Contractor shall arrange for access with the Buyer.

d. No uncleared Contractor personnel will be permitted within security areas without security escorts. These escorts will be furnished at no cost to the Contractor; however, a 24-hour advance notice of the Contractor's access requirements is necessary.

e. The Contractor shall schedule his work so as to minimize the number of security escorts required.

f. <u>"Q" Access Authorization Requirements</u>

Personnel with "Q" access authorization will be required for Building 881 and compound area.

g. For personnel requiring "Q" access authorization, the Buyer will furnish the necessary security forms (for the Contractor's personnel to complete) and all required investigations incidental to obtaining access authorizations, at no cost to the Contractor. Such action normally requires 150 to 180 calendar days. The Buyer reserves the right to limit the number of "Q" access authorizations to be processed by each craft or to require additional access authorizations if deemed necessary to properly prosecute the project.

h. All persons receiving access authorizations will be subjected to lectures, badging, and miscellaneous administrative actions, estimated to take approximately 4 hours per man. All costs for the time involved as a result of these actions shall

be borne by the Contractor, whether it involves more or less time than estimated above. All persons being terminated from "Q" access authorization work on this contract, whether by reason of completion of assigned work or for other reasons, will be required to attend security lectures and sign affidavits regarding treatment of classified information which may have been accumulated while on the project. Termination procedures will require approximately 15 minutes per man. All costs for the time involved will be borne by the Contractor.

i. If the Contractor cannot obtain sufficient personnel having "Q" access authorizations to complete work on this contract, the Contractor may apply for an extension of the contract time to allow for the processing of the required access authorizations.

j. Neither DOE's denial of a "Q" access authorization to the Contractor's employee, nor DOE's termination of a "Q" access authorization previously granted to such employee shall be the basis for an extension of the contract period or for an increase in the contract price.

k. Security forms to obtain "Q" access authorizations for Contractor personnel shall be returned to the Buyer, filled out as required, within 7 days after Notice to Proceed. Failure to return properly completed forms, within the time limit, may be cause for termination of contract.

01106 HEALTH SCIENCES MEASURES

a. Portions of the work under this contract will be performed in areas subject to Rocky Flats Health, Safety & Environment rules and regulations as specified below.

All persons requiring access to these areas will be subjected to lectures and administrative actions which are estimated to take approximately 3 hours per man. All costs for the time involved as a result of these actions shall be born by the Contractor, whether it involves more or less time than that estimated above.

b. Reimbursement for Equipment Retained by the Buyer:

1. Tools and equipment shall be monitored prior to being removed from construction areas.

2. Any tools or equipment which are determined by the Buyer to be unsuitable for future use after having been monitored by the Buyer's Radiation Monitoring personnel will be retained by and disposition made by the Buyer.

3. Reasonable compensation will be made for any tools or equipment which are retained by the Buyer. The

Contractor shall immediately notify the Buyer in writing of the value which he places on the tools and/or equipment and the basis for such valuation.

c. Specific Requirements

1. Building

Contractor personnel working inside this building will be required to participate in programs designed to measure radionuclide exposure.

Two body counts will be required of each worker assigned to this building (additional body counts may be required at the discretion of Radiation Monitoring). One count will be required immediately prior to starting work in the building and the other will be required when all work on this project is completed. Each body count will require approximately 1 hour, which will be in addition to the previously mentioned lectures and administrative actions. Urine samples may be requested by the Health Sciences Department in cases of possible exposure or as an alternative to body counting.

Working personnel inside this building also shall be required to wear protective clothing furnished by the Government, consisting of:

(a) Shoe covers and shoes
(b) Coveralls
(c) Dosimetry badges
(d) Gloves
(e) Respirators

It is estimated that the use of respirators may be required approximately ___ percent of the time while working in designated areas.

Personnel using respirators shall limit the growth of facial hair or such persons will not be allowed to work in the restricted area.

(f) Underclothing

(g) In order to comply with the requirements of ANSI Z88.2, 1980, paragraph 3.5.3, a current (within a year) medical statement is required approving physical suitability of contractor personnel that will be required to wear respiratory protection equipment. A physician's approval must be presented in writing prior to the time the person is to be fitted for the respirator.

2. Contractor personnel working demolition on this project will be required to participate in programs designed to establish safe removal and disposal of asbestos materials. These procedures are addressed in Technical Provision 02075, "Removal and Disposal of Asbestos Materials."

3. Protective clothing required for Contractor's nonworking supervisory personnel entering areas for short periods will be shoe covers, respirators, and dosimetry badges.

4. Any person moving from a plutonium, uranium, or beryllium area to a nonplutonium, nonuranium, or nonberryllium area within this building shall monitor himself at the boundary between the two areas. Any person moving from a plutonium, uranium, or beryllium area to a nonplutonium, nonuranium, or nonberyllium area with the intention of leaving the building shall have himself monitored.

5. All persons required to wear protective clothing will be required to take a shower at the close of each work day in shower facilities provided by the Buyer. Towels and lockers will be furnished by the Buyer.

6. Food, beverages, and tobacco are not permitted in the construction areas of this project.

7. Radiation Monitoring coverage will be provided by the Buyer on an as-required basis, except that a radiation monitor will be present during all demolition or removal operations.

01107 SEQUENCE OF CONSTRUCTION

The Contractor shall arrange his schedule such that, when work is started, work will proceed promptly and vigorously to completion. The Buyer may require the Contractor to show satisfactory proof that materials, equipment, workers, etc., are or will be available as require to complete the work without undue delay.

The following sequence of construction shall be followed:

a. Construction of Treatment Facility and related building modifications located in Building 830 complete with all piping, electrical, and necessary appurtenances to result in a complete and operable facility; and construction of tank storage pad and installation of all tanks, piping, and valving leading to and from treatment facilities at Building 830.

b. This work shall be completed, inspected, and accepted for use by Owner prior to construction, specifically

dewatering, of any remaining facilities. This is to enable treatment of all collected ground water during construction of pipeline, French Drain and Infiltration Gallery facilities.

c. Upon acceptance of facilities described in paragraph "a" above, the Contractor may proceed with all remaining items. During dewatering operations, the Contractor is responsible to collect, transport (pump or truck), treat (Buyer will furnish labor, materials, and utilities) and dispose of (via a temporary connection to the Building 881 drain area) all ground water collected and removed from construction excavations.

01108 HEALTH AND SAFETY

In addition to the requirements of GP-23, the following safety items will be emphasized and enforced:

a. Ladders

1. No three-legged ladders will be allowed.

2. No wooden ladders will be allowed in any building.

3. Aluminum ladders will not be allowed for work in areas where there is electrical power equipment or in Building 830.

4. Industrial fiberglass ladders will be allowed.

b. All contractors shall comply with NFPA 241 (Safeguarding Building Construction and Demolition Operations).

c. All workmen will be required to wear hard hats. All visitors to posted construction areas will be required to wear hard hats.

d. All compaction performed with vibratory equipment will be performed by workmen wearing approved foot protection devices.

e. All Contractor personnel will wear shirts, long pants, and shoes on the plant site.

f. A lift device known as the "Xtraman Hoist" or any lifting devices where, by design, the operator or any other person is used as the ballast or counterweight of the device is not to be used on construction projects at the Rocky Flats Plant.

g. Smoking restriction shall be as posted.

h. Safety meetings shall be held weekly.

01109 MEDICAL RADIOISOTOPE PROCEDURES ON CONTRACTOR PERSONNEL

All persons engaged in construction at the Rocky Flats Plant are required to report any diagnostic or therapeutic treatment with radioisotopes to the Buyer. Personnel should report prior to treatment, if possible, or immediately after such treatment when they return to work.

01110 MONTHLY EMPLOYMENT UTILIZATION REPORT

Contractors using crafts subject to Part I of the Colorado Statewide Plan and/or subject to mandatory goals and ranges of Part II should submit Form CC-257 (Monthly Employment Utilization Report) no later than the 20th day of each month to:

Denver Area Office Director
OFCCP/ESA
2500 Curtis Street - Suite 100
Denver, CO 80205

01111 ROOF PROTECTION

Personnel requiring access to the roofs of various buildings shall comply with the following requirements:

a. Temporary walkways will be installed to and around any work areas.

b. Material will not be set on the roof surface unless suitable protection is provided for the roof surface.

c. All scrap and excess material must be removed daily when the work or exercise is complete.

01112 PRIVATELY OWNED RADIO PAGERS

Security regulations do not allow the use of privately owned radio pagers at the Rocky Flats Plant except in areas designated as "controlled," such as the warehouse, maintenance shops, garage, etc. Pagers must also be left in privately owned vehicles when entering any area that is not a "controlled" area.

01113 HOLIDAY WORK CURTAILMENT

During the holiday periods covering the days from November 24, 1988, through November 27, 1988, and from December 25, 1988, through January 1, 1989, Construction Contractor activities will be suspended. Subcontractors shall plan their work

accordingly. Access to the plant site during these time periods will be by special arrangement with the Buyer only.

01114 ACCESS TO BUILDING 830 AND STORAGE TANK AREA

The Buyer is responsible for permitting the Contractor to temporarily relocate the Building 881 security fence to allow access to Building 830 and the storage tank area for the duration of construction activities. Relocation and replacement are at the expense of the Contractor, shall be coordinated with the requirements of the Buyer, and shall be in accordance with Buyer's security fencing standards.

END OF SECTION

SECTION 01300
SUBMITTALS

01301 GENERAL (Refer to GP-2)

a. Shop drawings, catalog data, equipment and material lists, elementary diagrams, wiring diagrams, installation instructions, maintenance manuals and instructions, and operation brochures shall be submitted for the items of equipment and materials in accordance with the coded legend herein within the time specified unless otherwise directed by the Buyer. If materials or equipment are required and are not specifically listed therein, the most closely related item listed will govern the type of submittals required. The submittal shall include a typewritten list showing each item and manufacturer for approval and shall be submitted concurrently with all equipment which forms a system or subsystem that must be reviewed simultaneously because of coordination requirements. These submittals shall be corrected to "as-built" conditions prior to the completion of the project and turned over to the Buyer. Catalogs for submittal shall have unrelated pages removed with capacities and specified parameters relating to the item or items clearly marked. The maintenance manuals and instructions shall indicate routine-type work defined by step-by-step instructions that should be performed to insure long life and proper operations; the recommended frequency of performance is also to be included. Instructions should include possible trouble spots with diagnosis and correction of each. These manuals shall be turned over to the Buyer at the completion of the project. The theory of operation brochures shall describe the function of each component or subassembly in block-diagram-type presentation to a degree that a mechanic will understand the product well enough to operate and maintain it. These brochures will be submitted to the Buyer at the completion of the project.

b. The Contractor shall submit to the Buyer, for review, copies as required by the Buyer or descriptive submittals (as described in paragraph a., above) for all items he proposes to use in the project, complete, containing all required detailed information. After approval has been indicated on each copy by appropriate signature, stamp, and date, three or more copies will be retained by the Buyer and the balance will be returned to the Contractor.

c. Approval of descriptive submittals will not relieve the Contractor of the responsibility for correcting any errors which may exist or for meeting requirements of the specifications. No partial submittals will be accepted.

d. If required, samples and descriptive data shall be submitted within the time specified in these specifications, or if no time is specified, within a reasonable time before use to permit inspection and testing; and shall be shipped prepaid and delivered as specified in these specifications and shall be properly marked to show the name of the material, trade name of manufacturer, place of origin, name and location of work where the material represented by the sample is to be used, and name of Contractor submitting the sample. Samples not subject to destructive tests may be retained until completion of the work, but thereafter will be returned to the Contractor, if he so requested in writing, at his own expense. Failure of any samples to pass the specified requirements will be sufficient cause for refusal to consider further any samples from the same manufacturer whose materials failed to pass the tests. Written authorization of the Buyer is required for inclusion into the work of items proposed to be substituted in lieu of those specified or referenced. (See the clause of the General Provisions entitled "Materials and Workmanship.") The opinion of the Buyer relating to the equality of items shall be final. Any changes required in the details and dimensions indicated on the drawings as a result of approved substitution shall be properly made, as approved by the Buyer and at the expense of the Contractor. If the Contractor fails to submit for approval the required data within the specified time in accordance with the preceding paragraph, the Buyer will select a complete line of materials and/or equipment. If the Contractor submits for inclusion in the work materials and/or equipment not in accordance with the specifications, the Buyer will have the right to reject them and select a full line of materials and/or equipment. The selection made by the Buyer will be final and binding and the items shall be furnished and installed by the Contractor without change in the contract price.

e. This provision shall be deemed superseded to the extent of conflict, if any, between this provision and any provision in the technical sections of the specifications.

01302 SPECIFIC REQUIREMENTS

a. Descriptive submittals shall be made for the items of equipment and materials set forth in the following tables within 30 calendar days after receipt of Notice to Proceed. Submittals marked with an asterisk must be in reproducible form, the same size and scale as the Contract Drawings, or as directed. The Buyer will issue,

upon request, 22-inch by 34-inch Mylar drafting media for the above work. Submit eight complete sets for each submittal item, except fire equipment items. Submit ten complete sets for each fire equipment item. One reproducible set of drawings may be submitted in lieu of the multiple sets of drawings required with the above.

LEGEND

a. Shop Drawings
b. Catalog Data
c. Equipment List
d. Material List
e. Elementary Diagrams and Wiring Diagrams
f. Installation Instructions
g. Maintenance Instructions
h. Operating Instructions
i. Samples, Colors
j. Certifications
k. Performance Curves
l. Design Data
m. Recommended Spare Parts Lists
n. Computations

b. The Contractor shall submit all forms, data, information, certificates, schedules, etc., as required in other sections of the specifications. Omission of an item from the above tabulation does not relieve the Contractor from the responsibility for submitting the items required.

PART II: PRODUCTS - NOT USED

PART III: EXECUTION

3.1 SUBMITTAL-GENERAL REQUIREMENTS

The Contractor shall submit to the Buyer for its review and approval all shop drawings, samples, materials lists, equipment data, test plans, instruction manuals, record documents, manufacturers' equipment manuals, and other submittals required by the Contract Documents and herein, or subsequently required by Modifications. All such items required to be submitted for review shall be furnished by and at the expense of the Contractor and any work affected by them shall not proceed without such review. Submittals and their contents shall be properly prepared, identified, and transmitted as provided herein or as the Buyer may otherwise direct. Except for record documents, test plans, and instructional manuals for operation and maintenance, submittal shall be approved before the materials or equipment covered by the submittal is delivered to the site. The progress schedule required under General Conditions, Article 2 - Preliminary Matters, shall be coordinated to this requirement.

A. Submittal Review Time. Not less than 30 days shall be allowed for the review of submittals, not including the time necessary for delivery or mailing, and shall cause no delay in the work. Extension of the Contract time will not be granted because of the Contractor's failure to make timely and correctly prepared and presented submittals with allowance for the checking and review periods.

B. Deviations. At the time of the submission, the Contractor shall give notice in writing in the submittal of any deviation from the requirements of the Contract Documents. The deviations shall be clearly indicated or described including all other changes required to correlate the work. The Contractor shall state in writing all variation in costs occasioned by the deviations and his assumption of the cost of all related changes if the deviation is approved. Requirements stated in Paragraph E below shall also apply.

C. Method of Submittal. The Contractor shall deliver submittals by means of dated, signed, and sequence numbered transmittals on the Buyer provided forms, identifying as to initial or resubmitted status, and fully describing the submittal contents. Equipment which is specified in one section of the Specifications shall not be combined in a single submittal with equipment specified in other Sections of the Specifications. Submittals are not acceptable directly from Subcontractors, suppliers, or manufacturers. In each transmittal the Contractor shall state the Buyer's Project Number and name, name and address of Contractor, name and address of Subcontractor, Manufacturer, Supplier or Distributor as applicable, Plan Reference and Specification Section, Articles, and paragraphs to which the submittal pertains; accompanying data sheets, catalogs, and brochures shall be identified in the same manner. Where several types or models are contained in the literature the Contractor shall delete non-applicable portions or specifically indicate which portions are intended and applicable. Submittal transmittals shall fully index all items submitted.

1. Incomplete Submittals. Including those not correctly transmitted, not correctly titled and identified, or not bearing the contractor's review and approval stamp, will be returned to the Contractor without review.

2. Interrelated Submittals. Except where the preparation of a submittal is dependent upon the approval of a prior submittal, all submittals pertaining to the same class or portion of the work shall be submitted simultaneously.

D. Contractor's Review and Approval. Every submittal of shop drawings, samples, materials lists, equipment data, instruction manuals, and other submittals upon which the proper execution of the work is dependent shall bear the

Contractor's review and approval stamp certifying that the Contractor (1) has reviewed, checked, and approved the submittal and has coordinated the contents with the requirements of the work and the Contract Documents including related work, (2) has determined and verified all quantities, field measurements, field construction criteria, materials, equipment, catalog numbers, and similar data, or will do so, and (3) states the work covered by the submittal is recommended by the Contractor and the Contractor's guarantee will fully apply thereto. The Contractor's stamp shall be dated and signed by the Contractor in every case.

E. Review and Approval. Submittals will be reviewed only for conformance with the design concept of the Project and with the information given in the Contract Documents. The approval of a separate item as such will not indicate approval of the assembly in which the item functions nor shall approval be construed as revising, if any way, the requirements for a fully integrated and operable system as specified. The approval of submittals shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents or for any revision in resubmittals unless the Contractor has given notice in writing of the deviation or revision at the time of submission or resubmission and written approval has been given to the specific deviation or revision, nor shall any approval relieve the Contractor of responsibility for errors or omissions in the submittals or for the accuracy of dimensions and quantities, the adequacy of connections, and the proper and acceptable fitting, execution, and completion of the work.

F. Corrections and Resubmittals. The Contractor shall make all required corrections and shall resubmit the required number of corrected submittals until approved on a Buyer provided form. The Contractor shall direct specific attention in writing to revisions other than the corrections called for on previous submittals, and shall state in writing all variations in costs and his assumption of the cost of related changes the same as is required for deviations in 1.1B. Identify each resubmittal with number of the original submittal followed by consecutive letters starting with "A" for first resubmitted, "B" for second resubmitted, etc. The Buyer reserves the right to deduct moneys from the amounts due to Contractor to cover the cost of its review time beyond the second submission.

G. Check of Returned Submittals. The Contractor shall check submittals returned to him for correction and ascertain if the corrections result in extra cost to him above that included under the Contract Documents, and shall give written notice to the Buyer within five days if, in his opinion, such extra cost results from corrections. By failing to so notify the Buyer or by starting any work covered by a submittal, the

Contractor waives all claims for extra costs resulting from required corrections.

H. Conformance. No work represented by required submittals shall be purchased or commenced until the applicable submittal has been approved. Work shall conform to the approved submittals and all other requirements of the Contract Documents unless subsequently revised by an appropriate modification, in which case the Contractor shall prepare and submit revised submittals as may be required. The Contractor shall not proceed with any related work which may be affected by the work covered under submittals until the applicable submittals have been approved, particularly where piping, machinery, equipment, concrete work and the required arrangements, embedments, and clearances are involved.

I. Piecemeal Submittals. Except for reinforcing steel submittals, piecemeal submittals will be returned unreviewed. However, for mechanical equipment and the like, separate submittals for embedded items, embedded metal work and anchors will be reviewed.

1.2 CPM PROGRESS SCHEDULE

Refer Section 01310, Critical Path Schedule, as it concerns Construction Schedule and required use of Critical Path Method (CPM).

1.3 SHOP DRAWINGS

Each submittal shall be complete with respect to dimensions, design criteria, materials, connections, bases, foundations, anchors,and the like, and shall be accompanied by technical and performance data as necessary to fully illustrate conformance with the Contract Documents. Unless otherwise specified, each submittal shall include one set of reproducible copies or two sets of black-line printed copies. The printed copies, one for Buyer and one for its Engineer, shall be submitted folded to 8-1/2 in. x 11 in. size. The reproducible set will be returned to the Contractor marked to show the required corrections or approval. For catalogue cuts and the like which are 8-1/2 x 11 inch format provide no less than four (4) copies of which three will be retained by the Buyer and its Consultant.

A. Title Block and Identification. On each shop drawing, provide a space for the Consultant's approval or correction stamp and a title block showing the following:

1. Name and address of Contractor.
2. Name and address of Subcontractor, manufacturer, supplier, or distributor, as applicable.
3. Name and address of Buyer.
4. Date, scale of drawings, and identification number.

5. Contractor's review and approval stamp.
6. Buyer's number.
7. Plan reference and specification section reference.
8. Project name.

B. Preparation and Size. Details and information shall be clearly drawn, dimensioned, noted, and cross referenced. Unless otherwise approved, prepare shop drawings of the same size as the Contract Drawings or on 8-1/2 by 11 inch sheets as applicable.

C. Data. Unless the following data is included in instruction manuals or equipment data submitted prior to or with the shop drawings, submit with the shop drawings complete catalog and technical data for all manufactured products, materials, machinery, and equipment covered by the shop drawing submittal. Include data showing for each item, as applicable, the following information:

1. Manufacturer's specifications and details.
2. Applicable technical data and performance curves.
3. Preparation, assembly, and installation instruction with allowable tolerances.
4. Connection requirements.
5. Pre-startup servicing and operating methods.
6. Other data and information necessary to demonstrate that the proposed items conform to the Contract Documents.

D. Information Required. Shop drawings shall contain details and information fully developing the pertaining Contract Document requirements and such other information as may be specified or required for approval, including but not limited to:

1. Related work with cross references to applicable portions of the Contract Documents.
2. Dimensions including variations between indicated dimensions and actual conditions.
3. Physical configurations with critical dimensions for clearance, access, and servicing.
4. List of materials including fasteners and connectors.
5. Structural construction and assemblies, welds shown by AWS symbols, and each fastener and connector shown on type and class.
6. Grouting work, including grouting space and material.
7. Concrete foundations and bases for machinery and equipment including joints, joint filler and sealer, and reinforcing.
8. Anchor bolt details showing type and class, sizes, embedments, projections, and locations measured with respect to permanent structural features. An anchor bolt template shall be shown on the Shop Drawings and shall be furnished unless waived in writing by the Buyer.

9. Protective coatings and factory finishes fully described as to materials, number of coats, plated and metallic coating finishes, treatments, and similar information, all based on specified requirements. The term "as specified" is not acceptable for this purpose.
10. Machinery and equipment details. Standard catalog items need not be illustrated in detail, but indicate and detail sizes, supports, and connections.
11. Location of auxiliary items that are parts of machinery and equipment included sight glasses, petcocks, gages, lubrication fittings and access, and maintenance monitoring devices.
12. Piping systems and piping including layout, fittings, valves, appurtenances,hangers and supports, and sleeves.
13. Electrical equipment showing plans, elevations, sections, arrangements, materials, anchor bolts, supports, weights, wiring and circuit diagrams, internal connections, busses, grounding, conduit spaces, layout of instruments, gages, meters, and other components.
14. Written descriptions fully describing the operation of all control circuits, start-up sequencing, shut down sequencing and alarms.
15. Underground duct banks showing typical details of conduits, joints, spacers, and means of securing conduits in place during concrete placement.
16. Dielectric connections, and materials and methods to be used to isolate aluminum from dissimilar materials.
17. Full-size lettering layouts for data plate and nameplate inscriptions.

E. Details and Connections. Satisfactorily detail all connections required to complete the work, including details necessary to make indicated or specified additions to existing work or to provide connections for future work. Design connections and parts of strength to withstand, without adverse deflection or stress, all loads or pressures to which they may be subjected and to develop the strength of the members or parts connected. In no case shall the connections, parts, or details be inferior to those required by the Contract Documents.

F. Related Work. The term "by others" is not acceptable for the description of related work shown in the shop drawings. Clearly note by name or description the Contractor, Subcontractor, or trade to provide such related work; where such name or description is missing, it shall be understood and agreed that the Contractor is to furnish and install such related work.

G. Clearances. Do not proceed with any related work that may be affected by piping, machinery, equipment, or other work therein until shop drawings and data showing all components with acceptable clearances have been approved.

H. Composite Shop Drawings With Installation Layouts. Prepare and submit drawings, wherever specified or required, to resolve tight or conflicting field conditions. Show dimensional plans and elevations of the materials or equipment of all trades in the involved area or space, and include complete information as to arrangements, locations, clearances, avoidance of interferences, access, sizes, supports, connections, services, assembly, disassembly, and installation. Composite shop drawings and layouts shall be coordinated in the field by the Contractor and his Subcontractors for proper relationship to the work of all trades, based on field conditions, and shall be checked and approved by them before submittal. Contractor shall have competent technical personnel readily available for such coordinating and checking.

1.4 SAMPLES

Unless otherwise specified, each submittal shall include two sets of samples. One set of approved samples and all disapproved samples will be returned to the Contractor. Samples of value retained by the Buyer will be returned to the Contractor after completion of the work if the Contractor's first transmittal of the sample requests its return. Approved samples of manufactured items returned to the Contractor may be installed in the work if the location is recorded and the samples bear temporary identification as such.

A. Identification. Label or tag each sample or set of samples identifying the manufacturer's name and address, brand name, catalog number, intended use and other data specified in Article 1.1C herein.

B. Colors, Patterns, and Textures. For items required to be of selected and approved colors, patterns, textures, or other finish, submit sufficient samples to show the range of shades, tones, values, patterns, textures, or other features corresponding to the instructions and requirements specified.

C. Field-Applied Paint and Coatings. Submit samples of finishes at least 60 days prior to start of such finishing operations in conformance with requirements specified in Section 09900, Painting and Protective Coatings.

D. Factory Finish Colors. Colors of material specified to be furnished with a factory finish are subject to approval. Submit duplicate samples of factory finishes showing the full range of available colors for selection and approval when requested by the Buyer.

3.5 MATERIALS LISTS AND EQUIPMENT DATA

Materials lists and equipment data shall be submitted for all items proposed to be incorporated into the work. In determining acceptability, consideration will be given to the availability of maintenance and replacement parts and materials, the availability of manufacturer's technical representatives, other factors that related to the maintenance and repair of installed items without excessive inconvenience to the Buyer, guarantees and warranties, as well as determination of conformance with the Contract Documents.

A. Materials Furnished Under Standard Specifications. For materials specified by reference to standard or reference specifications, the Contractor shall prepare and submit for approval a list of such materials by manufacturer's names and identifications to the extent requested by the Buyer.

B. Material Lists. Submittal copies shall be neatly bound with sturdy labeled covers. Copies shall contain an index listing the contents. Loose submittals will be returned unreviewed. For each item listed, the Contractor shall include the manufacturer's name and address, trade or brand name, local supplier's name and address, catalog numbers and cuts, brochures, terms and conditions of manufacturer's guarantee and warranty, other information to fully describe the item, and supplementary information as may be required for approval. Cuts, brochures, and data shall be marked to indicate the items proposed and the intended use. Unless otherwise specified, each submittal shall include not less than four bound copies, three of which will be retained by the Buyer and its Consultant and the rest of which will be returned to the Contractor marked to show the required corrections or approval.

C. Equipment Data. The Contractor shall submit complete technical and catalog data for every item of mechanical and electrical equipment and machinery to be incorporated in the work, including components. Submittal copies shall be bound, indexed, and contain information as required in paragraph 1.5B for submittal of materials lists and shall further include specific information on performance and operating curves and data, ratings, capacities, characteristics, efficiencies, and other data to fully illustrate and describe the items as may be specified or required for approval, in particular, equipment incorporating logic circuits shall have a draft of a detailed theory of operation. Data shall be submitted in sets covering complete systems or functioning units. Unless otherwise specified, each submittal shall include not less than four bound copies, three of which will be retained by the Buyer and its Consultant and the rest of which will be returned to the Contractor marked to show the required corrections or approval.

1.6 INSTRUCTION MANUALS

The Contractor shall obtain data from the various manufacturers and submit instruction (operation and maintenance) manuals covering all mechanical equipment and machinery installed in the work.

A. Contents. Each manual shall have an index listing the contents. Information in the manuals shall include not less than (1) general, introduction and overall equipment description, purpose, functions, and simplified theory of operation, (2) specifications, (3) installation instructions, procedures, sequences, and precautions, including tolerances for level, horizontal, and vertical alignment, (4) grouting requirements including grout spaces and materials, (5) list showing lubricants for each items of mechanical equipment, approximate quantities needed per year, and recommended lubrication intervals; where possible, types of lubricants shall be consolidated with equipment manufacturers' approval to minimize the number of different lubricants required for plant maintenance, (6) startup and beginning operation procedures, (7) operational procedures, (8) shut down procedures, (9) short- and long-term inactivation procedures, (10) maintenance, calibration, and repair instruction, (11) parts lists and spare parts recommendations, (12) lists of all special tools, instruments, accessories, and special lifting and handling devices required for periodic maintenance, repair, adjustment, and calibration, (13) wiring diagrams and detailed circuit operation description, (14) performance curves and data and (15) other information as may be specified or required for approval.

B. Format and Organization.

1. Use drawings and pictorials to illustrate the printed text as necessary to fully present the information.

2. Where information covers a family of similar items of equipment, identify the applicable portions by heavy weighted arrows, boxes or circles, <u>or strike-out the inapplicable information</u>. Non-conforming data are not acceptable and will be returned for rework and resubmitted.

3. Contractor shall incorporate into books all Manufacturers' Equipment Manuals including those specified in pertinent sections of the specifications. These books shall be organized by Equipment Class in same manner and sequence as the specifications, i.e. Mechanical, Electrical, Instrumentation, etc. Book size and quantity shall be sufficient for inclusion of all data, and be of type and quality hereinafter specified in Article 1.6C.

4. Within each book of manuals, provide a Table of Contents for that book. If more than one book is necessary for a Class of Equipment, place a complete Table of Contents for that Class of Equipment within each book of that Class.

5. In addition, an overall Index of Contents shall be prepared in ten sets and submitted separately to the Buyer for his insertion in the Operation and Maintenance Manuals.

6. When a manufacturer's manual exceeds one inch in thickness and is bound as specified in Paragraph 1.6C it need not be rebound within another book, but the Overall Index shall refer to it by title and indicate that it is bound separately.

C. Manual Binding.

1. Bind all books in sturdy hard covers fastened to provide full view of contents on each page, and ease of making content additions or replacements. No book shall be more than four inches thick. Manuals less than one inch thick shall be bound in substantial three-ring loose leaf binders; others shall have rigid covers secured by operable locking-bars to permit full view opening with contents bound by hinged interfacing pairs of three-ring binding posts, as manufactured by McBee, Springfield, MO., or Inter-City, St. Louis, MO., Wilson Jones, or equal.

2. Permanently label face of cover and bound edge of each book "MANUFACTURERS' INSTRUCTION MANUAL," and indicate Class of Equipment, i.e., Mechanical, Electrical, Instrumentation, etc. or name specific equipment if a single unit is contained. Where more than one book is needed for a Class of Equipment or a single specific equipment unit, number books consecutively BOOK I, BOOK II, etc.

3. If more than one Class of Equipment is contained in a book, separate each class with a tabbed stiff divider insert page.

4. Prior to purchase or delivery, submit samples of each intended type of binder and obtain approval from the Buyer.

D. Manual Submittals. Submittals shall include two copies of each manual, one of which will be returned to the Contractor marked to show the required corrections or approval. When

approved, the Contractor shall deliver ten copies to the Buyer unless otherwise specified.

1.7 INSTALLATION INSTRUCTIONS

In addition to the instructions submitted under Article 1.6, the Contractor shall submit two copies of manufacturers' installation instructions for material and equipment incorporated in the work to the extent specified in other Sections and Divisions of the Specifications or requested by the Buyer for its review. Installation instructions will be reviewed for general adequacy only. After review, the Contractor shall distribute copies to all those involved with the instructions.

1.8 OTHER SUBMITTALS

Provide no less than four copies of other submittals such as calculations, manufacturer's certified reports, operational demonstration and system validation reports specified in other Sections and Divisions of the Specifications three of which will be retained by the Buyer and its Consultant and the rest of which will be returned to the Contractor marked to show the required corrections.

1.9 FORM OF APPROVAL

A. Copies of submittals which are returned to the Contractor and which are subject to approval will be marked with notations (a), (b), (c), or (d), and may also be marked with notation (e), in which case the action so indicated shall be taken by the Contractor.

(a) Approved subject to the Contract Requirements.
(b) Approved subject to changes shown and to the Contract requirements.
(c) Disapproved pending completion of corrections noted.
(d) Returned without complete review - incomplete submittal not in accordance with Contract Requirements.
(e) Special direction or comments.

B. Returned copies of drawings marked with either notation (a) or (b) authorize Contractor to proceed with the fabrication, installation or construction, or any combination thereof, covered by such returned drawings, provided, that such fabrication, installation or construction shall be subject to the comments, if any, shown on such returned copies. Although fabrication may proceed on a notation (b), Contractor shall incorporate the comments, resubmit, and obtain notation (a) before release for shipment can be granted.

C. Returned copies of drawings marked with notation (c) or (d) shall be corrected as necessary and revised drawings shall be submitted in the same manner as before.

D. Returned copies of drawings marked with either notation (c), (d), or (e) shall be resubmitted not later than 10 days after date of transmittal by Buyer of such copies of such drawings.

1.10 TOOLS, ACCESSORIES, SPARE PARTS, AND MAINTENANCE MATERIALS

The Contractor shall furnish and deliver all special tools, instruments, accessories, spare parts, and maintenance materials required by the Contract documents, and shall furnish and deliver the special tools, instruments, accessories,and special lifting and handling devices shown in the instruction manuals approved under Article 1.6. Unless otherwise specified or directed, the items shall be delivered to the Buyer, with the Contractor's written transmittal accompanying each shipment, in the manufacturers' original containers labeled to described the contents and the equipment for which it is furnished. Where specifically required in the Section covering the material the Contractor shall furnish a metal cabinet to house this equipment.

1.11 RECORD DRAWINGS AND SPECIFICATIONS

The Contractor shall maintain one record copy of all drawings, specifications, addenda, modifications, approved submittals, correspondence, and transmittals at the site in good order and readily available to the Buyer. The record drawings shall be clearly and correctly marked and the record specifications annotated by the Contractor to show all changes made during the construction process at the time the changed work is installed. No such changes shall be made in the work unless previously authorized by a modification or by specific approval of deviations or revisions in submittals.

A. Buried and Concealed Work. The Contractor shall record the precise location of all piping, conduits, ducts, cables, and like work that is buried, embedded in concrete or masonry, or concealed in wood or metal framed walls and structures at the time such work is installed and prior to concealment. Each feature of the concealed work, such as the beginning and end of straight runs, radius center point of curved runs, angles, connections, plugged tees or other fittings for future connections, and like items shall be accurately located but not less than two dimensions to permanent structures. The depth below finish grade, slab, or paving shall be noted for buried pipe, conduit, or ducts at the beginning and end of straight grade runs and at all grade change points, excepting sewer or drain lines between manholes. Should the Contractor fail to record such buried or concealed work, he shall uncover the unrecorded work to the extent required by the District and shall satisfactorily restore and reconstruct the removed work with no change in the Contract Price or the Contract Time.

B. Delivery. Upon completion and prior to final inspection of the work, and as a condition of final payment, the Contractor shall submit the record drawings and specifications to the Buyer for review, and shall make such revisions or corrections as may be necessary for them to be a true, complete, and accurate record of the work in the opinion of the Buyer. When approved, the Contractor shall deliver the record drawings and specifications to the Buyer.

1.12 REVISION OF SUBMITTALS

Whenever a modification causes a change to the information contained in previously approved submittals, the Contractor shall submit information and data corresponding to the changed requirements for approval. After completion of the operational test required in Section 01005, General Mechanical and Equipment Provisions, the Contractor shall submit revised or additional information and data for the instruction manuals and equipment data as the buyer may require. Revision submittals shall be submitted following the procedures required for previously approved submittals.

END OF SECTION

SECTION 01500
TEMPORARY FACILITIES, CONTROLS, AND SPECIAL PROJECT REQUIREMENTS

01501 FIRE PROTECTION SYSTEMS

The fire protection extinguishers shall be installed by the Contractor when the Ultraviolet Light/Peroxide Treatment Module is installed in Building 830.

01502 TEMPORARY FIELD OFFICE

The Contractor will not be required to furnish and maintain field office facilities for the Buyer; however, he shall provide for his own field office requirements if needed.

When a Contractor provides a temporary office or storage facility which is either a trailer or a portable building, it will be located _____, and be secured in accordance with the Standard for Trailer Anchorage on Rockwell Std. No. SC103.

01503 GOVERNMENT-FURNISHED PROPERTY (Refer to GP-7)

a. The Buyer or the Government will furnish to the Contractor, as free issue, the following property to be incorporated or installed in the work or used in its performance:

Item No.	Quantity	Description
1	1	Ultra violet Light/ Peroxide Treatment Module
2	1	Hydrogen Peroxide Storage/ Feed Module
3	4	ASME Storage Tanks

b. Such property will be furnished on or before _____.

c. Such property will be furnished at _____.

01504 AVAILABILITY OF UTILITIES AND SERVICES (Refer to GP-19)

a. Water and electricity to complete construction of this contract work will be made available to the Contractor within 100 ft of the jobsite for work within existing buildings. For exterior work, water and electricity will be made available at the nearest building where designated by the Buyer.

b. The Area Plot Plan, attached to this section, shows the parking area for the personal cars of the Contractor's employees. These cars must remain parked at the designated

area throughout the working day. Only the Contractor's working vehicles will be permitted to be driven on the plantsite except before starting time and after quitting time.

c. For interior work, Construction personnel can use toilet facilities adjacent to the work areas. For exterior work, the Contractor shall furnish toilet facilities for his personnel.

d. All 120-volt, single-phase, 15-and 20-ampere receptacle outlets, serving tools, or equipment being used outside of buildings shall be equipped with ground-fault circuit interrupters. Such interrupters shall be furnished by the Contractor. This requirement will be strictly enforced.

01505 SALVAGE AND DISPOSAL OF REMOVED MATERIALS (Refer to GP-21)

a. Posted dumping grounds on the plantsite which have been designated by the Buyer shall be the only areas used as dumping areas for waste materials unless written permission is obtained from the Buyer for disposal at other locations.

b. The Contractor is encouraged to use returnable containers and packages for all materials and supplies delivered to the jobsite. The Contractor shall limit, as much as possible, the amount of waste accumulated during construction.

c. All material being removed from buildings shall be monitored by the Buyer before being moved from the area.

The Buyer will furnish lockable boxes to the construction site for the disposal of materials that are determined to emit radionuclides. The Contractor shall place materials so designated in these boxes. Waste boxes will be kept locked and stored inside buildings.

d. The Contractor shall, at all times, keep the work area clean and orderly. All debris, scrap, and rubble shall be removed from the work area as they are created. At the end of each work shift, the work area shall be swept clean and left in a neat and orderly manner. Access routes for other personnel must be kept clear at all times.

e. Installed equipment and materials removed by the Contractor under this contract, and not authorized to be reused in the work, shall remain the property of the Buyer. All such equipment and material shall be properly identified and

delivered in the Buyer as directed by the Buyer. The Contractor shall use care in removing salvageable materials and equipment so as not to cause undue damage that may render the equipment or materials unusable.

01506 CONCRETE TRUCK WASHOUT

Concrete truck washout will be permitted at the Rocky Flats landfill as noted on the area Plot Plan, attached to this section, in a location approved by the Buyer.

01507 TESTING (Refer to GP-25)

a. If it is provided in the technical sections that a test is to be performed at Buyer expense, costs of any such test which reveals that the contract requirements have not been met will be paid by the Contractor and not the Buyer.

b. The Contractor shall cooperate with the Buyer and any testing organization selected by the Buyer in the preparation for the performance of any test to be conducted by the Buyer or any testing organization selected by the Buyer.

c. Tests of Pressure Vessels

1. Prior to installation and acceptance by the Buyer, any power boiler, low-pressure heating boiler, or unfired pressure vessel that is included within the scope of the ASME Boiler and Pressure Vessel Code, operated at pressures of 15 pounds per square inch or greater, furnished under this contract, will be stamped with ASME Boiler and Pressure Vessel Code Symbol and a National Board of Boiler and Pressure Vessel Inspector's number, thus certifying that all necessary tests have been performed. Manufacturer's data reports (unless exempted by the ASME Code) will be filed with the National Board in Columbus, Ohio.

   Five copies of these data reports and National Board Certificate shall be submitted to the Buyer.

2. Any boilers or pressure vessels operated at pressures stated above, utilized by the Contractor in his performance of the work, will be similarly tested and certified before being brought on the project and annually thereafter so long as they are used on the project site.

d. If it is provided in the technical specifications that the Contractor is to perform field radiography of welds, the following shall apply:

1. All field radiography shall be performed by a radiographer who is licensed by the Department of Health, State of Colorado.

2. Prior to starting such work, the Contractor shall present to the Buyer for his approval written procedures regarding:

   (a) The handling and use of the radioactive source on the plantsite and

   (b) The operational methods to be followed in performing the field radiography.

01508 WORK PERMITS

At least 24 hours prior to the start of any excavation or welding, the Contractor shall request the appropriate work permit from the Buyer. These permits are issued as a matter of course. For excavations involving installation of buried utilities including electrical and alarm systems, metallic-coated plastic detector tape will be issued as GFE to the Contractor to be installed approximately 12 inches directly above the buried utility or as directed by the Buyer.

01509 UTILITY OUTAGES

The Contractor shall furnish the Buyer 48 hours advance notice of any planned utility outage.

01510 SPECIAL CONTROLS

a. Noise Control. Comply with OSHA requirements as to allowable noise levels during construction. Equip all internal combustion engines in vehicles and construction equipment with effective mufflers. Prevent noise disturbance to adjoining property owners and the public.

b. Dust Control. Sprinkle streets and places where construction operations create a dust nuisance at frequent intervals and not less than twice daily. Be responsible for all damage resulting from dust produced by construction operations.

c. Water Control. Perform grading and other operations to maintain site drainage. Do not allow surface water to accumulate in excavations, under structures, or in ponds on the site and control surface water by means of ditches, dams, temporary pumps and piping, and other necessary

methods. Legally dispose of surface and subsurface water and do not allow mud, silt, or debris to flow on to adjoining or public property.

d. Air Pollution Control. Comply with all laws, ordinances, rules, regulations, and other restrictions pertaining to air pollution. Do not use any fuel nor perform any operation that emits smoke which is defined as equal to Ringleman No. 2 or darker.

e. Temporary Heating. Furnish and pay for heat, fuel, and services to protect the Work against injury from dampness and cold until final acceptance, and to maintain correct temperatures and ventilation in buildings before finish lumber and millwork are delivered, and throughout placing of finish and other finishing operations such as painting and installation of resilient coverings.

   1. Temporary Heating Equipment. Use equipment that produces no combustion gases or that discharges such gases directly to the exterior atmosphere by ducts, tubes, or similar conduits.

   2. Permanent Systems. Building heating and ventilating systems may be used. Furnish a competent engineer to operate systems and be solely responsible for damage to equipment during such temporary operation. Operate systems as necessary to maintain correct temperatures and ventilation within buildings during finishing operations. During temporary heating and ventilating equip systems with temporary throwaway type filters to prevent dust entering supply systems. Be responsible for delivering systems free of dust and lint at time of final acceptance.

01511 SANITARY FACILITIES

a. Toilet and Washing Facilities. Provide temporary chemical toilets and fresh water washing facilities for the use of all workmen at the site. Supply paper, soap, and towels, and maintain the facilities in a clean and sanitary condition. Pit type privies are not permitted.

b. Drinking Water. Maintain a supply of cool pure drinking water at the site, readily available to workmen, with individual disposal drinking cups or a sanitary bubbler fountain.

01512 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

Remove temporary facilities and controls from the site and where the Work is performed when no longer required in the Buyer's opinion. Clean up and restore areas occupied by temporary facilities to acceptable condition.

END OF SECTION 01500

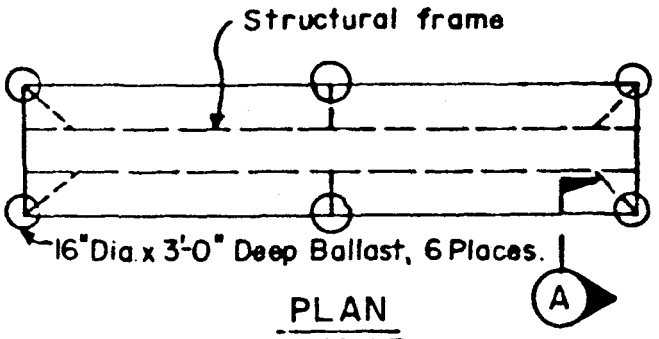
STANDARD FOR TRAILER ANCHORAGE

Trailers will have the following minimum anchorage measures taken to insure stability during high winds.

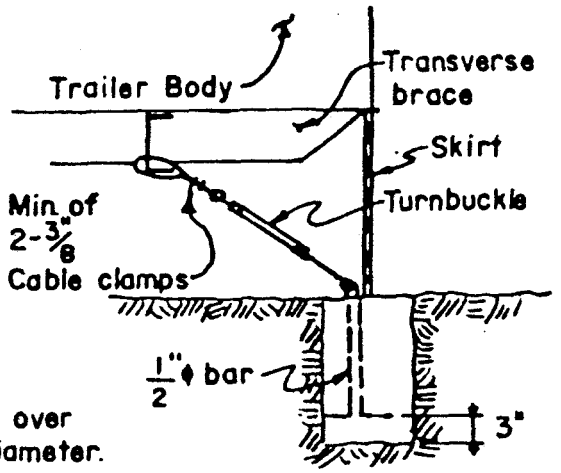
1. Long direction of trailer located in an east-west direction.
2. Located immediately east of an existing structure.
3. Base of trailer blocked up with 8"x 8"x16" concrete blocks to the working elevation and tied down per sketch. Blocks will be placed at each tiedown point shown on the sketch.

"If for any reason measures 1 thru 3 cannot be followed, further analysis will be required by Engineering & Construction."

4. The Building Supt will be responsible for inspection of Trailer blocking and tiedown integrity a minimum of twice a year, with assistance from Safety if required.
5. When the usual internal walls are going to be removed, in order to provide an open work space, a check with Engineering must be made to determine the need for additional internal bracing.



PLAN
NO SCALE



SECTION "A"
NO SCALE

(1) Loop 3/8" Wire rope thru 1" holes in frame or over frame then loop thru turnbuckle of same diameter.

(2) Turnbuckle fastened to 1/2" ϕ Anchor embedded in 16" dia. x 3'-0" deep concrete ballast 6 places.

(3) Locate all holes and or loops within 4" of transverse member.

ROCKY FLATS PLANT STD

Issue	Description	Appr'd.	Appr'd	Date	By	Appr'd	Clos.
A	ORIGINAL ISSUE	GWB		2-20-73	WGL	[illegible]	

SAFETY — Design Engrg. Dept.

STANDARD FOR:
TRAILER ANCHORAGE

ROCKWELL INTERNATIONAL
ATOMICS INTERNATIONAL DIVISION
ERDA CONTRACT E (29-2)-3533
ROCKY FLATS PLANT — GOLDEN, COLORADO 80401

SIZE	DRAWING NUMBER	ISSUE	SHEET
A	23854-1	A	1 of 1

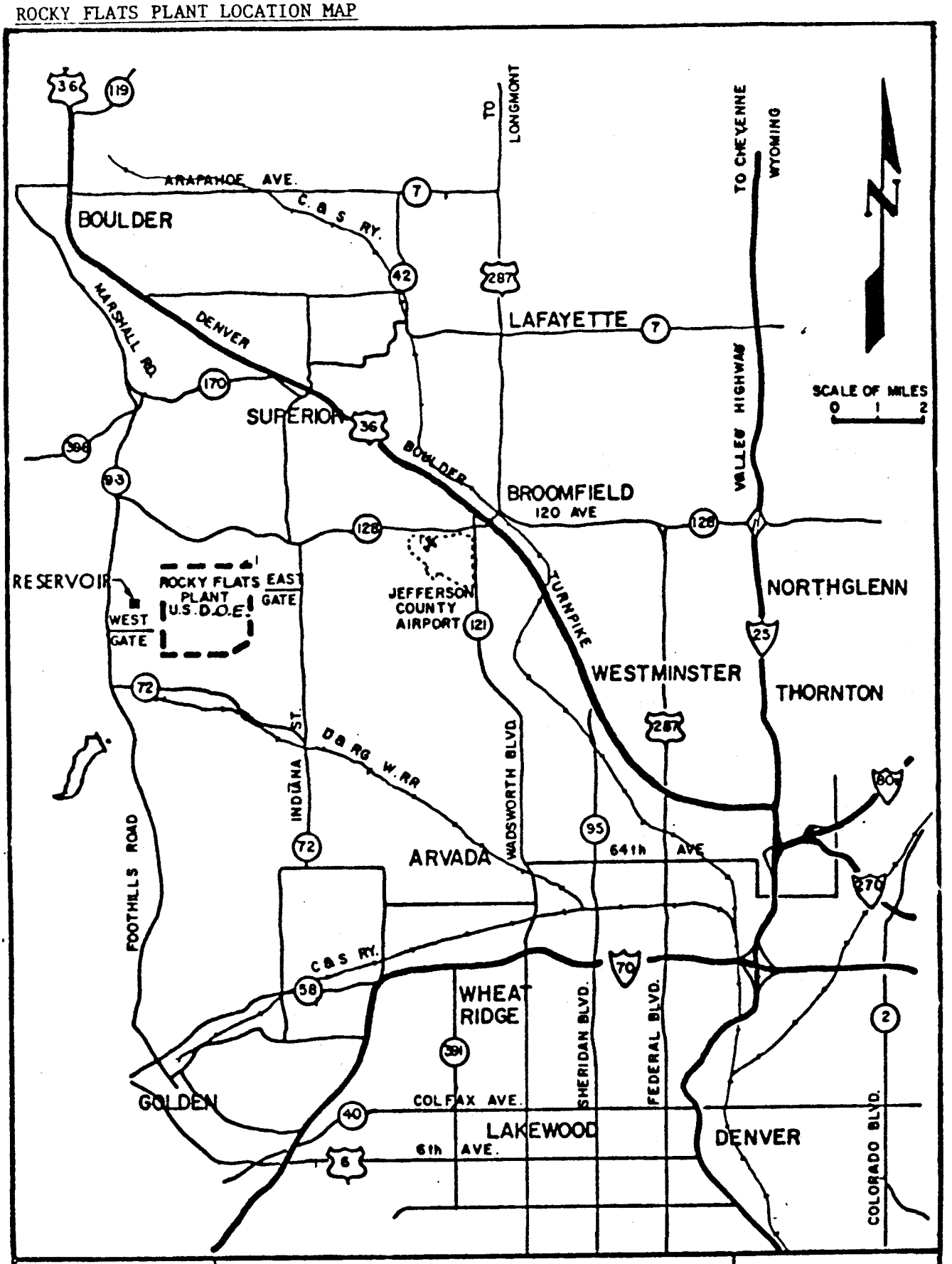
STANDARD NO. SC 103

S
Cr

RF-46149 (12-71) PLBK-HS

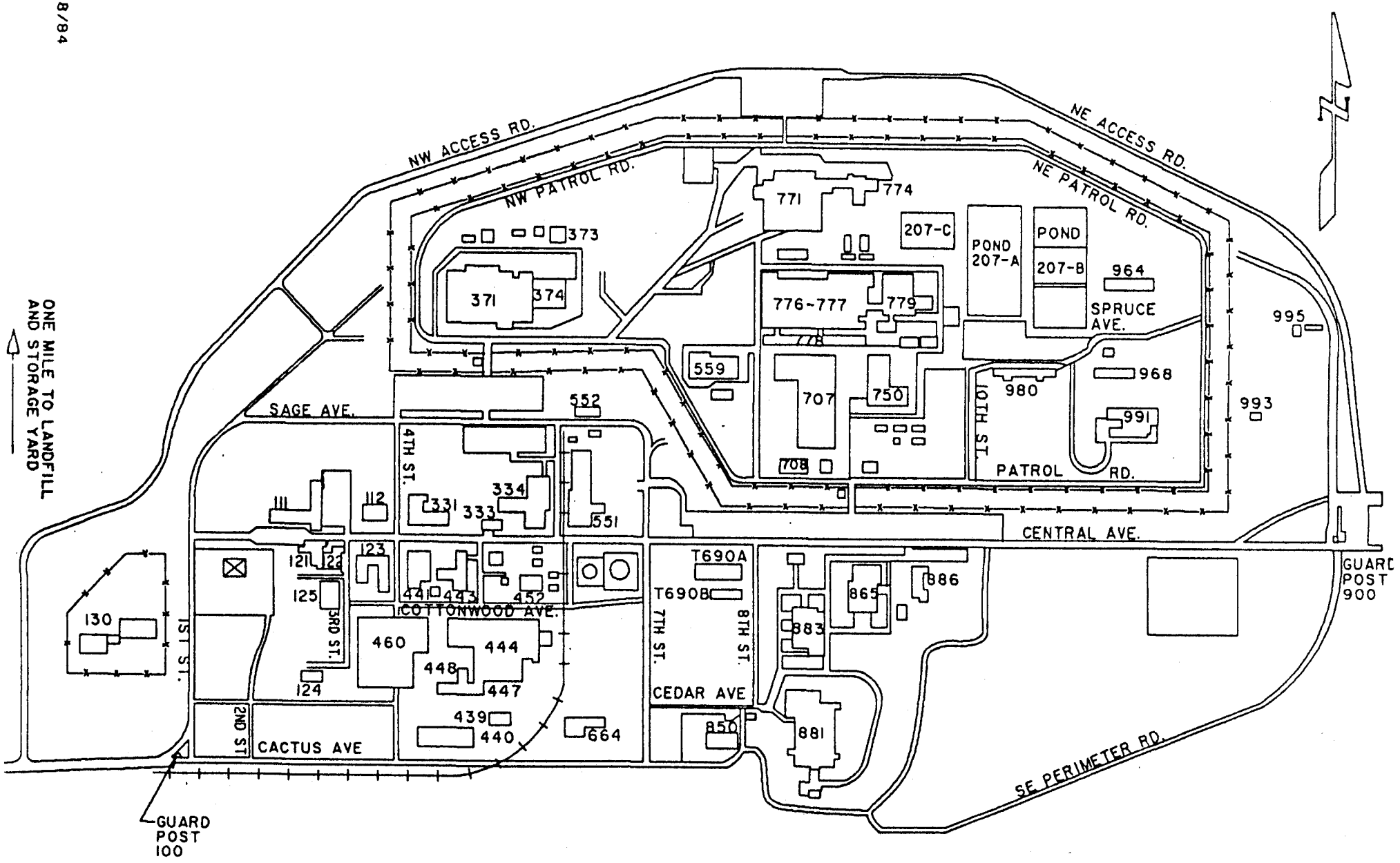
GPO 780-780/3

ROCKY FLATS PLANT LOCATION MAP



DATE— 1/28/81	ROCKY FLATS PLANT
SCALE—GRAPHIC	LOCATION MAP

8/84



ROCKY FLATS AREA PLOT PLAN

•VI.R.MISC.BLL.RF.AREAPLOTPLAN

SECTION 02110--DEMOLITION

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. Schedule and accomplish work in a manner that will minimize dust, debris, and unnecessary interference with existing operations in the area of the work.

B. Keep demolition work damp to limit dust.

1.2 PROTECTION: Maintain barricades around all demolition work as necessary to protect surrounding property and to provide safe working conditions for personnel.

1.3 APPROVALS: Before commencing demolition work, obtain the Buyer's written approval of the sequence of operation, working plan, and proposed protective measures.

1.4 LOCATION OF DEMOLITION: Demolition shall include, but not be limited to, the following items:

A. Removal of concrete floor and existing equipment pads in Building 830, including reinforcing bars.

B. Removal of existing electrical facilities inside of Building 830 as noted on the drawings.

C. Removal of a section of existing retaining wall adjacent to loading dock to allow construction of new tank pad.

PART II: PRODUCTS

2.1 ITEMS SALVAGED FOR REUSE AT SITE

A. Items indicated on the drawings and/or designated by the Buyer shall be salvaged and installed in the new work.

B. Items damaged in removal shall be repaired and refinished, or replaced with new matching items, to the satisfaction of the Buyer.

2.2 ITEMS SALVAGED NOT FOR REUSE AT SITE: Items designated to be salvaged, but not designated to be used in the contract work, shall be delivered to the Government as directed by the Buyer.

PART III: EXECUTION

3.1 DEMOLITION

A. Perform work in an orderly manner, and remove trash daily. Avoid damaging work not being demolished.

B. Make a saw cut a minimum of 1 in. deep around the perimeter of openings to be made through concrete walls and floors before the concrete is broken out, unless otherwise shown on the drawings.

3.2 EXISTING UTILITIES

A. Do not disturb existing utilities which are to remain.

B. Existing utilities which are indicated as abandoned may be removed to the extent that they interfere with new work.

C. Excavation, trenching, and backfilling required for the removal of existing utilities and structures shall conform to Section 02200, Earthwork.

3.3 DISPOSAL OF RUBBLE

A. Break up concrete and concrete block in a manner approved by the Buyer.

B. Transport all rubble to a sanitary landfill as shown on Rocky Flats Area Plot Plan in Section 01500, Special Contract Requirements.

END OF SECTION

SECTION 02200--EARTHWORK

PART I: GENERAL

1.1 APPROVAL: Prior to starting any excavations, an approved excavation permit and written permission shall be obtained from the Buyer.

1.2 PROTECTION AND SAFETY

A. Traffic Control

1. Keep all roads, sidewalks, and parking areas which are not part of this project usable at all times.

2. The Buyer shall provide all necessary barricades, lights, signals, etc., for the protection of the workers and the public, as established by the Occupational Safety and Health Administration (OSHA) Construction Safety and Health Regulation 29 CFR, Part 1926, Subpart G, Signs, Signals, and Barricades.

B. Excavations, Trenching, and Shoring

1. All excavations, trenching, and shoring shall comply with the rules and regulations as established by OSHA Construction Safety and Health Regulations 29 CFR, Part 1926, Subpart P, Excavation, Trenching, and Shoring.

2. OSHA Pamphlet 2226, Excavation and Trenching Operations, can be used as an additional aid.

1.3 EXISTING UTILITIES

A. Notify the Buyer immediately when existing utilities are encountered during excavation.

B. Obtain approval from the Buyer before backfilling existing utilities.

PART II: PRODUCTS

2.1 GENERAL

A. Material to be excavated or cleared is assumed to be earth, claystone, and other materials that can be removed with a power shovel.

B. If rock, other than claystone, is encountered within the limits of excavation, notify the Buyer immediately and do not proceed except as instructed.

2.2 FILL MATERIALS

A. Fill material for structures and utility trenches shall be granular soils free or organic matter.

B. Sand fill shall pass a 20-mesh and be retained on a 200-mesh U.S. Standard sieve and shall be free of organic material, trash, and debris.

C. Class I Structural Fill--Suitable excavated material containing no stones having a diameter greater than 3 in.

D. Class II Structural Fill--Suitable excavated material containing no stones having a diameter greater than 6 in.

E. Pipeline Embedment Material--This material shall consist of sand fill.

F. Water, Gas, and Underground Conduit Embedment Material--This material shall be sand fill.

G. Frozen materials shall not be used for fill.

H. All suitable material removed from the excavation shall be used in forming fills. No excavated material shall be wasted without approval of the Buyer.

I. Fill for storage areas and roads shall consist of overburden and bedrock materials, including broken asphalt pavement, obtained from excavated areas.

J. Drain Rock--This material shall consist of 3/4 inch washed and cleaned crushed stone.

K. Top Soil--Material within 1 foot of the surface. This material is not suitable for supprt of structural loads or use as backfill.

2.3 WARNING TAPE: Furnished by Buyer and installed by Contractor.

PART III: EXECUTION

3.1 GENERAL

A. The worksite and areas shown on the drawings shall be cleared of all natural obstructions and existing foundations, pavement, utility lines, and other items which will interfere with the construction operations, as approved by the Buyer.

B. Proper allowances shall be made for form construction, waterproofing, shoring, and inspection. Where walls or footings are authorized to be deposited directly against excavated surfaces, the surfaces shall be sharp, clean, and

true. Bottoms of excavations for footings, piers, grade beams, etc., shall be level, clean, and clear of loose materials.

C. Protect bottoms of all excavations from free-standing water and frost. Do not place foundations, footings, grade beams, or slabs on wet or frozen ground.

D. Suitable excavated material which is required for fill under slabs shall be separately stockpiled as directed by the Buyer.

E. All excavated materials will be tested by the Owner's Health Physics representative. Any excavated materials exceeding the criteria for placement as fill shall be immediately segregated from other uncontaminated materials and placed in containers provided by the Buyer. The Buyer shall arrange for removal and disposal of these containers.

Rubble, debris, and excess material which passes these tests will be disposed of as directed in item 3.10 of this section.

F. All excavated materials shall be handled in such a manner to minimize contaminant dispersion via aeolian disperson or leaching. No excavated materials shall be transported or stored downgradient of the proposed French drain and shall be placed as a surface wall in the area of known contamination. Prior to excavation, soils shall be wetted to a moisture content exceeding optimum moisture as defined by Standard Proctor Compaction Testing, ASTM D-698. In general, during handling, the excavated materials shall be thoroughly wetted but shall not contain moisture to the extent which will interfere with the Contractor's handling equipment. Excavated materials in stockpiles shall be immediately stabilized by covering or other approved means immediately upon conclusion of work at that particular stockpile. During final placement of waste excavation add such covering as may be necessary so that aeolian dispersion is minimized. No earthwork shall be permitted during periods in which the wind velocity exceeds 30 mph. Long-term erosion protection shall be provided by seeding and irrigation as required or by other means approved by the Buyer. Irrigation shall not begin until after the French drain and treatment unit are functional. Earthwork operations shall be planned and conducted in a manner to promote maximum handling efficiency. Materials shall be immediately placed and compacted after initial excavation where practicable.

3.2 TOPSOIL REMOVAL: The topsoil from all areas to be excavated shall be tested according to item 3.1E of this section. Acceptable topsoil shall be removed and stockpiled as per item 3.1F of this section for later use in reclaiming the excavated areas.

3.3 TRENCHING

A. Trenching for utility systems shall be of sufficient width for proper laying of pipe and conduit. The trench banks shall be as nearly vertical as is practical. Undercutting will not be permitted. Trenches shall be of sufficient depth to provide not less than the minimum cover shown on the drawings or 3 feet.

B. Temporary trench excavations shall at all times conform to the safety reqirements as specified in items 1.2.B.1 and 2 of this section.

C. The minimum width of pipe trenches, measured at the crown of the pipe, shall not be less than 12-inches (30.48 cm) greater than the exterior diameter of the pipe, exclusive of bells and the minimum base width of such trench shall be not less than 12-inches (30.48 cm) greater than the exterior diameter of the pipe, exclusive of special structures or connections, and such minimum width shall be exclusive of all trench supports.

D. The maximum allowable width of trench for all pipelines measured at the top of the pipe shall be the outside diameter of the pipe (exclusive of bells or collars) plus 24-inches (60.96 cm), and such maximum shall be inclusive of all timbers. A trench wider than the outside diameter plus 24-inches (60.96 cm) may be used without special bedding if the Contractor, at his expense will furnish pipe of the required strength to carry the additional trench load. Such modifications shall be submitted to the Buyer and approved in writing. When ever such maximum allowable width of trench is exceeded for any reason, except as provided for on the Plans or in the Specifications, or by the written direction of the Buyer, the Buyer (may) (shall), at his discretion, require that the Contractor, at his own expense for all labor and materials, cradle the pipe in 2500 psi (175.77 Kg/cm2) compressive strength concrete, or other approved pipe bedding.

E. Except by special permission by the Buyer, only that amount of pipe construction will be permitted, including excavation, construction of pipeline, and backfill in any one location, which can be completed in one day; however, maximum length of open trench shall never exceed 600 feet (182.9 m). This length includes open excavation, pipe laying and appurtenant construction and backfill which has not been temporarily resurfaced.

F. Loose cobbles or boulders shall be removed from the sides of the trenches before allowing workmen into the excavation, or the trench slopes must be protected with screening or other

methods. Trench side slopes shall be kept moist during construction to prevent local sloughing and raveling.

G. Surcharge loads due to construction equipment shall not be permitted within 5 feet (1.524 m) of the top of any excavated slope

H. If the Contractor elects to shore or otherwise stabilize the trench sides, he shall file with the Buyer for review, copies of drawings for same prepared and signed by a Civil Engineer duly registered in the State of Colorado before commencing excavation.

I. The sides of the trenches shall be supported with plank sheeting and bracing in such a manner as to prevent caving of the sides of the trench. Space left by withdrawal of sheeting or shoring shall be filled completely with dry granular material blown or rammed in place. All trenches deeper than 5-feet (1.524 m) shall be shored unless cut to the angle of repose of the excavated soils.

J. Benching of the trench excavation is permitted to allow power shovel access to full depth of trench as long as all other items of item 3.3 of this section are adhered to.

3.4 OVEREXCAVATION

A. All unstable materials encountered below the established elevation of the excavation which will not provide a firm foundation for subsequent work shall be removed as directed.

B. Where the excavation is directed to be made below the established elevations, the excavation, if under slabs, shall be restored to the proper elevation in accordance with the procedure specified for backfilling, or if under footings, the depth of the walls or footing shall be increased as may be directed by the Buyer.

C. Excavations carried below the depths indicated WITHOUT SPECIFIC DIRECTION shall be returned to the proper elevation in accordance with the procedure specified for backfilling, except that in wall or footing excavations, the concrete shall be extended to the bottom of the excavation.

3.5 BACKFILLING

A. Prior to backfilling, remove all forms and clean excavations of all trash and debris.

B. Trenches for piping, conduits, or other underground utilities shall be backfilled to a minimum of 6 in. over the top of the pipe, conduit, cable, etc., with sand fill unless otherwise detailed on the drawings.

C. Fill shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required degree of compaction may be obtained. Each layer shall be compacted by hand or machine tampers or by other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method.

D. Install Buyer-furnished orange warning tape 12 inches above any underground utilities or piping.

3.6 PLACEMENT OF FILL ABOVE GRADE

A. Preparation of Ground Surface

1. Where fill is placed over existing pavement or compacted gravel, scarify and compact the existing surface before placing fills.

2. Uniformly moisten areas to receive fill and compact to minimum 90 percent of maximum density as determined by the Modified Proctor Testing Method.

3. Immediately following wetting, uniformly compact the material by rolling to obtain 90 percent maximum density as determined by the Modified Proctor Testing Method.

B. Spreading Fill Material

1. Completed fill shall correspond to the contours shown on the drawings.

2. Place fill materials in successive layers of loose materials not more than 6 in. deep.

3. Uniformly spread each layer using a road machine or other approved device.

4. Compact each layer of fill thoroughly using an approved roller to obtain 90 percent maximum density, as determined by the Modified Proctor Testing Method.

3.7 SUBGRADE PREPARATION FOR ROADS: Roadbeds not requiring fill shall be prepared as follows:

A. Subgrade Preparation

1. Rough grade the roadbed to the approximate final shape of subgrade required.

2. Scarify the roadbed to a minimum depth of 6 in., and thoroughly cultivate until the material is finely divided.

3. Alternately water and recultivate the subgrade material to obtain the optimum moisture content required for compaction. Minimum depth of moistened subgrade shall be 6 inches.

B. Shaping

1. Shape subgrade to a true cross section sufficiently higher than the specified grade to allow for compaction.

2. Rough grading shall be done in a manner that will not leave ridges of material that will interfere with immediate drainage of water from the subgrade.

3. During shaping and compacting, any high spots or depressions that develop in the subgrade shall be scarified, cut down, or backfilled and compacted as specified below.

C. Wetting and compacting

1. Furnish sufficient watering equipment to ensure proper moisture content of all materials being placed.

2. Sprinkle each course of material in a manner that will avoid areas of dry material alternated by areas of saturated soil or pools of water.

3.8 COMPACTION

A. Except as otherwise specified, moisture/density relationships shall be as determined by American Society for Testing and Materials (ASTM) D1557, and the degree of field compaction shall be controlled with ASTM D1556 or ASTM D2922. All tests will be taken by the Government.

B. The Government will pay for any test for soil compaction that passes the requirements of the specifications, but the Contractor shall pay for any soil tests that indicate the soil compaction does not meet requirements of the specifications.

3.9 GRADING

A. Uniformly smooth grade all areas covered by the project, including excavated and backfilled sections, and adjacent transition areas. The degree of finish shall be that ordinarily obtainable from either blade graded or scraper operations.

B. The finish surface shall be not more than 0.15 feet above or below the established grade or approved cross section.

C. All drainage swales shall be finished so as to drain readily.

3.10 DISPOSAL OF DEBRIS AND EXCESS MATERIAL: All debris and excess material must be tested per item 3.1.F of this section before disposal. Rubble and debris not restricted per item 3.1.F of this section and not suitable for fill shall be transported to a sanitary landfill 1 mile northeast of Access Gate 8.

Excess material from excavation, not restricted per item 3.1.F of this section, and unsuitable for or not required for backfilling, shall be wasted, spread, and leveled or graded as directed by the Buyer within 1 mile of the site.

3.11 DEWATERING

A. Drainage water from construction operations, storm water, or ground water shall be tested for contamination by the Buyer's Health Physics representative before it is removed from the construction site.

B. Drainage water deemed contaminated with radiation shall..... Drainage water deemed contaminated with VOC's shall... Uncontaminated drainage water shall...

C. Drainage water shall be handled so that no damage will be done to the excavations, pipe, or structures. The contractor shall be responsible for any damages to persons or property on or off the construction site due to such drainage water.

D. Grading shall be done as necessary to prevent surface water from flowing into excavations.

SECTION 02551
SANITARY SEWERS

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02110--Demolition

B. Section 02200--Earthwork

PART II: PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) SEWER PIPE AND FITTINGS

A. Pipe--American Society for Testing and Materials (ASTM) 3034, wall thickness SDR 35

B. Fittings--ASTM 3034, wall thickness SDR 35

2.2 ELASTOMERIC SEALS (GASKETS) FOR JOINING PLASTIC PIPE: ASTM F477

2.3 CAST IRON FITTINGS: AWWA C110

2.4 CAST IRON PIPE: Cast iron soil pipe, coated, hub and spigot to ASTM A-74.

2.5 PRECAST REINFORCED CONCRETE MANHOLE SECTIONS: ASTM 478

2.6 MANHOLE RINGS AND COVERS: MaClear, O.S. Denver

2.7 MANHOLE JOINT SEALER: Ram-Nek

2.8 WARNING TAPE: Furnished by Buyer and installed by Contractor

PART III: EXECUTION

3.1 LAYING PIPE AND INSTALLING FITTINGS

A. The Contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to the lines and grades shown on the plans. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

B. The Contractor shall inspect all pipe and fittings before they are installed and reject any piece that is damaged by handling or defective to a degree which will materially affect the function and service of the pipe.

C. The Contractor shall take adequate measures to prevent the intrusion of foreign materials of any kind into the pipe or fittings. At the end of each day's work, the Contractor

shall adequately plug any open ends of installed pipe and fittings in order to prevent the intrusion of foreign materials.

D. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Spaces for pipe bells shall be dug in the subgrade to accommodate the bells. These spaces shall be deep enough to ensure that the bells do not bear the load of the pipe. After installation, the barrel of each pipe section shall be in contact with the bedding for its full length, exclusive of the bell.

E. Pipe shall not be installed on frozen, soft, or spongy subgrade material. Pipe shall not be installed in standing water. The Contractor shall furnish all necessary equipment and labor to properly dewater the trench, as the need arises, at the Contractor's cost.

F. Pipe which is not reasonably true in alignment or grade or which shows any settlement after laying shall be taken up and relaid without extra compensation to the Contractor.

G. Pipe and fittings shall be joined in accordance with accepted industry practice. The end of the barrel and the inside of the bell shall be clean prior to joining. The gasket shall be lubricated in accordance with the manufacturer's recommendations, placed in the bell, and the spigot shall be inserted in the bell to full depth. Nuts and bolts on mechanical joints shall be torqued in accordance with manufacturer's instructions.

3.2 INSTALLING PRECAST CONCRETE MANHOLES: Precast manholes shall be installed in accordance with ASTM C891.

END OF SECTION

SECTION 02553
WATER LINES

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02110--Demolition

B. Section 02200--Earthwork

PART II: PRODUCTS

2.1 PIPE: Schedule 40 galvanized butt weld or continuous welded steel to ASTM A-120 primed and wrapped with a cold applied tape, Type I or Type II conforming to AWWA C209.

2.2 FITTINGS: Galvanized malleable iron threaded fittings conforming to ANSI B16.3, ASTM A-47, and ASTM A-153.

PART III: EXECUTION

3.1 LAYING PIPE AND INSTALLING FITTINGS

A. The Contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to the lines and grades shown on the plans. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

B. The Contractor shall inspect all pipe and fittings before they are installed and reject any piece that is damaged by handling or defective to a degree which will materially affect the function and service of the pipe.

C. The Contractor shall take adequate measures to prevent the intrusion of foreign materials of any kind into the pipe or fittings. At the end of each day's work, the Contractor shall adequately plug any open ends of installed pipe and fittings in order to prevent the intrusion of foreign materials.

D. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Spaces for pipe bells shall be dug in the subgrade to accommodate the bells. These spaces shall be deep enough to ensure that the bells do not bear the load of the pipe. After installation, the barrel of each pipe section shall be in contact with the bedding for its full length, exclusive of the bell.

E. Pipe shall not be installed on frozen, soft, or spongy subgrade material. Pipe shall not be installed in standing water. The Contractor shall furnish all necessary equipment

and labor to properly dewater the trench, as the need arises, at the Contractor's costs.

F. Pipe which is not reasonably true in alignment grade or which shows any settlement after laying shall be taken up and relaid without extra compensation to the Contractor.

G. Pipe and fittings shall be joined in accordance with accepted industry practice. The end of the barrel and the inside of the bell shall be clean prior to joining. The gasket shall be lubricated in accordance to the manufacturer's recommendations, placed in the bell, and the spigot shall be inserted in the bell to full depth. Nuts and bolts on mechanical joints shall be torqued in accordance with manufacturer's instructions.

3.2 PRESSURE AND LEAKAGE TESTS: Testing pressure shall be that pressure existing in the main (approximately 40 psig). The trench shall be backfilled to the minimum depth required to perform a pressure test under nonopen trench conditions prior to commencing the test. The trench shall be observed for obvious leaks for a period of 30 min.

This test will be the minimum acceptable and will not relieve the Contractor of any responsibility for the integrity of the pipeline.

The Contractor shall furnish all necessary labor, tools, equipment, gages,a and parts of whatever nature required to properly perform the pressure test and shall make all repairs and corrections necessary to furnish a water line in conformance with this specification at the Contractor's cost.

3.3 DISINFECTION: The new water lines shall be disinfected in a manner which will satisfy Jefferson County Health Department requirements. Notify Industrial Hygiene 24 hrs in advance of the beginning of sterilization and of the subsequent flushing.

END OF SECTION

SECTION 02554

FRENCH DRAIN AND INFILITRATION GALLERY

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02110: Demolition

B. Section 02200: Earthwork

PART II: PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Gallery Transfer Pipe: Schedule 30, ASTM D-1785, Type I

B. Drain Pipe: Schedule 80, perforated

C. Pipe Fittings: Schedule 80, socket weld, ASTM D-2467 Type I

D. Cement for Socket Weld Joints: Solvent cement in accordance with ASTM F493 and as recommended by the manufacturer of the pipe and fittings.

E. Primer: Primer as recommended by manufacturer of the pipe and fittings.

NOTE

PVC pipe and fitting joints shall be solvent welded with the exception of equipment connections which may be threaded or flanged. Fabrication and installation shall be in accordance with the recommendations of the manufacturer of the pipe and fittings. If threaded connections are required, solvent weld threaded adapters shall be used in place of threading the pipe.

2.2 IMPERMEABLE SYNTHETIC MEMBRANE

A. Hypalon, 36 mil.

or B. High density Polyethylene, 30 mil.

or C. PVC, 30 mil.

2.3 FILTER FABRIC

A. Celanese Mirafi 500 X

or B. Trevira Spunbond 1114

2.4 BACKFILL MATERIAL

A. Drain Rock: 3/4"-crushed stone. Cleaned and washed.

B. Class I Structural Fill: Suitable excavated material containing no stones having a diameter greater than 3 inches.

C. Class II Structural Fill: Suitable excavated material containing no stone having a diameter greater than 6 inches.

D. Topsoil: Material within 1 ft. of the surface. This material is not suitable for support of structural loads or use as backfill.

2.5 WARNING TAPE: Furnished by Buyer and installed by Contractor.

2.6 GROUT: 2000 psi cement grouting

PART III: EXECUTION

3.1 FRENCH DRAIN

A. The trench shall be excavated per the specification in Section 2200 according to the drawing.

B. Grout as needed to maintain impermeability of claystone bedrock.

C. Impermeable Membrane

1. The impermeable membrane shall be handled in a manner to prevent puncture or damage. Damaged sections of the impermeable membrane will not be used.

2. The impermeable membrane shall be field seamed per the manufacturer's recommendations as required to meet the dimensions on the drawings.

3. The impermeable membrane shall be installed in the trench to cover the up-gradient face of the bedrock, bottom of the trench, and the down-gradient face of the trench as shown on the drawing. Care should be taken not to cover the up-gradient side of the trench above the top of the bedrock.

4. Pipe penetration through the impermeable membrane shall be sealed per manufacturer's recommendations and details in the drawings.

D. Filter Fabric

1. The filter fabric shall be handled in a manner to prevent puncture or damage. Damaged sections of the filter fabric will not be used.

2. Sections of the filter fabric shall be seamed by overlapping sections by a minimum of 1 foot. For horizontal seams the upper section will overlap the lower section to prevent backfill material from entering behind the filter fabric. The filter fabric can be pined as required.

3. Filter fabric is to be installed on the up-gradient side of the trench and the top of the drain rock as shown in the drawing.

4. Pipe penetration through the filter fabric shall be sealed per manufacturer's recommendations and details in the drawings.

E. PIPE BEDDING

The bottom of the trench shall be covered with one foot of drain rock so as to provide the drain pipe with a firm and uniform bearing surface over the entire length of the pipe.

F. LAYING DRAINPIPE AND INSTALLING FITTINGS

1. The Contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to the lines and grade shown on the plans. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

2. The Contracting Officer shall inspect all pipe and fittings before they are installed and reject any piece that is damaged by handling or defective to a degree which will materially affect the function and service of the pipe.

3. The Contractor shall take adequate measures to prevent the intrusion of foreign materials of any kind into the pipe or fittings. At the end of each day's work, the Contractor shall adequately plug any open ends of installed pipe and fittings in order to prevent the intrusion of foreign materials.

4. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Lay pipe with perforated side down.

5. Pipe shall be installed on frozen, soft, or spongy subgrade material. Pipe shall not be installed in standing water. The Contractor shall furnish all necessary equipment and labor to properly dewater the trench, as the need arises, at the Contractor's cost.

6. Pipe which is not reasonably true in alignment or grade, or which shows any settlement after laying, shall be taken up and relaid without extra compensation to the Contractor.

7. Pipe and fittings shall be joined in accordance with accepted industry practice.

G. BACKFILL

1. The pipe zone shall be backfilled by hand by placing material simultaneously on both sides of the pipe for the full width of the trench in layers 6-inches in depth. Each layer shall be compacted to a compaction of not less than 90 percent of maximum density as determined by the Modified Proctor Testing Method. Care should be taken not to damage the pipe. The pipe zone is considered to extend to 12 inches above the top of the pipe.

2. Drain rock shall also be used to backfill the trench above the pipe zone to a point 4 feet below the ground surface. Drain rock shall be placed in horizontal layers not in excess of 6 inches in thickness. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method. Filter fabric shall be placed over the top of the final layer of drain rock as shown in the drawing.

3. Three feet of Class I Structural Fill shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method. Orange tape shall be placed in the Structural Fill one foot above the filter fabric.

4. One foot of Topsoil shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method.

3.2 INFILTRATION GALLERY

A. The trench shall be excavated per the specification in Section 2200 according to the drawing.

B. Filter Fabric

1. The filter fabric shall be handled in a manner to prevent puncture or damage. Damaged sections of the filter fabric will not be used.

2. Sections of the filter fabric shall be seamed by overlapping sections by a minimum of 1 foot. For horizontal seams the upper section will overlap the lower section to prevent backfill material from entering behind the filter fabric. The filter fabric can be pined as required.

3. Filter fabric is to be installed on the up-gradient and down-gradient sides of the trench and the top and bottom of the drain rock as shown in the drawing.

4. Pipe penetration through the filter fabric shall be sealed per manufacturer's recommendations and details in the drawings.

C. PIPE BEDDING: Drain rock shall be used to backfill the trench to a point 6 feet below the ground surface. Drain rock shall be placed in horizontal layers not in excess of 6 inches in thickness. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method.

D. LAYING DRAIN PIPE AND INSTALLING FITTINGS

1. The Contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to the lines and grade shown on the plans. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

2. The Contracting Officer shall inspect all pipe and fittings before they are installed and reject any piece that is damaged by handling or defective to a degree which will materially affect the function and service of the pipe.

3. The Contractor shall take adequate measures to prevent the intrusion of foreign materials of any kind into the pipe or fittings. At the end of each day's work, the Contractor shall adequately plug any open ends of

installed pipe and fittings in order to prevent the intrusion of foreign materials.

4. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Lay pipe with perforated side down.

5. Pipe shall not be installed on frozen, soft, or spongy subgrade material. Pipe shall not be installed in standing water. The Contractor shall furnish all necessary equipment and labor to properly dewater the trench, as the need arises, at the Contractor's cost.

6. Pipe which is not reasonably true in alignment or grade, or which shows any settlement after laying, shall be taken up and relaid without extra compensation to the Contractor.

7. Pipe and fittings shall be joined in accordance with accepted industry practice.

E. BACKFILL

1. The pipe zone shall be backfilled by hand by placing material simultaneously on both sides of the pipe for the full width of the trench in layers 6-inches in depth. Each layer shall be compacted to a compaction of not less than 90 percent of maximum density as determined by the Modified Proctor Testing Method. Care should be taken not to damage the pipe. The pipe zone is considered to extend to 6-inches above the top of the pipe. Filter fabric shall be placed over the top of the final layer of drain rock as shown in the drawing.

2. Five feet of Class I Structural Fill shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method. Orange tape shall be placed in the Structural Fill one foot above the filter fabric.

3. One foot of Topsoil shall be placed in horizontal layers not in excess of 6-inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method.

3.3 GALLERY TRANSFER PIPING

A. Trench: The trench shall be excavated per the specification in Section 2200 according to the drawing.

B. Pipe Bedding: The bottom of the trench shall be covered with six inches of pipeline embedment material so as to provide the pipe with a firm and uniform bearing surface over the entire length of the pipe.

C. LAYING PIPELINE AND INSTALLING FITTINGS

1. The Contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to the lines and grade shown on the plans. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

2. The Contracting officer shall inspect all pipe and fittings before they are installed and reject any piece that is damaged by handling or defective to a degree which will materially affect the function and service of the pipe.

3. The Contractor shall take adequate measures to prevent the intrusion of foreign materials of any kind into the pipe or fittings. At the end of each day's work, the Contractor shall adequately plug any open ends of installed pipe and fittings in order to prevent the intrusion of foreign materials.

4. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Lay pipe with perforated side down.

5. Pipe shall not be installed on frozen, soft, or spongy subgrade material. Pipe shall not be installed in standing water. The Contractor shall furnish all necessary equipment and labor to properly dewater the trench, as the need arises, at the Contractor's cost.

6. Pipe which is not reasonably true in alignment or grade, or which shows any settlement after laying, shall be taken up and relaid without extra compensation to the Contractor.

7. Pipe and fittings shall be joined in accordance with accepted industry practice.

D. BACKFILL

1. The pipe zone shall be backfilled by hand by placing pipeline embedment material simultaneously on both sides of the pipe for the full width of the trench in layers 6-inches in depth. Each layer shall be compacted to a compaction of not less than 90 percent of maximum density as determined by the Modified Proctor Testing Method. Care should be taken not to damage the pipe. The pipe zone is considered to extend to 6-inches above the top of the pipe.

2. Class I Structural Fill as shown on the drawings shall be placed in horizontal layers not in excess of 6-inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method. Orange tape shall be placed in the Structural Fill one foot above the pipeline.

3. One foot of Topsoil shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method.

SECTION 03100
CONCRETE FORMWORK

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03200--Concrete Reinforcement
B. Section 03300--Cast-in-Place Concrete

1.2 APPROVALS: All concrete formwork complete and in place shall be approved by the Buyer before concrete is placed.

1.3 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies. The requirements of OSHA Part 1926, Section 1926.701 apply to the Work of this Section, and the Contractor shall prepare and maintain at least one copy of the required drawings at the site. Design of the structures shown on the Drawings does not include any allowance or consideration for imposed construction loads. Forms, shoring and falsework shall be adequate for imposed live and dead loads, including equipment, height of concrete drop, concrete and foundation pressures, stresses, lateral stability, and other safety factors during construction.

1.4 SHOP DRAWINGS. Concrete construction joints and expansion joints shall be of the types and locations indicated. Submit shop drawings for approval showing proposed location and type of required construction for any joints not shown on the drawings, and sequence of forming and concrete placing operations. Submit shop drawings at least 15 working days in advance of form fabrication.

PART II: PRODUCTS

2.1 FORMS

A. Forms for all surfaces shall be made of surfaced lumber, plywood, or material which will provide a surface at least equal to surfaced lumber or plywood.

B. Forms for all exposed surfaces shall be constructed of plywood or an approved equal. Plywood for forms shall be of the grade Exterior B-B (concrete form) conforming to the latest Product Standard for Soft Plywood, Construction and Industrial, of the National Bureau of Standards.

C. Plywood panels shall be not less than 5/8 in. thick.

D. Plywood less than 5/8 in. thick otherwise conforming to the requirements specified herein may be used with a continuous backing of 3/4-in. sheeting.

E. Metal forms shall be approved by the Buyer.

2.2 MISCELLANEOUS MATERIALS

A. Form Coating--A colorless mineral oil similar to Horn's form film.

B. Form ties shall be adjustable in length and be so constructed that no metal will be within 1 in. of finished surfaces after form removal. Wire ties shall not be used where the concrete will be exposed to weathering or to view.

2.3 FORM JOINT SEALERS. For joints between form panels, use resilient foam rubber strips, nonhardening plastic type calking compound free of oil, or waterproof pressure-sensitive plastic tape of minimum 8 mil thickness and 2" (50mm) width. For form tie holes, use rubber plugs, plastic calking compound, or equal.

2.4 MOLDS. For grooves, drips, rebates, profiles, chamfers, and similar items, smooth milled pine or douglas fir coated with specified form coating, or standard product extruded polymer plastic units of the indicated or required shapes.

PART III: EXECUTION

3.1 DESIGN REQUIREMENTS: Formwork shall be designed and erected by the Contractor in accordance with the American Concrete Institute (ACI) Recommended Practice for Concrete Formwork (ACI Standard 347) and in accordance with the following:

1. Forms shall conform to the shape, lines, and dimensions of members as called for on the drawings and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage of concrete.

2. Forms shall be properly braced or tied together to maintain position and shape under load.

3. Joints shall be leakproof and arranged vertically.

4. Lumber previously used in forms shall have nails withdrawn, and surfaces to be exposed to concrete shall be cleaned before reuse.

5. Forms shall be so placed as to be readily removable without hammering or prying against the concrete.

3.2 CORNER FORMS. All vertical and horizontal corners to be exposed when forms are removed shall have a 3/4- X 3/4-in. minimum chamfer unless indicated otherwise on the drawings.

3.3 EQUIPMENT PADS: Equipment pad sizing and location as well as anchor bolt size, type and location shall be confirmed by equipment manufacturer.

3.4 COATING

A. Apply two coatings of form oil to forms before placing concrete.

B. After application, remove surplus oil from forms, and before placing concrete, remove all oil from reinforcing steel.

3.5 EMBEDDED PIPING AND ROUGH HARDWARE. All trades which require openings for the passage of pipes, conduits, and other inserts shall be consulted and the necessary pipe sleeves, anchors, or other required inserts shall be properly and accurately installed, and equipment pads properly sized. Openings shall be reinforced as indicated and required. Conduits or pipes shall be located so as not to reduce the strength of the construction, and in no case shall pipes other than conduits be placed in a slab 4-1/2" (11 cm) or less in thickness. Conduit embedded in a concrete slab shall not have an outside diameter greater than 1/3 of the thickness of the slab nor be placed below bottom reinforcing steel or over top reinforcing steel. Conduits may be embedded in walls provided they are not larger in outside diameter than 1/3 the thickness of the wall, are not spaced closer than three diameters on center, and do not impair the strength of the structure. Embedded pipes and conduits shall be supported independently from reinforcing steel in manner to prevent metallic contact and thereby prevent electrolytic deterioration. Pipes and conduits where embedded shall be placed as nearly as possible to the center line of the concrete section. All conduit, piping and other wall penetrations, reinforcements and anchor bolt sizing and locations shall be subject to Buyer's review and approval.

3.6 REMOVAL OF FORMS AND FALSE WORK

A. Leave false work and forms in place under structural slabs, beams, and girders for 14 days after the day of the last pour except:

1. When high early strength cement is used, forms for all structures may be removed after 2 days.

2. In cold weather, this length of time shall be determined by the 2 utilizing test cylinders cured under jobsite conditions.

B. Removal all other forms in not less than 12 hr.

3.7 FILLING HOLES: Holes remaining from bolts or form ties or rods shall be filled solid with cement mortar. All excess mortar at face of filled holes shall be struck-off flush.

END OF SECTION

SECTION 03200
CONCRETE REINFORCEMENT

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100--Concrete Formwork

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

1.2 DELIVERY AND HANDLING

A. Deliver steel reinforcement in an undamaged condition, and store away from drainage ways and vehicular traffic.

B. Handle reinforcement in a manner that will avoid bending or permanent deforming of the bars.

1.3 SUBMITTALS. Submit the following in advance of fabrication in conformance with applicable requirements of General Conditions.

A. Shop Drawings. Submit shop drawings for reinforcing steel prepared in accordance with ACI 315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures". Show layouts, bending diagrams, assembly diagrams, dimensioned types and locations of all bar laps and splices, and shapes, dimensions, and details of bar reinforcing and accessories. Include layout plans for bar supports and chairs, with typical details. Dimensions and quantities shown on the shop drawings are the responsibility of the Contractor and Buyer's approval of shop drawings shall not constitute approval of dimensions and quantities thereon.

B. Samples. Submit two 12" (30.5cm) long samples of each bar support and two samples of each individual type chair, with catalog data.

PART II: PRODUCTS

2.1 MATERIALS

A. Reinforcement Bars--Conform to American Society for Testing and Materials (ASTM) A-615, Grade 40.

B. Mesh Reinforcement--Conform to ASTM A-185.

PART III: EXECUTION

3.1 DESIGN: Reinforcing details shown on the drawings shall govern the furnishing, fabrication, and placing of reinforcement. Construction shall conform to the following requirements:

1. Quantities and placement of reinforcement shall be in accordance with American Concrete Institute Standard 318 and the Manual of Standard Practice of the Concrete Reinforcing Steel Institute.

2. Splices

   a. Splices of bars shall be made only where shown on the plans or as approved by the engineer. Where bars are spliced they shall be lapped at least 30 bar diameters unless otherwise shown on the plans.

   b. Splicing shall be accomplished by placing the bars in contact with each other and wiring them together with annealed steel wire, 16 gage minimum.

   c. Welding of reinforcing steel will not be permitted unless specifically authorized by the Buyer.

3.2 PLACING OF REINFORCEMENT

A. Before placing, thoroughly clean all reinforcement of rust, dirt, mill scale or coatings, and other material which would reduce the bond.

B. Reinforcement appreciably reduced in section shall not be used.

C. Following any substantial delay in the work, previously placed reinforcement left for future bonding shall be inspected and cleaned.

D. Do not bend or straighten reinforcement in a manner that will injure the material.

E. Heating of reinforcement for bending or straightening will not be permitted.

F. Torch cutting of reinforcing steel will not be permitted.

G. Reinforcement shall be accurately placed and securely tied at all intersections and splices with 16-gage black annealed wire and shall be securely held in position

during the placing of concrete by spacers, chairs, and approved supports.

H. Welded Wire Mesh. Install necessary supports and chairs to hold in place during concrete pours. Straighten mesh to lay in flat plane and bend mesh as shown or required to fit work. Laps shall be no less than one complete mesh unless otherwise detailed. Tie every other wire at laps.

END OF SECTION

SECTION 03300--CAST-IN-PLACE CONCRETE

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03100--Concrete Formwork

B. Section 03200--Concrete Reinforcement

C. Section 03400--Precast Concrete

1.2 APPROVALS

A. Obtain written approval from the Buyer before placing concrete.

B. Obtain approval for each individual pour or structure.

1.3 DESIGN CRITERIA

A. The design of the concrete mix, that is, the exact proportion of cement, aggregates, additives, and water, shall be the responsibility of the Contractor.

B. The proposed mix shall be submitted for approval 10 working days prior to placing concrete.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Temperature--Do not place concrete unless the atmospheric temperature in the shade is above 40 degrees F and rising (except as noted below).

B. Weather--Do not place concrete in rainy weather.

C. Cold Weather Concreting

1. Obtain permission from Buyer before doing any cold weather concreting.

2. Perform concrete work in accordance with American Concrete Institute (ACI) Standard 306 when the mean daily temperature is 40 degrees F or there is a danger of the temperature falling below 32 degrees F.

PART II: PRODUCTS

2.1 MATERIALS

A. Cement

1. Portland Cement: Conform to American Society for Testing and Materials (ASTM) C150, Type I or Type II.

2. Air-Entraining Portland Cement: Conform to ASTM C150, Type IA or IIA, low alkali.

3. High Early Strength Portland Cement: Conform to ASTM C150, Type III.

B. Aggregate

1. Aggregate for Regular-Weight Concrete: Conform to ASTM C33.

2. Aggregate for Lightweight Concrete: Conform to ASTM C330.

3. Coarse aggregate shall be 3/4- to 1-1/2-in. maximum size.

C. Water--Clean and potable.

D. Admixtures

1. Air Entraining: Conform to ASTM C260.

2. Obtain approval for use of admixtures (except air entraining).

E. Expansion Joint Material

1. For vertical application, use self-expanding cork or sponge rubber conforming to ASTM D1752.

2. For horizontal application, use nonextruding asphalt-impregnated fiber material conforming to ASTM D1751.

F. Curing Materials

1. Water-Proof Paper: Conform to ASTM C171, Type I or Type II.

2. Polythylene Sheeting: Minimum 4 mils thick, white color.

3. Curing Compound: Conform to ASTM C309, Type 2, having a white-pigmented base.

2.2 PROPORTIONING OF CONCRETE

A. Concrete shall be proportioned in accordance with ACI Standard 211.1 to attain the required design strength.

B. Air entrainment shall be used in concrete for all structures that will be exposed to freezing and thawing.

C. The concrete shall have a slump appropriate for the selected work. Slump shall not be less than 1 in. nor greater than 4 in. except as authorized by the Buyer.

D. Concrete shall be designed to develop the minimum compressive strength as shown on the drawings. When the compressive strength is not indicated on the drawings, it shall be a minimum of 4,000 PSI at 28 days.

2.3 MIXING OF CONCRETE

A. Concrete shall be mixed in accordance with ACI Standards 318 and 304.

B. Transit-mixed concrete shall be mixed and delivered in accordance with ACI Standard 304.

C. When necessary for proper control of concrete, mixing of transit-mixed concrete shall be done at site of concrete placement.

PART III: EXECUTION

3.1 PREPARATION FOR PLACING CONCRETE

A. Remove water and mud from excavation.

B. Remove hardened concrete, wood chips, ice, and other debris from the interior of forms.

C. Oil or wet forms just prior to placing concrete.

D. Notify other crafts so they may deliver anchors for other work. Obtain their assistance in setting anchors if required.

E. Moisten absorptive foundations against which concrete will be placed.

3.2 PLACING CONCRETE

A. Concrete shall be placed in accordance with ACI Standards 318 and 304.

B. Concrete shall be placed in forms within 60 min. from the time of introduction of cement and water.

C. Do not retemper concrete.

D. Deposit concrete as close as practicable to its final position. Do not drop concrete more than 5 ft.

E. Place concrete in continuous horizontal layers; the depth of each layer shall not exceed 12 in.

3.3 MECHANICAL AGITATION

A. Immediately after depositing, compact the concrete by means of mechanical vibrators. Slabs may instead be compacted by means of grid tampers when approved by the Buyer.

B. Vibrator shall be flexible electric type or approved compressed-air type.

C. Do not place vibrator against reinforcing or forms or use vibrator to transport concrete within forms.

3.4 FINISHING CONCRETE

A. Smooth Finish--Give smooth finish to all exterior concrete surfaces, except slabs, that will be exposed to view.

1. Thoroughly wet and then brush coat surfaces with cement grout (one part Portland cement to two parts fine aggregate mixed with water to consistency of thick paint).

2. Spread grout with sponge or wood float to fill all pits and surface irregularities.

3. Scrape off excess grout and rub surface with burlap to remove visible grout film.

4. In hot weather, keep grout damp by means of fog spray during the setting period.

B. Rubbed Finish--Give rubbed finish to interior concrete surfaces, except slabs, that will be exposed to view.

1. Give smooth finish as specified above, then rub with carborundum stones and water.

2. Do not use mortar or grout during rubbing.

3. Remove excess mortar that is worked up during rubbing.

C. Monolithic Slab Finish--Give monolithic finish to interior floor slabs.

1. Compact fresh concrete and screed to required elevation.

2. Float to a true, even plane with no coarse aggregate visible.

3. After surface moisture has disappeared, steel trowel floor slab to a smooth, even finish, free from trowel marks.

D. Broomed Finish--Give broomed finish to all trading surfaces of docks, walks, and steps exterior to the building.

1. Give monolithic finish as specified above, except immediately after steel troweling brush surface with a stiff bristle brush.

2. Brush in parallel strokes at right angles to the normal flow of traffic.

E. Slab Flatness Tolerances--Finished cast-in-place slabs shall not vary more than 1/8 in. from a 10-ft. straightedge.

3.5 CURING: Protect concrete against loss of moisture for at least 7 days by using one of the following methods for the surfaces indicated:

1) Vertical Surfaces and Under Surfaces of Beams and Elevated Slabs

a) Moist cure with forms in place for the full curing period, or

b) Cover with wet burlap, or

c) Fog spray.

2) Slabs Ongrade and Floor Slabs

a) Cover with water-proof curing paper or polyethylene sheet, lapped 4 in. at joints and sealed with tape or

b) Cover with burlap or cotton mats and keep such covering continuously wet.

3) Exterior Walks, Docks, and Stairs

a) Apply curing compound in a two-coat continuous operation using a minimum of 1 gal. per 200 ft^2 for each coat. Apply second coat at right angles to direction of first coat or

b) use method indicated in paragraph 1) above.

c) Do not use curing compound on concrete surface to which future concrete will be bonded.

3.6 PATCHING

A. Immediately after removal of forms, remove all fins and loose material.

B. Chip out to solid concrete all honeycomb, aggregate pockets, and voids over 3/4 in. in diameter.

C. Fill chipped holes with epoxy mortar or neat cement grout. Finish holes flush to adjacent surfaces.

D. Damp cure patchwork for 72 hr.

3.7 FIELD QUALITY CONTROL

A. Sample-Taking

1. Preparation of concrete samples and testing of such samples shall be the responsibility of the Government.

2. The Contractor shall provide assistance in obtaining concrete samples.

3. The buyer may take three test cylinders from each placement of 50 yd^3 or fraction thereof.

B. Compression Tests

1. Test cylinders shall be made in accordance with ASTM C31 and tested in accordance with ASTM C39.

2. One cylinder will be tested at 7 days, one at 28 days, and one retained as a spare.

C. Slump Tests--Slump of concrete shall be determined at point of discharge from the mixer in accordance with ASTM C143.

END OF SECTION

SECTION 03400 PRECAST CONCRETE

PART I: GENERAL

1.1 Provide shop/erection drawings prepared by State of Colorado licensed Civil Engineer showing exact profile and size of each unit, steel reinforcement, lifting inserts and other pertinent details related to fabrication, handling and installation. Setting plans shall show connections and anchorage to supports, conditions to receive work of other trades and method of installation.

PART II: PRODUCTS

2.1 FABRICATION. Accurately produce respective precast units true size and configuration shown. Work shall be performed by manufacturer and crews experienced by production and handling of precast concrete.

A. Reinforce each unit as detailed, and additionally as designed by State of Colorado Licensed Civil Engineer to withstand entailed loads in handling, movement and installation.

B. Equip units with approved lifting devices for safe handling and ease of installation.

C. Finish exposed surfaces with dense smooth troweled finish free of flaws and irregularities, and true to required configurations. Top surfaces and exposed edges of units shall have uniform color and texture per requirements of Section "Concrete Finishing".

D. Cure precast units to 4,000 PSI minimum compressive strength, as verified by compressive cylinder tests, before installation.

E. Precast units damaged during handling or storage shall be repaired or replaced as directed.

PART III: EXECUTION

3.1 In fully coordinated manner with work of other trades, deliver and accurately and securely install work of this Section in a timely manner to prevent delay to job progress.

A. Align and secure precast units in accordance with drawings and approved shop/erection drawings.

B. Neatly finish work, and remove from the site all surplus materials and rubbish attributed to this work.

END OF SECTION

SECTION 03600--GROUT

PART I: GENERAL

1.1 DELIVERY AND STORAGE: Store all grouting materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

PART II: PRODUCTS

2.1 GROUT

A. Composition shall be one part Portland cement and three parts sand.

B. Add water to create a stiff mixture.

C. Minimum compressive strength shall be 1,500 PSI at 28 days.

D. Discard grout not placed after 1 1/2 hr.

PART III: EXECUTION

3.1 GROUTING

A. Pack grout tightly around well casings, pipe or conduit in penetrations through masonry or concrete walls and other locations as called for or shown on the drawings.

B. Smooth exposed surfaces of grout to blend with adjacent surfaces.

END OF SECTION

SECTION 03601--NONSHRINK GROUT

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE: Structural steel, base plates, anchoring devices, and leveling shims: Section 15050.

1.2 DELIVERY AND STORAGE: Store all nonshrink grouting materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

PART II: PRODUCTS

2.1 MATERIALS

A. Nonshrink grout for setting column bases, anchor bolts, equipment, and other items shown on the drawings shall be one of the following types:

1. EMBECO (premix): As manufactured by Master Builders Company.

2. Ceilcote 648: As manufactured by The Ceilcote Company, Inc.

B. Adhesive for Ceilcote Grout--Ceilcote 348 Adhesive Fast Set as manufactured by The Ceilcote Company, Inc.

C. Portland Cement--Conform to American Society for Testing Materials (ASTM) C150, Type I.

D. Sand--Conform to ASTM C33, Fine Aggregate.

E. Pea Gravel--Conform to ASTM C33, Coarse Aggregate, graded so that at least 90% passes 3/8-in. sieve and 90% is retained by a No. 4 sieve.

2.2 MIXES

A. EMBECO Grout

1. For less than 2-in. clearances or where size or shape of space makes grouting difficult, use standard EMBECO grout and water.

2. For greater than 2-in. clearances where coarse aggregate will not obstruct free passage of the grout, use EMBECO grout with 3/8-in. aggregate (premixed).

3. Use the minimum amount of water necessary to produce a flowable grout without causing either segregation or bleeding. After the grout has been mixed, do not add more water for any reason.

B. Ceilcote Grout--Mix according to manufacturer's instructions.

C. Portland Cement Mortar for Raked-Out Edges of EMBECO Grout--One part Portland cement, two parts sand, and 0.50 parts water by weight.

PART III: EXECUTION

3.1 FORMWORK

A. Build leakproof forms that are strong and able to withstand grout pressures.

B. Provide enough clearance between the formwork and the area to be grouted to permit proper placement of grout.

3.2 SURFACE PREPARATION

A. Clean concrete surfaces to be grouted of all defective concrete, dirt, oil, grease, and other foreign matter.

B. Lightly roughen the concrete.

C. Remove grease and foreign materials from all steel surfaces in contact with grout.

D. Align, level, and maintain final positioning of all components to be grouted.

E. Saturate all concrete surfaces with clean water, remove excess water, and leave none standing.

3.3 PLACING

A. Place nonshrink grouting quickly and continuously by the most practical means permissible: pouring, pumping, or under gravity pressure. Do not use either pneumatic-pressure or dry-packing methods without written permission.

B. Where practicable, apply grout from one side only to avoid entrapping air.

C. Do not vibrate the placed grout mixture or allow it to be placed if the area is being vibrated by nearby equipment.

D. Do not remove leveling shims for at least 48 hr. after grout has been placed.

E. After the EMBECO grout has reached initial set, rake out all exposed edges approximately 1/2 in. into the grouted area and point with cement-sand mortar or grout.

3.4 CURING: Cure grout for 3 days after placing by

END OF SECTION

SECTION 05400--LIGHTGAGE FRAMING

PART I: GENERAL

SUBMITTALS: Submit erection manual and catalog data for substitute manufacturer. See section entitled Special Conditions.

PART II: PRODUCTS

2.1 MANUFACTURER: Lightgage framing shall be as manufactured by the Porta Fab Corporation.

2.2 MATERIALS

A. Screw-On Metal Studs, non-load (axial) bearing type. Conform to ASTM C645 and the following:

1. Standard Studs. Roll formed from minimum 25 and 20 gage electrogalvanized steel with utility openings punched in stud webs at 24-in. (0.61m) centers maximum. Flanges shall be 1-1/4 in. (31.75mm) in width or greater, and shall have stiffening hems or returns. For structural studs, use same studs, except fabricated of 16 gage steel. Provide 6 in. (15.2cm) or larger studs where necessary to contain utilities and other work in walls; Contractor shall coordinate the related trades. Unless otherwise shown, studs shall be 3-1/4 in. (8.255cm).

2. Stud Height. Gages specified above are minimum. Wherever required stud heights exceed Building Code approvals, provide heavier gage or additionally stiffened studs and/or decrease stud spacing as is necessary to conform to Code approvals at no extra cost to Owner.

3. Stud Accessories. Provide standard related accessories, such as floor and ceiling runners, clips, bridging, fasteners, and the like, of same manufacture as each type of stud specified, as required to make complete and proper installations.

B. Furring and Runner Channels. Hot-rolled or cold rolled steel channels coated with rust-inhibitive paint, and weighing before coating, per 1,000 lin. ft. (304.8m) not less than:

Size	Hot-Rolled	Cold-Rolled
3/4 in. (19mm)	300 lbs (136.1 kg)	300 lbs (136.1 kg)
1-1/2 in. (38mm)	1120 lbs (508 kg)	475 lbs (215.5 kg)
2 in. (50.8mm)	1260 lbs (573.8 kg)	590 lbs (267.6 kg)

C. Screw-On Furring Channels. Formed of minimum 0.022 in. (0.559mm) thick steel, full galvanized, minimum 1-3/8 in. (34.9mm) face width, 2-3/4 in. (69.8mm) base span, and 7/8 in. (22.2mm) furring depth.

D. Wires. Soft-annealed galvanized steel wires, 8 gage for hanger wires and 16 gage for framing, unless otherwise specified.

E. Screws. Corrosion-resistant self-tapping bugle-head spiral-thread type, minimum 1 in. (25.4mm) long for securing first layer of gypsum wallboard and minimum 1-5/8 in. (41.3mm) long for securing second layer of gypsum wallboard, conform to ASTM C646.

F. Attachment Devices for Framing. 3/16 in. x 1-1/4 in. (4.8mm by 31.8mm) power driven studs for anchorage of studs and stud tracks to concrete; self-tapping, #6 Phillips bugle head screws for 22-gage and lighter material x lengths as required; heavy-duty self-tapping Phillips head screws for 20-gage and heavier material x lengths as required; power driven devices for anchorage of furring channels to concrete.

G. Gypsum Board. See Section 09250.

2.3 FINISH: All light-gage steel members shall be galvanized.

PART III: EXECUTION

3.1 INSTALLATION

A. Studs shall be set 16 in. on center and spaced by bridging as shown on the drawings.

B. Finished framing shall be plumb, neat in appearance, and free from defects.

3.2 FIELD CONNECTION

A. Welded as recommended by manufacturer.

B. Self-drilling, self-tapping sheet metal screws or bolts.

END OF SECTION

SECTION 07201 -- METAL BUILDING INSULATION

PART I: GENERAL

1.1 DELIVERY AND STORAGE

A. Deliver insulation materials to jobsite in manufacturer's original containers or bundles. Do not open until inspected by the Buyer.

B. Protect materials from contact with soil and moisture during storage.

1.2 ENVIRONMENTAL CONDITIONS: Building interior must be dry and free of all condensation and moisture during installation of insulation.

PART II: PRODUCTS

2.1 Insulation for side walls shall be Owens-Corning metal framing commercial wall insulation 3-1/2 in. thick x 16 in. wide.

2.2 Insulation for ceiling shall be 3-1/2 in. fiberglass with foil backing.

PART III: EXECUTION

3.1 CEILING INSULATION

A. Install foil side down (toward room).

B. Butt against all surrounding structural members.

3.2 WALL INSULATION

A. Butt tight against all surrounding structural members.

B. At eaves, install insulation in any cavities that may be left between structural member and ceiling insulation.

C. Apply adhesive at top of insulation to prevent settling away from sill at eave.

END OF SECTION

SECTION 07900--CAULKING AND SEALANTS

PART I: GENERAL

1.1 LOCATION: Apply sealant around the following locations:

1. Door frames and thresholds.
2. Expansion joints.
3. Roofing penetrations, collars, and flashings.
4. Elsewhere as shown on the drawings.

1.2 DELIVERY AND STORAGE OF MATERIALS

A. Deliver and store materials in original packages until ready to use.

B. Store in a manner that will prevent damage by water, freezing, breakage, or contact with foreign materials.

PART II: PRODUCTS

2.1 MATERIALS

A. Silicone Sealant--Silpruf SCS-1300, one part primerless silicone sealant, as manufactured by General Electric.

B. Backup Rod

1. Backup rod shall be extruded, flexible, compressible, polyethylene foam, designed for backup of elastomeric cold applied sealants.
2. Diameter: 25% to 50% greater than the joint width.

C. Bond Breaker--Polyvinyl chloride electrical tape with adhesive back.

D. Acoustical Sealant.--Where designated or required at interior and acoustic partitions, use: "Acoustical Sealant" produced by USG, Tremco, or equal products.

PART III: EXECUTION

3.1 PREPARATION

A. Surfaces of joints to be sealed shall be clean, dry, and free from oil, dirt, frost, and foreign matter.

B. Use backup rod for wide joints when recommended by manufacturer of sealant.

C. Ambient temperature shall be between 40 degrees and 100 degrees F when sealant is applied.

D. Thoroughly wash concrete and masonry surfaces to remove soluble alkaline salts.

E. Clean metal surfaces of corrosion by wire brushing or using chemical cleaners as recommended by sealant manufacturer.

3.2 APPLICATION

A. General

1. Sealant shall be uniformly smooth and free of wrinkles.

2. Apply sealant sufficiently convex to result in a flush joint when dry.

3. Follow manufacturer's recommendations.

B. Door Frames

1. Apply sealant bead around frames in concrete or masonry walls.

2. Gaps larger than 1/2 in. between frame and opening shall be grouted in by other trades.

C. Thresholds

1. Set metal thresholds in sealant bed at least 1/8 in. thick.

2. Secure threshold in place with minimum of three expansion screws.

3. Remove excess sealant around edges.

D. Expansion Joints--Clean joints, apply bond breaker, and apply silicone sealant.

3.3 CLEANUP: Clean all sealant from adjacent surfaces.

END OF SECTION

SECTION 07901--PIPE PENETRATIONS

PART I: GENERAL

1.1 LOCATION. Apply calking or sealant as follows: at pipe, duct, and conduit penetrations; exterior and interior walls; ceilings; floor slabs; penetrations between contaminated and contaminated zones; and as noted unless otherwise shown on the contract drawings.

1.2 DELIVERY AND STORAGE OF MATERIALS

A. Deliver and store materials in original packages until ready to use.

B. Store in a manner that will prevent damage by water, freezing, breakage, or contact with foreign materials.

PART II: PRODUCTS

2.1 MATERIALS

A. Silicone Sealant: General Electric silicone white Silpruf sealant shall be installed in accordance with manufacturer's recommended procedure.

B. Polyurethane Sealant: For floors use Vulkem 45 as manufactured by Mameco International,, one part, pourable, primerless, self-leveling sealant, gray in color, and conforming to Federal Specification TT-S-00230 C, Type 1 (Class A).

C. White Oakum: Twisted jute packing to commercial standards, imbedded with bentonite.

D. Pipe Sleeve: Schedule 40 galvanized pipe or fabricated from zinc-coated steel sheet having a nominal weight of not less than 1.656 psf. Length shall be sufficient to pass through the entire thickness of the wall and floor.

PART III: EXECUTION

3.1 PREPARATION

A. Surfaces of joints to be sealed shall be clean, dry, and free from oil, dirt, frost, and foreign matter. Fresh concrete at joints to be sealed shall have cured for at lest 7 days prior to sealing.

B. Ambient temperature shall be above 40 degrees F and below 100 degrees F when sealant is applied.

C. Clean metal surfaces of corrosion by wire brushing or using chemical cleaners.

3.2 APPLICATION

A. General

1. Sealant shall be uniformly smooth and free of wrinkles.

2. Apply sealant sufficiently convex to result in a filled joint that is flush after sealant has dried.

3. Follow manufacturer's recommendations.

B. Pipe Penetrations

1. Concrete Block Walls: Drill or cut for a snug fit with the pipe sleeve or cast in place with mortar.

2. Light-Gage Metal Walls and Permanent-Type Ceilings: Drill for a snug fit with the pipe or pipe insulation. Seal around the pipe on both sides of the wall or ceiling with sealant.

3. Banker Partitions and Suspended Ceilings: Drill for a snug fit with the pipe or pipe insulation. Sealing is not required.

4. New Concrete Walls: Cast pipe sleeve in place.

5. Existing Concrete Walls: Drill for snug fit with the pipe sleeve.

6. Concrete Floors (other than floors on grade): Drill for a snug fit with pipe sleeve. Pipe sleeve extend a minimum of 2 in. above the floor.

C. Sleeving

1. The space between the pipe and pipe sleeve or insulation and sleeve shall not be less than 1/2 in. and shall be firmly packed with white oakum and sealed on both ends with a minimum of 1 in. of sealant.

2. Seal between pipe sleeve and penetration with sealant. Seal around sleeve and concrete on both sides of penetration with a 1/4-in. bead of sealant.

3. Use Link-Seal where shown on drawings.

3.3 CLEANUP: Clean all sealant from adjacent surfaces.

SECTION 08100--HOLLOW METAL DOORS AND FRAMES

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 08700--Finish Hardware

B. Section 08800--Glazing

C. Section 09900--Field Painting

1.2 QUALITY CONTROL--CERTIFICATIONS

A. Furnish certification of label construction for doors not requiring labels but requiring labeled construction.

B. Heat transmission test shall be certified by an approved independent testing laboratory.

1.3 SUBMITTALS--SHOP DRAWINGS

A. Submit shop drawings covering each type of door and frame, frame conditions, and complete anchorage details, supplemented by suitable schedules covering doors and frames.

B. Show glass and louver opening sizes and locations in doors.

C. Indicate size, gage, and location of reinforcement for hardware on drawings.

D. Detail connections of hollow metal work to structural steel framing concealed in hollow metal work.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle hollow metal work in a manner to prevent damage and deterioration.

B. Store doors upright in a protected dry area at least 1 in. off the ground or floor and at least 1/4 in. between individual pieces.

C. Protect exposed finish surfaces of prefinished items with masking tape.

PART II: PRODUCTS

2.1 BASIC MATERIAL

A. Sheet steel for frames shall be hot-rolled carbon steel.

B. Sheet steel for doors shall be cold-rolled stretcher level sheet steel.

2.2 FRAMES

A. Frames for new and existing concrete and masonry opening shall be rough buck and cabinet jamb type. If an existing opening is too small to accept a standard rough buck jamb, a combination jamb may be used.

B. Frames for metal stud walls shall be combination buck, frame, and trim type.

C. Minimum Gage--14 gage for all frames.

D. Corner joints shall have all contact edges closed tight with faces and stops continuously welded and ground smooth. Knockdown-type frames are not acceptable except for rough buck and cabinet jamb type.

E. Form 5/8-in. minimum stop integral with frame.

F. Provide three holes for each strike jamb and two holes for header of double frames for application of door silencers.

G. When possible, provide frames with 14-gage floor clips welded to each jamb member.

H. Provide two 16-gage steel spreaders for double-rabbeted frames tack welded to the bottom of both jambs.

I. Anchors

1. Masonry Anchors: Provide frames anchored into masonry with four 3/8-in. J-bolts per rough buck jamb for doors to 7 ft. and one additional anchor per jamb for each 18 in. of height over 7 ft.

2. Steel Stud Anchor: Provide frames anchored to steel studs with three 16-gage Z-shaped anchors per jamb for doors to 7 ft. and one additional anchor per jamb for each 18 in. of height over 7 ft.

3. Bolt Anchors: Provide frames anchored into existing conditions with four 3/8-in. minimum-bolt-type anchors per rough buck jamb for doors to 7 ft. and one additional anchor per jamb for each 18 in. of height over 7 ft.

2.3 DOORS

A. All doors shall be 1-3/4 in. thick with continuously welded edges, dressed and ground smooth and with no visible seams on door faces or vertical edges.

B. Face sheets shall be 16-gage steel for doors up to 3 ft. 6 in. wide. Doors 3 ft. 6 in. and wider shall have 12-gage face sheets, except where label requirements specify 16 gage.

C. Internal Stiffeners

1. Surface sheets shall be supported by Z-channel or continuous truss members not less than 16 gage (28 gage for continuous truss), spaced not more than 6 in. on center and internally spot welded to both surface sheets not more than 4 in. on center.

2. Top and bottom edges of all doors shall be closed flush with continuous 16-gage channel members extending full width of door.

3. Edges of doors shall be supported by 16-gage interior edge channels extending full height of door.

D. Interior surfaces of door shall be treated with a sound-deadening material to eliminate metallic ring.

E. Clearances

1. Between doors and frames at head and jamb, 1/8 in.

2. At still where no threshold is used, 1/2 in. Where threshold is used, 1/8 in. between door and threshold.

3. Between meeting edge of doors in pairs, 1/8 in.

4. Bevel edges of single-acting doors, 1/8 in. in 2 in.

2.4 PREPARATION FOR FINISH HARDWARE

A. Doors and frames shall be factory reinforced, drilled, and tapped for mortise template hardware in accordance with the approved hardware schedule. Obtain current hardware templates from hardware supplier.

B. Provide welded-in reinforcing plates for surface-applied hardware.

C. Frame Reinforcement--Thicknesses and sizes for frame reinforcement shall be as follows:

1. Butt Hinges: 3/16-in. plate 9 in. long and full width of the frame profile.

2. Closer: 12-gage channel section 12 in. long and full width of frame trim.

3. Reinforcements for Strikes, Flush Bolts, and All Other Surface-Mounted Hardware: 12 gage.

END OF SECTION

SECTION 08210--WOOD DOORS

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 08700--Hardware and Specialties

B. Section 09900--Painting

C. Section 08100--Door Frames

1.2 SUBMITTALS: Submit shop drawings showing detail dimensions and construction details.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle in a manner to prevent damage.

B. Store doors upright, in a protected dry area, at least 1 in. off the floor.

PART II: PRODUCTS

2.1 BASIC MATERIALS

A. Veneer shall be birch.

B. Vertical edges shall be finished with birch.

C. Core shall be solid low-density wood blocking.

2.2 CONSTRUCTION

A. Doors shall be not less than five-ply construction, 1-3/4 in. thick. Width and height shall be sized for installation into metal frames 3 ft. wide x 7 ft. high with the following clearances:

- Jambs--1/8 in.
- Head--1/8 in.
- Sill--1/3 in.

B. Core--Solid-core blocking of random lengths, edge glued, and joints well staggered.

C. Vertical Edges--Minimum of 5/8-in.-thick wood matching the veneer.

D. Top and Bottom Edges--Minimum of 1-1/4-in.-thick wood. Type of wood to be mill option.

E. Veneer--Veneer and cross bonding shall be fully bonded to the core.

F. Finish--Veneer shall have a finely sanded surface.

G. Machining--Doors shall be factory-machined to receive the hardware specified. Hinge locations shall be determined and machined at the jobsite.

H. Adhesive for cross bonding and veneer shall be Type II, interior water-resistant resin.

PART III: EXECUTION

3.1 INSTALLATION

A. Door shall be properly hung to provide the clearances as specified.

B. Apply hardware in accordance with the manufacturer's templates and instructions.

C. Adjust operable parts for correct function.

D. Remove all hardware and reinstall after finish painting is complete.

3.2 INSPECTION

A. Cuts, scratches, and other imperfections in the veneer shall be repaired as directed by the owner.

B. Any door that is warped or twisted shall be replaced.

3.3 The dimensions and other requirements for the door are noted on the drawings.

END OF SECTION

SECTION 08500--METAL WINDOWS

PART I: GENERAL

1.1 DESCRIPTION: Furnish and install metal windows and frames.

1.2 SUBMITTALS: Submit catalog data fully describing products and drawings showing installation and also showing anchors, hardware, operators, and other components not included in manufacturer's standard data.

1.3 HANDLING: Protect windows and frames from breakage, scratches, and dents.

1.4 STRENGTH: Provide system with modifications and reinforcement as necessary to withstand uniform pressures from wind velocities up to 150 mph and static pressure equal to 75 lb/ft^2.

PART II: PRODUCTS

MATERIAL: All windows shall be of the commercial projected type. Members shall be welded or interlocked rigidly at joints with accurate and close fits. Welded joints shall be dressed on weathering contact surfaces and on exposed surfaces of all windows. Glass rebates shall be not less than 5/16 in. deep and provide for inside glazing. Sash shall have bonderized factory prime coat. Provide standard factory-applied hardware.

PART III: EXECUTION

Erect window units with accurately aligned and tight joints, securely anchored in place. Seal joints and entire perimeter of work, exterior, and interior. Clean surfaces and protect exposed portions of the framing from damage.

END OF SECTION

SECTION 08700--HARDWARE AND SPECIALTIES

PART I: GENERAL

1.1 SUBMITTALS

A. Submit complete listing of hardware to be furnished showing:

- Door mark number
- Government number or manufacturer specified
- Size (where applicable)
- Finish
- Proposed manufacturer and catalog number
- Quantity of each item

B. Furnish manufacturer's literature for each item for evaluation of products.

1.2 DELIVERY

A. Deliver hardware items to project site in manufacturer's original packages.

B. Hardware for each door shall be separately packaged and marked with the respective door mark number.

1.3 PROTECTION

A. Protect finish hardware from damage and marring of finish.

B. Any hardware which becomes damaged or marred prior to final acceptance shall be replaced with new, identical items.

PART II: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Door hardware shall be the standard products of the following manufacturers:

- Best
- Corbin
- Von Duprin
- Standley
- Russwinn

B. Substitute manufacturers will be accepted only by submittal when approved manufacturer is not available.

2.2 MATERIALS

A. Butt Hinges

1. Butt hinges shall be heavy-duty wrought steel, full mortised, five knuckle ball bearing, nonrising (and on exterior doors nonremovable), loose-pin hinges.

2. Conform to Federal Specification FF-h-16c, Type T2115 (Stanley FBB-168).

3. Furnish three 4-1/2- x 4-1/2-in. butts for each door unless otherwise specified.

B. Closers

1. Closers shall be compact overhead surface-mounted type with separate spring power adjustment for general and latching speed.

2. Conform to Federal Specification FF-H-121c, Type 3001, Size V (Norton Series 1600).

3. Furnish regular arm with closer unless hold-open or fusible-link feature is specified in the hardware schedule.

C. Locksets

1. Locksets and latchsets shall be cylindrical, full-mortise types.

2. Conform to Federal Specification FF-H-00106b, Series 86, with 4S trim (Corbin 7500 series with antifriction latchbolt).

3. The function for each lockset shall be as specified in the hardware schedule.

D. Exit Devices

1. Exit (panic) devices shall be mortise-lock types. Vertical-rod exit devices shall have rods completely concealed in door.

2. Conform to federal Specification FF-H-00106b, Series 820 (Von Duprin 8800 series).

3. The function for each exit device shall be as specified in the hardware schedule.

E. Flush Bolts

1. Flush bolts shall be made of forged brass and bronze and have standard 12-in. length.

2. Conform to Federal Specification FF-H-00111b, Type 1045. (Sargent 3470.)

3. Furnish bottom flush bolt with dust-proof recessed strike.

F. Door Stops

1. Wall stops shall be of forged brass or bronze and conform to Federal Specification FF-H-00111b, type 1320 (Sargent 3372).

2. Floor stops shall be of forged brass or bronze and conform to Federal Specification FF-H-00111b, type 1328 (Sargent 3374).

G. Fastenings of suitable size, quality, and type shall be provided to secure hardware in position. Machine screws and expansion shields shall be provided for securing items of hardware to concrete or masonry.

H. Miscellaneous materials and components (coordinating devices, kickplates, etc.) not indicated in this article shall be as specified in the hardware schedule.

2.3 FINISH: The exposed surfaces of all finish hardware items shall be dull bronze, U.S. 10, unless otherwise specified.

2.4 KEYING

A. All locksets and deadbolts shall be a type that will accept Best 1E64 cylinder.

B. Cores and keys will be furnished and installed by the Buyer.

C. Cylinders shall be furnished and installed by the Buyer.

PART III: EXECUTION

3.1 HARDWARE INSTALLATION

A. Install hardware items in accordance with manufacturer's recommended instructions and templates.

B. Hinges

1. Install top hinge with center of hinge not more than 9 in. below top of door.

2. Install bottom hinge with center of hinge not more than 12 in. above finish floor.

3. Install intermediate hinges equidistance between top and bottom hinges.

C. Door Closers

1. Install in accordance with templates and instructions furnished by manufacturer.

2. Mount closer on room side of door.

D. Locks, Latches, and Strikes--Center strike of knob locks and knob latches 40-1/2 in. above finish floor

E. Weatherstripping

1. Install on metal frames and doors in accordance with installation instructions furnished.

2. Fit tightly at corners to maintain continuity around door.

3.2 CLEANING AND ADJUSTING

A. Before final acceptance, clean and adjust all hardware.

B. Demonstrate correct function of hardware in presence of Buyer.

3.3 HARDWARE SCHEDULE

A. The quantity, function, and other requirements of finish hardware items for each door are noted on the hardware schedule.

B. Hardware items for each door is identified by a door mark as shown on the drawings.

END OF SECTION

SECTION 08800--GLAZING

PART I: GENERAL

1.1 DELIVERY AND STORAGE

A. Deliver glass with manufacturer's label intact. Do not remove label until all glass has been installed and inspected.

B. Store all materials in a clean, dry, protected area.

1.2 PROTECTION

A. Protect glass from plaster, welding, or other work that may cause damage.

B. Identify glazed openings with colorful flagging that are removably attached to heads and jambs. Do not attach labels, tapes, or markings directly to the glass.

PART II: PRODUCTS

2.1 MATERIALS

A. Sheet glass shall be flat drawn, B quality, clear, and 1/4 in. thick, as manufactured by Pittsburgh Plate Glass Company.

B. Glazing compound shall be Silicone Construction Sealant as manufactured by General Electric in Aluminum Color SE-1209. Primer shall be Silicone Prime SCP-153 as manufactured by General Electric.

C. Glazing tape shall be performed synthetic polymer-based resilient tape, self-adhering, Pittsburgh Plate Glass Company Duribbon 1072.

PART III: EXECUTION

3.1 INSPECTION

A. All surfaces of openings to receive glass shall be examined for defects insofar as glass and glazing work is affected.

B. No glazing work shall be done until such defects have been corrected.

3.2 GLAZING PREPARATION

A. Remove all rivet, screw, bolt, or other projections from specified clearances in the glazing rabbet by grinding.

B. Clean and dry all surfaces to be glazed.

C. Apply primer in accordance with manufacturer's recommendations.

D. Remove and later rest glazing stops.

E. Seal all sash corners and fabrication intersections to make the sash weathertight.

3.3 GLASS PREPARATION

A. Determine actual dimensions of the glass required for glazed openings by measurement.

B. Glass cut to size shall have edges smooth and straight.

C. Edge clearances, tolerances, and block setting heights shall be as recommended in the Flat Glass Jobbers Association Glazing Manual GM-1965.

3.4 INSTALLATION OF GLASS

A. Glazing in Metal

1. Install glass by means of snap-in or screw-on glazing stops as standard with the manufacturer of the door or window frames.

2. Provide a positive seal between the glass and the metal on both sides of the glass by means of vinyl or neoprene glazing strips or by bedding and face-and-back puttying with the specified glazing compound.

3. Attach glazing stops, other than snap-in types, with counter sunk screws on maximum 5-in. centers.

4. Secure glass with and rest on a minimum of two spring clips or separations per side except where vinyl or neoprene glazing strips are used in connection with glazing stops.

3.5 CLEANING

A. When the glass installation has been completed and approved by the Buyer, remove all labels and any evidences of glazing work on the frames or sash.

B. Thoroughly clean all surfaces of the glass.

C. Replace any glass that has been scratched or otherwise damaged during installation.

END OF SECTION

SECTION 09250--GYPSUM DRYWALL

PART I: GENERAL

1.1 DELIVERY AND STORAGE OF MATERIALS

A. Deliver manufacturer's original containers, bundles, or packages to jobsite with seals unbroken and labels intact.

B. Store materials in an approved manner and protect from contact with soil and exposure to the elements.

1.2 ENVIRONMENTAL CONDITIONS

A. Cold Weather--Heat the building before and during the application of the joint system to maintain a minimum uniform temperature of 55 degrees F.

B. Moisture--Provide ventilation to eliminate excessive moisture.

1.3 PROTECTION: Protect adjacent work and equipment from damage during wallboard application and joint treatment.

PART II: PRODUCTS

2.1 MATERIALS

A. Gypsum Wallboard

1. Conform to American Society for Testing and Materials (ASTM) C36.

2. Gypsum wallboard for general use shall be 5/8 in. thick with tapered edges.

3. Provide in 4-ft. widths and in lengths as long as practical to eliminate butt joints.

B. Joint Tape--Conform to ASTM C475--Perf-A-Tape as manufactured by United States Gypsum.

C. Joint and Finishing Compounds

1. Conform to ASTM C475.

2. Use Perf-A-Tape Joint Compound (or All-Purpose Ready-Mixed Compound) for embedding and first-coat application.

3. Use Perf-A-Tape Topping Compound (or Perf-A-Tape Ready-Mixed Topping Compound) for fill and finishing.

D. Inside and outside vertical corner reinforcement shall be as manufactured by United States Gypsum.

E. One-inch drywall screws, Type S, shall be used to attach drywall to steel studs or furring channels in conventional construction.

2.2 MIXING OF JOINT AND FINISHING COMPOUNDS

A. Mix and use joint and finishing compounds in accordance with manufacturer's recommendations as shown on the bag.

B. Use ready-mixed materials as they come in original containers.

PART III: EXECUTION

3.1 GENERAL: Installation of gypsum wallboard shall be in accordance with American National Standards Institute Standard A97.1, The Application and Finishing of Wallboard, and the following.

3.2 INSTALLATION OF GYPSUM WALLBOARD

A. Drive screws so that the top of the screwhead is just below the wallboard surface without breaking the surface paper of the wallboard or stripping the framing member around the screw.

B. Space screws 3/8 in. to 1/2 in. from the ends and edges of the wallboard. Space screws at 12 in. on center for framing members 24 in. on center.

3.3 JOINT TREATMENT

A. Installation of Joint Tape

1. Using a suitable tool or machine, apply a thin, uniform layer of Perf-A-Tape Joint Compound, approximately 3 in. wide, over the joint to be reinforced.

2. Center Perf-A-Tape over the joint and set into the compound leaving sufficient compound under the tape to provide proper bond. Recommended procedure is to apply a skim coat of compound after embedding tape.

3. Reinforce inside and outside vertical corner angles with the Perf-A-Tape folded to conform to adjoining surfaces and to form a straight, true angle. After drying, cover the Perf-A-Tape with one coat of topping.

4. Clean excess compound from the surface of the wallboard and allow all joints to dry a minimum of 24 hr. between each application of compound.

B. Application of Joint and Topping Compound

1. Apply one coat of joint compound before or after hardening is complete in the embedding coat.

2. Apply two coats of topping compound over the joint compound. Spread each coat evenly over and slightly beyond the tapered edge area of the wallboard, and feather at the edges.

3. Apply each coat with a smooth, uniform slight crown over the joint and with the edges feathered slightly beyond the preceding coat.

C. Where Dur-A-Bead corner reinforcing is used, apply at least two coats of compound over the reinforcing as outlined in paragraph B above. When completed, the compound shall extend approximately 8 to 10 in. on either side of the exposed metal nosing.

D. Where Perf-A-Bead corner reinforcing is used, apply and conceal the reinforcing in accordance with the manufacturer's instructions.

E. Sand all coats as necessary after each application of joint compound or topping has dried. Leave all wallboard and treated areas uniformly smooth and ready to receive decoration after the final coat and sanding.

3.4 CLEANUP: Remove all misplaced and splattered joint compound from surrounding surfaces and the area of work. Leave all areas clean and dry.

END OF SECTION

SECTION 09650--RESILIENT FLOORING

PART I: GENERAL

1.1 SUBMITTALS

A. Samples

1. Submit minimum of two samples of each type and color or pattern of resilient flooring and base material.

2. Mark samples with name of Buyer, project identification, and area where materials are to be used.

B. Maintenance Materials

1. Furnish additional floor-covering materials of each size, color, pattern, and type of material included in the work.

2. Furnish materials at the rate of one carton for each 1,000 ft^2 or less.

1.2 PRODUCT DELIVERY AND STORAGE

A. Deliver materials to project site in manufacturer's original unopened containers with all identification labels intact.

B. Store and protect materials in accordance with manufacturer's directions and recommendations.

C. Unless otherwise directed, store materials in original containers at not less than 70 degrees F for not less than 24 hr immediately before installation.

1.3 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperature in space to receive tile between 70 degrees and 90 degrees F for not less than 24 hr before and 48 hr after installation.

B. Maintain minimum temperature of 55 degrees F after flooring is installed.

PART II: PRODUCTS

2.1 FLOOR-COVERING MATERIALS

A. General

1. Uniform in thickness and size.

2. Edges cut accurately and square.

3. Uniform color and patterns.

B. Standard Asphalt Tile

1. Federal Specification SS-T-312, Type I.

2. Face Size: 9 x 9 x 1/8 in. thick.

C. Vinyl Asbestos Tile

1. Federal Specification SS-T-312, Type IV.

2. Face Size: 12 x 12 x 1/8 in. thick.

2.2 BASE MATERIALS

A. General

1. Uniform in thickness.

2. Lengths as long as practicable to suit conditions of installation.

B. Rubber Base

1. Federal Specification SS-W-40, Type I.

2. Six in. high, coved, flat, or carpet style.

C. Standard Vinyl Base

1. Federal Specification SS-W-40, Type II.

2. Six in. high, coved, flat, or carpet style.

D. Factory Premolded Corners--Match base materials.

2.3 APPLICATION MATERIALS

A. General--Provide type and brands of adhesive as recommended by manufacturer of covering material for the conditions of installation.

B. Asphalt Emulsion Adhesive--Federal Specification MMM-A-115, Class II.

C. Asphalt Cutback Adhesive--Federal Specification MMM-A-110.

D. Wax, Cleaner, or Other Finishing Material--As recommended by floor covering manufacturer.

PART III: EXECUTION

3.1 INSPECTION OF SURFACES

A. Examine substrate for conditions that would affect execution and quality of resilient flooring as specified.

B. Correct defects before proceeding with installation.

3.2 PREPARATION

A. Remove dirt, oil, grease, or other foreign matter from surfaces to receive flooring.

B. Fill cracks less than 1/16 in. wide and depressions less than 1/8 in. deep with crack filler. Other defects shall be corrected by the trades involved.

3.3 APPLICATION OF ADHESIVES

A. Mix and apply adhesives in accordance with manufacturer's instructions.

B. Provide safety precautions during mixing and application as recommended by adhesive manufacturer.

C. Apply uniformly over surface with notched trowel.

3.4 INSTALLATION OF TILE MATERIALS

A. Lay tile to center of room or space.

B. Work toward perimeter.

C. Cut border tile neatly and accurately to fit within 1/32 in. of abutting surfaces.

D. Lay tile parallel to room axis in straight courses; lay tile with grain or pattern running in a perpendicular direction between adjacent tile.

3.5 INSTALLATION OF BASE

A. Install base around perimeter of room or space and at toe spaces of casework of cabinets.

B. Cut into accurate lengths for minimum number of joints.

C. Match edges at all seams or double-cut adjoining lengths.

D. Apply adhesive and firmly adhere to wall.

E. Press down so bottom cove edge follows floor profile.

F. Form internal corners coping and bending around corner.

G. Form external corners by using premolded corners.

3.6 FINISHING AND CLEANING

A. Upon completion of installation of floor covering, adjacent work, and after materials have set, clean surfaces with a neutral cleaner as recommended by flooring manufacturer.

B. Apply two coats of nonslip wax and buff to a sheen.

C. Protect completed work from traffic and damage.

END OF SECTION

SECTION 09900--PAINTING

PART I: GENERAL

1.1 QUALITY ASSURANCE

A. Include on label of containers:

- Manufacturer's name
- Type of paint
- Manufacturer's stock number
- Color
- Instructions for application
- Paint analysis

B. Field Quality Control

1. Request review of first finished room, space, or item of each color scheme required by Buyer for color, texture, and workmanship.

2. When required by Buyer, paint surface not smaller than 50 ft^2 as project standard for selected types of paint.

1.2 SUBMITTALS

A. Furnish test samples of materials when required by the Buyer.

B. Color Samples

1. Submit color samples or charts from which final colors shall be selected by the Buyer.

2. Colors indicated in the paint schedule shall be matched as closely as possible.

C. Submit proposed paint and color schedule for approval, including for each item:

- Surface to be painted
- Type of paint
- Special thinners required, if any
- Color
- Special surface preparation required

1.4 PRODUCTS DELIVERY AND STORAGE

A. Delivery of Materials--Except for locally mixed custom colors, deliver materials in sealed containers with labels intact and legible.

B. Storage of Materials

1. Paint materials and related equipment shall be stored outside of the building in the area assigned by the Buyer.

2. The Contractor shall provide storage facilities adequate to protect the paint materials and equipment from inclement weather. The storage facilities shall have adequate ventilation. During cold weather, the storage facilities shall be heated to not less than the minimum recommended by the paint products manufacturer and at no time shall the temperature be below 35 degrees F.

3. At the end of each work day, all paint materials shall be removed from the work area and properly stored.

4. The Contractor shall obtain approval from the Buyer for all paint storage facilities used at the jobsite. All storage facilities used on the jobsite will be subject to inspection at any time by the Buyer's fire inspector.

1.5 JOB CONDITIONS

A. Environmental Conditions

1. Comply with manufacturer's recommendations for environmental conditions under which coatings and coating systems can be applied.

2. Do not apply finish in areas where dust is being generated.

3. Provide adequate ventilation when using flammable or toxic paint materials.

B. Protection

1. Cover or otherwise protect surfaces not being painted.

2. Furnish fire-retardant protective coverings. Do not use flammable material for protective coverings unless special permission is obtained from the Buyer.

PART II: PRODUCTS

2.1 MATERIALS

A. Materials selected for painting systems for each type of surface shall be the products of a single manufacturer.

B. Other products not specified, but required for the job, shall be "first-line" products designed for the intended use.

2.2 COLORS: Colors of paints shall match color chips selected by the Buyer.

2.3 MIXING AND TINTING

A. Deliver paints ready mixed to jobsite.

B. Accomplish job mixing and job tinting only when acceptable to the Buyer.

C. Using tinting colors recommended by manufacturer for the specific type of finish.

PART III: EXECUTION

3.1 INSPECTION

A. Examine surfaces scheduled to receive paint for conditions that will adversely affect execution, permanence, or quality of work and which cannot be put into an acceptable condition through preparatory work.

B. Do not proceed with surface preparation or coating application until conditions are suitable and approved by the Buyer.

3.2 PREPARATION OF SURFACES

A. Gypsum Wallboard and Plaster

1. Fill narrow, shallow cracks and small holes with spackling compound.

2. Rake deep, wide cracks, and deep holes.

a. Dampen with clean water.

b. Gypsum Wallboard--fill with thin layers of drywall joint cement.

3. Allow to dry.

4. Sand smooth. Do not raise nap of paper on wallboard.

B. Ferrous Metals Surfaces

1. Prepare surface in accordance with SSPC-SP2, Hand Tool Cleaning.

2. Feather edges of sound paint.

C. Galvanized Metal--Clean surface in accordance with SSPC-SP1, Solvent Cleaning. Dry with clean lint-free cloth.

D. Aluminum--Clean surface in accordance with SSPC-SP1, Solvent Cleaning. Dry with clean lint-free cloth.

E. Wood

1. Clean soiled surfaces with alcohol wash.

2. Sand to smooth and even surface; then dust off.

3. Apply knot sealer to all knots, pitch, and resinous sapwood before priming coat is applied.

4. Fill nail holes, cracks, open joints, and other defects with putty or wood filler after priming coat has dried. Color to match finish color.

3.3 APPLICATION

A. Apply paint with suitable brushes, rollers, or spraying equipment.

1. Do not exceed rate of application recommended by paint manufacturer for type of surface involved.

2. Keep brushes, rollers, and spraying equipment clean, dry, and free from contaminants.

B. Comply with recommendation of product manufacturer for drying time between succeeding coats.

C. Vary slightly the color of successive coats. Tinting shall be uniform.

D. Sand and dust between each coat to remove defects visible from a distance of 5 ft.

E. Finish coats shall be smooth, free of brush marks, streaks, laps or pileup of paints, and skipped or missed areas.

1. Finished metal surfaces shall be free of skips, voids, or pinholes in any coat when tested with a low-voltage detector.

2. Doors, frames, and finished metal work or wood work shall be painted by brush or spray only. Do not roll.

F. Inspection

1. Do not apply successive coats until each completed coat has been inspected and approved by the Buyer.

2. Only inspected coats of paint will be considered in determining the number of coats applied.

3. Defective or improper previous coatings shall be removed or corrected to the satisfaction of the Buyer.

G. Make edges of paint adjoining other materials or colors clean and sharp with no overlapping.

H. Apply primer on all work before glazing.

I. Do not paint over fire labels on fire doors.

J. Change colors at corner of stop where colors differ between adjoining spaces or rooms.

K. Refinish whole wall where portion of finish has been damaged or is not acceptable.

3.4 CLEANING

A. Touch up and restore finish where damaged.

B. Remove spilled, splashed, or splattered paint from all surfaces.

C. Do not mar surface finish of item being cleaned.

3.5 PAINTING SYSTEMS AND SCHEDULES

A. Painting Systems

1. Paint System One (PS-One), for interior-exterior metals.

a. Prime coat for touchup. Oil-base rust-inhibitive metal primer.

b. Finish--Solvent-type Alkyd enamel, two coats.

2. Paint System Two (PS-Two), for gypsum wallboard.

a. Prime Coat--Quick-drying emulsion sealer.

b. Finish--Acrylic latex interior semi-gloss enamel, two coats.

B. Paint Schedules (all colors will be selected by the Buyer when not specified in the following schedules).

1. Doors, Door Frames, and Steel Window Frames, Exterior and Interior Sides: PS-One.

2. Gypsum Wallboard Walls and Ceilings: PS-Two.

3. Pipe Identification: PS-One, white background with black lettering. See Division 15 for identification procedures.

C. Items Not Required To Be Painted

1. Piping, conduit, and ductwork in production, maintenance, and laboratory areas.

2. Roofing and roof-mounted fixtures.

3. Exterior galvanized metals.

END OF SECTION

SECTION 10210

WALL LOUVERS

PART I: GENERAL

1.1 DESCRIPTION: Requirements specified in Conditions of Contract and Division 1 form a part of this Section. Provide wall louver work, complete as indicated, specified and required.

1.2 SUBMITTALS: Prior to fabrication or delivery, submit the following and obtain Owner's approval.

A. Shop drawings indicating layout, dimensions, fabrication details, acoustical materials, sealing devices, reinforcement and method of attachment to adjacent construction.

B. Free air calculations for intended louver assemblies.

C. Manufacturer's certified acoustical and air flow test data and full description of factory finish intended to be supplied.

1.3 FIELD MEASUREMENTS: Take such field measurements as may be required to verify all dimensions. Report significant discrepancies between Drawings and field measurements to Buyer before fabrication of work.

1.4 REFERENCE STANDARDS: Section 7920, "Sealants and Calking", is hereby made a part of this Section. Work specified herein shall conform to the applicable requirements of those Reference Sections, including guarantees.

1.5 COORDINATION AND COOPERATION: Fabricate, deliver and install work in fully coordinated and cooperative manner and in such sequence as to assure accurate and uninterrupted progress of the work.

1.6 VERIFICATION OF CONDITIONS: Verify site conditions affecting work of this section. Notify Buyer in writing of any condition which would prevent satisfactory completion of the work. Proceeding with the work indicates acceptance of field conditions.

PART II: PRODUCTS

2.1 MATERIALS shall conform to the following requirements:

A. Exterior Fixed Aluminum Louvers (Scheduled Louver Type A): Model No. 4130 Extruded air Conditioning Louvers manufactured by Construction Specialties, Inc., Pen Ventilator Airstream Products Division mode ASA (extra-heavy or approved equal).

1. Finish: Construction specialties C/A Kynar 500 Fluorocarbon coating with color to be selected by Buyer from those standard with manufacturer, except for louver assemblies at Buyer pre-engineered building where finish color shall match that of building prefinished siding.

2. Bird Screens: Equip louver with 1/2 in. mesh, 0.063 in. diameter wire intercrimp screen secured within extruded aluminum frame, independent of louvers. Finish shall match louver, and screening shall be replaceable within the extruded frames.

3. Louver Construction: Fabricate frame and blades of 6063-T5 extruded aluminum sections, minimum 0.125 in. thick with reinforcing bosses. Provide complete with concealed interlocking extruded aluminum braces, and mechanically secured structural aluminum structural members. Maintain blade and frame alignment where extending around corners with continuous heliarc welds. Provide for expansion and contraction, and design complete assembly to carry a wind load of not less than 20 lbs. per sq. ft.

4. Insulated Blank-Off: Provide insulated blank-off assembled 2 in. thick panel, size matching exterior louver, having U-factor of less than .10 BTV per hr., sq. ft., degrees F. Panel shall be fabricated with an urethene core, faced on both sides with .032 in. thick aluminum sheet 5005-H134 . Panel's perimeter frame shall be 6063-T52 extruded aluminum sections, mitered at corners. Closed cell PVC perimeter compression gasket V8" x 1" shall insure tight closure of panel to louver. Panels shall be finished in C/S Kynar 500 color matching the louver. Insulated blend-off shall be as manufactured by Construction Specialties, Inc., Penn or approved equal.

PART III: EXECUTION

3.1 INSTALLATION: Erect to provide plumb, level, secure, aligned, watertight completed installation. Flash and seal perimeters.

A. Isolation: Isolate aluminum from contact with dissimilar metals to provide assured electrolite protection as follows:

Apply on contact surfaces a heavy brush coat of approved zinc chromate primer made with a synthetic resin vehicle, followed by two brush coats of approved aluminum metal and masonry paint; or apply a heavy coat of approved alkali-resistant bituminous paint; or separate surfaces with a non-absorptive tape or gasket.

B. Fasteners: Unless shown, specified, or approved, do not use screws of other fasteners on exposed surfaces. Where used, provide countersunk exposed fasteners with Phillips type flat heads. On clear anodized work, use aluminum or non-magnetic stainless steel. On color anodized work, use aluminum alloy fasteners finished to match adjoining surfaces. Provide fasteners of suitable sizes, located and spaced to securely connect work and resist imposed loads, and as may be required under other Sections, all subject to approval.

Perform installations in accordance with approved shop drawings, and leave work clean, free of flaws and chatter or vibration.

3.2 CLEANING

A. At the completion of the work, clean and remove from the premises all rubbish and accumulated materials and leave the work in a satisfactory condition.

B. All stains and damage to the finish caused by faulty workmanship or improper handling of materials during installation of work of this Section shall be cleaned or removed and replaced by the Contractor at no added expense to the Buyer.

3.3 INSPECTION: Before completing the work, Contractor shall carefully examine, and if necessary, test all work of this Section, make repairs to work, if damaged, and leave it in a satisfactory condition.

END OF SECTION

SECTION 11605--UTILITY ROOM FURNITURE

PART I: GENERAL

1.1 DESCRIPTION. Requirements specified in Conditions of the Contract and Division 1 form a part of this Section. Provide utility room furniture work, complete as indicated, specified and required.

A. Work Included in This Section. Principal items are:

1. Base and wall cabinets
2. Counter tops
3. Sinks and accessories as listed herein
4. Emergency eye/face wash and shower

B. Related Work Not Included in This Section.

1. Plumbing work included in Section 15400
2. Electrical service and connections (Division 16)
3. Office type furniture (Division 12)

1.2 SUBMITTALS.

A. Shop Drawings. Submit for approval prior to fabrication or delivery. Show materials, finishes, dimensions, connections with other trades, assembly, erection, and other related items necessary for a complete installation.

B. Samples. Submit samples of the following items for approval:

1. Table tops and counter tops.

2. One full-sized combination base cabinet and wall cabinet unit including locks, doors pulls, hinges, interior hardware, and required finish. Sample unit, if approved, may be installed in the Work after approval.

1.3 QUALITY. The manufacturers' names and model number designated herein are given for the purpose of identifying the requirements of the type, general construction, materials, and operation of the specified items; and are not given with the intention of limiting the items to those of the manufacturers listed herein.

Approval of an item of another manufacturer shall be based on evidence of equal of superior construction and special features as compared to the item specified.

PART II: PRODUCTS

2.1 GENERAL. All products shall be the best of their respective kinds to the purpose intended. Sink, emergency eye/face wash, and emergency shower assembly shall be complete and operable.

2.2 The following items are keyed to the drawings:

Case System counters or equal - white enamel finish.

A. B210 36"H x 24"D x 42"W 2 door sink base cabinet for double bowl assembly with double doors.

B. B310 36"H x 24"D x 42"W base cabinet with double door and shelving.

C. B311 36"H x 24"D x 42"W base cabinet with left hinged single door and shelving.

D. B312 36"H x 24"D x 42"W base cabinet with right hinged single door and shelving.

E. Cast epoxy counter top, 1" thickness, as needed with sink cutout.

F. Stainless steel double bowl sink.

G. High neck swiveled mixing faucet.

H. Standard safety shower per Rocky Flats Plant STD No. SMU-100.

I. Standard safety eye/face wash, floor mounted, per Rocky Flats STD No. SMU-101.

2.3 FIRE PREVENTION EQUIPMENT

A. MANUFACTURERS. Fire prevention equipment shall meet the requirements of NFPA Pamphlet No. 10. The equipment shall be as manufactured by General Fire Extinguisher Corp.; Standard Fire Equipment, Divn. of Zurn Co.; Potter-Roemer; Walter Kidde and Co.; or equal.

B. FIRE EXTINGUISHERS. The following chemcial fire extinguishers shall be furnished with wall brackets unless shown otherwise and installed.

No. Required	Capacity	Fire Class	U/L Rating
2	20 lbs.	A.B.C.	20 A, 80 B.C.

C. INSTALLATION. Install fire extinguishers with wall bracket as directed by Buyer.

2.4 FIRST AID EQUIPMENT

A. GENERAL. One first aid equipment kit shall be furnished and installed. First aid equipment shall consist of a pre-finished, wall-mounted metal cabinet, furnished complete with

standard medical supplies inside. Contents and cabinet shall be designed to meet or exceed the current requirements of OSHA General Industry Occupational Safety and Health Standards (29CFR1910).

B. MANUFACTURER. The following manufacturer's model equal to specified unit will be acceptable: Certified First Aid; Bullard Co.; Swift Laboratories, Inc.; Johnson & Johnson,; or equal.

C. MODEL. First aid kit shall be Industrial First Aid Kit for:

1-5 employees,	Swift, Model #340116	Johnson & Johnson Model "No. 10 Industrial"

Each first aid kit shall be supplied with No. 236 SB or No. 8129J snake bite kit in plastic case.

PART III: EXECUTION

3.1 INSTALLATION. Perform installation in accordance with the manufacturer's printed instructions and the approved shop drawings. Cabinets shall be plumb, level, and tight fitting to adjacent surfaces. Counter tops shall be level and shall consist of the largest pieces practicable for the installation. Counter top joints and joints to adjacent materials shall be tight, uniform, and filled with an epoxy filler, colored to match the counter top, and installed in accordance with the printed instructions of the counter top fabricator.

END OF SECTION

SECTION 15050--EQUIPMENT INSTALLATION

PART I: GENERAL

1.1 DESCRIPTION: This section covers the relocation, moving, installation, alignment, grouting, leveling, and testing of the equipment to be moved as shown on the drawings.

1.2 QUALITY ASSURANCE: The Contractor shall be responsible for providing all lifting, skidding, jacking, roller equipment, and labor to relocate the equipment.

1.3 SUBMITTALS: The Contractor shall furnish to the Buyer a general arrangement drawing showing necessary moving equipment which will be used in relocating the equipment. The Contractor shall furnish upon request of the Buyer necessary proof that the moving equipment is in a safe operating condition and that the moving equipment is capable of handling the loads to be imposed upon it. The Contractor shall furnish the Buyer the procedure of which the equipment shall be moved.

PART II: PRODUCTS

2.1 MATERIALS: General--The Contractor shall furnish and install adequate leveling plates, blocks, dowels, and shims. Plates and blocks shall be steel plate stock with sheared edges. Stock may be flame cut. All shim and dowel stock shall be cold-drawn steel. Dowels shall be straight with provisions for pulling.

PART III: EXECUTION

3.1 EQUIPMENT INSTALLATION

A. General--Equipment, both Contractor and Buyer furnished, shall be installed and fastened as indicated on the drawings complete with all appurtenances in place, aligned, tensioned (V-belt trans.), grouted, tested, and ready for operation.

B. Workmanship

1. After moving equipment into place, the Contractor shall carefully uncrate, assemble, and install the equipment.

   All work shall be performed by skilled, qualified mechanics working at their trade under experienced supervision. Equipment shall be completely assembled and all work shall be the product of first-class workmanship. Any defective or unsatisfactory installation work shall be corrected by the Contractor at the Contractor's expense.

2. Packing material shall be removed from the premises and disposed of as directed by the Buyer.

C. Lifting and handling

1. All lifting and handling shall conform to OSHA safety practices. All handling and positioning techniques employed, including lifting, skidding, and jacking, shall be performed in a manner that will avoid subjecting the equipment to undue flexure and stress. Hooks and slings shall not be attached in any manner that can possibly result in bending, damaging, or breaking any part of the equipment. Lifting attachments shall be provided as required for lifting and setting in place and shall be approved by the Contractor.

2. Pallets, cradles, and skids shall be used wherever necessary to safely handle equipment. Lifting eyes and lugs provided on the equipment shall be used in making lifts. Any saddles, spreader beams, or other special lifting equipment required shall be provided by the Contractor.

3. Any damage to the equipment which was not present prior to installation shall be repaired by the Contractor at no additional cost to the Buyer.

D. Foundation Preparations--All caulking and dirt shall be removed from the anchor bolts and sleeves for freedom of movement. The surfaces of the foundation shall be cleaned with water before grouting. The Contractor shall make no adjustments to anchor bolts except as directed or approved by the Buyer.

E. Grouting--Grouting shall be in accordance with Section 03300 and the manufacturer's instructions using nonshrink grout.

F. Leveling--All equipment specified in room shall be precision leveled as described below and as set forth in the American Society of Mechanical Engineers B5.16 Standard. All other equipment shall be set true and level.

1. Equipment to be set true and shall be leveled both in the longitudinal and axial direction with a 36-in. carpenter's level. These levels shall be approved by the Buyer.

2. Equipment which requires precision leveling shall be leveled within 0.0005 in. in 12 in. in two directions using a four-way "Fells" precision level. The level shall be located on the work table surface or on the longitudinal ways and cross sideways as applicable. The leveling surfaces shall be clean and free of nicks and burrs. At least three repeat readings shall be taken, without an intervening failure, rotating the level 180

degrees between readings. The Buyer shall observe the readings and will record the readings on each machine.

G. Operational Check--All spindles, drive motors, and accessory equipment such as fans, pumps, vacuum units, etc., are to be checked for proper rotation and operation before equipment is placed into service.

H. Touchup Paint--Surfaces of equipment installed hereunder, which are damaged or scratched during installation, shall be properly repaired and repainted to match existing paint used on the machine. The Contractor shall furnish all materials and labor required to accomplish this purpose.

END OF SECTION

SECTION 15060

PIPING AND APPURTENANCES

PART I: GENERAL

1.1 DESCRIPTION. Requirements specified in Division 1 form a part of this Section. Contractor shall furnish all tools, equipment, materials and supplies including all labor required for complete installation, testing, and flushing of piping and appurtenances all as shown on the Drawings and specified herein.

1.2 SCOPE OF WORK.

A. Work Included in This Section. The Work of this Section shall include the furnishing, installation, and testing of pipe, pipe supports, fittings, specials, thrust blocks, and all required appurtenances as shown on the Drawings and as required to make the entire piping system operable.

1.3 CONTRACTOR SUBMITTALS.

A. *General. Shop and erection drawings, together with other* required information specified, shall be submitted in accordance with the requirements of Division 1 of these Specifications and the requirements specified in this Section.

B. Shop Drawings. Shop drawings, complete with material, grade, and class for all pipe, fittings, and couplings and for all joints, coatings, and appurtenances shall be submitted. Detailed catalog and engineering data sheets shall be submitted for all components and a proposed schedule for delivering and installing the piping shall be included.

C. Erection Drawings.

1. General. Complete erection drawings for all buried and exposed piping shall be submitted. The drawings shall show and identify the pipe, pipe joints, fittings, couplings, joint harnesses, wall sleeves with sealant and backup thicknesses, wall castings, hangers, saddles, straps and other supports, and miscellaneous details.

2. Buried Piping. Erection Plans and Profile Drawings for all buried pipe shall show the following information:

a. Location, length, wall thickness, and type of joint for each pipe section and fitting to be furnished and installed;

b. Pipe axis station and elevation at all changes in gradient or horizontal alignment;

c. Within the limits of a horizontal or vertical curve, provide the station and invert or center line elevation to which the spigot end of each pipe section will be laid.

d. Provide the combined horizontal and vertical joint deflection at each horizontal and vertical curve or bend.

3. Exposed Piping. Erection and elevation drawings for all exposed piping shall show the location of the pipe, joints and couplings, critical clearances, orientation of valves, spacings of hangers and supports, and the location and size of anchor bolts.

D. Erection Procedure. The installation drawings shall be supplemented with a set of written procedures for performing the field piping installation. The procedures shall cover in detail the preparation and making of the push-on, mechanical, flanged, welded, calked, flared, hard-soldered, chemically-welded and screwed joints and couplings; measures to ensure integrity of interior pipe lining and exterior protective coating at all joints and couplings; the method of backing up and sealing the annular spaces in pipe sleeves; and the installation and adjustment of pipe hangers and other supports.

E. Protective Coating. A protective coating schedule shall be submitted, showing shop and field surface preparations, materials, methods of application, dry thicknesses and tests for defects, all in conformance with Section "Painting and Protective Coatings".

F. Testing Procedures. Procedures for testing the piping, and arrangements for obtaining and disposing of water for the tests shall be fully described. The equipment for testing shall be itemized. Details of bulkheads, flanges, or caps for the testing of the pipe shall be included with the submittal.

G. Calculations. Manufacturer's calculations of wall thickness for steel pipe and outlet design calculations shall be included in the submittal.

1.4 PRODUCT HANDLING, DELIVERY AND STORAGE.

A. General. Pipe shall at all times be handled with equipment designed to prevent damage to the interior or exterior coating of the pipeline.

B. Shipping. When making shipments, all chains, cables and hold-down equipment shall be carefully padded where in contact with the pipe. For steel pipe, when the deformation is projected to exceed one percent of the diameter, each end

of the pipe shall be properly braced with approved interior supports or spiders.

C. Unloading. Unloading from the trucks shall be done with care. No pipe shall be allowed to fall from trucks. Pipe shall only be unloaded using a crane or fork lift.

D. Gaskets. Gaskets shall be stored in containers or wrappers which will protect the gaskets from ozone and other atmospheric deterioration.

1.5 DRAWINGS. For purposes of clarity and legibility, the Drawings are essentially diagrammatic to the extent that many offsets, bends, and special fittings and exact locations are not indicated. Contractor shall carefully study the Drawings and determine for himself the extent of the Work and include in his bid all necessary bends, fittings and specials to install the Work in conformance with the Contract Documents.

PART II: PRODUCTS

2.1 GENERAL.

A. General Requirements. All pipe, fittings, couplings, and appurtenant items shall be new, free from defects or contamination, and wherever possible, shall be the standard product of the manufacturer. They shall be furnished in pressure or thickness classes as specified or shown. Unless otherwise indicated the size shown shall be the nominal pipe diameter.

B. Length. All pipe 48 inches and less in diameter shall be furnished in a maximum of 20 foot lengths, unless indicated otherwise.

C. Raised Face Flanges. When carbon steel or stainless steel flanges or flanged valves with raised face will be bolted directly to flat faced FRP, plastic, or cast iron flanged fittings or valves, the raised face shall be removed or spacers approved by the valve or pipe manufacturer shall be installed to allow bearing over 100 percent of the flange area.

D. Joints. All pipes above ground shall have screwed or flanged joints. Welded pipes will be permitted, provided that there are sufficient flanges at valves and equipment to permit easy diassembling. Buried pipes shall have bell and spigot joints, unless welded, flanged or other joints are shown or specified. All bolts and nuts for flanges, joints and couplings shall be galvanized unless specified otherwise.

E. Mechanical Couplings and Expansion Joints. Pipe mechanical couplings and expansion joints shall be provided at locations shown on the Drawings as a minimum requirement.

F. Grooved Fittings. The Contractor, with the Engineer approval, may provide Victaulic, Gustin Bacon or approved equal grooved end pipe fittings and connections in lieu of screwed or flanged fittings for steel, cast iron or ductile iron pipe. Grooved joints and couplings shall conform to paragraph "Mechanical Couplings" herein.

G. Screwed Flanges. Where pipe is furnished with screwed on flanges, the flange is to be screwed tight on the pipe until the pipe end projects beyond the face of the flange. The flange shall then be faced to give a flush finish of the pipe and flange. The flanges shall then be drilled, after attachment to the pipe, to insure bolt hole alignment.

H. Pipe Schedule. Pipe materials shall conform to the piping schedule included within this Section.

2.2 GALVANIZED STEEL PIPE AND FITTINGS

A. General. Galvanized steel pipe shall be welded and seamless steel pipe conforming to ASTM A-120 standard weight or extra strong as indicated in the schedule. End finish shall be threaded.

1. Threaded ends. Conform to ASTM A-120

B. Fittings and Joints. Provide threaded fittings as indicated in the Schedule.

1. Galvanized malleable iron threaded fittings conforming to ANSI B16.3; standard weight for standard weight pipe; extra heavy for extra strong pipe. Malleable iron shall conform to ASTM A-47; galvanizing shall conform to ASTM A-153.

C. Buried Galvanized Pipe. The exterior of buried galvanized pipe shall be primed and wrapped with a cold applied tape, Type I or Type II conforming to AWWA C209.

2.3 CAST IRON SOIL PIPE. Cast iron soil pipe (CISP) shall be furnished and installed complete with all the fittings, joint accessories and necessary appurtenances. The pipe and fittings shall be either no-hub or hub and spigot type.

A. Materials. All soil pipe, fittings and appurtenances, except where otherwise shown or specified shall conform to the following:

1. Hub and Spigot.

Pipe and Fittings - Cast Iron Soil Pipe Institute HS-72, Gray Iron ASTM A74.

Lead - Federal Specification QQ-C-40, Type I.

Packing - Clean, dry oakum.

2. No-Hub.

Pipe and Fittings - Cast Iron Soil Pipe Institute 301-72.

Compression Gaskets - ASTM C564.

B. Joints.

1. General. Pipe cuts shall be made with approved mechanical cutters to produce clean cuts, perpendicular to the pipe.

2. Hub and Spigot. Packing material shall be driven tightly against the inside base or shoulder of the hub with suitable yarning tools. Successive strands of packing material shall be driven to bottom of hub separately. After packing, the joint shall be filled with lead and caulked with suitable irons to produce watertight joints. Care shall be taken to avoid overstressing the hubs during caulking.

3. No-Hub. No-hub couplings shall be installed using a specially designed torque limiting wrench when tightening bands.

2.4 COPPER TUBING AND FITTINGS.

A. Copper tubing shall be hard-drawn conforming to the requirements of ASTM Designation B-88-80, Type L or Type K.

B. Fittings shall be compression and hard-solder type as required. Flared type shall be Parker-Hannefin "Triple-Lock," American Brass "Anaconda," Imperial Eastman "High-Seal," or equal. Hard solder fittings shall be wrought copper or cast brass conforming to the requirements of ASTM Designation B 62-74.

2.5 POLYVINYL CHLORIDE SCHEDULE PIPE AND FITTINGS. Pipe and fittings shall conform to the following requirements:

A. Polyvinyl Chloride Pipe. Polyvinyl Chloride Pipe shall conform to the requirements of ASTM Designation D1785, Schedule 80, designation 1120.

B. Polyvinyl Chloride Pipe Fittings. Fittings shall conform to the requirements of ASTM Designation D2467, Class 12454-B for socket type.

C. Joints in PVC Pipe and Fittings. Joints shall be the solvent-welded socket or flanged type. Flanges, where shown,

shall be 150-pound, and shall be of the same material as the pipe.

D. Bolts. Bolts for use with PVC flanges shall be steel, AISI Type 303, conforming to the requirements of ASTM Designation A320-79a.

E. Gaskets. Gaskets shall be a Teflon envelope with an asbestos or high polymer chloride resin core.

2.6 CHLORINATED POLYVINYL CHLORIDE SCHEDULE PIPE AND FITTINGS. Pipe and fittings shall conform to the following requirements:

A. Chlorinated Polyvinyl Chloride Pipe. Chlorinated Polyvinyl Chloride Pipe shall conform to the requirements of ASTM Designated D1784, Schedule 80, Class 23447-B.

B. Chlorinated Polyvinyl Chloride Pipe Fittings. Fittings shall conform to the requirements of ASTM Designation F439 for socket type fittings.

C. Joints in CPVC Pipe and Fittings. Joints shall be the solvent-welded socket or flanged type. Flanges, where shown, shall be 150-pound, and shall be of the same material as the pipe. Solvent weld joint shall comply with ASTM F493.

D. Bolts. Bolts for use with PVC flanges shall be steel, AISI Type 303, conforming to the requirements of ASTM Designation A320-79a.

E. Gaskets. Gaskets shall be a Teflon envelope with high polymer chloride resin core.

2.7 DOUBLE-WALLED CONTAINMENT PIPING. Containment piping shall be made from copolymer polypropylene material which conforms to ASTM D2146. The Asahi/American Proline double containment piping system or approved equal shall be used. The inside pipe nominal size shall be 2 inches and the outside pipe nominal size shall be 4 inches. Installation shall conform to "Proline Engineering Design Guide - Installation Practices" from Asahi/America or installation practices of alternate manufacturer. Transitions between containment piping and CPVC shall be made by flanges or by threaded slip joint plastic adapter or fitting. No plastic pipe shall be threaded.

2.8 PIPE HANGERS AND SUPPORTS. Pipe hangers, brackets, saddles, clamps, and other supports shall be adjustable type conforming to the requirements of ANSI B31.1, Section 6; shall have ample strength and rigidity to resist the hydraulic thrusts at changes in direction and at dead ends as well as the dead weight loads and the load carried; and shall be hot-dip galvanized, including all bolts, nuts, and threaded parts. Where not specifically identified or called out on the Drawings, computations showing adequacy

of Contractor selected hangers and supports to meet these requirements shall be submitted with the Shop Drawings. Hangers and supports so identified on the Drawings does not relieve the Contractor from meeting all requirements specified herein. Wherever possible, brackets shall be used in lieu of hangers.

A. General. Hangers and supports shall include all hanging and supporting devices of metallic construction shown, specified, or required for pipe lines, apparatus, and equipment other than electrical equipment. The Contractor's working drawings, as required herein, shall show the quantity, type, design, and location of all hangers and supports required under the various Contract items. Hangers and supports shall be painted the same as required for the supported piping.

1. Where specified or shown, bolts, stud bolts, rods, yokes, and nuts of hangers and supports shall be of steel. Bolts shall not be less than 1/2-inch diameter unless otherwise called for on the Drawings.

2. Except where otherwise shown, specified, or required, hangers, supports, anchors and concrete inserts shall be the standard types as manufactured by Elcen Co., Grinnell Co., Fee and Mason Manufacturing Co., or equal meeting the requirements specified herein. Unless otherwise approved by the Buyer, all hangers, supports, and concrete inserts shall be listed with the Underwriters' Laboratory.

B. Design. Hangers and supports shall be adequate to maintain the pipe lines, apparatus, and equipment in proper position and alignment under all operating conditions and have springs where necessary. Hangers and supports shall be of standard design where possible, and be best suited for the service required, as approved by the Buyer. Where required, they shall be screw adjustable after installation. Supporting devices shall be designed in accordance with the best practice and shall not be unnecessarily heavy. Sufficient hangers and supports shall be installed to provide a working safety factor of not less than 4 for each hanger, assuming that the hanger is supporting 12 feet of pipe filled with water. On pipes 3 inches in diameter and larger which are covered with heating insulation, hangers and supports shall include proper pipe protection saddles. Hangers and supports shall be designed to resist all enduced thrusts and lateral loads as required for seismic design by the current Uniform Building Code.

1. Hangers and supports shall be designed and selected in accordance with MSS Standard Practices: SP-58, Pipe Hangers and Supports - Materials and Design; and SP-69, Pipe Hangers and Supports - Selection and Application.

C. Supports for CPVC and PVC Piping. Rigid plastic piping normally shall be supported by the same type of hangers used with steel pipe, except that in no instance will C-clamp, or other point-bearing supports be allowed. Riser clamps, if required, shall be full-circumferential type only. Support spacing shall be based on the plastic pipe manufacturer's recommendations for the service conditions but not more than 5 feet on center. Flexible plastic tubing or rigid plastic pipe operating at temperatures high enough to lower its strength, shall be supported continuously by light metallic angles or channels and special hangers.

D. Saddle Stands. Saddle stands shall be of adjustable type. Each stand shall consist of a length of wrought pipe fitted at the base with a standard screw threaded cast iron flange and at the top with an adjustable saddle or roll. The base flange shall be bolted to the floor or foundation. Stanchions shall be of similar construction to the saddle stand, except that they shall be fitted at the top with cast iron pipe saddle supports or with pipe stanchion saddles with yokes and nuts. Where adjustable supporting devices are not required, pipe lines 3 inches in diameter and smaller may be supported on approved cast iron, malleable iron, or wrought steel hooks, hook plates, ring or ring plates.

E. Anchors. Anchors shall be furnished and installed where specified, shown, or required for holding the pipe lines and equipment in position or alignment. Anchors shall be designed for rigid fastening to the structures, either directly or through brackets. The design of all anchors shall be subject to approval by the Buyer.

1. Anchors for piping shall be of the cast iron chair type with wrought steel strap, except where anchors form an integral part of pipe fittings or where an anchor of special design is required.

F. Inserts. Inserts for concrete shall be furnished galvanized and shall be installed in the concrete structures where required for fastening supporting devices. They shall be designed to permit the rods to be adjusted horizontally in one plane and to lock the rod nut or head automatically. Nail slots shall be provided in the exposed flanges of the insert. Inserts shall be designed to carry safely the maximum load that can be imposed by the rod which they engage.

G. Materials. No use shall be made of wire, straps, chains, etc., for supporting piping nor shall cast expansion shields be used for anchoring bolts. Hangers and supports of metallic construction shall conform to the requirements specified herein and to the following standards:

1.	Structural steel	ASTM A36 and A283
2.	Steel bars (grade 1022)	ASTM A107
3.	Steel castings (grade N-1)	ASTM A27
4.	Iron castings (grade 35)	ASTM A42
5.	Cast iron pipe fittings (class 125)	ANSI B16.1
6.	Malleable iron castings	ASTM A47
7.	Bolting materials, steel	
	a. Bolts, yokes and stud bolts	ASTM A307
	b. Nuts	ASTM A563
	c. Physical requirements	
	(1) Tensile strength	60,000-72,000 psi
	(2) Yield strength	38,000-50,000 psi
	(3) Elongation	27 percent maximum
	(4) Reduction of area	35-55 percent
8.	Bolting materials, silicon bronze	
	a. Bolts, stud bolts, yokes and nuts (alloy A)	ASTM B98
	b. Physical requirements:	
	(1) Tensile strength	70,000 psi minimum
	(2) Yield strength	38,000 psi minimum
	(3) Elongation	17 percent maximum
9.	Bolting materials, stainless steel	
	a. Bolts, stud bolts and nuts (type 316)	ASTM A276
	b. Physical requirements:	
	(1) Tensile strength	75,000 psi minimum
	(2) Yield strength	30,000 psi minimum
	(3) Elongation	35 percent maximum
	(4) Reduction of area	45 percent maximum

10. Where specified or shown, bolts, stud bolts, rods, yokes and nuts of hangers and supports shall be of silicon bronze or stainless steel as specified above with dimensions, threads and sizes equivalent to those specified in steel. Where submerged in process fluids or where located in covered manholes, bolts, stud bolts, rods, yokes and nuts of hangers and supports shall be of silicon bronze, unless otherwise noted.

H. Supports for Piping. Brackets for support of piping from walls and columns shall be made of welded wrought steel and shall be designed for three maximum loads classified as follows:

1. Light 750 pounds

2. Medium 1,500 pounds

3. Heavy 3,000 pounds

When medium or heavy brackets are bolted to walls, back plates of adequate size and thickness shall be furnished and installed to distribute the load against the wall. When used on concrete walls the back plates shall be cast in the concrete. Where the use of back plates is not practicable, the brackets shall be fastened to the wall in such a manner that the safe bearing strength of the wall will not be exceeded. Pipe rolls or chairs shall be of the cast iron type. Pipe rolls shall be provided with threaded rods.

I. Spacing of Hangers. Pipe support spacing requirements are indicated on the Drawings or elsewhere in these Specifications, but in no case shall the spacing of hangers exceed the following:

MAXIMUM UNSUPPORTED PIPE SPAN

(FEET)

Nominal Pipe Size-Inches	Steel	PVC Max. Temp. 130°F Sch. 80
1/2	5	3.5
3/4	6	3.5
1	7	3.8
1-1/4	7	4.0
1-1/2	9	4.0
2	10	4.33
2-1/2	11	4.75
3	12	5.0
3-1/2	13	5.0
4	14	5.25
5	16	
6	17	6.0

J. Where concentrations of valves, fittings, and equipment occur, closer spacing of supports will be required. In no case shall any total hanger load (weight of piping, insulation, and contents) exceed the following load carrying capacities for hot rolled steel rod ASTM A36-77a):

Nominal Rod Diameter - Inches	Maximum Safe Load - Pounds Max. Temp. 650°F
1/2	1,130
5/8	1,810
3/4	2,710
7/8	3,770
1	4,960
1-1/8	6,230
1-1/4	8,000
1-3/8	9,470
1-1/2	11,630

2.9 PIPE MATERIAL SCHEDULE. The pipe material schedule is presented as Table 1 at the end of this Section. Pipe shall be as indicated in the schedule unless otherwise shown on the Drawings or specified otherwise. Pipe material listed therein shall conform to Specifications presented in Part II of this Section.

PART III: EXECUTION

3.1 GENERAL.

A. Care and Handling of Materials. All materials shall be carefully handled in all steps of fabrication, storing, loading, transporting, unloading, storing at the site, and installation, using the means and following the procedures submitted with the approved shop drawings. Pipe slings used during handling, and tie-down straps during transit shall be not less than 4-inch wide flat fiber or plastic straps.

B. Installation.

1. The different kinds of piping (buried and exposed) shall be installed in accordance with the Drawings and the procedures and methods submitted with the approved shop and erection Drawings. Such procedures and methods shall conform to or exceed the minimum requirement of the pipe manufacturer, and shall be as supplemented by the provisions specified herein. The interior of pipe, fittings, and couplings shall be clean and free from contamination when installed and effective means shall be taken to prevent the entrance of foreign matter during progress of the work. The types and sizes of pipes and fittings to be used shall be as specified herein and as shown on the Drawings. Where fittings are omitted from the Drawings, they shall be the same size as the piping and in all cases shall conform to the plumbing code requirements.

2. All pipe shall be carefully placed and supported at the proper lines and grades and where practicable shall be sloped to permit complete drainage. Piping runs shown

on the Drawings shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If relocations are required, they shall be approved by the Buyer.

C. Joints. In erecting the pipe, a sufficient number of screw unions, flanged joints, or mechanical couplings shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Screw unions may be employed on pipelines 3 inches in diameter and under. Flanged joints or mechanical couplings shall be employed on pipe 4 inches in diameter or larger unless otherwise shown on the Drawings. Dielectric unions must be installed at the junction of dissimilar metals.

D. Storage and Handling. During storage, handling, and transporting, every Precaution shall be taken to prevent injury to pipe. Pipe shall be handled only by means of approved hooks on ends of sections, by means of fabric slings, or other methods approved by the Buyer for the pipe used.

E. Verification of Dimensions. All dimensions essential to the correct location of the pipe, or fit of piping at equipment and valves, or to the proper location and orientation of pipe sleeves and wall castings, or to the avoidance of obstructions or conflict with other improvements, shall be accurately determined by the Contractor prior to fabrication of the piping involved. All required changes from the nominal locations shown on the Drawings shall be made by the Contractor and shall be included as a part of the work hereunder and be approved by the Buyer.

F. Pipe Sleeves. All piping which will pass through walls, slabs, footings, or beams shall be provided with specified pipe sleeves with annular space sealed or with wall castings. The Contractor shall provide the wall sleeves and castings for insertion in the concrete work covered in Section 03300, "Cast in Place Concrete," and shall verify their correct setting prior to concrete placement. The sleeve sealant shall be polyurethane caulking. No pipe joint will be allowed to occur in the sleeve. The seal on both ends of the sleeve shall be flush with the concrete surfaces on completion of work and drying of sealant. Caulking and sealing of wall sleeves shall conform to the following requirements:

1. Preparation for Sealing. The annular space between the pipe and sleeve shall be cleaned of all loose particles and contamination, and shall be dry prior to sealing. Tape or other recommended protection shall be applied on the structure surfaces to preclude contamination by the sealant, and any contamination which occurs shall be removed immediately, followed by a thorough washing of the surfaces with solvent. Prepared compound not used

during the application time limits designated by the manufacturer of such compound shall be discarded.

2. Application of Compound Sealant. The sealing shall be performed after any required primer has been applied and backup material placed. The work shall be performed in accordance with the submitted erection drawing detail and procedure, and all grooves shall be solidly filled. The application shall be made in clean, straight lines free of wrinkles, be tooled as required and finished with a convex surface just sufficient to provide the required flush surface upon drying. Work shall not be performed when the air temperature is below 50 degrees F.

3.2 BURIED PIPING.

A. Buried Pipe Installation. Buried piping shall be laid to the grades and alignment shown on the Drawings, and all trenching, bedding, and backfilling shall conform to the applicable requirements of Division 2; other work shall conform to the following sections of AWWA Standard C600.

Section 2, "Inspection, Receiving, Handling and Storage";
Section 3.1, "Alignment and Grade";
Section 3.3, "Pipe Installation";
Section 3.4, "Joint Assembly";
Section 3.6, "Valve and Fitting Installation";
Section 3.8, "Thrust Restraint";

The foregoing requirements shall govern the work, regardless of the type of pipe installed unless a more stringent requirement is specified. When the work is not in progress, open ends of pipe and fittings shall be securely closed. The piping shall be placed when trench and weather conditions are suitable. No pipe shall be laid in water, and responsibility for the diversion of drainage and dewatering of trenches during construction, including meeting all safety and environmental requirements, shall be borne by the Contractor. All pipe in place shall be approved as to line, grade, bedding, and proper joint construction before backfilling. In all backfilling operations, the Contractor shall be responsible for preventing damage to or misalignment of the pipe.

B. Joint Installation. Installation of joints and couplings for buried piping shall conform to the following requirements:

1. Joints for pipe 4-inch diameter and over, shall comply with the supplementary requirements specified herein, and joints of all sizes shall conform to the applicable requirements specified hereinafter for aboveground piping. Care shall be taken to keep pipe in correct alignment when making joints. Friction or lever pullers or other approved means of insuring straight pulling

shall be used on pipe larger than 8 inches and also on smaller sizes where damage to the end might occur. The "popping-on" of joints will not be permitted. The fitting of piping to valves, hydrants, and wall castings shall be worked out in advance of installation to ensure correct orientation of the mating ends and bedding of approach piping.

2. Silver solder shall be used for soldered joints in buried tubing.

C. Coverage. Unless otherwise shown on the Drawings, all buried piping shall have a coverage of at least 24 inches between the top of the pipe and the finished surface. Variations from the pipeline grade and alignment may be allowed to accommodate fabrication with the approval of the Buyer. All changes of grade shall require the approval of the Buyer on the installation drawings.

3.3 ABOVE GROUND NONBURIED PIPING.

A. Pipe Installation. All piping shall be installed in accordance with the erection drawings and the erection procedure submitted with the approved shop or erection drawings. The horizontal piping shall be run parallel to the building walls and shall be level except where otherwise shown or specified; parallel lines shall be grouped on the same horizontal or vertical plane wherever possible. Vertical piping shall be plumb, and the entire piping configuration shall allow adequate clearances for convenient access for painting and preventive maintenance of valves. Piping shall clear obstructions, preserve headroom, and keep openings and passageways clear. If structural difficulties or other work prevent the running of pipes or the setting of equipment at the point indicated on the Drawings, the necessary minor deviations therefrom, as determined by the Contractor and approved by the Buyer, will be allowed, and shall be shown on the erection drawings to be furnished. Except as otherwise shown or specified, piping installation work shall conform to the requirements of the printed or written recommendations of the manufacturer of the product involved for the given conditions, as approved.

B. Joint Installation. Installation of joints and couplings shall conform to the following requirements:

1. Joints and Couplings. Joints and Couplings shall be made in accordance with the specified requirements made part of the erection procedure submitted by the Contractor.

2. Pipe Threads. Pipe threads shall be in accordance with the requirements of ANSI B2.1, and shall be cut full and free from torn or ragged surfaces. No more than three

threads on the pipe at any joint shall remain exposed after installation. Threaded joints shall be established with Teflon tape applied to the male ends only. The use of thread cement or calking of threaded joints to stop or prevent leakage will not be permitted. Sharp-toothed pipe wrenches or similar wrenches shall not be used in making up copper or brass pipe.

3. Flanged Joints. Flanged joints shall be made with gaskets centered in the joint. Bolts, studs, and nuts shall be lubricated with graphite and oil so that the nuts can be turned by hand. Care shall be taken to prevent excessive initial tension to the bolt and studs and so that the tension applied is as nearly uniform as possible. The rust preventive compound applied to the faces of flanges before shipment shall be removed before installation.

4. Tubing. Tubing which is to be soldered shall be cut square, and all burrs shall be removed. Both the inside of the fitting and the outside of the tubing shall be well cleaned with steel wool before sweating. Care shall be taken to prevent annealing of fittings or hard-drawn tubing when making connections. Joints for soldered fittings shall be made with a non-corrosive, paste flux and solid string or wire solder composed of 95.5 percent tin, 4 percent copper, and 0.5 percent silver. Soft solder or cored solder will not be permitted. Tubing to be coupled with flared compression type fittings shall conform to the applicable provisions of the Joint Industry Conference (JIC) Standards and the recommendations of the manufacturer.

5. Mechanical Coupling Type Joints of the sleeve, grooved mechanical, split sleeve, and flanged coupling adapter types shall be made in accordance with the printed instructions of the manufacturer. The pipe ends to receive the couplings shall be finished to the outside diameter and surface finish required by the coupling manufacturer. Prior to assembly, all surfaces which will be inaccessible after installation shall be given protective coating.

6. Joint Harnesses shall be provided at sleeve type coupling joints on pressure pipelines and at all pump discharge piping. The harnesses shall be tightened just sufficiently to preclude displacement of the downstream piping under hydraulic thrust.

7. Electrical Insulation joints shall be provided at all connections between dissimilar metals and ferrous and non-ferrous pipe except where the nonferrous pipe is an electrical non-conductor. The joints shall be tested after completion to verify non-conductivity.

8. PVC Pipe Joints at fittings and couplings to valves and equipment shall be made in accordance with the manufacturer's printed instructions.

3.4 INSTALLATION OF DUCTILE OR CAST IRON PIPE.

A. Pipe Laying.

1. Inspection. All pipe shall be carefully inspected by the Buyer's representative for defects before installation. Such inspection shall include light tapping with a hammer while the pipe is suspended in the air. No pipe or fittings which are cracked or which show defects excluded by the Specifications for such pipe or fittings shall be used. All injuries to the protective coating of the pipe or fittings shall be carefully repaired by the Contractor.

2. Cleanliness of Material. All pipes, valves, and fittings shall be carefully cleaned before installation. Every open end of a pipe shall be carefully and securely plugged or capped before leaving the work.

3. Positioning. For bell and spigot pipe, the position or direction of bells, which shall normally face upstream of the flow, may be altered from the positions shown on the Drawings with the permission of the Buyer. Bells and spigots must be thoroughly cleaned and free from oil, grease, blisters, and excess coating before spigots are inserted into bells. The spigot end of the pipe shall be brought to true line and grade and be inserted to the full depth of the socket before the joints are made. The inner surface of the pipe shall be of uniform width and depth. If any pipe does not allow sufficient space for jointing material, it shall be replaced by one of proper dimensions.

4. Deflection. The maximum deflection in bell and spigot cast or ductile iron pipe joints shall be such that the joint opening measured at the outside of the pipe shall not exceed 0.8 inch and the calking space shall be not less than 0.24 inch.

5. Anchorage. Anchorage lugs shall be provided where there is a possibility of pulling the joint under pressure. Concrete thrust blocks may be used in lieu of the above for buried pipe.

6. Piping Through the Walls. Where pipes pass through walls, care shall be exercised to insure joints being watertight. The pipe shall be free of all dirt and grease to secure a tight bond with the concrete.

3.5 INSTALLATION OF POLYVINYL CHLORIDE SCHEDULE PIPE.

A. Fittings. Fittings for plastic pipe shall be flanged or of the socket type using the solvent weld process. Transition from plastic to steel pipe shall be by flanges or by threaded slip joint plastic adapter or fitting. No plastic pipe shall be threaded. No solvent shall be used on threaded end of plastic adapters or fittings.

B. Anchorage. All line valves and fittings at downpipes shall be anchored to the wall in a manner to prevent stress and rotation of the pipe.

C. Joints. Joint material for plastic pipe shall conform strictly to the printed recommendations of the pipe manufacturer. Solvent weld connections shall be made as follows:

1. Joints shall be wiped clean and a solvent supplied by the manufacturer applied to both male and female connections.

2. Two applications of the solvent shall be made.

3. The treated surfaces shall be forced together as soon as the pipe material becomes soft or tacky and given 1/4 turn as recommended by the manufacturer.

D. Laying Pipe in Trench.

1. Bedding.

The bottom of the trench shall be covered with 6 inches of pipe embedment material (see Section 02200) compacted to 90 percent of maximum density as determined by the modified proctor testing method so as to provide the pipe with a firm and uniform bearing surface over the entire length of the pipe.

2. Laying Pipe

a. The Contractor shall provide the necessary mason's lines and supports to ensure installation of the pipe to the lines and grade shown on the plans. Facilities for lowering the pipe into the trench shall be such that neither the pipe nor the trench will be damaged or disturbed.

b. The Contracting Officer shall inspect all pipe and fittings before they are installed and reject any piece that is damaged by handling or defective to a degree which will materially affect the function and service of the pipe.

c. The Contractor shall take adequate measures to prevent the intrusion of foreign materials of any kind into the pipe or fittings. At the end of each day's work, the Contractor shall adequately plug any open ends of installed pipe and fittings in order to prevent the intrusion of foreign materials.

d. The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. Lay pipe with perforated side down.

e. Pipe shall not be installed on frozen, soft, or spongy subgrade material. Pipe shall not be installed in standing water. The Contractor shall furnish all necessary equipment and labor to properly dewater the trench, as the need arises, at the Contractor's cost.

f. Pipe which is not reasonably true in alignment or grade, or which shows any settlement after laying, shall be taken up and relaid without extra compensation to the Contractor.

g. Pipe and fittings shall be joined in accordance with accepted industry practice.

3. Backfill

a. The pipe zone shall be backfilled by hand by placing embedment material simultaneously on both side of the pipe for the full width of the tench in layers 6-inches in depth. Each layer shall be compacted to a compaction of not less than 90 percent of maximum density as determined by the Modified Proctor Testing Method. Care should be taken not to damage the pipe. The pipe zone is considered to extend to 6 inches above the top of the pipe.

b. Power, control, and instrumentation cable shall be installed in embedment material as shown on the drawing.

c. Class I Structural Fill to within 1 foot of surface shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method. Orange tape shall be placed in the Structural Fill one foot above the electrical cables.

d. One foot of Topsoil shall be placed in horizontal layers not in excess of 6 inches in thickness and shall have a moisture content such that the required compaction may be obtained. Each layer shall be compacted by hand or machine tampers or other suitable equipment to 90 percent of maximum density as determined by the Modified Proctor Testing Method.

3.6 INSTALLATION OF PIPELINES THROUGH CONCRETE STRUCTURES.

A. Whenever a pipeline or any material terminates or extends at or through a structural wall or sump, the Contractor shall install, in advance of pouring the concrete, the fitting or special casting required for the particular installation. Otherwise, prepare and submit shop/erection drawings of other installation methods and obtain approvals in advance of commencement of work.

B. Whenever any run of pipe is installed per approved shop/erection drawings subsequent to placing of concrete, the Contractor shall accurately position the opening in the concrete for such pipelines. Unless otherwise required, all pipes penetrating fluid containing or earth supporting portions of the structure shall be ring flanged.

1. Opening shall be of sufficient size to permit a perfect final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through wall to insure water tightness around openings so formed.

2. The boxes or cores shall be provided with continuous keyways to hold the filling material in place and to insure a watertight joint.

3. Boxes or cores shall be filled with nonshrink grout or nonshrink concrete.

a. Non-Shrink Concrete. All non-shrink concrete shall contain one (1) pound of Embeco Aggregate per pound of water that is in excess of two gallons per sack of cement.

b. Non-Shrink Grout. Non-shrink grout shall be made with the following proportions:

1 part Type I Portland Cement (1 bag)
1 part Embeco Aggregate (100 lbs.)
1 part clean, well graded concrete sand (100 lbs.)
Approximately 5.5 gallons of water per bag of cement.

3.7 CHANGES IN LINE AND GRADE. In the event that obstructions not shown on the Drawings are encountered during the progress of the work which will require alterations to the Drawings, the Buyer shall have the authority to change the Drawings and order the necessary deviation from the line or grade. The Contractor shall not make any deviation from the specified line or grade without approval by the Buyer. Should any deviations in line or grade be permitted by the Buyer in order to reduce the amount of rock excavation or for other similar convenience to the Contractor, all additional costs for thrust blocks, valves, blowoff assemblies, extra pipe footage or other additional costs shall be borne by the Contractor.

3.8 IDENTIFICATION OF PIPING.

A. Piping Systems. Identification of piping systems shall conform to the requirements of ANSI A13.1, "Scheme for the Identification of Piping System," unless otherwise specified herein.

B. Color Identification. All exposed and or unburied pipe, including tubing, galvanized pipe, polyvinyl chloride pipe, shall be identified by color to show its use function. Color bands of an approved taped type may be used on PVC pipe and all other pipe not readily susceptible to painted finish. Markers shall be adhesive type with extra strength and suitable for continuous duty at 250 degrees F. All markers shall have a protective silicone film.

Both the direction of fluid flow, and the name of the fluid in the pipe shall be stenciled on all pipe at least once every twenty-five (25) feet and at every change of direction. Color bands shall be spaced at fifteen (15) foot intervals and every change in direction. The size of the letters and color bands shall be as specified in Section 15400. Color code shall be specified by the Buyer.

C. Labeling. After the painting of process piping is complete, the Contractor shall stencil the tag numbers of all valves numbered on the P and ID Drawings, on the pipe adjacent to the valve for pipe 2 inches and over. Characters shall be one inch high minimum and shall be oriented to be visible from the valve operating position. When the valve has extended operator shaft or chain operator, the number shall be placed both at the operating position and at the valve if the valve cannot be seen from the operating position. The latter requirement does not apply if the valve is buried. Valves in pipes under 2 inches shall have characters as large as the pipe will permit, or at the Buyer's option, on an adjacent surface. Characters shall be preferably white, however, if this would not provide sufficient contrast to the pipe, the Buyer may select another color. Paint used shall be of the same type and quality as used for painting the pipe.

3.9 PROTECTIVE COATINGS. Painting and coatings shall conform to the applicable requirements of Section "Painting and Protective Coatings", and the schedule submitted with the shop and erection-drawings. It shall be the Contractor's responsibility to fully coordinate the protective coating requirements with the foregoing color code identification requirements to ensure compatibility of materials used.

3.10 TESTING. The Contractor shall perform hydrostatic, leakage, and operational tests as specified herein. The Contractor shall perform all excavation and other work required to locate and repair leaks and correct other defects which may be disclosed or develop under tests; the Contractor shall replace all coating, painting, backfill, or other permanent work removed in locating or repairing leaks and correcting defective piping. All gages and control devices connected to lines being tested must be disconnected for the duration of the test. Water shall not be used in testing air lines, chlorine lines, nitrogen lines, or other gas carrying pipes. High pressure air testing of PVC pipe in exposed or above ground installations is not permitted. The Contractor shall furnish and install a chart type recording meter for the pressure tests. The Contractor shall submit to the Buyer before and after the test the gage and meter used so that these devices may be tested by the Buyer.

A. Testing Requirements.

1. Gravity Sewer Pipes or Other Pipelines Having Free Surface Flow Except Storm Drainage Pipelines. Vitrified clay pipe (VCP) and asbestos cement pipe (ACP) or other pipe having free surface flow shall be given a water exfiltration test as specified herein. The Contractor has the option of using a low pressure air test in lieu of the water exfiltration test. If excessive ground water is present which precludes use of the exfiltration test, the Contractor shall use either the low pressure air test or infiltration test.

2. Water Lines, Sewage Force mains and Other Pressure Piping Carrying Liquids. Water lines, sewage force mains and other pressure piping carrying liquids having bell and spigot gasketted joints shall be given a pressure and leakage test as specified herein.

Pipe Material	Test Standard
Ductile Iron	AWWA C-600
Cast Iron	AWWA C-600
PVC (AWWA C-900 Pipe)	AWWA C-600
Steel Pipe	AWWA C-200

3. Pressure Pipe, Flanged or Welded Joints. PVC, FRP, steel, cast iron, ductile iron or other pipe material, with solvent welded, welded, treaded, flanged, grooved end or flexible couplings and joints shall be pressure tested as specified herein. No leakage shall be permitted.

B. Pressure Tests.

1. General. All piping, including valves, shall be field-tested at a hydrostatic pressure of 50 psi above the pipe pressure class (unless specified otherwise in the Testing Schedule), corrected to the elevations of the test gage, with duration of two hours minimum, for each pressure test, except as otherwise specified in Testing Schedule. Piping conveying liquids between process tankage, not subject to pumping, shall be tested to the maximum possible pressure that can be obtained under static conditions. Air piping shall be tested using air or nitrogen.

2. Joint Exposure. All exposed pipe, fittings, valves, hydrants, and joints shall be carefully inspected before being cast in concrete and/or during the open trench tests. All defects discovered shall be corrected by removal and replacement, as approved by the Buyer, and the work then retested to demonstrate satisfactory performance. Where practical, no concrete encasement or backfilling of pipe joints will be permitted prior to the satisfactory completion of the tests in any given section.

3. Thrust Blocks. Temporary or permanent thrust blocks shall be placed as required prior to tests, and the Contractor shall provide all necessary braces, plugs, thrust blocks, caps, flanges, and other materials to permit proper performance of the pressure testing; tests shall not be conducted until the concrete thrust blocks are capable of withstanding the loads produced.

C. Leakage Tests.

1. General. Leakage tests shall be conducted concurrently with pressure test. The lowest pressure during the leakage test shall be no less than 5 psi below the pressure used in the pressure test. The allowable leakage for pipes conveying liquids between process tankage (not subject to pumping) shall be determined in accordance with AWWA C-600 Section 4.2 where in the equation, P is the maximum pressure occurring anywhere in the pipeline. The duration of the test shall be not less than two hours, and measurement shall be made by means of a calibrated suction tank showing the amount of water required by the test pump to accurately maintain

the specified test pressure. Tests shall be performed only in the presence of the Buyer, or, if scheduling of tests is such that the Buyer cannot attend due to conflicting commitment, tests may be performed without the Buyer's presence if the Contractor obtains written permission to do so from the Buyer prior to initiation of testing. No test report will be accepted unless proof of compliance with the foregoing requirement accompanies the test report.

3.11 FLUSHING.

A. General. All piping shall be flushed clean of all dirt and foreign material following completion of the hydrostatic and leakage test. Air and gas piping shall be purged with air or inert gas as directed by the Owner.

B. Equipment and Supplies. The Contractor shall provide all equipment, and supplies for performing the work, and shall waste the water at locations or by procedures approved by the Buyer. The Contractor shall be responsible for furnishing fittings and all special pipe taps required for injecting any required sterilizing solution.

3.12 DISINFECTION. Disinfection of the chemical dilution water, plant water and potable water lines shall be performed in accordance with AWWA Standard C601.

END OF SECTION

TABLE 1
PIPE MATERIAL SCHEDULE

Service	Application	Size	Pipe Material	Joint and Fittings
Influent	buried	2 in.	CPVC	glued
	exposed	2 in.	GS	threaded
	containment	2 in.	DW CPVC	glued
Effluent	buried	2 in.	CPVC	glued
	exposed	2 in.	GS	threaded
Transfer Pump Suction		2 in.	GS	threaded
Treatment	influent	2 in.	GS	threaded
	effluent	2 in.	GS	threaded
French Drain		6 in.	SLPVC	glued
Infiltration Gallery		6 in.	SLPVC	glued
Galery Transfer		6 in.	PVC	glued
Potable Water Supply	buried	2 in.	CSCW	threaded
Sanitary Sewer		4 in.	PVC	glued
Waste		4 in.	CISP	bell & spigot
		2 in.	GS	screwed
Tank Overflow		4 in.	GS	threaded
Potable Water	exposed	1-1/4 in.	C	solder
		1/2 in.	C	solder
Recirculation		2 in.	GS	threaded

KEY

CPVC - Chlorinated Polyvinyl Chloride
PVC - Polyvinyl Chloride
DWCPVC - Double Wall CPVC
GS - Galvanized Steel
GSCW - GS Coated and Wrapped
PPVC - Perforated PVC
C - Copper
CISP - Cast Iron Soil Pipe

SECTION 15099

PROCESS VALVES, REGULATORS AND MISCELLANEOUS COMPONENTS

PART I: GENERAL

1.1 DESCRIPTION. Requirements specified in the Conditions of the Contract and Division 1 form a part of this Section. The Contractor shall furnish all tools, equipment, materials, and supplies and shall perform all labor required to furnish and install all valves and appurtenances as indicated on the Drawings, and specified herein.

1.2 SCOPE OF WORK.

A. Work Included in This Section. The Work of this Section shall include the furnishing, installation, and testing of all valves and required appurtenances as specified herein, shown on the Drawings and as required to make the entire facility operable except for those valves and appurtenances required to be provided in other Sections of these Specifications.

1.3 SUBMITTALS. Provide the following in conformance with applicable requirements contained in Conditions of Contract and Division 1.

A. Shop Drawings. Submit shop drawings for process valves, regulators and miscellaneous components. Shop drawings shall be complete with bill-of- materials showing kind and class of materials, and catalog and engineering data showing compliance with the specified requirements.

B. For each type and model of valve provide:

1. Assembly instructions and spare parts list, and

2. Preventative/corrective maintenance instructions, and

3. Certificate of seat compatability with entailed fluid exposure.

C. Erection Drawings. Erection drawings shall include the procedures to be used in setting, supporting, and/or anchoring the valves, the fitting of line pipe to the valves for proper coupling, and for adjusting and testing all valve assemblies.

1.4 VALVE SCHEDULE. Valves shall be of the type shown on the Drawings and of the rating and construction as specified below. All valves of the same type shall be of the same make unless otherwise approved.

PART II: PRODUCTS

2.1 CPVC VALVES.

A. Ball valves shall be true union type with socket fittings. All parts in contact with fluid shall be CPVC, teflon, or viton. Pressure rated at 150 psi at 70°F minimum.

B. Globe valves shall have socket fittings. Pressure rated at 150 psi at 70°F minimum. All parts in contact with fluid shall be CPVC, teflon or viton.

C. Ball check valves shall have socket fittings and union connections, pressure rated at 150 psi at 70°F minimum and all parts in contact with fluid shall be CPVC, viton or teflon.

D. Swing check valves shall have flange connectors, clean out access, pressure rated at 150 psi at 70°F and all parts in contact with fluid shall be teflon or CPVC.

2.2 IRON BODY VALVES. Except as otherwise specified, iron body valves shall comply with ASTM A126 Class B.

2.3 PRESSURE RATING. All process valves shall be rated for a working pressure equal to or more than the pressure rating of the connecting piping unless specifically shown otherwise on the Drawings or specified in other Sections of these Specifications.

PART III: EXECUTION

3.1 INSTALLATION shall be in conformance with Section 15060 and the following requirements.

A. Valves and Valve Boxes shall be set in true alignment and grade in accordance with the procedures submitted with the shop and erection drawings, and the valves mounted as shown. All adjustments and operating settings of valves and appurtenances shall be made in accordance with procedures and detailed instructions furnished with the erection drawings.

B. Buried Valves shall be firmly supported in place by the foundations to preclude strain on the pipe connections. The valve boxes shall be checked for centering plumb over the wrench nut to ensure that the box cover is flush with the finish grade. Earth backfill shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box, or to undisturbed trench face if less than 4 feet. Valves shall have their interiors cleaned of all foreign matter before installation. The valves shall be inspected in opened and closed positions to ensure that all parts are in working condition.

C. Aboveground Valves shall be rigidly held in place using supports and hangers as shown on the drawings and as specified. The stem orientation of valves in elevated piping shall be as approved by the Buyer for accessibility, but no valve shall have stem in the downward direction. Saddle type valve supports shall be provided for all valves in vaults. Supports shall be of rugged construction providing at least 120 degrees under-support for the valve body, shall be constructed of steel as specified in Division 5, and shall be anchored to the foundations using galvanized anchor bolts.

3.2 TESTS.

A. Field Tests. Test all valves and appurtenances for proper operating adjustments and settings and for freedom from vibration, binding, scraping, and other defects. The adequacy of all pipe hangers and supports and valve supports to meet specified requirements shall be verified. All defects found shall be corrected as approved.

3.3 COORDINATION WITH INSTRUMENTATION. It shall be the responsibility of the Contractor to coordinate with Division 17 regarding the requirements of control valves.

3.4 CLEANING. All valves and appurtenances shall be flushed clean of all foreign matter together with the piping as specified in other sections.

END OF SECTION

SECTION 15140--PUMPS

PART I: GENERAL

1.1 RELATED WORK SPECIFIED ELSEWHERE

A. Section 15060, Piping

B. Section 15099, Process Valves

1.2 SCOPE OF WORK

A. The work in this section shall include the furnishing, installation, and testing of pumps and motors as shown on the drawings.

1.3 SUBMITTALS

The Contractor shall provide the following in conformance with applicable requirements in Division 1:

A. Installation maintenance, and operating instructions;

B. Pump curves;

C. Specifications of materials in contact with fluids being pumped.

PART II: PRODUCTS

2.1 WELL PUMPS

Well 1-88 Pump (P100) and French Drain Pumps (P101 A & B, P102 A & B, P103 A & B) shall be Grundfos model 5S03-9 or approved equal 1/3 HP, 3 3/4" wide, 1.2 to 7 GPM (5 GPM nominal), with stainless steel or fiberglass flow sleeve, 1" NPT discharge, 480 volt, 3 phase.

2.2 SUMP PUMP

Building 830 sump Pump (P300 A & B) shall be ABS brand model SEVH-4W or approved equal 4/10 HP, 9" wide, 40 GPM at 20 foot head, 1 1/2" NPT discharge, 230 volt, single phase.

2.3 TRANSFER PUMPS

Transfer pumps (P301, P302) shall be Aurora brand model 321, or approved equal, frame 56, 1 HP, 1" NPT discharge, 4" case bore, 33 GPM at 30 foot head, 480 volt, 3 phase.

PART III: EXECUTION

3.1 GENERAL

Contractor shall coordinate pump installation with other trades including concrete work, process piping, electrical, and

instrumentation. Installation shall comply with Section 15050 "Equipment Installation".

3.2 INSTALLATION

Pumps shall be mounted and plumbed, and electrical connections made as prescribed by the pump manufacturers.

3.3 TESTING

Pumps performance shall be tested as recommended by the manufacturers.

END OF SECTION 15140

SECTION 15175

TANKS

PART I: GENERAL

1.1 DESCRIPTION: This section covers the installation of the four (4) Government Furnished tanks (T-201, T-202, T-203, T-204). The tanks will be furnished on or before _____ at _____.

PART II: PRODUCTS

2.1 PROCESS VALVES: Process valves shall comply with the specifications in Section 15099. The following valves shall be supplied by the contractor for attachment to each of the four (4) tanks

- 2" plug valve on drain
- 1/2" spigot on sample port

2.2 INSULATION: Tank insulation and aluminum jacket will comply with Section 15180.

PART III: EXECUTION

3.1 Tanks shall be installed as shown on the drawings and as specified in Section 15050.

3.2 Process piping shall be connected as shown in the drawings and as specified in Sections 15060 and 15099.

3.3 The tanks shall be insulated as specified in Section 15180.

SECTION 15180--INSULATION

PART I: GENERAL

1.1 DESCRIPTION: This section covers the furnishing and installing of the insulation on exposed and buried above freezing zone (approximately five (5) feet of cover) influent and effluent piping, domestic cold water piping, and the four (4) outdoor installed ground water storage tanks as indicated on the drawings. The installed insulation shall completely insulate the systems as required for freeze protection.

1.2 SUBMITTALS: Submit shop drawings, catalog data, and descriptive literature of all items in accordance with requirements described in Division 1 of these specifications.

1.3 STORAGE AND HANDLING: All materials to be used shall be protected from the elements during storage. Materials shall be stored and handled in a manner so as to prevent damage. Any insulation exposed to moisture prior to installation shall be rejected by the Buyer.

PART II: PRODUCTS

2.1 General: Insulation shall be suitable for both indoor and outdoor use for temperatures ranging from -20 degrees F to 400 degrees F. The insulation shall have ratings not to exceed flame spread of 25, smoke development of 50, and fuel contribution of 50 when tested to American Society for Testing and Materials (ASTM) E-84 and Underwriters' Laboratories, Inc. (UL), 723.

2.2 Closed-Cell Insulation: Expanded closed-cell insulation shall be flexible, elastomeric thermal insulation, 4 PCF density, supplied in tubular form 1 1/2" thick for piping and flat sheets 2" thick for tanks. Thermal conductivity shall not exceed K=0.25 BTU x in./hr. x ft^2 x degrees F at 0 degrees F mean temperature per ASTM C177, water vapor permeability less than 0.17 perms per ASTM E 96 procedure E, water absorption less than 6% by weight per ASTM D 1056. The closed cell insulation shall be as manufactured by Armstrong Armaflex, Thermazip, Certain Teed or approved equal.

2.4 Jacketing: Fitting coves and jacketing for piping and tanks shall be aluminum alloy 3003-H14 per ASTM B209, thickness 0.025 in., fabricated to exact dimensions. Structural members, if used for reinforcement shall be alloy 6061-T. Clamps for underground applications shall be stainless steel and underground gasket material shall be neoprene.

2.5 Non-Shrinking Caulk: Suitable for outside application with temperature range from -30 degrees F to 100 degrees F.

PART III: EXECUTION

3.1 GENERAL

A. All necessary testing on piping and tanks shall be completed prior to installation of insulation.

B. Install all materials according to the approved recommendations of the manufacturer and conforming to the drawings and specifications.

C All insulation shall be installed over clean, dry surfaces.

D. Pipes and tanks to be insulated shall be as indicated on the drawings.

E. Work shall be done by a Contractor who is thoroughly familiar with insulation applications. Contractor shall exercise extreme care while backfilling insulated piping to protect jacket.

3.2 ABOVE GROUND INSULATION: Pipe insulation shall be 1 1/2" thick and tank insulation shall be a total of 2" thick. Molded pipe insulation shall be slit lengthwise and snapped over clean and dry piping already connected and/or slipped onto piping before it is connected. Fitting insulation shall be premolded or fabricated from 1 1/2" thick miter-cut tubular form or from 1 1/2" thick sheet insulation held in place with 16 gauge wire. Tank insulation shall be fabricated from 2" thick sheet. In all cases, butt joints and seams shall be sealed with manufacturer recommended contact adhesive. Both surfaces to be joined shall be coated with adhesive.

3.3 APPLICATION OF JACKET: Aluminum sheets for tanks and aluminum tubing for piping and/or fittings shall be joined in the field and sealed vapor tight with non-shrinking caulks. Structural reinforcement; when used, shall be attached to jacket with aluminum fasteners.

3.4 BELOW GROUND INSULATION AND JACKET: Pipe insulation and jacket shall be applied as above except that the jacket shall have a bottom aluminum boot completely sealed around the pipe to prevent any moisture intrusion. Each boot shall be secured to the pipe with a stainless steel clamp isolated from the aluminum jacket with a neoprene gasket. An identical gasket shall be provided between the pipe aNd aluminum boot to isolate dissimilar metals.

END OF SECTION

SECTION 15400--PLUMBING

PART I: GENERAL

1.1 DESCRIPTION: This section covers the furnishing, installing, adjusting, and testing of the piping systems as outlined herein and as indicated on the drawings.

1.2 SUBMITTALS

A. Shop drawings, catalog data, and descriptive literature of all items in accordance with requirements described in Division 1 of these specifications.

B. This data shall indicate overall dimensions, weights, metal gages, materials, construction details, certified capacities and ratings and all other information ncecessary for the evaluation of the materials and/or equipment.

1.3 EXPLANATION AND PRECEDENCE OF DRAWINGS

A. For purposes of clearness and legibility, the Drawings are essentially diagrammatic, and although size and location of equipment are drawn to scale where possible, the Contractor shall make use of all data in all of the Contract Documents and shall verify this information prior to and during construction.

B. Scale and figured dimensions are approximate and are for estimating purposes only. Before proceeding with the work, the Contractor shall assume all responsibility for the fitting of his materials and equipment to other parts of the equipment and structure.

C. Where apparatus and equipment have been indicated on Drawings, dimensions have been taken from typical equipment of the class indicated. The Contractor shall check the Drawings to see that the equipment to be installed will fit the spaces provided and allow ample room for maintenance and/or repair.

D. All work not shown in complete details shall be installed in conformance with accepted standard practice and manufacturer's recommendations.

E. Changes in location of all piping, apparatus and equipment as indicated on the Drawings, shall be made to meet the structural conditions as required and as approved by the Buyer. Any changes in Work which has not been installed and shall be made by the Contractor without additional compensation except changes which are caused by architectural and structural changes which increase the number of fixtures and lengths of pipe runs.

1.4 PERMITS, LICENSES AND INSPECTIONS

A. Contractor shall give the proper authority all notice required by law relative to the work in his charge and shall obtain the necessary permits. The Buyer shall pay the actual permit cost and inspection fees.

B. All work and materials shall conform to the latest Uniform Plumbing Code having jurisdiction; recommendations and requirements for NFPA and the local fire department or fire marshall; recommendations and requirements of the Buyer's Insurance Company, and the fire rating bureau, and any other local or state ordinances and regulations pertaining to adequate protection and/or guarding of any moving parts or otherwise hazardous locations.

1.5 TEMPORARY SERVICE: The furnishing of all water, and fuel required for the installation of the Work and for the period of operation during testing of the system is specified in the Division I or Conditions of Contract.

1.6 SITE UTILITIES AND CONNECTIONS: Refer to Site Plans for site utilities and make connections to water, and sewer after ascertaining that site systems have been tested and are ready for connection, and after building systems testing.

PART II: PRODUCTS

2.1 MATERIALS: Materials and/or workmanship involved in this Specification shall be of the best quality for the purpose intended, and all materials shall be new and in first class condition. Materials shall be clearly marked or stamped with the manufacturer's name and/or stamp and rating and shall be made in the U.S.A. Materials shall conform to those listed in the current Uniform Plumbing Code, and when not otherwise specified, shall conform to applicable ASTM and ASME specifications. "Approved Equal" or "Similar and Equal" refers to materials which in the opinion of the Buyer are similar and equal in all respects to materials or methods indicated on the Drawings or as specified. Buyer is not required to prove that a substitute material is not equal to the specified material, and it shall be mandatory that the Contractor submit in writing to the Buyer any and all evidence supporting his contention that the substituted material is equal to materials shown on the drawings or as specified. The Buyer reserves the right to reject any and all materials and workmanship, either before or after installation, that are not shown on the drawings, or specified, or the substitution of which has not been approved by the Buyer in writing. In all cases where manufacturers of articles used in this Contract furnish directions covering points not shown on the Drawings or herein specified, such directions shall be followed.

A. Pipings and Fittings

1. Raw water, domestic hot water (potable), and domestic cold water (potable) with a maximum, working pressure of 125 psig and maximum temperature of 200 degrees F.

Pipe	
3 in. and smaller	Schedule 40 galvanized butt weld or continuous welded steel to ASTM A-120
Fittings 3 in. and smaller	150# galvanized malleable iron screwed to ASTM A-153
Unions 3 in. and smaller	150# galvanized malleable iron screwed bronze to iron, ground joint
Gaskets all sizes	150# 1/16-in. full faced punched asbestos sheet JM-60 or Cranite
Bolting	Regular square-head machine bolts with heavy hex nuts to ASTM A-307 Grade B. ANSI B1.1 coarse thread series, Class 2B fit.
Gate Valves	
3 in. and smaller	150# bronze screwed
Walworth 12 Crane 435 or 464 1/2 Nibco/Scott I-135 Powell 2714	150# SWP saturated--300# WOG bronze body, integral Seat, double disc, rising Stem, union bonnet
Globe Valves	
3 in. and smaller	150# bronze screwed
Lunkenheimer 123 Crane 7 Walworth 95 Powell 150	150# SWP @ 450 degrees--300# WOG, bronze body, integral seat, flat composition disc (specify), rising stem, inside screw, union Bonnet

Angle Valves

3 in. and smaller	150# bronze screwed
Crane 17 or 350 Lunkenheimer 214 Walworth 96 Powell 151	150# SWP @ 500 degrees F--300# WOG, bronze body, integral seat composition disc, union Bonnet

Check Valves

3 in. and smaller	125# bronze screwed
Lunkenheimer 2144 Crane 34 Walworth 406 Powell 578	125#SWP @ 500 degrees F--200# WOG, bronze body, integral seat, bronze disc, screwed cap

2. Domestic hot water (potable), domestic cold water (potable) above ground, with a maximum working pressure of 125 psig and a maximum temperature of 200 degrees F:

Pipe

2 in. nom. and smaller	Type K or L hard-copper water tube to ASTM B-88

Fittings

2 in. nom. and smaller	Wrought copper solder joint to ANSI B16.22

Unions

2 in. nom. and smaller	Wrought copper solder joint to ANSI B16.22

Gate Valves

2 in. and smaller	1125# bronze soldered
Lunkenheimer 2133 Crane 1320 Walworth 4SJ Powell 1822	125# SWP saturated Bronze body, integral seat Solid wedge, nonrising stem Screwed bonnet

Globe Valves

2 in. and smaller	150# bronze soldered

Lunkenheimer	126	150# SWP saturated
Walworth	95S	Renewable composition disc (specify)
Powell	1823	Rising stem, inside screw union bonnet

Check Valves

2 in. and smaller	125# bronze soldered

Lunkenheimer	2145	125# SWP saturated
Crane	1303	Bronze body integral seat
Walworth	406S	Screwed cap
Powell	1825	

3. Sanitary Waste, Sanitary Vent, and Roof Drains

a. For sanitary waste above ground or inside building:

Piping

2 in. and smaller	Service cast iron, hub and spigot soil pipe to ASTM A-74 or hubless to CISPI 301

Fittings

2 in. and larger	Service cast iron, hub and spigot soil pipe fittings to ASTM A-74 or hubless to CISPI 301

Cleanouts

Cleanouts for cast iron pipe shall consist of a tapped, extra heavy cast iron ferrule, calked into cast iron fittings, and extra heavy brass tapered screw plug; cleanouts for steel pipe shall consist of extra heavy brass screw plugs in drainage fittings.

Cleanouts shall be provided at or near the foot of each vertical soil or waste stack. The distance between cleanouts in horizontal piping shall not exceed 50 ft. for 3 in. or less in size and not over 100 ft. for 4 in. and over in size. Cleanout shall also be provided in each branch line to fixtures and at each change of direction greater than 45 degrees.

The cleanout shall be of the same nominal size as the pipes to serve up to 4 in. in diameter and not less than 4 in. for larger piping.

Each cleanout shall be installed so that it opens in a direction opposite to the flow of the soil or waste or at right angles thereto, and except in the case of wye branch and end-of-line cleanouts, vertically above the flow of the pipe.

Cleanouts turning out through walls and up through floors shall be made with long sweep ells or wye and one-eighth bends with plugs and face or deck plates to conform to the architectural and/or mechanical drawings; wall plates shall be chrome-plated cast brass and floor plates shall be nickel bronze.

Cleanouts installed in finished floors to be covered by tile or composition flooring material shall be Zurn ZN-1405-7 or ZN-1400-7, with nickel bronze recessed inlay-type access cover. Cleanouts installed in finished walls shall be Zurn ZN-1440-1 or ZN-1460-8, with nickel bronze cover with securing screw.

Cleanouts installed in concrete floor other than mechanical rooms, garages, or heating tunnels shall be ZN-1405-2 or ZN-1400-2 furnished with nickel bronze top and adjustable to finished surface of floors.

Cleanouts installed in concrete floors in mechanical rooms, garages, or heating tunnels shall be Zurn Z-1423-27 or Z-1420-27.

b. For sanitary waste and sanitary vent below ground:

Piping

All sizes	Service cast iron, coated, hub and spigot soil pipe to ASTM A-74.

Fittings

All sizes	Service cast iron, coated, hub and spigot soil pipe fittings (use standard radius bends) to ASTM A-74 or ASTM C-564 and CISPI 301

c. For sanitary vent above ground:

Piping

3 in. and smaller	Schedule 40 galvanized buttweld or continuous welded steel to ASTM A-120

4 in. and larger	Service cast iron, hub and spigot soil pipe to ASTM A-74 or hubless to CISPI 301.
Fittings	
3 in. and smaller	Cast iron, black, screwed drainage fittings to ASTM A-126 and ANSI B16.12
4 in. and larger	Service cast iron, hub and spigot soil pipe fittings to ASTM A-74 or hubless to CISPI 301

d. For roof drains:

Piping	
6 in. and smaller	Schedule 40 galvanized buttweld or continuous welded steel to ASTM A-120
Fittings	
6 in. and smaller	150# galvanized malleable iron screwed to ASTM A-1917 and ANSI B16.3

B. Joining Materials

1. Threaded and Screwed: Teflon-filled thread sealing and lubricating compound or Teflon tape.

2. Solder Alloy: Soldered joints shall be made with a noncorrosive paste flux and solid string or wire 95.5-4-0.5 tin-copper-silver. Cored solder shall not be permitted. Refrigerant piping and brazed joints shall be made with SIL-FOS.

3. Dielectric unions shall be manufactured by Epco Company.

4. Pig lead shall conform to ASTM B29.

5. Elastomeric Joint: Positive double-seal elastomeric compression-type joints such as Tyler Ty-Seal.

2.2 PIPE HANGERS, ANCHORS, AND SUPPORTS

A. The materials of supports shall be compatible with the characteristics of the piping material so that neither shall have a deteriorating action on the other.

B. Supports shall be dimensionally compatible with the outside diameter of the pipe and/or insulation.

C. Pipe hangers, anchors, and supports and all their components shall be the standard products of a manufacturer. Straps, wire, and "all-threaded" rods shall not be used. The materials of all pipe hanging and supporting elements shall be in accordance with Manufacturers' Standardization Society (MSS) SP-58.

D. Hanger and support components shall be selected from Table 1 of MSS SP-69 within the system classification. All domestic cold water and hot water shall be from 60 degrees to 220 degrees F.

2.3 ESCUTCHEONS: Grinnell Figure 13, chromium plated.

2.4 TEST FLUIDS: Acceptable bubble tests fluids are American Gas and Chemical Inc., "Leak-Tec;" Cargrille Scientific, Inc., "Sho Gas;" Flamort Chemical Company, "Detect-A-Leak;" or Highside Chemicals, Inc., "Leak Finder Foam." Substitute test fluids shall be approved in writing by the Buyer.

2.5 EQUIPMENT

A. The following plumbing fixture catalog numbers are taken from the American Standard Catalogs. The Contractor shall submit a portfolio in six copies showing fixtures and trimmings to the Buyer for his approval before releasing fabrication and/or shipment.

B. All exposed, flush, waste, and supply pipes at the fixtures shall be chromium-plated brass pipe, iron pipe size. The faucets, stop valves, pop-up waste, traps, etc., shall be heavy cast brass, chromium plated. Supplies to all individual fixtures shall be equipped with high-grade, chromium-plated stop valves. All chromium plating shall be applied over a nickel-plated base.

C. S-1 Sink

1. Fixture: Elkay stainless steel double compartment, 6-in. deep basin, 20-gage stainless steel, self-rimming, underside to be coated with sound deadener. Three hold sink.

2. Supply Fitting: American Standard 7516.172 Centerset faucet 4-in. centers, 9-in. gooseneck spout with aerator, renewable seats, 4-in. handles, chrome finish.

3. Supply Pipe: American Standard 2302.115 3/8-in. IPS angle supply with stop, annealed vertical risers with loose key stop escutcheon.

4. Drain: Elkay drain outlet with 2 sink adaptor, stainless conical strainer plate with 1-1/2 in. tailpiece.

5. Trap: American Stnadard 4403.010 cast brass adjustable "P" trap with cleanout, waste to wall escutcheon.

D. Emergency Wash and Shower Station (EEW-1): Haws 8301, or equal, 10-inch drench shower head, stainless steel eye-bath bowl, hand and foot control, all chrome plated, with wall mounting brackets.

E. Floor Drain (FD-1): Smith 2010 B square-top nickel bronze 5-inch strainer, Zurn or Josam equal with cast bronze "P" trap for emergency eye wash and shower station area.

F. Water Heater (WH-1): Instantaneous electric water heater shall be instant-flow, tankless water heater at the point of use. Chronomite Laboratories, model S-30L/110 capacity 3 KW, 120v-single phase-60Hz, AEG Telefunken Series MDT 3KW, 120v-single phase-60 Hz or approved equal. Water heater shall be UL-listed, and shall be equipped with separate appliance flow restrictor.

PART III: EXECUTION:

3.1 GENERAL

A. The general arrangement of the piping shall be as indicated. Departures due to actual field conditions or other causes shall be approved by the Buyer. The Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of materials and equipment, as indicated, without substantial alteration.

B. The Contractor shall provide all material and labor required and shall make all connections to equipment having pipe connections and which are herein specified or shown on the drawings. Pipe provided for future connection to equipment shall be terminated with removable plugs, blind flanges, or caps.

C. Pipe shall be cut accurately to measurements established at the site by the Contractor and shall be worked into place without springing or forcing. Piping shall be run parallel with the lines of the building unless otherwise indicated. A clearance of not less than 1 in. shall be kept between pipe and other work or the different piping services. Brace connections and changes in pipe size shall be made with standard pipe fittings. Change in direction shall be made with fittings.

D. Screw joints shall be made with tapered threads properly cut conforming to ASME 82.1. Joints shall be made tight with thread sealing and lubricating compound or Teflon tape applied to male threads only.

E. Welding shall be performed according to the requirements of ANSI Standard B31.1, entitled "Power Piping" (Code for Pressure Piping).

F. Tubing shall be accurately cut to measure using the proper tools to ensure a square cut. Burrs shall be removed by using a reamer or file specifically designed for this purpose. Surfaces to be joined shall be throughly cleaned to remove any oil, grease, or heavy oxides. Tubing that is out of round shall be brought to true dimensions and roundness by use of a sizing tool. Apply flux to both the end of tubing and the socket of the fitting as quckly as possible after cleaning. Assembled joints that have not been soldered within 3 hr. shall be disassembled, cleaned, and refluxed before proceeding. If a joint is overheated to the extent of burning the flux, the joint shall be opened, recleaned, and refluxed. Surplus solder alloy shall be removed by wiping upon completion of each joint while it is still hot. Excessively large fillets will not be permitted.

G. Cast iron pipe joints shall be made by calking with two strands of tarred oakum, finishing the joint with molten lead bedded with hammer and calking tool, using for each joint not less than 12 oz. of per inch of diameter. Each joint shall be filled with one pouring of the lead. The lead shall not be covered with paint or putty.

At the option of the Contractor, joints for cast iron pipe and fittings may be by the use of elastomeric compression-type joints.

H. Cathodic Protection: Cathodic protection shall be provided in piping systems in accordance with the following requirements:

1. Insulating Couplings or Flanges shall be furnished and installed at all locations described herein, whether shown on the drawings or not, and except as noted.

   a. Install in water connections to water heater at points in water lines where ferrous and nonferrous pipes are connected together.

   b. Where Steel or Cast Iron Pipe in the ground connects to copper or brass piping above the ground, the transition from steel or cast iron pip to the copper or brass pipe shall be made above ground in all cases, and in an accessible location where practicable.

3.2 PIPE PENETRATIONS AND SLEEVING

Pipe penetrations shall conform to Section 07901

3.3 PIPE IDENTIFICATION

A. Definitions

1. Piping Systems: For the purpose of this section, piping system shall include fittings, valves, and piping accessories. Pipes are deinfed as conduits for the transport of gases and liquid.

2. Identification: Identication of piping system content (flow media) shall be a lettered legend giving the name of the contents in full (no abbreviations), as called out in the drawing legend.

B. Application

1. Location

a. All exposed or concealed piping in finished or unfinished areas shall be identified. Underground piping shall be excepted.

b. Identification and supplementary information legends shall be applied close to all valves, branches, changes in direction, on both sides of each floor, wall, or barrier equipment, and at a maximum of 20-ft. intervals on straight runs of piping.

2. Method

a. Pipes shall have identification clearly lettered with the aid of stencils. Stenciling shall be accomplished with paint materials only; tapes and "stick-on" labels and materials are not permitted. Pipe not otherwise painted shall be painted with a white patch of sufficient length and width to receive the legends. Black stenciling shall also be used on white patches. legends shall be clear, sharp, and legible.

b. Pipe or coverings less than 3/4-in. actual outside diameter shall have identification and supplementary information legends on 1/2-in.-wide aluminum tape, such as DYMO, banded in place.

3. Orientation of Legends: Attention shall be given to the orientation and visibility of identification legends. The legends shall be arranged and located so as to be easily readable by a person standing on the floor or at the normal access location to the pipe. Stenciled legends shall generally be arranged parallel with the axis of the pipe.

4. Letter height shall be as follows:

Pipe or Covering Actual Outside Diameter	Height of Lettering
3/4 in. to 1 1/2 in.	1/2 in.
Over 1 1/2 in. to 2 in.	3/4 in.
Over 2 in. to 6 in.	1 in.

3.4 FIELD QUALITY CONTROL

A. Cleaning--Piping shall be clean, free of scale, and throughly blown free of all foreign matter with dry compressed air. Valves and equipment shall be throughly cleaned. Each item and length of pipe shall be cleaned before assembly.

B. Testing

1. General: Testing of underground piping shall be accomplished before piping is covered. All labor, materials, and equipment used for tests shall be provided by the Contractor. If improper assembly is the cause for test failure, piping shall be reassembled and retested at no additional expense to the Buyer.

2. Domestic cold water shall be tested at normal working pressure. The only test required shall be a visual inspection of the piping. The test medium shall be water.

3. Sanitary sewer and vents shall be tested by the following methods:

   a. Test pressure shall be attained by filling the vent to overflowing.

   b. Use clean water as the test medium.

   c. Remove trapped air.

   d. Hold the test pressure for 1 hour and make a visual leak inspection. Water level loss shall not exceed 1 in.

C. Sterilization of Domestic Water Piping:--After installation and testing, flush water pipe clean, then sterilize with a solution containing not less than 6 oz. by weight of calcium hypochlorite (68% available chlorine) per 500 gal. of water. Allow solution to remain in system for a period of 8 hr. During this period, open and close valves and faucets several times. After sterilization, flush system with clean water until chlorine content is not greater than 0.2 parts per million. Solution shall be introduced after the shutoff valve.

END OF SECTION

SECTION 15800

HEATING AND VENTILATING

PART I: GENERAL

1.1 SCOPE: Requirements of Division 1 apply to this Section. Furnish and install complete heating, ventilating systems as shown on Drawings, as specified herein, furnishing all materials and performing all work required and necessary to complete and place systems in satisfactory operation.

A. Work Included in This Section. Principal items of work include, but are not limited to the following:

1. Sheet metal ducts, hangers, supports, wall caps, wall sleeve, volume dampers and accessories.

2. Insulation: Duct insulation, both thermal and sound.

3. Equipment: Exhaust fans and electric unit heater.

4. Low voltage temperature controls for unit heater and solid state speed controller with on-off feature..

5. Submittals, air balance, test, start-up and instruction to operators.

B. Related Work Not Included in This Section

1. All conduit and wiring, except as part of manufacturer preassembled equipment or where specifically noted otherwise.

2. Electrically provided fused disconnects.

3. Cutting and patching, except as noted and authorized.

4. Painting (except primecoat and behind registers and grilles).

5. Wall openings, except to confirm sizes and locations.

6. Exterior fixed wall louver with thermal insulated blank-off panel.

7. Roof flashing and counter flashing details for vents.

8. Access ladders and roof scuttles.

1.2 EXAMINATION OF DRAWINGS AND SITE: The Contractor by the act of submitting a Bid shall be deemed to have examined the site and all Mechanical, Architectural, Structural, Electrical and other Drawings and to have accepted such conditions and to have made allowances for them in preparing his Bid.

1.3 SUBMITTAL DATA: Contractor shall submit all catalogue, sizing and rating of exhaust fan, and unit heater, controls, and accessories, literature, with certified dimensions of size openings for approval before proceeding with work. Refer to Structural, Architectural and Electrical Details.

1.4 AS-BUILT DRAWINGS: Two complete sets of Mechanical Drawings shall be provided as "As-Built Drawings," which shall be separate, clean blue line prints reserved for the purpose of showing a complete picture of the Work actually installed. These drawings shall be kept current with the construction.

1.5 EXPLANATION AND PRECEDENCE OF DRAWINGS: It is intended that equipment shall be located as shown. Plans and Specifications are complementary to each other for a complete and satisfactory installation.

A. Work called for on the Drawings by note shall be furnished and installed whether or not specifically mentioned in the Specification. Any discrepancy between the Drawings and Specifications shall be brought to the attention of the Buyer for resolution.

B. Offsets and interferences may not be shown; the Contractor shall cooperate with other trades in avoiding interference.

1.6 ORDINANCES AND REGULATIONS: Materials, equipment and workmanship shall be designed to comply with and shall be installed in accordance with the requirements of all legally constituted public authorities having jurisdiction, including the current Uniform Building Code and Colorado State and Local ordinances and Safety Orders of the state Division of Occupational Health and Safety, and Rules and Regulations of the Insurance Service Office and NFPA. This shall include State of Colorado energy code requirements where applicable as locally adopted. Except that where provisions of these Specifications exceed such requirements, these Specifications shall govern.

1.7 PERMITS AND INSPECTIONS: Obtain and pay for all permits, licenses and inspections that are required for the performing of his work by all laws, ordinances, rules, regulations or orders of any body lawfully empowered to make or issue same, having jurisdiction.

1.8 PROTECTION OF FINISH: The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from whatever cause during the progress of the work and until final completion. All materials and equipment in storage and during construction shall be covered in such manner that no finished surfaces shall be damaged or marred and all moving parts shall be kept perfectly clean and dry.

1.9 TESTING AND BALANCING AIR DISTRIBUTION SYSTEMS: The Contractor shall adjust, test and air balance the exhaust ventilation system, and shall submit a report after final adjustment to ±5 percent of design CFM's in six sets. Refer to Article 3.

1.10 CLEANING EQUIPMENT AND MATERIALS: Thoroughly clean all parts of the equipment, appurtenances, etc., covered under this contract. Exposed parts which are to be painted shall be thoroughly cleaned of cement, plaster and other objectionable materials.

1.12 OPERATING INSTRUCTION: Three (3) copies of an instruction book giving complete service data on all equipment and systems shall be furnished to the Buyer for distribution.

1.13 GUARANTEE: The Contractor shall furnish a written guarantee to the effect that all material and work furnished under this section is guaranteed for one (1) year to be free from defects and faulty workmanship, and that any defective material or work shall be promptly repaired or replaced without additional cost to the Buyer. Guarantee period shall start at the acceptance of completed work by the Buyer.

PART II: PRODUCTS

2.1 ELECTRIC UNIT HEATER (UH-1): The Contractor shall furnish and install complete and operating electric heater of the size and capacity, as identified herein. Heater shall be Chromalox Model MUH-03-4 horizontal discharge or approved equal. The heater shall be UL listed, installed, wired and controlled in accordance with the Drawings, Specifications, and the manufacturer's recommendations and shall comply with all applicable local and national electric codes. The unit heaters shall be 3 kW, 480V, 3-phase, 60Hz. The unit heaters shall be horizontally mounted on wall universal bracket and swivel bracket. All sheet metal parts including fan shall be baked enamel finished. Unit shall be equipped with power disconnect switch and summer fan switch.

A. Horizontal Discharge Type Heaters

1. Casing: The casing shall be fabricated from heavy gauge zinc-coated steel finished with louvered front panel and removable bottom cover. The casing shall be finished in high gloss baked enamel. Adjustable discharge louvers shall be provided to control the direction of flow.

2. Heating Elements: The heating elements shall be aluminum finned, copper clad steel sheath, totally enclosed type, continuously finned. The heating elements shall be arranged in a manner that will insure an even and equal amount of air flow over all sections.

3. Motor: The fan motor shall be a totally enclosed, permanently lubricated, industrial type with automatic reset thermal overload protection.

4. Fan: The fan shall be an axial flow propeller type statically and dynamically balanced, designed for quiet, efficient operation. Fan speed shall not exceed 1,600 RPM. The fan shall be provided with wire guard mounted to the back of unit enclosure.

5. Overheat Protection: An automatic reset thermal cut-out shall be provided to disconnect the motor and heating elements in the event that normal operating temperatures are exceeded.

6. Heater Element Circuits: Heating element circuits shall be individually fused. Motor and thermostat circuits shall be fused separately to conform to NEC and UL Standard 1025. The unit shall have balanced phases.

7. Controls: Contactors and control circuit for 24V low voltage thermostat shall be factory wired and installed. The unit heaters shall be controlled by single stage, heating only, wall mounted line voltage thermostat as shown on the Drawings. The thermostat shall have 50 degrees F to 80 degrees F range set to start unit at 70 degrees F (field adjustable). The thermostat shall be Chromalox Model WR-IE30 or approved equal. Built-in fan override shall be provided to purge unit casing of excess heat after unit shut-down.

8. Supports: The contractor shall provide wall mounting brackets, swivel brackets, and all necessary hardware suitable to support unit heater in accordance with manufacturer's recommendations for clearances and weight. The brackets shall be adequately protected from corrosion: primed and epoxy painted.

9. Guarantee: All component parts of the heater shall be fully guaranteed for not less than one year.

2.2 EXHAUST FAN EF-1: Exhaust fan shall be ceiling mounted twin-wheel blower Loren-Coole model Gemini 5-15, Penn Ventilator Co. model Zephyr Z-10, or approved equal. Fan shall have capacity of 375 CFM at .25 in S. P. Electrical motor shall be 155 watts or smaller, 120v-single phase-60Hz. Unit shall be AMCA certified for air and

sound performance, and shall be UL-Listed. Fan shall be equipped with wall-cap with 1/2" mesh aluminum birdscreen, galvanized steel sheetmetal backdraft damper, and speed controller FSC by Loren-Coole or LT 30 by Penn.

2.3 SHEET METAL WORK

a. General

1. Sheet metal work shall be constructed of new galvanized prime grade sheet iron of American manufacturer, 24 gage, per SMACNA.

2. Dimensions of the ducts shown on the Drawings shall not be considered as absolute, but any changes from same shall be subject to approval by the Buyer. Where due to job conditions, duct sizes must be changed, equivalent areas shall be maintained.

3. Ducts shall be round and rectangular rigidly supported to the building construction on approved hangers in accordance with "SMACNA" Manual, latest edition.

4. Weights and construction of galvanized iron ducts shall be as indicated on the Drawings, and in accordance with Uniform Building Code, "SMACNA" Manual and NFPA No. 90A, fire protection requirements. When in conflict, the most stringent requirement shall govern. Duct system shall be for low velocity (less than 2000 FPM) and low pressure (less than 2 inches W. G.).

B. Sheet Metal Backdraft Dampers: Backdraft dampers shall be furnished and installed where required to completely prevent outside cold air entrance. Damper shall be 24 gauge galvanized sheet metal with bearing and shall require minimal pressure drop to open in direction of exhausted air flow.

2.4 INSULATION: Insulation for exhaust ductwork shall be Owens-Corning, J-M or approved equal, 2" thick Type III pink wrap faced with aluminum foil. Insulation shall comply with State of Colorado Building Efficiency Standards latest edition.

PART III: EXECUTION

3.1 EXECUTION AND INSTALLATION

A. Installation of electric unit heaters shall proceed smoothly, coordinated with building structure, providing accurate location and observing the necessary clearances for process equipment and piping, lighting and controls.

B. Equipment Supports: The Contractor shall provide all supports required for the installation of equipment furnished by him and shall provide and set all necessary anchor bolts and securely anchor into the building construction.

C. Approval on Materials and Equipment: Before procuring any material or equipment and before work is commenced, the Contractor shall submit six copies to the Buyer for approval, complete lists, including catalog cuts and descriptive matter of all materials and equipment. Submittal shall include electric unit heaters, thermostats, and accessories in brochure form identifying heater unit numbers and shall be submitted complete at one time.

3.2 DESIGN CRITERIA FOR HEATING SYSTEM AND VENTILATION SYSTEM

A. Outside Ambient Temperature Rocky Flats Golden, Colorado

Winter	-5 degrees F

B. Indoor Temperature

Room Winter	+68 degrees F (minimum)
Adjacent Interior Space	-5 degrees F

C. Ventilation Rates-Utility Room

Exhaust	0 to 15 air changes/hr.

Fresh air will be drawn through wall mounted intake louver.

Based on American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 1981 Weather Data and ASHRAE Cooling and Heating Load Calculation Manual.

3.3 HEATING AND VENTILATING SYSTEM DESCRIPTION AND OPERATIONS: Indoor temperature shall be maintained above 68 degrees F by means of electric unit heater as specified in paragraph 2.1 of this Section. The electric unit heaters shall be controlled by field setting of each thermostat. The setting will be accomplished by rotating the adjustable knob. When heating demand is satisfied, thermostats automatically deenergize related unit(s). Build-in fan over-ride will purge the units casing of excess heat after unit shut down.

Exhaust fan will be controlled from wall mounted solid state fan speed controller with on-off feature. The air flow rate may be adjusted from 0 to 100% by rotating the setting knob.

3.4 CONTROLS SUBMITTAL AND TEST AND START-UP REQUIREMENTS

A. Submit for approval, before proceeding, a detailed drawing of the air flow and temperature control systems showing interlocks with all mechanical equipment, list of materials

being furnished, and a detailed written description of the control sequence.

B. Calibrate all control devices, make all final settings and test the control system under operating conditions and make adjustment for satisfactory operation.

C Deliver and mount a copy of the control diagrams, material list and control sequences, all on a permanent type of print framed behind glass, or as directed.

D. Instruct the operating personnel on the operation and maintenance of the control system and provide manuals as specified which shall include control diagrams, control sequences and instruction sheet for each different control device furnished.

E. Submit a letter stating that the control system has been installed under the control manufacturer's supervision and has been adjusted, tested under operating conditions and left in satisfactory condition. The letter shall also state that the control manufacturer provides a service and parts guarantee for one (1) year from the date of installation acceptance, without additional cost to the Buyer.

3.5 ELECTRICAL WORK

A. The electrical work shown on the Drawings shall be furnished under Electrical work, including 24V low voltage controls conduit, and wiring unless indicated otherwise on the Drawings or in these Specifications. Coordination and supervision of the connection of controls or work affecting controls shall be under this Section. All other electrical work which is required for the installation and satisfactory operation of the temperature control system shall be furnished under this Section.

B. Electrical wiring shall be equal in quality and compatibility with that specified under the Electrical Division. The requirements of the Electrical Division shall govern the electrical work provided under this Section. All wiring, materials, and the completed installation shall conform to all governing codes and shall meet the approval of the local Authorities.

3.6 TESTING, ADJUSTING, AND BALANCING

A. The Contractor shall test all work, furnish all equipment and pay all costs of replacing and repairing any damage resulting form tests.

B. The systems shall be free from objectionable noise and vibration. The Contractor shall make proper provision, provide all materials and pay all costs necessary to remove objectionable noise and vibration.

C. Thoroughly clean system before starting.

D. After completion of the work, units controls, discharge louvers and devices requiring adjustment or regulation, shall be adjusted and/or regulated for proper operation, after which test runs shall be made.

3.7 OPERATIONAL REQUIREMENTS

A. Place systems in operation for one day and instruct the Buyer's operating personnel on operational requirements and systems functions, and demonstrate the operation of systems in the presence of the Construction Manager, and to the Buyer's satisfaction.

B. Provide six (6) sets of Service Manuals covering all operating equipment, including service parts lists and operating sequences and controls diagrams, with recommendations of minimum spares requirements.

1. Submit a letter stating that the control system has been installed per heater manufacturer's requirements and has been adjusted, tested under operating conditions and left in satisfactory condition. The letter shall also state that the control manufacturer provides a service and parts guarantee for one (1) year from the date of installation acceptance without additional costs to the Buyer.

3.8 MAINTENANCE AND OPERATIONAL INSTRUCTIONS: Upon completion of preliminary testing of operating systems, the Contractor shall place a competent man in charge who shall instruct the Buyer's Operator in all details of operation and maintenance. Arrangements shall be made through the Buyer to have a representative of the maintenance department concerned present for instruction.

END OF SECTION

SECTION 16010

ELECTRICAL

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. The installation shall apply, as a minimum requirement, with the applicable rules of the latest edition of the national Electrical Code (NEC), except where code requirements are exceeded as specified on the drawings or in this specification.

B. All electrical materials shall be new and as listed by the Underwriters' Laboratories, Inc. (UL), except as otherwise specified herein.

C. All electric lamps and bulbs shall be Government-furnished but installed by the Contractor.

D. The contract drawings indicate the extent and general arrangement of the conduit and wiring systems.

E. No portion of the permanent wiring system for the building shall be utilized until the final inspection is performed.

PART II: PRODUCTS

2.1 PRODUCT REQUIREMENTS: All electrical equipment shall be suitable for operation at an altitude of 6,000 ft.

PART III: EXECUTION

3.1 REPAIR OF EXISTING WORK: The work shall be carefully laid out in advance. Where any penetrations are necessary for the installation, support, or anchorage of the conduit, raceway, or other electrical work, this work shall be carefully done. Any damage to buildings, piping, or equipment shall be repaired at no expense to the Contractor.

3.2 INSPECTION AND ELECTRICAL TESTS

A. The Contractor shall test, under supervision of the Buyer of his designated representative, all wiring and connections for continuity and grounds, and when directed, he shall demonstrate, by Megger test, the insulation resistance of any circuit or group of circuits. Where such insulation resistance tests indicate the possibility of faulty insulation, the Contractor shall locate the point of fault, replace same with new material, and demonstrate by further test the elimination of such fault.

B. All grounds shall be tested and recorded in accordance with the specifications by a double-scale (0-20 and 0-300 ohms) Megger ground tester.

C. All 480-V3-phase feeder and feeds shall be given a Megger test before being put into operation. The Contractor shall furnish the test equipment.

D. Records of each inspection and test, together with the complete data and readings associated therewith, shall be entered on a form furnished by the Buyer for this purpose. Test data taken and compiled during the inspections shall be certified by the Contractor and the Buyer witnessing the tests. Records of the inspections and tests, together with the complete data on all readings taken, shall be made and incorporated into a formal report by the contractor.

E. Test each outgoing feeder emanating from a swtichgear motor control center, or panel. Open the feeder circuit breaker at the switchgear, motor control center, or panel. Disconnect the feeder at the supply and load ends.

1. Make a Megger insulation test between "A" and "B," "B" and "C," and the "C" and "A" phases.

2. Make a phase-to-ground Megger insulation test between the "A" phase and the "C" and "A" phases.

3. The minimum acceptable insulation resistance shall be 15 megohms.

F. After the interior wiring system installation is completed, and at such time as the Buyer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification.

SECTION 16050

BASIC MATERIALS AND METHODS

PART I: GENERAL

1.1 GENERAL REQUIREMENTS

A. The installation shall comply, as a minimum requirement, with the applicable rules of the latest edition of the National Electrical Code (NEC), except where code requirements are exceeded as specified on the drawings or in this specification.

B. All electrical materials shall be new and as listed by the Underwriters' Laboratories, Inc. (UL), except as otherwise specified herein.

C. All lamps shall be Government-furnished but installed by the Contractor.

D. The contract drawings indicate the extent and general arrangement of the conduit and wiring systems.

E. No portion of th permanent wiring system for the building shall be utilized until the final inspection.

PART II: PRODUCTS

2.1 PRODUCT REQUIREMENTS: All electrical equipment shall be suitable for operation at an altitude of 6,000 ft.

2.2 CIRCUIT BREAKERS: Circuit breakers for 120/220 V shall be bolt-on type, Westinghouse Quicklag, ITE Company's Type EQ, or Square D "ML." Poles shall be specified on the drawings.

2.3 CONDUCTORS

A. General: All conductors shall be sized according to the AWG standard. All conductors shall be copper. All conductors shall be stranded. Minimum size shall be No. 14. Wire sizes No. 14 through No. 1 shall be sized at a conductor temperature rating of 60 degrees Centigrade. Wire sizes No. 1/0 and larger shall be sized at a conductor temperature rating of 75 degrees Centigrade.

B. Conductors 25 OMCM and Larger shall be stranded, 600 volts, and Type RHW.

C. Conductors Smaller than 25 OMCM shall be stranded, 600 volt and Type THW, Type THWN or Type XHHW.

Other: All conductors for other than general use shall be as specified on the drawings.

D. Direct Burial Cable and Control Case shall be 600 volts, NEC Type MC with a 90 degrees Centigrade rating. The copper conductors shall be individually crosslinked polyethylene insulated, grouped together with bare grounding conductor and fillers, and covered with binding tape. The cable shall be enclosed in a close-fitting, impervious, continuous, corrugated aluminum C-L-X sheath with a polyvinyl chloride overall outer jacket. Power cable shall be 4 No. 10 AWG copper conductors with one No. 10 copper conductor used as a ground wire. Control cable shall be 12 No. 10 copper conductors. The cable shall be Okonite C-L-X Type MC (XHHW), or approved equal.

E. Direct Buried Instrumentation Cable shall be 300 volts, Type PLTC Armored instrumentation cable with 105 degrees Centigrade rating. Each copper conductor of the cable shall be insulated with a minimum of 15 mils of PVC. A 1.35 mil aluminum tape with copper drain wire shall provide shielding for each pair of wires. A No. 22 AWG copper wire with 15 mils of PVC insulation (105 degrees Centigrade rating) shall be provided as the communication wire in each cable. All shielded pairs shall be assembled using flame-retarding fillers to provide a round cable. An overall cable shield of aluminum tape and a copper drain wire shall be wrapped over all pairs of the cable. An inner jacket of PVC per UL Subject 13 shall be applied over the cable assembly. A L-L-X sheath of close-fitting, continuously welded and corrugated aluminum sheath shall be applied over the cable's inner jacket. An outer jacket of PVC per UL Subject 13 shall be applied over the C-L-X sheath.

Instrumentation cable shall be Okonite C-L-X Type P-05, or equal, with four (4) shielded pairs of No. 16 and conductors and overall cable shield.

F. Buried Cable Identification Tape shall be a plastic coated metallic marker tape not less than two inches in width. The tensile strength of the tape shall not be less than 50 pounds. The tape shall have a continuous legend: "BURIED ELECTRICAL CABLE BELOW." The tape shall be manufactured by Allen Systems In., Giffolyn Co. Inc., Lineguard Inc. or approved equal and shall be laid over the cable, except where encased in steel conduit.

G. Splices For Each Direct Buried Cable shall be sealed, complete unit suitable for direct burial under the same conditions as the cable. The splice shall consist of the following: a plastic, molded outer body that is snapped together around the spliced conductor; electrical insulating and sealing compound that is mixed and poured into the molded outer body; spacers inside the outer body that allow even distribution of compound

around the splice; rubber tape and sealing stripe; jumper wire with shield clips to provide shield continuity for instrumentation cable; and complete instructions.

Prior to enclosure in the molded outer body, each conductor of each cable shall be connected with a vinyl insulated butt connector. The splicing kit shall be sized to adequately accommodate the instrumentation cable actually furnished.

The insulated butt connectors shall be Panovit, Amp or 3M Series 401, or equal. The splicing kits shall be 3M Series 72, Series 82, Series 90, Series 85, or equal.

2.4 CONDUIT AND FITTINGS: Rigid steel conduit shall be zinc-coated and shall be 3/4 in. minimum size.

2.5 IDENTIFICATION

A. Nameplates shall be 1/16-in. thick laminated Bakelite.

B. Round brass tags, 1 1/4 in. diameter, shall be as furnished by mcmaster Carr Co., Catalog No. 1540T14.

C. Plastic embossing tape shall be as supplied by Dymo Products Company.

D. Paint, fluorescent fire orange, as manufactured by Day-Glo Color Corp. and sold by Danacolor, Inc., San Francisco, California.

PART III: EXECUTION

3.1 REPAIR OF EXISTING WORK: The work shall be carefully laid out in advance. Where any penetrations are necessary for the installation, support, or anchorage of the conduit, raceway, or other electrical work, this work shall be carefully done. Any damage to buildings, piping, or equipment shall be repaired at no expense to the Contractor.

3.2 CIRCUIT BREAKERS: Any installation, preparation, inspection, or performance requirements are included in Part II. Refer to this section for applicable execution requirements. The NEC shall be used as a minimum requirement.

3.3 WIRES AND CABLES

A. General

1. Wires and cables for power, lighting, and control shall, as far as practicable, be continuous from origin to destination without running splices in intermediate pull boxes or outlet boxes. Slack shall be left in all pull

boxes and sufficient slack at equipment to allow for neat, workmanlike termination.

2. A wire-pulling lubricant must be used when pulling conductors. If a pulling compound is used, it shall be Minerallac pull-in Compound 100 or Ideal Yellow 77.

B. Wire Marking

1. All wires shall be marked at both ends and all intermediate outlets with commercial wire markers.

2. All wires shall be color coded. The following color code shall be followed explicitly:

a. Power conductors shall be black with color-code banding. Phase colors shall be A: black, B: blue, and C red. Neutral conductors shall be white.

b. Motor control conductors (generally No. 14) shall be red for "stop" or No. 1 wire, yellow for the "seal-in" or No. 2 wire, and blue for the "start" or No. 3 wire.

c. Lighting circuit conductors shall be black for phase conductor, white for the neutral conductor, and red for switch leg.

d. Grounding conductors shall be green.

C. Splices and Terminations

1. In connecting wire and cable to equipment, various methods may be used depending upon the local condition. In general, the use of solderless pressure connectors for terminals, taps, and splices is recommended. Buchanan or Stakon TP series splices are acceptable on wire size up to 1/0 and for 1/0 ands larger, Burndy KSV Servits shall be used.

2. Lugs may be T & B, Stakon, or T & B method squeeze connector or Burndy Hi Press. All splices shall be made with solderless squeeze-type connectors whenever possible.

3. All motor lead connections shall be made by bolting the lug of the motor lead back to back with the conductor lug, bolting together with proper size machine screws and using flat washers. Motor connections shall be taped with one layer of washers. Motor connections shall be taped with one layer of yellow varnish cambric tape covered with several layers of rubber and friction tape

for vibrating equipment or Scot No. 33 for other equipment.

4. All tape splices 1/0 and larger shall be taped with one layer of varnish cambric tape. Outer taping shall be rubber and friction tape or Scotch No. 33 of sufficient wraps to equal wire insulation.

3.4 CONDUIT AND FITTINGS

A. Conduit

1. Conduit systems shall be installed in accordance with the applicable provisions of the NEC.

2. Conduits shall be concealed within the walls, ceilings, and floors where indicated and shall be kept at least 6-in. from parallel runs of steam pipes or hot water pipes. Exposed runs of conduit shall be installed with runs parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right-angle turns consisting of cast metal fittings or symmetrical bends. Bends and offsets shall be avoided where possible, but when necessary, shall be made with an approved hickey or conduit bending machine. The use of pipe tee or vise for bending conduit will not be permitted. Conduit that has been crushed or deformed in any way shall not be installed. Crushed or deformed conduit shall be replaced at no cost tot he Government at the discretion of the Buyer. Expansion fittings or other approved devices shall be used to provide for expansion where conduit crosses expansion joints.

3. Wooden plugs inserted in masonry or concrete wall shall not be used as a base to secure conduit support. Conduit shall be supported on approved types of galvanized wall brackets, ceiling trapeze, or strap hangers. Expansion anchors shall be used in concrete or brick, machine screws on metal surfaces and wood screws on wood construction. Nails shall not be used as the means of fastening boxes or conduits. Conduit risers exposed in wire shafts shall be supported at each floor level by means of approved U-clamp hangers. Conduit shall be installed in such a manner as to prevent the collection of trapped condensation. All runs of conduit shall be arranged so as to devoid of traps wherever possible. The Contractor shall exercise the necessary precautions to prevent the lodgment of dirt, plaster, or trash in conduit, fittings, and boxes during the course of installation. A run of conduit which has become clogged shall be entirely freed of these accumulation or shall be replaced. Conduit shall be securely fastened to all sheet metal outlet, junction, and pull boxes with

galvanized locknuts and one bushing installed in accordance with standard practice. Care shall be observed to see that the full number of threads project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be sufficiently tightened to draw the bushing into firm electrical contact with the box. Wiring shall not be installed in telephone system conduits unless otherwise specified. All conduits for telephone, or future electrical installation shall be provided with pull wires.

4. Empty conduit systems for telephone systems shall be installed with pull wires.

B. Conduit Fittings: Outlets shall be installed in the locations shown on the drawings. The Contractor shall study the general building plans in relation to the spaces surrounding each outlet in order that his work may fit the other work required. When necessary, the Contractor shall relocate outlets so that when fixtures or other fittings are installed, they will not interfere with other work or equipment. Only zinc-coated or cadmium-plated sheet steel boxes shall be used. Boxes shall be installed in a rigid and satisfactory manner, either by wood screws on wood, expansion anchors on masonry, or machine screws on steel work. One-piece gang boxes not less than 2-in. deep shall be utilized where necessary. Outlets in exposed work shall be of cast steel or alloy fitted with appropriate covers.

C. Wall Penetrations

1. Surfaces of joints to be sealed shall be clean, dry, and free from oil, dirt, frost, and foreign matter. Fresh concrete at joints to be sealed shall have cured for at least 7 days prior to sealing.

2. Ambient temperature shall be above 40 degrees F and below 100 degrees F when sealant is applied.

3. Clean metal surfaces of corrosion by wire brushing or using chemical cleaners.

4. Sealant shall be uniformly smooth and free of wrinkles.

5. Apply caulking sufficiently convex to result in a filled joint that is flush after the sealant has dried.

6. Clean all sealant from adjacent surfaces.

7. Follow manufacturer's recommendations.

8. Silicone sealant, General Electric silicone white Silpruf sealant, shall be installed in accordance with manufacturer's recommended procedure.

9. Core drill and seal existing concrete walls as above.

10. Drill or cut and seal existing masonry block wall as above.

3.5 IDENTIFICATION

A. Equipment to be identified includes:

1. Switchgear, motor control centers, lighting panels, and the disconnecting devices contained therein.

2. Disconnecting devices that are located in the area and not part of the items listed in paragraph 3.7.-A. 1. above.

3. Control panels, starters, pushbutton stations, and other control devices.

4. Receptacles and light switches.

5. Instruments and associated devices.

B. Legends

1. Nameplate legends shall be machine-engraved lettering to a depth that makes the legend contrast with the background. Letter sizes all be commensurate with equipment size.

2. Brass tag legends shall be machine-stamped or hand-stamped using dyes so that identification is embedded in the surface of the tag.

3. Plastic embossing tape legends shall be embossed using the proper lettering machine.

4. Panel directory cards shall be neatly typed for newly installed panels. Circuit changes to existing panels shall be hand-printed. After five changes, a new card shall be typed.

C. Identification

1. Nameplates for designating panels and motor control centers, shall follow the system shown hereinafter:

M C C 2

	0	Basement
	1,2, etc.	Floor Level
	MCC	Motor Control Center
	P, L	Power, Lighting
	PD	Distribution
	LD	(LD-Lighting Dist. PD-Power Dist.)
E Emer	BD	Bus Duct
	MD	Main Switchgear

2. The voltage designation shall also be shown on the nameplate.

3. Nameplates for disconnecting devices contained in panels and motor control centers shall list the equipment name and the location. Voltage designation shall not be included when the voltage is the same as for the panel and motor control center.

4. Nameplates on disconnect devices located in the area, but not part of a panel or motor control center, shall list the equipment name, power source identification, and voltage designation. Nameplates for disconnect devices located remotely from the equipment shall also show the equipment location.

5. Nameplates on items listed in the preceding paragraph shall list the equipment name while the individual switches and lights shall list the function (such as start, stop, on, off, etc.).

6. Panelboard directory cards shall list the circuit numbers and list the equipment name and location supplied by the circuits.

7. Tags on conduits for power and lighting systems shall list the panel, or motor control center designation, the circuit number, and voltage designation (for voltages other than 120 V).

8. Other conduit (instrument, control, etc.) shall be as shown on the drawings.

9. Lighting switches and receptacles shall be identified by panel and circuit number.

10. Instruments shall be identified as shown on the drawings.

D. Attachment and Location: Nameplates and tags shall be prominently located for easy reading and attached as follows:

1. Stenciled letters shall be applied by brush or by spraying.

2. Nameplates shall be attached with either adhesive or screws. If adhesive is used, it shall be a type that will hold firmly for the life of the nameplate while facilitating the removal of the nameplate when changes are required.

3. Brass tags shall be attached to the conduits with 14-gage copper wire at the point of origin, at the point of destination, and both sides of any penetration. Identification shall also be made where conduits enter or leave pull boxes, junction boxes, and terminal boxes.

4. Plastic embossing tape shall be attached to the device plates for light switches and receptacles. The sticky back of the tape shall not be relied upon entirely for attachment. Additional adhesive such as Goodyear Pliobond shall be used to ensure that the tape will not work loose.

E. Miscellaneous: When indicated, identification shall be as shown on drawings.

3.6 INSPECTION AND ELECTRICAL TESTS

A. The Contractor shall test, under supervision of the Buyer or his designated representative, all wiring and connections for continuity and grounds, and when directed, he shall demonstrate, by Megger test, the insulation resistance of any circuit or group of circuits. Where such insulation resistance tests indicate the possibility of faulty insulation, the Contractor shall locate the point of fault, replace same with new material, and demonstrate by further test the elimination of such fault.

B. All grounds shall be tested and recorded in accordance with specifications by a double-scale (0-20 and 0-300 Ohms) Megger ground tester.

C. All 480-V 3-phase feeder and feeds shall be given a Megger test before being put into operation. The Contractor shall furnish the test equipment.

D. Records of each inspection and test, together with complete data and readings associated therewith, shall be entered on a form furnished by the Buyer for this purpose. Test data taken and compiled during the inspections shall be certified by the Buyer and Contractor witnessing the tests. Records of the inspections and tests, together with the complete data on all readings taken, shall be made and incorporate into a formal report by the Contractor.

E. Test each outgoing feeder emanating from a switchgear, motor control center, or panel. Open the feeder circuit breaker at the switchgear, motor control center, or panel. Disconnect the feeder at the supply and load ends.

1. Make a Megger insulation test between "A" and "B," "B" and "C," and the "C" and "A" phases.

2. Make a phase-to-ground Megger insulation test between the "A" phase and ground. Repeat the test on the "B" and "C" phases.

3. The minimum acceptable insulation resistance shall be 15 Mega Ohms.

F. After the interior wiring system installation is completed, and at such time as the Buyer may direct, the contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification.

SECTION 16140

WIRING DEVICES

PART I: GENERAL

Refer to Section 16010, Part I, for applicable requirements.

PART II: PRODUCTS

2.1 RECEPTACLES: 120-V receptacles shall be as follows or as shown on drawings:

* Three-wire, 15-A, 125-V, regular
* Hubbell No. 5261 (single)
* Hubbell No. 5262 (duplex)

2.2 SWITCHES: For 120-V, singe-pole, 20-A, 125-V, Bryant Catalog Item 5861 or Hubbel Catalog Item 9805; for fluorescent lighting loads of 1,200-1, 800 W, use Bryant Catalog Item 5431, 30-A, "T" rated, or Bryant Item 4901.

For 120-V, three-way, 20-A, 125-V, Bryant Catalog Item 4967, or Hubbell Catalog Item 9903; for fluorescent lighting loads of 1,200-1, 800 W, use Bryant Item 5433, 30-A, "T" rated, or Bryant No. 4903.

PART III: EXECUTION

Refer to Section 16010, Part III, for applicable requirements.

SECTION 16150

ELECTRICAL POWER EQUIPMENT

PART I: GENERAL

1.1 MOTORS

A. Rating

Horsepower	Voltage	Phase
1/2 to 150 (inclusive)	230/460	3
Less than 1/2*	115/230	1

* All 3600-rpm motors, and any requiring high-starting torgue or where the continuity of operation is vital, shall be 460 V, 3 phase.

Motors smaller than 1/2 hp furnished on machine tools, or other equipment having a 460-V main drive motor, shall be as normally furnished by the manufacturer and shall include any accessories required to operate from the main power supply.

B. Enclosures: All motors shall be open type, unless otherwise specified.

Motors shall be only one of the following, unless otherwise specified:

1. Drip-proof

2. Totally enclosed fan cooled (TEFC) or totally enclosed nonventilated (TENC). Where frame size and price are the same, the nonventilated is preferred.

3. Explosion-proof of group and class specified.

4. Combination of any one of the above enclosures with a totally molded, vacuum impregnated, encapsulated winding.

C. Frames

1. All motor frames and end-bells shall be National Electrical Manufacturers Association (NEMA) standard.

2. Polyphase motors 1 hp and larger with frames larger than Frame 256 shall have cast iron or fabricated steel end-bells and frames.

D. Bearings: All motors shall have antifriction ball bearings unless otherwise specified, except fractional horsepower motors which may have sleeve bearings.

E. Connection Boxes: All polyphase motors 1 hp and larger shall have conduit connection boxes of cast iron or cast aluminum (with threaded opening) or steel plate. On fractional horsepower motors, where the connections are made in the end-bell space rather than in an attached connection box, a screwed conduit connection shall be provided in the end-bell. Where sheet metal terminal boxes are provided, they shall include knockouts for conduit terminations.

F. Refer to Section 16010, Part I, for additional requirements.

G. Motor information required of equipment manufacturer:

1. Manufacturer
2. Voltage rating
3. Horsepower
4. Full load speed revolutions per minute
5. Full load current
6. Frame number
7. Enclosure
8. Mounting (horizontal or vertical)
9. Base (flange or foot)
10. Slide rails (V-belt driven)
11.. Temperature rise degrees Centigrade
12. Insulation class
13. Rotation (viewed from shaft end)
14. Duty cycle
15. Location of terminal box
16. Special modifications

1.2 MOTOR CONTROL

Magnetic Motor Starters

Magnetic motor starters shall be installed in all cases where remote control is required and "no-voltage" or "undervoltage"protection is required. Two or three overload relays, for installation of interchangeable overload relay heaters, shall be furnished with each starter. Operating coil voltage, enclosure, number and position of auxiliary contacts, NEMA size, and all starter modifications shall be as shown on the drawings.

1.3 MOTOR CONTROL CENTERS

A. Enclosure: Motor control centers shall consist of one or more sections 90 in. high, 20 in. wide, and 20 in deep. Each section shall include top, bottom, and side wireways; horizontal and vertical bus bars; movable unit support bars;

pan-type, gasketed, pin-hinged doors with pressure-type fasteners; and provisions for locking. Each section shall conform to NEMA standard enclosures for NEMA Types 1. Each section shall have standardized construction, dimensions, and all provisions for replacement or addition of vertical sections to either side without adjustments, alterations, or structural changes. Each section shall be provided with removable sections for maintenance and inspection of all interior component parts. All sections shall be cleaned, primed, and painted with standard color.

B. Bus Bars: Horizontal bus bars shall be rated for 600-A capacity with a 50 degrees Centigrade rise, silver plated, and braced for 25,000-A rms fault current. Vertical bus bars shall extend full length of the working area. Each bar shall be silver plated and be braced to withstand 25,000-A rms fault current.

C. Control Units

1. Motor control centers shall be a combination of standardized combination starter units of NEMA Sizes 1 through 5. The smallest acceptable modular size shall be 12 in. high. Each unit shall be semienclosed and electrically isolated. Each unit shall be equipped with handles for removal from the sectional. Can-type or screw-type latches shall hold units in operating and test positions.

2. Silver-plated stab-on power connectors shall be furnished, on the back of each unit, to connect the line side of the unit to the vertical bus bars. Load side connections shall be equipped with pressure connectors. Pushbuttons and indicating lights shall be assembled to the control unit. Each control unit shall have all load and control connections wired to a terminal board at the side of the unit. All wiring shall conform to NEMA Class C.

D. General

1. All spare compartments shall be furnished complete with a bus, unit supports, and a matching blank door. All compartments, which contain control units, shall have doors with built-in reset button operators, and disconnect or circuit breaker operators, in the door. Doors shall have cover interlock latches to prevent the opening of the unit door when the disconnect is on. A screwdriver interlock bypass shall be incorporated to permit opening of the door for inspection without interrupting the power. All disconnect or circuit breaker operators shall be capable of being locked in the

2. Complete shop drawings, schematic, and elementary wiring diagrams shall be approved by the Contractor before purchase of the equipment.

1.4 REMOTE CONTROL UNITS

A. Pushbuttons, automatic selector switches, and pilot lights shall be of the Allen-Bradley Bulletin 8000T oil-tight type.

B. Limit switches, unless otherwise specified, shall be Allen-Bradley Bulletin 802T oil-tight units.

PART II: PRODUCTS

2.1 MOTORS: Reference Section 16700, Part I.

2.2 MOTOR CONTROL

A. Single-Phase Manual Starters: Single-phase manual starters shall conform to Allen-Bradley Bulletin 600.

B. Magnetic Motor Starters: Starters shall conform to the following:

1. Full-Voltage Starters: Allen-Bradley Bulletin 709.

2. Combination Circuit Breaker and Starter: Allen-Bradley Bulletin 713.

2.3 MOTOR CONTROL CENTERS: Motor control centers shall be as manufactured by Cutler Hammer, Allen-Bradley, or Westinghouse Electric Company, and comply with Part I, Section 1.3, above.

2.4 REMOTE CONTROL UNITS

A. Refer to Allen-Bradley Bulletin 800T for oil-tight-type pushbutton, hands-off, or automatic selector switches.

B. Refer to Allen-Bradley Bulletin 802T for oil-tight-type limit switches, unless otherwise specified.

PART III: EXECUTION

Refer to Part III of Section 16010 for applicable requirements.

SECTION 16160

PANELBOARDS

PART I: GENERAL

Refer to Section 16010, Part I, for applicable requirements.

PART II: PRODUCTS

1.2 LIGHTING PANELBOARD SYSTEMS

A. Enclosures: Cabinet boxes shall be constructed of zinc-coated sheet steel and shall conform to the requirements of the Underwriters' Laboratories, Inc. (UL), Standard for Cabinets and Boxes. Boxes shall be zinc coated after fabrication. Trims and doors shall have a suitable primer coat and a finish coat of a color specifically designated by the Contractor. Cabinets for panelboards shall be provided with not less than 5-in. wide wiring gutters at the sides, 6-in. wide at the top and bottom, and 5-3/4 in. deep. Surface cabinets shall be provided with trims having adjustable trim clamps. Trims shall be fitted with hinged doors having combined lock and latch. All locks shall be keyed alike. A directory holder shall be provided on the inside of the door. A neatly typed directory, properly identifying each circuit, shall be mounted in the directory holder.

B. Interiors: Panelboard interiors shall be made up with reinforced backpan with a means for adjusting in and out. Easy-access covers shall be provided over lug compartment and neutral bar. All bus bars shall be securely supported from backpan with bus bar insulators and shall not depend on branch circuit breakers for support. All bus bars shall be drilled and tapped full length to facilitate changes. All electrical connections shall be bolted--no current shall be carried by screws alone. Circuit breakers provided shall be of the bolt-on-type Westinghouse "Quick Lag;" IEE Type "EQ;" or Square D Type "QQ." New thin-style circuit breakers are not acceptable.

C. Grounding: Lighting panel enclosures shall be grounded to the main service ground system using ground conductors sized per the National Electrical Code (NEC).

D. Loading: Lighting panelboard lads shall be limited to 1,400 W for each 20-A single-pole circuit. A minimum of 25% spare capacity shall be designed into each panelboard.

E. Lighting Panelboard Manufacturers: complete panels for 120/208 V, 3 phase, four wire shall be Westinghouse Type NQB with branch circuit breakers indicated on the drawings, and with gutters specified in paragraph 2.1. A above.

PART III: EXECUTION

Refer to Part III of Section 16010 for applicable requirements.

SECTION 16450

GROUNDING

PART I: GENERAL

1.1 WORK INCLUDED

A. Work under this section includes providing grounding systems as shown on the drawings and as specified herein.

B. Furnish all labor, materials, tools, and equipment and perform all work and services necessary for or incidental to the erection and installation of the equipment in this section, complete with accessories, as shown on the contract drawings and as specified herein, in accordance with the provisions of the contract documents and completely coordinated with that of all other trades.

C. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation of equipment in this section shall be provided as part of this work.

1.2 QUALITY ASSURANCE--REFERENCED SPECIFICATIONS AND DOCUMENTS: Comply with the provisions of the following defined codes, standards, and specifications, except as otherwise noted or specified. Where a conflict occurs, the more stringent requirement shall govern. The publications listed below are refereed to in the text by the basic designation only.

1. National Electrical Code (NEC), latest edition.

2. Institute of Electrical and Electronic Engineers (IEEE) Standard 142, Recommended Practice for Grounding of Industrial and Commercial Power Systems.

3. All electrical materials shall be new and as listed by the Underwriters' Laboratires, Inc. (UL), except as otherwise specified herein.

PART II: PRODUCTS

2.1 GROUNDING ELECTRODES

A. Grounding electrodes shall consist of 3/4-in. or larger galvanized steel pipe or 5/8-in. or larger galvanized or copper-clad steel rods.

B. The preferred electrode shall be the copper-clad steel rod, 10 ft. long.

C. The standard length electrode shall be 10 ft. Where electrodes ar longer than the standard, their length shall be clearly marked near the top.

D. The size of the electrode used will depend on its length and the driving quality of the soil. It shall, if possible, be long enough to reach permanently moist earth below the frostline.

2.2 CONDUCTORS

A. Equipment Grounding Conductor: The equipment grounding conductor shall be an insulated (green) copper conductor.

B. Grounding Electrode Conductor: The grounding electrode conductor shall be copper.

PART III: EXECUTION

3.1 STANDARD GROUNDING SYSTEM OR MAIN LOOP

A. A standard grounding system or main loop shall consist of a grounded loop of bare stranded copper wire, buried at a depth of at least 3 ft. below grade, and completely encircling the tank farm.

B. The distance between grounds on this loop shall not excced 50 ft. At least two grounds shall be used, and where only two are required, each shall consist of three ground electrodes driven at the corners of an 8-ft. equilateral triangle and banded together. They shall be located on opposite sides of the building, perfectly at opposite corner. The ground rods, at the opposite corners of Building 830, are existing.

C. The loop shall be further bonded to the steel of steel frame buildings, all isolated grounds, and where practicable, to metal underground water and sewer piping systems, steel piling, well casings, etc. The steel frame of Building 830 is presently connected to the existing grounding electrode conductor.

D. The main ground loop, and its connections to driven electrodes and other ground terminals, shall not be smaller than size No. 1/0.

3.2 PIPE AND ROD ELECTRODES

A. Electrodes shall be driven at a distance of not less than 3 ft. from the building foundation walls or structure footings.

B. Where convenient, and with the approval of the Buyer, they may be drive in the bottom of excavations.

C. Where ground electrodes are part of a loop or standard grounding system, their tops shall be drive below grade.

D. Pipe electrodes shall be fitted with ground points and caps.

E. Isolated ground electrodes shall be left with their tops projecting 6 in. above the grade so that the removable connectors are accessible for inspection and testing of ground resistance.

3.3 GROUND CONNECTIONS

A. All ground connections shall be bolted or brazed.

B. In order to ensure a low-resistance joint, care shall be taken in cleaning and preparing the contact surfaces.

C. The ground terminal at piping or tanks shall consist of 1/4-i x 2- x 2-in. copper bar, brazed to the pipe or tank, to which is bolted a clamp-type terminal plug.

D. Connections of ground leads to isolated electrodes shall be made with bolted clamp-type connectors to facilitate removal for testing.

E. Disconnectors shall be installed in group leads to a standard grounding system or main loop.

F. No ground connections shall be made to gas piping.

3.4 EQUIPMENT GROUND SYSTEM

A. All metallic raceways, electrical equipment, and related enclosures shall be continuously grounded.

B. A separate equipment-grounding conductor (green wire) shall be installed in all raceways for feeders, branch circuits, etc., regardless of size, location, or length.

3.5 STATIC GROUNDING

A. Any metal surface which a nonconducting static- producing flammable liquid comes into contact with shall be grounded by a continuous metallic path to ground.

B. Gasketed flanges shall be bonded either by using at least two brass bolts with washers against clean faces of flanges or by bar flexible copper wire jumpers, using No. 6 as the minimum wire size.

C. Parallel pip lines shall be bonded and grounded at 30- to 40-ft. intervals and at every point where they cross within a few inches of each other or as indicated on the drawings.

3.6 TESTING GROUNDS

A. All grounds shall be tested and recorded in accordance with the specifications by a double-scale (0-30 and 0-300 Ohms) Megger ground tester, Type MEg, as manufactured by James G. Biddle Company.

B. Records of each inspection and test, together with complete data and readings associated therewith, shall be entered on a form furnished by the Contractor for this purpose. Test data taken and compiled during the inspections shall be certified by the Subcontractor and with the contractor witnessing the tests. Records of the inspections and tests, together with the complete data on all readings taken, shall be made and incorporated into a formal report.

C. The lowest possible resistance to ground is desirable. It shall not exceed 5 Ohms.

SECTION 16460

TRANSFORMERS

PART I: GENERAL

1.2 CONTROL TRANSFORMERS: Control transformers shall be 50 V-A, or larger.

1.3 LIGHTING TRANSFORMERS: Lighting transformers shall be dry type, Class "H" insulation; with ratio of 480 V, 3 phase, delta primary; 120/208 V, 3 phase, four wire wye secondary; Westinghouse Type "DT-3," with four 2 1/2% FCBN taps.

PART II: PRODUCTS

2.1 CONTROL TRANSFORMERS: Control transformers shall be Jefferson Electric Company or equal.

2.2 LIGHTING TRANSFORMERS: Lighting transformers shall be Westinghouse Type "DT-3," or equal with four 2-1/2% FCBN taps.

PART III: EXECUTION

3.1 Refer to Section 16010, Part III, for applicable execution requirements.

SECTION 16492

UNDERGROUND ELECTRICAL SERVICE

PART I: GENERAL

Refer to Section 16010, Part I, for applicable requirements.

PART II: PRODUCTS

2.1 SERVICE CONDUITS: Conduits for underground service shall conform to the National Electrical Code (NEC).

2.2 DUCTS: Underground ducts shall be heavy walled polyvinyl chloride, fiber duct (Orangeburg), or transite.

2.3 PRECAST CONCRETE PULL BOXES: Refer to Section 16492, Part III, and shall be as called out on the drawings.

PART III: EXECUTION

3.1 SERVICE CONDUIT INSTALLATION

A. Conduit for underground electric service shall be installed as shown on the drawings.

B. Conduits shall be buried a minimum of 3 ft. below finished grade.

3.2 DUCT INSTALLATIONS

A. Duct runs shall be run in north-south and east-west coordinates. Diagonal runs will not be permitted.

B. Duct runs shall be installed as straight as possible, with duct supported on spacers designed for that purpose. When bends are necessary, 5-degree couplings shall be used to make large radius bends. A tooling lathe designed for the type of duct being used shall be used to taper all joints. Drawknife or other makeshift arrangements will not be acceptable. Use manufacturer's sealing compound in all joints.

C. Duct runs shall be encased in concrete with no less than 3 in. of concrete between ducts and no less than 4 in. around the outside periphery.

D. When multiple ducts run are installed, they shall be banded together with steel banding wire no less than 5 ft. on center.

E. All duct runs shall be tied down in an acceptable manner. The Buyer shall inspect all duct installations before concrete is poured.

F. A pull wire shall be installed in each duct run. This wire shall be pulled into each duct as it is installed. Under no circumstances shall any amount of duct be installed without pull wire. The pull wire shall be No. 9 steel wire securely fastened at each end or completion of installation.

G. During construction, duct runs shall be plugged at the end of each working day with duct plugs.

H. Upon completion of duct runs, the Contractor shall pull a swab through ducts, then a mandrel 1/2 in. less in diameter than the duct to ensure straight, clean, unbroken lines. This shall be witnessed by the Buyer. Plugs shall be drilled for pull wire and then installed in spare ducts with pull wire securely attached at each end.

3.3 PRECAST CONCRETE PULL BOXES

A. All pull boxes shall have a sump pit.

B. All pull boxes shall have pull irons to afford an efficient method of pulling cable.

C. All pull boxes shall have a frame and cover specifically designed for that purpose.

D. All conduits entering pull boxes shall be terminated in end steel bells.

E. All pull boxes shall be completed, with a galvanized steel cover.

F. All pull boxes shall be complete with cable racks placed to allow the neat training of all cables around the bull box from entrance to exit.

Cable racks shall be sufficient in number to support all cables with 20% additional supports to accommodate future needs.

G. All excavations for pull boxes shall be large enough to afford room for waterproofing.

Pull box excavations shall be kept free of water, debris, and foreign materials. Pull box excavations of a depth to prevent cave-in hazards during construction shall be protected with shoring or sheet piling.

H. All work shall be inspected by the Buyer before backfilling.

I Pull boxes shall be of size as shown on the drawings.

J. Refer to the concrete section of specifications for type of concrete reinforcing and tests required.

3.4 TRENCHING AND BACKFILL

A. Trenching shall be of size and location as shown on the drawings. All trenching shall be kept free of water, debris, and foreign materials. Care shall be taken that trenches are properly sloped, where depth and job condition indicate a possible safety hazard to personnel, and approved by the Buyer.

The use of shoring and trench bracing may be required by the Buyer at no additional cost to the Government.

B. All backfill shall be done in 6-in. layers with each layer compacted 90% according to the Modified Proctor Method.

C. The backfill in the immediate area of cable or conduit shall be done with clean sand to a depth of 6 in. above cable or conduit. Succeeding layers of backfill may be with fill material compacted after each layer.

SECTION 16510

LIGHTING FIXTURES

PART I: GENERAL

Refer to Section 16010, Part I, for other requirements.

1.1 LIGHTING FIXTURE REQUIREMENTS

A. The Contractor shall furnish and install all lighting equipment and lighting fixtures included in the fixture schedule and for all outlets, as indicated on the drawings.

B. All lighting fixtures shall bear the Underwriters' Laboratories, Inc. (UL), label, manufacturer's label, and proper union label.

C. Interior wiring of all fixtures shall be Type "AF" fixture wire of 16 gage for fixtures up to and including 200 W. Fixtures over 200-W capacity shall be wired with 14-gage wire.

D. All fixtures shall be such that all parts will be continuously grounded.

1.3 FLUORESCENT FIXTURES

A. All fluorescent lampholders shall be the white phenolic compound, positive spring-action type.

B. Fluorescent fixtures shall be supported at all points as required for good practice and adequate support. The Contractor shall furnish all supports required, including structural members if required. Unistrut supports are acceptable.

C. All fluorescent fixtures shall be equipped with thermally protected, high-power-factor ballasts that are UL and Current Bid Monitor approved. All ballasts shall be Type"P" ballasts.

1.4 LAMP BULBS: All lamp bulbs for the fixtures shall be Government-furnished. The Contractor shall request all lamps required for the job by submitting a complete list of all types and sizes required.

PART II: PRODUCTS

2.1 MANUFACTURERS

Fixtures: Fixtures shall be as indicated in the lighting fixture schedule on the drawings.

PART III: EXECUTION

Refer to Section 16010, Part III, for applicable requirements

SECTION 16600

SPECIAL SYSTEMS

PART I: GENERAL

1.1 TELEPHONE

A. Conduit: Conduit shall be 3/4 inch Schedule 80 PVC below grade and 3/4 inch rigid steel zinc coated above grade. Conduit shall be installed with pull cable for installation telephone cables.

B. Outlets: Outlets shall be as shown on the drawings. Covers or access openings for telephone cable shall be equipped with rubber grommets.

PART II: PRODUCTS

Refer to Section 16010, Part II, and applicable Standards, for requirements.

The Buyer shall provide, install and connect telephone cables and equipment in conduit, pull boxes and outlets which are supplied and installed by Contractor.

PART III: EXECUTION

Refer to Section 16010, Part III, for applicable requirements.

SECTION 16700

HEAT TRACING

PART I: GENERAL

Refer to Session 16010, Part I, for general requirements.

1.1 HEAT TRACING REQUIREMENTS

A. The Contractor shall provide all heat tracing cable, all accessories and completely install the entire heat tracing system so that it will provide complete freeze protection for all pipelines (including valves, flanges, etc.) described below.

B. Pipelines Heat Traced

1. All pipelines run exposed outdoors shall be heat traced.

2. Pipelines run inside Building 830 to pipe connection point of treatment unit shall be heat traced.

3. Effluent pipelines and influent pipelines routed to remotely located sumps and well shall be heat traced to approximately 5'6" below grade where steel pipe transition to PVC PIPE OCCURS.

C. Fluid in pipelines is basically waste with limited quantity of contaminants.

D. Approximately minimum waste temperature desired is 50 degrees Fahrenheit.

E. Minimum expected ambient temperature is minus 30 degrees Fahrenheit.

F. All pipelines heat traced are galvanized steel and insulated as described in the appropriate specification sections of this contract.

G. The Heat Tracing System includes heat, heat tracing cable, insulation sleeves, molded boots, insulation retainers, splice boxes, end seals, cable ties, fittings, supports, hardware, thermostats, and any other required components. All equipment shall be Hemelex Auto-Trace, as indicated , specified and required.

H. Heat tracing cable shall be self-limiting type, which automatically limits its own maximum temperature; and below maximum temperature, the heater shall regulate its own heat output. The built-in temperature control shall be

accomplished by a semi-conductive heating material whose electrical resistance varies with its temperature.

I. Heat tracing cable shall have two (2) No. 16 AWG copper bus wires, a self-regulating semi-conductive cork, modified polyolefin jacket, and a fluoropolymer outer jacket covering screen. Heat tracing cable shall be Hemelex Auto-Trace Type 5BTV-CT with an output of 5.9 Watts per foot at 50 degrees Fahrenheit.

J. Each heat tracing circuit shall operate at 120 V AC and 60 Hz. Control of all circuits shall be by an ambient sensing thermostat controller, Chemelex Type AMC-1A (BD). The thermostat controller shall activate a contactor in Panel P to allow enerization of the heat tracing circuits. The thermostat controller shall become energized as a temperature of 40 degrees Fahrenheit.

K.

1. Each two (2) inch diameter pipeline shall be heat traced with <u>one</u> 5BTV1-CT cable attached to the pipe per standard Chemelex installation details.

2. Each four(4) inch diameter pipeline shall be heat traced with <u>two</u> 5BTV1-CT. Cables attached to the pipe per standard Chemelex installation details.

3. Flanges, valves, and supports shall be provided with the proper configuration of one or two 5BTV1-CT cables to maintain the 50 degrees Fahrenheit pipe fluid temperature. Heat tracing cable installation for flanges, valves, supports, etc. shall be per standard Chemelex installation details.

L. <u>Isometric Drawings and Details</u>: Contractor shall furnish isometric drawings of the complete heat traced pipeline installation for this project. The drawings shall show clearly each heat traced pipe, the heater cable or cables used for each pipe, the designation of the circuit breaker supplying each heat tracing cable circuit, references to specific heater cable installation details for each pipeline valve, flange and support, and all junction boxes required to interface between heat tracing cable and power circuit cable.

Contractor's detailed design of the heat tracing system shall utilize a maximum of six, 20 Amps, 120 VAC circuits to supply all heat tracing cable installed for the project pipelines.

M. Labels reading "ELECTRIC TRACED" shall be installed on the outside isulation of all electrically heat traced piping. The labels shall be placed at an interval of 20 feet or less so that they are readily visible.

PART II: PRODUCTS

2.1 MANUFACTURERS

Heat tracing equipment shall be Chemelex Auto-Tracer.

PART III: EXECUTION

Refer to Section 16010, Part III, for applicable requirements.

DIVISION 17000
PROCESS INSTRUMENTATION AND CONTROL SYSTEM

TABLE OF CONTENTS

DIVISION 17000

PROCESS INSTRUMENTATION AND CONTROL SYSTEM

PART 1. GENERAL REQUIREMENTS.

1.01 SCOPE OF WORK

The Contractor shall furnish, install and place into service operating process instrumentation and control systems including measuring, transmitting, indicating, recording, totalizing, controlling, alarm, analyzing equipment, Local Control Panel(s) and certain accessories, related to the wastewater treatment process, all as shown and specified.

1.02 SINGLE INSTRUMENT SUPPLIER

A. The Contractor shall assign to a Single Instrument Supplier full responsibility for the functional operation of all systems. This supplier shall perform all engineering necessary in order to select, to furnish, to supervise the installation of instruments, to calibrate, and to place into operation all meters, instruments, alarm equipment, Local Control Panels, Main Control Panel, other assemblies, accessories, and all other equipment as specified herein.

The foregoing shall enable the Contractor and the Owner to be assured that the full responsibility for the critical and complex technical requirements of Division 17000 and equipment of other divisions that interface with Division 17000 will reside in an organization which is qualified and experienced in the water treatment field and its process technology on a functional systems basis.

The Single Instrument Supplier, in fact, shall be the supplier of the following instruments and systems:

* Indicators
* Level Transmitters
* Temperature Sensing Transmitters
* Totalizers
* Signal Conditioners

Any supplier not engaged in the supplying of the above listed instruments and systems for the last 4 years shall not be acceptable as the certified Single Instrument Supplier.

1.03 RELATED WORK SPECIFIED ELSEWHERE

All the practices and codes specified in other Divisions of this Specification are to be adhered to. When the Contractor feels there is

a direct conflict between the Specifications of this Division and another Division(s) the Contractor shall notify the Engineer in writing and request clarification. Any work requiring changes resulting from the Contractor's failure to notice a conflict in the specification and/or to request clarification shall not be at the Owner's expense.

1.04 CODES AND STANDARDS

In these Specifications and on the Drawings, all systems, meters, instruments and other elements are represented schematically and are designated by numbers, as derived from criteria in Instrument Society of America (ISA) Standard S5.1. The nomenclature and numbers designated herein and on the Drawings shall be employed exclusively throughout shop drawings, data sheets and the like. Any other symbols, designations and nomenclature unique to the manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the Drawings. A permanent tag shall be supplied for identification of all field mounted elements, including flow meters and their transmitters, chemical analyzers and flow control valves. These tags shall identify the instrument, valve, analyzer, or meter, descriptively, as to the function and system.

All meters, instruments, and other components shall be the most recent models marketed by their manufacturers at the time of submittal of shop drawings. All technical data publications included with submittals shall be the most recent issue.

Signals shall be electronic, as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted. Electronic signals shall be 4 to 20 milliamperes dc isolated, except as noted.

All instruments to be panel-mounted at the Main Control Panel or the Field Panels (FP-XXX) shall have matching style and appearance. Panel mounted instruments supplied under this contract shall be of the same type, model, or class, and be of one manufacturer.

Signal isolators shall be furnished and installed in each measurement and control loop, wherever required, to assure adjacent component impedance match or where feedback paths may be generated. Signal converters shall be included where required, to resolve any signal level incompatibilities. Signal power boosters shall be included, as required by the manufacturer's instrument load characteristics, to assure sufficient power to each component of each loop.

Equipment or methods requiring redesign of any project details are not acceptable without prior written approval of the Engineer. Any changes inherent to a proposed alternative shall be at no additional cost to the Owner. The required approval shall be obtained in writing by the Single Instrument Supplier through the Contractor prior to submittal of shop drawings and data. Any proposal for approval of alternative equipment or methods shall include evidence of improved performance, operational

advantage and maintenance enhancement over the equipment or method specified, or shall include evidence that a specified component is not available. Otherwise, alternative methods shall not be proposed.

1.05 PREPARATION OF SUBMITTAL DRAWINGS AND DATA.

It is incumbent upon the Contractor to coordinate the work specified in these Sections so that a complete instrumentation and control system for the facility will be provided and will be supported by accurate shop and as-built drawings. As a part of his responsibility as assigned by the Contractor, the Single Instrument Supplier shall prepare and submit through the Contractor, complete organized shop drawings, as specified herein. Interfaces between instruments, such as control valves, flow meters, level meters, temperature meters, and rotating/process equipment shall be the sole responsibility of the Single Instrument Supplier and interface devices/methods shall be included in his shop drawing submittal.

A. SHOP DRAWINGS

In accordance with the GENERAL CONDITIONS, the Contractor shall submit for review the required sets of detailed drawings and data prepared and organized by the Single Instrument Supplier who was designated at the time of bidding. These Drawings and data shall be submitted as a complete package at one time within 120 calendar days after date of notice to proceed on of Contract, and shall include:

A-1 INSTRUMENT INDEX. Complete instrument index showing point tag, description, service type, range, units, manufacturer, and any special features for all instrumentation and control components shown on the Drawings.

A-2 DATA SHEETS. Data sheets for each component, together with a technical product brochure or bulletin. The data sheets shall show:

* Component name used herein and on the Drawings
* Manufacturer's model number or other product designation
* Project tag number used herein and on the Drawings
* Project system or loop of which the component is a part
* Input and output characteristics
* Scale range and units (if any) and multiplier (if any)
* Requirements for air supply (if any)
* Requirements for electric supply (if any
* Materials of component parts to be in contact with or otherwise exposed to process media

A complete Table of Contents shall be included in front of each bound submittal volume. A separate technical brochure or bulletin shall be included with each instrument data sheet. Each component data sheet shall be organized similar to ISA Form S20. The data sheets shall be indexed in the submittal by systems or loops, as a separate group for each system or loop. If, within a single system or loop, a single instrument is employed more than once, one data sheet with one brochure or bulletin may cover identical uses of that instrument in that system. System groups or loops shall be separated by labeled tabs.

A-3 LOOP DRAWINGS. Drawings showing definitive diagrams for every Instrumentation Loop System. These diagrams shall show and identify each component of each loop or system using legend and symbols from ISA Standard S5.4, extending the format of ISA Standard S5.1 as used on the Project Drawings. (Each system or loop diagram shall be drawn on a separate 11" by 17" drawing sheet.) A complete Table of Contents and a complete legend sheet showing only the symbols and legends used in the loop drawings shall appear in the front of each loop drawing set.

A-4 CONTROL PANELS. Arrangement and construction Drawings for the Main Control Panel and the Field Panels (FP-XXX) as shown on the Drawings and for other special enclosed assemblies for field installation shall be submitted complete with Bill-of-Material and color samples for review by Engineer and Owner. Review comments shall be incorporated in the panel design prior to fabrication. These Drawings also shall include enough other details, including prototype photographs, to define exactly the style and overall appearance of the assembly. A finish treatment sample shall be included. Each Drawing shall include a complete Bill-of-Material.

A-5 INSTALLATION DETAILS. Installation, mounting and anchoring details for all component and assemblies to be field-mounted, including conduit connection or entry details.

B. ORGANIZATION

The organization of the initial Shop Drawing Submittal required above shall be compatible to eventual inclusion as one Volume of the Operation and Maintenance Manuals Submittal and shall include final alterations reflecting "As-built" conditions. Accordingly, the initial multi-copy submittal shall be bound in three-ring binders of type specified for the Operation and Maintenance Manuals.

During the period of preparation of this submittal, the Contractor shall authorize direct, informal liaison between his Single Instrument Supplier and the Engineer for exchange of technical information. As a result of this liaison, certain minor refinements and revisions in the Instrumentation and Control systems as specified may be authorized informally by the Engineer, but these will not alter the Scope of Work or cause an increase in the Contract price. During this informal exchange, no verbal statement by the Engineer shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant formal exception to, or variation from these Specifications. Approval for refinements, revisions, exceptions and the like shall be formalized by acceptance of Shop Drawings.

1.06 ACCURACY AND QUALITY ASSURANCE

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

1.07 SPECIALIZED TECHNICAL SERVICES.

At no additional cost to the Owner, the Single Instrument Supplier shall provide the services of qualified technical representatives of the manufacturers of the equipment listed below for calibration, testing and start-up.

* Flow Meters and Transmitters
* Level Meters and Transmitters
* Temperature Meters and Transmitters
* Current Trips

1.08 WARRANTIES.

For warranty requirements, refer to General Conditions.

1.09 OPERATION AND MAINTENANCE MANUALS

In accordance with the GENERAL CONDITIONS, the required number of sets of technical manuals shall be supplied to the Owner, as a condition of acceptance of the project. Each set shall consist of one or more Volumes, each of which shall be bound in a standard size, 3-ring,

looseleaf, vinyl plastic hard cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches and binders shall have a spline window to indicate Volume, Number and Contents.

A minimum of three sets of preliminary O & M manuals shall be submitted to the Engineer for review. Following the Engineer's review, one set will be returned to the Contractor with comments. The & M manuals shall be revised and/or amended as required and the requisite final sets, including "As-built" Drawings, shall be submitted to the Engineer fifteen (15) days prior to start-up. The Engineer will distribute the copies.

Each set of these manuals shall include installation, internal wiring diagrams, component locations, connection, operating, troubleshooting, maintenance and overhaul instructions in complete detail. This shall provide the Owner with comprehensive information on all systems and components to enable operation, service, maintenance and repair. Exploded or other detailed views of all instruments, assemblies, and accessory components shall be included together with complete parts lists and ordering instructions.

1.10 SPARE PARTS RECOMMENDATIONS.

The Contractor shall include, as part of his submittal package, a list of recommended spare parts covering items required under Division 17000 of these Specifications. The total cost of these spare parts shall be not less than $1,000, exclusive of all Contractor mark-ups, and this sum shall be a part of the Contractor's total bid price. The Single Instrument Supplier shall be responsible for delivery of the spare parts, as directed by the Owner, after plant start-up. Prior to delivery of the spare parts, the Owner shall have the option of adding or deleting or exchanging any originally enumerated component based on current list prices for each item. These spare parts requirements are in addition to those specified elsewhere in this Division.

1.11 SPECIAL TOOLS AND TEST EQUIPMENT.

One set of special tools and test equipment shall be furnished to the owner for system maintenance. The tools and equipment shall include, but not be limited to, digital volt-ohm milliammeters, milliampere and voltage signal generators, pulse counters, and test extension devices or modules. These tools shall permit testing and trouble-shooting of any equipment furnished under this Division.

A list of these special tools required shall be submitted for approval by the Engineer. The tools shall be supplied and suitably wrapped and identified for application.

1.12 DEFINITION OF ACCEPTANCE.

System acceptance shall be defined as that point in time when:

1. The complete system of process instrumentation and controls as specified in Division 17000 has successfully completed all testing requirements cited in Division 17000.

2. All submittals and documentation have been submitted, reviewed and resubmitted in final "As-built" condition as specified in Division 17000.

3. All Owner's staff personnel training programs as cited in Division 17000 have been completed.

4. All spare part requirements and supplies as cited in Division 17000 have been delivered to the Owner.

5. All special tools and test equipment as cited in Division 17000 have been delivered to the Owner.

PART 2 PRODUCTS

2.01 GENERAL INSTRUMENTATION CRITERIA AND REQUIREMENT

The following are specifications for process instruments and panel-mounted hardware. Whenever any material, device or product is specified by name of manufacturer or by catalog number, the name or number is used for the purpose of establishing a standard of quality. Unless specifically stated, this procedure does not eliminate from competition other products of equal or better quality by other manufacturers. The decision relative to equivalence shall be made solely by the Engineer.

2.02 ENCLOSURES AND CONTROL PANELS

A. MAIN CONTROL PANEL

A-1 General Requirements. The main control panel shall be a double wide section of the MCC as specified under the Electrical Division. This control section shall be totally isolated from the other sections of the MCC by a metal divider that is electrically insulated on both sides. It shall not be possible for any person working in the control cabinet to come in contact with any power residing in the other sections of this enclosure. All meters, indicating lights, relays, and other electrical devices shall be as specified under this division or under the electrical divisions.

A-2 Construction. Instrumentation Main Control Panel (MCP) shall have a single continuously hinged front opening

door. Panel edges shall be smoothly rounded and holes for the instruments, pushbutton, and other devices shall be cut, punched, or drilled and smoothly finished with rounded edges. Sand the panel faces and remove all mill scale, rust, grease, and oil prior to finishing. Fill scratches, dents, and other imperfections on the front and side surfaces with putty and grind or sand smooth prior to touch up painting. Apply one spray coat of light gray primer surfacer to all panel and mounting pan surfaces and allow to dry thoroughly, then sand with suitable abrasive. Any remaining imperfections shall then be filled, dried, and sanded. Then finish all rear surfaces of the panel and mounting pan subpanel surfaces with at least one coat of white lacquer. Then apply one spray coat of finish lacquer to exposed panel fronts and permit it to dry. After thorough drying, sand lightly before applying the finish coat. Finish coat to exposed panel fronts shall consist of a further application of lacquer and shall not be polished. The finished front and side surfaces shall have a minimum film thickness of three mils and shall be smooth and uniform in texture, free from pinholes, sags, runs, skips, scratches, dents, or any other imperfections. The top, bottom, and back surfaces shall be uniformly coated and free from pinholes, sags, runs, and skips. The finish color shall be chosen by the Owner based on color charts submitted by the panel manufactured. The bottom of the panel may be bolted to anchors in the floor and the top of the panel shall be braced against a building wall or other structural member.

Provide mounting pans as shown or required for mounting of all the control relays and other auxiliary items as shown. The mounting pans shall be located such that all components are readily accessible.

A-3 Panel Wiring. All panel wiring shall be completed and tested prior to shipment. All external connections shall be by way of numbered terminal blocks. Power connection to the panel shall be via indicating circuit breakers providing 'ON', 'TRIPPED' and 'OFF' positions of the operating handle. Power distribution inside the panel shall be via fuses mounted on a clearly marked fuse block. Each loop shall be separately fused. Fuse block shall have 20% spares.

Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties, and shall be secured to panels at both sides of the 'hinge loop' so that conductors are not strained at terminals.

Wiring run to control devices on the front panel shall be tied together at short intervals and secured to the inside face of the panel using adhesive mounts.

Wiring to terminals on rear panel mounted instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same place as the rear of the instruments. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer's review.

All electrical wiring 115-volt or greater on the panels shall be in accordance with the standards of the NEC. Wires shall be type MTW stranded copper, 600-volt insulation, and shall be in sizes not less than No. 14-gauge, suitable for the currents to be carried.

All power wiring shall be enclosed in plastic wiring ducts. Connections to the terminal strips shall be made using pressure type lugs. Locate all fuses on a common fuse block with circuit designations. Terminate all connections to external equipment on numbered terminal blocks. 20-AMP, 120-volt, single-phase circuits will be extended to each control panel. Provide a numbered termination for these power leads.

Signal wiring generally shall conform to the same standard as for power wiring, except that signal wiring may be grouped by the use of plastic wiring harness, if desired. If wiring harnesses are used, metallic tubing, raceway, or ducts will not be required. Signal wiring shall be separated a minimum of 6 inches from AC power wiring, including the connections to the terminal strips. Terminate all connections to external equipment at numbered terminal blocks.

A-4 Identification of Wiring. Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be permanently marked heatshrink plastic. Numbers shall be typed.

A-5 Terminal Blocks. Terminal blocks shall be molded plastic with barriers and box lug terminals and shall be rated 15 amperes at 600-volts. White typed marking strips, fastened securely to the molded section, shall be provided, and wire numbers or circuit identifications shall be marked thereon with permanent marking fluid. Terminal blocks shall be Connectron NFT3, or equal.

A fused terminal blocks shall be provided for each 2-wire transmitter for its power supply connection. The fused terminal block shall be Connectron No. NFT-F1 or equal, with 30 milliamp fuse.

B. FIELD PANELS

B-1 General Requirements. The Contractor shall furnish, install and place into service new Field Panels (FP-XXX) as shown on the Drawings and as described in the Specifications. All FP's shall be mounted, leveled and anchored on concrete bases provided by the Contractor and as shown. Shims shall be provided to set panel levels. All FP's shall be two compartment cabinets divided by a horizontal metal sheet that is electrically insulated. The bottom section shall be for 480/120 volt power. the top section shall be for instrumentation and control. The magnetic fields generated by the 480 volt power must not penetrate the top section of the enclosure.

B-2 Panel Construction. Each FP shall be fabricated from sheet steel with a two-piece, 10-gauge, steel front. Top and sides of the panel shall be 14-gauge sheet steel and rear shall be 14-gauge sheet steel. Provide steel angle stiffeners required to prevent panel deflection under instrument loading or operation. Each panel shall have two access doors in the front as shown, one for the power section and one for the instrument section. Panel shall br rate NEMA 4X.

All panel cabinets shall be provided with 120 VAC duplex utility outlets

All components except those on the front panels shall be mounted behind on fixed or swing-out panels; terminal blocks for field connections shall be mounted on fixed channels located near the bottom of the sections, but clear of the conduit entry area. Fixed panels shall be located so as not to prevent access to the terminals of components mounted on the front panels. Swing-out panels shall be arranged to swing completely out and not to obstruct access within the cabinets to other components, wiring, and terminal blocks on fixed panels, or front panels.

B-3 Panel Wiring. All external connections shall be by way of numbered terminal blocks. Power connection to the panel shall be via indicating circuit breakers providing 'ON', 'TRIPPED' and 'OFF' positions of the operating handle. Power distribution inside the panel shall be via fuses mounted on a clearly marked fuse block. Each

loop/device shall be separately fused. Fuse block shall have 20% spares.

Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties, and shall be secured to panels at both sides of the 'hinge loop' so that conductors are not strained at terminals.

Wiring run to control devices on the front panels shall be tied together at short intervals and secured to the inside face of the panel using adhesive mounts.

Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same place as the rear of the instruments. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the Engineer's review.

All electrical wiring 115-volt or greater on the panels shall be in accordance with the standards of the NEC. Wires shall be Type MTW stranded copper, 600-volt insulation, and shall be in sizes not less than No. 14-gauge, suitable for the currents to be carried.

All power wiring shall be enclosed in plastic wiring ducts. Connections to the terminal strips shall be made using pressure type lugs. Locate all fuses on a common fuse block with circuit designations. Terminate all connections to external equipment on numbered terminal blocks. 20-AMP, 120-volt, single-phase circuits will be extended to each control panel. Provide a numbered termination for these power leads.

Signal wiring generally shall conform to the same standard as for power wiring, except that signal wiring may be grouped by the use of plastic wiring harness, if desired. If wiring harnesses are used, metallic tubing, raceway, or ducts will not be required. Signal wiring shall be separated a minimum of 6 inches from AC power wiring, including the connections to the terminal strips. Terminate all connections to external equipment at numbered terminal blocks.

B-4 Identification of Wiring. Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings. These numbers shall be marked on all conductors at every terminal using white numbered wire markers which shall be

permanently marked heatshrink plastic. Number shall be typed.

B-5 Terminal Blocks. Terminal blocks shall be molded plastic with barriers and box lug terminals and shall be rated 15 amperes at 600-volts. White marking strips, fastened securely to the molded section, shall be provided, and wire numbers or circuit identifications shall be marked thereon with permanent marked fluid. Terminal blocks shall be Connectron NFT3, or equal.

A fused terminal block shall be provided for each 2-wire transmitter for its power supply connection. The fused terminal block shall be Connectron No. NFT-F1 or equal, with 30 milliamp fuse.

B-6 Nameplates. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, each electronic trip, and the like, mounted inside the Local Control Panels. These shall be descriptive, to define the function and system of such element. These nameplates shall be of the same material as those on the front of the Local Control Panels. These nameplates shall be fabricated from black-face, white-center, laminated engraving plastic and shall be Formica Type ES-1, No. 1014; VI-LAM overlay nametags by N/P Company or equal. Nameplate mounting hardware shall not be visible from the face of the Local Control Panels.

Nameplates shall be provided from instruments, function titles for each group of instruments, and other components mounted on the front panels of the Local Control Panels, as shown. Colors, lettering, and style, shall be as selected by the Engineer.

B-7 PAINTING

All faces shall be ground smooth and all steel shall be treated with zinc phosphate, bonderized or otherwise given a rust preventive treatment. They shall then be given a primer compatible with the manufacturer's painting system and then the final coats of durable enamel shall be applied. The final enamel color shall be selected by the Owner. The final coating shall be free from blemishes and shall be protected during shipment, storage, and installation. The Contractor shall refinish all scratches or damage that occur before final acceptance.

2.03 PROCESS INSTRUMENTATION

A. FLOW ELEMENT, PADDELWHEEL. Element shall be insertion type paddle wheel made of an inert material and shall include an installation housing in the form of a "T" fitting. Element shall be capable of accepting a 1/2" conduit connection as a minimum size. Element shall be SIGNET ROTOR-X.

B. FLOW INDICATING TRANSMITTER TOTALIZER. Modules shall accept a single input signal and shall display current flow rate as well as display the totalized flow. Totalized flow shall be displayed on a 7-digit non-resettable counter. Module shall be capable of re-transmitting the totalized flow. Modules shall operate on 120 VAC, 60 HZ power. Module shall be SIGNET ACCUM-U-FLO MODEL MK 575.

C. FLOW TOTALIZER. Modules shall accept a single input signal and shall display the totalized flow. Totalized flow shall be displayed on a 7-digit non-resettable counter. Modules shall operate on 120 VAC, 60 HZ power. Module shall be SIGNET ACCUM-U-FLO MODEL MK 579.

D. INDICATORS. Indicators shall be the electronic type with independent dual bar graphs and digital read-out at the top. Scales shall be linearly graduated in engineering units. Indicators shall each have a separate DC power supply. Case size shall be 3" by 6" suitable for panel mounting. Indicators shall be DIXSON DIN INDICATORS.

E. LEVEL ELEMENT AND TRANSMITTER, ADMITTANCE (TANKS 201, 202, 203, 204). Unit shall employ an admittance measurement technique, using low power RF to measure the level of a product in a grounded vessel. The sensing element shall be the immersion type with mounting suitable for installation shown. Sensing element length shall be as required for noted scale range. Sensing element shall be Teflon coated and shall be constructed so as to be unaffected by coating buildups. The sensing element shall be interconnected to an indicating transmitter by an integral cable with length as shown (100 feet maximum). Sensor and interconnecting cable shall be intrinsically safe in accordance with NFPA 493.

Indicating transmitter shall be suitable for pipe stand or wall mounting with a NEMA 4X enclosure. The indicating transmitter output shall be a 4-20 mAdc signal linearly proportional to the level, into a load impedance of 0-400 ohms without load adjustments . Output span and zero shall be field adjustable. Indicating transmitter shall include an adjustable 0-30 seconds measured. RFI filters shall be provided, as required, to eliminate effects of extraneous interferences. Indicator scale shall be 3-inch scale minimum, visible from outside the unit, and shall be linearly graduated with scale range as noted. Overall system accuracy shall be

plus or minus 1.0 percent of full scale for sensing element temperatures to 200 degrees F and 150 psig pressure.

Unit shall be Drexelbrook Type 508, Level Measuring system. No substitutions will be permitted.

F. LEVEL ELEMENT AND MULTI-POINT LEVEL CONTROLLER (WELL AND SUMPS). Unit shall employ an admittance measurement technique, using low power RF to measure the level of a product. The sensing element shall be the immersion type with mounting suitable for installation shown. Sensing element length shall be as required for noted scale range. Sensing element shall be Teflon coated and shall be constructed so as to be unaffected by coating buildups. The sensing element shall be interconnected to an indicating transmitter by an integral cable with length as shown (100 feet maximum). Sensor and interconnecting cable shall be intrinsically safe in accordance with NFPA 493.

Transmitter shall be suitable for pipe stand or wall mounting in a NEMA 4X enclosure. LED indicators shall be provided to show set point activation. Transmitter shall produce output contact transfers as required by each application. Four independent set-points one for each individual isolated outputs shall be provided. The output shall be isolated DPDT contact rated for 5 Amps continuous at 120 VAC. Each set-point shall be continuously adjustable over the full input span and shall be repeatable within +0.1 percent full scale.

Unit shall be Drexelbrook Type 506 Level Measuring System with a weighted flexible probe. No substitutions will be permitted.

G. TEMPERATURE WELL AND TRANSMITTER, RESISTANCE TYPE. Sensing element shall be the platinum resistance type and shall conform to the 100-ohm nominal at zero degree centigrade with a calibration curve per SAMA standard RC-21-4-1966. The sensing element shall be magnesium oxide insulated having 316 stainless steel sheath, 1/4 inch in diameter. Sensing element shall be in a three-wire configuration. The sensing element accuracy shall be plus or minus 1/4 percent of reading or plus or minus 0.25 degree F, whichever is greater. The unit shall be provided with a 304 stainless steel thermowell with a 1-inch NPT connection, a 3-inch lagging extension and an insertion length as noted. The well interior shall be designed and sized to match the construction of the sensing element so as to permit close contact for maximum heat transfer, easy removal, and quick and accurate temperature measurement.

Indicating transmitter shall be mounted in a NEMA 4x enclosure suitable for a pipe stand.

Indicating transmitter shall be two wire type powered from a remote, external +24VDC power supply. Indicating transmitter shall accept the three wires from the sensing element and transmit a proportional 4-20 mAdc signal capable of driving 0-400 ohms load impedance without any load adjustments. The transmitter shall provide an input-to-output signal isolation of 500 VDC minimum. The transmitter output shall be immune to RFI and EMI. Unit shall have a calibrated accuracy of plus or minus 0.2 percent of range noted. Unit shall be suitable for thermowell mounting, and its accuracy shall not be affected by more than 0.25 percent of span per 50 degrees F change in environmental temperature. Transmitter unit shall include an integral local indicator with a minimum 3-inch scale range linearly graduated in process variable units with accuracy of plus or minus 2.0 percent of span. Indicator transmitter unit case construction shall be suitable for NEMA 4X requirements, unless otherwise noted.

Units shall be Rosemount Model 444 Alphaline temperature transmitter, Fisher Controls Model PM-513, or equal.

H. ELECTRONIC CURRENT TRIPS. Modules shall accept a single 4-20 mADC input signal and shall produce output contact transfers as required by each application. Dual independent set-points within individual isolated outputs shall be provided. The output shall be isolated DPDT contact rated for 5 Amps continuous at 120 VAC. Each set-point shall be continuously adjustable over the full input span and shall be repeatable within +0.1 percent full scale. Each shall have a light emitting diode to denote the output relay is energized. Each module shall have adjustable dead band from 1-100 percent of full scale. Modules shall operate on 120 VAC, 60 Hz power. Modules shall be RIS-ET-1200, or equal.

I. POWER SUPPLY, DC. Provide dc power supplies as required to power instruments and loops requiring external dc power. Power supplies shall convert 120-volt, 60 Hz power to dc power of the appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that the instruments being supplied can operate within their required tolerances. Output overvoltage and overcurrent protective devices shall be provided with the power supply to protect the instruments from damage due to power supply failure and to protect the power supply from damage due to external failure. Provide NEMA 1 enclosure for indoor installations and NEMA 4 for out-of-door installations.

J. CONTROL RELAYS. Control relays shall have 120-volt ac coils, except as noted; contacts shall be rated as required, 10 amperes minimum. Each shall be plug-in type with dust cover and sockets. These relays shall be Potter-Brumfield Type KRP, General Electric Type CR120, or equal. All relays shall be the products of one manufacturer.

K. SELECTOR SWITCHES, PUSHBUTTON, AND INDICATING LIGHTS. Devices shall be the square type with back plane lighting. Devices shall indicate/provide multiple functions within a single housing as indicated by the drawing. Devices shall be products of ALLEN BRADLEY or equal. Review electrical division for additional details.

PART 3 EXECUTION

3.01 INSTALLATION REQUIREMENTS

All instruments shall be installed, wired, calibrated, tested, and placed into service under the supervision of the Technical Field Representative of the Single Instrument Supplier (except as noted in Section 1.07). All installation, wiring, calibration shall be per the instrument manufacturers recommended guidelines.

3.02 INSTALLATION, CALIBRATION AND TESTING.

Under the on-site direction of a technical field representative of the Single Instrument Supplier designated by the Contractor at the time of bidding, all systems specified in Section 13400 shall be installed, connected, calibrated and tested, and in coordination with the Engineer and the Owner, shall be started to place the plant into operation. This shall include final calibration of equipment specified elsewhere in these Specifications, including pumps, valves, chemical feeders, analyzers and the like.

The applicable provisions of the following Sections under Division 16, ELECTRICAL, shall apply to work and equipment specified herein, the same as if stated in full herein:

* Codes and Standards
* Equipment, Materials and Workmanship
* Designation of Locations
* Wiring Practices
* Grounding
* Terminal Cabinets and Compartments
* Testing
* Equipment Anchoring
* Conductor and Equipment Identification
* Process Control Devices

After all installation and connection work has been completed it shall be checked for correctness verifying installation of instruments, polarity of electric power and signal connections, and all similar details. The Technical Field Representative of the Single Instrument Supplier and the Technical Representative of the Instrument Manufacturer as specified in Part 1.07 of Division 13400 shall be responsible for checking the correctness of instrument installation. The Technical

Field Representative of the Single Instrument Supplier shall certify in writing to the Contractor that he has completed such checkout and that any discrepancies have been corrected by the Installation Personnel. A copy of this certification shall be supplied by the Contractor to the Engineer. This certification shall indicate that all physical installation are in accordance with the Contract Documents and manufacturer's recommendations.

All instruments and systems shall be calibrated after installation, in conformance with the Component Manufacturer's instructions. This shall verify that those conditions and applications of this installation, and the components and/or systems are within the specified limits of accuracy. Defective elements which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. This calibration work shall be accomplished by the Technical Field Representative of the Single Instrument Supplier or by the Technical Representative of the Instrument Manufacturer as specified in Part 1.07 of Division 13400. The Technical Field Representative of the Single Instrument Supplier shall certify in writing to the Contractor that all calibrations have been made and that all systems are ready to operate; a copy of his certification shall be supplied by the Contractor to the Engineer. A legible copy of the calibration sheet for each instrument/system shall be supplied to the Engineer by the Contractor.

The burden of proof of conformance to specified accuracy and performance is on the Contractor using his designated Single Instrument Supplier. He shall supply necessary test equipment and technical personnel if he is called upon to prove accuracy and/or performance, at no separate additional cost to the Owner, wherever reasonable doubt or evidence of malfunction or poor performance may appear within the warranty period.

All systems shall be exercised through operational tests in the presence of the Engineer in order to demonstrate achievement of the specified performance. Operational tests depend upon completion of all work specified elsewhere in these Specifications. The scheduling of tests shall be coordinated by the Contractor among all parties involved so that the tests may proceed without delays or disruption by incomplete work.

Copies of all certifications and calibration sheets must be submitted to the Engineer for review two weeks prior to the scheduling of testing. If in the opinion of the Engineer the certifications and/or calibration sheets are not complete or are incorrect they shall be returned to the Contractor for resubmittal prior to testing. Testing shall then be rescheduled as outlined above. The testing shall be in addition to those specified elsewhere in this Division.

3.03 TRAINING RECOMMENDATIONS AND START-UP.

When all systems are assessed by the Contractor to have been successfully carried through complete operational tests with a minimum of simulation, and the Engineer concurs in this assessment, plant start-

up by the Owner's personnel can follow. For a minimum of one day prior to start-up, the operating personnel shall be instructed in the functions and operation of each analog system and shall be shown the various adjustable and set point features which may require readjustment, resetting or checking and recalibration of analog hardware by them from time to time. This instruction shall be scheduled at a time arranged with the Owner at least two weeks in advance. Instruction shall be given by qualified persons who are familiar in advance with the actual systems being installed in the plant. This training shall be in addition to those specified elsewhere in this Division.

3.04 LOOP DESCRIPTIONS

A. GENERAL

All loops shall be placed into service to control the process or indicate the plant/process status as outlined in these Specifications and/or as shown on the Drawings.

B. LOOP DESCRIPTIONS

B-1 WELL 1-88 PUMPING CONTROL LOOP 100

The well level shall be controlled as follows:

a. Measure the well level and on high level start the pump. Stop the pump on low level. (LE, LSHL-100)

b. Measure the flow rate (FE-100), indicate and totalize flow locally (FITQ-100), totalize flow at the MCP (FQI-100).

c. Provide HAND/OFF/AUTO control of the pump via HK-100. Locate HK-100 on the MCP as shown on the drawings.

- When HK-100 is in the "HAND" position the pump shall be running.
- When HK-100 is in the "OFF" position the pump shall be off, however the "JOG" pushbutton shall still be able to activate the pump.
- When HK-100 is in the "AUTO" position the pump shall be turned on/off via level control switches (LSHL-100).

d. Prevent the pump from turning on in the "AUTO" mode if the INFLUENT storage tank(s) is full or if the valve to the tank(s) is not open.

e. Alarm pump failure to start at the MCP (QA-100).

f. Indicate pump status locally and at the MCP (QL-100).

g. Provide a "JOG" pushbutton on the FP (HS-100).

EQUIPMENT:

LE-100	LEVEL ELEMENT, ADDMITTANCE Weighted flexible cable, 30 feet in length Field Adjustable
LSHL-100	LEVEL CONTROLLER, MULIT POINT Range: 0-30 feet
FE-100	FLOW ELEMENT with "T" HOUSING PADDLEWHEEL RANGE: 0-10 GPM
FITQ-100	INDICATING TRANSMITTER TOTALIZER FLOW RANGE: 0-10 GPM TOTALIZER: 7-DIGIT NON-RESETTABLE
FQI-100	TOTALIZER: 7-DIGIT NON-RESETTABLE
HK-100	SELECTOR SWITCH, 3-POSITION BACKLIGHTED HAND - GOLD BACKLIGHTING OFF - RED BACKLIGHTING AUTO - GREEN BACKLIGHTING LENSE TO BE ENGRAVED WITH POSITION
HS-100	PUSHBUTTON
QA-100	RED ALARM LIGHT, ENGRAVED "PUMP-100 FAILURE"
QL-100(FP)	INDICATING LIGHT GREEN - RUNNING RED - OFF
QL-100(MCP)	INDICATING LIGHT GREEN - RUNNING RED - OFF

B-2 COLLECTION WELL PUMPING CONTROL LOOPS 101,102,103

The collection well level shall be controlled as follows:

a. Measure the well level and on high level start the lead pump. On increasing level start the lag pump. Stop the pump(s) on low level (LE, LSHL-10X where X=1,2,3). Provide an alternator circuit to switch the lead and lag pump after each use.

b. Measure the flow rate (FE-10X where X=1,2,3), indicate and totalize flow locally (FITQ-10X where X=1,2,3), totalize flow at the MCP (FQI-10X where X=1,2,3).

c. Provide HAND/OFF/AUTO control for each of the pumps via HK-10XA and HK-10XB where X=1,2,3. Locate HK-10XA and HK-10XB on the MCP as shown on the drawings.

- When HK-10X where X=1,2,3 is in the "HAND" position the pump shall be running.
- When HK-10X where X=1,2,3 is in the "OFF" position the pump shall be off, however the "JOG" pushbutton shall still be able to activate the pump.
- When HK-10X where X=1,2,3 is in the "AUTO" position the pump shall be turned on/off via level control switches (LSHL-10X where X=1,2,3).

d. Prevent the pump(s) from turning on in the "AUTO" mode if the INFLUENT storage tank(s) is full or if the valve to the tank(s) is not open.

e. Alarm pump(s) failure to start at the MCP (QA-10XA and QA-10XB where X=1,2,3).

f. Indicate pump status locally and at the MCP (QL-10XA and QL-10XB where X=1,2,3).

g. Provide a "JOG" pushbutton on the FP (HS-10XA and HS-10XB where X=1,2,3).

EQUIPMENT: (See note below)

LE-10X	LEVEL ELEMENT, ADDMITTANCE Weighted Flexible cable, 50 feet in length Field Adjustable
LSHL-10X	LEVEL CONTROLLER, MULIT POINT Range: 0-50 feet
FE-10X	FLOW ELEMENT with "T" HOUSING PADDLEWHEEL RANGE: 0-15 GPM
FITQ-10X	INDICATING TRANSMITTER TOTALIZER FLOW RANGE: 0-15 GPM TOTALIZER: 7-DIGIT NON-RESETTABLE
FQI-10X	TOTALIZER: 7-DIGIT NON-RESETTABLE

HK-10X	SELECTOR SWITCH, 3-POSITION BACKLIGHTED HAND - GOLD BACKLIGHTING OFF - RED BACKLIGHTING AUTO - GREEN BACKLIGHTING LENSE TO BE ENGRAVED WITH POSITION
HS-10X	PUSHBUTTON
QA-10X	RED ALARM LIGHT, ENGRAVED "PUMP-10X FAILURE"
QL-10X(FP)	INDICATING LIGHT GREEN - RUNNING RED - OFF
QL-10X(MCP)	INDICATING LIGHT GREEN - RUNNING RED - OFF

NOTE: Only the switches, alarms, and indicating lights necessary for the single pump have been listen above. Duplicate them for the second pump.

B-3 BLDG. 830 SUMP PUMP CONTROL LOOPS 300

The sump level shall be controlled as follows:

a. Provide 3 level switches (floats) to start/stop the sump pumps. Start the lead pump on high level (LSH-300); start the lag pump on high-high level (LSHH-300); stop pump(s) on low level (LSL-300). Provide an alternator circuit to switch the lead and lag pump after each use.

b. Provide HAND/OFF/AUTO control for each of the pumps via HK-300A and HK-300B . Locate HK-300A and HK-300B on the FP as shown on the drawings.

- When HK-300 is in the "HAND" position the pump shall be running.
- When HK-300 is in the "OFF" position the pump shall be off.
- When HK-300 is in the "AUTO" position the pump shall be turned on/off via level control switches (LSL-300, LSH-300, LSHH-300).

c. Prevent the pump(s) from turning on in the "AUTO" mode if the INFLUENT storage tank(s) is full or if the valve to the tank(s) is not open.

d. Alarm pump(s) failure to start at the FP (QA-300A and QA-300B).

e. Indicate pump status locally at the FP (QL-300A and QL-300B).

EQUIPMENT: (See note below)

LSHH-300	LEVEL SWITCH, FLOAT FORM C CONTACTS
LSH-300	LEVEL SWITCH, FLOAT FORM C CONTACTS
LSL-300	LEVEL SWITCH, FLOAT FORM C CONTACTS
HK-300A	SELECTOR SWITCH, 3-POSITION BACKLIGHTED HAND - GOLD BACKLIGHTING OFF - RED BACKLIGHTING AUTO - GREEN BACKLIGHTING LENSE TO BE ENGRAVED WITH POSITION
QA-300	RED ALARM LIGHT, ENGRAVED "PUMP-300 FAILURE"
QL-300	INDICATING LIGHT GREEN - RUNNING RED - OFF

NOTE: Only the switches, alarms, and indicating lights necessary for a single pump have been listed above. Duplicate them for the second pump.

B-4 INFLUENT STORAGE TANK CONTROL LOOPS 201,202

The influent storage tanks shall be controlled as follows:

a. Measure tank level and indicate level locally (LE, LIT-20X where X=1,2). Transmit a 4-20 mAdc signal linearly proportional to level to the MCP. At the MCP provide the following signals and/or indicators.

- Indicate level on the MCP (LI-20X where X=1,2).
- Activate an alarm and the "DIALER" on tank high-high level (The HIGH on LSHL-20XA where X=1,2).
- On low-low level send a contact closure to prevent the heating element from operating (The LOW on LSHL-20XA where X=1,2).

- On high level send a contact closure to prevent the "WELL" pumps from operating (The HIGH on LSHL-20XB where X=1,2).
- On low level send a contact closure to the "TREATMENT UNIT" (The LOW on LSHL-20XB where X=1,2).

b. Measure tank temperature and indicate temperature locally (TE, TIT-20X where X=1,2). Transmit a 4-20 mAdc signal linearly proportional to temperature to the MCP. At the MCP provide the following signals and/or indicators.

- Activate an alarm and the "DIALER" on tank high-high or low-low temperature (The HIGH or LOW on TSHL-20XA where X=1,2).
- On low temperature send a contact closure to start the heating element operating (The LOW on TSHL-20XB where X=1,2).
- On high temperature send a contact closure to stop the heating element operating (The HIGH on TSHL-20XB where X=1,2).

c. Provide position switches on the tank influent valve and the tank effluent valve (ZS-20XA and ZS-20XB where X=1,2). Indicate valve position at the MCP (ZI-20XA and ZI-20XB where X=1,2). (Position switch will close when valve is closed.)

EQUIPMENT:

LE-20X	LEVEL ELEMENT, ADDMITTANCE ROD LENGTH: 9.5 FEET
LIT-20X	LEVEL INDICATING TRANSMITTER RANGE: 0-9 feet OUTPUT: 4-20 mAdc
LSHL-20XA	CURRENT TRIP HIGH SETTING: 8 FEET 10 INCHES LOW SETTING: 1.5 FEET
LSHL-20XB	CURRENT TRIP HIGH SETTING: 8.5 FEET LOW SETTING: 0.0 FEET
LI-20X	INDICATOR, ELECTRONIC RANGE: 0-9 FEET
QA-20XA	RED ALARM LIGHT, ENGRAVED "TANK-20X HIGH"

TE-20X	TEMPERATURE ELEMENT, RESISTANCE TYPE LENGTH: 2 FEET
TIT-20X	TEMPERATURE INDICATING TRANSMITTER RANGE: 20-120 DEGREES F OUTPUT: 4-20 mAdc
TSHL-20XA	CURRENT TRIP HIGH SETTING: 115 DEGREES F LOW SETTING: 33 DEGREES F
TSHL-20XB	CURRENT TRIP HIGH SETTING: 36 DEGREES F LOW SETTING: 40 DEGREES F
QA-20XB	RED ALARM LIGHT, ENGRAVED "TANK-20X TEMP HIGH/LOW"
ZS-20X (A,B)	LIMIT SWITCH
ZI-20X (A,B)	INDICATING LIGHT GREEN - OPEN RED - CLOSED

B-5 EFFLUENT STORAGE TANK CONTROL LOOPS 203,204

The influent storage tanks shall be controlled as follows:

a. Measure tank level and indicate level locally (LE, LIT-20X where X=3,4). Transmit a 4-20 mAdc signal linearly proportional to level to the MCP. At the MCP provide the following signals and/or indicators.

- Indicate level on the MCP (LI-20X where X=3,4).
- Activate an alarm and the "DIALER" on tank high-high level (The HIGH on LSHL-20XA where X=3,4).
- On low-low level send a contact closure to prevent the heating element from operating (The LOW on LSHL-20XA where X=3,4).
- On high level send a contact closure to the "TREATMENT UNIT" (The HIGH on LSHL-20XB where X=3,4).
- On low level send a contact closure to the "TREATMENT UNIT" (The LOW on LSHL-20XB where X=3,4).

b. Measure tank temperature and indicate temperature locally (TE, TIT-20X where X=3,4). Transmit a 4-20 mAdc signal linearly proportional to temperature to the MCP. At the MCP provide the following signals and/or indicators.

- Activate an alarm and the "DIALER" on tank high-high or low-low temperature (The HIGH or LOW on TSHL-20XA where X=3,4).
- On low temperature send a contact closure to start the heating element operating (The LOW on TSHL-20XB where X=3,4).
- On high temperature send a contact closure to stop the heating element operating (The HIGH on TSHL-20XB where X=3,4).

c. Provide position switches on the tank influent valve, the tank effluent valve, and the tank recirculation valve ZS-20XA, ZS-20XB, and ZS-20XC where X=3,4). Indicate valve position at the MCP (ZI-20XA, ZI-20XB and ZI-20XC where X=3,4). (Position switch will close when valve is closed.)

EQUIPMENT:

LE-20X	LEVEL ELEMENT, ADDMITTANCE ROD LENGTH: 9.5 FEET
LIT-20X	LEVEL INDICATING TRANSMITTER RANGE: 0-9 feet OUTPUT: 4-20 mAdc
LSHL-20XA	CURRENT TRIP HIGH SETTING: 8 FEET 10 INCHES LOW SETTING: 1.5 FEET
LSHL-20XB	CURRENT TRIP HIGH SETTING: 8.5 FEET LOW SETTING: 0.0 FEET
LI-20X	INDICATOR, ELECTRONIC RANGE: 0-9 FEET
QA-20XA	RED ALARM LIGHT, ENGRAVED "TANK-20X HIGH"
TE-20X	TEMPERATURE ELEMENT, RESISTANCE TYPE LENGTH: 2 FEET
TIT-20X	TEMPERATURE INDICATING TRANSMITTER RANGE: 20-120 DEGREES F OUTPUT: 4-20 mAdc
TSHL-20XA	CURRENT TRIP HIGH SETTING: 115 DEGREES F LOW SETTING: 33 DEGREES F

TSHL-20XB	CURRENT TRIP HIGH SETTING: 36 DEGREES F LOW SETTING: 40 DEGREES F
QA-20XB	RED ALARM LIGHT, ENGRAVED "TANK-20X TEMP HIGH/LOW"
ZS-20X (A,B,C)	LIMIT SWITCH
ZI-20X (A,B,C)	INDICATING LIGHT GREEN - OPEN RED - CLOSED

B-6 WELL PUMPING SYSTEM STATUS LOOPS 205

The system status shall be monitored and status displayed as follows:

a. Well pumping shall be "ENABLED" whenever a pumping path to an INFLUENT storage exists (tank influent valve open) and provided the tank is not full. System status shall be indicated on the MCP (QL-205).

EQUIPMENT:

QL-205	INDICATING LIGHTS ENABLED - GREEN DISABLED - RED

B-7 TRANSFER PUMPS PUMPING CONTROL LOOPS 301,302

The transfer pumps shall be controlled as follows:

a. Provide P1/OFF/P2 control the pumps via HK-301. Locate HK-301 on the MCP as shown on the drawings.

- When HK-301 is in the "P1" position pump P-301 shall be enabled for control via the treatment unit.
- When HK-301 is in the "OFF" position then both pumps shall be off, however the "JOG" pushbuttons shall still be able to activate the pumps.
- When HK-301 is in the "P2" position pump P-302 shall be enabled for control via the treatment unit.

b. Pump status shall be feed back to the treatment unit for system monitoring.

c. Indicate pump status at the MCP (QL-30XA and QL-30XB where X=1,2,).

d. Provide a "JOG" pushbutton on the MCP (HS-301 and HS-302).

EQUIPMENT:

HK-300	SELECTOR SWITCH, 3-POSITION BACKLIGHTED P1 - GREEN BACKLIGHTING OFF - RED BACKLIGHTING P2 - GREEN BACKLIGHTING LENSE TO BE ENGRAVED WITH POSITION
HS-301	PUSHBUTTON
HS-302	PUSHBUTTON
QL-301	INDICATING LIGHT GREEN-RUNNING RED-OFF
QL-302	INDICATING LIGHT GREEN-RUNNING RED-OFF

SECTION 17220

LEAK DETECTION SYSTEM

PART I: GENERAL

1.1 DESCRIPTION: Requirements of Division 1 and Section 17000 form a part of this Section. This Section specifies the panel mounted and miscellaneous field instruments and equipment to perform the required functions in conjunction with information and equipment specified in other Sections of Division 17.

A. Unit Responsibility. It shall be the responsibility of ICM Subcontractor as described in Section 17000 of this Division to insure that the instruments and equipment furnished under this Section are compatible with the equipment furnished under other sections of this Division and other Divisions of these Specifications, and that the signal transmission methods are compatible.

B. Case colors shall be compatible with the panel colors and subject to final approval by the Buyer. Normally, compatible standard colors of the manufacturer shall be acceptable.

1.2 QUALITY ASSURANCE

A. Manufacturer. In addition to requirements of Section 17000, instrumentation and monitoring equipment furnished shall be manufactured by a firm regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design.

B. Maintainability. All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.

C. Materials and Installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART II: PRODUCTS

2.1 LEAK DETECTION SYSTEMS

A. General. The leak detection systems shall be provided as specified herein and/or on the Drawings. The systems shall continuously monitor the double wall piping installations for leakage of water, contaminated or otherwise. The system shall be comprised of a remotely located sensing element and a monitoring panel. The monitoring panel shall provide audible and visual alarms.

B. Liquid Level Sensors

1. General Description. The sensor shall be capable of detecting a minimum of 0.5 inches of water collected in the annular space between the primary and secondary pipe walls which drains to the collection and draw-off sump in the manhole as shown on the Drawings.

2. Specific Requirements

a. The sensors shall be suitable for CPVC pipe and fittings as shown on the Drawings.

b. The sensor shall be mounted on the bottom of the collection and the drawn-off sump as shown on the Drawings.

c. The sensor shall be suitable for remote mounting up to 200 feet from the leak monitoring panel.

3. Construction. The sensors shall be UL listed and suitable for installation in a Class 1, Division 1, Group D areas.

4. Electrical Power Requirements The liquid level sensors shall be powered by the Leak Monitoring Panel.

C. Leak Monitoring Panel

1. General Description. The leak monitoring panel shall continuously monitor the status of the remote liquid level sensor and provide audible and visual alarms.

2. Specific Requirements

a. The monitoring panel shall include power indicators, as alarm test switch and an audible alarm silencer.

b. The monitoring panel shall have an intrinsically safe power supply including intrinsically safe barriers to all sensors.

3. Construction. The leak monitoring panel shall be housed in a NEMA 1 enclosure, suitable for wall mounting, UL listed and Factor Mutual approved. Connections for signal inputs, outputs, and electrical power shall be located on the lower side of the housing and shall accommodate standard electrical conduit fittings.

4. Electrical Power Requirements. The leak monitoring panel shall operate from standard electrical power utilities furnishing 120 Vac, 60 Hz, single-phase service.

5. Temperature Compatibility. The leak monitoring panel shall be tested and guaranteed for performance in ambient temperatures ranging between 0 to 120 degrees F.

D. Manufacturer. The Leak Detection System shall be as manufactured by Ronan or equal.

Part III: EXECUTION: Installation, testing and start-up shall be in accordance with Section 17000 of these Specifications.

SECTION 17550
AUTOMATIC TELEPHONE DIALER

PART 1: GENERAL

1.01 DESCRIPTION. Requirements of Conditions of the Contract, Division 1 and Section 17000 form a part of this Section. This Section specifies the instruments and equipment to perform the required functions in conjunction with information and equipment specified in other Sections of Division 17. Schedules where required for equipment appear at the end of this Section. These shall not be construed as complete bills of material.

A. Unit Responsibility. It shall be the responsibility of the ICM Subcontractor as described in Section 17000 of this Division to insure that the instruments and equipment furnished under this Section are compatible with the equipment furnished under Sections of this Division and other Divisions of these specifications, and that the signal transmission methods are compatible.

B. Case colors shall be compatible with panel colors and subject to final approval by the Buyer. Normally, compatible standard colors of the manufacturer shall be acceptable.

1.02 QUALITY ASSURANCE

A. Manufacturer. In addition to requirements of Section 17000, instrumentation and control equipment furnished shall be manufactured by a firm regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design.

PART 2: PRODUCTS

2.01 AUTOMATIC TELEPHONE DIALER

A. General Description. The telephone dialer system shall monitor operations in an unmanned facility where in the event of an alarm condition indicated by remote contact operations, the dialer system shall automatically initiate contact with present telephone numbers to advise of alarm condition. The telephone dialer system shall communicate in voice format. The advisory message shall define the location of the emergency and the nature of the alarm condition.

B. Capacity for Monitoring. The dialer system shall be capable of receiving input contact operations from up to four (4) independent sources, as specified in the schedule. Contact operation shall be either NC or NO and be jumper or switch selectable. The dialer system shall be capable of reporting in a single telephone call the existence of one or a multiple number of alarm conditions.

C. Capacity for Dialing. The dialer system shall be capable of dialing up to four (4) telephone numbers. The dialer system shall have the capacity to use up to sixteen (16) digits to define the telephone number.

For example, the dialer system shall be capable of dialing one or more numbers to connect itself to an "outside" line, followed by "1" if required, plus area code in three digits if required, and finally, a standard seven-digit telephone number.

D. Telephone Line Requirements. The dialer system shall use standard telephone lines. Systems which require dedicated telephone lines or other specialized telemetering methods are not acceptable.

1. Installation of the dialer system shall be readily achieved by plugging the dialer directly into a modular jack supplied as a part of a normal telephone line installation.

2. It is desirable, not essential, that the dialer system be compatible with a telephone installation which will permit inclusion of a standard telephone handset at the monitoring station. Such an arrangement shall permit personnel to make outgoing telephone calls without interference with the dialer system installation.

3. The dialer system shall include the telephone line coupler required by the Federal Communications Commission. Preference will be given to those dialer systems which contain the coupler as an integrated portion of the dialer itself.

E. Programming. The dialer system shall be equipped with a keyboard to enter telephone numbers to be dialed and the sequence in which the dialing procedure shall be executed. Subsequent alterations to the telephone numbers or the sequence in which they are called shall be entered by the same keyboard.

Messages shall be similarly programmed by entering 2 digit numbers for the selected words from a list of 100 words.

The dialer system shall incorporate a playback feature which permits the person establishing the program of telephone numbers to confirm that the data stored in the dialer system's program is correct. This confirmation shall be achieved by the ability of the dialer system to enunciate through an audio speaker located on the front panel of the system the complete series of telephone numbers and their calling sequence. Controls located on the keyboard shall make this confirmation procedure available at any time. Other controls located on the keyboard shall be available to initiate a test-run of the dialer system's complete alarm advisory operation, including optionally the actual telephone dialing process.

F. Identification of Dialer. In reporting an alarm the dialer system shall be required to identify itself by "Station Number" from which the receiving person can deduce its geographical location.

To this end, the dialer system shall be equipped with manually operated switches which can be used to set the station identification number. Two digits minimum shall be used. These switches shall be readily accessible and shall be alterable without need for tools.

G. Operation.

1. The dialer system shall proceed to deliver its alarm message a minimum of sixteen (16) times, pausing at the completion of each message to permit the receiving person to acknowledge by pressing a tone button on the touch-tone type phone.

2. If acknowledgement is not received on the first telephone call because the telephone receiving the call did not answer or the receiving party did not acknowledge, the dialer system shall terminate the first call by hanging up. The system shall wait approximately sixty (60) seconds before proceeding to the next telephone number. The dialer shall repeat the cycle, continuing indefinitely until the alarm problem is eliminated or the dialer system is turned off entirely at the site.

3. The format of the alarm message to be delivered by the dialer system shall contain sufficient vocabulary to identify the location of the dialer system and the nature of the alarm.

H. Optional Acknowledgement Generator. Where the receiving telephone uses a rotary dialing mechanism, the supplier of the subject dialer system shall make available at optional extra cost a battery-powered handheld tone generator. The output audible tone signal from this device shall provide the signalling acknowledgement when it is directed into the telephone handset mouthpiece.

I. Electrical Power Requirements. The dialer system shall operate from standard electric power utilities furnishing 120 Vac, 60 Hz, single-phase service. The dialer system shall be furnished with an integrally-mounted rechargeable d-c battery power supply which shall automatically serve the system in event of failure of commercial power for a period of not less than twenty-four (24) hours continuously. Restoration of the ac power source shall restore the battery to full capacity through use of a float-charging circuit included in the system. The dialer shall automatically initiate the calling sequence of ac power failure.

J. Construction. The housing for the dialer system shall be UL-listed, heavy gauge steel, fiberglass or aluminum. Access to controls shall require opening of a hinged door. Connections for alarm-signalling inputs, electrical power and telephone shall be located on the lower side of the housing and shall accommodate standard electrical conduit fittings in three separate ports.

K. Temperature Compatibility. The dialer system shall be tested and guaranteed for performance in ambient temperatures ranging between 0 to 120 degrees F.

L. Manufacturer. The dialer system shall be of a quality equal to that manufactured by Butler National Corporation.

PART 3: EXECUTION

3.01 Installation, testing, validation, and start-up shall be as specified in Section 17000. The automatic telephone dialer shall be installed to monitor and respond to alarm signals shown on the process and instrumentation diagram as specified in Section 17000.

END OF SECTION

SECTION 19000
EXTRACTION WELL 1-88

PART I: GENERAL

1.1 DESCRIPTION: This section covers the furnishing and installing of well 1-88, construction materials and the general method of construction. Well 1-88 is a shallow extraction well and shall be constructed to the dimensions as shown in the Drawings. The well is approximately 20 feet in total depth from top of pitless adapter to bottom of well casing. The well will use a pitless adapter which will be fitted with a stainless steel continuous slotted well screen to the depth shown. The pitless adapter and casing will be installed in a 36-inch diameter well boring. The bottom 5 feet of un-slotted casing shall be placed below the bedrock level and grouted as shown on the Drawings. The annular space between the well boring and the well casing shall be filled with a gravel filter packing as determined by the method outlined herein.

1.2 SUBMITTALS: Contractor shall submit shop drawings, catalog data, and descriptive literature of all items in accordance with requirements described in Division 1 of these Specifications. Specifically, the Contractor shall submit information on the pitless adapter, well screen selected, and gradation of selected filter pack material.

PART II: PRODUCTS

2.1 MATERIALS

A. Pitless Adapter. The pitless adapter shall be as manufactured by Baker, Monitor Division, type PS or equal, and shall have a one-year warranty period. The adapter shall accommodate an 8-inch stainless steel connection to the well screen described in paragraph 2.1.B.

B. Well screen. The well screen shall be of the continuous slot type, fabricated from type 304 stainless steel as manufactured by Johnson Filtration Systems or equal. The screen shall have a nominal diameter of 8 inches and a maximum slot size of 0.02 inches. It shall be the responsibility of the Contractor to assure that a minimum of 85 percent of the filter pack material, as defined in paragraph 2.1.C, will be retained by the selected well screen. The terminal portion of the well casing, the unslotted portion, shall be of type 306 stainless steel and shall be fitted with a threaded end cap.

C. Filter pack. The filter pack material shall consist of clean, washed, uniformly graded sand material meeting the following specification. The filter pack material shall be determined by taking the finest grain size anticipated to be retained (that passing a U.S. Standard Sieve size 100) and multiplying

it by 6. This size shall be the 70 percent retained grain size of the filter pack material used. The uniformity coefficient (the size sieve that retains 40 percent of the sample, divided by the size sieve that retains 90 percent) shall not be greater than 2.5. The gradation of the filter pack material shall form a smooth and gradual size distribution curve when plotted. The Contractor shall ensure that the well screen openings will retain a minimum of 85 percent of the filter pack material.

PART III: EXECUTION

3.1 INSTALLATION

A. The well shall be constructed using a boring or drilling method as determined by the Contractor. The well boring shall be approximately 36 inches in diameter and extend to the soil-bedrock interface as determined in the field by the Buyer or their appointed representative. During and immediately after the boring or drilling operation, the Contractor shall provide a "sonotube" or other acceptable means of preventing sloughing of the soil wall into the boring. This protection shall remain in place until the filter pack material is placed. After the 36-inch boring is complete, a smaller, approximately 12-inch diameter boring shall be made in the center of the 36-inch boring, extending approximately 6 feet into the bedrock. The unslotted portion of the casing shall be placed into this smaller boring and the annular space between the casing and the boring grouted in place. The grout material shall be placed using a tremie tube with a minimum diameter of 2 inches. It is recommended that the entire well assembly be placed as a unit (unslotted portion with end cap, slotted screen portion, connection to adapter, and pitless adapter) to enable proper alignment. The well assembly shall be secured in proper alignment and the annular space between the 36-inch boring and the well screen filled to the elevation shown with filter pack material. Th filter pack material shall be placed using a tremie tube. The "sonotube" or other soil retention means shall be withdrawn as the filter pack material is placed. The remaining upper portion of the boring shall be grouted as shown on the Drawings. All material excavated from the boring shall be disposed of in accordance with the provisions of Section ___.

B. The installation of the pump, motor, pump shroud, power cables and level sensing element, shall be in accordance with the manufacturer's recommendations and at the elevations as shown on the Drawings.

C. The well will be developed using pumping. Because of the expected low production of the well, it is anticipated that pumping for a continuous period will not be possible, therefore, developmental pumping will consist of periodic

pumping over a period of time to be determined by the Buyer and negotiated with the Contractor. All water from well development shall be delivered via the influent pipeline or trucked to the influent storage tanks for treatment.

END OF SECTION

SECTION 3
GOVERNMENT FURNISHED EQUIPMENT
PURCHASE SPECIFICATION

INDEX

AMSE STORAGE TANKS

ULTRAVIOLET LIGHT/HYDROGEN PEROXIDE
TREATMENT UNIT

SPECIFICATION
FOR
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
CODE STAMPED VESSEL

1. SCOPE

1.1 This specification covers design, fabrication, test, inspection, and shipping requirements for American Society of Mechanical Engineers (ASME) Code stamped vessel, four tanks, Tag Nos. T-201, T-202, T-203, and T-204 (Bldg. 830). The attached drawings and/or data sheets are a part of this Specification.

1.2 The Seller shall be responsible for the designing, fabricating, testing, and performance of the vessels covered by this Specification. The Seller shall also be responsible for conformance to all applicable codes, regulations, and standards.

2. REFERENCE STANDARDS

1) ASME Boiler and Pressure Vessel Code, latest edition and addendas.

2) American National Standards Institute (ANSI) Standard and Steel Pipe Flanges and Flanged Fittings, B16.5, latest revision.

3) American Society for Nondestructive Testing (ASNT).

4) Uniform Building Code (UBC).

3. GENERAL REQUIREMENTS

3.1 The attached drawings and/or data sheets shall be used for the specific design data, dimensional data, fitting schedule, and general configuration. Weldments and detailed design features shall be the responsibility of the Seller.

3.2 In case of conflict between this Specification and the drawings or data sheets, standards or regulations, the Buyer shall be notified by the Seller for resolution by the Buyer.

3.3 No modifications or deviations from these specifications (including attached drawings) shall be made unless authorized in writing by the Buyer.

3.4 Any thicknesses shown on the drawings and/or data sheets for the vessels or their components shall be considered minimum thicknesses only. The Seller is solely responsible for the vessels' design and fabrication.

3.5 All material shall be new and free of defects.

3.6 Warranty provisions shall be as indicated in the "Terms and Conditions" that are part of the purchase order.

4. GENERAL DESIGN REQUIREMENTS

4.1 The vessel shall be designed, fabricated per the ASME Code, Section VIII, Division 1. It will be ASME code stamped and registered with the National Board of Boiler and Pressure Vessel Inspectors.

4.2 The vessel shall be designed per the design conditions and external loadings given on the drawings and/or data sheets that are part of the specifications. All loading conditions shall be examined including loads induced into the vessel shells or heads by support attachments.

4.3 The vessel and its support structure shall be designed to maintain structural integrity during and after a seismic event.

4.4 Lifting lugs shall be designed, detailed on fabrication drawings, and furnished by the Seller. They shall allow the vessel to be lifted vertically or horizontally. The lifting lugs shall be designed so that any one lug can support the entire weight of the vessel assembly. The lugs shall not protrude beyond the edges of the vessel, and shall be designed to prevent distortion of the shell or head during lifting.

5. SEISMIC REQUIREMENTS

5.1 Seismic qualification shall be accomplished by the following method. Alternative methods may be used if the alternative is approved by the Buyer. The Seller shall not proceed with fabrication prior to this approval.

5.2 The vessels shall be classified as structurally simple so the design for seismic forces may be based on a static analysis. The earthquake forces applied to the vessels shall equal their maxiumum weight including contents multiplied by the horizontal and vertical seismic factors given on the drawings and/or data sheets. The distribution of these forces shall be assumed to be the same as the distribution of mass. The horizontal force shall be assumed to act in any direction and shall be considered to act simultaneously with the vertical force. The earthquake forces shall be combined with static and normal operating forces. The combined stresses induced in the vessel by seismic, static, and operating forces shall not exceed 95 percent of the ASME yield stress or 150 percent of the ASME allowable unit stress (both taken at operating temperature), whichever is least.

Vertical: 1.2
Horizontal: 1.8

6. GENERAL FABRICATION REQUIREMENTS

6.1 All fabrication and materials shall comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, latest edition and addenda.

6.2 Fabrication tolerances for vessels shall be as specified in the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 and on the data sheets.

6.3 Flanged nozzles shall be 150 pound raised face conforming to ANSI B16.5. Nozzle projections from outside diameter of shell to extreme face of flange shall be as follows unless otherwise specified:

Thru 4 inches	- 6 inch projection
6 inch, 8 inch, and 10 inch	- 8 inch projection

6.4 Except as otherwise noted, orientation of bolt holes for flanged nozzles shall straddle vertical and horizontal centerlines.

6.5 External attachments shall be of the same material as the shell and heads to which they are directly attached.

6.6 Longitudinal and circumferential seams shall be located to clear openings, their reinforcing pads, and saddle supports. When covering of a circumferential seam is unavoidable, the seam shall be ground flush and inspected prior to welding the pad in place.

6.7 Except as otherwise specified, horizontal vessels shall be supported by two saddles, one fixed and one sliding. Saddles shall be welded to the vessel, unless otherwise specified on the data sheets.

6.8 Any repairs reqired to bring the vessel into compliance with these specifications will be done at the Seller's expense.

6.9 A stainless steel nameplate shall be seal-welded to a bracket which in turn is seal-welded to the vessel. No exceptions will be allowed for the seal welding requirement on the nameplate and bracket. In addition to the required ASME nameplate data, the following information shall also be stamped in 3/16-inch-high letters on the nameplate:

1) Capacity in gallons.
2) Shell and head material and thicknesses in inches.
3) Weight of vessel empty in pounds.
4) Rocky Flats purchase order number.
5) Rocky Flats specification number.
6) Rocky Flats equipment name and item number.

6.10 Shielded metal arc, gas metal arc, gas tungsten arc, and submerged arc welding are acceptable welding methods. However, all weld metal exposed to the process shall be gas tungsten arc welding. In such a case, that portion of the weld not exposed to the process may be any of the other acceptable methods.

6.11 All weld joints exposed to the process fluid shall be designed to avoid ill crevices.

6.12 PAINTING

6.12.1 The tank interior shall be painted according to Tnemec System No. 20-1 Epoxy-Polyamide or equal. The system shall consist of surface preparation by SSPC-SP10 near-white blast cleaning, shop primer of 20-1255 Pota-Pox Primer (4.0 dry film-mils), shop finish coat of 20-2000 Pota-Pox finish (5.0 dry film-mils).

6.12.2 The tank exterior shall be painted according to Tnemec System No. 70-1 Aliphatic Polyester Polyurethane or equal. The system shall consist of surface preparation by SSPC-SP6 commercial blast cleaning, shop primer of 66-Color Hi-Build Epoxoline, field finish coat of 71-Color Endura-Shield. The Seller shall furnish the Buyer with a color chart for final determination of color by the Buyer. The primer shall be the same color as the finish coat.

7. INSPECTION AND TESTING

7.1 NONDESTRUCTIVE EXAMINATION REQUIREMENTS

7.1.1 Nondestructive examination (NDE) methods shall be performed per the ASME Code, Section V, latest edition and addenda using certified personnel per the ASNT Recommended Practice SNT-TC-1a.

7.1.2 All butt weld joints shall be 100 percent radiographed with acceptance criteria per UW-51 of the ASME Code, Section VIII, Division 1, latest edition and addenda.

7.1.3 All pressure containment welds not radiographed shall have their root passes and finished weld surfaces liquid penetrant examined with acceptance criteria per the ASME code, Section VIII, Division 1, latest edition and addenda, Appendix 8.

7.1.4 All radiography shall be performed using the double film technique. The Buyer's inspector shall be permitted to read both sets simultaneously, and one set shall become the property of the Buyer.

7.1.5 All nonpressure containment welds shall be visually inspected with obvious defects such as undercutting, cracks, nonfusion, etc., rejected as unacceptable until repaired or replaced.

7.2 INSPECTION

7.2.1 The Buyer reserves the right to inspect any work performed on the Buyer's equipment any time during fabrication.

7.2.2 The Buyer reserves the right to waive any of the inspection requirements in this Specification.

7.2.3 The Buyer shall be provided the opportunity to witness all NDE and the ASME hydrostatic test. He shall also witness the vessel fit-up prior to welding. The Buyer will also perform a final inspection coincidental with the hydrostatic test. The Seller shall not ship the vessel until authorized by the Buyer.

7.2.4 The Seller shall notify the Buyer at least seven working days prior to a required inspection of the vessel.

7.2.5 The Seller shall furnish all equipment, services, and utilities necessary for proper testing and inspection of the vessel.

7.2.6 All reinforcing pads shall be pneumatically tested at 25 psig. The test hole shall be left open after testing.

7.2.7 Test water used for hydrostatically testing austenitic stainless steel or nickel alloy vessels shall not contain more than 100 ppm of chloride ions.

7.2.8 Final acceptance shall be contingent upon satisfactory inspection at the Buyer's plant and after receipt and approval of all documentation required by this Specification and the purchase order.

8. PREPARATION FOR SHIPMENT

8.1 All fabrication debris shall be removed and all water thoroughly drained from the vessel.

8.2 The vessel surfaces shall be prepared and painted as indicated on the data sheet and/or drawing.

8.3 All openings shall be covered or plugged to prevent dust, dirt, or other foreign material from entering the vessel.

8.4 The vessel and any separate parts shall be suitably crated or skidded to prevent damage during handling and shipment.

8.5 The vessel and any separately packed items shall be clearly marked with the Buyer's purchase order number, project number, shipping weight, and destination.

9. SUBMITTAL REQUIREMENTS

9.1 GENERAL REQUIREMENTS

The Seller shall furnish the following approval and final data. Each document shall be clearly identified with the Buyer's purchase order number and project number.

9.2 APPROVAL DATA

9.2.1 Three complete sets of design calculations and fabrication drawings shall be submitted and one set returned approved by the Buyer before purchase of materials or fabrication. The Buyer's approval shall not relieve the Seller of his responsibility for the design, drawing accuracy, quality of workmanship, and conformance to this Specification.

9.2.2 If a method other than static is selected for seismic design, three copies of a detailed description must be submitted and approved before proceeding with the design calculations and drawings.

9.2.3 Three copies of a weld map indicating welding procedures and NDE method used for each pressure containing weld must be submitted and approved before start of fabrication.

9.2.4 ASME welding procedures and welder qualification records applicable to this project shall be available for review by the Buyer's inspector during his initial inspection and any subsequent inspections.

9.3 FINAL DATA

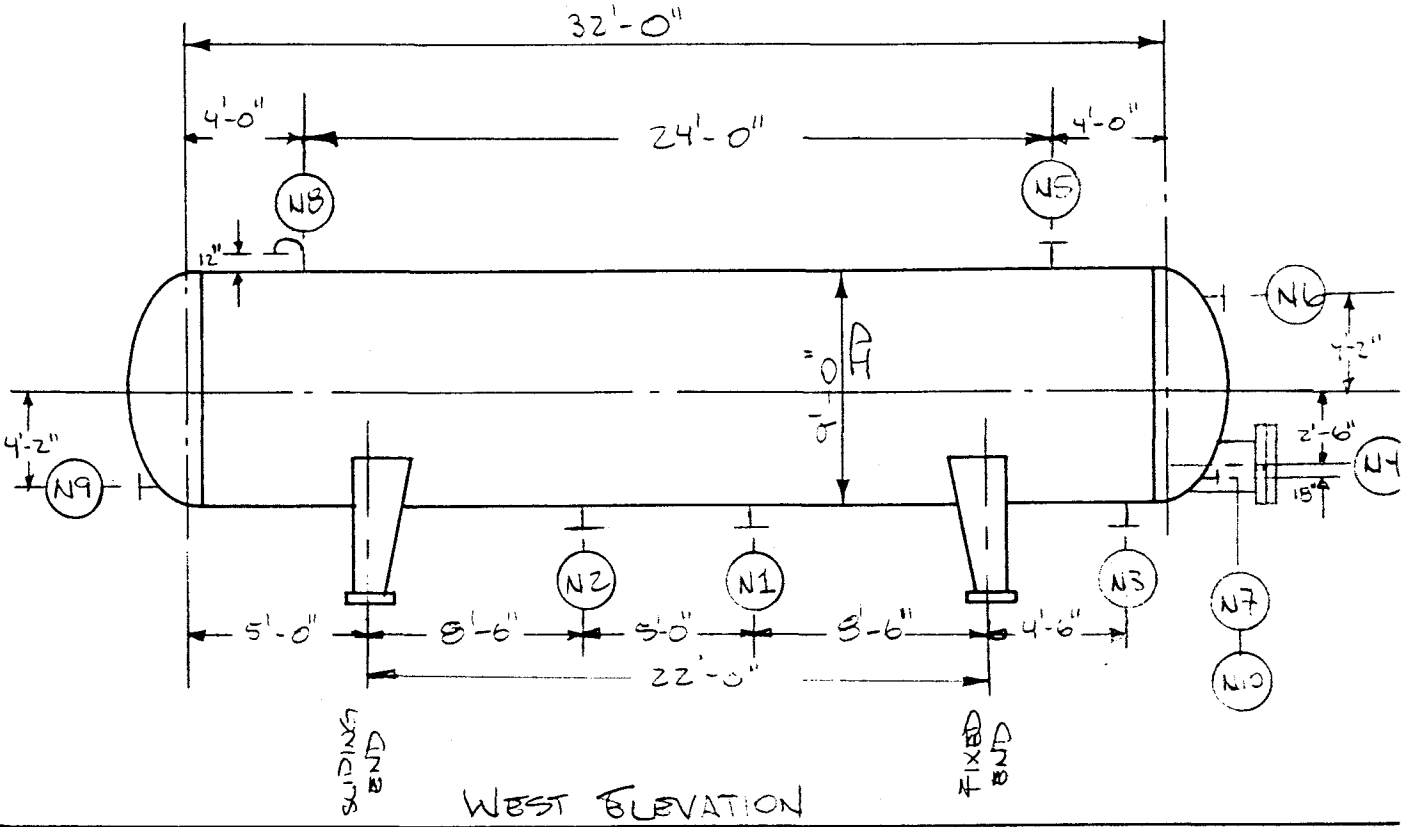
9.3.1 The following listed data shall be furnished as five separate booklets. Any pertinent data not listed shall also be included.

Five complete sets of "as-built" fabrication drawings and calculations.

1) Five sets of material mill test reports and/or certifications.
2) Five sets of all NDE test reports.
3) One set of radiographs (furnished in first booklet only).
4) Five weld maps.
5) Five ASME Manufacturer's Data Reports.
6) Five stress-relieving charts (if applicable).
7) Five sets of applicable welding procedures.
8) Five sets of applicable welder's qualifications.

REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION	REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION

NOTES: 1. Gaskets shall be Garlock Gylon Style 36-10 off white, 1/8" Thick.
2. Manufacturer shall supply manway cover and bolts.



WEST ELEVATION

DESIGN DATA

1. Operating Press at AMB °F ATM psig
2. Design Press at 150 °F 15 psig
3. Crsn Allow: Shell 1/16" Heads 1/16"
4. Code Stamp YES
5. Stress Relief _____ X-Rayed 100%
6. Materials
   - Shell SA 516-70
   - Head SA 516-70
   - Support SA 516-70
   - Bolts (Ext) SA 193 B7
   - Nuts SA 194 2H
   - Flanges SA-180
   - Couplings SA-180
   - Nozzle-Necks SA-106
   - Gaskets SEE NOTE
7. Fabricated Wt BY VENDOR lb
8. Operating Wt BY VENDOR lb
9. Test Wt BY VENDOR lb
10. Paint SEE SPECIFICATIONS
11. Insulation SUPPLIED SEPERATELY
12. Fireproofing NONE

NOZZLES AND COUPLINGS

Item	No.	Size	Rating	Facing	Service
	N1	2"	150#	RF	INLET
	N2	2"	150#	RF	OUTLET
	N3	2"	150#	RF	DRAIN
	N4	24"	150#	RF	MANWAY
	N5	6"	150#	RF	LEVEL INDICATORS
	N6	4"	150#	RF	OVERFLOW
	N7	1/2"	150#	RF	SAMPLING POINT
	N8	4"	150#	RF	VENT
	N9	5"	150#	RF	IMMERSION HEATER
	N10	1 1/2"	150#	RF	TEMPERATURE WELL

RMP DATA SHEET
THE RALPH M. PARSONS COMPANY

HORIZONTAL VESSEL-PROCESS
TANK T-201

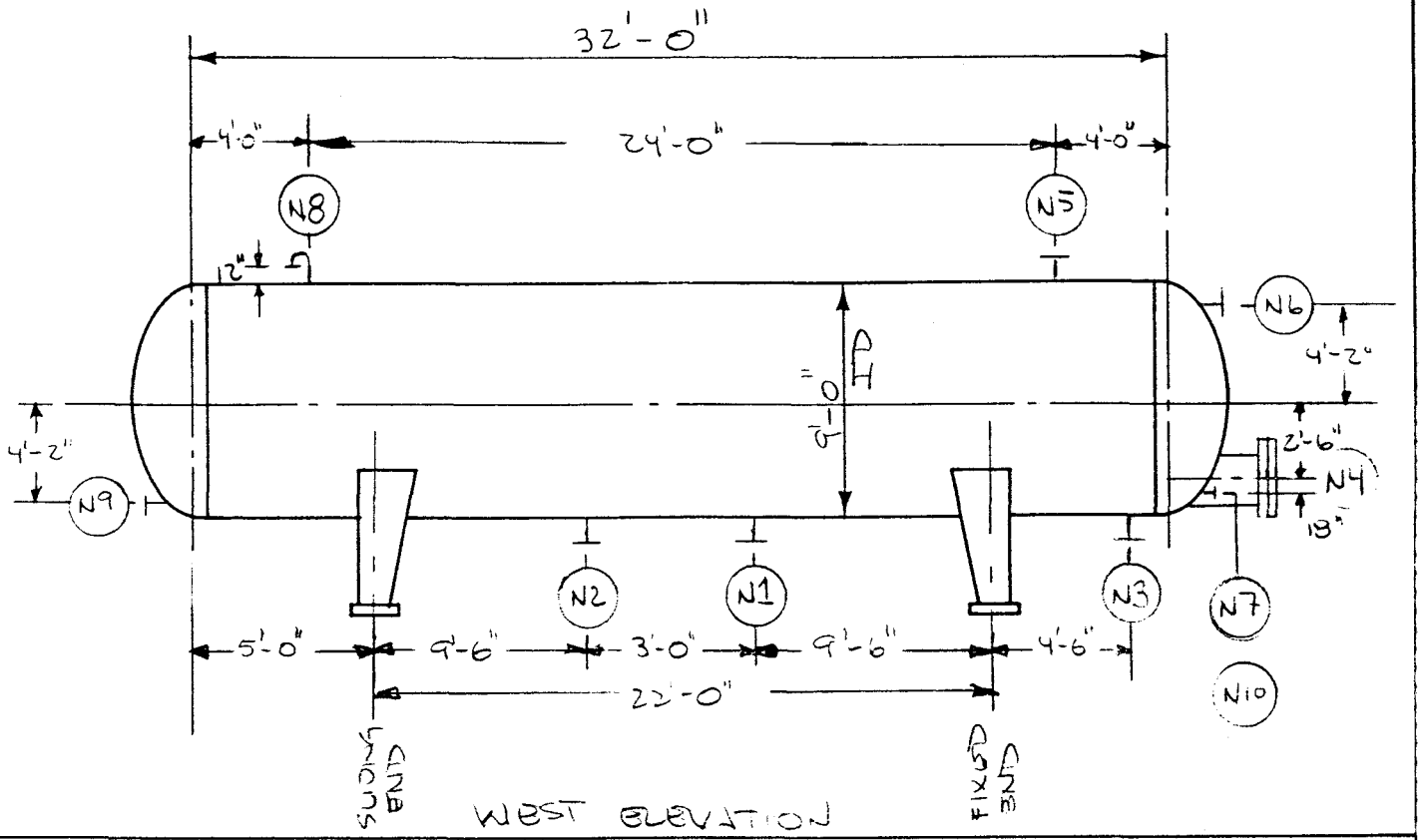
SHEET 7 OF 10 | JOB NUMBER | DOCUMENT NUMBER | REV

ENG-VS-200 DC-

REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION

REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION

NOTES: 1. Gaskets shall be Garlock Gylon Style 36-10 off white, 1/8" THICK.
2. Manufacturer shall supply manway cover and bolts.



WEST ELEVATION

DESIGN DATA

1. Operating Press at AMB °F ATM psig
2. Design Press at 150 °F 15 psig
3. Crsn Allow: Shell 1/16" Heads 1/16"
4. Code Stamp YES
5. Stress Relief _____ X-Rayed 100%
6. Materials
   - Shell SA 516-70
   - Head SA 516-70
   - Support SA 516-70
   - Bolts (Ext) SA 193 B7
   - Nuts SA 194 2H
   - Flanges SA 180
   - Couplings SA 180
   - Nozzle-Necks SA 106
   - Gaskets SEE NOTE
7. Fabricated Wt BY VENDOR lb
8. Operating Wt BY VENDOR lb
9. Test Wt BY VENDOR lb
10. Paint SEE SPECIFICATIONS
11. Insulation SUPPLIED SEPERATELY
12. Fireproofing NONE

NOZZLES AND COUPLINGS

Item	No.	Size	Rating	Facing	Service
	N1	2"	150#	RF	INLET
	N2	2"	150#	RF	OUTLET
	N3	2"	150#	RF	DRAIN
	N4	24"	150#	RF	MANWAY
	N5	6"	150#	RF	LEVEL INDICATORS
	N6	4"	150#	RF	OVERFLOW
	N7	1/2"	150#	RF	SAMPLING POINT
	N8	4"	150#	RF	VENT
	N9	5"	150#	RF	IMMERSION HEATER
	N10	1 1/2"	150#	RF	TEMPERATURE WELL

RMP DATA SHEET
THE RALPH M. PARSONS COMPANY

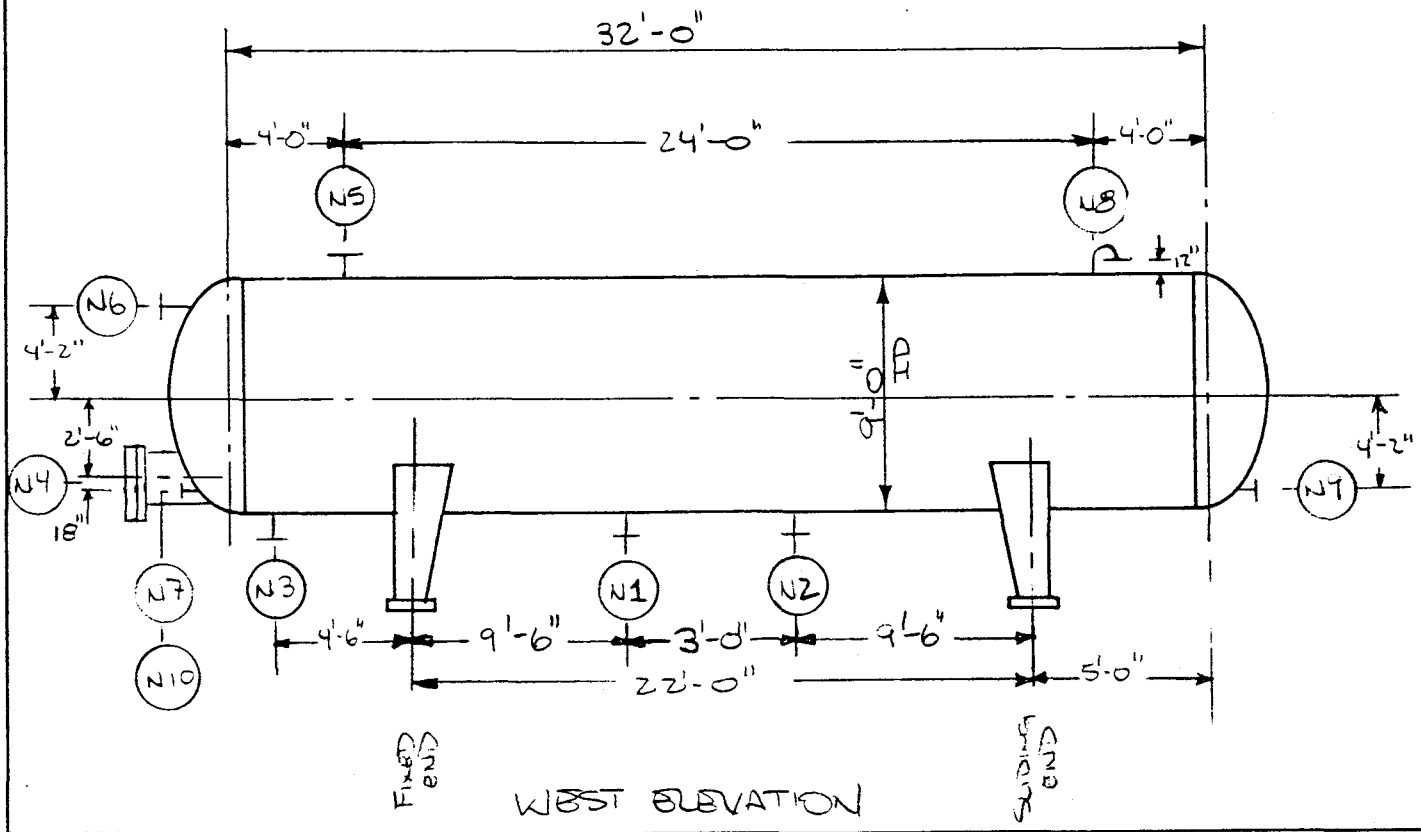
HORIZONTAL VESSEL-PROCESS
TANK T-202

SHEET 8 OF 10
JOB NUMBER
DOCUMENT NUMBER
REV

ENG-VS-200
DC-

REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION	REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION

NOTES: 1. Gaskets shall be Garlock Gylon Style 36-10 off white, 1/8" thick.
2. Manufacturer shall supply manway cover and bolts.



WEST ELEVATION

DESIGN DATA

1. Operating Press at AMB °F ATM psig
2. Design Press at 150 °F 15 psig
3. Crsn Allow: Shell 1/16" Heads 1/16"
4. Code Stamp YES
5. Stress Relief _____ X-Rayed 100%
6. Materials
   - Shell SA 516-70
   - Head SA 516-70
   - Support SA 516-70
   - Bolts (Ext) SA 193 B7
   - Nuts SA 194 2H
   - Flanges SA 180
   - Couplings SA 180
   - Nozzle-Necks SA 106
   - Gaskets SEE NOTE
7. Fabricated Wt BY VENDOR lb
8. Operating Wt BY VENDOR lb
9. Test Wt BY VENDOR lb
10. Paint SEE SPECIFICATIONS
11. Insulation SUPPLIED SEPERATELY
12. Fireproofing NONE

NOZZLES AND COUPLINGS

Item	No.	Size	Rating	Facing	Service
	N1	2"	150#	RF	INLET
	N2	4"	150#	RF	OUTLET
	N3	2"	150#	RF	DRAIN
	N4	24"	150#	RF	MANWAY
	N5	6"	150#	RF	LEVEL INDICATORS
	N6	4"	150#	RF	OVERFLOW
	N7	1/2"	150#	RF	SAMPLING PORT
	N8	4"	150#	RF	VENT
	N9	5"	150#	RF	IMMERSION HEATER
	N10	1 1/2"	150#	RF	TEMPERATURE WELL

RMP DATA SHEET
THE RALPH M. PARSONS COMPANY

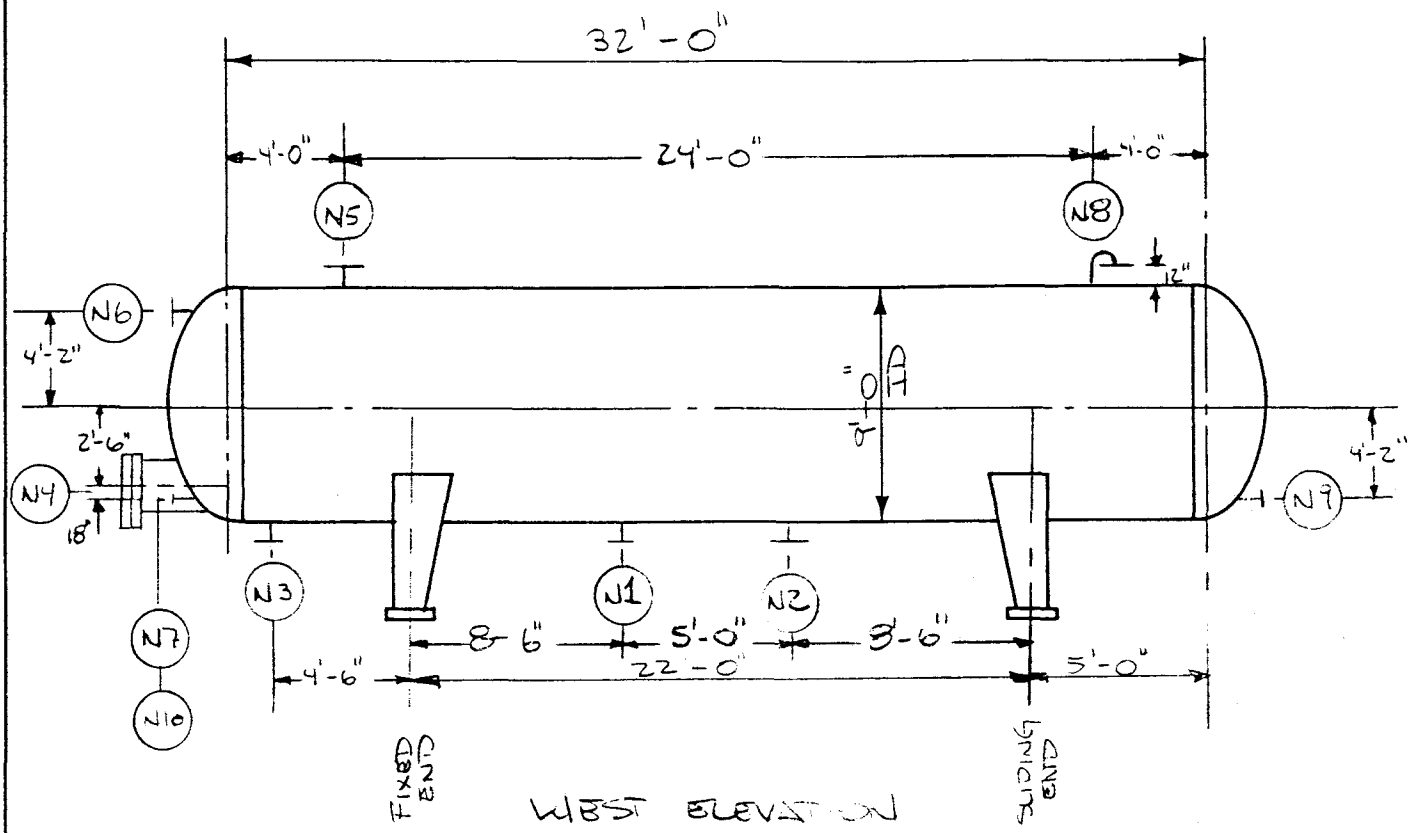
HORIZONTAL VESSEL-PROCESS
TANK T-203

SHEET 9 OF 10 | JOB NUMBER | DOCUMENT NUMBER | REV

ENG-VS-200 DC-

REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION	REVISIONS	NO.	DATE	BY	CK	APP	DESCRIPTION

NOTES: 1. Gaskets shall be Garlock Gylon Style 3510 off white, 1/8" Thick.
2. Manufacturer shall supply manway cover and bolts.



WEST ELEVATION

DESIGN DATA

1. Operating Press at AMB °F ATM psig
2. Design Press at 150 °F 15 psig
3. Crsn Allow: Shell 1/16" Heads 1/16"
4. Code Stamp YES
5. Stress Relief _____ X-Rayed 100%
6. Materials
   - Shell SA 516-70
   - Head SA 516-70
   - Support SA 516-70
   - Bolts (Ext) SA 193 B7
   - Nuts SA 194 2H
   - Flanges SA-180
   - Couplings SA-180
   - Nozzle-Necks SA-106
   - Gaskets SEE NOTE
7. Fabricated Wt BY VENDOR lb
8. Operating Wt BY VENDOR lb
9. Test Wt BY VENDOR lb
10. Paint SEE SPECIFICATIONS
11. Insulation SUPPLIED SEPERATELY
12. Fireproofing NONE

NOZZLES AND COUPLINGS

Item	No.	Size	Rating	Facing	Service
	N1	2"	150#	RF	INLET
	N2	4"	150#	RF	OUTLET
	N3	2"	150#	RF	DRAIN
	N4	24"	150#	RF	MANWAY
	N5	6"	150#	RF	LEVEL INDICATORS
	N6	4"	150#	RF	OVERFLOW
	N7	1/2"	150#	RF	SAMPLING POINT
	N8	4"	150#	RF	VENT
	N9	5"	150#	RF	IMMERSION HEATER
	N10	1 1/2"	150#	RF	TEMPERATURE WELL

RMP DATA SHEET
THE RALPH M. PARSONS COMPANY

HORIZONTAL VESSEL-PROCESS
TANK T-204

SHEET	OF	JOB NUMBER
10	10	

DOCUMENT NUMBER	REV

ENG-VS-200 DC-

SPECIFICATION

FOR AN

ULTRAVIOLET LIGHT/HYDROGEN PEROXIDE

TREATMENT UNIT

1. SCOPE

1.1 This specification covers the design, fabrication, and performance requirements for an ultraviolet light (UV)/hydrogen peroxide (H_2O_2) treatment unit.

1.2 The Seller shall be responsible for the engineering, design, construction, shipping, assembling, testing, and performance of all equipment furnished.

2. GENERAL REQUIREMENTS

2.1 The equipment shall include all components necessary for a complete operating unit even though the components may not be identified in this specification.

2.2 All components shall be new, free of defects or mechanical damage, and in operating condition.

2.3 Equipment performance shall be rated at 6,000 feet above sea level.

2.4 Manuals, instructions, labels, controls, and any other printed material shall be in English.

2.5 Codes and standards shall be those in effect on the date of the order.

3. PRELIMINARY TEST AND FINAL ACCEPTANCE

3.1 A preliminary inspection and performance test shall be performed at the Seller's plant to verify that the requirements set forth in this specification exclusive of Section 7, have been met. The Seller shall furnish the support equipment, services and utilities necessary to performance test

his equipment. The tests shall include an operational check of each component and a demonstration of overall performance.

3.2 A representative of the Buyer shall be present to witness all phases of the preliminary tests and inspect the equipment. The Seller shall notify the Buyer at least seven (7) working days before the equipment will be ready for preliminary testing.

3.3 Final acceptance shall be contingent upon satisfactory testing at the point of installation in accordance with the provisions of Section 11 "Acceptance and Testing" to demonstrate that the equipment conforms to the specifications.

4. PACKAGING AND SHIPPING

Package and protect equipment to prevent physical damage and environmental damage during shipping or handling. Protect machined surfaces from rust. Drain fluids and blow lines dry before packaging. Plug fluid and lubrication terminations to exclude moisture, dust, dirt, or other foreign material. Contractor is responsible for unloading prior to installation.

5. DESCRIPTIVE SUBMITTALS

5.1 Submit for Buyer's approval, catalog data; equipment and material lists; elementary diagrams; wiring diagrams; installation isntructions; maintenance manuals and instructions; and operation brochures for equipment and materials listed in Section 5.7 of this specification within the time limits indicated on the purchase order.

5.2 Submit engineering data and shop drawings for approval before fabrication begins and show in sufficient detail for the Buyer to examine Seller's conformance to the design concept, arrangement and general construction set forth in these specifications. Catalogs submitted shall have clearly identified capacities and specified parameters relating to this specification with unrelated pages removed. One set of

shop drawings will be promptly returned by the Buyer with comments or with approval. Buyer's approval shall not relieve the Seller of responsibility for the design accuracy of the drawings, quality of workmanship, and performance to specification of this equipment.

5.3 Provide final drawings in reproducible form. Identify drawings with the equipment builders drawing title and number, and equipment or job order number.

5.4 Define installation requirements so the Buyer can prepare the installation site before receiving equipment. Describe electric power service, utility, piping, floor loading, and foundation requirements, as applicable, by schematic diagrams, connection details, layouts, and instructions.

5.5 Operating and maintenance instructions shall explain operating theory and provide step-by-step instructions for preventive maintenance to ensure safe operation and long life. Instructions shall include lubrication schedules and block and schematic diagrams to describe trouble-shooting diagnoses with corrective action for malfunctions and schedules for frequency of maintenance checks.

5.6 Instructions shall be in English, written in terms easily understood by operating and maintenance techicians, and bound into a properly identified manual.

5.7 The minimum list of submittals required shall be as indicated below.

5.7.1 <u>Preliminary Engineering Data and Shop Drawings</u>

1) Photographs, dimensional outlines, assembly drawings, and general arrangements.

2) Overall dimensions, total weight, weight distribution, capacities.

3) Weight and size of largest component to be shipped.

4) Recommended access and clearance data.

5) Service connections, utility requirements, electrical wiring diagrams.

6) Preliminary equipment list.

7) Motor data.

8) Copy of performance test procedure.

5.7.2 Installation Data and Instructions

1) Recommended method of leveling and anchoring.

2) Anchor bolt layout and sizes.

3) Electrical power requirements (location, size and type).

4) Detailed equipment and material lists.

5) Assembly drawings and details.

6) Installation instructions.

5.7.3 Final Data, Operating and Maintenance Instructions

1) Factory performance data, characteristics, and curves.

2) Complete parts lists, including on hand spare parts recommended, and price list.

3) Final drawings including sectional or exploded views, showing all parts.

4) Final motor data.

5) Final operating and maintenance instructions, manuals, and electrical diagrams.

5.8 Five copies of all submittals shall be sent under separate cover identified by the Buyer's purchase order number. Each submittal shall include a contact name and telephone number for each component supplier. Buyer will not be responsible for recovery of such material packed with the equipment.

5.9 Submittal Schedule

1) Paragraph 5.7.1 materials shall be submitted with bid.

2) Paragraph 5.7.2 materials shall be submitted within 5 calender days following notice of award by Buyer.

3) Paragraph 5.7.3 materials shall be submitted at the time of equipment delivery to site.

6. PHYSICAL AND ENVIRONMENTAL LIMITATIONS

6.1 The UV/H202 unit will be housed in an existing building, Building 830.

6.2 The attached figure, Figure 1, indicates the available floor area for the Seller's equipment. Both areas 1 and 2 may be used. The Seller shall include a suggested equipment layout and dimensions of major pieces of equipment with his/her bid.

6.3 The maximum roof height in area 1 is 12.5 feet along the building centerline. This height drops to 10 feet at the walls.

6.4 The maximum roof height in area 2 is 9.5 feet at the common wall with area 1. This height drops to 8.5 feet at the opposite wall.

6.5 Access to area 1 is through double doors with an approximate opening of 8 feet wide by 7.5 feet high. Access to area 2 is limited to a door with an approximate opening of 3 feet wide by 6 feet high. Additional access to both areas is possible. The Seller shall indicate the size of such an opening, if necessary, with his/her bid.

6.6 Both areas 1 and 2 are protected from wind, rain, and snow. However, current plans for these areas do not include provision for additional heating. Therefore, the Seller shall provide in his design the ability of the equipment to not only operate at temperatures down to -20 degrees Fairenheit, but also the provision, via a programmable controller as noted in Paragraph 9.2.4, to automatically drain the unit upon shutdown in freezing conditions , if required, and to refill the unit, restart the lamps and bring them up to full power and restart the unit under similar conditions.

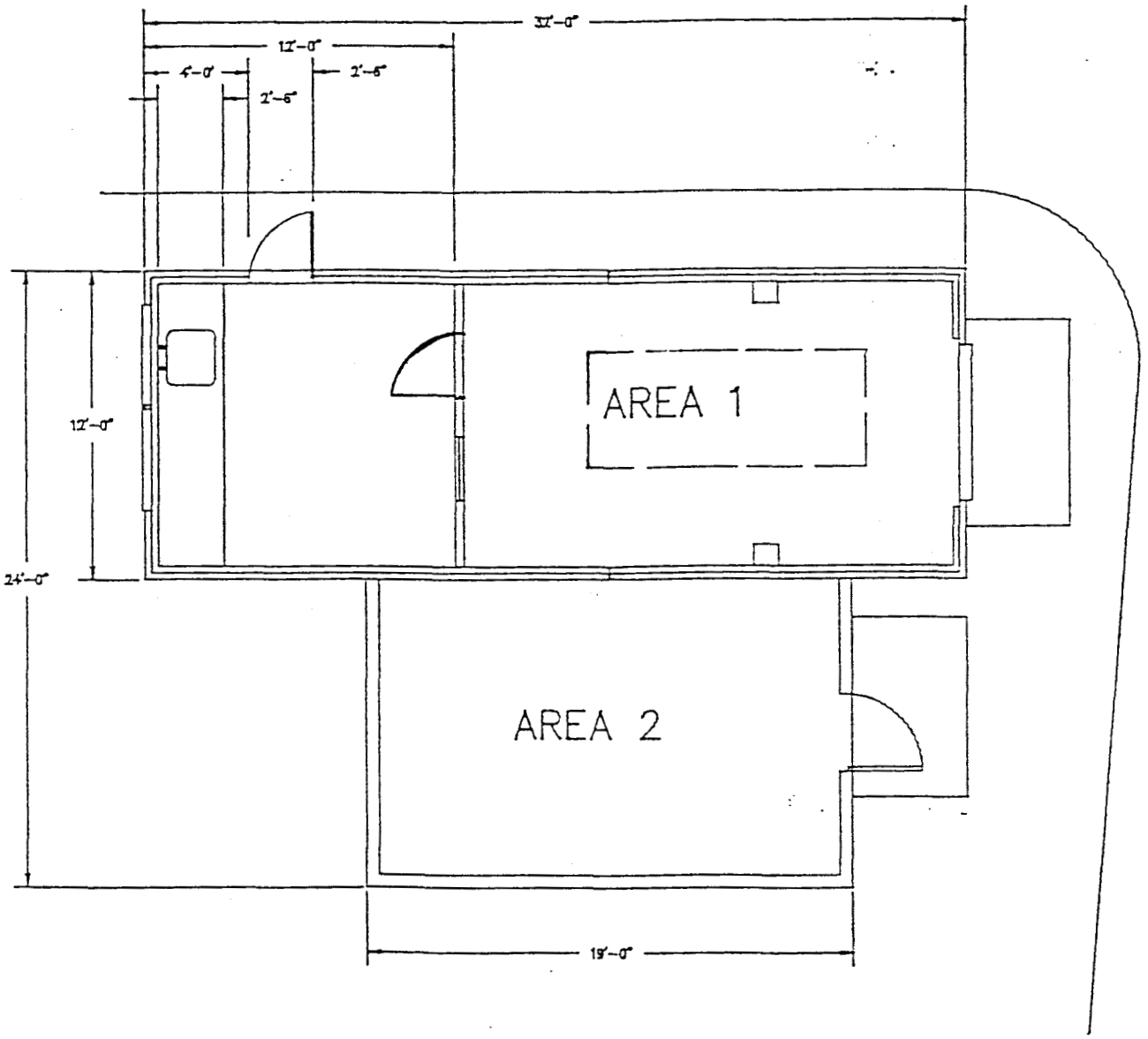


FIGURE 1

7. PERFORMANCE REQUIREMENTS

7.1 The UV/H2O2 treatment unit shall be capable of the chemical oxidation and destruction of toxic organic contaminants in water.

7.2 The expected composite concentrations of organic compounds in the feedstream to the UV/H2O2 treatment unit are as follows.

Compound	Composite Concentration (ug/l)
Trichloroethene	1216
Tetrachloroethene	344
1,1-dichloroethene	930
1,2-trans-dichloroethene	158
1,1-dichloroethane	7
1,2-dichloroethane	6
1,1,1-trichloroethane	943
1,1,2-trichloroethane	7
Chloroform	5
Carbon Tetrachloride	93
Methylene Chloride	15
Toluene	10

The treatment unit shall be capable of treating influent waters with individual concentrations ranging from 25% to 150% of the values shown.

7.3 Other anticipated feedstream characteristics are as follows.

1) Feedwater stream may range from 32 degrees to 130 degrees Fairenheit.

2) The expected pressure at the influent to the treatment unit is 9 psig plus the head loss through the Sellers equipment at maximum flow. Influent pressure may range from 9 to 25 psi and the Seller shall provide any required pressure reducing system or valve as an integral part of the supplied system.

7.4 The expected composite concentration of other elements and ions in the feedstream to the UV/H2O2 treatment unit are as follows.

Element	Composite Concentration (mg/l)	Ion	Composite Concentration (mg/l)
Al	0.06	Ca	125
Ba	0.13	Mg	19
Cu	0.01	K	4
Fe	0.06	Na	120
Mn	0.14	HCO_3	278
Ni	0.09	Cl	141
Se	0.06	NO_3	6
Sr	0.97	SO_3	154
Zn	0.06	TDS	803
		Oil and Grease	6
		TSS	6

The system shall be capable of successful operation with influent having individual concentrations ranging between 0 mg/l and those indicated in the following table.

7.5 Required treated effluent concentrations from the UV/H202 treatment unit shall be less than the proposed Colorado Drinking Water Standards as follows.

Compound	Limit (ug/l) EPA Method 8010
Trichloroethene	2.7
1,2-dichloroethane	0.94
1,1,1-trichloroethane	200
1,1,2-trichloroethane	0.06
Chloroform	0.19

7.6 The UV/H202 treatment unit shall meet the criteria defined above at a design maximum sustained flowrate of 30 gallons per minute.

7.7 The UV/H202 treatment unit shall have a turn-down capability of 3:1. Unit inflow will be a function of influent pumping conditions, i.e. two speed pumps, and not a responsibility of Seller. However, the unit must be capable of sensing and determining the influent flow if it is required for proper system operation and to meet turndown requirements.

8. APPLICABLE PUBLICATIONS

The following specifications and standards of issues listed in this paragraph (including the amendments, addenda, and errata designated), but referred to hereinafter by basic designation only, form a part of this specification to the extent required by the references thereto. If this specification is in conflict with the referenced documents, this specification takes preference.

8.1 American National Standards Institute (ANSI)

ANSI-TI-1A Practices for Nondestructive Testing Personnel Qualification and Certification

8.2 American Welding Society (AWS)

AWS D1.1 Structural Welding Code

8.3 American Society of Mechanical Engineers (ASME)

ASME Boiler and Pressure Vessel Code, Section VIII	Pressure Vessels, Division 1
Section IX	Welding and Brazing Qualifications
ASME/ANSI B31	Code for Pressure Piping

8.4 National Electrical Manufacturers Association (NEMA)

MG-1-1978 (including Rev. 1 through 7)	Motors and Generators
MG-2	Safety Standards for Construction and Guide for Selection, Installation and Use of Electrical Motors and Generators

8.5 Steel Structures Painting Council (SSPC)

SP-2 Hand tool cleaning

SP-3 Power tool cleaning

SP-6 Sandblasting

9. MATERIAL AND EQUIPMENT

9.1 General

9.1.1 The UV/H202 treatment unit shall consist of two modules. One shall be a UV reactor module and the second a peroxide storage/feed module.

9.1.2 Both modules shall be shipped pre-piped and pre-wired. Seller is responsible for supplying all inter-skid piping and wiring to provide a fully functional and operating system.

9.1.3 Items to be provided by the Owner include the following.

1) Building 830 with concrete foundations.

2) Electric power to the Sellers main control panel. Power will be 480 V 3-phase.

3) Contaminated water piping to the Sellers influent connection at the conditions detailed in Section 7. The reactor vessel shall comply with ASME specifications for 15 psi and the Seller is to provide pressure reduction in accordance with paragraph 7.3.

4) Treated water piping to the sellers effluent connection.

9.2 UV Reactor Module

9.2.1 UV Lamps

1) The module shall contain the appropriate number of lamps to meet the requirements of Section 7.

2) All lamps shall be horizontally or vertically mounted within quartz sheaths to prevent contact with water and to allow lamp removal and inspection without having to drain the reactor.

3) Lamp seals shall be of materials compatible with the expected feedstream composition.

9.2.2 Reactor (Oxidation Chamber)

1) The reactor shall be of sufficent size to allow the necessary residence time for the destruction of toxic organics to meet the requirements of Section 7.

2) The interior of the reactor shall be suitably baffled to allow complete mixing of solutions and to prevent short circuiting.

3) The reactor shall be of Type 304 or 316 stainless steel welded construction. If the expected operating pressure within the reactor will be in excess of 15 psig, the ASME Boiler and Pressure Vessel Code shall apply to design and fabrication. All components within the reactor shall be of materials compatible with the expected feedstream composition and shall be resistant to prolonged exposure to UV light.

4) Connections shall be provided for process influent and effluent, influent and effluent sampling, and a low point drain.

5) The reactor shall have provisions for protection from over-pressurization.

9.2.3 Piping

1) All piping shall be of Type 304 or 316 Schedule 40 stainless steel or Schedule 80 PVC construction.

2) All valves shall be of the same material as the piping system which it is a part of. All valve seats and seals shall be of fluoroelastomer materials.

3) Piping fabrication methods shall be consistent with the materials of construction and expected service conditions. Pressure piping rated at greater than 15 psig shall comply with the requirements of the ASME/ANSI Pressure Piping Code.

4) All gaskets shall be of fluoroelastomer materials suitable for intended use.

5) All piping and valves shall be designed for ease of operation and maintenance.

6) All final connections, i.e. process influent and effluent connections, vent, sample, and drain lines, shall be threaded (NPT) or flanged.

9.2.4 Instrumentation, Controls, and Alarms

1) Instruments, controls, alarms and indicating alarms (alarms with integral indicating light) shall be industrial grade equipment from established manufacturers; state of the art type instruments shall be provided.

2) All electrical and instrument enclosures shall be NEMA 12.

3) All wiring shall be in accordance with the National Electric Code.

4) Instruments, controls, and alarms shall include the following.

   a) Reactor high temperature indicating alarm and shut-off.

   b) Lamp drive unit high temperature indicating alarm and shut-off.

   c) Reactor and lamp drive unit temperature gauges.

   d) Reactor high pressure indicating alarm and shut-off.

   e) Reactor pressure gauge.

   f) Lamp end enclosure moisture indicating alarm and shut-off.

   g) Flow rate indication and total.

   h) Low flow indicating alarm and shut-off.

   i) Influent tank low level indicating alarm and shut-off. The probes and control signal lines will be provided by others. The interface for the closure switches shall be 4-20 ma control loops.

j) Effluent tank high level indicating alarm and shut-off. The probes and control signal lines will be provided by others. The interface for the closure switches shall be 4-20 ma control loops.

k) Shut-off due to opening of lamp access panel.

l) Run time meter to indicate hours of unit operation.

m) Individual lamp amperage readout and total amperage readout.

n) Individual or lamp bank on/off controls.

o) Influent tank selector switch and indicator light to activate appropriate low level signal discussed in item (i).

p) Relay, normally open, that will close upon any alarm condition. The contact shall be used by the Buyer to activate an automatic dialer system.

q) Programmable controller to stop and restart the unit.

r) Solenoid shutoff valve, closed when system is off, to prevent gravity flow of water.

s) Flow control valve adjustable from 5-40 gpm.

5) A relay, normally closed in the on condition, shall be provided to indicate pump shut-off conditions which may be used to control pumps via the MCC which is to be provided by the Contractor.

6) The controls for the peroxide storage/feed module shall be interlocked with the reactor module control panel such that the peroxide module operates in conjunction with the reactor module.

9.2.5 Structural Frames

1) Structural framing shall be of welded carbon steel construction.

2) The framing shall be designed to evenly distribute the weight of the modules components.

3) The module framework shall be designed such that the unit may be picked up by either forklift or overhead crane.

9.2.6 Finish

1) Stainless steel finish shall be 2B bright mill finish.

2) Ungalvanized ferrous (carbon) steel surfaces shall be cleaned using SSPC - SP-6 (Sandblasting), SP-3 (Power Tool Cleaning) or SP-2 (Hand Tool Cleaning). Surface shall be free of any rust or dirt prior to application of coating. Coating shall consist of one of the following three alternatives:

a) AMERCOAT ALTERNATE. Prime coat Amercoat 185 (3 mil). Finish coats (minimum of 2) Amercoat 5401 (3 mils total). Total thickness of system 6 mils.

b) ENGARD ALTERNATE. Prime coat Engard 126 (3 mils). Finish coats (minimum of 2) Engard 222 (3 mils total). Total thickness of system 6 mils.

c) KOPPERS ALTERNATE. Prime coat Koppers 622 HB (3 mills). Finish coats (minimum of 2) Koppers 501 (3 mils total). Total thickness of system 6 mils.

9.2.7 Welding

1) Welding shall be in accordance with AWS procedures or an approved alternate. All procedures shall be submitted to the Buyer for approval prior to the start of welding.

2) If the reactor vessel is fabricated in accordance with ASME Boiler and Pressure Vessel Code, per paragraph 9.2.2. The welding requirements of ASME Section IX shall apply. In this case, welders and welding operators shall be currently qualified in accordance with the code for the materials and process to be used.

9.3 Peroxide Storage/Feed Module

9.3.1 Peroxide Tank

1) The tank shall store 50% hydrogen peroxide.

2) The peroxide tank shall be sized to provide one months storage capacity.

3) The peroxide tank shall be cross linked high density polyethylene with UV inhibitors.

9.3.2 Metering Pumps

1) Two metering pumps for feeding peroxide to the reactor module shall be provided.

2) Metering pumps are to be diaphragm pumps. One metering pump shall be active and the second shall be standby. Each pump shall be capable of meeting system requirements. The peroxide feed rate and hence the metering pumps shall be either flow proportional or peroxide residual paced and shall not be constant feed independent of flow or residual.

3) Pumps must be capable of pumping up to 50% peroxide solutions over the entire range of concentrations that are required to meet the performance requirements in Section 7.

4) All pump materials shall be compatible with the solutions being pumped.

5) Approved pump manufacturers include Milton Roy, BIF, and Wallace-Tiernan.

9.3.3 Piping

1) Items 1 through 5 in Section 9.2.3 apply to this module.

2) Interconnecting piping between the two modules shall be type 304 or 316 stainless steel tubing or Schedule 40 pipe or Schedule 80 CPVC pipe.

3) Overpressure protection for piping shall be provided.

9.3.4 Instrumentation, Controls, and Alarms

1) Items 1 through 3 in Section 9.2.4 apply to this module.

2) Instruments, controls, and alarms shall include the following.

a) On/off/auto switches for each pump.

b) In the auto mode, the pumps shall be controlled from the UV reactor module.

9.3.5 Structural Frames

These requirements are the same as Section 9.2.5.

9.3.6 Finish

These requirements are the same as Section 9.2.6.

9.3.7 Welding

These requirements are the same as Section 9.2.7.

10. TEST REQUIREMENTS

10.1 All electrical systems shall be factory tested.

10.2 All controls, indicators, and alarms shall be factory tested.

10.3 Reactor welds shall be inspected in accordance with the appropriate welding codes and hydrostatically tested at 50 psi for 30 minutes with no leaks allowed. Where leaks are found, the joints shall be rewelded, flanged tightened, seals replaced, or other corrective measures taken and retested until no leakage is observed. Mastic or caulking compound shall not be used to stop leaks.

10.4 All pumps and piping shall be hydrostatically tested at 1.5 times the design pressure for 30 minuts with no leaks allowed. Where leaks are found, the joints shall be rewelded, flanged tightened, seals replaced, or other corrective measures taken and retested until no leakage is observed. Mastic or caulking compound shall not be used to stop leaks.

11. INSTALLATION AND START-UP ASSISTANCE

11.1 The Seller shall supply onsite supervision for the placement and installation of the UV/H202 treatment unit. It should be assumed that the site (i.e. Building 830) will be ready when the unit is shipped and that these activities will require 5 working days.

11.2 Once installation is completed, an acceptance test shall be run. Acceptance shall be contingent upon the unit treating up to 15,000 gallons of water with a minimum on line factor of 90 percent to the specifications discussed in Section 7. The Seller shall be notified at least 5 days in advance of the schedule for the test.

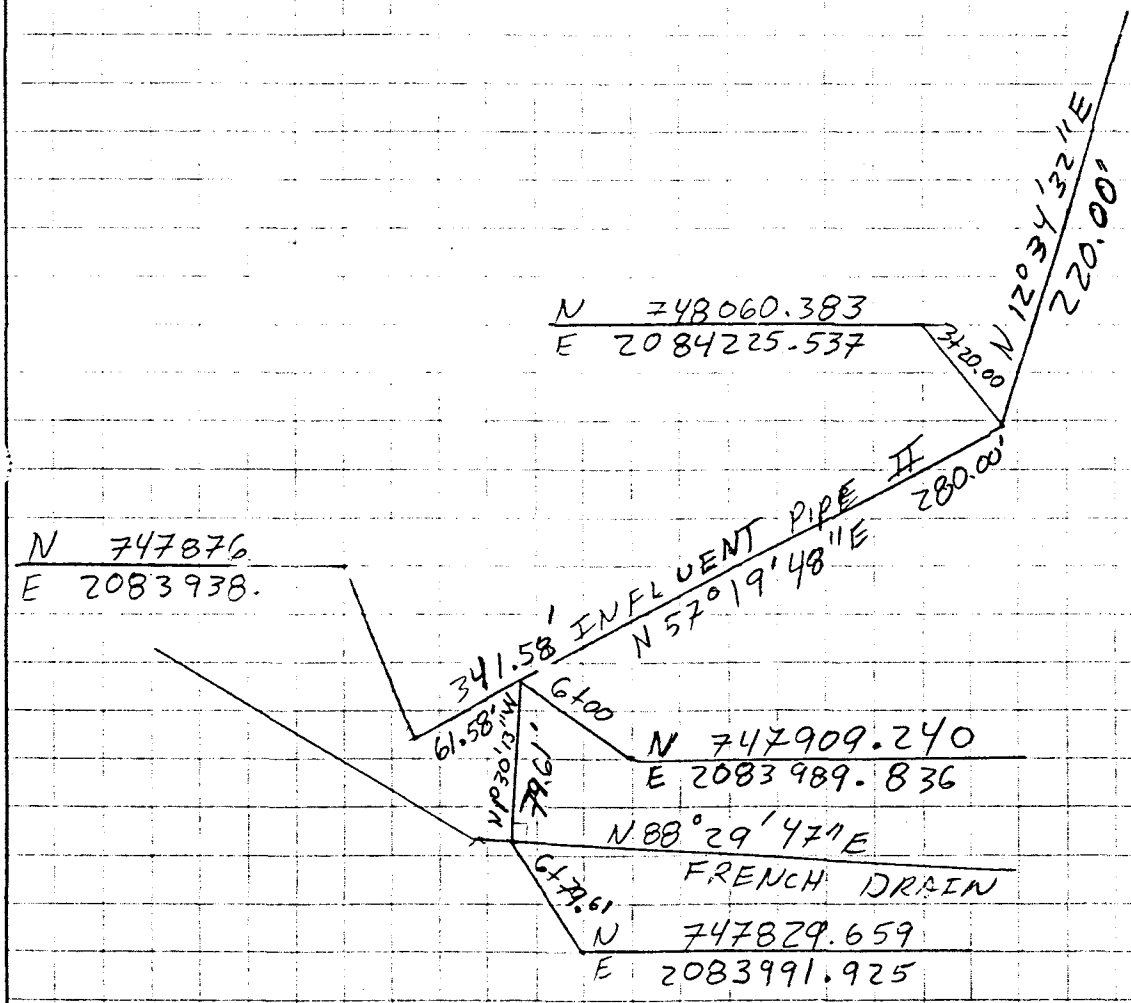
11.3 The Owner shall provide analytical services for water samples taken during the acceptance testing. If difficulties attributable to equipment provided by the Seller necessitate additional periods of acceptance testing, the Seller shall be responsible for costs of additional analytical services.

11.4 Once the unit is accepted, the Seller shall provide two consecutive days of onsite operator training.

SECTION 4
CALCULATIONS

ENGINEERING-SCIENCE

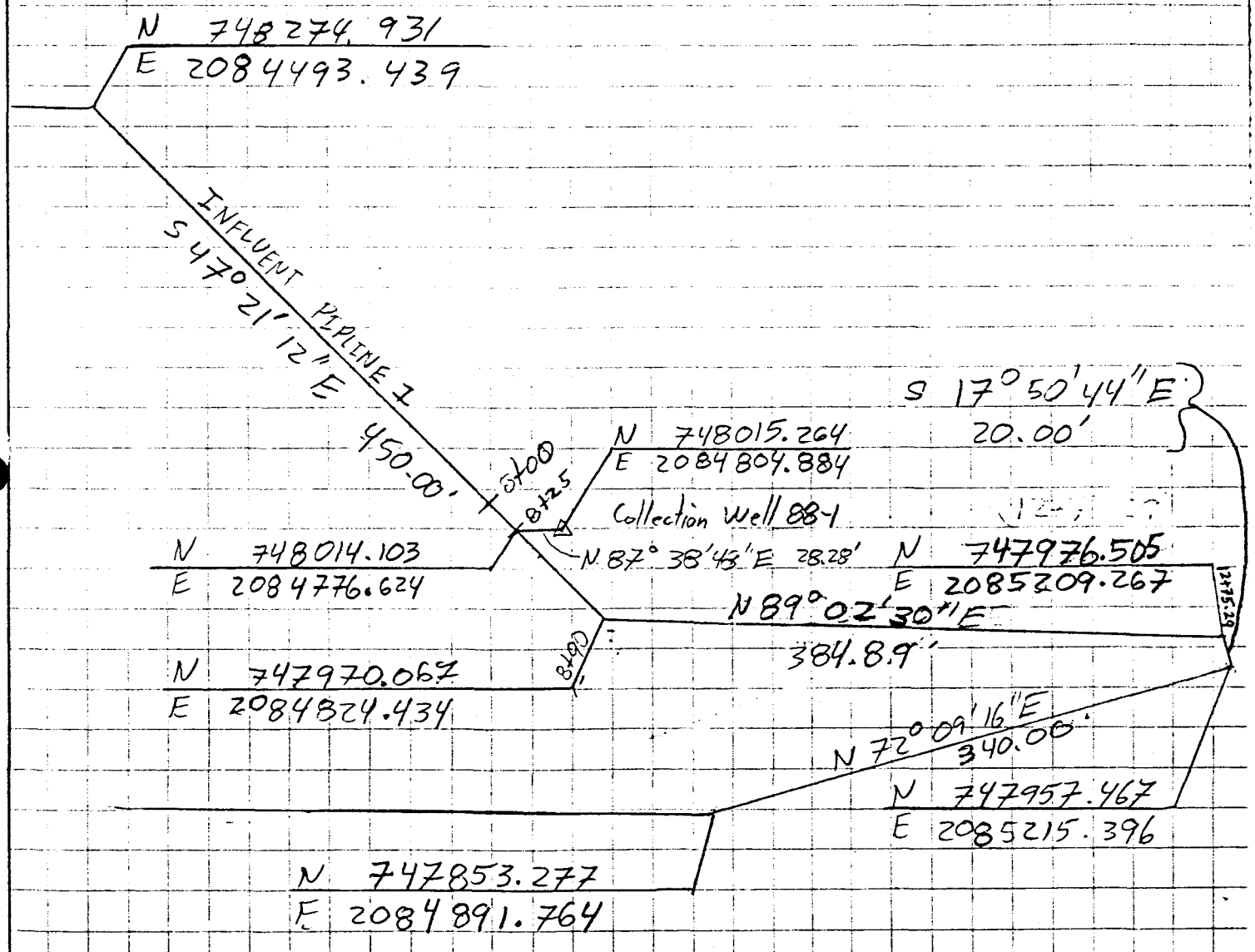
Client: Rocky Flat.
Subject: Relocate Influent Pipe II & Bldg 881 Drain line
Job No. DE075.01
By: CWT
Checked: GSH
Sheet 1 of 1
Date 8/3/88
Rev.



ES-COR-8 (5/88)

ENGINEERING-SCIENCE

Client: Rocky Flats
Subject: Relocat Influent Pipe I And Collection Well 88-1
Job No. DE075.07
By: CWT
Checked: GJH
Sheet 1 of 1
Date: 8/3/88
Rev.



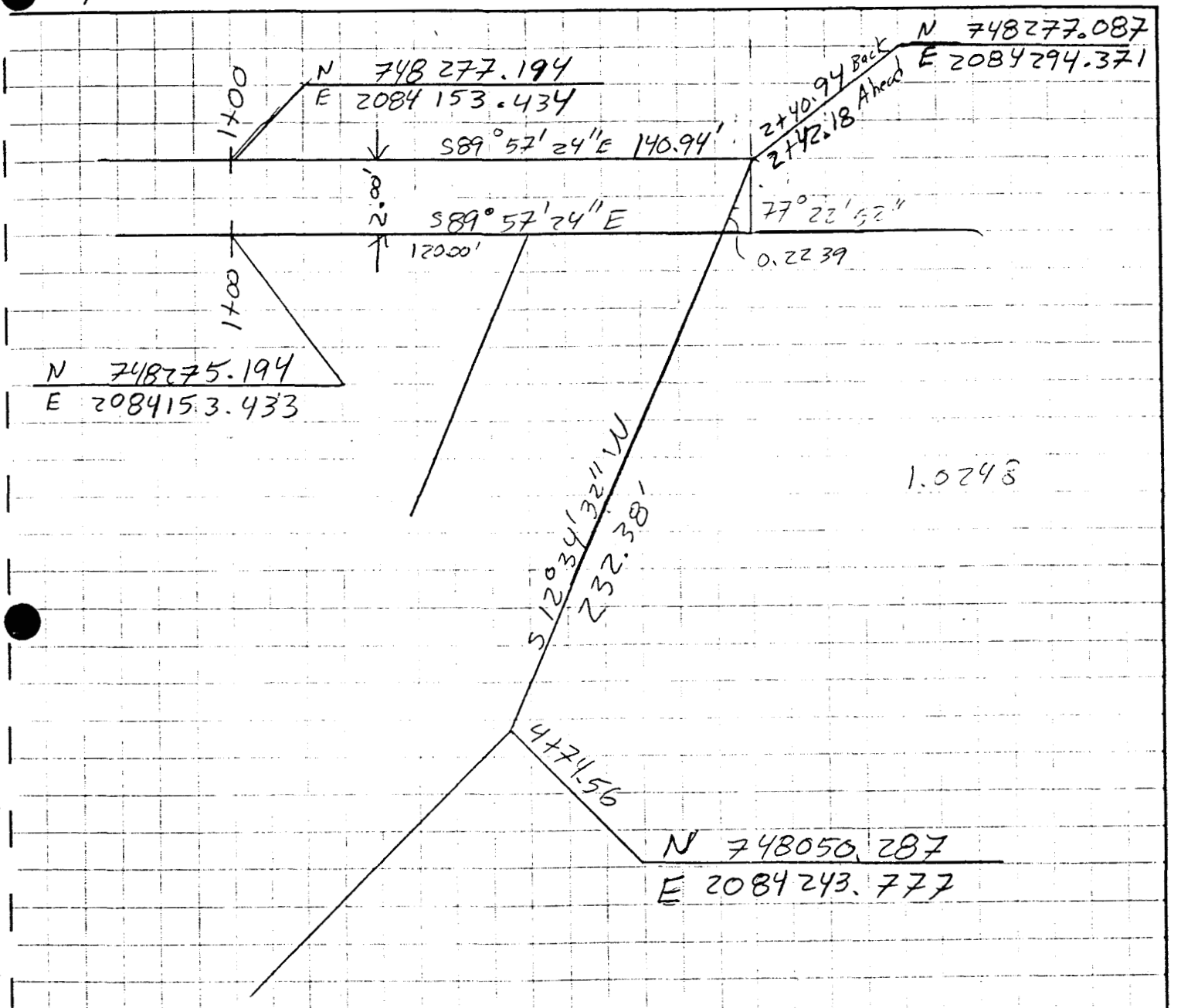
ES-COR-8 (5/88)

ES ENGINEERING-SCIENCE

Client: Rocky Flats
Subject: Realignment of Effluent Pipeline add station equation

Job No. DE075.01
By: CWT
Checked: GSH

Sheet 1 of 1
Date: 8/4/88
Rev.

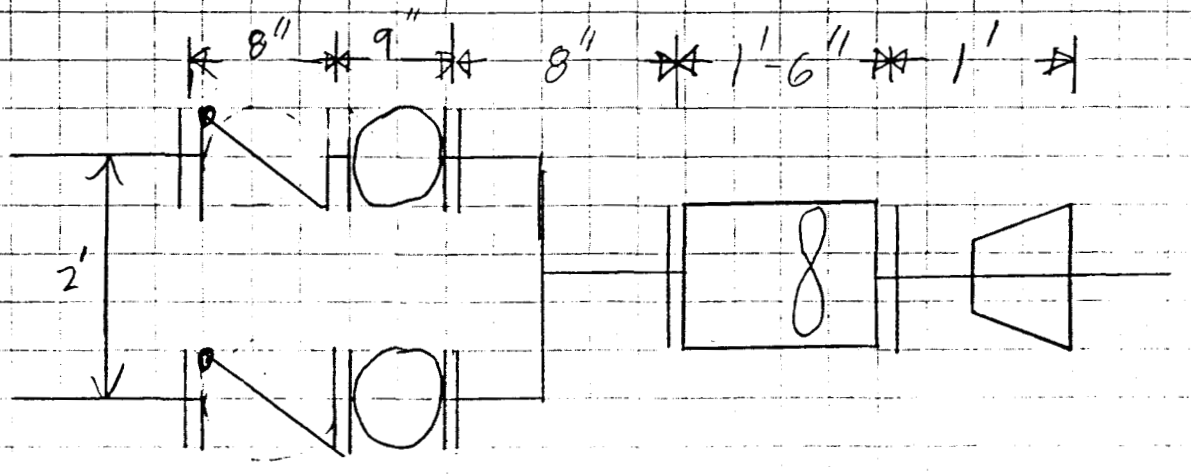


ENGINEERING-SCIENCE

Client: Rocky Flats
Subject: Pipe / Valve lengths for Meter Vault

Job No. DE075.01
By: CWT
Checked: GSH

Sheet 1 of 1
Date 8/1/88
Rev.



ES-COR-8 (5/88)

Project: Depth to Bedrock
No. DE075.01
By CWT Chkd. GSK
Date 7/12/89 Sht. 1 Of

Boring No.	Station	Offset	Depth to Bedrock (FT)	Total Depth (FT)
Tank Pad	0+84	5' LT	—	20
3	2+35	—	6	10
4	6+75		4.5	10
5	4+20	7' RT	9.5	10
6	1+10	0	23	25
7	3+10	0	19	24.5
8	5+36	2' RT	36	39
9	8+50	2' LT	17	20
10	11+50	4' LT	13.5	18
11	14+40	1' LT	4	10
12	16+00	2' LT	12	15
13	4+03	165' RT	—	10
14	7+55	118' RT	—	10
15	10+70	104' RT	—	10
16	13+72	90' RT	—	10

ES ENGINEERING-SCIENCE

Client Rocky Flats
Subject Pump Selection
GRUNDFOS SUBMERSIBLES

Job No. DE 075.01
By CWT
Checked GSH

Sheet 1 of 2
Date 9/10/88
Rev.

FRENCH DRAIN #1 COLLECTION SUMP

TDH (MIN) = 103', TDH (MAX) = 116'
ASSUMING Q = 5.0 gpm.

USING PUMP MODEL 5S03-9, 1/3 HP range 1.2-7 gpm

Q @ 103' ≈ 6.6 gpm

Q @ 116' ≈ 6.3 gpm

USING PUMP MODEL 10S03-6 range 5-14 gpm

Q @ 103' ≈ 10.8 gpm

Q @ 116' ≈ 9.7 gpm

FRENCH DRAIN #2 COLLECTION SUMP

TDH (MIN) = 85', TDH (MAX.) = 97'
Assuming Q = 5.0 gpm

USING PUMP MODEL 5S03-9, 1/3 HP range 1-2-7 gpm

Q @ 85' ≈ 7.0 gpm

Q @ 97' ≈ 6.8 gpm

USING PUMP MODEL 10S03-6, 1/3 HP range 5-14 gpm

Q @ 85' ≈ 12.3 gpm

Q @ 97' ≈ 11.3 gpm

ES ENGINEERING-SCIENCE

Client Rocky Flats | Job No. DE075.01 | Sheet 2 of 2
Subject Pump Selection | By CWT | Date 9/10/88
GRUNDFOS SUBMERSIBLES | Checked GSH | Rev.

BUILDING 881 FOUNDATION DRAIN COLLECTION SUMP

TDH (MIN.) = 55' TDH (MAX) = 70'
ASSUMING Q = 5 gpm

USING PUMP MODEL 5S03-9, 1/3 HP range 1.2-7 gpm

Q @ 55' ≈ ? out of range (7.7)

Q @ 70' ≈ ? out of range (7.4)

USING PUMP MODEL 10S03-6, 1/3 HP range 5-14 gpm

Q @ 55' ≈ 14.1 gpm

Q @ 70' ≈ 13.1 gpm

Well 88-1

TDH (MIN.) = 70', TDH (MAX.) = 105'
ASSUMING Q = 5 gpm

USING PUMP MODEL 5S03-9, 1/3 HP, range 1.2-7 gpm

Q @ 70' ≈ ? out of Range (7.4)

Q @ 105' ≈ 6.6 gpm

USING PUMP MODEL 10S03-6 1/3 HP, range 5-14 gpm

Q @ 70' ≈ 13.1 gpm

Q @ 105' ≈ 10.7 gpm

ENGINEERING-SCIENCE

Client: Rocky Flats
Subject: Sizing of Flow Sleeve Diameter for pumps
Job No. DE075.01
By: CWT
Checked: GSH
Sheet 1 of 1
Date 9/10/88
Rev.

Assuming: the following.

Q_{min} = 5 gallons per minute (gal/min)

Given:

V_{min} = 0.25 feet per second (ft/s) for a 3 3/4 Outside diameter Grundfos submersible pump.

Solution:

Area required

$$A_{max} = \frac{Q_{min}}{V_{min}}$$

$$Q_{min} = \frac{5\,gal}{min}\left(\frac{Ft^3}{7.48\,gal}\right)\left(\frac{min}{60\,s}\right) = 0.011\ FT^3/s$$

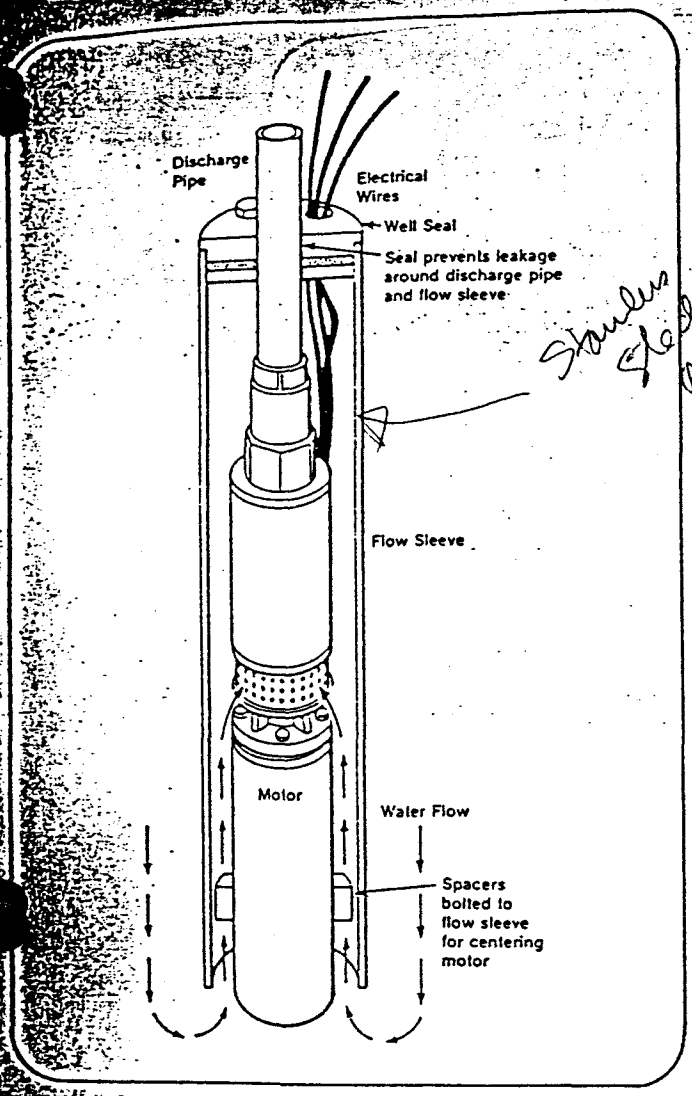
$$A_{max} = \frac{0.011\ FT^3/s}{0.25\ FT/s} = 0.044\ FT^2$$

$$A = \frac{\pi}{4}\left(\left(\frac{D}{12}\right)^2 - \left(\frac{3.75}{12}\right)^2\right) = \frac{\pi}{576}\left[D^2 - (3.75)^2\right]$$

$$D_{max} = \left[A_{max}\left(\frac{576}{\pi}\right) + (3.75)^2\right]^{1/2} = \left[\frac{0.044\,(576)}{\pi} + (3.75)^2\right]^{1/2}$$

D_{max} = 4.7 inches $\therefore$ $D_{max} = 4''$

Constructing a Flow Sleeve



Stainless steel or fiber glass

GOULDS PUMPS, INC.
SENECA FALLS, NEW YORK 13148

Form No. 10-23-81-1A-WS
Litho in U.S.A.

TABLE A

Minimum Water Flow Requirements for Submersible Pump Motors

Motor Diameter	Casing or Sleeve I.D. in Inches	Min. GPM Flow Pass the Motor
4"	4	1.2
	5	7
	6	13
	7	21
	8	30
6"	6	10
	7	28
	8	45
	10	85
	12	140
	14	198
	16	275
8"	8	10
	10	55
	12	110
	14	180
	16	255

a. A flow inducer or sleeve must be used if the water enters the well above the motor or if there is insufficient water flow past the motor.

b. The minimum water velocity over 4" motors is 0.25 feet per second.

c. The minimum water velocity over 6" and 8" motors is 0.5 feet per second.

TABLE B

Engine Driven Generators fo Submersible Pumps

Motor HP for Single or Three Phase Units	Minimum Kilowatt Rating of Gen for Three-Wire Submersible Pump: Externally Regulated	Intern Regula
0.33	1.5	1.2
0.50	2.0	1.5
0.75	3.0	2.0
1.0	4.0	2.5
1.5	5.0	3.0
2.0	7.5	4.0
3.0	10.0	5.0
5.0	15.0	7.5
7.5	20.0	10.0
10.0	30.0	15.0
15.0	40.0	20.0
20.0	60.0	25.0
25.0	75.0	30.0
30.0	100.0	40.0
40.0	100.0	50.0
50.0	150.0	60.0
60.0	175.0	75.0
75.0	250.0	100.0
100.0	300.0	150.0

Notes:

1. Table is based on typical 80°C. rise continuous duty generat 35% maximum voltage dip during starting single and three pl motors.
2. Contact the manufacturer of the generator whenever possible assure his unit has adequate capacity to run the submersible
3. If the generator rating is in KVA instead of kilowatts, multiply above ratings by 1.25 to obtain KVA.

TABLE C

Transformer Capacity Required for Three-Phase Submersible Pump Motors

Three-Phase Motor HP	Minimum Total KVA Required*	Minimum KVA Rating for Each Transformer: 2 Transformers Open Delta or Wye	3 Transformers Delta or Wye
1½	3	2	1
2	4	2	1½
3	5	3	2
5	7½	5	3
7½	10	7½	5
10	15	10	5
15	20	15	7½
20	25	15	10
25	30	20	10
30	40	25	15
40	50	30	20
50	60	35	20
60	75	40	25
75	90	50	30
100	120	65	40

*Pump motor KVA requi ments only, and does nc include allowances for other loads.

TABLE D

Submersible Pump Cable Selection Chart 60 Hz

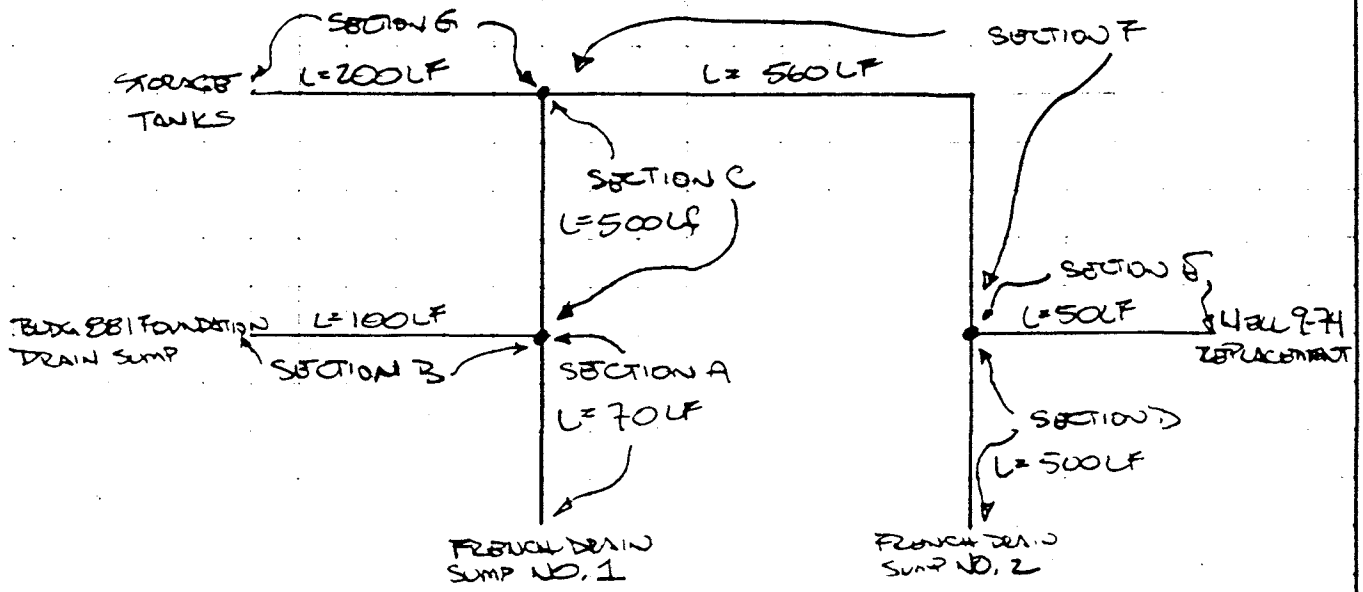
The following tables list the recommended copper cable sizes and various cable lengths for submersible pump motors.

These tables comply with the 1978 edition of the National Electric Code Table 310-16, Column 2 for 75°C wire. The ampacity (cu carrying properties of a conductor) have been divided by 1.25 per the N.E.C., Article 430-22, for motor branch circuits based on m amps at rated horsepower.

To assure adequate starting torque, the maximum cable lengths are calculated to maintain 95% of the service entrance volt at the motor when the motor is running at maximum nameplate amps. Cable sizes larger than specified may always be used and reduce power usage.

The use of cables smaller than the recommended sizes will void the warranty. Smaller cable sizes will cause reduced star torque and poor motor operation.

SCHEMATIC OF SYSTEM



TYPE OF PUMP TO BE USED: GRUNDFOS VERTIL WELL

APPROX FLOW: 5 GPM = 0.011 CFS

ASSUME PIPE DIAM = 2"

DETERMINE VELOCITY V $V = Q/A$

$$A = \pi \frac{[2/12]^2}{4} = 0.022 \text{ SF}$$

$$V = 0.011 \text{ CFS} / 0.022 \text{ SF}$$

$$V = 0.5 \text{ FPS}$$

A 1" DIA. PIPE WOULD GIVE A VELOCITY OF ≈ 2.0 FPS. THIS WOULD BE BETTER HOWEVER A 1" PIPE WOULD BE TOO SMALL, THEREFORE STAY WITH 2" PIPE MIN.

ES ENGINEERING-SCIENCE

Client: ROCKY FLATS | Job No. D0075.02 | Sheet 2 of 8

Subject: 881 HILLSIDE | By: GPH | Date: 8-8-88

FRENCH DRAIN & BLDG 881 PUMP DESIGN | Checked: RLD | Rev.

DESIGN OF PUMPS: CONSIDER HEAD LOSS THROUGH PIPE AT TWO EXTREMES:

1. ALL PUMPS RUNNING; MAX FLOW
2. ONE PUMP RUNNING; MIN FLOW

DETERMINE DIFFERENT VELOCITIES

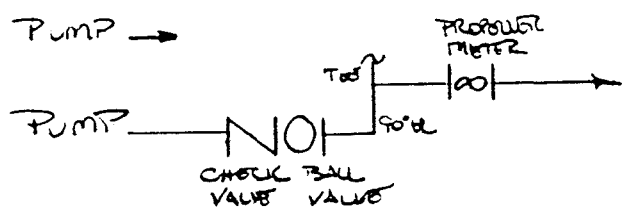
$Q = AV$ (2" PIPE)

$V = Q/A$ $A = 0.022$

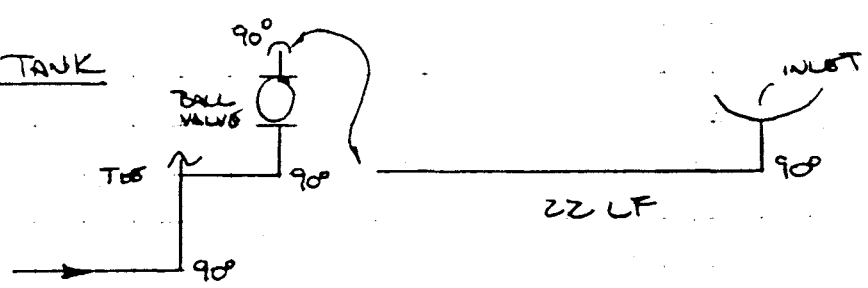
# OF PUMPS	gpm Q	cfs Q	fps V
1	5	0.011	0.5
2	10	0.022	1.0
3	15	0.033	1.5

DETERMINE FRICTION LOSSES

AT PUMP



AT STORAGE TANK



ES ENGINEERING-SCIENCE

Client: ROCKY FLATS
Subject: 881 HILLSIDE
FRENCH DRAIN & BLDG 881 PUMP DESIGN

Job No. D0075.02
By: GSH
Checked: RLA

Sheet 3 of 8
Date 8-8-88
Rev.

FRICTION LOSSES AT PUMP

FITTING	EQUIVALENT LENGTH ½"	¾"	1"	2"
CHECK VALVE				20
BALL VALVE				20
90° EL				5
TEE				13
MOTOR				30 (ESTIMATE)
TOTAL				38 ≈ 50 FT

FRICTION LOSSES AT STORAGE TANK – USING GALVANIZED STEEL PIPE

FITTING	EQUIVALENT LENGTH 2"
90° EL	5.5
TEE	13.5
90° EL	6.5
BALL VALVE	50.0
90° EL	6.5
90° EL	5.5
INLET	8.5
TOTAL	94.0 ≈ 100 FT

ES ENGINEERING-SCIENCE

Client: ROCKY FLATS
Subject: 881 HILLSIDE
FRENCH DRAIN & BLDG 881 PUMP DESIGN

Job No. D0075.02
By: GSH
Checked: RLA

Sheet 4 of 8
Date 8-8-88
Rev.

EQUIVALENT LENGTH OF PIPE

1. SECTION A

FITTINGS	50.0
TEE	10.0
STRAIGHT	70.0
TOTAL	130.0

2. SECTION B

FITTINGS	50.0
TEE	10.0
STRAIGHT	100.0
TOTAL	160.0

3. SECTION C

TOTAL 500.0 LF

4. SECTION D

FITTINGS	50.0
TEE	10.0
STRAIGHT	500.0
TOTAL	560.0

5. SECTION E

FITTINGS	50.0
TEE	10.0
STRAIGHT	50.0
TOTAL	110.0

6. SECTION F

TOTAL 560.0 LF

ES ENGINEERING-SCIENCE

Client: ROCKY FLATS
Subject: 881 HILLSIDE
FRENCH DRAIN & BLDG 881 PUMP DESIGN

Job No: D8075.02
By: GSH
Checked: RLA

Sheet 5 of 8
Date 8-8-88
Rev.

7. SECTION G

PVC

TEE		10.0
STRAIGHT		200.0
	TOTAL	210.0

GALVANIZED STEEL

FITTING		100.0
STRAIGHT	x	30.0
	TOTAL	130.0

TOTAL = 340

ES ENGINEERING-SCIENCE

Client: Rocky Flats | Job No. DB075.02 | Sheet 6 of 8

Subject: 881 Hillside | By: GSH | Date: 8.8.88

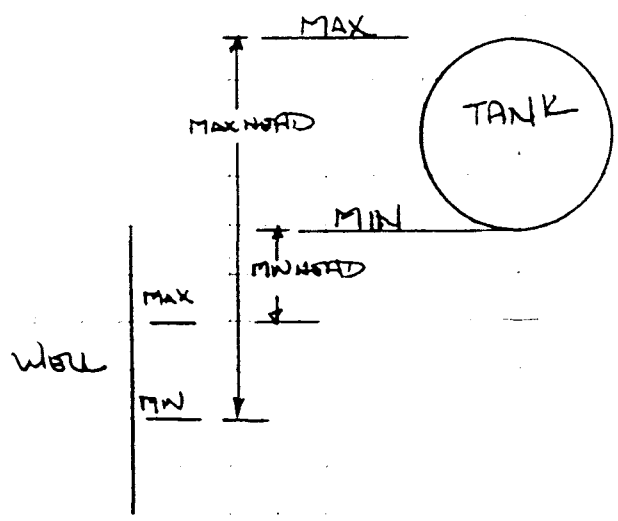
FRENCH DRAIN + BLDG 881 PUMP DESIGN | Checked: RLD | Rev.

STATIC HEAD

STORAGE TANK PAD	≈ 5980.0
HEIGHT OF PEDESTAL	2.0
HEIGHT OF SADDLE	0.5
	5982.5

MIN LIQUID LEVEL ≈ 5982.5
MAX LIQUID LEVEL ≈ 5992

PUMP	MIN LEVEL	MAX LEVEL	MIN HEAD	MAX HEAD
F.D #1	5801.0	5885.0	97.5	111.0
FD #2	5900.0	5904.0	78.5	92.0
BLDG 881 DRAIN	5928.0	5933.0	49.5	64.0
WELL 88-1	5892.0	5918.0	64.5	100.0



ES ENGINEERING-SCIENCE

Client: Rocky Flats | Job No. D6075.02 | Sheet 8 of 8

Subject: 881 Hillside | By: GSH | Date: 8-9-88

French Drain & Bldg 881 Pump Design | Checked: RLA | Rev.

Well 88-1 Pump

			5GPM	10GPM	20GPM
STATIC HEAD		65 - 100 FT			
FRICTION HEAD			0.09FT/100FT	0.24FT/100FT	0.80FT/100
(5GPM max)	SECTION E	110 LF	0.10	0.10	0.10
(10GPM max)	SECTION F	560 LF	0.50	1.34	1.34
(20GPM max)	SECTION G	340 LF	0.31	0.82	2.92
		TOTAL	0.91	2.26	4.36

CONCLUSION: FRICTION LOSSES ARE MINIMAL REGARDLESS OF THE FLOW RATE. ADD 5.0 FT TO STATIC HEAD

DESIGN CONDITIONS Q = 5 GPM

	HEAD
FRENCH DRAIN #1	103 - 116 FT
FRENCH DRAIN #2	85 - 97 FT
BLDG 881 FOUNDATION	55 - 70 FT
WELL 88-1	70 - 105 FT

ES ENGINEERING-SCIENCE

Client: Rocky Flats
Subject: 881 Hillside
French Drain & Bldg 881 Pump Design

Job No. D8095.02
By: GSH
Checked: RLA

Sheet 7 of 8
Date: 8-9-88
Rev.

French Drain Sump No. 1

STATIC HEAD 98 - 111 FT

FRICTION HEAD

			5GPM	10GPM	20GPM
			0.09 FT/100 FT	0.24 FT/100 FT	0.86 FT/100 FT
(5GPM MAX)	SECTION A	130 LF	0.12	0.12	0.12
(10GPM MAX)	SECTION C	500 LF	0.45	1.20	1.20
(20GPM MAX)	SECTION G	340 LF	0.31	0.82	2.92
		TOTAL	0.88 FT	2.14 FT	4.24 FT

French Drain Sump No. 2

STATIC HEAD 79 - 92 FT

FRICTION HEAD

			5GPM	10GPM	20GPM
			0.09 FT/100 FT	0.24 FT/100 FT	0.86 FT/100 FT
(5GPM MAX)	SECTION D	560 LF	0.50	0.50	0.50
(10GPM MAX)	SECTION F	560 LF	0.50	1.34	1.34
(20GPM MAX)	SECTION G	340 LF	0.31	0.82	2.92
		TOTAL	1.31	2.66	4.76

Bldg 88 Found. Drain

STATIC HEAD 50 - 64 FT

FRICTION HEAD

			5GPM	10GPM	20GPM
			0.09 FT/100 FT	0.24 FT/100 FT	0.86 FT/100 FT
(5GPM MAX)	SECTION B	160 LF	0.14	0.14	0.14
(10GPM MAX)	SECTION C	500 LF	0.45	1.20	1.20
(20GPM MAX)	SECTION G	340 LF	0.31	0.82	2.92
		TOTAL	0.90	2.16	4.26

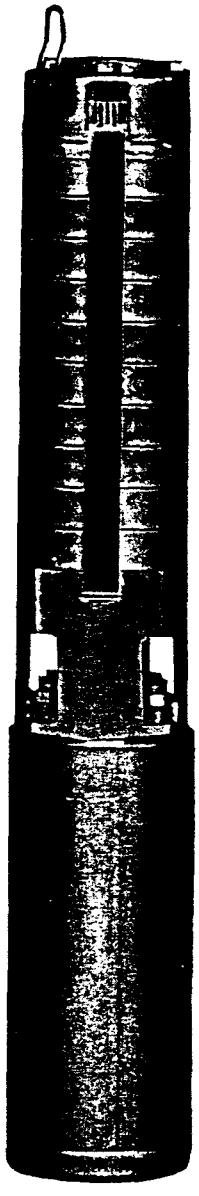
MODEL
5S

5 GPM

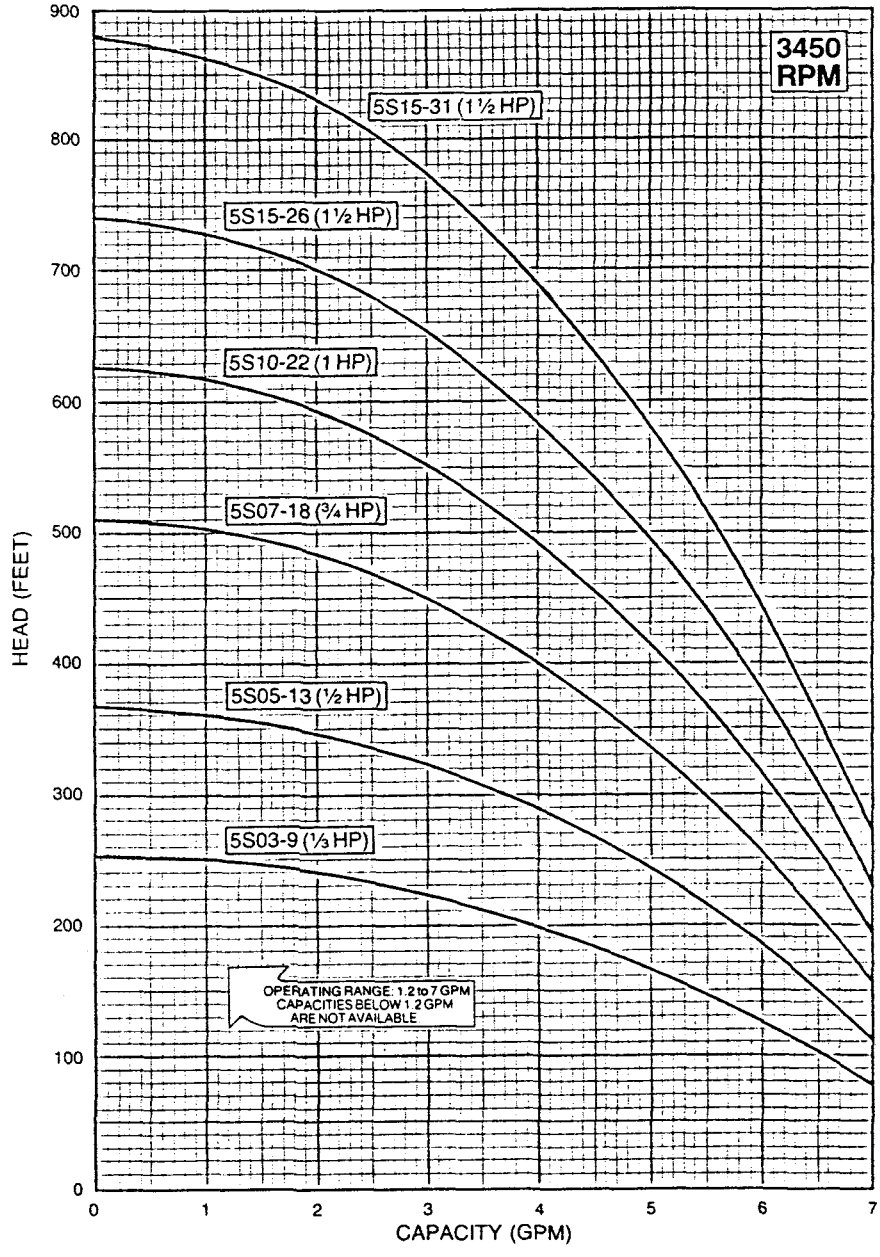
GRUNDFOS

FLOW RANGE
1.2 to 7 GPM

PUMP OUTLET
1" NPT



PERFORMANCE CURVES



DIMENSIONS AND WEIGHTS

MODEL NO.	HP	LENGTH (INCHES)	WIDTH (INCHES)	APPROX. UNIT SHIPPING WT. (LBS.)
5S03-9	⅓	24 ⅜	3 ¾	27
5S05-13	½	28 ½	3 ¾	31
5S07-18	¾	33 ¼	3 ¾	34
5S10-22	1	37 ⅛	3 ¾	42
5S15-26	1 ½	42	3 ¾	46
5S15-31	1 ½	47 ⅞	3 ¾	58

Specifications are subject to change without notice.

ES ENGINEERING-SCIENCE

Client	ROCKY FLATS	Job No.	D0075.02
Subject	881 HILLSIDE	By	GSH
	TRANSFER PUMP DESIGN	Checked	RLA

Sheet 1 of 3
Date 8-5-88
Rev.

TRANSFER PUMP DESIGN

DESCRIPTION : PUMPS USED TO DELIVER UNTREATED WATER FROM STORAGE TANKS TO TREATMENT UNIT

LOCATION : BLDG 830 TREATMENT UNIT AREA

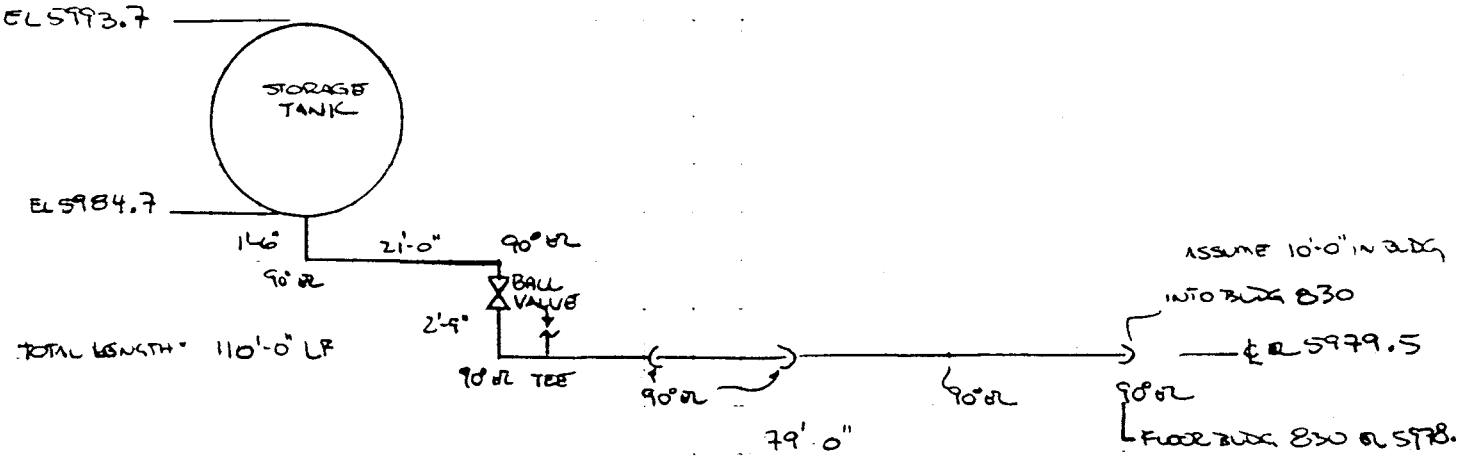
TYPE : END SUCTION CENTRIFUGAL

QUANTITY : 30 GPM

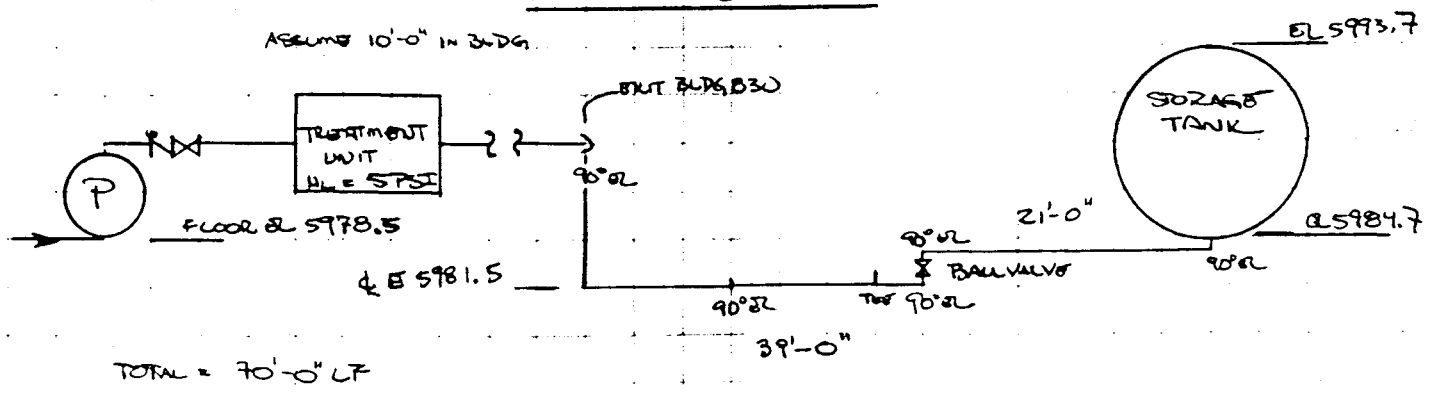
HEAD : TO BE DETERMINED; MANUFACTURER REQUIRES 3-5 PSI AT TREATMENT UNIT INLET FOR LOSSES THROUGH UNIT.

SYSTEM SCHEMATIC

SUCTION HEAD



DISCHARGE HEAD



DETERMINE SUCTION HEAD

MINIMUM DEPTH IN TANK =	5984.7
ASSUME ℄ PUMP 12" OFF FLOOR =	5979.5
HEAD ON PUMP	5.2 FT

FRICTION LOSSES

FITTINGS			EQUIVALENT LENGTH/FITTING		
90° EL	10	×	5.5 ft	=	55.0 LF
TEE	2	×	12.0 FT	=	24.0 LF
BALL VALVE	2	×	30.0 ft	=	60.0 LF
INLET	1	×	4.5 ft	=	4.5 LF

STRAIGHT PIPE = 110 LF Pressure drop = 0.75 psi/100 LF

TOTAL EQUIVALENT LENGTH	120 LF
STRAIGHT LENGTH	144 LF
TOTAL	264 LF × 0.75 psi/100 LF

$H_L = 1.98 \text{ psi} \times 2.31 \text{ ft/psi} = 4.57 \text{ ft.}$

SUCTION HEAD = 5.2 ft
FRICTION LOSS = − 4.6 ft

NPSH = 0.6 ft Net Positive Suction Head

NPSH = 0.6 FT MINIMUM (TANK EMPTY)
= 9.4 FT MAXIMUM (TANK FULL)

ES ENGINEERING-SCIENCE

Client: Rocky Flats | Job No. D0075.02 | Sheet 3 of 3
Subject: 881 Hillside | By: GSA | Date: 8-5-88
Transfer Pump Design | Checked: RLA | Rev.

Determine Discharge Head

Maximum depth in tank ≈ 5993.5
Assume ℄ pump 12' off floor 5979.5
Static head 14.0 ft

Friction losses

Fittings			Equivalent length/fitting		
90° ell	5	×	5.5	=	27.5 LF
Tee	1	×	12.0	=	12.0 LF
Ball valve	2	×	30.0	=	60.0 LF
Check valve	1	×	22.0	=	22.0 LF
Treatment unit	5 psi	×	2.31 ft/psi	=	11.5 LF
Outlet	1	×	9.0	=	9.0 LF
			Total	=	142.0 LF

Straight pipe = 80 LF Pressure drop = 0.75 psi / 100 LF

Total equiv length = 142.0 LF
Straight length = 80.0 LF
Total = 222.0 LF × 0.75 psi / 100 LF = 1.67 psi

H_L = 1.67 psi × 2.31 ft/psi = 3.86 ft.
H_L through treatment unit = 5.0 psi = 11.6 ft.
Treatment unit = 11.6
Static head = 14.0 ft
Friction head = 3.9 ft.
Total = 29.5 ft = 12.8 psi

Pump Design Criteria

Q = 30 GPM
TDH = 29.5 (tank full) 12.8 psi
20.0 (tank empty) 8.7 psi

FRICTION LOSS OF WATER (IN FEET OF PIPE) THROUGH 100' OF

SCHEDULE 40 PLASTIC PIPE

U.S GALS. MIN. PER	½" PIPE Vel ft./sec	½" PIPE Loss In Feet	¾" PIPE Vel ft/sec	¾" PIPE Loss In Feet	1" PIPE Vel ft/sec	1" PIPE Loss In Feet	1¼" PIPE Vel ft/sec	1¼" PIPE Loss In Feet	1½" PIPE Vel ft/sec	1½" PIPE Loss In Feet	2" PIPE Vel ft/sec	2" PIPE Loss In feet	2½" PIPE Vel ft/sec	2½" PIPE Loss In Feet	3" PIPE Vel ft/sec	3" PIPE Loss In Feet	3½" PIPE Vel ft/sec	3½" PIPE Loss In Feet	4" PIPE Vel ft/sec	4" PIPE Loss In Feet	U.S GALS. PER MIN.
2	2.10	3.47	1.20	0.89																	2
4	4.21	12.7	2.41	3.29	1.49	1.01	.86	.27	.63	.12											4
6	6.31	26.8	3.61	6.91	2.23	2.14	1.29	.57	.94	.26	.61	.09									6
8	8.42	46.1	4.81	11.8	2.98	3.68	1.72	.95	1.26	.45	.82	.16	.52	.05							8
10	10.5	69.1	6.02	17.9	3.72	5.50	2.14	1.44	1.57	.67	1.02	.24	.65	.08	.45	.03					10
12			7.22	24.9	4.46	7.71	2.57	2.02	1.39	.94	1.23	.37	.78	.11	.54	.05					12
15			9.02	37.6	5.60	11.8	3.21	3.05	2.36	1.41	1.53	.51	.98	.17	.68	.07	.50	.03			15
18			10.8	50.9	6.69	16.5	3.86	4.28	2.83	1.99	1.84	.70	1.18	.24	.82	.10	.59	.04			18
20	5" PIPE		12.0	63.9	7.44	19.7	4.29	5.21	3.15	2.44	2.04	.86	1.31	.29	.91	.12	.67	.05	.51	.03	20
25					9.30	30.1	5.36	7.80	3.80	3.43	2.55	1.28	1.63	.43	1.13	.18	.84	.08	.64	.04	25
30	.49	.02			11.15	41.8	6.43	10.8	4.72	5.17	3.06	1.80	1.96	.61	1.36	.25	1.00	.11	.77	.06	30
35	.57	.03			13.02	55.9	7.51	14.7	5.51	6.91	3.57	2.40	2.29	.81	1.59	.33	1.17	.15	.89	.08	35
40	.65	.04	6" PIPE		14.88	71.4	8.58	18.8	6.30	8.83	4.08	3.10	2.61	1.03	1.82	.43	1.34	.19	1.02	.10	40
45	.73	.04					9.65	23.5	7.08	10.9	4.60	3.85	2.94	1.32	2.04	.54	1.51	.24	1.15	.13	45
50	.82	.05	.57	.02			10.7	28.2	7.87	13.3	5.11	4.65	3.27	1.56	2.27	.65	1.67	.29	1.28	.16	50
55	.90	.06	.62	.02			11.8	33.8	8.66	16.0	5.62	5.55	3.59	1.88	2.45	.74	1.79	.34	1.41	.19	55
60	.98	.07	.68	.03			12.9	40.0	9.44	18.6	6.13	6.53	3.92	2.19	2.72	.90	2.01	.40	1.53	.22	60
65	1.06	.09	.74	.04			13.9	46.7	10.2	21.6	6.64	7.56	4.24	2.53	2.89	1.02	2.11	.47	1.66	.25	65
70	1.14	.10	.79	.04			15.0	53.1	11.0	24.9	7.15	8.64	4.58	2.91	3.18	1.21	2.34	.54	1.79	.30	70
75	1.22	.11	.85	.05			16.1	60.6	11.8	28.2	7.66	9.82	4.91	3.33	3.33	1.41	2.43	.60	1.91	.34	75
80	1.31	.13	.91	.05			17.2	68.2	12.6	32.0	8.17	11.1	5.23	3.71	3.63	1.54	2.68	.69	2.04	.38	80
85	1.39	.15	.96	.06			18.2	77.0	13.4	35.3	8.68	12.5	5.56	3.81	3.78	1.66	2.76	.76	2.17	.42	85
90	1.47	.16	1.02	.07			19.3	84.6	14.7	39.5	9.19	13.8	5.88	4.61	4.09	1.92	3.01	.85	2.30	.47	90
95	1.55	.18	1.08	.07					14.9	43.7	9.70	15.3	6.21	5.07	4.22	2.04	3.10	.96	2.42	.53	95
100	1.63	.19	1.13	.08					15.7	47.9	10.2	16.8	6.54	5.64	4.54	2.33	3.33	1.03	2.55	.57	100
110	1.79	.23	1.25	.10					17.3	57.3	11.2	20.2	7.18	6.81	5.00	2.82	3.57	1.25	2.81	.69	110
120	1.96	.27	1.36	.11	8" PIPE				18.9	67.2	12.2	23.5	7.84	7.89	5.45	3.29	3.99	1.45	3.06	.80	120
130	2.12	.31	1.47	.13					20.5	78.0	13.3	27.3	8.48	8.79	5.91	3.81	4.22	1.68	3.31	.93	130
140	2.29	.36	1.59	.15	.90	.04			22.0	89.3	14.3	31.5	9.15	10.5	6.35	4.32	4.54	1.93	3.57	1.07	140
150	2.45	.41	1.70	.17	.96	.04					15.3	35.7	9.81	12.0	6.82	4.93	4.87	2.19	3.82	1.23	150
160	2.61	.46	1.82	.19	1.02	.05					16.3	40.4	10.5	13.6	7.26	5.54	5.19	2.47	4.08	1.37	160
170	2.77	.51	1.92	.21	1.08	.05					17.4	45.1	11.1	16.0	7.71	6.25	5.52	2.75	4.33	1.53	170
180	2.94	.57	2.04	.24	1.15	.06					18.4	50.3	11.8	16.8	8.17	6.58	5.85	3.07	4.60	1.70	180
190	3.10	.63	2.16	.26	1.21	.07	10" PIPE				19.4	55.5	12.4	18.6	8.63	7.28	6.17	3.39	4.84	1.88	190
200	3.27	.70	2.27	.29	1.28	.07					20.4	60.6	13.1	20.3	9.08	8.36	6.50	3.73	5.11	2.06	200
220	3.59	.83	2.50	.34	1.40	.08	.90	.03			22.5	72.4	14.4	24.9	9.99	10.0	7.14	4.45	5.62	2.44	220
240	3.92	.98	2.72	.41	1.53	.10	.98	.03			24.5	85.5	15.7	28.7	10.9	11.8	7.79	5.22	6.13	2.91	240
260	4.25	1.13	2.95	.47	1.66	.12	1.06	.04			26.6	99.2	17.0	33.0	11.8	13.7	8.44	6.07	6.64	3.28	260
280	4.58	1.30	3.18	.54	1.79	.13	1.15	.04					18.3	38.1	12.7	15.7	9.09	6.95	7.15	3.85	280
300	4.90	1.48	3.40	.62	1.91	.15	1.22	.05					19.6	43.2	13.6	17.9	9.74	7.90	7.66	4.37	300
320	5.23	1.66	3.64	.69	2.05	.17	1.31	06					20.9	48.4	14.5	20.1	10.4	8.88	8.17	4.93	320
340	5.54	1.87	3.84	.76	2.18	.19	1.39	.07	12" PIPE				22.2	54.5	15.4	22.5	11.0	9.96	8.68	5.50	340
360	5.87	2.07	4.08	.86	2.30	.21	1.47	.07					23.5	60.2	16.3	24.9	11.7	11.0	9.19	6.15	360
380	6.19	2.28	4.31	.94	2.43	.24	1.55	.08	1.08	.03			24.8	66.7	17.2	27.7	12.3	12.2	9.69	6.58	380
400	6.54	2.5	4.55	1.03	2.60	.25	1.63	.09	1.14	.04			26.1	73.3	18.2	30.6	13.0	13.4	10.2	7.52	400
450	7.35	3.1	5.11	1.29	2.92	.32	1.84	.11	1.28	.05					20.4	36.7	14.6	16.7	11.5	9.31	450
500	8.17	3.8	5.68	1.36	3.19	.39	2.04	.13	1.42	.05					22.7	46.1	16.2	20.3	12.8	11.3	500
550	8.99	4.5	6.25	1.86	3.52	.46	2.24	.16	1.56	.06					24.9	55.0	17.9	24.3	14.0	13.5	550
600	9.80	5.3	6.81	2.19	3.84	.54	2.45	.18	1.70	.07					27.2	64.4	19.5	28.5	15.3	15.8	600
650	10.6	6.2	7.38	2.53	4.16	.63	2.65	.21	1.84	.09							21.1	33.0	16.6	18.3	650
700	11.4	7.1	7.95	2.92	4.46	.72	2.86	.24	1.99	.10							22.7	37.9	17.9	21.1	700
750	12.3	8.1	8.50	3.35	4.80	.82	3.06	.28	2.13	.11							24.4	43.0	19.1	24.0	750
800	13.1	9.1	9.08	3.74	5.10	89	3.26	.31	2.27	.13							26.0	48.4	20.4	26.8	800
850	13.9	10.2	9.65	4.21	5.48	1.03	3.47	.35	2.41	.15							27.6	54.1	21.7	30.1	850
900	14.7	11.3	10.2	4.75	5.75	1.16	3.67	.39	2.56	.16									23.0	33.4	900
950	15.5	12.5	10.8	5.26	6.06	1.35	3.88	.43	2.70	.18											950
1000	16.3	13.7	11.3	5.66	6.38	1.40	4.08	.48	2.84	.19											1000
1100	18.0	16.4	12.5	6.84	7.03	1.65	4.49	.56	3.13	.23											1100
1200	19.6	19.2	13.6	8.04	7.66	1.96	4.90	.66	3.41	.27											1200
1300			14.7	8.6	8.30	2.28	5.31	.76	3.69	.31											1300
1400			15.9	10.6	8.95	2.59	5.71	.88	3.98	.37											1400
1500			17.0	12.0	9.58	2.93	6.12	1.00	4.26	.42											1500
1600			18.1	12.6	10.2	3.29	6.53	1.12	4.55	.46											1600
1800					11.5	4.13	7.35	1.39	5.11	.57											1800
2000					12.8	5.03	8.16	1.69	5.68	.70											2000
2200					14.0	6.00	8.98	1.99	6.25	.85											2200
2400					15.3	6.7	9.80	2.37	6.8	.98											2400
2600							10.6	2.73	7.38	1.14											2600
2800							11.4	3.15	7.95	1.29											2800
3000							12.2	3.58	8.52	1.48											3000
3200							13.0	3.7	9.10	1.65											3200
3500							14.3	4.74	9.95	1.96											3500
3800							15.5	6.3	10.8	2.30											3800
4200									11.9	2.76											4200
4500									12.8	3.24											4500
5000									14.2	3.95											5000
5500																					5500
6000																					6000

Figures underlined indicate maximum recommended velocity in ft./sec. which should never exceed 5.0 ft./sec.

Resistances of Elbows, Tees and Bends—Table I

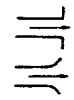
(Resistance in equivalent pipe length, ft)

Nominal Pipe Size, In	90° Elbows*		90° Bends*		Tee	
	Short Radius, $R = 1D$	Long Radius $R = 1.5D$	$R = 5D$	$R = 10D$	Flow-Through Branch	Flow-Through
1½	4.5	3	2.5	4	8	3
2	5.25	3.5	3	5	11	3.5
2½	6	4	3.5	6	13	4
3	7.5	5	4	7.5	16	5
4	10.5	7	5.5	10	20	7
6	15	10	8.5	15	30	10
8	21	14	11	20	40	14
10	24	16	14	25	50	16
12	32	21	16	30	60	21
14	33	22	19	33	65	22
16	39	26	21	38	75	26
18	44	29	24	42	86	29
20	48	32	27	50	100	32
24	57	38	32	60	120	38

*For 45° elbows and bends, estimate 50% of tabulated values. For 180° returns, double the tabulated values.

Resistances of Horizontal and Vertical Inlets and Outlets—Table II

(Resistance in equivalent pipe length, ft)

Resistance Coefficient	$K = 1.0$	$K = 0.78$	$K = 0.5$	$K = 0.23$
Nominal Pipe Size, In				
½	2	1.5	1	0.5
¾	3	2.5	1.5	0.75
1	4	3	2	1
1½	7	5.5	3.5	1.75
2	9	7	4.5	2.25
3	15	12	7.5	3.75
4	20	16	10	5
6	36	29	18	9
8	48	38	24	12
10	62	49	31	15
12	78	60	39	19
14	88	70	44	22
16	100	78	50	25
18	120	95	60	30
20	136	107	68	34
24	170	135	85	42

Resistances to Flow for Various Types of Valves—Table III

(Resistance in equivalent pipe length, ft)

Nominal Pipe Size, In	Gate, Fully Open	Globe,* Fully Open, Bevel or Plug Seat			Check		Straight-Through Valve[1]	Three-Way Valve[2]		Butterfly, Fully Open
		90°	60°	45°	Swing	Ball		Straight-Through Flows	Flow-Through Branch	
1½	1.75	46	23	18	17	20	2.5	6	20	6
2	2.25	60	30	24	22	25	3.5	7.5	24	8
2½	2.75	70	38	30	27	30	4	9	30	10
3	3.5	90	45	38	35	38	5	12		12
4	4.5	120	60	48	45	50	6.5	15	48	15
6	6.5	175	88	72	65	75	10	22	70	23
8	9	230	120	95	90	100	13	30	95	27
10	12	280	150	130	120	130	16	38	120	35
12	14	320	170	145	140	150	19			40
14	15	380	190	160	150	170	20			45
16	17	420	220	180	170	190	22			50
18	18	480	250	205	180	210	24			58
20	20	530	290	240	200	240	27			64
24	32	630	330	270	250	290	33			78

*For partially closed globe valves, multiply tabulated values by 3 for three-quarters open, by 12 for one-half open, and by 70 for one-quarter open.
[1]With port area open. Port area = pipe area.
[2]Port area equals 80% of pipe area.

14300 SO. RIDGE AVE. - ORLAND PARK, ILLINOIS 60462 - PHONE: 312-349-7111

Resistances of Eccentric and Concentric Reducers, And of Sudden Changes in Line Size—Table IV
(Resistance in equivalent pipe length, ft)

Nominal Sizes, In		d_2 d_1 / d_2 d_1	d_1 d_2 / d_1 d_2
d_1	d_2		
¾	½	0.6	0.5
1	½	1.2	0.7
	¾	0.6	0.6
1 ½	¾	1.6	1.0
	1	1.2	0.9
2	1	2.2	1.3
	1 ½	1.3	1.3
3	1 ½	3.8	2.4
	2	2.7	2.3
4	2	5	3.2
	3	3	3
6	3	8	5
	4	4	4
8	4	12	7
	6	7	7
10	4	15	8
	6	14	9.5
	8	6	6
12	6	19	12
	8	14	12
	10	6.5	6.5
14	6	22	14
	8	22	14
	10	15	13
	12	6	6
16	8	27	17
	10	23	17
	12	15	15
	14	7	7
18	10	30	19
	12	23	19
	14	15	15
	16	4	4
20	12	30	23
	14	21	23
	16	13	13
	18	5	5
24	18	25	25
	20	12	12

Note: Add these equivalent lengths to the equivalent length of the smaller pipe and its components.

Section 6

DESIGN TABLES

TABLE 9
OPERATING PRESSURES OF PROLINE™ COPOLYMER POLYPROPYLENE PIPE AND FITTINGS

Temperature			Rated Working Pressure	
°F	°C	Years	Pro 45	Pro 150
68	20	1	58 psi	180 psi
		5	52	168
		10	53	165
		25	51	156
		50	45	150
86	30	1	49	154
		5	46	145
		10	46	141
		25	45	136
		50	44	133
104	40	1	45	133
		5	41	125
		10	41	122
		25	36	113
		50	35	104
122	50	1	36	113
		5	34	104
		10	32	99
		25	29	90
		50	26	70
140	60	1	30	96
		5	26	81
		12	24	75
		25	21	64
		50	18	55
158	70	1	26	78
		5	20	61
		10	18	55
		25	15	46
		30	15	46
176	80	1	20	61
		5	15	46
		10	13	41
		20	12	38
203	95	1	13	41
		5	10	32
		10	8	26

NOTE: Data is based on pipe and fittings protected from UV radiation. The table applies to water.

TABLE 10
OPERATING PRESSURES OF SUPER PROLINE™ KYNAR™ PIPE AND FITTINGS

Temperature			Rated Working Pressure	
°F	°C	Years	Super Pro 230 ½"–2½"	Super Pro 150 3"–12"
68	20	50	230 psi	150 psi
104	40	50	156	95
140	60	50	108	68
176	80	50	78	48
212	100	50	58	35
248	120	50	45	28
284	140	50	35	23

NOTE: Larger sizes are also available in Super Pro 230 — Consult factory. The table applies to water.

TABLE 11
EQUIVALENT LENGTH OF PIPE PER FITTING (FOR FRICTION LOSSES) IN FEET

Nominal Asahi Pipe Diameter (Inches)	90° Elbow	45° Elbow	Tee	90° Elbow (Long Radius)	45° Elbow (Long Radius)
½	1.5	0.8	3.25		
¾	2	1	4		
1	2.75	1.25	6		
1¼	3.5	1.7	8		
1½	4.25	2	9		
2	5.5	2.5	12		
2½	7	3	14		
3	8	3.8	17		
4	11	5	21		
6	16	7.5	34		
8	20	10	44		
10	25	12.5	55		
12	32	15	58		
14			80	25	12
16			90	30	15
18			100	32.5	16
20			110	35	17
24			140	40	20

TABLE 13
PROLINE™ PRO 150 VELOCITIES AND PRESSURE DROPS

Flow Rate gpm	½ V	½ P	¾ V	¾ P	1 V	1 P	1¼ V	1¼ P	1½ V	1½ P	2 V	2 P	2½ V	2½ P	3 V	3 P	4 V	4 P	6 V	6 P	8 V	8 P	10 V	10 P	12 V	12 P	14 V	14 P	16 V	16 P	18 V	18 P
1	1.17	0.55	0.68	0.15	0.39	0.04	0.24	0.01																								
2	2.34	1.99	1.37	0.54	0.78	0.14	0.49	0.04	0.32	0.02																						
5	5.84	10.84	3.42	2.95	1.95	0.75	1.22	0.24	0.79	0.08	0.5	0.03	0.35	0.01	0.24	0.01																
7	8.18	20.21	4.79	5.51	2.72	1.39	1.71	0.45	1.11	0.16	0.7	0.05	0.49	0.02	0.34	0.02																
10	11.7	39.12	6.85	10.66	3.89	2.7	2.45	0.87	1.58	0.3	1	0.1	0.7	0.04	0.49	0.03																
15			10.3	22.59	5.84	5.72	3.67	1.85	2.37	0.64	1.49	0.21	1.05	0.09	0.73	0.06	0.49	0.01														
20					7.78	9.74	4.9	3.15	3.16	1.09	1.99	0.36	1.41	0.15	0.97	0.1	0.65	0.02														
25					9.73	14.72	6.12	4.77	3.95	1.64	2.49	0.54	1.76	0.23	1.22	0.13	0.81	0.03														
30					11.7	20.63	7.34	6.68	4.74	2.3	2.99	0.75	2.11	0.32	1.46	0.17	0.98	0.05														
35							8.57	8.89	5.53	3.07	3.49	1	2.46	0.43	1.7	0.23	1.14	0.06	0.54	0.01												
40							9.79	11.38	6.32	3.92	3.98	1.27	2.81	0.55	1.94	0.28	1.3	0.08	0.62	0.02												
45							11	14.16	7.11	4.88	4.48	1.59	3.16	0.68	2.19	0.34	1.46	0.1	0.69	0.02												
50									7.9	5.93	4.98	1.93	3.52	0.83	2.43	0.47	1.63	0.13	0.77	0.03												
60									9.48	8.31	5.98	2.71	4.22	1.16	2.92	0.63	1.95	0.18	0.92	0.03	0.59	0.01										
70									11.1	11.1	6.97	3.6	4.92	1.54	3.4	0.81	2.28	0.24	1.08	0.04	0.69	0.02										
80											7.97	4.61	5.62	1.97	3.89	1	2.6	0.3	1.23	0.05	0.79	0.02										
90											8.96	5.73	6.33	2.46	4.38	1.22	2.93	0.38	1.39	0.06	0.89	0.03										
100											9.96	6.97	7.03	2.99	4.86	1.84	3.25	0.46	1.54	0.07	0.98	0.03										
125											12.5	10.5	8.79	4.52	6.08	2.56	4.06	0.69	1.92	0.11	1.23	0.04	0.79	0.01								
150													10.6	6.33	7.29	3.43	4.88	1.07	2.31	0.16	1.48	0.05	0.95	0.02								
175															8.51	4.39	5.69	1.29	2.69	0.21	1.72	0.07	1.1	0.02								
200															9.72	6.64	6.5	1.65	3.08	0.27	1.97	0.09	1.26	0.03								
250															12.2	9.31	8.13	2.49	3.85	0.4	2.46	0.13	1.58	0.05	0.99	0.01						
300																	9.75	3.5	4.62	0.57	2.95	0.19	1.89	0.06	1.19	0.02	0.94	0.01				
350																	11.4	4.64	5.39	0.75	3.44	0.26	2.21	0.09	1.39	0.03	1.09	0.02				
400																			6.16	0.97	3.94	0.32	2.52	0.11	1.59	0.03	1.25	0.02				
450																			6.93	1.2	4.43	0.4	2.84	0.14	1.78	0.04	1.4	0.03	1.11	0.01		
500																			7.69	1.46	4.92	0.49	3.15	0.16	1.98	0.05	1.56	0.03	1.23	0.02		
600																			9.23	2.04	5.9	0.69	3.78	0.23	2.38	0.07	1.87	0.04	1.48	0.02	1.17	0.01
700																			10.8	2.72	6.89	0.92	4.41	0.31	2.78	0.1	2.19	0.06	1.72	0.03	1.36	0.02
800																					7.87	1.17	5.04	0.4	3.17	0.13	2.5	0.07	1.97	0.04	1.55	0.02
900																					8.85	1.46	5.67	0.49	3.57	0.16	2.81	0.09	2.21	0.05	1.75	0.03
1000																					9.84	1.78	6.3	0.6	3.97	0.19	3.12	0.11	2.46	0.06	1.94	0.03
2000																							12.6	2.17	7.93	0.7	6.24	0.39	4.92	0.22	3.89	0.13
2500																									9.92	1.07	7.8	0.59	6.15	0.33	4.86	0.19
5000																													12.3	1.2	9.72	0.68
7500																															14.6	1.43

See comments below

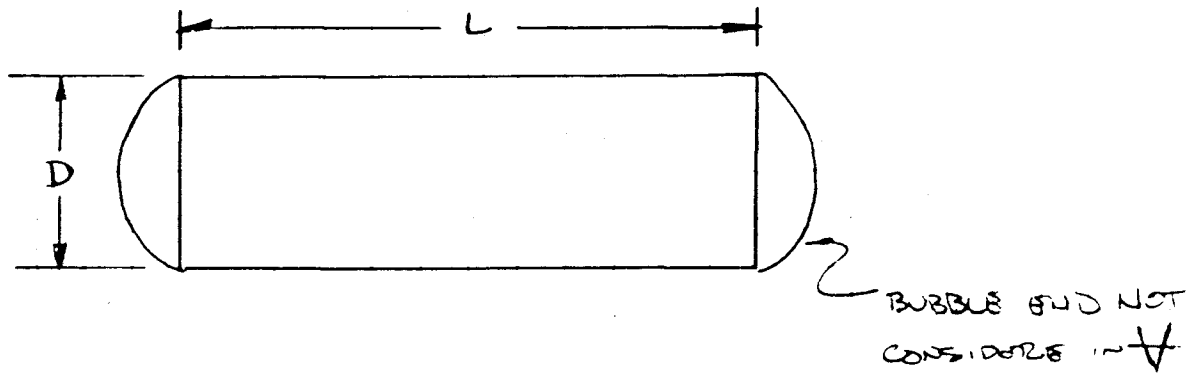
TABLE 14
PROLINE™ PRO 45 VELOCITIES AND PRESSURE DROPS

Flow Rate gpm	2 V	2 P	2½ V	2½ P	3 V	3 P	4 V	4 P	6 V	6 P	7 V	7 P	10 V	10 P	12 V	12 P	14 V	14 P	16 V	16 P	18 V	18 P	20 V	20 P	24 V	24 P
5	0.38	0.01																								
7	0.53	0.03	0.37	0.01																						
10	0.76	0.05	0.53	0.02	0.37	0.01																				
15	1.13	0.1	0.8	0.05	0.55	0.02																				
20	1.51	0.18	1.07	0.08	0.74	0.03	0.5	0.01																		
25	1.89	0.27	1.34	0.12	0.92	0.05	0.62	0.02																		
30	2.27	0.38	1.6	0.16	1.11	0.06	0.74	0.03																		
35	2.64	0.51	1.87	0.22	1.29	0.09	0.87	0.03																		
40	3.02	0.65	2.14	0.28	1.48	0.11	0.99	0.04																		
45	3.4	0.81	2.4	0.35	1.66	0.14	1.12	0.05																		
50	3.78	0.99	2.67	0.42	1.84	0.17	1.24	0.06																		
60	4.53	1.38	3.2	0.59	2.22	0.24	1.49	0.09	0.7	0.01																
70	5.29	1.84	3.74	0.79	2.59	0.32	1.74	0.12	0.82	0.02																
80	6.04	2.35	4.27	1.03	2.96	0.41	1.99	0.16	0.94	0.03																
90	6.8	2.93	4.8	1.26	3.33	0.52	2.23	0.19	1.05	0.03																
100	7.55	3.56	5.34	1.53	3.69	0.62	2.48	0.24	1.17	0.04																
125	9.44	5.38	6.68	2.34	4.62	0.94	3.1	0.36	1.46	0.06	0.93	0.01														
150	11.3		8.01	3.24	5.54	1.33	3.72	0.5	1.76	0.08	1.12	0.03														
175			9.35	4.31	6.47	1.76	4.34	0.67	2.05	0.11	1.31	0.03	0.84	0.01												
200			10.68	5.53	7.39	2.26	4.96	0.86	2.34	0.14	1.5	0.03	0.96	0.02												
250					9.24	3.41	6.2	1.29	2.93	0.21	1.87	0.05	1.2	0.02												
300					11.08	4.78	7.44	1.81	3.51	0.29	2.24	0.07	1.44	0.03												
350							8.68	2.42	4.1	0.39	2.62	0.1	1.68	0.04	1.06	0.01										
400							9.93	3.09	4.68	0.5	2.99	0.13	1.92	0.06	1.21	0.02										
450							11.17	3.84	5.27	0.62	3.37	0.16	2.16	0.07	1.36	0.02	1.07									
500									5.85	0.75	3.74	0.19	2.4	0.09	1.51	0.03	1.19	0.02								
600									7.02	1.05	4.49	0.26	2.87	0.12	1.81	0.04	1.43	0.02	1.12	0.01						
700									8.19	1.4	5.24	0.36	3.35	0.15	2.11	0.05	1.66	0.03	1.31	0.02						
800									9.36	1.79	5.98	0.45	3.83	0.2	2.41	0.06	1.9	0.04	1.5	0.02						
900									10.53	2.23	6.73	0.56	4.31	0.26	2.71	0.08	2.14	0.05	1.68	0.03	1.3	0.01				
1000									11.7	2.71	7.48	0.68	4.79	0.31	3.02	0.1	2.38	0.06	1.87	0.03	1.48	0.02	1.2	0.01		
2000											14.96	2.47	9.58	1.11	6.03	0.36	4.75	0.2	3.74	0.11	2.96	0.06	2.39	0.04	1.51	0.01
2500													11.96	1.68	7.54	0.55	5.94	0.31	4.67	0.17	3.69	0.1	2.99	0.06	1.89	0.02
5000																	11.88	1.1	9.35	0.61	7.39	0.35	5.98	0.21	3.77	0.07
7500																			14	0.3	11	0.74	8.97	0.44	5.66	0.14
10000																					14.8	1.26	12	0.75	7.55	0.24

V = Velocity of water in ft/s; P = Pressure drop in psi/100 ft of pipe based upon the Hazen and Williams method, using C = 150.

ES ENGINEERING-SCIENCE

Client	Rocky Flats	Job No.	D0075.02
Subject	Storage Tanks Horizontal Sizing	By	CGSHORN
		Checked	RLA
Sheet	1 of 1	Date	7/15/88
Rev.			



15,000 gal ÷ 7.48 gal/cf = 2,005 cf.

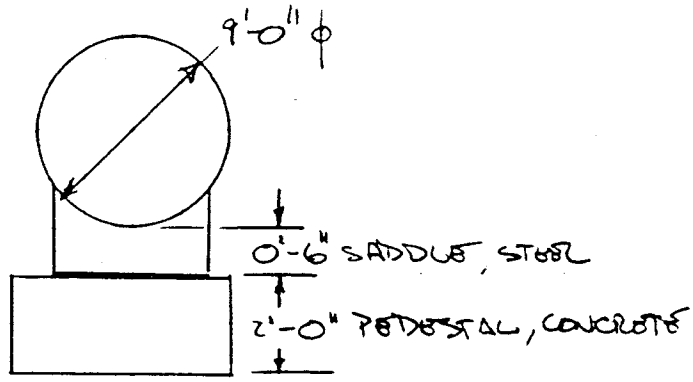
$$2{,}005\ cf = \frac{\pi D^2}{4} \cdot L$$

$$2{,}005 = \frac{\pi (9)^2}{4} \cdot L$$

$$L = 31.5\ ft \approx 32.0\ ft.$$

$$\text{Actual } \forall = \frac{\pi (9)^2}{4} \cdot 32$$

$$\forall = 2{,}035.75\ cf = 15{,}227.4\ gal.$$



ROCKWELL INTERNATIONAL
TANK 201 THRU 204
INSULATION / HEATING

DE 075.02
VM
GSH

1 2
08/09/88

ASSUME 1 1/2" THK INSULATION U = .167
BTU/HR-SF-°F W/ ALUM. SHEET

Q = A × U × Δt [BTU/HR]

A = (24 × π × 9.25 + 2 × .755 × 9.25²) = 1,122.4 SF

U = .167

ΔT = 35° − (−30) = 65°F −30°F THE LOWEST RECORDED FOR DENVER

Q = 1,122.4 × .167 × 65 = 12,185 BTU/HR

WIND EFFECT 35 MPH → FACTOR 3.3

SAFETY FACTOR 2 (ASSUMED)

HEAT LOSS Q_{WALLS} = 12,185 × 3.3 × 2 = 80,420 BTU/

HEAT LOSS DUE TO VENTING

4 AIR CHANGES OF AIR ABOVE THE WATER SURFACE

Q_A = 50 CFM × 1.09 × ΔT = 5,630 BTU/HR

TOTAL HEAT LOSS Q_T = 86,100 BTU/HR

REQUIRED HEATER = 86,100 / 3,415 = 25 KW

ADDITIONAL SAFETY

WATER HEAT CONTENT $Q = m \times Cp \times \Delta t$

$Q = 15{,}300 \times 8.33 \times 1.0 \times 3 = 382{,}350$ BTU

ASSUME 3 × 24 HRS WITHOUT PUMPING

$\frac{382{,}350}{3 \times 24} = 5{,}310$ BTU/HR → 1.5 KW

LESS REQ'D

SUMMARY: 1. EITHER PROVIDE STILL AIR CONDITION AROUND TANKS (IF SIMPLE BLDG. W/OUT INSULATION PROVIDED NO HEATING AT ALL IS NEEDED OR:

2. PROVIDE 1½" THK INSULATION OF U = .167 BTU/SF °F HR MINIMUM AND 25 KW IMMERSION HEATER FOR EA. TANK. YOU MAY USE 30 KW TO HAVE ADDITIONAL 20% CAPACITY

HEATING LOAD

U_{WALL} = .10 BTU/HR °F SF (AGED INSULATION)

U_{DOOR} = .49 — " — SOLID WOOD 1.5 [illegible]

U_{GLASS} = .49 — " — (DOUBLE GLASS)

U_{ROOF} = .10 — " — (AGED INSULATION)

$U_{PARTITION}$ = .10 — " —

WALLS $(3\times12\times10-2.5\times6.67)\times.10\times(70-(-5))$ =	2,575 BTU/HR
ROOF $12\times12\times.10\times75$ =	1,080 — " —
DOOR $2\times2.5\times6.67\times.49\times75$ =	1,230 — " —
GLASS $2.5\times4.0\times.49\times75$ =	370 — " —
PARTITION $[12\times10-(10+16.73)]\times.10\times75$	700 — " —
EDGE $3\times12\times55$ BTU/LF	1,980 — " —
INFILTRATION 1.0 AC/HR $\times12\times12\times10\times\frac{1}{60}\times1.04\times75$	1,960 — " —
TOTAL HEATING LOAD	9,395 BTU/HR

REQ'D HEATER SIZE = $\frac{9\,895}{3,413}$ = 2.9 kW

USE 3.0 kW UNIT HEATER

CROSSWINDER MO. MUH-03-4, DAYTON 2E EQUAL

VENTILATION

ROOM VOL. = 12 × 12 × 10 = 1,440 FT³

4 AC/HR $\frac{1,440 \times 4}{60}$ = 96 CFM USE 100 CFM

6 AC/HR 144 150 CFM

8 AC/HR 200 CFM

12 AC/HR 300 CFM

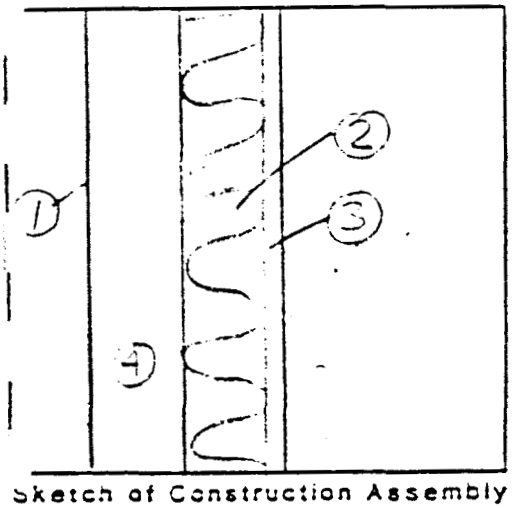
USE LOREN-COOK CEILING EXH. FAN MODEL GEMINI 5-15 CAP. 375 CFM @ .25" SP W/ ELEC. MOTOR 155 W, 1500 RPM, 115V-1Φ-60 Hz. W/ VARIABLE SPEED CONTROLLER FSC, WALL CAP WC-50 W/ 1/2" MESH ALUM. BIRDSCREEN; PENN ZEPHYR Z-10 W/ SL 20 WALL CAP, LT 30 VARIABLE SPEED CONTROLLER OR UL-LISTED, AMCA CERTIFIED FOR AIR FLOW AND ACOUSTICAL PERFORMANCE EQUAL.

TABLE 1 CLIMATIC CONDITIONS FOR THE UNITED STATES[a]

Col. 1	Col. 2		Col. 3		Col. 4	Winter[d] Col. 5		Summer[e] Col. 6			Col. 7	Col. 8		
State and Station	Latitude[b]		Longitude[b]		Elevation[c]	Design Dry-Bulb		Design Dry-Bulb and Mean Coincident Wet-Bulb			Mean Daily	Design Wet-Bulb		
	°	′	°	′	Ft	99%	97.5%	1%	2.5%	5%	Range	1%	2.5%	5%
Concord	38	0	122	0	195	24	27	100/69	97/68	94/67	32	71	70	68
Covina	34	0	117	5	575	32	35	98/69	95/68	92/67	31	73	71	70
Crescent City AP	41	5	124	0	50	31	33	68/60	65/59	63/58	18	62	60	59
Downey	34	0	118	1	116	37	40	93/70	89/70	86/69	22	72	71	70
El Cajon	32	4	117	0	525	42	44	83/69	80/69	78/68	30	71	70	68
El Centro AP (S)	32	5	115	4	−30	35	38	112/74	110/74	108/74	34	81	80	78
Escondido	33	0	117	1	660	39	41	89/68	85/68	82/68	30	71	70	69
Eureaka/ Arcata AP	41	0	124	1	217	31	33	68/60	65/59	63/58	11	62	60	59
Fairfield-Travis AFB	38	2	122	0	72	29	32	99/68	95/67	91/66	34	70	68	67
Fresno AP (S)	36	5	119	4	326	28	30	102/70	100/69	97/68	34	72	71	70
Hamilton AFB	38	0	122	3	3	30	32	89/68	84/66	80/65	28	72	69	67
Laguna Beach	33	3	117	5	35	41	43	83/68	80/68	77/67	18	70	69	68
Livermore	37	4	122	0	545	24	27	100/69	97/68	93/67	24	71	70	68
Lompoc, Vandenburg AFB	34	4	120	3	552	35	38	75/61	70/61	67/60	20	63	61	60
Long Beach AP	33	5	118	1	34	41	43	83/68	80/68	77/67	22	70	69	68
Los Angeles AP (S)	34	0	118	2	99	41	43	83/68	80/68	77/67	15	70	69	68
Los Angeles CO (S)	34	0	118	1	312	37	40	93/70	89/70	86/69	20	72	71	70
Merced-Castle AFB	37	2	120	3	178	29	31	102/70	99/69	96/68	36	72	71	70
Modesto	37	4	121	0	91	28	30	101/69	98/68	95/67	36	71	70	69
Monterey	36	4	121	5	38	35	38	75/63	71/61	68/61	20	64	62	61
Napa	38	2	122	2	16	30	32	100/69	96/68	92/67	30	71	69	68
Needles AP	34	5	114	4	913	30	33	112/71	110/71	108/70	27	75	75	74
Oakland AP	37	4	122	1	3	34	36	85/64	80/63	75/62	19	66	64	63
Oceanside	33	1	117	2	30	41	43	83/68	80/68	77/67	13	70	69	68
Ontario	34	0	117	36	995	31	33	102/70	99/69	96/67	36	74	72	71
Oxnard	34	1	119	1	43	34	36	83/66	80/64	77/63	19	70	68	67
Palmdale AP	34	4	118	1	2517	18	22	103/65	101/65	98/64	35	69	67	66
Palm Springs	33	5	116	4	411	33	35	112/71	110/70	108/70	35	76	74	73
Pasadena	34	1	118	1	864	32	35	98/69	95/68	92/67	29	73	71	70
Petaluma	38	1	122	4	27	26	29	94/68	90/66	87/65	31	72	70	68
Pomona CO	34	0	117	5	871	28	30	102/70	99/69	95/68	36	74	72	71
Redding AP	40	3	122	1	495	29	31	105/68	102/67	100/66	32	71	69	68
Redlands	34	0	117	1	1318	31	33	102/70	99/69	96/68	33	74	72	71
Richmond	38	0	122	2	55	34	36	85/64	80/63	75/62	17	66	64	63
Riverside-March AFB (S)	33	5	117	2	1511	29	32	100/68	98/68	95/67	37	72	71	70
Sacramento AP	38	3	121	3	17	30	32	101/70	98/70	94/69	36	72	71	70
Salinas AP	36	4	121	4	74	30	32	74/61	70/60	67/59	24	62	61	59
San Bernardino, Norton AFB	34	1	117	1	1125	31	33	102/70	99/69	96/68	38	74	72	71
San Diego AP	32	4	117	1	19	42	44	83/69	80/69	78/68	12	71	70	68
San Fernando	34	1	118	3	977	37	39	95/68	91/68	88/67	38	71	70	69
San Francisco AP	37	4	122	2	8	35	38	82/64	77/63	73/62	20	65	64	62
San Francisco CO	37	5	122	3	52	38	40	74/63	71/62	69/61	14	64	62	61
San Jose AP	37	2	122	0	70r	34	36	85/66	81/65	77/64	26	68	67	65
San Luis Obispo	35	2	120	4	315	33	35	92/69	88/70	84/69	26	73	71	70
Santa Ana AP	33	4	117	5	115r	37	39	89/69	85/68	82/68	28	71	70	69
Santa Barbara MAP	34	3	119	5	10	34	36	81/67	77/66	75/65	24	68	67	66
Santa Cruz	37	0	122	0	125	35	38	75/63	71/61	68/61	28	64	62	61
Santa Maria AP (S)	34	5	120	3	238	31	33	81/64	76/63	73/62	23	65	64	63
Santa Monica CO	34	0	118	3	57	41	43	83/68	80/68	77/67	16	70	69	68
Santa Paula	34	2	119	0	263	33	35	90/68	86/67	84/66	36	71	69	68
Santa Rosa	38	3	122	5	167	27	29	99/68	95/67	91/66	34	70	68	67
Stockton AP	37	5	121	2	28	28	30	100/69	97/68	94/67	37	71	70	68
Ukiah	39	1	122	4	620	27	29	99/69	95/68	91/67	40	70	68	67
Visalia	36	2	119	1	354	28	30	102/70	100/69	97/68	38	72	71	70
Yreka	41	4	122	4	2625	13	17	95/65	92/64	89/63	38	67	65	64
Yuba City	39	1	121	4	70	29	31	104/68	101/67	99/66	36	71	69	68
COLORADO														
Alamosa AP	37	3	105	5	7536	−21	−16	84/57	82/57	80/57	35	62	61	60
Boulder	40	0	105	2	5385	−2	8	93/59	91/59	89/59	27	64	63	62
Colorado Springs AP	38	5	104	4	6173	−3	2	91/58	88/57	86/57	30	63	62	61
Denver AP	39	5	104	5	5283	−5	1	93/59	91/59	89/59	28	64	63	62
Durango	37	1	107	5	6550	−1	4	89/59	87/59	85/59	30	64	63	62

Check one and write in construction assembly number below (e.g. Wall-1, Roof-2, etc.)

☐ Wall- ____
☐ Roof- ____
☐ Floor- ____



Sketch of Construction Assembly

Framing type: _____

If wood complete the following and adjust construction assembly for framing:

Size: ____" X ____"

Spacing: _____" O.C.

Indicate area, weight of construction assembly, and appropriate factors below:

Wall: Area _____ ft^2
Weight _____ lb/ft^3
MCF _____
TD_{eq} _____

Roof: Area _____ ft^2
Weight _____ lb/ft^3
M_c _____
A_c _____

Floor: Area _____ ft^2
(Slab only)

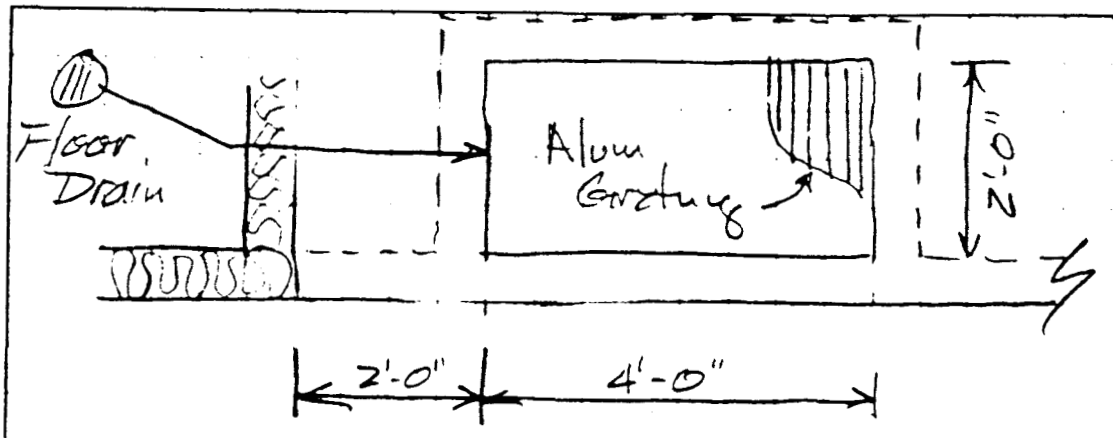
List of Construction Components	~~AIR SPACE~~	R-Value WALL
1. METAL PANEL	.04	0.04
2. R-11 INSULATION	11.00	11.00
3. 5/8" GYP BOARD	.56	.56
4. AIR SPACE > 3.5"	1.05	
5.		
6.		
7.		
8.		

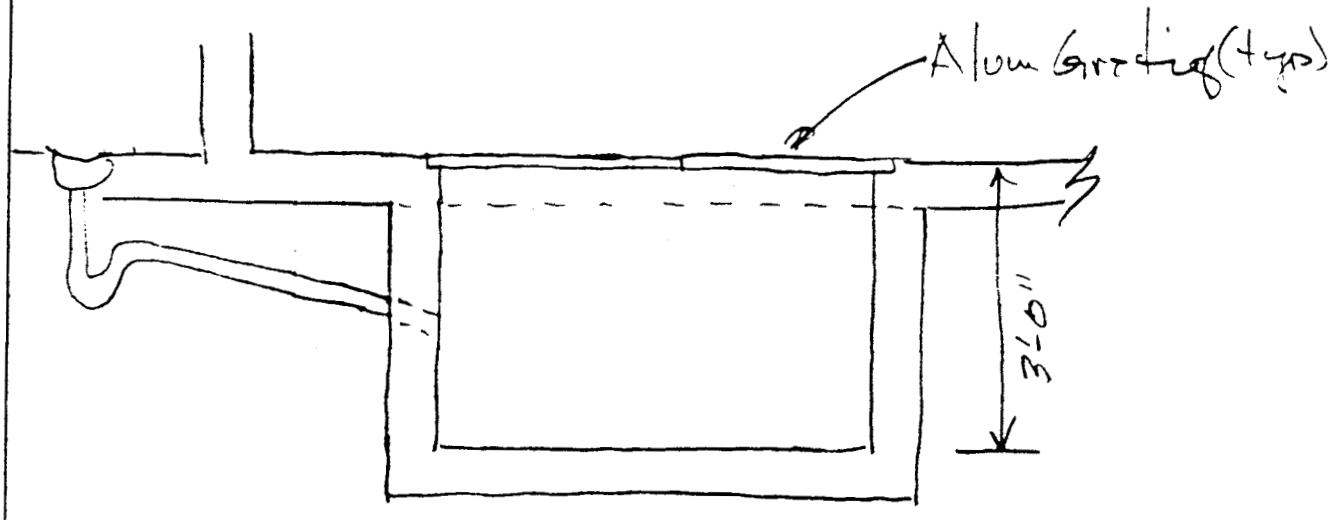
	~~Cooling~~	Heating
Outside Surface Air Film	.17	.17
Inside Surface Air Film	.62	.68
Total Thermal Resistance (R_T)	12.45	12.45
U-Value ($1/R_T$)	.07	.09

Note: Total R_T and U-Value must be adjusted for the effect of framing when appropriate.

ES ENGINEERING-SCIENCE

Client: Rocky Flats
Subject: Bldg 830 Sump
Job No. DE075.02
By: RLA
Checked: GSH
Sheet 1 of 1
Date: 8/11/88
Rev.





Volume: 4 X 2 X 2 (water depth) = 16 ft³

≅ 120 gallons

Pump capacity ≅ 25 gpm

Run time ≅ 5 minutes

Two pumps 1- Active, 1- Stdby) Automatic alternator

STRUCTURAL CALCULATIONS

	SH #
STORAGE TANK PADS & RET. WALLS.	2 - 5
BUILDING 881 HILLSIDE / TREATMENT UNITS PADS	6

STANDARDS:

1985 U.B.C.

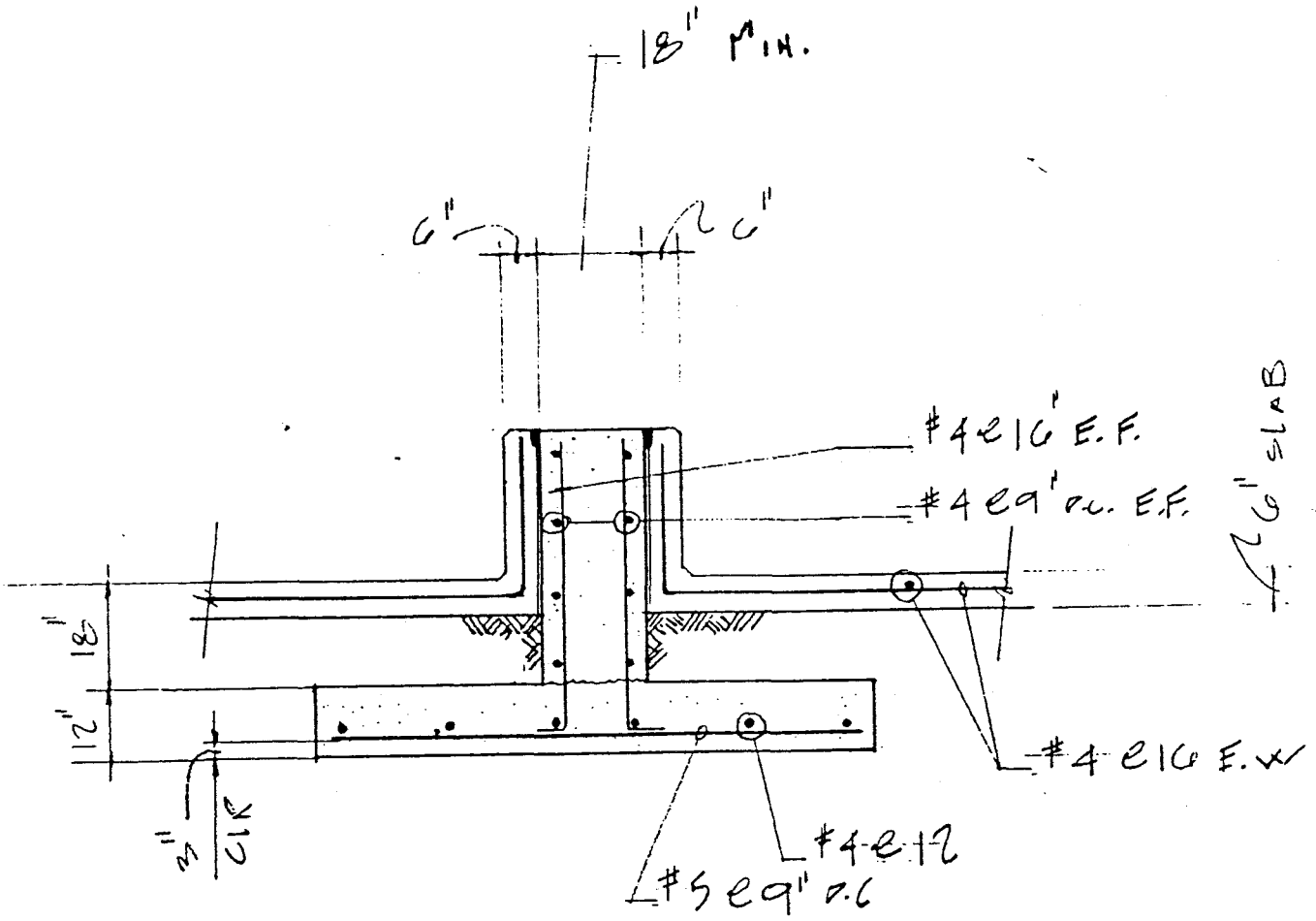
A.C.I. 318-83

ENGINEERING-SCIENCE

Client RMP CO | Job No. PE075.02 | Sheet 1A of

Subject ROCKY FLATS | By A.C | Date 8-1

Checked UAHE | Rev.



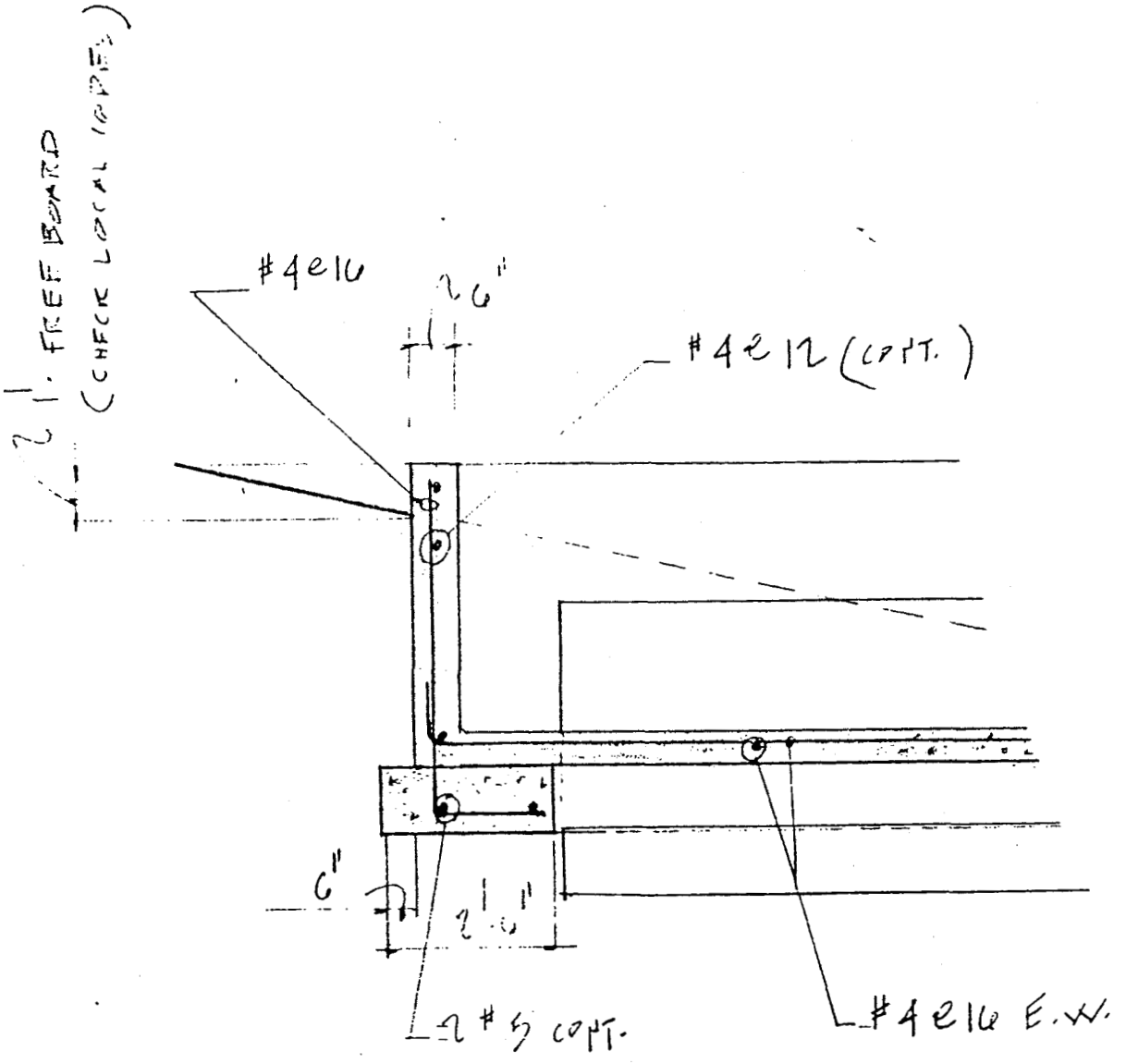
TANK FOOTING

ENGINEERING-SCIENCE

Client RMP CO | Job No. D8075.02 | Sheet 1B of

Subject ROCKY FLATS | By A.C | Date

Checked VAHE | Rev.



TYPICAL RETAINING WALL

ENGINEERING-SCIENCE

Client RMPCO. Job No. PE075.02 Sheet 2 of

Subject ROCKY FLATS By A.C Date 8-1

Checked VAHE Rev.

STORAGE TANK PAD.

TANK FOOTINGS:

TANK DIM: $\begin{cases} D = 9' \\ L = 34' \end{cases}$

TANK VOLUME $= \pi D^2/4 \times L = 3.14 \times 9^2/4 \times 34 = 2161.89 ft^3$

LIQUID WT $= 62.4 \#/ft^3$

TANK WT $= 62.4 \times 2161.89 \cong 134902^\#$ LIQUID

$= 14500^\#$ STEEL SHELL

$149402^\#$

TANK SUPPORTED ON TWO PADS.

$P = 149402^\#/2 = 74701^\#$

DETERMINE FTG. SIZE AND SOIL PRESSURE.

ASSUME 8'x10' PAD 15" DEEP.

PAD WT: $1.25' \times 8' \times 10' \times 150 \#/ft^3 = 15000^\#$

PEDESTAL WT $= 1.5 \times 4' \times 10' \times 150 \#/ft^3 = 9000^\#$

TOTAL WT $= 74701^\# + 15000^\# + 9000^\# = 98701^\#$

$q = 98701^\#/8' \times 10' = 1233.76$ psf $\not< 2500$ psf (17.1

USE 8x10 FTG. WITH 1'-0" MIN. DEPTH.

FOOTING REINFORCEMENT

IGNORE THE WT. OF THE FOOTING FOR MOMENT AND SHEAR CALCULATIONS.

NOTE: SINCE 3000 PSI CONCRETE WILL BE USED FOR THE CONTAINEMENT SLAB & WALLS USE 3000 PSI CONCRETE AT TANK FTG'S.

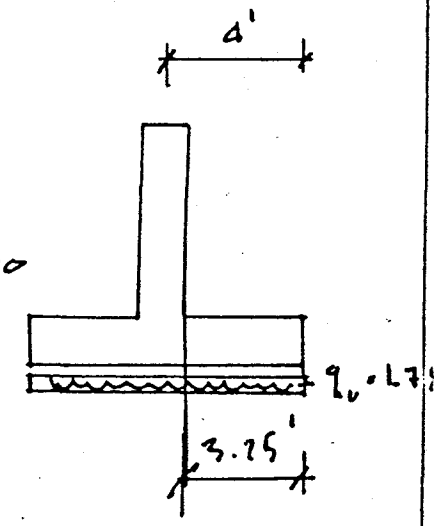
$q = (74701 + 9000)/80 = 1046.26$ psf.

$q_u = 1.7 \times 1046.26 = 1779$ psf. $= 1.78$ ksf.

$M_u = w_u \ell^2/2 = 1.78 \times 3.25^2/2 = 9.4$ k-ft

$V_u = w_u \ell = 1.78 \times 3.25 = 5.78$ k

$d = 12'' - (3'' + .625/2) = 8.68''$



CHECK SHEAR

$\phi V_c = .85 \times [2 \times \sqrt{3000} \times 12 \times 8.68]/1000$

$= 9.69^k > 5.78^k$ O.K.

REINFORCEMENT

$bd^2 = 12 \times 8.68^2 = 904.1$

$K_n = 12000 M_u / bd^2 = 12000 \times 9.4 / 904.1 = 124.76$ LESS THAN MINIMUM.

$1.33 \times A_{s\,req} = 1.33 \times (M_u / d\, a_n) = 1.33 \times (9.4 / 8.68 \times 4.38) = .33$ in^2.

USE #5 @ 9" O.C $\rightarrow A_s = .41$ in^2

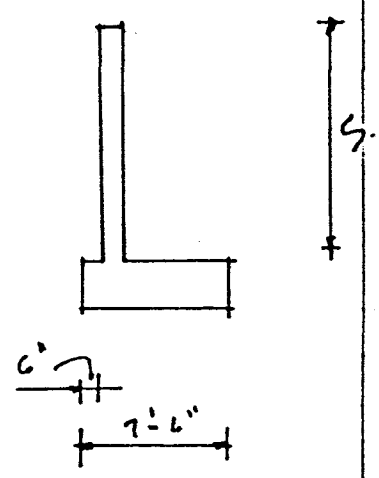
RETAINING WALLS:

2:1 SLOPE → EQUIVALENT FLUID PRESS = 45 #/ft³

$H_{MAX} = 5'$.

$M_o = wH^3/6 = 45 \times 5^3/6 = 937.5$ #-ft

$V_o = wH^2/2 = 45 \times 5^2/2 = 562.5$ #-ft



CHECK OVERTURNING:

USE 7'-6" FTG:

SOIL WT = .5' × 5' × 100 #/ft = 250 #

WALL WT = .5 × 5 × 150 = 375 #

FTG WT = 1 × 7.5 × 150 = 375 #

$M_R = 250^{\#} \times 2.25' + 375^{\#} \times 1.75' + 375^{\#} \times 1.25' = 1687.5$ #-ft

$F_S = M_R / M_o = 1687.5 / 937.5 = 1.8$ O.K.

SHEAR O.K BY INSPECTION SINCE THE CONTAINMENT SLAB WILL RESTRAIN THE WALL.

CHECK SOIL PRESSURE:

$P = 250 + 375 + 375 = 1000$ #

$M = 937.5$ #-ft $- (250 \times 1' + 375 \times .5') = 500$ #

$e = M/P = .5'$ OUTSIDE THE MIDDLE THIRD.

ENGINEERING-SCIENCE

Client RMP co | Job No. DE0 75.02 | Sheet 5 of
Subject ROCKY FLATS | By A.C | Date 8-1
Checked VAHE | Rev.

$\ell = (w/2 - e) \times 3 = (2.5/2 - .5) \times 3 = 2.75.$

$q_{max}\, \ell^2/2 = P$

$q_{max} = 2P/\ell^2 = 2 \times 1000/2.25^2 = 395.$ psf. < 2500 psf O

— WALL REINFORCEMENT:

$M_U = 1.7 \times M_o = 1.7 \times 937.5 = 1.59^{K\text{-}ft.}$

$V_U = 1.7 \times V = 1.7 \times 562.5 = .96^{K}.$

$d = 3''$ (6" WALL)

CHECK SHEAR

$\phi V_c = .85 \times [2 \times \sqrt{3000} \times 12 \times 3]/1000 = 3.35^{K} > .96^{K}$ O.K.

REINFORCEMENT

$bd^2 = 12 \times 3^2 = 108$

$K_u = 12000 \times 1.59/108 = 176.66$

$\rho = .0035$

$A_{s\,req} = .0035 \times 12 \times 3 = .126\ in^2$

USE #4 @ 16 $A_s = .15\ in^2$ O.K.

FTG. REINFORCEMENT: USE #4 @ 16 O.K BY INSPECTION

ENGINEERING-SCIENCE

Client R.M.P CO. Job No. DF075.02 Sheet 6 of

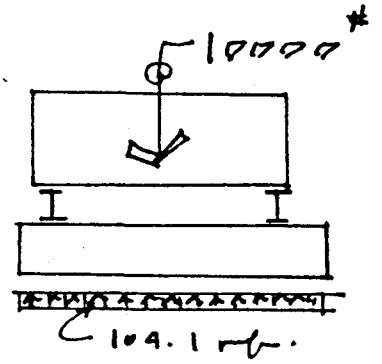
Subject ROCKY FLATS By A.C Date 8-1

Checked VAHE Rev.

TREATMENT UNITS PADS:

TOTAL LOAD = 10000# TO BE SUPPORTED ON TWO SKIDS, 10' LONG SPACED @ 16' O.C.

MIN. PAD SIZE = 8' x 12' = 96 ft²



$q = 10000/96 = 104.1$ plf (WT OF FTG. NOT INCLUDED)

$q_u = 1.7 \times 104.1 = 177$ plf.

NOTE: USE 18" MIN FTG. FOR MASS REQUIREMENTS (VERIFY WITH EQ. MFR.)

CONSERVATIVELY:

$M_u = wl^2/8 = .177 \times 6^2/8 = .79$ k-ft.

MINIMUM STEEL

$A_{s\,min} = 1.33 \times M_u/d_{an} = 1.33 \times .79/(14.68 \times 4.45) = .016$ in²

MINIMUM SLAB REINF. $= (.0018 \times bd) =$

$= .0018 \times 12 \times 14.68 = .31$

USE #5 @ 12 E.W.

SHEAR O.K BY INSPECTION.

8.0 FOUNDATION SLAB RECOMMENDATIONS FOR THE WATER STORAGE FACILITY

Beneath a thin layer of TOPSOIL, the boring at the storage tank facility encountered gravelly CLAY to 9 (nine) feet underlain by approximately 10 (ten) feet of SAND and GRAVEL.

Based on the laboratory test results and our analysis, it is our opinion that the storage tanks can be satisfactorily supported on the proposed pad or mat foundation. We recommend a maximum allowable net bearing pressure of 2,500 (two thousand five hundred) psf be used bearing on the gravelly CLAY material.

Based on the above design pressure and assuming a relatively stable bearing surface is established, total settlements should be minimal.

No expansive soils were encountered in the borings at the storage tank facility. Groundwater was present at approximately 12 (twelve) feet below the existing ground surface. It is not anticipated that the existing groundwater level will interfere with construction or the support function of the tank facility foundation.

The foundation excavation should not be left open for extended periods of time. All soft, wet, very loose, or otherwise disturbed materials should be removed prior to concrete placement.

ES ENGINEERING-SCIENCE

Client: ROCKY FLATS
Subject: ELECTRICAL LOAD CALCS.

Job No. DE075.02
By Chapman
Checked

Sheet 1 of 1
Date 8-17-88
Rev.

MOTOR CONTROL CENTER MCC 1

	AMPS AT 480V, 3Ø
TANK 001 IMMERSION HEATER - 30 KW	36.0
" 002 " " "	36.0
" 003 " " "	36.0
" 004 " " "	36.0
UH-1 HEATER - 3 KW	3.6
UCP-1 TREATMENT PLANT - 70 KVA	84.0
FEED PUMPS - (2) 1/2 HP	2.0
WELL PUMPS - (7) 1/2 HP	7.0
TRANSFORMER TP - 30 KVA	36.0
	276.6

ILLUMINATION SUMMARY SHE

ROOM NAME	AREA WIDTH	AREA LENGTH	AREA HEIGHT(hrc)	ROOM CAVITY RATIO	% CEILING REFLECTANCE	% WALL REFLECTANCE	COEFFICIENT OF UTILIZATION	MAINTENANCE FACTOR	LUMENS PER LAMP	NUMBER OF LAMPS	FOOTCANDLES	REMARKS (FIXTURE TYPE, MANUFACTURER NO., ETC.)
OFFICE/ UTILITY ROOM	11	16	7½	6.7	70	50	.36	.75	3050	8	52	LITHONIA VC440

ROOM CAVITY RATIO = $\frac{5 \times hrc\ (RM.\ LENGTH + RM.\ WIDTH)}{RM.\ LENGTH \times RM.\ WIDTH}$

FOOTCANDLES = $\frac{LAMP\ LUMENS \times NO.\ LAMPS \times C.U. \times M.F.}{LENGTH \times WIDTH}$

FLOOR REFLECTANCE = 20%

PROJECT: BUILDING 830 ROCKY FLATS

JOB NO.: DE075.02

BY: Chapman

DATE: 8-17-88

ENGINEERING SCIENCE

Client: Rocky Flats | Job No. | Sheet ___ of ___
Subject: Cable Sizeing | By: JJD | Date: 8/23/88
Checked | Rev.

Cable Sizing for Direct Burial Cable

- Load at each pump panel: say ½ HP plus misc.

  ∴ $S_{pm} \sim 1$ KVA

- Max. on one circuit is 2 pump panels

  ∴ $S_{pm} \sim 2$ KVA at 480 Volts, 3φ

  ∴ $\frac{2\ KVA}{(\sqrt{3})(480V)} = \frac{2000}{800} \approx$ 3 Amps

- Per pump drawing, distances to each site are:

  a. 1275' – Collection Sump No. 1
  b. 875' – " Well
  c. 975' – " Sump No. 2
  d. 875' – " " For Bldg 881

- ∴ Use 1300' of run

- Per (W) Cat. 55-000, 8th Edition, Pages 26 & 27.

$$\frac{(3A)(1300')}{100}(.215) \approx 8.6\ \text{Volts}$$

VD Factor for No. 10

∴ $\frac{8.6V}{480V} \approx 2\%$ ∴ OK for #10

ES-COR 8 (9/86)

Client Rolling Fork | Job No. | Sheet ___ of ___
Subject Conduit Sizing | By JVD | Date 8/23/95
Checked | Rev.

1. POWER CABLE

- PER OKONITE SECTION 3, SHEET 10. TYPE MC W/ C-L-X SHEATH

- 4 No. 10 → O.D. = .73 in AREA = .42 sq. in

∴ 1 - 4C No. 10 → 1 1/4" CONDUIT NEEDED

∴ 2 · 4C No. 10 → (2)(.42) = .84 sq in → 2" CONDUIT NEEDED

2. CONTROL CABLE

- PER OKONITE SECTION 3, SHEET 10. TYPE MC WITH C-L-X SHEATH

- 12 No. 10 → O.D. → 1.1 in AREA = 0.95 sq. in

∴ 1 - 12 CONDUCTOR No. 10 → 2" CONDUIT

∴ 2 - 12 CONDUCTOR No. 10 → (2)(.95) = 1.9 sq in → 3" CONDUIT

3. INSTRUMENTATION CABLE

- PER OKONITE SECTION 5, SHEET 9; TYPE MC WITH C-L-X SHEATH

- CABLE W/ 4 PAIRS No. 16 → O.D. = .85 in AREA = .57 sq. in → 1 1/4"

- 2 CABLES W/ 4 PAIRS No. 16 → (2)(.57 sq. in) = 1.14 sq in → 2" CONDUIT

4. CONTROL CABLE / INSTRUMENTATION CABLE

- 1 CABLE W/ 12 No. 10 AND 1 CABLE W/ 4 PAIRS No. 16 → .95 + .57 = 1.52 sq. in → 2 1/2" CONDUIT

ES COR 8 (9/86)

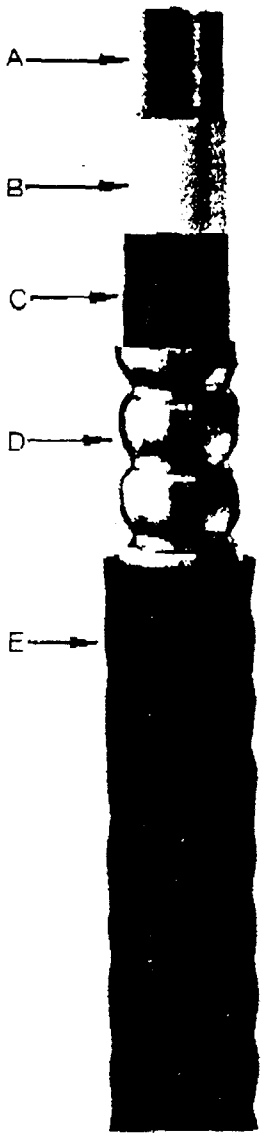
08 30 95 01:39 PM

Gas-Blocked C-L-X® Type MC (XHHW)

600V Power and Control Cable—Aluminum Sheath

Multiple Copper Conductors/90C Rating

For Cable Tray Use • Sunlight Resistant • For Direct Burial



A Bare, Annealed, Stranded Copper Conductors Insulation—Color Coded for Identification
B Gas/Vapor Blocking
C Binder Tape
D Impervious, Continuous Corrugated, Aluminum C-L-X Sheath
E Black Okoseal Jacket

Insulation

X-Olene® is Okonite's trade name for its chemically cross-linked (vulcanized) polyethylene, with high dielectric strength.

Color Coding

Conductors are color coded using base colors and tracers as shown on the back of this Data Sheet.

Assembly and Coverings

The conductors are cabled together with non-hygroscopic fillers, elastomeric filling compound and a binder tape overall. The C-L-X® sheath exceeds the grounding conductor requirements of Table 250-95 of the 1984 NEC and UL 1569. Where indicated, grounding conductor(s), located in the outer interstice(s), are provided for supplemental grounding. The impervious, continuous, corrugated aluminum C-L-X sheath provides complete protection against moisture, liquids and gases and has excellent mechanical strength. For direct burial in the ground, embedment in concrete, or for areas subjected to corrosive atmospheres, the C-L-X sheath is protected with a black Okoseal® (PVC) jacket.

Applications

Gas-Blocked C-L-X Type MC cables have a gas/vapor-tight continuous sheath and a blocked core which will not transmit gases or vapors through the cable core in excess of the quantity permitted for sealing fittings. As authorized by Section 501-5(e) (2) of the 1984 NEC, this cable may be installed without cable seals.

Gas-Blocked C-L-X Type MC cables are recommended an an economical alternate to a wire in conduit system in Class I, Division 2 hazardous locations. They are authorized for use on services, feeders and branch circuits for power, lighting, control and signaling circuits in accordance with Articles 334 and 725 of the NEC.

Gas-Blocked C-L-X Type MC cables may be installed indoors or outdoors, in wet or dry locations, as open runs of cable secured to supports spaced not more than six feet apart, in cable tray, as aerial cable on a messenger, and in any approved raceway.

Specifications

Conductors: Bare soft annealed copper, Class "B" stranding per ASTM B-8.

Insulation: X-Olene per ICEA S-66-524 and UL 44, Labeled UL Type XHHW.

Conductor Identification: Base colors and tracers, grounding conductor colored green.

Assembly: Per UL 1569, with non-hygroscopic fillers, elastomeric filling compound and a binder tape overall.

Sheath: Close fitting, impervious, continuous, corrugated aluminum C-L-X per UL 1569. Exceeds grounding conductor requirements of 1984 NEC Table 250-95.

Jacket: Black Okoseal (PVC) per UL 1569.

Conforms to applicable requirements of IEC 502, 540, and 332-3.

U.L. Listing

C-L-X is UL Listed as Type MC cable. Core blocking against gases/vapors is tested and verified by The Okonite Company.

Product Features

- Authorized for use in Class I, Division 2 hazardous locations.
- Gas/Vapor-tight continuous metallic sheath excludes moisture, gases and liquids.
- Blocked core prevents transmission of gases or vapors through cable core.
- Eliminates cable seals in Class I, Division 2 hazardous locations as authorized in Section 501-5(e) (2) of 1984 NEC.
- Complete pre-packaged, factory tested wiring system.
- Lower installed system cost than conduit systems and required seals.
- Passes the 210,000 BTU Vertical Tray Flame Test utilizing the corner configuration.
- Provides excellent grounding safety.
- Excellent compression and impact resistance.
- For use in cable tray.
- For direct burial.
- Sunlight resistant.
- 90C continuous operating temperature in all types of installations.

130C emergency rating
250C short circuit rating

Gas-Blocked C-L-X® Type MC (XHHW)

600V Power and Control Cable—Aluminum Sheath

Multiple Copper Conductors/90C Rating

For Cable Tray Use - Sunlight Resistant - For Direct Burial

Insulation Thickness: 30 Mils (0.76mm)

	Catalog Number	Conductor Size - AWG (Strands)	Number of Conductors	C-L-X OD - Inches	Cable OD - mm	Cable OD - Inches	C-L-X OD - mm	Cross-Sect. Area* sq./in.	Net Weight - lbs./M'	Approx Ship Weight - lbs./M'	◊Ampacity - 90C (Amps)	◊◊Ampacity - 90C Tray (Amps)
	546-31-5562	14(7x)	2	0.46	11.7	0.57	14.5	0.26	170	200	25	25
♦	546-31-5563		3	0.46	11.7	0.57	14.5	0.26	205	235	25	
♦	546-31-5564		4	0.51	13.0	0.62	15.7	0.30	230	275	20	
♦	546-31-5565		5	0.58	14.6	0.69	17.5	0.37	270	315	20	
♦	546-31-5567		7	0.62	15.7	0.73	18.5	0.42	315	360	17.5	
	546-31-5569		9	0.71	18.0	0.82	20.8	0.53	380	455	17.5	
♦	546-31-5572		12	0.80	20.3	0.91	23.1	0.65	460	535	17.5	
	546-31-5642	12(7x)	2	0.46	11.7	0.57	14.5	0.26	200	230	30	30
♦	546-31-5643		3	0.51	13.0	0.62	15.7	0.30	235	280	30	
	546-31-5644		4	0.58	14.6	0.69	17.5	0.37	290	335	24	
	546-31-5645		5	0.62	15.7	0.73	18.5	0.42	335	380	24	
♦	546-31-5647		7	0.66	16.8	0.77	19.6	0.47	390	430	21	
♦	546-31-5649		9	0.75	19.0	0.86	21.8	0.58	490	565	21	
	546-31-5652		12	0.85	21.6	0.96	24.4	0.72	600	710	21	
	546-31-5722	10(7x)	2	0.58	14.6	0.69	17.5	0.37	270	315	40	40
♦	546-31-5723		3	0.58	14.6	0.69	17.5	0.37	310	355	40	
♦	546-31-5724		4	0.62	15.7	0.73	18.5	0.42	365	410	32	
	546-31-5725		5	0.71	18.0	0.82	20.8	0.53	440	515	32	
	546-31-5727		7	0.75	19.0	0.86	21.8	0.58	535	610	28	
	546-31-5729		9	0.90	22.9	1.01	25.7	0.80	650	760	28	
	546-31-5732		12	0.99	25.1	1.10	27.9	0.95	810	920	28	

♦ **Authorized Stock Item**—Available from our Service Centers.

Minimum Manufacturing Quantity for non-stock items: 5000 ft

Length Tolerance—Cut lengths of 1000 feet or longer are subject to a tolerance of ± 10%, less than 1000 feet, ± 15%.

*Cross-sectional area for calculation of cable tray fill in accordance with NEC Section 318-8.

Jacket Thickness

CLX O.D. (in.)	Thickness (mils)
0-1.50	50
1.51-2.25	60
2.26-3.00	75

Ampacities

◊Ampacities are based on Table 310-16 of the 1984 *National Electrical Code* for XHHW conductors rated 90C, in a multiconductor cable, at an ambient temperature of 30C (86F).

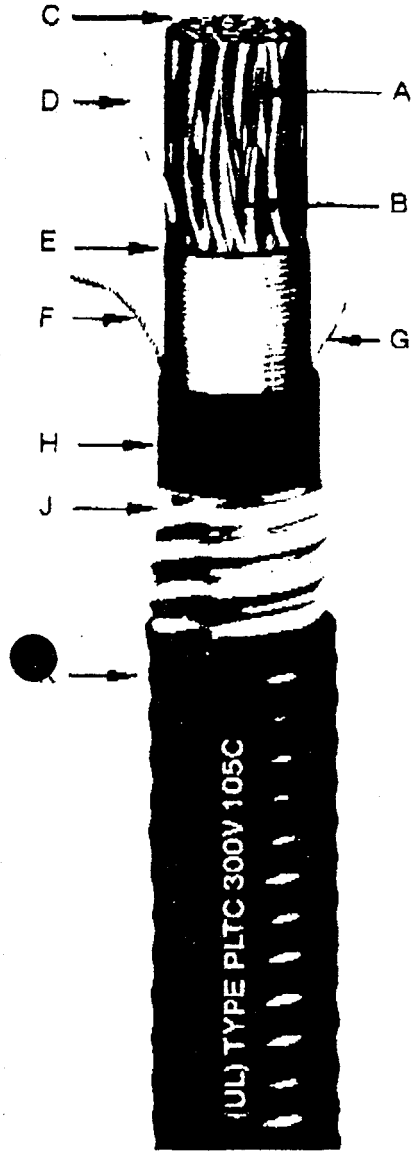
The ampacities shown apply to open runs of cable, installation in any approved raceway, *direct burial in the earth*, or as aerial cable on a messenger. Derating for more than three current carrying conductors within the cable is in accordance with Note 8 to NEC Tables 310-16 through 310-19.

◊◊The ampacities shown apply to cables installed in cable tray in accordance with NEC Section 318-8. Derating for more than three conductors in a cable is not required as authorized by NEC Section 318-10.

C-L-X Type P-OS

Type PLTC Armored Instrumentation Cable

Multiple Pairs or Triads - Overall Shield
300 Volts - 105C Rating
For Cable Tray Use



- **A** Bare Stranded Copper Conductor
- **B** Okoseal Insulation
- **C** Twisted Pairs/Triads
- **D** Communication Wire
- **E** Double Faced Aluminum/ Synthetic Polymer Backed Tape
- **F** Tinned Stranded Copper Drain Wire
- **G** Rip Cord
- **H** Inner Black Okoseal Jacket
- **J** Impervious, Continuous, Corrugated Aluminum C-L-X Sheath
- **K** Outer Black Okoseal Jacket

Specifications

Conductors: Bare soft annealed copper, Class B, 7-strand concentric per ASTM B-8.

Insulation: Flame-retardant Okoseal (PVC) per UL Subject 13, 15 mils nominal thickness, 105C temperature rating.

Conductor Identification: Pigmented black and red in pairs, black, red and blue in triads; red conductor numerically printed for group identification.

Communications Wire: 22 AWG, 7-strand, bare copper conductor, 15 mils nominal flame-retardant Okoseal insulation, 105C temperature rating.

Assembly: Pairs or triads assembled with 1½" - 2½" left-hand lay. Flame-retardant, non-wicking fillers included where required to provide a round cable.

Cable Shield: 2.35 mil blue double faced aluminum/synthetic polymer backed tape overlapped to provide 100% coverage, and a 7-strand tinned copper drain wire, same size as conductor.

Inner Jacket: Black, flame-retardant Okoseal per UL Subject 13. A rip cord is laid longitudinally under the jacket to facilitate removal.

C-L-X Sheath: A close-fitting impervious continuously welded and corrugated aluminum sheath provides complete protection against moisture, liquids, and gases, has excellent mechanical strength and provides equipment grounding through the sheath.

Outer Jacket: Black, flame-retardant Okoseal per UL Subject 13.

UL Listed Type PLTC (Power-Limited Tray Cable) and Power-Limited Circuit Cable for use in Class II or III circuits in accordance with Article 725 of the National Electrical Code.

Applications

C-L-X Type P-OS (Pairs/triads - Overall Shield) instrumentation cables are designed for use as instrumentation, process control and computer cables in Class II or III Power-Limited Circuits as defined in NEC Article 725. They are suitable for installation in wet or dry locations with conductor operating temperature up to 105C. They may be installed in cable tray, in any raceway, as open runs of cable. UL Type PLTC is authorized for use above grade in Class I, Division 2 hazardous locations.

The overall shield eliminates most of the static interference from the electric field radiated by power cables and other electrical equipment.

The C-L-X sheath provides the physical protection against mechanical damage as required in NEC Section 725-18 as well as complete protection against moisture or gases entering the cable.

For dc service in wet locations X-Olene insulation having an overall aluminum C-L-X armor construction is recommended.

Product Features

- Passes flame test for use in cable tray.
- Sunlight resistant
- Oil resistant.
- C-L-X enclosure permits installation in cable tray containing light and power cables without a barrier separator.
- Individual pairs or triads are numbered and color coded for simplified hook-up.
- Good noise rejection.
- Communication wire included in each cable for voice communication during installation or instrument calibration.
- Impervious, continuous sheath excludes moisture, gases and liquids.
- C-L-X sheath exceeds equipment grounding conductor requirements of NEC Section 250-95.
- Excellent compression and impact resistance.
- Lower installed system cost than conduit or EMT systems.
- No limit to number of bends in run.
- OSHA Acceptable.

Additional Information

Sizes, Weights and Dimensions are contained on the reverse of this sheet. For additional information contact your local Okonite representative or Customer Service Center Manager.

C-L-X Type P-OS

Type PLTC Armored Instrumentation Cable

Multiple Pairs or Triads - Overall Shield
00 Volts - 105C Rating
For Cable Tray Use

Section 5: Sheet 8

Catalog Number	Strand Size (AWG)	No. of Pairs	No. of Triads	Inner Jacket Thickness (mils)	Core O.D. (in)	C-L-X O.D. (in)	Outer Jacket (mils)	Cable O.D. (in)	Cross-Sectional Area* (sq in)	Approx Net Weight (lbs/1000')	Approx Ship Weight (lbs/1000')
564-10-3202	20(7X)	2		40	0.37	0.57	50	0.88	0.36	185	220
564-10-3204		4		50	0.43	0.65	50	0.76	0.46	235	295
564-10-3206		6		50	0.51	0.74	50	0.85	0.57	285	345
564-10-3208		8		60	0.55	0.79	50	0.90	0.64	320	380
564-10-3210		10		50	0.61	0.84	50	0.95	0.70	360	420
564-10-3212		12		60	0.65	0.88	50	0.99	0.77	405	495
564-10-3216		16		60	0.69	0.92	50	1.03	0.84	455	550
564-10-3220		20		60	0.76	1.02	50	1.13	1.00	525	620
564-10-3224		24		60	0.84	1.10	50	1.21	1.16	595	700
564-10-3236		36		70	0.97	1.29	50	1.40	1.53	820	945
564-10-3250		50		70	1.14	1.47	50	1.58	1.95	1030	1205
564-15-3204			4	50	0.48	0.65	50	0.76	0.46	260	320
564-15-3208			8	50	0.61	0.84	50	0.95	0.70	375	435
564-15-3212			12	60	0.75	1.02	50	1.13	1.00	500	595
564-15-3216			16	60	0.83	1.10	50	1.21	1.16	595	700
564-15-3224			24	70	1.04	1.37	50	1.48	1.73	855	1035
564-15-3236			36	70	1.19	1.51	60	1.65	2.13	1125	1300
564-10-3302	18(7X)	2		50	0.43	0.65	50	0.76	0.46	230	290
564-10-3304		4		50	0.48	0.65	50	0.76	0.46	265	325
564-10-3306		6		50	0.56	0.79	50	0.90	0.64	330	390
564-10-3308		8		60	0.63	0.88	50	0.99	0.77	400	490
564-10-3310		10		60	0.70	0.97	50	1.08	0.91	455	550
564-10-3312		12		60	0.73	0.97	50	1.08	0.91	485	580
564-10-3316		16		60	0.77	1.06	50	1.17	1.08	570	665
564-10-3320		20		60	0.85	1.10	50	1.21	1.16	645	750
564-10-3324		24		70	0.96	1.29	50	1.40	1.53	810	935
564-10-3336		36		70	1.09	1.42	50	1.53	1.84	1035	1215
564-10-3350		50		80	1.30	1.64	60	1.78	2.48	1390	1640
564-15-3304			4	50	0.53	0.74	50	0.85	0.57	315	375
564-15-3308			8	60	0.70	0.97	50	1.08	0.91	480	575
564-15-3312			12	60	0.84	1.10	50	1.21	1.16	620	725
564-15-3316			16	70	0.95	1.24	50	1.35	1.42	800	920
564-15-3324			24	70	1.17	1.51	60	1.65	2.13	1110	1285
564-15-3336			36	80	1.36	1.74	60	1.87	2.75	1485	1735
564-10-3402	16(7X)	2		50	0.48	0.65	50	0.76	0.46	250	310
564-10-3404		4		50	0.53	0.74	50	0.85	0.57	320	380
564-10-3406		6		60	0.65	0.92	50	1.03	0.84	425	520
564-10-3408		8		60	0.71	0.97	50	1.08	0.91	485	580
564-10-3410		10		60	0.79	1.06	50	1.17	1.08	555	650
564-10-3412		12		60	0.82	1.10	50	1.21	1.16	615	720
564-10-3416		16		60	0.86	1.15	50	1.26	1.24	715	820
564-10-3420		20		70	0.97	1.29	50	1.40	1.53	895	1020
564-10-3424		24		70	1.08	1.42	50	1.53	1.84	1030	1210
564-10-3436		36		70	1.23	1.56	60	1.69	2.24	1380	1630
564-10-3450		50		80	1.47	1.83	60	1.96	3.01	1815	2215
564-15-3404			4	50	0.59	0.84	50	0.95	0.70	390	450
564-15-3408			8	60	0.79	1.06	50	1.17	1.08	600	695
564-15-3412			12	70	0.97	1.29	50	1.40	1.53	855	980
564-15-3416			16	70	1.08	1.42	50	1.53	1.84	1025	1205
564-15-3424			24	80	1.35	1.69	60	1.82	2.60	1455	1705
564-15-3436			36	80	1.54	1.92	60	2.05	3.29	1935	2335

ELECTRICAL SPECIFICATIONS
Per UL Subject 13

Conductor Resistance, nominal ..... ohms/1000 ft. @20C
20 AWG 10.4
18 AWG 6.5
16 AWG 4.1

Insulation Test Voltage (each lead) ..... 5000 Volts ac

Dielectric Test Voltage ..... 900 Volts ac for 15 sec

Shield Isolation Test
Pair to Cable Shield ..... between 100 M ohms/1000 ft

Insulation Resistance Constant @60F, minimum
(natural material typical value) ..... 2000 Megaohm-1000 ft

Loop Resistance, nominal (2 conductor) ..... ohms/1000 ft. @20C
20 AWG 20.8
18 AWG 13.0
16 AWG 8.2

Mutual Capacitance (PF/ft)*
#20 37
#18 41
#16 44

*Typical Value

- Cross-sectional area for calculation of cable tray fill in accordance with NEC Section 318-8.

Copper or bronze C-L-X available on special order. To order C-L-X Type P-OS without the outer Okoseal jacket, change the sixth digit of the catalog number from 3 to 1, for example to order 1 pr. 20 AWG with a bare aluminum C-L-X, the catalog number would be 564-10-1212.

C-L-X products manufactured in the United States under license granted by Kabelmetal of Hannover, Germany.

Length Tolerance: Cut lengths of 1000 ft. or longer are subject to a tolerance of ±10%; less than 1000 ft. ±15%.

October, 1985

THE OKONITE COMPANY
Ramsey, New Jersey 07446

SECTION 5
QUALITY ACCEPTANCE CRITERIA CHECKLIST

QUALITY ACCEPTANCE CRITERIA CHECKLIST

(PER FACILITIES ENGINEERING PROCEDURE NO. DES-18)

MWO/AUTH NO. _____ BLDG. _____

JOB TITLE Building 881 Hillside Remedial Action

ITEM/DESC	ACCEPTANCE CRITERIA	RESP DEPT	DATE COMPLETED	PASS FAIL	INSP INIT	REMARKS
Health Sciences Measures	Sec. 1106 a, c					
Trench Safety	02200-1.2B - OSHA 29CFR 1926 P					
Backfill Compaction	Sec. 02200-3.1F, 3.8 A&B. ASTM-D-698 D-1557,D-1556,D2922					
Sewer Pipe	Sec. 2551-2.1 to 2.5 ASTM 3034,F-477,A-74, 473,AWW-A-C110.					
Water Lines	Sec. 02553-2.1,2.2 ASTM-A-120,A-47,A-153 AWWA-C209,ANSI-B16.3					
Water Line Pressure Test	Sec. 02553-3.2					
Water Line Disinfection	Sec. 02553-3.3					
Concrete Formwork	Sec. 03100-1.3 OSHA 29CFR 1926.701					
Concrete Formwork Design	Sec. 03100-3.1 ACI Standard 347					
Concrete Reinforcement	Sec. 03200-1.3A, 2.1 ACI Standard 315 ASTM A-615,A-185					
Concrete	Sec. 03300-1.4C2, ACI Std. 306, ASTM C-150,C-33,C260,D-1752, D-1751,C-171,C-309 ACI Std. 211.1, 318,304					

January 13, 1988

SHEET ___ OF ___

QUALITY ACCEPTANCE CRITERIA CHECKLIST

(PER FACILITIES ENGINEERING PROCEDURE NO. DES-18)

MWO/AUTH NO. _____ BLDG. _____

JOB TITLE Building 831 Hillside Remedial Action

ITEM/DESC	ACCEPTANCE CRITERIA	RESP DEPT	DATE COMPLETED	PASS FAIL	INSP INIT	REMARKS
Grout	Sec. 03601-2.1 ASTM-C-150, C-33					
Lightgage	Sec. 05400-2.2 ASTM-C-645					
Hardware and Specialties	Sec. 08700-2.2 Fed. Spec. FF-h-16C, 121C, -106b, -111b					
Gypsum Wallboard	Sec. 09250-2.1 ASTM C-36, C-475					
Resilient Flooring	Sec. 09650-2.1 Fed. Spec. SS-T-312, -W-40, MMM-A-115, -110					
Paint	Sec. 09900-1.1					
Safety Shower and Eyewash	Sec. 11605-2.2 Rocky Flats Std.-SMU -100, -101					
Fire Prevention Equipment	Sec. 11605-2.3 NFPA pamphlet No. 10					
First Aid Equipment	Sec. 11605-2.4 OSHA 29CFR 1910					
Equipment Leveling	Sec. 15050-3.1F ASME B.5.16					
Piping	Sec. 15060-2.2 to 2.8					

January 13, 1988

SHEET OF

QUALITY ACCEPTANCE CRITERIA CHECKLIST

(PER FACILITIES ENGINEERING PROCEDURE NO. DES-18)

MWO/AUTH NO. _____ BLDG. _____

JOB TITLE Building 881 Hillside Remedial Action

ITEM/DESC	ACCEPTANCE CRITERIA	RESP DEPT	DATE COMPLETED	PASS FAIL	INSP INIT	REMARKS
Pipe and Tank Insulation	Sec. 15180-2.1-2.4 ASTM E-84,E-96,D1056 B-209,; UL-723					
Plumbing	Sec.. 15400 Part II					
Room Heater	Sec. 15800-2.1 UL listed					
Exhaust Fan	Sec. 15800-2.2 AMCA Certified UL listed					
Electrical Tests	Sec. 16010-3.2					
Electric Motors	Sec. 16150-1.1,1.2 NEMA Standard					
General Electrical	Sec. 16050-1.1,2.3,3.6 Nat. Elec. Code, UL					
Electrical Panelboards	Sec. 16160 UL, NEC					
Electrical Grounding	Sec. 16450-1.2 NEC, IEEE 142, UL					
Lighting Fixtures	Sec. 16510-1.1 UL					

January 13, 1988

SHEET ___ OF ___

QUALITY ACCEPTANCE CRITERIA CHECKLIST

(PER FACILITIES ENGINEERING PROCEDURE NO. DES-18)

MWO/AUTH NO. _____ BLDG. _____

JOB TITLE Building 881 Hillside Remedial Action

ITEM/DESC	ACCEPTANCE CRITERIA	RESP DEPT	DATE COMPLETED	PASS FAIL	INSP INIT	REMARKS
Instrumentation	Sec. 17000 1.04,1.06 ISA-S5.1					
Leak Detection	Sec. 17220 1.2					
Automatic Telephone Dialer	Sec. 16550-1.02					

January 13, 1988

SHEET __ OF __

SECTION 6
COMPONENT CHECKOUT (CC)
AND
SYSTEMS OPERATIONS (SO) TEST PRCEDURES

COMPONENT CHECKOUT

881 HILLSIDE REMEDIAL ACTION

REF: P & ID NO. 38548-002

COMPONENT		CHECKOUT SATISFACTORILY YES	NO	CHECKERS INITIALS	DATE
METERS					
FE-100	(1" INF-CPVC)				
FE-101	(1" INF-CPVC)				
FE-102	(1" INF-CPVC)				
FE-103	(1" INF-CPVC)				
PUMPS					
P-100	Collection Well 88-1 Pump				
P-101A	French Drain Collection Sump 1 Pump				
P-101B	French Drain Collection Sump 1 Pump				
P-102A	French Drain Collection Sump 2 Pump				
P-102B	French Drain Collection Sump 2 Pump				
P-103A	Building 881 Foundation Drain Collection Sump Pump				
P-103B	Building 881 Foundation Drain Collection Well Sump				
P-300A	Building 830 Sump Pump				
P-300B	Building 830 Sump Pump				
VALVES					
V-100	(1" INF-CPVC)				
V-101A	(1" INF1-CPVC)				
V-101B	(1" INF1-CPVC)				
V-102A	(1" INF2-CPVC)				
V-102B	(1" INF2-CPVC)				
V-103A	(1" INF-CPVC)				
V-103B	(1" INF-CPVC)				
V-300A	(1.5" W - GS)				
V-300B	(1.5" W - GS)				
V-300C	(2.0" W - GS)				

COMPONENT CHECKOUT

881 HILLSIDE REMEDIAL ACTION

REF: P & ID NO. 38548-002

COMPONENT	CHECKOUT SATISFACTORILY YES	NO	CHECKERS INITIALS	DATE
HAND VALVES				
HV-100 (1" INF-CPVC)				
HV-101A (1" INF-CPVC)				
HV-101B (1" INF1-CPVC)				
HV-102A (1 INF2-CPVC)				
HV-102B (1" INF2-CPVC)				
HV-103A (1" INF-CPVC)				
HV-103B (1" INF-CPVC)				
HV-300A (1.5" W - GS)				
HV-300B (1.5" W - GS)				

COMPONENT CHECKOUT

811 HILLSIDE REMEDIAL ACTION

REF: P & ID NO. 38548-003

COMPONENT		CHECKOUT SATISFACTORILY YES	NO	CHECKERS INITIALS	DATE
TANKS					
T-201	Influent Storage Tank				
T-202	Influent Storage Tank				
T-203	Effluent Storage Tank				
T-204	Effluent Storage Tank				
HAND VALVES					
HV-201A	(2" INF-GS)				
HV-201B	(2" TPS-GS)				
HV-201C	(2" W - GS)				
HV-202A	(2" INF-GS)				
HV-202B	(2" TPS-GS)				
HV-202C	(2" W - GS)				
HV-203A	(2" TPS-GS)				
HV-203B	(2" EFF-GS)				
HV-203C	(2" REC-GS)				
HV-204A	(2" TPS-GS)				
HV-204B	(2" EFF-GS)				
HV-204C	(2" REC-GS)				

COMPONENT CHECKOUT

881 HILLSIDE REMEDIAL ACTION

REF: P & ID NO. 38548-004

COMPONENT		CHECKOUT SATISFACTORILY YES	NO	CHECKERS INITIALS	DATE
PUMPS					
P-301	Influent Transfer Pump				
P-302	Influent Transfer Pump				
SPECIALTY ITEMS					
Ultraviolet Light Hydrogen Peroxide Treatment Unit					
VALVES					
V-301A	(2" TI - GS)				
V-303A	(2" TI - GS)				
HAND VALVES					
HV-301A	(2" TPS - GS)				
HV-301B	(2" TPS - GS)				
HV-302A	(2" TI - GS)				
HV-302B	(2" TI - GS)				

SYSTEMS OPERATIONAL TEST

PROCEDURES FOR

BUILDING 881 HILLSIDE

COLLECTION, TREATMENT AND INFILTRATION SYSTEM

BUILDING 830

August 1988

BUILDING 881 HILSIDE

GROUNDWATER COLLECTION, TREATMENT AND INFILTRATION SYSTEM
BUILDING 830

SYSTEMS OPERATIONAL TESTS PROCEDURES

Approved for release:

830 Building Operations	_____	_____ Date
830 Building Utilities	_____	_____ Date
Facilities Engineering	_____	_____ Date
HS&E Area Engineer	_____	_____ Date

SYSTEMS OPERATIONAL TEST PROCEDURE

BUILDING 881 HILSIDE

GROUNDWATER COLLECTION, TREATMENT AND INFILTRATION SYSTEM
BUILDING 830

TESTING CERTIFIED AS COMPLETE

I. ROCKWELL

Construction Management _____

Facilities Quality Assurance _____

Waste Operations _____

Facilities Project Management _____

Facilites Engineering _____

II. DEPARTMENT OF ENERGY _____

CONTENTS

BUILDING 881 HILLSIDE

GROUNDWATER COLLECTION, TREATMENT AND INFILTRATION SYSTEM
BUILDING 830

1. INTRODUCTION

1.1 General Description

A groundwater collection, treatment and infiltration system has been constructed to treat collect contaminated groundwater from the Building 881 Hillside area, treat it with an ultraviolet light-hydrogen peroxide treatment process and return, via an infiltration gallery, the treated water to the shallow groundwater table. The system consists of:

a. A French drain groundwater collection system;

b. Two sump pump installations in the drain to deliver water to the treatment unit storage tanks;

c. Well 1-88 which intercepts shallow contaminated water and delivers it to the treatment unit storage tanks;

d. Building 881 drain sump pump which intercepts the foundation drainage and delivers it to the treatment unit storage tanks;

e. Two 15,000 gallon influent storage tanks with level measurement and freezing protection;

f. A pre-engineered ultraviolet light-hydrogen peroxide treatment system housed in Building 830;

g. Two 15,000 gallon effluent storage tanks; and

h. An infiltration gallery designed to return treated groundwater to the shallow alluvial aquifer on the Building 881 hillside.

2. INSTRUCTIONS

2.1 Responsibilites

a. Waste Operations will assign a responsible Testing Engineer to obtain all necessary permits and safety reviews and conduct the SO Test.

b. Facilities Engineering Project Engineer will witness the SO Test and issue appropriate Engineering Orders (EO's) or Field Change Orders (FCO's) to correct any deficiencies found during the SO Test.

2.2 Test Data

a. Perform an "On-the-Job" safety review and complete Form RF-13010, Rev 2166 MHS-16-2.4, "Work Permit."

b. Record all required test data on the System Operational (SO) test sheets in the "What-to-Look-For" column during the equipment testing.

c. Log sheets generated during the SO tes are retained and filed with the user's copy of the SO test.

d. Contact the responsible Testing Engineer if improper response is obtained during the testing.

2.3 Safety

a. Safety related paperwork is retained and filed with the master copy. This paperwork includes, but is not limited to, vessel entry permits, work permits, etc. If numerous copies are identical, such as work permits, one copy is filed with the master copy with a notation of the number of identical copies generated.

b. Assure adequate shut down of equipment at the end of the test.

c. A red tag is used to indicate equipment malfunction.

d. All testing activities are accomplished in accordance with the Rockwell Health, Safety & Environment Manual.

2.4 Performance Accepted

a. Performance acceptance of each piece of equipment, valve, pump. etc., is indicated on the SO test sheet. The responsible enginee: dates and initials each test sheet in the "Remarks" column when th work described is completed and accepted.

2.5 Performance Not Accepted

b. Responsible Testing Engineer contacts Construction Management an explains the deficiency. Construction Management places a red ta on the equipment and transmits deficiency information to Facilitie Project Managment.

2.6 Exceptions-Recommendations

a. Exceptions are defined as equipment deficiencies found whe comparing equipment performance with equipment desig specifications and drawings. When exceptions are identified, the are listed, dated, and initialed in the "Remarks" column of the S test form. The responsible engineer notifies Constructic Management that tested equipment is not accepted and a Constructic Management representative attaches a red tag to the equipment. Tl red tag remains on the equipment until the exception is resolved.

b. Exception resolutions are listed in the "Remarks" column wi initials and date of resolution.

c. Recommendations are defined as equipment deficiencies tha were n covered by the design criteria but are considered necessary for tl

completion of a safe, efficient system.

d. Testing Team observations and recommendations are defined in a letter to the Project Engineer. This letter is distributed after testing results are finalized and the Facilities Engineering Manager has approved the letter. This letter defines the recommendations as equipment deficiencies, betterments, and safety considerations for safe and efficient operation of the system.

2.7 Master Copy

a. When testing is completed, the original test sheets are replaced with work copies containing test results. The finished document contains the typed tests and hadwritten test data, notations, exceptions, deficiency corrections, and supplemental paperwork generated during the test.

b. The finalized master copy and associated documents are transmitted to Facilities Quality Assurance where it is placed on permanent file with other project files and information. Copies, one each are distrubuted as follows:

Construction Management
Waste Operations
Facilities Project Management
Facilities Engineering
Department of Energy

3. GENERAL REQUIREMENTS

	REVIEWED, CHECKED, &/OR COMPLETED	INITIA & DATE
a. Read this entire SO Test Procedure	( )	_____
b. Review P&ID sheets 38548-001,002,003,004	( )	_____
c. Become familiar with equipment, piping. and instrumentation of the system	( )	_____
d. Check the following items:		
(1). Electrical power ready for use	( )	_____
(2). All instruments have been calibrated and are ready for use	( )	_____
(3). Potable water ready for use	( )	_____
(4). Treatment unit and Peroxide unit are installed and functional per mfgr	( )	_____
(5). Turn all valves, pumps and treatment unit off	( )	_____

PREREQUISITES	HOW TO TEST	WHAT TO LOOK FOR
( ) Check Temperature Probes on each tank.	( ) With tanks filled, confirm temperature inication at MCP.	
	( ) Electronically simulate low temperature condition	( ) Check for contact closure of immersion heaters. Check each tank heater.
	( ) Electronically simulate low water condtion in each tank	( ) Check to see that heaters turn off on low water condition
( ) Check Heat Tracing of Pipe	( ) Electronically simulate low temperature on control system	( ) Confirm heat tracing is functional at low temperatures.
( ) Check for Bldg. 830 sump operation	( ) Turn sump unit on. ( ) Open valves 300A and 300B. ( ) Fill sump with water until Pumps turn on.	
( ) Check High Level Tank Alarm	( ) Simulate High Level condition electronically	( ) Check for alarm at MCP and operation of telephone dialer.
( ) Check Moisture Detector in Double wall pipe section	( ) Simulate moisture present signal at detection probe	( ) Confirm alarm at Detector panel
( ) Check Telphone dialer	( ) Simulate alarm condition, ie. high water tank alarm	( ) Confirm dialer operational and number dialed correct
( ) Check sink and unit heater	( ) Turn on cold water ( ) Turn on hot water	( ) Confirm water flow ( ) Confirm hot water unit heater operational

SAFETY CONSIDERATIONS:

REMARKS:

Completed: _____

By: _____

PREREQUISITES	HOW TO TEST	WHAT TO LOOK FOR
( ) Verify influent and effluent tanks and valves are operational	( ) Check tank levels at MCP ( ) Check limit switches and operation of valves 201A/B, 202A/B, 203A/B/C, and 204A/B/C at influent and effluent tanks ( ) Check that drain valves and sample ports are closed on all tanks	( ) Verify tank levels are zero ( ) Verify valve positions are shown as opened or closed on the MCP
( ) Verify hydrogen peroxide module is ready and functional	( ) Check hydrogen peroxide level in storage/mixing tank and metering pump setting. Verify as operational. Refer to manufacturer's SO procedures for complete SO testing	( ) Hydrogen Peroxide present ( ) Metering pump runs on manual setting
( ) Verify ultraviolet treatment module is ready and funcional	( ) Refer to Manufacturer's SO procedures for complete SO testing procedures	

SAFETY CONSIDERATIONS:

REMARKS:

Completed: _____

By: _____

PREREQUISITES	HOW TO TEST	WHAT TO LOOK FOR
( ) Prepare influent tanks for pump and well testing. Pump to tank T-201	( ) Open valve 201A open ( ) Close valves 201B, 202A/B	( ) Check status on MCP ( ) Check status on MCP
( ) Check Well 1-88	( ) Open Valve 100 ( ) Confirm power is on ( ) Turn HOA switch to Hand to start ( ) Turn HOA switch to Auto ( ) Check off level control	( ) Check in meter vault ( ) Check at MCC ( ) Check flow indicator ( ) Check for auto start ( ) Let pump run until low water shuts off
( ) Check sump 101 for operation	( ) Open Valve 101A/B ( ) Confirm power is on ( ) Turn HOA switch to Hand to start ( ) Turn HOA switch to Auto ( ) Check off level control ( ) Switch lead/lag pump	( ) Check in meter vault ( ) Check at MCC ( ) Check flow indicator ( ) Check for auto start ( ) Let pumps run until low water shuts off ( ) Repeat test for alt pump
( ) Check sump 102 for operation	( ) Open Valve 102A/B ( ) Confirm power is on ( ) Turn HOA switch to Hand to start ( ) Turn HOA switch to Auto ( ) Check off level control ( ) Switch lead/lag pump	( ) Check in meter vault ( ) Check at MCC ( ) Check flow indicator ( ) Check for auto start ( ) Let pumps run until low water shutoff ( ) Repeat test for alt pump
( ) Check sump 103 for operation	( ) Open Valve 103A/B ( ) Confirm power is on ( ) Turn HOA switch to Hand to start ( ) Turn HOA switch to Auto ( ) Check off level control ( ) Switch lead/lag pump	( ) Check in meter vault ( ) Check at MCC ( ) Check flow indicator ( ) Check for auto start ( ) Let pumps run until low water shutoff ( ) Repeat test for alt pump

SAFETY CONSIDERATIONS:

REMARKS:

Completed: _____

By: _____

By: _____

PREREQUISITES	HOW TO TEST	WHAT TO LOOK FOR
( ) Check collection system shut-off	( ) Place sump pumps and well in auto mode. Simulate the following conditions which should shut-off the collection system and signal an alarm condition:	
	( ) Simulate tank full condition on tank selected for fill.	( ) Check for system shut down.
	( ) Close inlet valve to selected influent tank closing limit switch. Either valve 201A or 201B.	( ) Check for system shut down.
( ) Check for proper flow indication of well and sump pumps	( ) Place sump pumps and well auto mode.	( ) Check operating light ( ) Confirm flow indication at MCP

SAFETY CONSIDERATIONS:

REMARKS:

Completed: _____
By: _____
By: _____

PREREQUISITES	HOW TO TEST	WHAT TO LOOK FOR
( ) Fill tank(s) for operation test	( ) Select influent tank 201 or 202.	
	( ) Open influent tank inlet valve and close non-selected tank inlet valve.	( ) Check valve indication at MCP
	( ) Close influent tank outlet valves 201B and 202B.	( ) Check valve indication at MCP
	( ) Place sumps and well in auto mode and fill selected tank to 10,000 gallon min.	( ) Check sump and well operation at MCP and flow indication ( ) Check tank level indicator
( ) Select effluent tank for operation test	( ) Select effluent tank 203 or 204	
	( ) Open effluent tank inlet valve and close non-selected tank inlet valve.	( ) Check valve indication at MCP
	( ) Close effluent outlet valves 203B and 204B.	( ) Check valve indication at MCP
	( ) Close recycle valves 203C and 204C.	( ) Check valve indication at MCP

SAFETY CONSIDERATIONS:

REMARKS:

Completed: _____

By: _____

PREREQUISITES	HOW TO TEST	WHAT TO LOOK FOR
( ) Check influent transfer pumps	( ) Open valves 301A,301B and 302A,302B. ( ) With treatment unit OFF Press JOG switch of each pump	( ) Check for pump rotation on each pump.
( ) Check for treatment unit operation	( ) Refer to manufacturers startup and testing procedures. Note: Mfgr should provide on-site startup, testing and training per specification.	( ) Check for flow in unit on flow indicator. ( ) Confirm operation per Mfgr specs with laboratory analysis of effluent.

NOTE: PROCEED WITH FOLLOWING ONLY AFTER LABORATORY RESULTS CONFIRM EFFLUENT IS TREATED TO STANDARDS WHICH ALLOW DISCHARGE!!!!

( ) Release treated effluent to infiltration gallery.	( ) Open outlet valve of treated effluent tank. Confirm level is dropping and flow is out of tank.	( ) Check level indication at MCP.
( ) Check emergency shower/eyewash	( ) Pull shower handle	( ) Check for adequate and continuous water flow
( ) Check ventillation and unit heater	( ) Turn heater thermostat up ( ) Turn vent thermostat down	( ) Confirm heater and fan turn on. ( ) Confirm vent fan turns on

SAFETY CONSIDERATIONS:

REMARKS:

Completed: _____

By: _____

SECTION 7
COST ESTIMATE

Per previous agreement, the Title II design cost estimate for the 881 Hillside Remedial Action is being provided under separate cover.