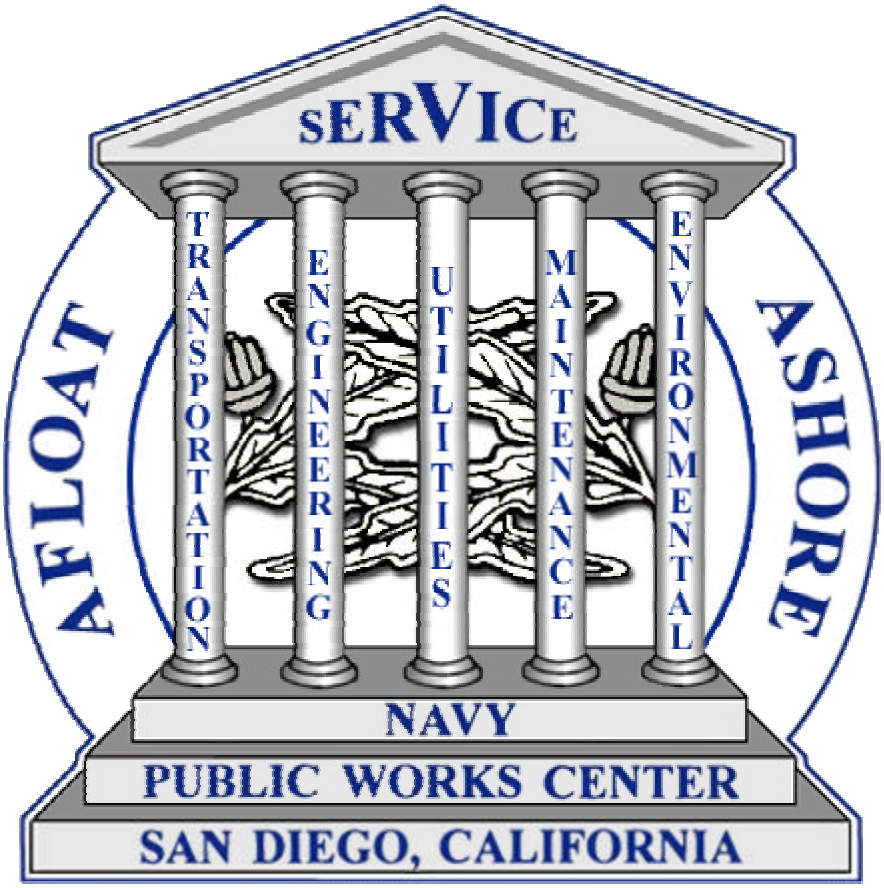


Navy Public Works Center, San Diego
Utilities Standards

SECTION 16001

EXTERIOR POWER DISTRIBUTION SYSTEMS

1 GENERAL

1.1 SUMMARY

1.1.1 Section Includes

This section includes requirements for the provision of the exterior power distribution systems.

1.1.2 Components Included

This section includes, but is not limited to, requirements for wire and cable, conduit and fittings, transformers, surge arresters, fuses, secondary service switchboards and sections, multi-way sulfur hexafluoride (SF6) selector switches, metering and UCS equipment, and grounding and bonding equipment. The color shall be consistent for all equipment - "Olive Green", Munsell number 76Y/3.29/1.5 per ASTM D 1535. Paint coating shall comply with NEMA ICS6, corrosion resistance test ANSI C37.20.

1.2 QUALITY ASSURANCE

1.2.1 Cable Splicer's/Terminator's Qualifications

Submit for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables the name and qualifications of the cable splicer/terminator. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer.

1.3 SUBMITTALS

1.3.1 Exterior Power Systems

Submit the following shop drawings, procedures and catalog data to the Navy Public Works Center for approval:

a. Transformers and accessories
b. SF6 Switches
c. Cables
d. Terminations
e. Conduit
f. Secondary switchboard and components
g. Metering equipment
h. Circuit Breakers
i. Utility control system wiring diagram
j. Field testing plan

2 PRODUCTS

2.1 SYSTEM PERFORMANCE

2.1.1 Exterior Power Distribution System Requirements

The design and construction of the exterior electrical power distribution system shall conform with ANSI C2. Encase all underground conduit in concrete.
The electrical point of connection is as indicated where the electrical characteristics are:

a. Voltage: [ ] kilovolts

b. Available symmetrical short circuit rating shall be [derived by calculation][as indicated].

The Contractor shall provide all work and equipment as indicated on the drawings.

2.2 COMPONENT PERFORMANCE

2.2.1 Underground Electrical Work

2.2.1.1 Wire and Cable

2.2.1.1.1 600 Volt Wires and Cables

Service entrance conductors shall be single conductor type USE. Conductor size and number of conductors in each conduit shall be as indicated. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by 3 inch wide color-coded tape. Conductors No. 10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

2.2.1.1.2 Medium Voltage Cable

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 12 months prior to date of delivery to the site shall not be accepted.

Medium voltage cable shall be single conductor Ethylene Propylene Rubber (EPR) insulated, shielded power cable rated at 15kv, 133% insulation level. The cable shall be capable of operating continously in both wet and dry locations at 105 degrees C for normal operation, 130 degrees C under emergency operation conditions and 250 degrees C under short circuit conditions. The conductor size is specified in the plans. The conductor shield, insulation, and the insulation shield shall be applied continuously in the same pass by triple extrusion process. The cable shall be insulated, jacketed and tested in accordance with AEIC CS6, in the same plant by the same manufacturer. Certified AEIC qualification data shall be required prior

to order placement, and certified test reports are to be supplied at the time of shipment. Cable ends shall be sealed. Cable shall be equipped with a factory-installed cable pulling eye. Pulling eye shall not exceed the outside diameter of the cable.

CONDUCTOR: Shall be class B stranded annealed copper per Part 2 of ICEA S-68-516.

CONDUCTOR SHIELD: Shall be extruded black, semi-conducting thermosetting compound applied directly over the conductor. The conductor shield shall be thermally and chemically compatible with the conductor and insulation. Conductor shield may be uniformly and firmly bonded to the overlaying insulation and to be free stripping from the conductor. The thickness of the conductor shall conform to AEIC CS6.

INSULATION: Shall be Ethylene Propylene Rubber conforming to AEIC CS6 and shall have a minimum average thickness of 220 mils.

INSULATION SHIELD: Shall be extruded black, semi-conducting thermosetting compound applied directly over the insulation. The insulation shield shall be thermally and chemically compatible with the conductor and insulation. The insulation shield shall be free stripping leaving no conducting particle or other residue on the insulation surface. The thickness of the insulation shield shall conform to AEIC CS6.

COPPER TAPE SHIELD: Shall have a thickness of 5 mils, helically applied over the insulation shield with a minimum of 12.5% overlap.

JACKET: Shall be chlorosulfonated polyethylene with a minimum thickness of 80 mils.

2.2.1.2 Medium Voltage Cable Joints

Provide joints (splices) in accordance with IEEE 404 suitable for 25 kV voltage and insulation level, and rated for continuous immersion in water. Upon request, supply manufacturer's design qualification test report in accordance with IEEE 404. Connectors for joint shall be tin-plated electrolytic copper, having ends tapered and having center stops to equalize cable insertion. Connectors shall be rated for voltage of 35 kV minimum.

a. Heat-shrinkable joint: Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.

2.2.1.3 Fireproofing Tape

Furnish tape composed of a flexible conformable unsupported intumescent elastomer. Tape shall be not less than .762 mm thick, noncorrosive to cable sheath, self-extinguishing, noncombustible, and shall not deteriorate when subjected to oil, water, gases, salt water, sewage, and fungus.

2.2.2 Conduit

PVC type EB-35 and fittings per NEMA TC-9

2.2.3 Pad-mounted Transformers

Equipment shall comply with applicable articles of IEEE C57 . Audible sound levels shall comply with the following:

kVA	DECIBELS (MAX)
75	51
112.5	55
150	55
225	55
300	55
500	56
750	57
1000	58

2.2.3.1 Compartments

The high- and low-voltage compartments shall be separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.3.1.1 High Voltage, Dead-Front

High-voltage compartment shall contain the incoming line, insulated high-voltage dead-break connectors, bushing well inserts, six high-voltage bushing wells configured for loop feed application, access to oil-immersed fuses, dead-front surge arresters, tap changer handle, connector parking stands and ground pad.

a. Insulated high-voltage dead-break connectors: Provide elbow connectors as specified for the SF6 switch.

b. Bushing well inserts: IEEE 386, 600 amperes, 25 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

c. Provide bayonet oil-immersed, expulsion fuses in series with oil-immersed, partial-range, current-limiting fuses. Bayonet fuse links shall sense both high currents and high oil temperature in order to provide thermal protection to the transformer. Coordinate transformer protection with expulsion fuse clearing low-current faults and current-limiting fuse clearing high-current faults beyond the interrupting rating of the expulsion fuse. In order to eliminate or minimize oil spills, the bayonet fuse assembly shall include an oil retention valve inside the housing which closes when the fuse holder is removed and an external drip shield. Warning shall be conspicuously displayed within the high-voltage compartment cautioning against removing or inserting fuses unless the load-break switch is in the open position and the tank pressure has been released.

   Bayonet fuse assembly: 150 kV BIL.

   Oil-immersed current-limiting fuses: ANSI C37.47; 50,000 rms amperes symmetrical interrupting rating at the system voltage specified. Provide three spare fuses.

d. Surge arresters: ANSI/IEEE C62.11, rated 12 kV, with maximum continuous operating voltage of 10.2 kV rms line-to-neutral, discharge class of 10 kA, fully shielded, dead-front, metal-oxide-varister, intermediate class, elbow type with resistance-graded gap, suitable for plugging into bushing well inserts. Provide three arresters for radial feed circuits.

e. Parking stands: Provide a parking stand near each bushing well.

2.2.3.1.2 Low Voltage

Low-voltage compartment shall contain low-voltage bushings with NEMA spade terminals, accessories, stainless steel diagrammatic transformer nameplate, and ground pad.

a. Accessories shall include drain valve with sampler device, fill plug, pressure relief device with contacts, liquid level gage with contacts, pressure-vacuum gage with contacts, and dial type thermometer with contacts and 4-20mA output and maximum temperature indicator. All contacts and 4-20mA outputs shall be wired to the UCS.

b. Copper NEMA spade lug with more than six holes shall have additional support at the ends of the lugs, and shall be supported from above.

2.2.3.2 Transformer

a. Oil-insulated [less-flammable liquid-insulated] [edible less flammable liquid], two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer shall be rated as indicated, 95 kV BIL.

c. Transformer voltage ratings, as indicated.

d. Tap changer shall be externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Tap changers shall clearly indicate which tap setting is in use.

e. Minimum tested impedance shall not be less than 3.5 percent at 85 degrees C, or as indicated.

f. Transformer shall include lifting lugs and provisions for jacking under base. The transformer base construction shall be of the fabricated type and suitable for using rollers or skidding in any direction. Provide transformer top with an access handhole. Transformer shall have its kVA rating conspicuously displayed on its enclosure. The transformer shall have an insulated low-voltage neutral bushing with lugs for ground cable, and with removable ground strap.

g. Alarm contacts for monitoring of temperature, pressure, vacuum and liquid level via contacts for wiring to the UCS. Temperature monitoring shall include 4-20mA output.

2.2.3.3 Insulating Liquid

a. Mineral oil: ASTM D 3487, Type II, tested in accordance with ASTM D 117. Provide identification of transformer as "non-PCB" and "Type II mineral oil" on the nameplate.

[b. Less-flammable transformer liquids: NFPA 70 and FM P7825for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D 92 and a dielectric strength not less than 33 kV tested per ASTM D 877. Do not provide nonflammable transformer liquids including askarel and insulating liquids containing polychlorinated biphenyls (PCB's) and tetrachloroethylene (perchloroethylene), chlorine compounds, and halogenated compounds. Do not provide silicone. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.]

2.2.3.4 Corrosion Protection

Bases and cabinets of transformers shall be corrosion resistant and shall be fabricated of stainless steel conforming to ASTM A 167, Type 304 or 304L. Base shall include any part of pad-mounted transformer that is within 3 inches of concrete pad. Form cabinets of stainless steel sheets no less than No. 13 U.S. gage. Paint bases, cabinets, and tanks. Paint coating system shall comply with ANSI C57.12.28 regardless of base, cabinet, and tank material.

2.2.3.5 SPARE PARTS

a. Provide 1 set of three 15kV spare fuses.

b. Provide three wrenches for high voltage compartment.

c. Provide 6 spare pad locks keyed to AASM1.

2.2.4 Secondary Service Switchboards

Provide NEMA 3R, freestanding switchboard. The switchboard shall be designed for outdoor service with insect and rodent-proof screened ventilation louvers and gasketing to insure a weatherproof assembly under rain, snow, sleet and hurricane conditions. The switchboard shall be the product of one manufacturer. Switchboard shall consist of main and feeder vertical sections an the utility control cabinet as described below. External doors shall have a minimum of five hinges and 3-point latching mechanisms and shall be padlockable. The main breaker and metering sections shall have doors with a minimum of five hinges. All doors, both front and rear, shall have the capability of being latched open greater than 90 degrees from the closed position. All bussing shall be copper. Easy access to the bus shall be made from rear door entrances. All control wiring shall be tie wrapped in plastic troughs and machine fastened to interior metal cabinet or struts in 10" intervals maximum. Adhesives shall not be permitted for securing control wiring. The exterior surface of the switchboard shall be free of any sheet metal fasteners or self threading screws. All enclosing metal

cabinets and doors shall be carriage bolted 11 gage steel. Roof and floor shall be constructed of 8 gage steel. All circuit breaker, current transformer or space compartments shall be fastened with self aligning bolts. Switchboards shall comply wit applicable articles of IEEE C37.

2.2.4.1 Switchboard Vertical Section

Each vertical section shall include:

a. Doors: Front, rear and all interior doors shall be furnished with full length hinges and have an open latched position greater than 90 degrees. Door knobs and rotating hardware shall be stainless steel. Doors shall have door keepers and louvers with replaceable fiberglass filters.

b. Lights: Each section vestibule shall be furnished with a fluorescent light and light switch.

c. Receptacles: One ground fault protected receptacle shall be provided in each one of the sections.

d. Heaters: Provide two stainless steel strip heaters, rated 1000 watts, 240V, operated on 120 volts, in each breaker compartment. Heaters shall be controlled by a thermostat and humidistat located inside the secondary switchboard section. Humidistats shall be industrial type, high limit, to maintain compartments within the range of 30 percent to 60 percent relative humidity. Electric heaters in switchboard assemblies shall be energized while the equipment is stored or in place prior to being placed in service.

e. Roof shall be sloped from front to rear.

2.2.4.1.1 Utility Control System (UCS) Components

The manufacturer of the switchboard shall provide the following related items in the switchboard for the utility control system:

a. Transducers, alarm contacts, metering and control devices, including those in the transformers and SF6 switches.

b. All wiring to and from transducers, circuit breaker alarm contacts, metering and control devices, located within the switchboard. All wiring inputs shall terminate at the terminal strips inside the utility control cabinet.

All metering components such as meters and transducers shall be located in one vertical section (utility control cabinet) with all field device terminal blocks for ct’s, transformer monitoring points, circuit breaker status. Provide a 3 foot by 3 foot space for mounting the future RTU adjacent the terminal blocks. Provide one thermostatically controlled heater and one heater controlled by a humidistat. Heater ratings shall be as specified above.

2.2.4.2 Secondary Main Circuit Breaker (More Than 2000 Amps))

UL listed stationary type, insulated case circuit breaker, manually operated, three pole, single throw with positive acting indication of breaker position. The continuous ampere rating shall be as indicated. All breakers shall be UL listed for application in their intended enclosure for 100% of their continuous ampere rating. Frame size and ampere ratings shall be as indicated on the drawings. Provide breaker A and B status contacts for UCS monitoring.

2.2.4.2.1 Interrupting Capacity

The interrupting capacity of the main circuit breaker shall be matched to the indicated bus rating.

2.2.4.2.2 Circuit Breaker Rating and Adjustment

The continuous ampere rating of the breaker shall be determined by the insertion of an interchangeable rating plug that matches the load and cable requirements. The rating plug shall be interlocked with a solid state tripping mechanism to automatically "open" the breaker when the plug is removed. The breaker shall remain "trip free" with the plug removed. In addition, rating plugs shall be keyed to prevent incorrect application between different frame ratings. Complete system selective coordination shall be provided by the addition of the following time/current curve shaping adjustments for phase currents:

a. Ampere setting
b. Long time delay
c. Short time pickup
d. Short time delay
e. Instantaneous

All adjustments shall be made using non-removable discreet step, high reliability switching plugs for precise settings. A sealable transparent cover shall be provided over the adjustment to prevent tampering. Access to adjust breaker setting shall be accomplished by removing the transparent cover only. Do not provide ground fault tripping.

2.2.4.2.3 Circuit Breaker Status Indication

The solid state trip unit devices shall be provided with two visual indicators to indicate the automatic tripping mode of the breaker (i.e. overload or short circuit).

2.2.4.2.4 Circuit Breaker Test Points

All breakers shall be provided with test points for in-service functional testing of the features provided. Provide 2 hand held test kits to test the above functions.

2.2.4.2.5 Circuit Breaker Operation

The breakers shall be capable of a minimum of 4000 interruptions of rated current followed by 4000 operations at no load without maintenance. Submit manufacturer’s certification. Further, the breaker shall be equipped with field replaceable contacts.

2.2.4.3 Secondary Main and Feeder Breakers (2000 Amps and Less)

Bolt-on type Fed. Spec.W-C-375B. Molded-case type. Circuit breakers shall have a quick-make, quick-break operating mechanism and shall be equipped with ambient-compensated thermal magnetic trip low to high settings. Provide ampere frame size and adjustable trip plug as indicated for all circuit breakers. Circuit breaker shall trip free of the handle, and the handle position shall indicate whether the breaker is "on", "off" or "tripped." Circuit breaker is to be mounted so that when removed the bussing will not be disturbed. An overload in one phase shall cause all three phases to trip. Short circuit bracing shall match the indicated bus brace rating. Provide breaker A and B status contacts for UCS monitoring.

2.2.4.4 Kilowatt-Hour Meters – SWITCHBOARD TYPE, CLASS 20, DEMAND TYPE

ANSI C12.1, ANSI C12.10, ANSI 12.16, ANSI C12.18, ANSI C12.19 ANSI c12.20, Type II, Class 3, Style B and shall have pulse module and load profile module with recording capability of 64k data storage. Kilowatt-hour meters shall be switchboard type totally compatible to each particular application. Kilowatt-hour meters shall be of one manufacturer. The meters shall have an electronic demand recording register and shall be secondary reading as indicated. The register shall be used to indicate maximum kilowatt demand as well as cumulative or continuously cumulative demand. Demand shall be measured on a block-interval basis. It shall have provisions to be programmed to calculate demand on a rolling interval basis. Enable TOU measurement module at the factory. Switchboard meters – 3-stator, 3 phase, 4-wire, 120 volt, class 20, and secondary type. Switchboard type case with paddle for meter removal incorporating automatically short-circuiting of current transformer circuits. Meter covers shall be polycarbonate resins with opcomport and reset. Battery mounting location shall be in the front. Provide blank tag fixed to the meter faceplate for the addition of the meter multiplier which will be the product of the current transformers and potential transformer ratio and will be filled in by PWC at the job site. The normal billing data scroll shall be fully programmable. Pulse module with programmable ratio selection. Meters shall be programmed after installation through opcomport. Liquid crystal display, 9 digits, blinking squares confirm register operation. Large digits for data and smaller digits for display identifier. Wire KYZ output to the utility control cabinet.

2.2.4.5 Fuse Blocks

Pullout type, 30 amp rating, NEMA Class J with fuses, 3 pole.

2.2.4.5.1 Fuses

Pull out type, NEMA Class J, current limiting.

2.2.4.6 Terminal Boards/Blocks

Terminal boards shall be bolt on type 240 volt, 30 amp for lay down on control systems wiring. Provide with engraved plastic terminal strips and screw type terminals for external wiring between components and for internal wiring between removable assemblies. Terminal blocks associated with current transformers shall be short circuiting type, 6 circuit, compatible

with current transformer wiring systems and shall have shorting bars with shorting screws. Terminate conductors for current transformers with ring-tongued lugs. Each block shall be secured to the compartment by mechanical means. Terminal boards identification shall be identical in similar units. External wiring shall be color-coded consistently for similar terminal boards. Terminal boards/blocks shall be arranged so that access to them shall be in the front of the switchboard only within the utility control cabinet.

2.2.4.7 Wire Marking

Mark control and metering conductors at each end. Provide factory-installed, white plastic tubing, heat shrink with black block type letters on factory-installed wiring. On field-installed wiring, provide white, preprinted, polyvinyl chloride (PVC) sleeves, heat stamped with black block type letters. Each sleeve shall contain a single letter or number. Provide specific wire markings using the appropriate combination of individual sleeves. Each wire marker shall indicate the device or equipment, including specific terminal number to which the remote end of the wire is attached.

2.2.4.8 Switchboard Wiring

Cell and panel control wiring shall be run in plastic wiring trough having slots at each side for branching of the wires. Wiring to the hinged panels shall be carried across the hinges in laced bundles arranged so that the wires twist rather than bend. All wiring shall be correctly and clearly identified with letters and/or numbers at each end of the wire. The wire marker shall show the origination and destination. Provide identified terminal boards with engraved plastic terminal strips for external wiring between components and for internal wiring between removable assemblies. Terminal board identification shall be identical in all similar units. Color code external wiring consistently for all similar terminal boards. Switchboard control wiring shall terminate at terminal boards with ring-tongue terminals. Control circuit terminations shall be properly identified.

2.2.4.9 Control Cable

Control cable shall be stranded “SIS” type, except for analog utility control circuits. Conductors shall be copper, and shall be #12 AWG minimum. Conductors shall be color coded per contract drawings or labeled on each end. Control cable for analog transducer circuits shall be #18 copper twisted and shielded pairs rated for 300 volts. All devices shall be wired to the utility control cabinet. Control circuit terminations shall be properly identified.

2.2.4.10 AC Voltmeter

Transformer rated, 250 volt, 60 Hz input, 4 inch for use with 288 to 120 volt potential transformers. Provide external dropping resistor if required. Voltmeter shall provide +1 percent accuracy at full scale. Scale shall span 250 degrees. Mounting shall be flush type.

2.2.4.11 Voltmeter Switch

Voltmeter switch shall be designed specifically for the purpose and shall have seven positions, one position for each phase to neutral and one

position for each phase to phase and “off”. Contacts shall be rated for 20 amperes, 600 volts AC. Switch shall have metal shaft and removable handle.

2.2.4.12 Potential Transformer

Potential transformers shall be rated for interior use. Voltage rating shall provide 120 volts, 3 phase, 4 wire, 60 Hertz, wye to kilowatt-hour meter, insulation class, 600 volts. Potential transformers BIL shall be 10 KV and accuracy class 0.3 at burdens w, x and y. Thermal rating shall be 500 VA.

2.2.4.13 Voltage Transducer

Voltage transducer wiring shall be connected to a potential transformer. Provide three (3) spare transducers for each switchboard. Transducer housing shall be constructed of ferrous metal. The voltage Transducer shall include the following features: Full scale shall be 150 volts. Load shall be single phase. Potential input shall be 115 VAC. Potential burden shall be a maximum of 2.5 VA at 120 volts. Burden shall be 0.1 VA per element at 120 volts, 2 VA per element with 5 amperes input. Output shall be 4-20mA DC. Accuracy/Linearity at 25 deg C: +0.25% at rated output, 0.5% of full scale includes, influences due to variation in voltage, current, power factor, wave form, frequency and output load impedance. Operating temperature range 0 degree F to 150 degree F, 400 ms for output to register 99% of final value. Frequency range shall be 58-62 Hz. AC component range shall be 0.5% of maximum output. Power factor range shall be Unity to load or lag zero. Calibration adjustment shall be +10%. Zero adjustment is not required. Dielectric strength shall be 1800V RMS at 60 Hz between each input circuit and all other components. External amplifier power of 120V is required.

2.2.4.14 AC Ammeter

Transformer rated, 5 amperes, 60 Hz input, 4 inch for use with current transformers. Ammeter shall provide +1 percent accuracy at full scale. Scale shall span 250 degrees. Mounting shall be flush type.

2.2.4.15 Ammeter Switch

Ammeter switch shall be designed specifically for the purpose and shall short circuit all current circuits except the one being read. Contacts shall be rated for 20 amperes, 600 volts AC. Switch shall have 4-position escutcheon indicating each phase and “off”. Switch shall have metal shaft and removable handle.

2.2.4.16 Current Transformers

Current transformers for metering application shall be multi-ratio type, with a minimum of 9 ratios, 5 terminals, rated for interior use. Insulation class rating shall be 600 volts, 60 hertz, and shall have an accuracy classification of 0.3 for ANSI standard burdens. Current transformer ratios shall be set as indicated on the drawings and if not on the drawings, set to match circuit breaker trip settings. Current transformers shall be bracket or rack mounted in secondary cabinets and positioned to allow cables to easily route through the current transformer opening. Integral circuit breaker current transformers shall not be used for metering. Installation of current transformers shall have all ratios brought out to individual shorting

blocks, each wire shall be identified on both ends. Use ring type lugs. Current transformer installation shall have H1 side of the current transformer facing power source. At shorting terminal block provide ground jumper on the 6th terminal and ground the current transformer on the side of the shorting terminal block which is wired to the KWH meter or amp transducer. Provide the following:

Multi-ratio	Current Rating Amperes (RATIOS)	Taps
600 to 5	50 to 5	2 and 3
	100 to 5	1 and 2
	150 to 5	1 and 3
	200 to 5	4 and 5
	250 to 5	3 and 4
	300 to 5	2 and 4
	400 to 5	1 and 4
	450 to 5	3 and 5
	500 to 5	2 and 5
	600 to 5	1 and 5
1200 to 5	100 to 5	2 and 3
	200 to 5	1 and 2
	300 to 5	1 and 3
	400 to 5	4 and 5
	500 to 5	3 and 4
	600 to 5	2 and 4
	800 to 5	1 and 4
	900 to 5	3 and 5
	1000 to 5	2 and 5
	1200 to 5	1 and 5
2000 to 5	300 to 5	3 and 4
	400 to 5	1 and 2
	500 to 5	4 and 5
	800 to 5	2 and 3
	1100 to 5	2 and 4
	1200 to 5	1 and3
	1500 to 5	1 and 4
	1600 to 5	2 and 5
	2000 to 5	1 and 5
3000 to 5	300 to 5	3 and 4
	500 to 5	4 and 5
	800 to 5	3 and 5
	1000 to 5	1 and 2
	1200 to 5	2 and 3
	1500 to 5	2 and 4
	2000 to 5	2 and 5
	2200 to 5	1 and 3
	2500 to 5	1 and 4
	3000 to 5	1 and 5

4000 to 5	500 to 5	1 and 2
	1000 to 5	3 and 4
	1500 to 5	2 and 3
	2000 to 5	1 and 3
	2500 to 5	2 and 4
	3000 to 5	1 and 4
	3500 to 5	2 and 5
	4000 to 5	1 and 5

2.2.4.17 Current Transducer

Feeder amperage shall be monitored by current transducers as shown on the control drawings. Wiring input shall be connected to current transformer. Provide three (3) spare transducers for each switchboard. Transducer housing shall be constructed of ferrous metal. Ampere transducers shall be single element, constant current output and shall have characteristics equal to or better than the following: Input current shall be 0-5 amperes AC single phase measurements. Input shall be capable of continuously carrying 10 amperes AC or withstanding 250 amperes AC for 1 second. Output current shall be 4-20 milliamps (mA) DC. Calibration adjustment shall be +2% minimum. Output ripple shall be 0.5% maximum. Response time shall be 0.1 seconds for output to register 99% of a sudden input change. Accuracy/Linearity 25-1/4C shall be +0.5 of full scale overall between 0-5 amperes, load variation of 0-108 ohms and frequency variation of 50-500 Hz. Temperature effect shall be +1% maximum between –20 degree C to 60 degree C. Humidity effect shall be 0.05% without condensation. Burden shall be 1 VA maximum. Voltage input shall be nominal 120V at a range of 85-135V and shall be capable of withstanding 175V overload continuously.

2.2.4.18 Control Power transformer

NEMA ST 20, rated 7.5 kVA, 1-phase, 3-wire, 60 hertz, dry-type, 480 primary volts to 120/240 secondary volts complete with primary current limiting fuses and secondary molded case circuit breakers. Wire using 3-#6 THW on both primary and secondary. Transformers shall be accessible from the front and in NEMA 1 housing.

2.2.5 Pad-Mounted SF6 (Sulfur Hexafluoride) Insulated Interrupter Switch

ANSI C37.71 and ASTM D 2472. The SF-6 gas switch shall be rated for 600 amperes, 15,500 volts 110kV BIL, 40 KA momentary and fault close asymmetrical rating. Switches shall be three-pole, multi-way type as shown on the drawings, with two operating positions identified as OPEN, and CLOSED. Viewing windows (minimum two per tank) shall be provided for inspection of all operating positions. These windows shall be bolt-mounted type with retained and cushioned gaskets. Individual switch blades or links shall be provided for each incoming feeder. The switches shall be load-break type assemblies with external operating handles, and switch blade contact arrangements as shown on the drawings. Contact shall be self-aligning, silver-plated copper type with arc shields to minimize contact wear. Contact travel shall be clearly visible through the viewing windows. Contacts shall be rated for 500 service operations. Each switch tank shall be constructed of minimum 6.35mm-thick welded steel plate, welded at all joints. The tank shall be suitable for frame mounting. A gas pressure gauge with a 4-20mA output shall be provided and wired to the utility control cabinet. The switch shall be provided with a fill valve, plug, air

test fittings, lifting eyes, ground bus, grounding provisions, one line diagrams, operating handle, and compression spring operator. A galvanized steel angle and/or channel frame allowing 48" from finish grade to high voltage bushings shall be provided. Low profile type or integral door type switches are not acceptable. The switch tank shall be bolted to the frame. Additional outdoor weather-proof 11 gauge steel enclosure with doors and padlockable handle shall be provided as shown on drawings. Parking stands shall be provided to "Park" cables after removal. Color of switch enclosure shall match unit substation color. Mount switch on concrete pad at least 203 mm thick. Provide bare copper cable, not less than 610 mm below connected to ground rods and each switch way.

2.2.5.1 Cable Termination

The switch shall have field replaceable (from exterior of tank) 600 Amp apparatus bushings, complete with elbow connectors for rear connection of cables. Bushings and connectors shall be rated for 25 kV operation. Connectors shall be capable of accepting 3/0 to 750 MCM cables. All cables shall be marked by phase, for each terminator location. The switch compartments shall not be utilized as splicing junction boxes.

2.2.5.2 Circuit Diagram

Circuit diagram with circuits labeled per contract drawings, nameplate indicating manufacturer and switch rating as specified above shall be provided. Include pad labels and circuit numbers.

2.2.5.3 Elbow Connector and Accessories

IEEE 386. Apparatus (elbow) connectors shall be a fully shielded, fully submersible, hot stick operable, separable insulated connector, designed for de-energized operation. The connector shall be designed to terminate specified cable. The connector shall consist of a housing, conductor contact, male contact, and bail assembly. The housing shall be made of a specially molded, non-tracking type rubber with an outer conductive jacket 1/8 inch thick. The contacts shall be high conductive, silver plated copper with compression disc washers to insure positive contact pressure when engaged. The connectors shall be rated as follows:

Continuous Load Current	600A RMS
8-Hour Overload Current	900A RMS
Voltage Nominal	25kV
Phase to Ground Voltage	14.4kV minimum
Impulse Withstand Voltage (BIL)	125kV, 1, 2 x 50 wave
Withstand Voltage	42kV, 60HZ, 1 Min. 80kV, DC, 15 Min.
Corona Extinction	40000 RMS Asymmetrical for 12 Cycles

2.2.5.4 Accessories

a. Basic insulating plugs, dead end plugs and connecting plug shall be fully shielded, fully submersible devices to interface the apparatus connectors. The electrical rating shall be the same as for apparatus connectors. Provide one (1) for each unused bushing.

b. Shield adapter and grounding device shall be furnished for intercepting cable shielding and proper grounding.

c. All premolded products such as basic insulating plugs, dead end plugs, connecting plugs, end caps, shield adapters, and grounding devices shall be the product of one manufacturer.

d. Provide three (3) spare elbow connectors for each switch and turn these over to the Contracting Officer.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Verification of Conditions

Coordinate the electrical work with the work of other trades at the jobsite to ensure that components which are to be incorporated into the electrical system are available to prevent delays or interruptions as the work progresses. Verify that conditions are suitable for installation of the electrical system.

3.1.2 Installation Underground

3.1.2.1 Underground Duct with Concrete Encasement

Ducts for electrical power distribution shall not be smaller than 127 mm in diameter. The concrete encasement surrounding the bank shall be rectangular in cross-section. Separate conduits by a minimum concrete thickness of 63.5 mm, except separate power conduits from control conduits by a minimum concrete thickness of 76.2 mm.

The top of the concrete encasement shall not be less than 457 mm below grade except that under roads and pavement it shall be not less than 610 mm below grade.

3.1.2.2 Meters and Current Transformers

Provide in accordance with ANSI C12.1.

3.1.2.3 Foundation for Equipment and Assemblies

Mount transformer on concrete slab. The slab shall be at least 203 mm thick, reinforced as indicated. If reinforcement is not indicated then provide slab with a 152mm by 152 mm - W2.9 by W2.9 mesh placed uniformly 102 mm from the top of the slab. Slab shall be placed on a 152 mm thick, well-compacted gravel base. The top of the concrete slab shall be approximately 102 mm above the finished grade. Edges above grade shall have 12.7 mm chamfer. The slab shall be of adequate size to project at least 203 mm beyond the equipment. Provide conduit turnups and cable entrance space required by the equipment to be mounted. Seal voids around conduit openings in slab with water- and oil-resistant caulking or sealant. Cut off and bush conduits 76.2 mm above slab surface. Provide curbing to contain transformer oil leaks.

3.1.2.4 Grounding Electrodes

Provide cone pointed driven ground rods driven full depth plus 152 mm, installed to provide an earth ground of the value before stated.

3.1.2.5 Pad Mounted Transformer Grounding

Provide ground loop around the pad perimeter consisting of four ground rods located at opposite corners, connected with No. 4/0 bare copper grounding conductors. Provide copper grounding conductors and connect them to the ground loop. Provide a ground conductor from the transformer secondary neutral to ground loop sized in accordance with NFPA 70. All connections shall be made with exothermic welding. Grounding conductor from transformer secondary neutral shall be insulated and run to the ground loop separate from arrester and ground pad conductor. The ground loop, surge arrester conductor, and conductor from transformer ground pads to ground loop shall be No. 4/0 bare copper. When additional work is required to obtain the specified ground resistance, the provision of the contract covering "Changes" shall apply.

3.1.2.6 Fence Grounding

Fences around electrical equipment shall be grounded with a ground rod at each fixed gate post and at each corner post. Drive ground rods adjacent to the ground loop until the top is 304.8 mm below grade. Attach the ground rod to the ground loop by exothermic welding. Attach a No. 4/0 bare copper conductor by exothermic fusion weld process, to the ground rods and extend underground to the immediate vicinity of fence post. Lace the conductor vertically into 304.8 mm of fence mesh and fasten by two exothermic welds, one to bond wire to post and the other to bond wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm by 25.4 mm flexible braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.1.3 ACCEPTANCE TESTING

The Contractor shall engage the services of a recognized independent testing firm or independent electrical consulting firm to perform short-circuit and coordination studies as herein specified. The Contractor shall engage the services of a recognized independent testing firm for the purpose of performing inspections and tests as herein specified. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such inspections and tests. The inspections and tests shall determine suitability for energization. An itemized description of equipment to be inspected and tested is as follows:

12KV Cable and terminations
Pad Mounted transformer
SF6 switches
Secondary distribution sections.
Circuit Breakers, 100 amp trip and larger.
Instrument Transformers
Metering Systems.
Grounding Systems

3.1.3.1 APPLICABLE CODES, STANDARDS, AND REFERENCES

InterNational Electrical Testing Association Acceptance Testing Specifications For Electric Power Distribution Equipment and Systems, 1999.

All inspections and tests shall be performed in accordance with applicable codes and standards including: NEC, ANSI, IEEE, NFPA, NEMA, and OSHA.

3.1.3.2 QUALIFICATIONS OF INDEPENDENT TESTING ORGANIZATION

The independent testing organization shall have been engaged in full practice in the final inspection, testing, calibration, and adjusting of electrical distribution systems, for a minimum of ten years. The independent testing organization shall be financially independent of the supplier, producer, or installer of the equipment. The independent testing organization shall have a calibration program with accuracy traceable every six months in an unbroken chain, to the National Institute of Standards and Technology.(NIST) The independent testing organization shall have a designated safety representative on the project. The safety standards followed shall include OSHA and NFPA 70E. Inspection, testing, and calibration shall be performed by an engineering technician, certified by a national organization, with a minimum of five years experience inspecting, testing, and calibrating electrical equipment, systems and devices. Information on the certified engineering technician shall be submitted to the Contacting Officer’s Representative for approval prior to the start of work. The qualifications of the independent testing organization shall be submitted to the Contracting officer’s representative for approval prior to the start of testing. Full membership in the InterNational Electrical Testing Association constitutes proof of meeting all of the above requirements. The contractor shall supply to the independent testing organization complete sets of approved drawings, coordination study, settings of all adjustable devices, and other information necessary for an accurate inspection and evaluation of the system prior to performance of any tests. After the evaluation of the system and equipment has been made, the independent testing organization shall submit for approval an acceptance test procedure for each item of electrical distribution equipment to be tested on this project. No testing shall be performed until the test procedures have been approved.

3.1.3.3 RESPONSIBILITY

The contractor shall perform routine insulation resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the independent testing organization specified herein. The contractor shall supply a suitable and stable power source of electrical power to each test site. The independent testing organization shall specify the specific power requirements. The independent testing organization shall notify the contracting officer’s representative prior to commencement of any testing. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported. The independent testing organization shall maintain a written record of all tests and shall assemble and certify a final test report. The independent testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

3.1.3.4 REPORT SUBMITTALS

Six bound copies of the certified test reports shall be submitted to the Government at the completion of the project. The final report shall be signed and stamped by a registered engineer and shall include the following information:

Summary of the project

Description of equipment tested
Visual inspection report
Description of tests
Test results
Conclusions and recommendations
Appendix including appropriate test forms
Identification of test equipment used

3.1.3.5 INSPECTION AND TEST PROCEDURES

Perform all tests, including any optional tests listed in NETA ATS-1999. This applies to all equipment provided on the project.

3.1.4 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least three times, demonstrating satisfactory operation each time.

End of Section

SECTION 16745

FIBER OPTICS DATA TRANSMISSION FOR EXTERIOR UTILITY CONTROL SYSTEM
Version 6.1 07/28/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	(1997) National Electrical Safety Code

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 170	(1957) Monochrome Television Studio Facilities
ANSI/EIA/TIA-455-41	(1993) Compressive Loading Resistance of Fiber Optic Cables
ANSI/EIA-472D00A	(1993) Fiber Optic Communications Cable for Outside Plant Use

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	2001 Rules and Regulations: Radio Frequency Devices

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. (IEEE)

IEEE C62.41	1991 Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	1997 Enclosures for Electrical Equipment (1000 Volts Maximum)

UNDERWRITERS LABORATORIES INC. (UL)

UL 1449	1996 (Errata 1986) Transient Voltage Surge Suppressors

1.2 RELATED REQUIREMENTS

Section 16050, "Electrical General Requirements," applies to this section, with the additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

Provide fiber optic (FO) data transmission media (DTM) for analog or digital communications. Data transmission system shall consist of transmitter and receiver modules connected by transmission lines and terminal devices. Computing devices, as defined in FCC Part 15, certified to comply with requirements for Class A computing devices and labeled as set forth in FCC Part 15.

1.3.2 Electrical Requirements

Equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.3.3 Power Line Surge Protection

Provide surge protection for equipment connected to AC circuits from power line surges. Surge protector; IEEE C62.41 UL 1449. Do not use fuses for surge protection.

1.3.4 Signal Line Surge Protection

Provide protection for communication equipment against power surges induced on wire line connections of any communication circuit. Cables and connectors serving as communications circuit between a fiber optic transmitter or receiver and any device shall have surge protectors installed at each end. Provide additional triple electrode gas surge protectors rated for the application on each wirelike circuit within three feet of the building cable entrance. Do not use fuses for surge protection. Test inputs and outputs in both normal and common mode using the following wave forms:

a. 10 microsecond rise time by 1000 microsecond pulse width wave form with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond rise time by 20 microsecond pulse width wave form with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.4 SUBMITTALS

Submit the following in accordance with Section 01300, "Submittals."

1.4.1 SD-02, Manufacturer's Catalog Data

a. FO cable

b. ST Fiber optic connectors

1.4.2 SD-05, Design Data

a. Optical link power budget

b. Signal bandwidth analysis

Submit complete system descriptions, analyses, and calculations used in sizing equipment required in Section 16800, "Utility Control System Addition ." Descriptions and calculations shall show how the equipment will operate as a system.

1.4.2.1 Optical Link Power Budget

Submit calculation for transmission power losses between the transmitter and receiver.

1.4.2.2 Signal Bandwidth Analysis

Submit analysis to assure that all components have sufficient bandwidth to transmit the required signal.

1.4.3 SD-08, Statements

a. Installer's qualifications

b. Instructor's qualifications

c. FO system operational test plan

1.4.3.1 Installer's Qualifications

Prior to installation, submit data for approval by PWC code 611, Navy Public Works Center 32nd Street Naval Station, of the installer's experience and qualifications specified in paragraph entitled, "Evidence of Experience and Qualifications."

1.4.3.2 Instructor's Qualifications

Prior to installation, submit data of the instructor's experience and qualifications as specified in paragraph entitled "Evidence of Experience and Qualifications."

1.4.3.3 FO System Operational Test Plan

Submit for approval at least 30 days prior to commencement of formal operational testing. Include detailed procedures for operational test of FO system component and performance of an integrated system test.

1.4.4 SD-11, Factory Test Report

a. FO cable reel test

1.4.5 SD-12, Field Test Reports

a. Field test

1.4.6 SD-14 Samples

One each of the following samples shall be submitted to the ROICC with the manufacture's data list for approval. The samples will become the property of the government.

a. 36" piece of fiber optic cable

b. 1 ST Fiber optic connector kit

c. 1 Fiber optic cable marker tag

1.4.7 SD-19, Operation and Maintenance Manuals

a. Fiber optic (FO) data transmission media, Data Package 5

Submit operation and maintenance data in accordance with Section 01730, "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

1.5.1 Evidence of Experience and Qualifications

1.5.1.1 Installer

Show that the installer who will perform the work has a minimum of 2 years experience successfully installing FO cable system of the same type and design as specified herein. Include the names, locations, and points of contact of at least two installations of the same type and design as specified herein where the installer has installed such systems. Indicate the type of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 12 months.

1.5.1.2 Instructor

Show that the instructor, who will train operation and maintenance personnel, has a minimum of 24 hours training from a recognized technical organization, and 2 years experience in the installation of FO cable system of the type specified.

1.6 SITE CONDITIONS

1.6.1 Environmental Requirements

Provide equipment and cable rated for continuous operation under ambient environmental conditions of 0 to 60 degrees C and humidity up to 100 percent condensing or as normally encountered for the installed locations.

PART 2 PRODUCTS

2.1 FO CABLE

ANSI/EIA-472D00A for underground and buried use. Cable shall contain 6 fiber optic conductors. Individual fiber conductors shall be color coded. Cable shall be from the same manufacturer, of the same type, and of the same size.

2.1.1 Multimode Fiber

Fibers shall be multimode, fully graded index glass core with glass cladding, and with acrylate covering over the cladding, in accordance with the following.

Core Diameter:	62.5 microns
Cladding Diameter:	125 microns
Covering Diameter:	250 microns
Strength:	50 kpsi, minimum
Numerical Aperture:	0.275
Wavelength:	Dual window at 850 and 1330 nanometers
Attenuation:	< 3.0 dB/km at 850 nanometers < 1.0 dB/km at 1330 nanometers
Bandwidth:	> 160 MHz-km at 850 nanometers > 500 MHz-km at 1330 nanometers

2.1.2 Cable Construction

Cable components shall withstand the environment where the cable is installed for a minimum of 20 years.

2.1.2.1 Mechanical Stress

Mechanical stress present in the cable shall not be transmitted to the optical fibers. The FO cable shall use loose tube construction. In loose tube construction the optical fibers shall be surrounded by a tube buffer, be contained in a channel, or otherwise loosely packaged to provide clearance between the fibers and the inside of the container to allow for thermal expansions without constraining the fiber. The protective container shall be extruded from a material having a coefficient of friction sufficiently low to allow the fiber free movement.

2.1.2.2 Protective Covering

Provide continuous covering on a single length cable with same material, and shall be free from holes, splits, blisters, and other imperfections. Covering shall be flame retardant, moisture resistant, non nutrient to fungus, ultraviolet light resistant, nontoxic, and electrically nonconductive. A flooding compound shall be applied into the interior of the fiber tubes, into the interstitial spaces between the tubes, to the core covering, over the core covering, and between any unbonded surfaces of the non-metallic strength member and jacket of all cable to be installed underground, and in locations susceptible to moisture.

2.1.2.3 Strength Members

Non-metallic strength members shall be integral part of the cable construction. The combined strength of the members shall be sufficient to support the stress of installation and protect the cable in service.

2.1.2.4 Cable Outer Jacket

Provide Polyvinylchloride (PVC) cable jacket. Jacket shall be continuous, smooth, and free from holes, splits, blisters, and other imperfections. Jacket shall be flame retardant, moisture resistant, non nutrient to fungus, ultraviolet light resistant, nontoxic, and electrically nonconductive.

2.1.2.5 Tensile Strength

Cables of 12 fibers or less shall withstand an installation tensile load of not less than 3000 Newtons and not less than 1000 Newtons continuous tensile load. Cables with more than 12 fibers shall withstand an installation load of not less than 6000 Newtons and a long term tensile load of not less than 1500 Newtons.

2.1.2.6 Impact and Crush Resistance

Minimum crush resistance of 2000 Newtons per square centimeter, tested in accordance with ANSI/EIA/TIA-455-41.

2.1.2.7 Storage Temperature Range

Minus 40 degrees C minimum and 70 degrees C maximum.

2.2 CONDUIT

Conduit as specified in Section 16375, "Underground Electrical Work."

2.3 ENCLOSURES

Provide metallic enclosures for fiber optic data transmission equipment. NEMA 250, type NEMA 12 or NEMA 4X enclosures. Enclosures shall be 14 gauge steel with oil resistant gaskets.

2.4 SOURCE QUALITY CONTROL

Contractor shall certify that FO cable conform to the requirements of this specification and ANSI/EIA-472D00A.

2.4.1 Preparation for FO Cable Delivery

Ship cable on reels with a minimum overage of 10 percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, attenuation, bandwidth, and date of manufacture. Provide water resistant label and the indelible writing on the labels.

2.4.2 FO Cable Reel Test

Test 100 percent of the fibers with an optical time domain reflectometer (OTDR) at 850 nanometers prior to shipment of the FO cable. Calibrate OTDR to show anomalies of 0.2 dB as a minimum. Submit photograph traces to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

Install system components and appurtenances in accordance with the manufacturer's instructions, and ANSI C2. Provide necessary interconnections, services, and adjustments required for a complete and operable data transmission system.

3.1.1 Connectors

All fibers, including spare fibers, shall have jumpers or pigtails of not less than one meter installed at each end of the cable. ST type connectors shall be installed on each fiber of the fiber optic cable at each termination point of the cable. After installation all fibers in the fiber optic cable shall have connectors at each end. Provide a Fiber Optic Distribution Enclosure at each termination point with couplings for each fiber. Provide 2-6 foot fiber optic jumper cables with connectors on each end. Each fiber optic jumper cable shall consist of two fibers.

3.1.2 Underground Installation

Install underground electrical work for FO system as specified in Section 16375, "Underground Electrical Work."

3.1.3 Splices

Splices shall not be permitted. Splices shown on contract drawings are for reference only. All fiber optic cable shall be one continuous cable from Pad/Substation/Station to Pad/Substation/Station.

3.1.4 FO Cable in Ducts or Conduits

Provide cable lubricant compatible with the cable sheathing material when pulling cable. Attach pulling fixtures to the cable strength members. When indirect attachments are used, match the grip diameter and length to the cable diameter and characteristics. When indirect attachment is used on cables having only central strength members, reduce pulling forces to ensure that fibers are not damaged from forces being transmitted to the strength member. During pulling of the cable, continuously monitor pull line tension and do not exceed the maximum tension given by the cable manufacturer. Mechanical stress placed upon the cable during installation shall be such that cable is not twisted or stretched. Provide cable feeder guide between cable reel and face of duct or conduit to protect and guide cable into the duct or conduit as it played off the reel. As the cable is played off the reel, carefully inspect for jacket defects. Take precautions during installation to prevent the cable from being kinked or crushed and that minimum bend radius is not exceeded at any time. Hand feed and guide cable through each manhole or handhole and apply additional lubricant at intermediate manholes or handholes. When practicable, use the center

pulling technique to lower pulling tension. Pull the cable from the center point of cable run towards the end termination points. When the cable is pulled out of a manhole or handhole, protect cable from dirt and moisture by laying cable on a ground covering.

3.1.5 Pull String

Pull in ¼ inch polypropylene pull string with the fiber optic cable. The pull string shall be tied off in each manhole.

3.1.6 Identification and Labeling

Provide identification tags or labels for each cable. Labeling format shall be identified and provide complete record to the Contracting Officer with final documentation. The fiber optic cable shall be routed through each manhole and loosely tie wrapped to the cable rack. The cable shall not be kinked or crushed and the minimum bend radius shall not be exceeded. The fiber optic cable shall be clearly tagged in each manhole. The tag shall identify it as fiber optic cable and shall identify the termination points.

3.2 FIELD QUALITY CONTROL

Furnish test equipment, instrumentation, personnel, and supplies necessary to perform all testing. Contracting Officer shall be given 10 working days notice prior to each test.

3.2.1 Field Test

Verify complete operation of data transmission system during field testing. Perform test on 100 percent of the fibers of each circuit and repeat from the opposite end of each circuit. Field tests shall include as a minimum:

a. Optical time domain reflectometer (OTDR) test at 850 nanometers, of the FO cable. Calibrate OTDR to show anomalies of 0.2 dB as a minimum. Replace any cable that fails the test with a new cable. Splicing of the cable will not be permitted. Notify the Contracting Officer of the problem and the replacement schedule. Test the new cable. Submit photographic traces for each circuit to the Contracting Officer.

b. Perform power attenuation test at light wavelength of the transmitter to be used on the circuit being tested. Measure flux at the FO receiver end and compare to the flux injected at the transmitter end. Provide a jumper at each end of the circuit under test to validate end connector loss. Rotational optimization of the connectors will not permitted. Circuit loss shall not exceed the calculated circuit loss by more than 2 dB. Replace any cable that fails the test with a new cable. Splicing will not be permitted. Notify the Contracting Officer of the problem and the replacement schedule. Test the new cable. Provide copies of the test report to the Contracting Officer.

c. Test and verify that transmitter/receiver pair of each circuit has a gain margin which shall exceed the circuit loss by at least 6 dB. When measured gain margin of any circuit is less than 6 dB, provide a repeater on the circuit to maintain a minimum gain margin of 6 dB. Provide copies of the test report to the Contracting Officer.

3.2.2 Performance Verification Test

FO data transmission system shall be tested as a part of the completed system during operational acceptance test as specified in Section 16800.

End of Section

SECTION 16800
UTILITY CONTROL SYSTEM
Version DNP 2.0 20-Aug-02

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C2	1997 National Electrical Safety Code
ANSI C12	1978 Electricity Metering, Code for
ANSI X3.74	1979 National Standard Code for Information Interchange (ASCII)

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

BSP 41004	1973 Bell System Technical Reference Data Communications Using Voice band Private Line Channels

DEPARTMENT OF DEFENSE (DOD)

DOD DIAM 50-3	MAY 83 Physical Security Standards for Sensitive Compartment Information Facilities, Defense Intelligence Agency

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 232-E	(1991) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data
EIA 455-13	(1984; R 1990) FOTP-13 Visual and Mechanical Inspections of Fibers, Cables, Connectors, and/or Other Fiber Optic Devices
EIA 455-25A	(1989) FOTP-25 Repeated Impact Testing of Fiber Optic Cables and Cable Assemblies
EIA 455-30B	(1991) FOTP-30 Frequency Domain Measurement of Multimode Optical Fiber ` Information Transmission Capacity
EIA 455-41	(1985) FOTP-41 Compressive Loading Resistance of Fiber Optic Cables
EIA 455-46A	(1990) FOTP-46 Spectral Attenuation Measurement for Long-Length, Graded-Index Optical Fibers
EIA 455-47B	(1992) FOTP-47 Output Far-Field Radiation Pattern Measurement

EIA 455-58A	(1990) FTOP-58 Core Diameter Measurement of Graded-Index Optical Fibers
EIA 455-59	(1989) FOTP-59 Measurement of Fiber Point Defects Using an OTDR
EIA 455-61	(1989) FOTP-61 Measurement of Fiber or Cable Attenuation Using an OTDR
EIA 455-65	(1988) FOTP-65 Optical Fiber Flexure Test
EIA 455-88	(1987) FOTP-88 Fiber Optic Cable Bend Test
EIA 455-91	(1986; R 1991) FOTP-91 Fiber Optic Cable Twist-Bend Test
EIA 455-104	(1988) FOTP-104 Fiber Optic Cable Cyclic Flexing Test
EIA 455-171	(1987) FOTP-171 Attenuation by Substitution Measurement - for Short-Length Multimode Graded-Index and Single-Mode Optical Fiber Cable Assemblies
EIA 455-177A	(1992) FOTP-177 Numerical Aperture Measurement of Graded-Index Optical Fibers
EIA 485	(1993) Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multi point Systems

FEDERAL SPECIFICATIONS (FS)

FS ZZ-R 765	Rubber, Silicon; Low and High Temperature and Tear Resistant

INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS (IEEE)

IEEE C57.13	(1978; R 1986) Instrument Transformers
IEEE C37.90.1	(1989; R 1995) IEEE Standard Surge Withstanding Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits
IEEE STD 100	(1988) IEEE Standard Dictionary of Electrical and Electronic Terms
IEEE STD 142	(1982) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE STD 802.3	(1985) Carrier Sense Multiple Access with Collision Detection (CSMSA/CD) Access Method and Physical Layer Specification

MILITARY STANDARDS (MIL-STD)

MIL-STD-461	Electronic Interference Characteristics Requirements for Equipment
MIL-STD-2202	(Basic) Energy Monitoring and Control Systems Factory Tests
MIL-STD-2203	(Basic) Energy Monitoring and Control Systems Performance Verification and Endurance Tests

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000) Industrial Controls and Systems
NEMA ICS 6	1993 Enclosures for Electrical Equipment (1000 volts maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	2002 National Electrical Code

UNDERWRITER'S LABORATORY

UL 864	Signaling System
UL 910	(1991) Test for Flame-Propagation Smoke-Density Values for Electric Optical Fiber Cables Used in Spa Transporting Environmental Air
UL 1666	(1991) Test for Flame Propagation of Electrical and Optical-Fiber Installed Vertically in Shafts
UL 916	Energy Management Equipment

DEPARTMENT OF DEFENSE (DOD)

DOD DIAM 50-3	MAY 83 Physical Security Standards for Sensitive Compartment Information Facilities, Defense Intelligence Agency

RURAL UTILITIES SERVICE (RUS)

RUS REA PE-60	(1979) Trunk Carrier Systems
RUS REA PE-80	(1979: Rev. Oct. 1982) Gas Tuber Surge Arresters

1.2 SYSTEM DESCRIPTION

1.2.1 General

Expand the Utility Control System (UCS) in a distributed processing network manner as described and shown. The existing system central which is located at PWC Utilities Building 272 Naval Station, San Diego, provides operator interactions, data collection and overall system supervision coordination and control. The existing Central System communicates with the existing Remote Terminal Units via a phone line and fiber optic network. The existing Remote Terminal Units perform data consolidation, control algorithms, productions, and calculations and they manage all control functions within their date environment. Sensed data is obtained from the Input\Output Panels, which are part of the RTU or are located within their particular data environment and communicate with the RTU's via fiber optic networks. Every connected analog output (AO)/ analog input (AI) and every digital output (DO)/digital input (DI) represents a "point" where referred to in this specification.

1.2.1.1 Communication Protocol

RTU'S must support DNP 3.0 protocol. Provide all necessary hardware and/or driver software if not present in the existing UCS. The contractor shall provide new RTU's as specified and shown which pass the pre-construction test specified in the paragraph titled “Preconstruction Acceptance Test” and interface correctly with the existing UCS system.

1.2.1.2 Expansion Requirements

The Contractor shall provide sufficient cards in each RTU to accommodate I/O points in the sum total of base contract plus Additional points in the quantity of 15% (minimum 2 of each point type) of actual implemented points in the base contract. The Additional points shall be furnished as wired-in spares. The Contractor shall also provide empty card slots in each RTU for future expansion. The empty card slots shall be capable of supporting 4 additional analog points and 8 additional digital points. Based on these requirements, the Contractor shall determine actual CPU memory and speed requirements, number of I/O cards, power supply capacity, battery capacity, and enclosure dimensions.

1.2.2 System Reliability

a. The system, including all components and appurtenances, shall be configured and installed to yield a mean time between failure (MTBF) of at least 2000 hours.

b. The minimum MTBF for all other major system components, including CPUs, power supplies, and RTUs shall exceed 14,000 hours.

c. With the exception of a fiber-optic cable cut or other similar cable destruction, the Mean-Time-To-Repair for the system shall not exceed 12 hours based on an electronic technician, trained as specified, having the recommended set of spare parts, a test set, and with repair beginning within 15 minutes of the failure.

1.2.3 System Accuracy

The system shall maintain an end-to-end accuracy for 1 year from sensor to operator's console for the applications specified and shall display the value as specified.

1.2.3.1 High temperature

High temperature with a range of 200 to 500 F plus or minus 2.0 F (display and print to nearest 1.0 F).

1.2.3.2 Pressure

Pressure with a range for the specific application plus or minus 2.0% of range (display and print to nearest psi).

1.2.3.3 Flow

Flow with a range for the specific application plus or minus 3.0% of range (display and print to nearest unit).

1.2.3.4 KWH

KWH with a range for the specific application plus or minus 0.5% of reading (display and print to nearest KWH).

1.2.3.5 Current

Current with a range for the specific application plus or minus 0.5% of reading(display and print to nearest ampere).

1.2.3.6 Voltage

Voltage with a range for the specific application plus or minus 0.5% of reading (display and print to nearest volt).

1.2.3.7 Power Factor

Power Factor with a range for the specific application plus or minus 1.0% of reading (display and print to nearest hundredth).

1.2.4 Data Base Update

Under system normal heavy load, the CPU point data base is to be updated in both the primary and the backup CPU's. System normal heavy load conditions are defined as the occurrence throughout the system of a total of three status changes, three digital alarms, three analog high or low limit alarms and three analog quantity changes within the high and low limits during a single 1- second interval. This number of similar occurrences shall repeat on a continuous basis during successive 1-second intervals for a period of 2 minutes. Specified system operation and performance shall be maintained under system normal heavy load conditions.

1.2.5 Environmental Conditions

All UCS field equipment shall operate without damage or degradation under the following ambient conditions, unless otherwise noted.

a. Operating Temperature: 32 degrees F to 122 degrees F

b. Humidity: 10 % to 95 %, non condensing

c. Corrosion: All UCS field equipment circuit boards shall be coated or similarly protected against the marine environment in San Diego.

d. Vibration and Shock: All UCS equipment shall withstand normal shock and vibration that will be encountered during transport and subsequent installation operations. Portable equipment shall withstand normal usage.

1.2.6 Electrical Transients and Electromagnetic Interference

All RTUs shall be designed to withstand electrical surges and other transients in accordance with IEEE C37.90.1. Equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

1.2.6.1 Sensor and Control Wiring Surge Protection

All digital and analog inputs and outputs shall be protected against surges induced on control and sensor wiring, and meet the requirements of IEEE C37.90.1. Fuses shall not be used for surge protection.

1.2.6.2 Communications Links Surge Protection

All communications equipment shall be protected against surges induced on any communications link and meet the requirements of IEEE C37.90 while equipment is operating. Fuses shall not be used for surge protection. All cables and conductors, except fiber optics, which serve as communications links shall have surge protection circuits installed at each end. Protection shall be furnished at equipment and additional triple electrode gas surge protectors rated for the application on each wire line circuit shall be installed within three feet of the building cable entrance. Surge protection shall meet the requirements of REA PE-60 and REA PE-80.

1.2.7 RTU Power Line Conditioner

Power Line Conditioners shall be furnished for each RTU. The Power Line Conditioners shall provide both voltage regulation and noise rejection. The Power Line Conditioners shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The Power Line Conditioners shall be sized for 125% of the actual connected KVA load. Characteristics of the Power Line Conditioners shall be as follows:

a. At 85% load, the output voltage shall not deviate by more than plus or minus 1% of nominal when the input voltage fluctuates between -20% to +10% of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3% of nominal. Full correction of load switching disturbances shall be accomplished within 5 cycles,

and 95% correction shall be accomplished within 2 cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3.5% at full load.

1.3 SUBMITTALS

Submit the following in accordance with Section 1300, "Submittals."

1.3.2 SD-02, Shop Drawings

Shop Drawings shall contain complete wiring, routing and schematic diagrams, to demonstrate that the additions has been coordinated with and will properly function as a part of the existing UCS system. Drawings shall show proposed layout and installation of all equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. All letter symbols and engineering unit abbreviations utilized in information displays and printouts shall conform to the ASHRAE Handbook of Fundamentals.

a. System modification block diagrams, showing how the new equipment will be integrated into the existing system. G

b. Transmission schematic for the UCS addition showing all Data Transmission Media, modems and any other interface devices. G

c. Wiring and Termination drawing of sensors and control devices at the RTU's showing RTU terminal numbers and terminal numbers in the switchgear or at the sensing device provided. G

d. Provide a single line diagram with all mains and feeders for each station. Show instrumentation CT's and PT's with their ratios and show all metering devices. G

e. Points list for each (RTU) showing a point description, type of point and type of input. G

f. RTU factory order forms. G

g. Control diagrams implemented. G

h. Sequence of Operation. G

i. Equipment interlock. G

1.3.1 03, Product Data

Manufacturers Data shall be submitted in accordance with the GENERAL PROVISIONS of the specification and shall consist of a complete list of equipment and materials, including manufacturers descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Contractor shall provide the following:

a. Remote Terminal Units (RTU) G

b. Software & Data Transmission Protocol Interface Documentation G

c. Fiber Optic Modem G

d. Telephone Modem G

e. Field Enclosures and Heating Elements G

f. Switches and Relays G

g. Control Panels G

h. Charger/Battery Banks with alarm points G

i. Catalog cuts and model numbers/part numbers for spare maintenamce parts per paragraph titled “Maintenance Parts”. G

1.3.3 Testing Submittals (Preconstruction test).

The Contractor shall prepare a test plan and a test procedure for the preconstruction test specified in the paragraph titled “Testing”. .The Contractor shall deliver the preconstruction test plan and procedure for approval. After receipt of written approval of the preconstruction test plan and procedure, the Contractor may schedule the preconstruction test.

1.3.3.1 Installer's Qualifications

Prior to installation, submit data to the Contracting Officer, of the installer's experience and qualifications specified in the paragraph titled “Qualifications of Installer”.

1.3.3.2 Instructor's Qualifications

Prior to installation, submit data to the Contracting Officer, of the instructor's experience and qualifications specified in the paragraph titled “Qualifications of Instructor”.

1.3.3.3 Manufacturer's Qualifications

Prior to installation, submit data to the Contracting Officer, of the manufacturer's qualifications specified in the paragraph titled “Manufacture Qualifications”.

1.3.4 SD-04, Samples

One each of the following samples shall be submitted to the ROICC with the manufacturer's data list for approval. The samples will become the property of the government and will not be considered a part of the maintenance parts listed in the paragraph entitled “Maintenance Parts”.

a. 36" piece fiber optic cable G

b. 1 - Fiber optic modem G

c. 1 - RTU analog input board G

d. 1 - RTU digital input board G

1.3.5 SD-06 Test Reports

a. Preconstruction test G

b. RTU panels (hardware & software) G

c. Complete operational UCS systems. G

1.3.6 SD-10, Operation and Maintenance Manuals

Submit as required for systems and equipment indicated in the technical sections. Furnish seven copies, bound in binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment tests, furnish three copies to the Navy PWC Codes 611 at time of final inspection and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover: the words "OPERATING AND MAINTENANCE MANUAL", the name and location of the system, equipment, building, name of Contractor, and Contract Number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing system or equipment and the local representatives for the system or equipment. Include a table of contents with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include:

a. As-Built Shop Drawings as specified in the paragraph titled “Shop Drawings”.

b. Furnish As-Built Shop Drawings on diskettes acceptable to the Government. The diskettes shall contain complete shop drawings for items a, b, c, d, and e in the paragraph titled “SD-10 Shop Drawings“ but are not limited to these items. Furnish the items a, b, c, d in AutoCad Version 14 or compatible format. Furnish item e in Microsoft Access format or a format convertible to Microsoft Access. Provide 2 complete sets of diskettes.

c. A description of the function of each principal item of the equipment.

d. Installation and maintenance instructions.

e. Safety precautions.

f. Diagrams and illustrations.

g. Testing methods.

h. Performance data.

i. Lubrication and calibration schedules, including type, grade, temperature range, and frequency.

j. Parts list. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.

k. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications.

1.3.6 Certified Test Reports (7 copies)

a. Preconstruction test

b. RTU panels (hardware & software)

c. Complete operational UCS systems.

1.4 TESTING

1.4.1 General

The Contractor shall perform testing of all Master Station and associated equipment, field equipment, during the preconstruction test and at the sites, including adjustments of the completed UCS, as specified. Test equipment used to perform any function under this contract shall be furnished by the Contractor. The Contractor is responsible for providing all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of any planned testing shall be given to the Government at least 14 days prior to any test, and in no case shall notice be given until after the Contractor has received written Government approval of the specific testing procedures.

1.4.1.1 Test Plans

The test plans shall define all the tests required to ensure that the expanded system meets technical, operational, and performance specifications. The test plans shall define location, milestones for the tests, identifying simulation programs, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities of the functions to be tested.

1.4.1.2 Test Procedures and Reports

The procedures shall be developed from the test plans and design documentation. The procedures shall consist of detailed instructions for test setup, execution and evaluation of test results. The test report shall be used to document results of the tests. Reports shall be delivered to the Government within seven days after completion of each test.

1.4.2 Preconstruction Acceptance Test

The Contractor shall perform a two week preconstruction operational acceptance test of UCS hardware/software. The test shall demonstrate and document that the new RTUs are compatible with the existing UCS system and that the new RTUs do not interfere with or degrade the operation of the existing system. The test shall demonstrate and document that the new RTUs are compatible with the existing UCS system communication format, timing and protocol. The test shall demonstrate and document operation of input and output devices and software operation and modifications. Submit, for approval, a test plan and a test procedure for the hardware and software preconstruction acceptance test. The test plan shall explain in detail the

expected results and how the expected result will demonstrate that the new equipment will meet the requirements of the specification, sequence of operation and I/O summary tables. The test procedure will describe the methods for simulating the necessary conditions of operation to demonstrate performance of the new data gathering equipment, input generation devices, output responses and software to be provided under this contract.

1.4.2.1 Preconstruction Acceptance Test Exception

The Contractor may request an exception from the Pre-Construction test. The Government will grant an exception at its discretion in the case of RTU's which are known to be compatible with the existing UCS system. If the Government does not grant an exception the Pre-Construction test must be passed or the equipment will be deemed not acceptable.

1.4.2.2 Delivery "Test Plans" and "Test Procedures and Reports"

Documents for the on-site test shall be delivered to the Government 28 days prior to the start of testing. Delivery and installation of the proposed RTU and data emulator shall be at least 14 days prior to start of test. Test shall commence no later than 60 days after Notice of Award.

1.4.2.3 Software Testing

The complete software algorithms for the project shall be programmed into the existing central system serving PWC - San Diego. All English language descriptors and point assignments shall be completely implemented. The existing report generator unit shall be programmed to completely monitor all testing for a two week period and record the state of all connected devices hourly for the entire two week period. A hand written log shall also be kept during periods of testing, detailing and modifications to the test setup, and describing the reason for those modifications. The hand written log shall also include a description of any RTU failures or alarms and any communication failures or alarms.

1.4.2.4 Test Site

Hardware and software test shall be performed at the Building 272 CPU room. The Contractor shall furnish all phone line modems, fiber optic modems and any equipment required to simulate conditions which will be encountered in the installation to be completed under this project.

1.4.2.5 Test Completion

Upon completion of the preconstruction hardware and software test, all reports and log books shall be delivered to the Government. The Government or the Contractor may terminate the test any time during the two week testing period for an unsuccessful attempt to test either the hardware or the software. Upon test failure, the Contractor will be allowed seven days maximum before starting a retest. A second unsuccessful attempt will require complete resubmittal and retesting. Unsuccessful equipment and software will not be allowed a third test.

1.4.2.6 System Liability

During the entire testing period, the Contractor shall be liable for all existing software and computer operation as covered in this specification,

Part 3 paragraph titled “General”. The Government will provide non-proprietary information it has and direct the Contractor as to where to obtain other information. It shall be the contractors responsibility to obtain the necessary information and to provide all software and hardware necessary to provide a complete and operable system.

1.5 TRAINING

The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the UCS as specified. The training shall be oriented to the specific system being installed under this contract. Training manuals shall be delivered for each trainee with two additional copies delivered for archival at Building 272 Naval Station 32nd Street. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The Contractor is responsible for furnishing all audiovisual equipment and all all other training materials and supplies. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday during the daytime shift at the training facility. Approval of the planned training schedule shall be obtained at least 30 days prior to the training.

1.5.1 Operators Training I

The Contractor shall provide at least 2 days of training for 3 people before the field checkout and the final test. The training shall be orientated towards installation, configuration and programming of the RTU and any communications equipment provided under this contract. The Contractor shall also provide training on the installation and configuration of any software added under this contract. At the end of the training the student should be able to install, configure and program an RTU or the communications equipment. The student shall also be able install and configure any software added under this contract.

1.5.2 Operators Training II

The Contractor shall provide at least 1 days training for 3 people before the Performance Verification Test. The training shall be orientated towards operation and maintenance of the equipment installed under this contract. The training shall include:

a. Physical layout of UCS panels, components and sensors.

b. Troubleshooting and diagnostic procedures.

c. Repair instructions.

d. Preventive maintenance procedures and schedules.

e. Calibration procedures.

1.6 WARRANTY

1.6.1 General Requirements

The Contractor shall provide all warranty required and equipment necessary to maintain all the UCS equipment and materials provided under this project

in operation. The warranty services shall be provided for a period of 1 year after acceptance of the system. Warranty work shall include preventive maintenance in addition to repairs, replacements, and adjustments. Written permission shall be obtained prior to performing any service work or adjustments which have any impact on facility operations.

1.6.2 Description of Work

Warranty services shall consist of the adjustment and repair of the UCS system . Warranty services shall include system software updates, maintenance of data transmission equipment and media, RTUs, and all new sensors and control devices. Contractor shall provide the manufacturer's required adjustments and all other work necessary to maintain the system in operation.

1.6.3 Personnel

Service personnel shall be qualified to accomplish all work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

1.6.4 Schedule of Work

1.6.4.1 General

The Contractor shall perform 2 major inspections. One half of the analog inputs shall be calibrated during the first major inspection and the other half of the analogs shall be calibrated during the second major inspection. The first major inspection shall be 6 months after the beginning of the warranty period and the second major inspection shall be at the end of the warranty period.

1.6.4.2 Major Inspections

These inspections shall include the following work:

a. Clean all RTUs, and interface panels including interior and exterior surfaces.

b. Perform diagnostics on all equipment.

c. Check and calibrate each field device. Check and calibrate 50% of the total analog points during the first major inspection. Check and calibrate the remaining 50% of the analog points during the second major inspection. Certify analog test instrumentation accuracy to be twice that of the device being calibrated. Check at least 50% of all digital points at all RTU sites for operation during the first major inspection. Check the remaining digital points at the second major inspection.

d. Run all system software diagnostics and correct all diagnosed problems.

e. Resolve any previous outstanding problems.

1.6.4.3 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays.

1.6.5 Emergency Service

The Government will initiate service calls when the UCS is not functioning properly. Qualified personnel shall be available to provide complete service to the UCS. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at the site within 24 hours after receiving a request for service. The UCS shall be restored to proper operating condition within 48 hours after receiving a request for service.

1.6.6 Operation

Performance of scheduled adjustments and repair shall verify operation of the UCS as demonstrated by the applicable tests of the performance verification test.

1.6.7 Records and Logs

The Contractor shall keep records and logs of each task, and shall organize cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices on a site-by-site basis. The log shall contain all initial analog span and zero calibration values and all digital points. Complete logs shall be kept and shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the UCS.

1.6.8 Work Requests

The Contractor shall separately record each service call request, as received. The form shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within five days after work is accomplished.

1.6.9 System Modifications

The Contractor shall make any recommendations for system modification in writing to the Government. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.7 QUALITY ASSURANCE

1.7.1 Qualifications of Installer

Prior to installation, the Prime Contractor shall show that he has successfully installed systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor

having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems and certify that these systems have performed satisfactorily in the manner intended for a period of not less than 36 months.

1.7.2 Qualification of Instructor

Show that the instructor, who will train operation and maintenance personnel has a minimum of 24 hours training in teaching or has a minimum of 5 years field experience with systems of the same type and design.

1.7.3 Manufacture Qualifications

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products shall have been in satisfactory commercial or industrial use for five years prior to bid opening. The five year use shall include applications of equipment and materials and similar circumstances and of similar size. The five years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures.

1.8 CONTRACTOR FURNISHED DATA TRANSMISSION MEDIA (DTM)

1.8.1 General

Provide all DTM not shown as Government furnished. Provide all transmission equipment required. Test all DTM and furnish a report to the Government demonstrating compliance as specified. Division 16402 shall provide all conduit and provide all wiring over 100 volts.

1.8.1.1 Communications Interface

The Contractor shall provide all phone modems or fiber optic modems for communication between the new RTUs and the existing UCS system at Bldg. 272 N.S. The Contractor shall insure that the new RTUs and modems are compatible with the existing UCS phone/line fiber optic network.

1.8.1.1.1 Phone Line Modems

If the new RTUs communicate with the existing UCS system via phone lines at N.S. the contractor shall furnish V.34 4 wire phone line modems compatible with the existing phone line modems. Phone modems shall be configurable from the front panel without the use of a terminal or computer and shall have a Liquid Crystal display which displays status and configuration options.

1.8.1.1.2 Fiber Optic Modems

If the new RTUs communicate over fiber optic cable a fiber optic modem with ST type fiber optic connectors shall be provided at each RTU for communication on the existing/new fiber optic transmission network as specified herein. Fiber optic modems shall allow full duplex, asynchronous, point-to-point digital communication using a fiber optic pair The Fiber optic modems shall have a minimum power budget of -15 db. The Fiber optic modems shall have 4 fiber optic connections and repeat both the transmit and

receive signals. Fiber optic modems shall have LEDs for power, transmitted data and received data. Fiber optic modems shall accept inputs and provide outputs compatible with EIA 232-E or EIA 485. Digital data rates through each link shall be a minimum of 38.4 KBPS. The operating wavelength shall be centered on 850 nanometers. Contractor shall insure new RTUs are compatible with the existing fiber optic/phone line network.

1.8.1.2 Wire lines Characteristics

The performance characteristics of wire lines shall equal that of a 3002 voice grade circuit as defined in American Telephone and Telegraph Company BSP 41004.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Equipment Standardization

Where two units of the same class of equipment are required, these units shall be products of a single and same manufacturer. Each major component of equipment shall have the manufacturers name and address, and the model number in a conspicuous place. All components shall match existing automation system for parts and service standardization, and shall be factory ordered specifically for this project. Warehoused, earlier generation equipment, re-built equipment or substituted equipment shall not be accepted. The UCS addition components including RTU's shall be an integrated assembly of coordinated design; constructed, tested and guaranteed by a single manufacturer, assembled at a single location, tested and Government inspected and approved prior to shipment to the job site.

2.1.2 Manufacture Qualifications

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products shall have been in satisfactory commercial or industrial use for five years prior to bid opening. The five year use shall include applications of equipment and materials and similar circumstances and of similar size. The five years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures.

2.1.3 Manufacturer's Nameplate

For each item of equipment, provide a nameplate bearing the manufacturer's name, address, model number and serial number securely affixed in a conspicuous place; the nameplate of a distributing agent will not be acceptable.

2.2 ENCLOSURES

2.2.1 General

Enclosures shall conform to the requirements of NEMA 250 for the types specified. Finish color shall be the manufacturer's standard, unless otherwise indicated. Damaged surfaces shall be repaired and refinished using original type finish. Enclosures installed outdoors shall be type NEMA 12 or

NEMA 4X stainless steel, unless otherwise shown. Enclosures shall have removable hinged doors with hasps for padlocks. Provide 2 padlocks for each enclosure to match existing Utilities lock system, BEST, 7 pin with 2 inch shackle. Padlocks to be keyed alike and match existing keys. Provide 2 keys for each padlock. Non metallic enclosures shall contain EMI/RFI shielding equivalent to a 14 gauge steel enclosure. Enclosures for RTUs and transducer cabinets installed outdoors shall contain a space heater, controlled by a humidistat and a thermostat, to maintain the enclosure above the dew point.

2.2.2 Enclosure Nameplates

Laminated plastic nameplates shall be provided for each equipment enclosure. Laminated plastic shall be 1/8-inch thick, white with black center core. Nameplates shall be a minimum of 1-inch by 3-inches, with minimum 1/4-inch high engraved block lettering. The nameplate for each equipment enclosure shall include the designator or number as shown on drawings and the site name. Site names shall be provided after order placement. Nameplates shall be attached to the equipment with stainless steel panhead screws.

2.2.3 Internal Wiring, Cabling, and Terminal Blocks

a. Internal wiring in factory pre-wired enclosures shall be installed according to the Contractor's standard as to wire size, insulation, and method of termination on internal equipment. Each individual conductor in individual enclosures shall be uniquely identified. Splices shall not be permitted.

b. The Contractor shall provide terminal blocks for conductors requiring connection to circuits external to the specified equipment, and shall be suitable for up to 14 AWG wire. Spade type compression connectors shall be provided. Terminal blocks shall be grouped for easy accessibility unrestricted by interference from structural members and internal devices. Sufficient space shall be provided on each side of each terminal block to allow an orderly arrangement of all leads to be terminated on the block. Plastic wiring duct or other factory mounted cable support devices shall be provided to support cables for external circuit wiring.

c. Terminal blocks, interposing relays, switches, or similar devices shall be readily accessible. The equipment shall be located in compartments, enclosures, or junction boxes in such arrangement that a serviceman shall have direct access to the equipment without removal of barriers, cover plates, or wiring. Grouped terminal blocks for all external connections shall be provided. All wiring leaving an enclosure shall leave from terminal blocks or prefabricated connectors and not from other devices in the enclosure. Terminal blocks and jumpers shall be permanently and uniquely marked in conformance with NEMA ICS 1.

2.2.4 Power Supplies

Power supplies shall accept 120 VAC nominal as input and shall have dual isolated dc outputs to power all RTU components. They shall be factory-mounted inside of the equipment enclosures.

2.2.5 Size Limitations

a. Free-standing RTU enclosures shall be a maximum of 90-inches high by 36-inches wide by 30-inches deep.

b. Certain RTUs shall be located inside existing electrical substation compartments, as shown on the drawings. The location of these RTUs have been sized according to industry average physical dimensions. Depending on equipment furnished, these RTUs may not fit in the locations shown, but may need to be mounted at an alternate location outside the substation in a type 4X stainless steel enclosure. The Contractor shall be responsible, in those instances where the specified mounting area is inadequate, for providing all necessary hardware, accessories, and wiring required for an alternate mounting location at no extra charge to the Government. Substation compartment mounted RTU enclosures shall not exceed 36 X 30 X 16 inches in size at any single location. If the RTU point requirement exceeds the maximum point count for a 36 X 30 X 16 inch enclosure for any RTU location, a second RTU enclosure shall be furnished.

2.2.6 Salt Environment

All enclosures indicated as requiring a type 4X stainless steel rating will be subjected to a salt-laden, corrosive environment typical to that found in Southern California marine applications. All metallic surfaces shall be protected by suitable coatings applied in the manufacturer's facility. Surfaces inaccessible after assembly shall be protected for the equipment lifetime of 20 years.

2.2.7 Exterior Enclosure Finish

All enclosures located outdoors, including sun shields, shall have a corrosion resistant finish, gloss white in color for maximum reflectivity.

2.3 REMOTE TERMINAL UNIT PANEL (RTU)

2.3.1 General

RTU's shall be provided to connect the points listed to an existing Utility Control computer system located at Bldg. 272 N.S. The contractor shall insure that the RTU`s interface correctly with and be compatible with the existing UCS system communication format, timing and protocol. The contractor shall also insure that the RTU software is successfully supported by the existing UCS system central computer software such that the existing software and hardware will not have to be modified (in any way) for the system to operate properly.

2.3.1.1 Controls

Each RTU with control outputs shall be equipped with a switch to disconnect the power to the digital output relays or otherwise inhibit all digital output points without shutting off the RTU or otherwise affecting its operation. An auxiliary contact on the disable switch shall be wired to one of the RTU digital input points to provide remote indication of the switch status. The RTU shall include the following controls:

a. Main Power Switch.

b. On-off line switch - enables and disables communications with the Master Station.

c. Reset switch - initializes CPU operation.

2.3.1.2 Indicators

Each RTU shall include the following indicators:

a. Power on-includes one for each power supply voltage.

b. On Line.

d. RTU outputs disabled.

2.3.1.3 Accessories

a. Each RTU enclosure shall have a grounded 120 VAC duplex convenience outlet mounted and wired within each enclosure.

b. Branch circuit protection shall be provided for the electrical accessories in each enclosure and shall have provisions for terminating a 120Vac, single-phase, grounded power supply circuit as shown and specified.

c. All RTU enclosures shall have a door slot on the inside of the door, suitable for storing the manual specific to each site.

2.3.1.4 Grounding

Isolated copper ground buses in RTUs for grounding control cable wiring shields shall be furnished with a ground lug and interconnected with a minimum 10 AWG insulated ground cable.

2.3.1.5 Expansion Capacity

Each RTU shall have a minimum of 15% of its I/O functions as expansion capacity. The expansion points provided shall be in the same proportion as the implemented I/O functions in the RTU, but in no case shall there be less than two extra points of each implemented I/O type. The Contractor shall furnish sufficient I/O to implement the base contract I/O points, and required expansion points. In addition the RTU shall have spare capacity which is capable of supporting 4 additional analog points and 8 additional digital points. If the RTU does not have this spare capacity a larger or additional RTU must be furnished. The RTU I/O functions shall be furnished complete, with no changes or additions necessary to support implementation of expansion functions. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. Implementation of expansion points (by others) shall necessitate only providing the additional field sensor or control, field wiring including connection to the RTU, and point definition assignment by the operator.

2.3.1.6 RTU - UPS

Each RTU shall be equipped with a (UPS) Uninterruptable Power Supply. Each UPS shall be sized to supply continuous full power to the fully loaded and operational RTU, including the fiber-optics modem (but not including the strip heater), for a minimum of 4 hours. Provide auxiliary contacts for standby or on line operation.

2.3.2 RTU

2.3.2.1 General

The Contractor shall furnish complete, fully operational, Microprocessor based RTUs. The RTUs shall not require the use of PROM or EPROM burners to make revisions to point parameters. The RTU shall operate autonomously in the event of a communication failure with the Master Station, collecting data from its I/O points utilizing a real-time clock function. RTU's shall be used to connect the points to the system and contain all necessary I/O functions to collect data from field sensors, and operate control devices and shall be furnished complete. Output relays associated with digital signals shall be considered part of the I/O function, whether physically mounted in the enclosure or separately mounted. The RTU shall report the status of all digital points and the values of all analog points which have changed since the last report. The RTU shall be fully supervised to detect failures and failures shall be reported to the system loader/terminal and at the Master Station.

2.3.2.2 RTU Capabilities

a. Communication

The RTU shall be capable of communicating using dedicated land lines, 900MHz Radio, Spread Spectrum Radio, Microwave and other communication applications which may include cellular or Satellite communications. Each communication process shall update the master station with real-time control and data information.

b. Monitoring

The RTU shall report the status of all points which have changed or value since the last report. The system shall have internal diagnostics which will aid in localizing faults down to the board level. Local annunciation via LEDs and program accessible status bits shall be available. RTUs shall be capable of handling start-stop commands, digital alarms and status inputs, analog inputs and outputs and totalization. The RTU shall be capable of interfacing with Intelligent Electronic Devices (IED).

2.3.2.3 Compatibility

Panels shall be identical to, and components interchangeable with existing spare parts and, those panels of similar usage already installed at Navy Public Works Center, San Diego. Panels and hardware manufactured more than 6 months before delivery to the job site shall not be used.

2.3.2.3 RTU Processor and Memory

The RTU processor shall be at least 32 bit with a 32 bit data and address bus and shall have a minimum of 1 megabyte of RAM.

2.3.2.4 Communications

a. Communications interfaces shall be provided for each RTU. Each RTU shall connect to the host via an RS232 or RS422 port or fiber optic modem, as shown. Where fiber optic circuits are shown, the Contractor shall furnish fiber optic modems installed in each RTU enclosure for communications with the host.

b. Each RTU shall have a minimum of 2 communication ports as follows:

(1) Port 1: RTU to Master Station
(2) Port 2: RTU to portable tester (EIA 232-E).

c. All fiber optic modems shall be in accordance with the requirements of SECTION 16745, FIBER OPTICS DATA TRANSMISSIONS FOR EXTERIOR SYSTEMS.

d. The RTU shall be capable of communicating with Intelligent Electronic Devices using the DNP V3.0 level 2 protocol. The RTU shall be capable of acting as a data concentrator which transfers data from the IED to the master station.

2.3.2.5 Transducerless I/O board

A Transducerless I/O board shall be available from the same Manufacturer and shall meet the requirements of the RTU specified above and be furnished where required. The Transducerless I/O board shall accept AC analog inputs directly configurable for current and voltage. Input ranges of 0 to 5 amperes and 0 to 120 Volts shall be accommodated. Accuracy's shall be 0.25% of full scale. The device shall measure and calculate the following quantities as shown or specified:

a. Phase voltage, phase current and neutral current.
b. Fault current up to 20 times full scale.
c. KW, KVAR(bidirectional), KWH(bidirectional), and KVARH(both total and for each phase).
d. Power factor
e. Harmonics (2nd through 5th)
f. Voltage quality data (sag and dwell)

2.3.3 I/O Card Functions

2.3.3.1 Analog Inputs (AI)

The AI function shall monitor each analog input, perform A-to-D conversion, and hold the digital value in a buffer for interrogation. The A-to-D conversion shall have a minimum resolution of 12 bits plus sign. Signal conditioning shall be provided for each analog input. Contractor shall individually calibrate all analog inputs for zero and span, in hardware or in software. The AI shall incorporate common mode noise rejection of 70 dB

from 0 to 60 Hz for differential inputs, and normal mode noise rejection of 60 dB at 60 Hz from a source impedance of 10,000 ohms. Input ranges shall be within the range of 0-1 ma dc, nominal impedance of 10,000 ohms, or 4 to 20 ma dc, nominal impedance of 300 ohms.

2.3.3.2 Analog Outputs (AO)

The AO function shall accept digital data, perform D-to-A conversion, and output a signal within the range of 4 to 20 ma. dc. D-to-A conversion shall have a minimum resolution of 8 bits plus sign. Contractor shall individually calibrate all analog outputs for zero and span. Open circuit protection on current outputs shall be provided.

2.3.3.3 Digital Inputs (DI)

The DI function shall accept on-off, open-close, or other change of state (two state data) indications from dry contacts. All status changes shall be reported regardless of whether they were the result of commanded or uncommanded operations. All field contacts shall be opto-isolated from RTUs internal power. The field contact input to the RTU shall be either a Form "A" or a Form "B" contact. The input circuitry shall be accept either a Form "A" or Form "B" contact as a normal condition. Sensing voltage for devices supplying digital inputs shall be powered by the RTUs. Input signals shall be filtered to minimize noise and contact bounce, with a filter time constant of 1 milliseconds. A digital filter shall be used for this application.

2.3.3.4 Sequence of Events (SOE)

2.3.3.4 Sequence of Events (SOE)

All RTUs shall be able to perform SOE functions as specified. RTUs indicated by the I/O Lists to have SOE points shall contain all necessary equipment to determine and time tag the order of occurrence of changes of the external contacts. Time tagging shall be accurate to plus "0" or minus 2 milliseconds at the SOE card. If the Contractor's equipment requires separate SOE and DI points, DI points shall be furnished in the specified quantity plus a quantity equal to that specified for SOE points.

2.3.3.5 Digital Outputs (DO)

The DO function shall provide contact closures for momentary and maintained operation of output devices. DO relays shall have an initial breakdown voltage between contacts and coil of at least 500 V peak. Protection against an applied steady-state voltage up to 180 Vac peak shall be provided. Minimum contact rating shall be 1 ampere at 24 Vac. Upon command, each output relay shall close for a definite but adjustable period of time. The time of closure shall be between 0.1 second and 60 seconds and the timing shall be accomplished by software on a point by point basis. These relays shall be de-energized in the event of RTU malfunction. Each momentary Raise or Open/Lower or Close control point and each Open/Close central point shall consist of a Raise (or Open) output and a separate Lower (or Close) output. Separate relays shall be provided for each RAISE (or OPEN) and each LOWER (or CLOSE) function. Reed relays shall be encapsulated in a container housed in a plastic, epoxy, or metal case. Contacts shall be rated for the application. Operating and release times shall be 1

millisecond or less. Relays shall be rated for a minimum life of 10 million mechanical operations and shall be equipped with coil transient suppression devices to limit transients to 150% of rated coil voltage. Each relay contact shall be wired to a terminal block for external wiring to each of its control output interposing relays.

2.3.3.6 Select Before Operate

The RTU shall be capable of Select Before Operate control operations. The SBO function shall operate as follows.

a. Device Selection - Upon receipt of the Master Station command message, the specified device will be selected.

b. Device Selection Validation - After device selection, the address of the selected device will be encoded and sent to the Master Station for validation.

c. Control Execution - Upon receipt of the command execution message from the Master Station, the command will be executed. If the message is not received within ten seconds, the device will be deselected.

2.3.3.6 Pulse Accumulator Inputs (PI)

The pulse accumulator function shall have the same characteristics as the DI, except that a buffer shall be provided to totalize pulses and allow for interrogation by the system. The pulse accumulator shall accept rates up to 10 pulses per second. The accumulator points shall totalize pulses received from dry contacts. A sensing voltage shall be supplied from the RTUs. Accumulator points shall accept Form C contacts (both the "Y" and "Z" contacts on the KYZ shall be monitored) from all Kilowatt-hour meters, and Forms "A" or "B" contact inputs from all flowmeter processors. Each pulse accumulator shall totalize a count of up to at least 65,536 and shall be able to be read at any time without loss of input data. When each pulse accumulator reaches its maximum value, it shall automatically reset to zero, and begin counting pulses again. The RTU shall accept a freeze command from the Master Station. When a freeze command is received, by the RTU, the accumulated totals will be transferred to a buffer area for storage and interrogation. Changes of state, which occur between the freeze and the next interrogation will continue to be accumulated.

2.4 OUTPUT DEVICES

2.4.1 Control Relays

Control relay contacts shall be rated for the application, with a minimum of two sets of Form C contacts, enclosed in a dust proof enclosure. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression limiting transients to non-damaging levels.

2.4.2 Time Delay Relays

Time delay relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dust proof enclosure. Relays shall be equipped with coil transient suppression devices to limit

transients to non-damaging levels. Delayed contact opening or closing shall be adjustable.

2.4.3 Latching Relays

Latching relay contacts shall be rated for the application with a minimum of two sets of Form C contacts enclosed in a dust proof enclosure. Operating time shall be 20 milliseconds or less, with release time of 10 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to non-damaging levels.

2.5 FIBER OPTIC CABLE

Shall be as specified in Section 16745 “Fiber Optics Data Transmission for Exterior System”.

2.6 WIRE AND CABLE

Install in accordance with NFPA 70 and manufacturers recommendation.

2.7 MAINTENANCE PARTS

The following Maintenance parts shall be delivered to PWC Code 611.

a. (1) Complete fully operational RTU capable of supporting the following I/O points. The RTU shall include all power supplies, main boards, accessory boards, cables and software required to provide a fully functional RTU.

40 Analog inputs each
30 Digital inputs each
8 digital outputs each
8 totalizers each

b. (1) Fiber Optic modems
c. (1) UPS unit

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Provide installation supervision by manufacturer's factory trained personnel directly employed by the manufacturer. Installation of UCS hardware and software shall be in accordance with manufacturers written instructions. The contractor shall furnish all necessary interconnections, services, and adjustments required for a complete and operable system. Any additional central or remote UCS memory or software required for implementation of new UCS components under this project shall be responsibility of the contractor. The Government shall be given "Unlimited Rights" to any custom software added to the UCS central system under this contract. It is the contractors responsibility to provide the required programming without training or assistance from Government personnel. The existing central system consists of 2 separate computers networked to a common database. Programming and

archiving required under this contract shall not cause any computer to be off-line in excess of 2 hours on any occurrence or a total of 8 hours in the aggregate for the total installation of this project. If these requirements are exceeded, the Contracting Officer reserves the right to provide emergency repair to the existing system at the expense of the contractor.

3.1.2 Qualifications of Installer

Prior to installation, the Prime Contractor shall submit data for the approval of the Contracting Officer which will show that he has successfully installed systems of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems and certify that these systems have performed satisfactorily in the manner intended for a period of not less than 36 months.

3.1.3 I/O Summary Tables

The Contractor shall provide hardware and software for all points listed in the Part 3 paragraph titled “Utility Control System Input/Output Points List” and/or shown on the drawings.

3.2 EXISTING CONTROLS

The contractor shall connect to and utilize the existing local control loops and devices which are suitable for use with UCS. Control devices that are usable in their original configuration without modification may be reused. Sensing elements shall be new and shall be installed in addition to, not in place of, existing sensors and indicators. Modification of the original design of any existing device by either internal or external additions shall not be permitted. Submit written requests to disconnect and controls to obtain equipment down time. Only after receiving Government approval of these requests shall such work be allowed to proceed. The contractor shall assume responsibility for the existing local control loops and devices being incorporated in to the UCS at the time construction work begins on each local control loop. If the local control loop or any device fails while the contractor has responsibility, the contractor shall diagnose the failure and perform necessary corrections per the UCS manufacturer's recommendations. The contractor shall be held responsible for repair costs due to contractor negligence or abuse of Government equipment. The contractors responsibility for any existing devices and local control loops shall terminate upon the Government's acceptance of this UCS system addition.

3.3 FIELD EQUIPMENT

3.3.1 Enclosures

The Contractor shall not penetrate the top of any enclosure housing a RTU. All penetrations shall be sealed to preclude the entry of water using a silicon material conforming to Fed Spec FS ZZ-R 765. Enclosures shall be NEMA 4X or 12 when installed in other than a clean dry indoor environment, and as shown. Enclosures shall be 14 gauge steel. Provide oil resistant gasket for all NEMA 4X or 12 enclosures.

3.3.2 Output Devices

3.3.2.1 Relays and Contactors

Division 16 shall install relays and contactors in new cabinets. Contact ratings and duty shall be selected in accordance with NEMA ICS 1.

3.4 INSTALLATION - SYSTEM EQUIPMENT

Install all system equipment required for an operational UCS system. Conduit and wire shall be installed as specified.

3.4.1 Cable Runs

Keep cable runs as short as possible, allowing extra length for connecting to terminal boards. Use vinyl tape, sleeves, or grommets to protect cables from vibration at points where they pass around sharp corners or through penetrations.

3.4.2 Fiber Optic Cable

Install fiber optic cables in strict compliance with Section 16745.

3.4.3 Grounding

Grounding shall be in accordance with ANSI C2. All ground wire shall be copper. Demonstrate ground resistance as specified.

3.4.4 Labeling

Each field wire shall be labeled or coded at each end. Each point of all field terminal strips shall be permanently labeled or coded to show the instrument or item served. Wiring from switchgear to UCS terminal blocks shall be installed by the switchgear manufacturer. Wiring between utility control cabinets shall be installed by electrical contractor. Wiring from terminal cabinet to RTU panel terminal strips shall be installed by the prime contractor'S UCS subcontractor.

3.5 SITE TESTING

3.5.1 General

The Contractor shall provide all personnel, equipment, instrumentation and supplies necessary to perform all site testing. The Government will witness all PVT and endurance testing, and written permission must be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced, including results of each test procedure, during PVT and endurance testing shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test.

3.5.2 Field Testing Scheduling.

The Contractor shall schedule the field testing so there is sufficient time after the field test is complete for the Government to inspect all the

equipment installed under this contract. The Government inspection will not begin until the Contractor has completed the field testing and provided as-built drawings of the installation. The Performance Verification Test will not begin until the Government inspection is complete.

3.5.3 Contractor's Field Testing

The Contractor shall calibrate field equipment and test the data transmission system before the system is placed on line. The Contractor shall calibrate each instrumentation device connected to the UCS by making a comparison between the reading at the device and the display at the Master Station, using a standard traceable to the NIST, which shall be at least twice as accurate as the device to be calibrated. The Contractor shall check each control point or monitoring point within the UCS by making a comparison between the control command or status at the Master Station and field device. The Contractor shall verify operation of all systems as specified upon UCS failure or loss of power, and that all systems return to UCS control automatically upon resumption of UCS operation or return of power. The Contractor shall deliver a report describing results of functional tests, diagnostics, and UCS calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin the PVT. The Contractor shall schedule his Field Test so that after it is complete the Government will have time to inspect all the equipment installed under this contract. The field testing report shall also include a copy of the approved PVT procedure.

3.5.4 Performance Verification Test (PVT)

The Contractor shall demonstrate compliance of the completed UCS with the contract documents. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The PVT as specified shall not be started until after receipt by the Contractor of written permission by the Government, based on the Contractor's written report including certification of successful completion of Contractor Field Testing as specified, successful completion of training as specified and upon successful completion of Government inspection of the equipment as specified. The Contractor shall use MIL-STD-2203 to establish format for the test results documentation. The PVT shall be performed as an integrated test with the UCS Central System and with all equipment specified operating and exchanging actual data under fully loaded conditions.

3.5.4.1 Phase I (Testing)

The test shall be conducted 24 hours per day, for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing. If the system experiences no failures during the Phase I test, the Contractor may proceed directly to the warranty period after receipt by the Contractor of written permission from the Government.

3.5.4.2 Phase II (Assessment)

After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Government. The report shall explain in detail the nature of

each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing shall be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than five business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government shall determine the restart point, and may require that the Phase I test be totally or partially rerun. The Contractor shall not commence any required retesting until after receipt of written notification by the Government. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed. If the retest is completed without any failures, the Contractor will provide seven copies of the test report to the government.

3.5.4.3 Exclusions

The Contractor shall not be held responsible for failures resulting from the following:

a. An outage of the main power supply in excess of the capacity of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the system performed as specified.

b. Failure of a Government furnished communications link, provided that the RTU automatically and correctly operates in the stand-alone mode as specified, and that the failure was not due to Contractor furnished equipment, installation, or software.

c. Failure of existing Government-owned equipment, provided that the failure was not due to Contractor-furnished equipment, installation, or software.

3.6 UTILITY CONTROL SYSTEM INPUT/OUTPUT POINTS LIST

3.6.1 I/O Requirements

The contractor shall furnish RTUs with I/O boards to support all points on the drawings or in the specification. In addition the contractor shall furnish points for all Amp Transducers, Voltage Transducers, Status or Alarm contacts added under this contract.

3.6.2 Unit Substation (12KV/480Y-277V or 12KV/208Y-120V)

a. Transformer Dry

Winding Temperature	Analog	4-20 MA.
Winding Temperature	Alarm	N.O. Contacts
Fan On/Off (if present)	Status	N.O. Contacts

a. Transformer Liquid Filled

Liquid Temperature	Analog	4-20 MA

Liquid High Temperature	Alarm	N.O. Contacts
Mechanical Relief Device	Alarm	N.O. Contacts
Low Liquid Level	Alarm	N.O. Contacts
Fan On/Off	Status	N.O. Contacts

b. Main Circuit Breaker

Breaker Status	Status	N.O. Contact
Breaker Trip	Control	Control Relay
Breaker Trip	Alarm	N.O. Contact
Amperage (ea. phase)	Analog (3)	4-20 MA
Voltage (ea. phase)	Analog (3)	4-20 MA
Kilowatt Hour (KYZ)	Totalizer	10 Pulses/Sec. max

c. Each Feeder including Spares

Breaker Status	Status	N.O. Contact
Breaker Trip	Alarm	N.O. Contact
Amps (ea. phase)	Analog (3)	4-20 MA
Kilowatt Hour (KYZ)	Totalizer	10 Pulses/Sec. max

d. Miscellaneous

RTU Loss of Digital Input Voltage	Alarm	N.C. Contacts
Loss of A/C Voltage	Alarm	N.C. Contacts

3.6.3 Unit Substation (12KV/480V)

a. Liquid filled Transformer

Liquid Temperature	Analog	4-20 MA.
Liquid High Temperature	Alarm	N.O. Contacts
Mechanical Relief Device	Alarm	N.O. Contacts
Low Liquid Level	Alarm	N.O. Contacts
Fan On/Off	Status	N.O. Contacts

a. Dry Transformer

Winding Temperature	Analog	4-20 MA.
Winding Temperature	Alarm	N.O. Contacts Fan
On/Off	Status	N.O. Contacts

b. Main Circuit Breaker

Breaker Status	Status	N.O. Contacts
Breaker Trip	Control	Control Relay
Breaker Trip	Alarm	N.O. Contacts
Amperage (ea. phase)	Analog (3)	4-20 MA
Voltage (ea. phase)	Analog (3)	4-20 MA
Kilowatt Hour (KYZ)	Totalizer	10 Pulses/Sec. max

c. Each Feeder including Spares

Breaker Status	Status	N.O. Contact
Breaker Trip	Alarm	N.O. Contact

Amps (ea. phase)	Analog (3)	4-20 MA
Kilowatt Hour (KYZ)	Totalizer	10 Pulses/Sec. max

d. Miscellaneous

RTU Loss of Digital Input Voltage	Alarm	N.C. Contacts
Loss of A/C Voltage	Alarm	N.C. Contacts

3.6.4 Skid Mount (12 KV/480V)

a. Liquid filled Transformer

Liquid Temperature	Analog	4-20 MA.
Liquid High Temperature	Alarm	N.O. Contacts
Mechanical Relief Device	Alarm	N.O. Contacts
Low Liquid Level	Alarm	N.O. Contacts
Fan On/Off	Status	N.O. Contacts

b. Dry Transformer

Winding Temperature	Analog	4-20 MA.
Winding Temperature	Alarm	N.O. Contacts
Fan On/Off	Status	N.O. Contacts

c. Main Circuit Breaker

Breaker Status	Status	N.O. Contacts Breaker
Trip	Control	Control Relay
Breaker Trip	Alarm	N.O. Contact
Amperage (ea. phase)	Analog (3)	4-10 MA
Voltage (ea. phase)	Analog (3)	4-20 MA
Power Factor	Analog (1)	4-20 MA
Kilowatt Hour (KYZ)	Totalizer	10 Pulses/Sec max

d. Each Feeder Including Spares

Breaker Status	Status	N.O. Contact
Breaker Trip	Alarm	N.O. Contact
Amps B phase	Analog (1)	4-20 MA

Provide software calculations of KW and KWH for each breaker using B phase amperage, Main Breaker voltage (3 phases) and power factor.

e. Miscellaneous

RTU Loss of Digital Input Voltage	Alarm	N.C. Contacts
Loss of A/C Voltage	Alarm	N.C. Contacts

3.6.5 69KV Transformer and Breakers

a. 69/12KV Trans

Low Nitrogen	Alarm	N.O. Contact
Fan On/Off	Status	N.O. Contact
Mechanical Pressure Relief Device	Alarm	N.O. Contact
Winding High Temp	Alarm	N.O. Contact
Low Liquid Level	Alarm	N.O. Contact
Liquid High Temp	Alarm	N.O Contact
Liquid Flow	Alarm	N.O. Contact
Sudden Pressure Relay	Alarm	N.O. Contact
Load Tap Changer Position	Analog	4-20 MA
Differential Relay	Alarm	N.O. Contact

b. 69 KV Oil Circuit Breaker

Breaker Status	Status	N.O. Contact
Amps (ea. phase)	Analog (3)	4-20 MA
Volts (ea. phase)	Analog (3)	4-20 MA
Power Factor	Analog	4-20 MA
Kilowatts	Analog (1)	4-20 MA
Kilowatt Hour (KYZ)	Totalizer	10 Pulses/Sec. max
Overcurrent Relay (each phase)	Alarm (3)	N.O. Contact
Phase Ground Current Relay	Alarm	N.O. Contact
Instant.Over current Relay (each phase)	Alarm (3)	N.O. Contact
Instant. Ground Current	Alarm	N.O. Contact
Pressure Relay	Alarm	N.O. Contact
Pressure Safety Valve	Alarm	N.O. Contact
Compressor Failure	Alarm	N.O. Contact

c. Miscellaneous Items

86 Device Bus 1	Alarm	N.O. Contact
86 Device Bus 2	Alarm	N.O. Contact
Control Power	Totalizer	10 Pulses/sec. max.
Loss of Control Power	Alarm	N.O. Contacts
Battery Low Voltage	Alarm	N.O. Contacts
Battery Charger Failure	Alarm	N.O. Contacts
Trench High Water	Alarm	N.O. Contacts

3.6.6 Switching Station

a. Tie Breaker

Breaker Status	Status	N.O. Contacts
Remote Trip	Control	Control Relay
Remote Switch On/Off	Status	N.O. Contacts

b. Main Breaker

Breaker Locked Out	Control	Control Relay
Remote Trip	Control	Control Relay
Remote Switch On/Off	Status	N.O. Contacts
Breaker Status	Status	N.O. Contacts

Overcurrent Relay (Each Phase)	Alarm (3)	N.O. Contacts
Phase Ground Current	Alarm (1)	N.O. Contact
Instant. Overcurrent Relay (Each Phase)	Alarm (3)	N.O. Contact
Ground Current Instant.	Alarm (1)	N.O. Contact
Pilot Wire	Alarm	N.O. Contact
Amps (Each Phase	Analog (3)	4-20 MA
Volts (Each Phase)	Analog (3)	4-20 MA
Power Factor	Analog	4-20 MA
Kilowatts	Analog	4-20 MA
Kilovars	Analog	4-20 MA

c. Feeder Breaker

Breaker Locked Out	Control	Control Relay
Remote Trip	Control	Control Relay
Remote Switch On/Off	Status	N.O. Contact
Breaker Status	Status	N.O. Contact
Overcurrent Relay (Each Phase)	Alarm (3)	N.O. Contact
Phase Ground Current	Alarm (1)	N.O. Contact
Instant. Overcurrent Relay (Each Phase)	Alarm (3)	N.O. Contact
Ground Current Instant.	Alarm (1)	N.O. Contact
Pilot Wire	Alarm	N.O. Contact
Amps (Each Phase)	Analog (3)	4-20 MA
Kilowatts	Analog	4-20 MA
Demand Meter KWH	(KYZ)Totalizer	10 Pulses/Sec. max.

d. Miscellaneous Items

86 Device Bus 1	Alarm	N.O. Contact
86 Device Bus 2	Alarm	N.O. Contact
Loss of Control Power	Alarm	N.O. Contact
Battery Low Voltage	Alarm	N.O. Contact
Trench High Water	Alarm	N.O. Contact
Sump Pump Run	Status	N.O. Contact
Auto Transfer Switch (Normal)	Status	N.O. Contact
Auto Transfer Switch (Standby)	Status	N.O. Contact
Control Power (KYZ)	Totalizer	10 Pulses/Sec.

3.6.7 Steam Flow Meter/High Temperature Water Meter

Consumption	Totalizer	10 Pulses/Sec.
Temperature	Analog	4-20 MA
Pressure	Analog	4-20 MA
Flow	Analog	4-20 MA

3.6.8 Compressed Air Meter

Consumption	Totalizer	10 Pulses/Sec.
Temperature	Analog	4-20 MA

Pressure	Analog	4-20 MA
Flow	Analog	4-20 MA

3.6.9 Gas Meter

Consumption	Totalizer	10 Pulses/Sec.

3.6.10 Water meter

Consumption	Totalizer	10 Pulses/Sec.

3.6.11 Pumping Station

Breaker Status	Status	N.O. Contacts
Amps (ea. phase)	Analog (3)	4-20 MA
Volts (ea. phase)	Analog (3)	4-20 MA
KWH Meter (KYZ)	Totalizer	10 Pulses/Sec.
Breaker Trip	Alarm	N.O. Contract
Loss of Power	Alarm	N.O. Contract
Loss of Control Power	Alarm	N.O. Contract
Loss of VFD (3)	Alarm (3)	N.O. Contract
Pressure	Analog	4-20 MA
Tank High Water	Alarm	N.O. Contract
Tank Low Water	Alarm	N.O. Contract
Overflow Pipe	Alarm	N.O. Contract
Low Air Pressure	Alarm	N.O. Contract

3.6.12 Generator

Trip	Alarm	N.O. Contract
Low Oil	Alarm	N.O. Contract
Loss of Battery Voltage	Alarm	N.O. Contacts
Loss of Battery Charger	Alarm	N.O. Contacts
Overcrank	Alarm	N.O. Contract
Low Fuel	Alarm	N.O. Contract
Water Temperature	Alarm	N.O. Contract
Overspeed	Alarm	N.O. Contract
Oil	Alarm	N.O. Contract

3.6.13 Outside Air

Temperature	Analog	3000 OHM RTD
Dewpoint	Analog	Plat. Thin Film
Barometric Pressure	Analog	

3.6.14 Sewage Lift Station

Pump 1 Run	Digital	N.O. Contact
Pump 1 Fail	Digital	N.O. Contact
Hand/Off/Auto Switch Position		
	Digital	N.O. Contact
Pump 2 Run	Digital	N.O. Contact
Pump 2 Fail	Digital	N.O. Contact
Hand/Off/Auto Switch Position		
	Digital	N.O. Contact
Pump 3 Run	Digital	N.O. Contact

Pump 3 Fail	Digital	N.O. Contact
Hand/Off/Auto Switch Position	Digital	N.O. Contact
Call for Lead	Digital	N.O. Contact
Call for Lag	Digital	N.O. Contact
Wet Well High Water	Digital	N.O. Contact
Wet Well Low Level Warning	Digital	N.O. Contact
Dry Well High Water	Digital	N.O. Contact
Power Failure	Digital	N.O. Contact
Ground Fault	Digital	N.O. Contact
Ventilation Fan Status	Digital	N.O. Contact
Main Breaker Status	Digital	N.O. Contact
Main Breaker Overcurrent Trip	Digital	N.O. Contact
Transfer Switch Position	Digital	N.O. Contact
Low Bubbler Air Pressure	Digital	N.O. Contact
KWH Meter KYZ	Totalizer	10 Pulses/Sec max.
Wet Well Level	Analog	4-20ma
Discharge Pressure	Analog	4-20ma

Current Transducers

Feeder amperage shall be monitored by current transducers as shown on the control drawings. Wiring input shall be connected to current transformer. Provide three (3) spare transducers for each substation. Transducer housing shall be constructed of ferrous metal. Ampere transducers shall be single element, constant current output and shall have characteristics equal to or better than the following:

Input Current: 0-5 amperes AC single phase measurements. Input shall be capable of continuously carrying 10 amperes AC or withstanding 250 amperes AC for 1 second.

Output Current: 4-20 milliamps (mA) DC

Calibration Adjustment: +2% minimum

Output Ripple: 0.5% maximum

Response Time: 0.1 seconds for output to register 99% of a sudden input change.

Accuracy/Linearity 25-1/4C : +0.5 of full scale overall between 0-5 amperes, load variation of 0-108 ohms and frequency variation of 50-500Hz.

Temperature: +1% maximum between –20 deg C to 60 deg C.

Humidity: 0.05%

Frequency Range: 50-500Hz

Operating Environment: Ambient temperatures between –20 deg C to +60 deg C. Humidity 95% without condensation.

Burden: 1VA maximum

Current Output: Nominal 120v range 85-135V. Shall be capable of withstanding 175V overload continuously, or 100 amperes for 1 second.

Voltage Input: Nominal 120V range 85-135V. Shall be capable of withstanding 175V overload continuously.

CURRENT TRANSFORMERS 1200/5 TYPE
(FILE SPECCT2.DOC)

2.2.15.2 Current Transformers

Current transformers for metering application shall be multi-ratio type, with a minimum of 10 ratios, 5 terminals, rated for interior use. Insulation class rating shall be 600 volts, 60 hertz, and shall have an accuracy classification of 0-3 for ANSI standard burdens. Current transformer ratios shall be set as indicated on the drawings and if not on the drawings, set to match circuit breaker trip settings. Current transformers shall be bracket or rack mounted in secondary cabinets and positioned to allow cables to easily route through the current transformer opening. Integral circuit breaker current transformers shall not be used for metering. Provide the following:

Multi-ratio	Current Rating Amperes (RATIOS)	Taps
1200 to 5	100 to 5	2 and 3
	200 to 5	1 and 2
	300 to 5	1 and 3
	400 to 5	4 and 5
	500 to 5	3 and 4
	600 to 5	2 and 4
	800 to 5	1 and 4
	900 to 5	3 and 5
	1000 to 5	2 and 5
	1200 to 5	1 and 5

SWITCHBOARD TYPE, CLASS 20, DEMAND TYPE KV

Kilowatt-Hour Meters: ANSI C12.1, ANSI C12.10, ANSI C12.13, ANSI C12.16, ANSI C12.18, ANSI C12.19, ANSI C12.20, Type II, Class 3, Style B and shall have pulse module and load profile module. Kilowatt-hour Meters shall be switchboard type totally compatible to each particular application. Kilowatt-hour meters shall be of one manufacturer.

a. The meters shall have an electronic demand recording register and shall be secondary reading as indicated. The register shall be used to indicate maximum kilowatt demand as well as cumulative or continuously cumulative demand. Demand shall be measured on a block-interval basis. It shall have provisions to be programmed to calculate demand on a rolling interval basis.

b. The electronic module register shall be of modular design with non-volatile data storage. Downloading meter stored data thru opcomport. Recording capability of data storage - 64K.

c. All electronic modules shall be physically identical.

d. Enable TOU measurement module at the factory.

e. Switchboard meters - 3-stator, 3-phase, 4-wire, 120 volt, class 20, and secondary type.
(Modify this section to match projects meter application on voltage and type)

f. Provide blank tag fixed to the meter faceplate for the addition of the meter multiplier will be the product of the current transformers and potential transformer ratio and will be filled in by PWC on the job site.

g. Switchboard case with paddle for meter removal incorporating automatically short-circuiting of current transformer circuits.

h. Meter covers shall be polycarbonate resins with opcomport and reset. Battery mounting location shall be in front.

i. The normal billing data scroll shall be fully programmable. The following items shall be able to be displayed in the data scroll.

(1) Number of demand resets
(2) End-of-interval indication
(3) Maximum Demand
(4) New maximum demand indication
(5) Cumulative or continuously cumulative
(6) Time remaining in interval
(7) Kilowatt hours

j. The register shall incorporate a built-in test mode that allows it to be tested without the need for any special tools or other accessories and saves data and constant prior to start of test. The following quantities shall be available for display in the test mode:
    (1) Time remaining in demand interval
    (2) Present interval's accumulating demand
    (3) Maximum demand
    (4) Number of impulses being received by the register

k. Pulse module with programmable ratio selection.

l. Meters shall be programmed after installation thru opcomport.

m. Meters shall be tested, calibrated and certified after installation.

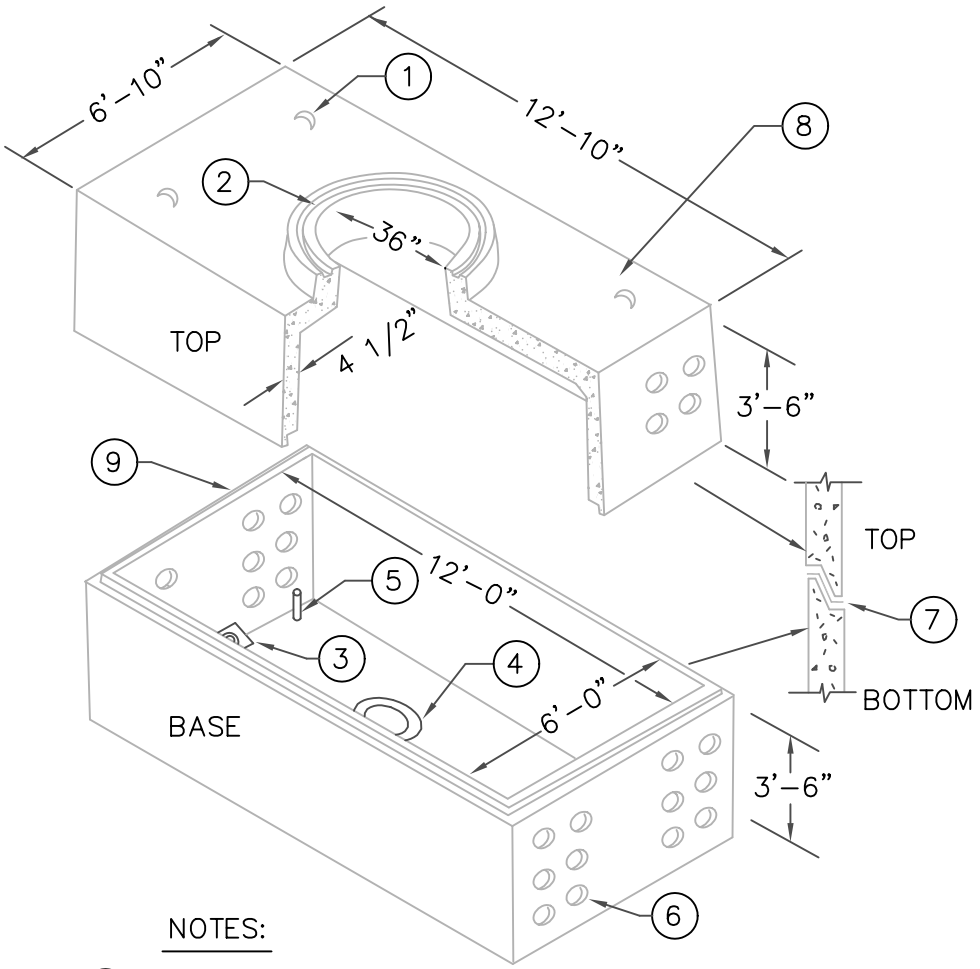
n. Self-monitoring to provide for:
    (1) Unprogrammed register
    (2) RAM checksum error
    (3) ROM checksum error
    (4) Hardware failure
    (5) Memory failure
    (6) EPROM error
    (7) battery fault

o. Liquid crystal display, 9 digits, blinking squares confirm register operation. Large digits for data and smaller digits for display identifier.

p. Display operations, programmable sequence with display identifiers. Display identifiers shall be selectable for each item. Continually sequence with time selectable for each item.

q. Maintenance Parts:
    (1) 2 Batteries
    (2) 2 complete KV meters

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD HIGH VOLTAGE MANHOLE		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTES:

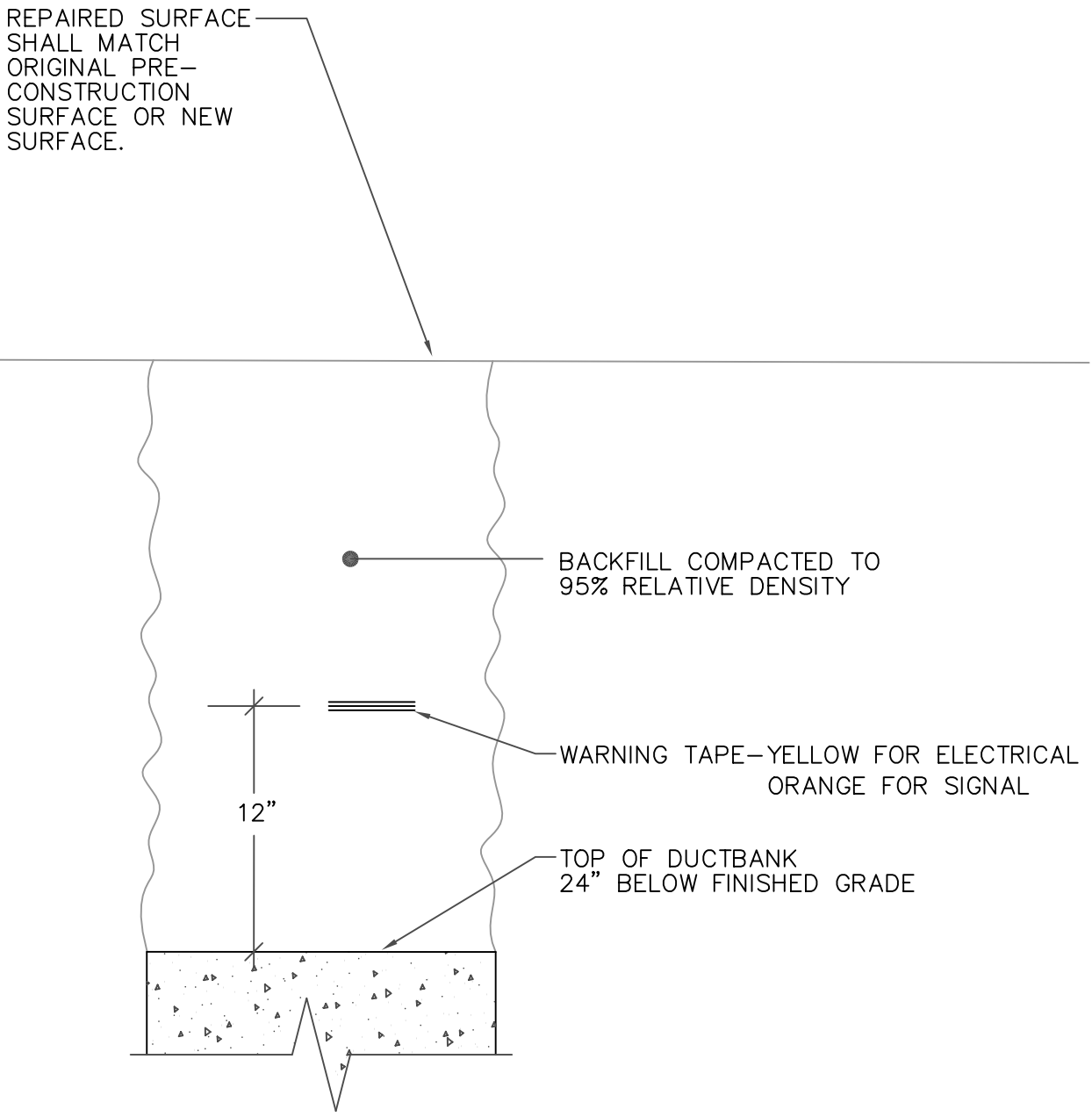
1. #4 REBAR HOOKS FOR HANDLING.
2. GROOVE TO RECEIVE PRE-CAST NECKING.
3. 7/8' DIA. PULLING IRON OPPOSITE KNOCKOUTS. 9 EACH INCLUDING SUMP.
4. 12" DIA. SUMP (FLR. SLOPES TO SUMP).
5. GROUND ROD 5/8" DIA. COPPER GROUND ROD FACTORY CONNECTED TO REBAR. ONE IN FLOOR SECTION, ONE IN ROOF SECTION.
6. 5" DIA. KNOCKOUT TERMINATORS, 20 PLACES EACH END.
7. PROVED JOINT SEALANT FOR A WATERPROOF SEAL.
8. RATED FOR H20 BRIDGE LOADING.
9. PRECAST 6'-0" X 12'-0" CONCRETE MANHOLE.

DETAIL- HIGH VOLTAGE MANHOLE

SCALE: NOT TO SCALE

NPWC-1

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD TYPICAL CROSS SECTION UNPAVED AREAS		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.

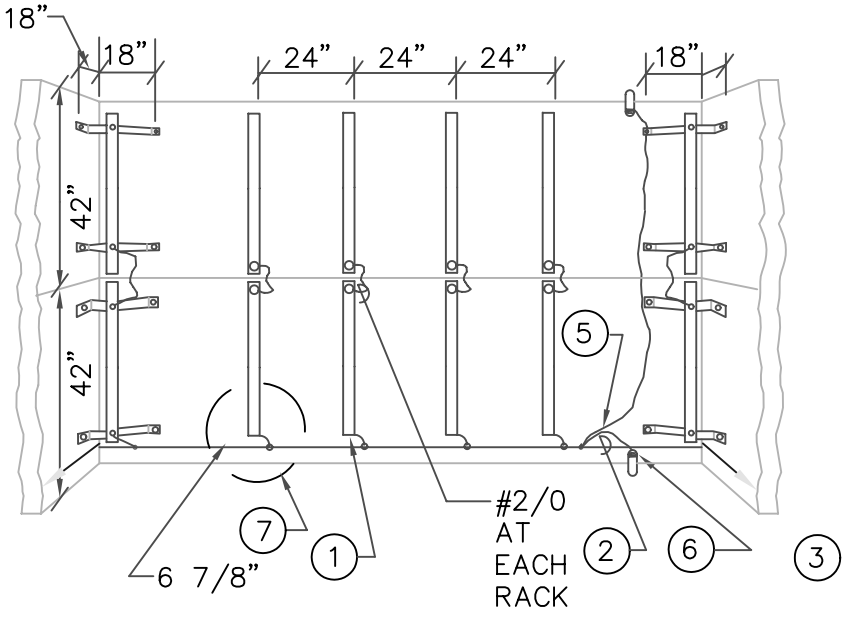


DETAIL- TYPICAL CROSS SECTION UNPAVED AREAS

SCALE: NOT TO SCALE

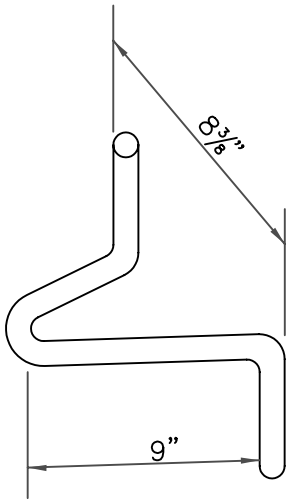
NPWC-2

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD MANHOLE ACCESSORIES		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTES:

1. CABLE RACK TYPICAL 4 – SIDES. QUANTITY 36.
2. CONTINUOUS LOOP #4/0 GROUND WIRE.
3. BOND TO GROUND ROD WITH #4/0.
4. FOR PLAN VIEW OF CORNER RACK SEE DRAWING NPWC–7.
5. BOND TO GROUND RODS WITH #4/0.
6. GROUND RODS TO BE FACTORY CONNECTED TO REBAR.
7. FOR RACK CONNECTION TO GROUND WIRE SEE DRAWING NPWC–7.



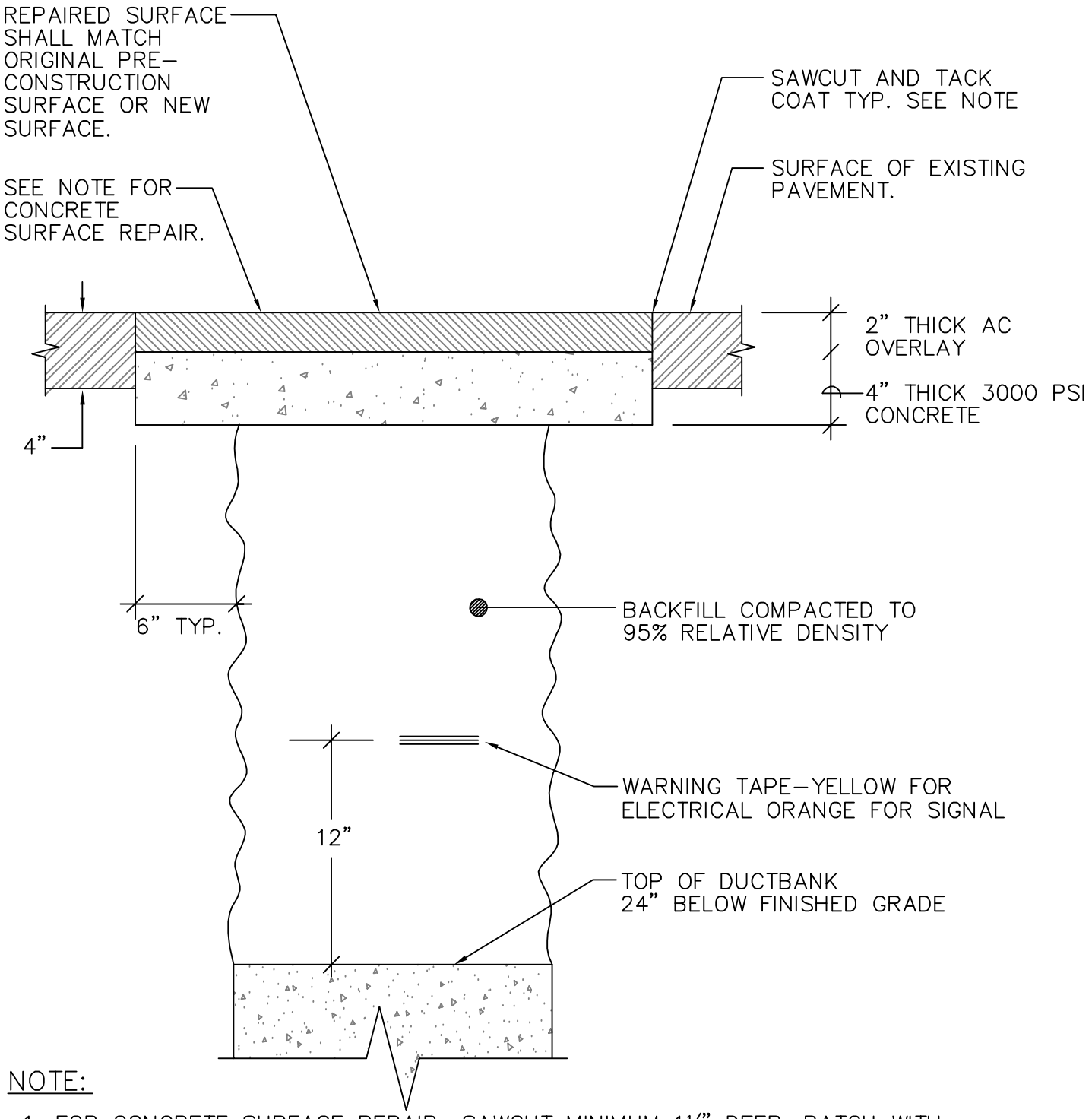
DETAIL OF
PULLING–IN IRON

DETAIL– MANHOLE ACCESSORIES

SCALE: NOT TO SCALE

NPWC–3

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD TYPICAL CROSS SECTION PAVED AREAS		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTE:

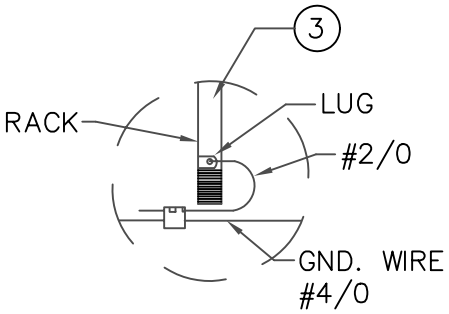
1. FOR CONCRETE SURFACE REPAIR: SAWCUT MINIMUM 1½" DEEP. PATCH WITH 7" LAYER OF 3000 PSI CONCRETE IN LIEU OF 4" CONCRETE AND 2" AC OVERLAY

DETAIL – TYPICAL CROSS SECTION PAVED AREAS

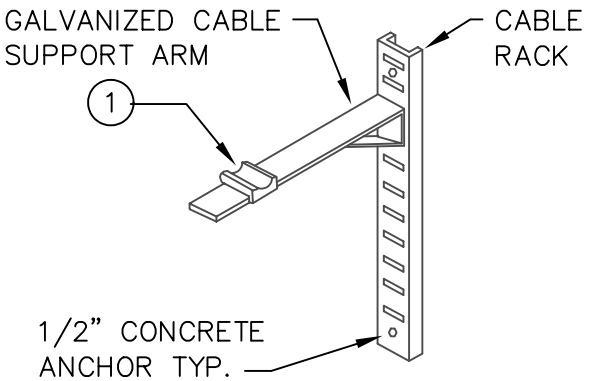
SCALE: NOT TO SCALE

NPWC-4

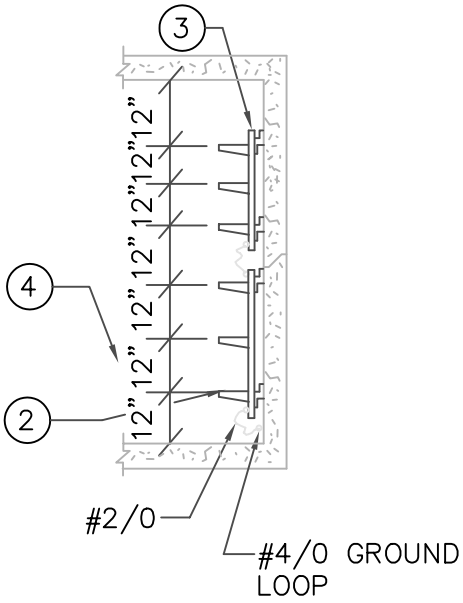
DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD MANHOLE RACK AND GROUNDING		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



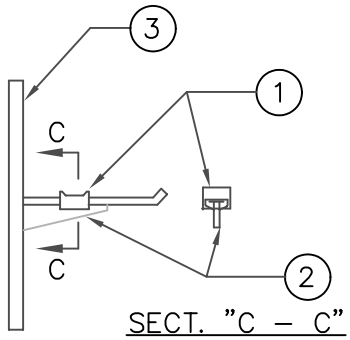
RACK CONNECTION TO GROUND WIRE



CABLE SUPPORT DETAIL

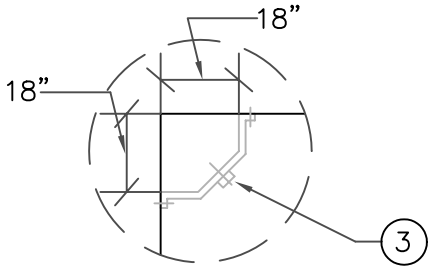


MANHOLE SECTION



SECT. "C – C"

RACK SIDE VIEW



PLAN VIEW – CORNER RACK SUPPORT

NOTES:

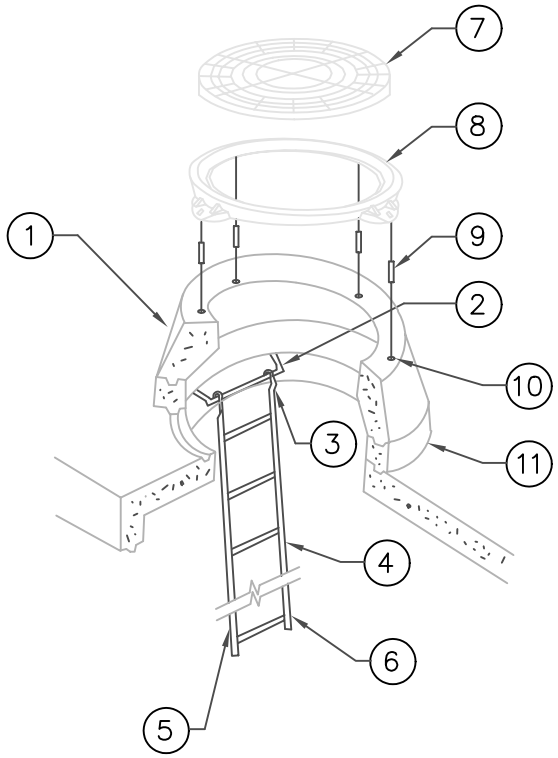
1. TYPICAL PORCELAIN INSULATORS WITH 1 1/2" RADIUS, 2 3/4" WIDTH AND 3" LENGTH, (PROVIDE QTY. AS REQUIRED TO SUPPORT CABLES.)
2. TYPICAL GALV. STEEL CABLE RACK ARM 10" EXTENSION FROM FACE TO RACK, 1 1/2" X 1 1/16" X 3/16" STEEL LOCK CLIP.
3. TYPICAL CABLE RACK.
4. TYPICAL SPACE FOR RACKING CABLES

DETAIL– MANHOLE RACK AND GROUNDING

SCALE: NOT TO SCALE

NPWC–7

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD TYPICAL MANHOLE LADDER AND INSTALLATION		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTES:

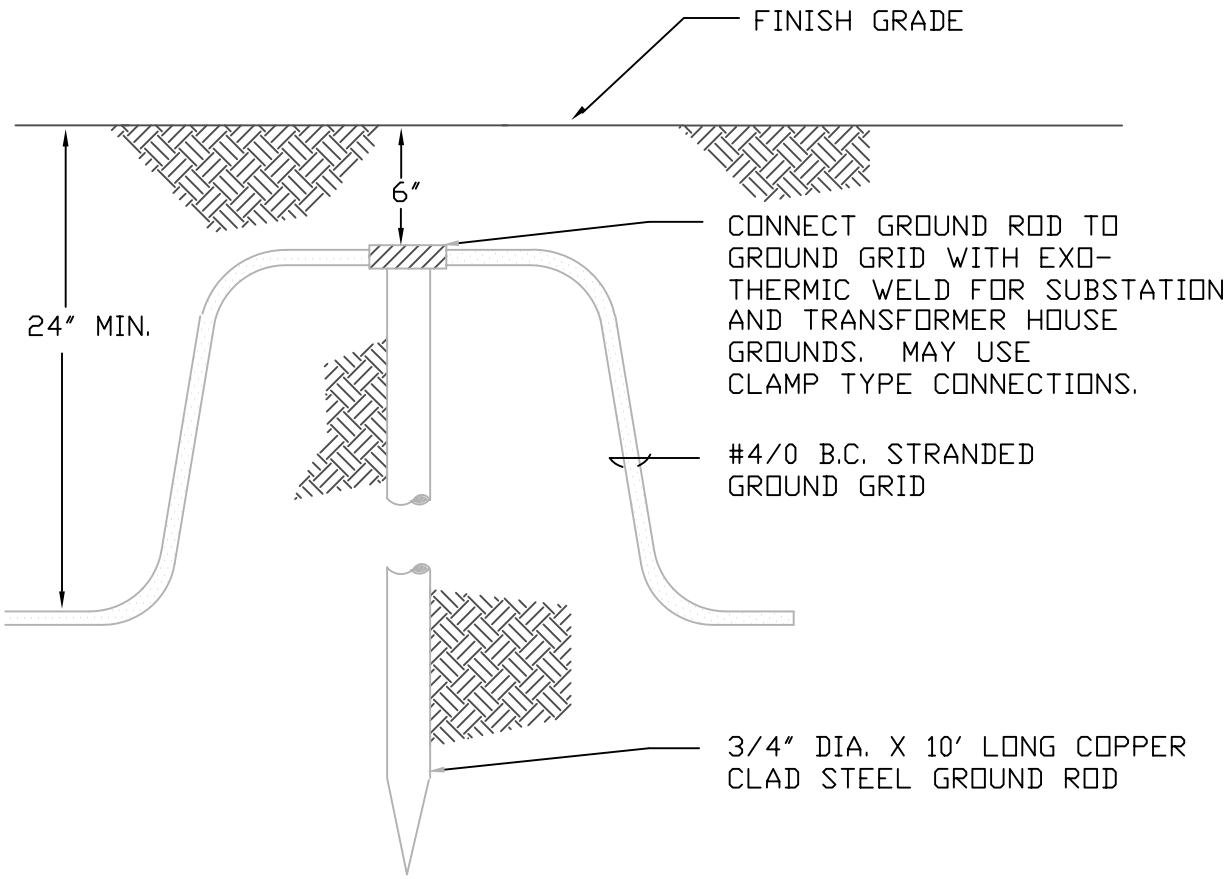
1. PRECAST CONCRETE MANHOLE CONE.
2. GALVANIZED STEP SUPPORT BAR 3/4" DIA. PLACED BETWEEN JOINTS 12" O.C. FOR EXTENDED GRADE RINGS.
3. HANG FROM SUPPORT BAR.
4. GALVANIZED STEEL LADDER 12" WIDE WITH 5/8" DIA. RUNGS.
5. GROUND WITH #4/0 WIRE. PROVIDE BOLTED LUG CONNECTION TO LADDER.
6. LENGTH AS REQUIRED TO HOOK ON SUPPORT BAR AND REST ON CONC. FLOOR AT 15° ANGLE FROM VERTICAL PLANE.
7. TRAFFIC COVER. INPRINT ON COVER "E" FOR ELECTRIC.
8. FRAME.
9. STAINLESS STEEL ADJUSTING STUDS. 4 PLACES.
10. ½" DIAMETER INSERTS FOR ADJUSTING STUDS. 4 PLACES.
11. PRECAST CONCRETE GRADE RINGS QUANITY AS REQUIRED TO SET COVER 1" ABOVE ADJACENT GRADE.

DETAIL— TYPICAL MANHOLE LADDER AND INSTALLATION

SCALE: NOT TO SCALE

NPWC—8

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD GROUND GIRDLE		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.

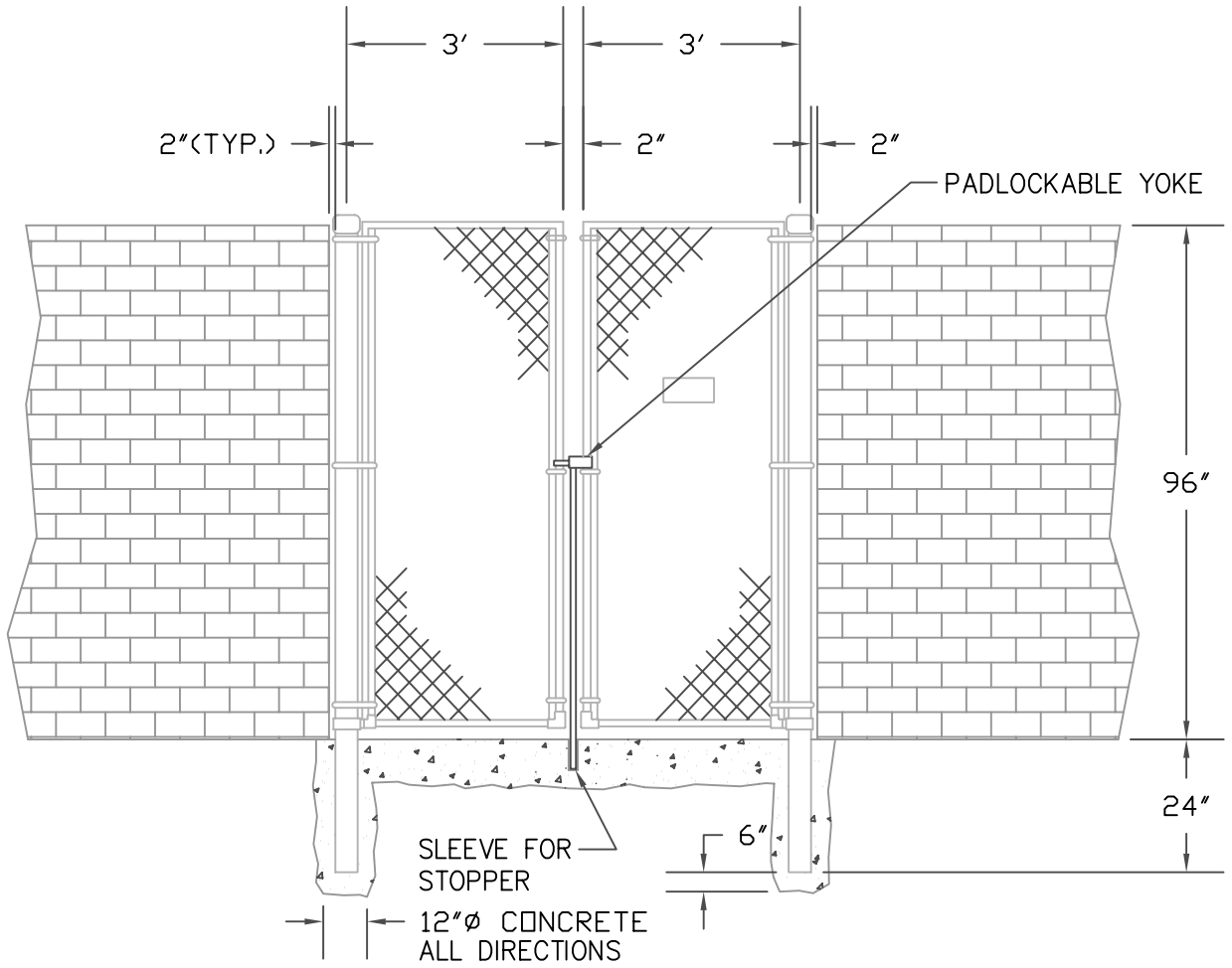


DETAIL–GROUND GIRDLE

SCALE: NOT TO SCALE

NPWC–11

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD ELECTRICAL SUBSTATION GATE		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTES:

1. ALL METALIC PARTS TO BE BLACK PVC COATED.
2. OUTSIDE OF WALL TO BE SPLIT FACE (FINISH PER STATION MASTER PLAN).

DETAIL–ELECTRICAL SUBSTATION GATE

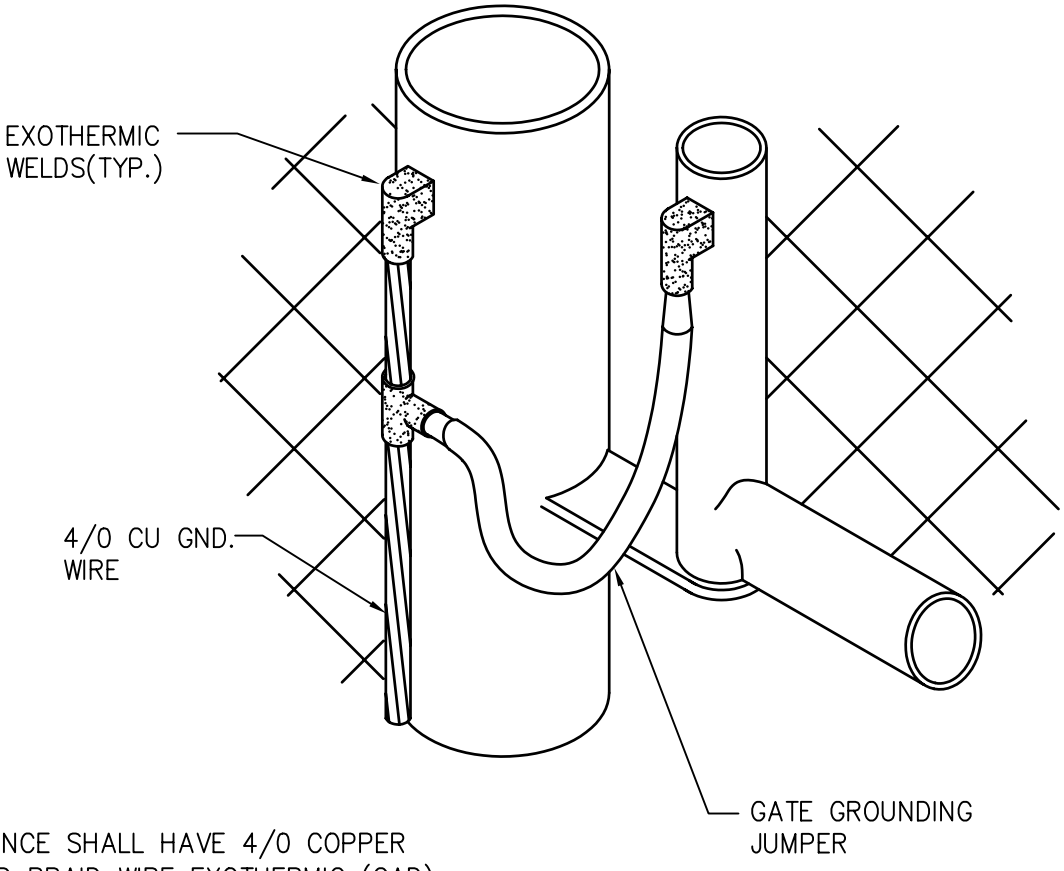
SCALE: NOT TO SCALE

NPWC–12

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD

GATE GROUNDING



NOTE: THE FENCE SHALL HAVE 4/0 COPPER GROUND BRAID WIRE EXOTHERMIC (CAD) WELDED TO THE PAD GROUND GRID.

NOTE: REAPPLY PVC COATING OVER WELDING.

DETAIL–GATE GROUNDING

SCALE: NOT TO SCALE

NPWC–13

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD PAD MOUNT SECONDARY BLADING		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.

(4) HOLE BLADES

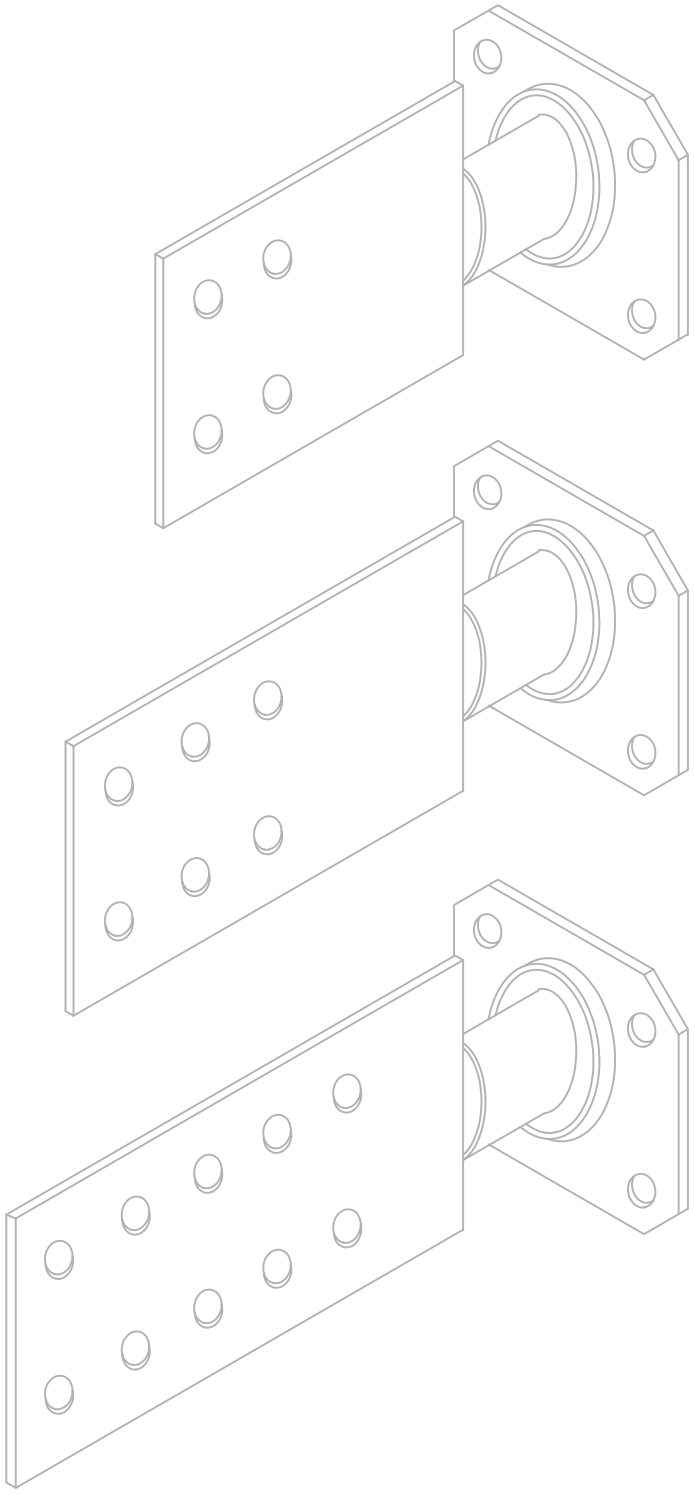
kVA RATING	LOW-VOLTAGE RATING (VOLTS)
75-300	208Y/120
75-500	480, 480Y/277

(6) HOLE BLADES

kVA RATING	LOW-VOLTAGE RATING (VOLTS)
500	208Y/120
750-1500	480, 480Y/277

kVA RATING	LOW-VOLTAGE RATING (VOLTS)
750-1000	208Y/120
2000-2500	480, 480Y/277

10 HOLE BLADES REQUIRE SUPPORT PER SPECIFICATIONS

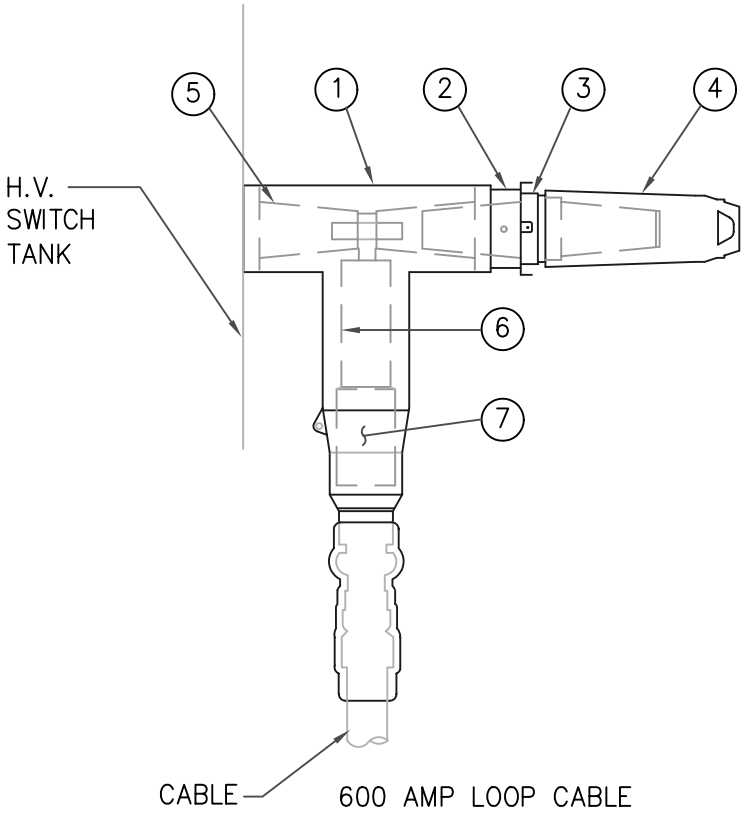


DETAIL-PAD MOUNT SECONDARY BLADING

SCALE: NOT TO SCALE

NPWC-16

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD		
	LOOP CONNECTION TO 600 AMP SELECTOR SWITCH–25KV		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



1. ELBOW TEE
2. 600/200 AMP REDUCING TAP WELL
3. LOADBREAK BUSHING PLUG
4. 200 AMP INSULATING RECEPTACLE
5. 600 AMP UNIVERSAL BUSHING
6. CONDUCTOR CONNECTOR
7. CABLE ADAPTER

DETAIL–LOOP CONNECTION TO 600 AMP SELECTOR SWITCH – 25KV

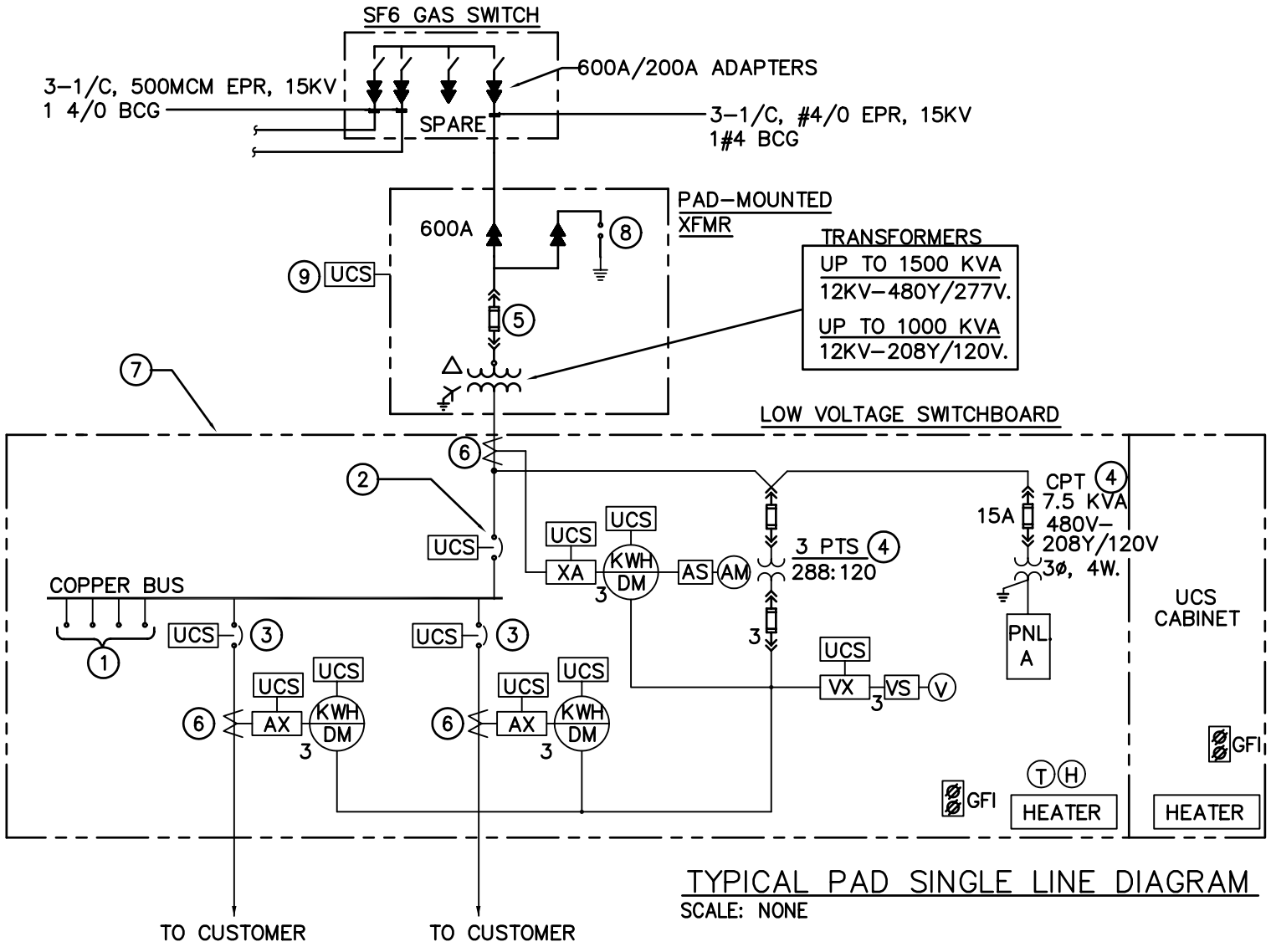
SCALE: NOT TO SCALE

NPWC–19

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD REV.1/2001

TYPICAL PAD SINGLE LINE DIAGRAM



TYPICAL PAD SINGLE LINE DIAGRAM

SCALE: NONE

NOTES

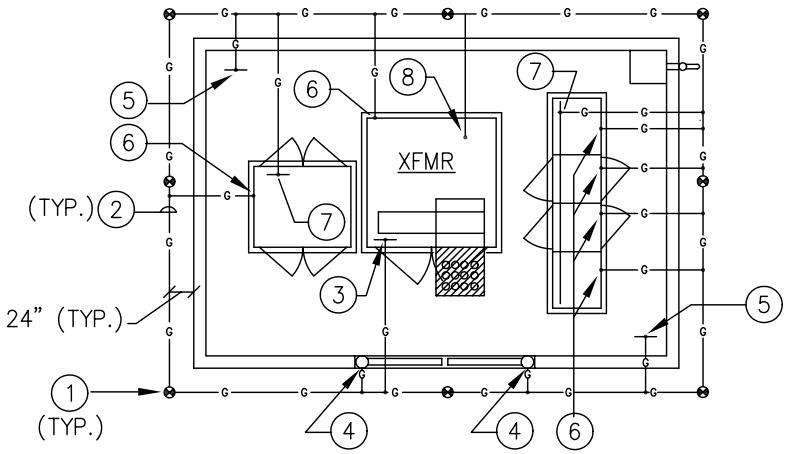
1. BUSSED SPACE FOR SPARES, # DETERMINED BY JOB
2. MAIN CIRCUIT BREAKER. INSULATED CASE FOR MAINS GREATER THAN 2000A AND MOLDED CASE FOR MAINS 2000A AND LESS, STATIONARY, SOLID STATE TRIP, NO GFCI. A&B DRY CONTACT FOR CIRCUIT BREAKER STATUS
3. MOLDED CASE CIRCUIT BREAKER AND A&B DRY CONTACT FOR CIRCUIT BREAKER STATUS.
4. NOTE: CPT AND PT'S NOT REQUIRED ON 208/120V SECONDARY SYSTEMS.
5. BAYONET OIL IMMERSED FUSE.
6. ALL WIRES FROM THE MULTI–RATIO CURRENT TRANSFORMER (MRCT) SHALL BE CONNECTED TO A CURRENT TRANSFORMER SHORTING TERMINAL BLOCK(CTSTB).
7. EACH SECTION TO HAVE SWITCHED SINGLE TUBE FLUORESCENT LUMINAIRE, DUPLEX GFI RECEPTACLE, AND SWITCHBOARD TYPE METERS
8. INTERMEDIATE CLASS MOV SURGE ARRESTORS
9. ALL DEVICES PER SPEC 16001 PARA 2.2.3.2 (g) OR G5000 2.1.2A.2(a) TEMP, PRESSURE VACUUM, AND LIQUID LEVEL.

NPWC–21DB

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD REV.1/2001

PAD GROUNDING–SINGLE & MULTIPLE CUSTOMER



NOTES:

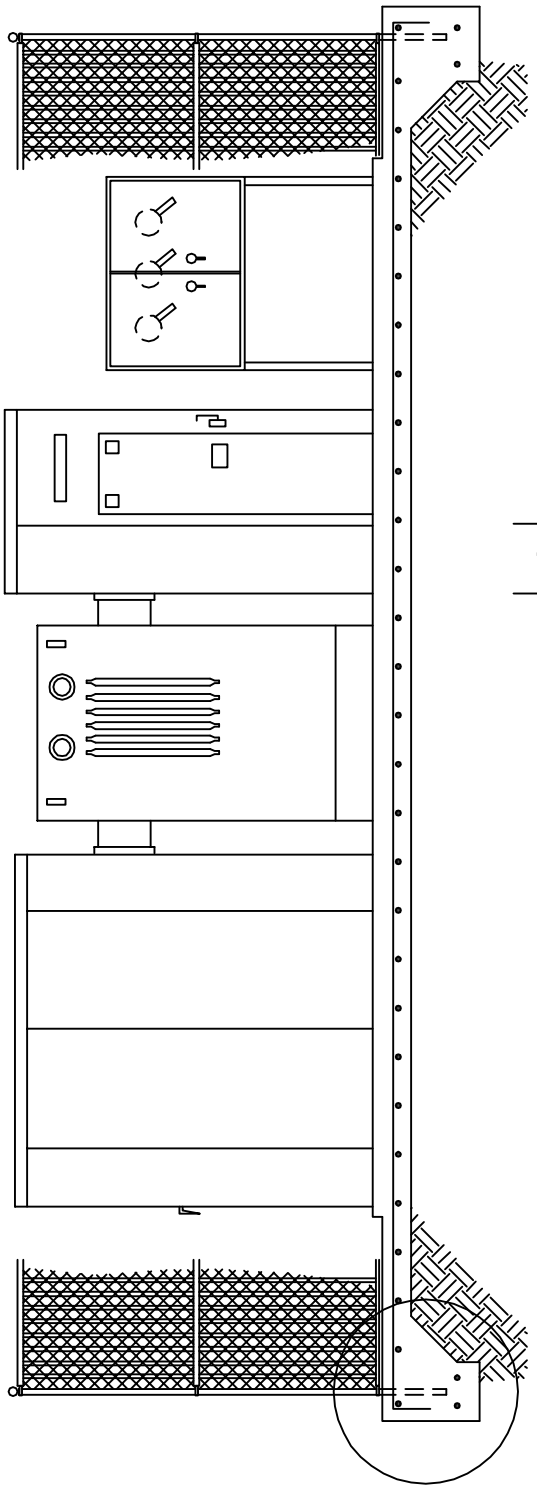
1. GROUND ROD 3/4" X 10'–0", COPPER CLAD STEEL, EVERY 10 FEET.
2. BARE COPPER WIRE, #4/0 TYP., 24" BELOW GRADE.
3. #4/0 BC GROUND CONNECTION TO SURGE ARRESTORS.
4. FLEXIBLE COPPER GROUND STRAP CONNECTED FROM GATE FRAME TO STATIONARY GATE POST.
5. GROUND CONNECTION TO STEEL REBARS #4/0 BC.
6. #4/0 BC GROUND CONNECTION TO EQUIPMENT ENCLOSURE.
7. #4/0 BC GROUND CONNECTION TO EQUIPMENT GROUND BUS.
8. GROUND CONNECTION TO TRANSFORMER NEUTRAL BUSHING. SIZE WIRE PER NEC.

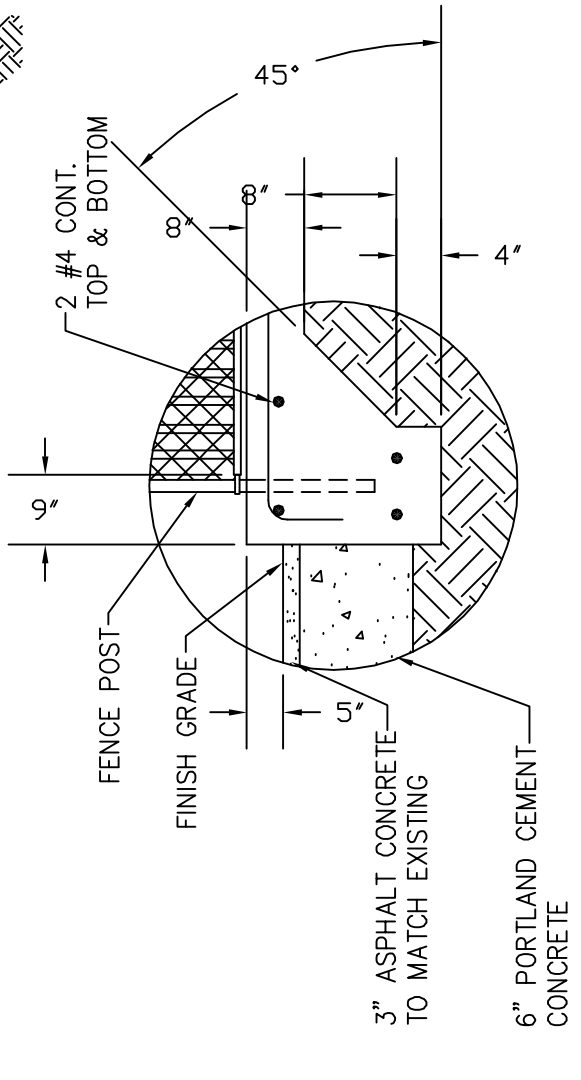
PAD GROUNDING–SINGLE AND MULTIPLE CUSTOMER

SCALE: NONE

NPWC–22DB

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD CHAIN LINK ENCLOSURE		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.





DETAIL–CHAIN LINK ENCLOSURE

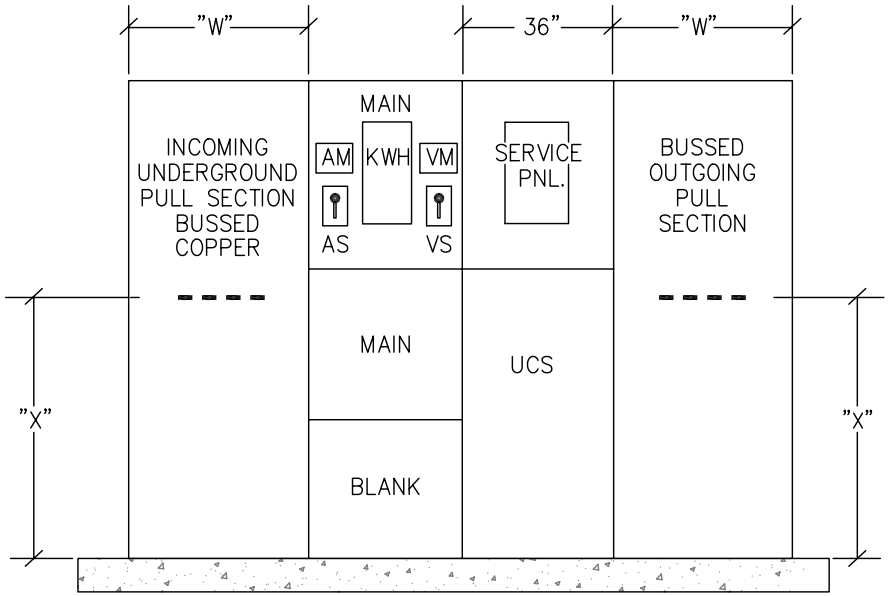
SCALE: NOT TO SCALE

NPWC–23

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD REV.1/2001

SINGLE LARGE CUSTOMER SERVICE SECONDARY



MINIMUM PULL SECTION DIMENSIONS			
PULL SECTION RATING–AMPS	"W" WIDTH 3W	4W	"X" LUG HEIGHT
0–400	10"	14"	22"–72"
401–800	16"	22"	26"–72"
801–1200	–	30"	26"–72"
1201–2000	–	35"	42"–72"
2001–3000	–	42"	60"–72"

SINGLE LARGE CUSTOMER SERVICE SECONDARY

SCALE: NOT TO SCALE

NPWC–25DB

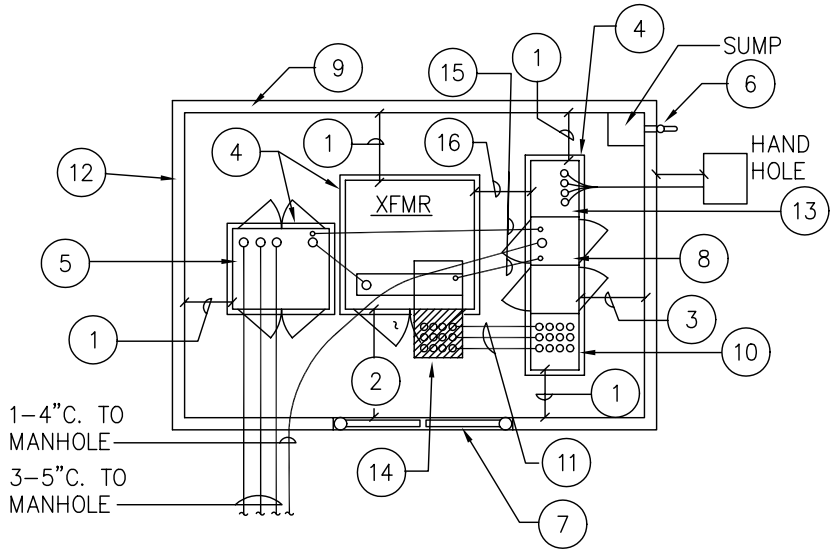
11ND–PWC 4856/38 (REV. 12–79)

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD

REV.1/2001

PAD MOUNT CONFIGURATION – SINGLE CUSTOMER



FOR ADDITIONAL INFORMATION SEE SHEETS NPWC–25DB & NPWC–22DB

PAD NOTES:

1. HANDHOLE NOT REQUIRED FOR (6)–4" DUCTS OR LESS.
2. DELETE SELECTOR SWITCH IF CONNECTION TO PRIMARY IS FROM AN EXISTING SWITCH.
3. SLOPE PAD TOWARD SUMP.

ELECTRICAL NOTES

1. 3'–0" MIN.
2. 5'–0" MIN.
3. 4'–0" MIN.
4. 4" HOUSEKEEPING PAD.
5. 4–WAY LB SELECTOR SWITCH.
6. STAINLESS STEEL NIPPLE AND DRAIN VALVE.
7. DUAL GATE CENTERED ON HV. XFMR COMPARTMENT
8. UCS AND PANEL "A"
9. 4" HIGH X 6" WIDE CURB FOR OIL CONTAINMENT.
10. INCOMING U.G. PULL SECTION
11. 4" SECONDARY AS REQUIRED 12 MAX.
12. BLOCK/ CHAIN LINK ENCLOSURE PER STATION B.E.A.P.
13. OUT GOING SECTION GROUP DISTRIBUTION AS AS INDICATED
14. 3' X 6'X 48" DEEP HANDHOLE OVER 3" OF 3/8" GRAVEL. HALF COVER
15. 1–2"C FOR CONTROL CABLES
16. 42" MIN.

PAD CONFIGURATION – SINGLE CUSTOMER

SCALE: NONE

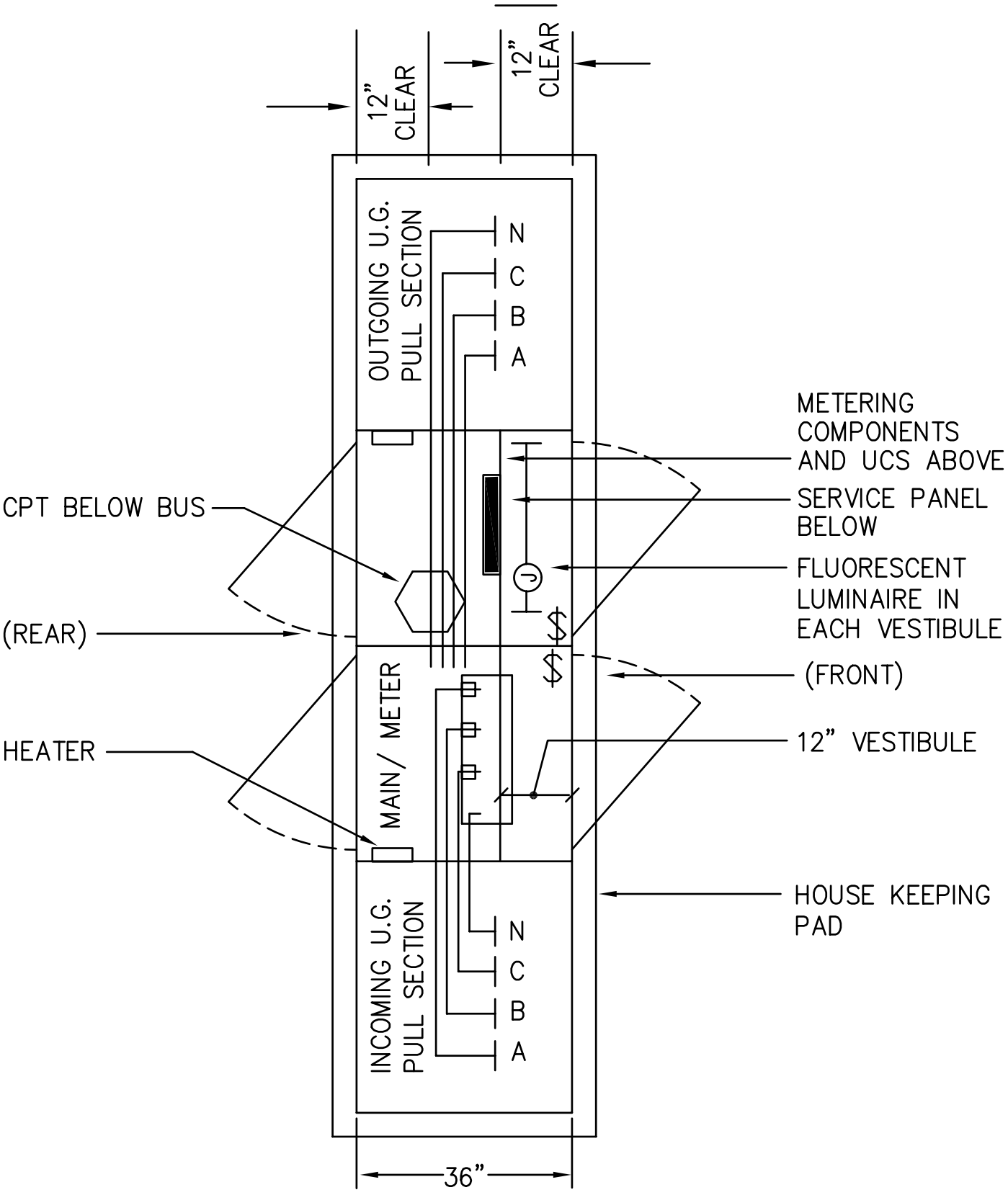
UP TO 1500 KVA @ 480V.
UP TO 1000 KVA @ 208V

NPWC–26DB

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD

TOP VIEW SINGLE LARGE SERVICE SECONDARY

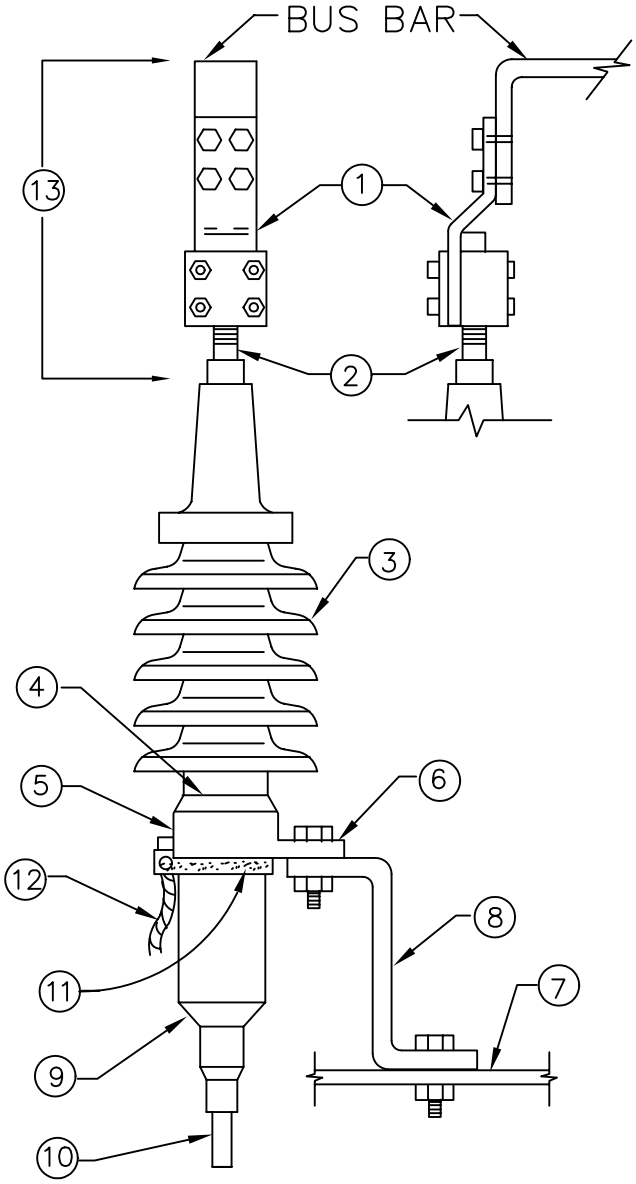


TOP VIEW SINGLE LARGE SERVICE SECONDARY

SCALE: 1/2" = 1'-0"

NPWC-27

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD CABLE TERMINATION		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTES:

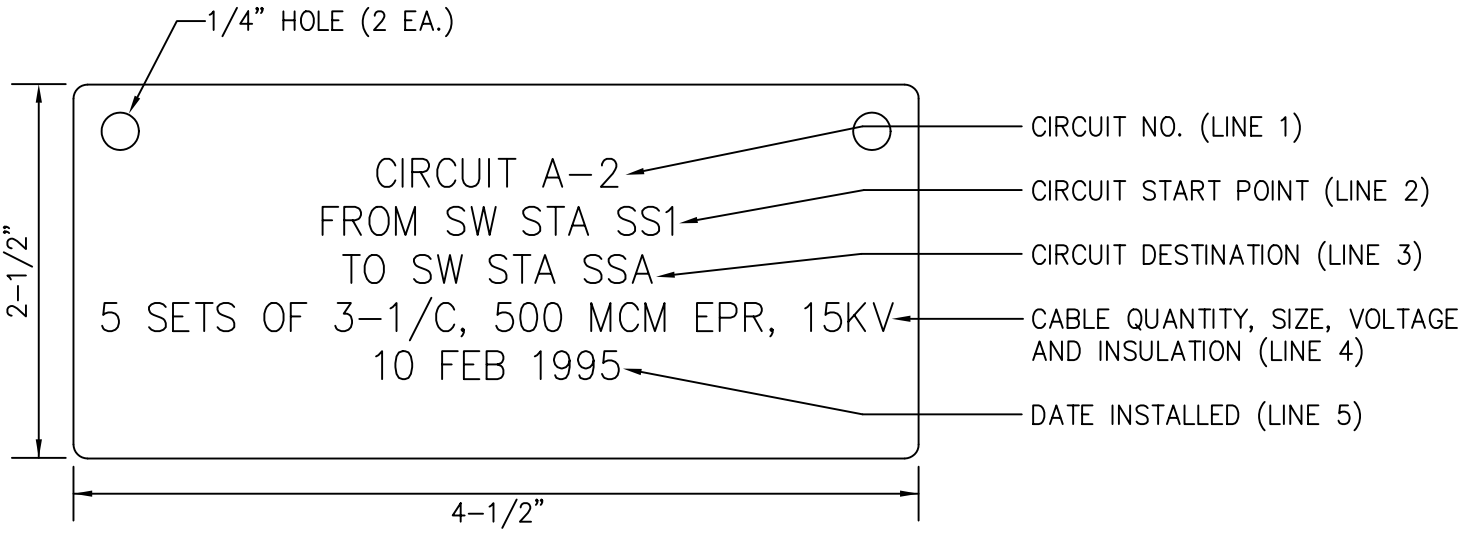
1. TYPICAL 4 BOLT OFFSET FLAT PAD AERIAL TERMINATION CONNECTOR. AERIAL LUGS SHALL BE INSULATED. (INSULATION NOT REQUIRED FOR AIR INTERRUPTER SWITCH)
2. TYPICAL SOLID COPPER COMPRESSION CONNECTOR. (EPR CABLE SIZE AS NOTED ON THE DWGS.)
3. TYPICAL AERIAL SERVICE 25KV PORCELAIN INSULATOR ASSEMBLY.
4. STRESS CONE PROVIDED WITH INTEGRAL CABLE GROUNDING COIL.
5. TYPICAL MOUNTING CASTING UTILIZED FOR RIGID SUPPORT AND GROUNDING.
6. TYPICAL MOUNTING CASTING SHALL BE BOLTED TO SUPPORT BRACKET.
7. TYPICAL SUPPORT BRACKET SHALL BE BOLTED TO CUBICAL HOUSING.
8. TYPICAL 6"X6"X 1/4" STEEL SUPPORT BRACKET.
9. TYPICAL RUBBER BOOT PROTECTIVE SLEEVE.
10. TYPICAL 15KV CABLE. SIZE AS NOTED ON THE DWGS.
11. TYPICAL STAINLESS STEEL RETENTION AND GROUNDING CONNECTION CLAMP.
12. TYPICAL 200A BRAIDED CU. GND. CONDUCTOR TO CUBICLE GROUND BUS.
13. PROVIDE 25KV INSULATING TAPE OR BOOTS OVER CONNECTION.

DETAIL– CABLE TERMINATION

SCALE: NOT TO SCALE

NPWC–31

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD CABLE IDENTIFICATION TAG		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTES:

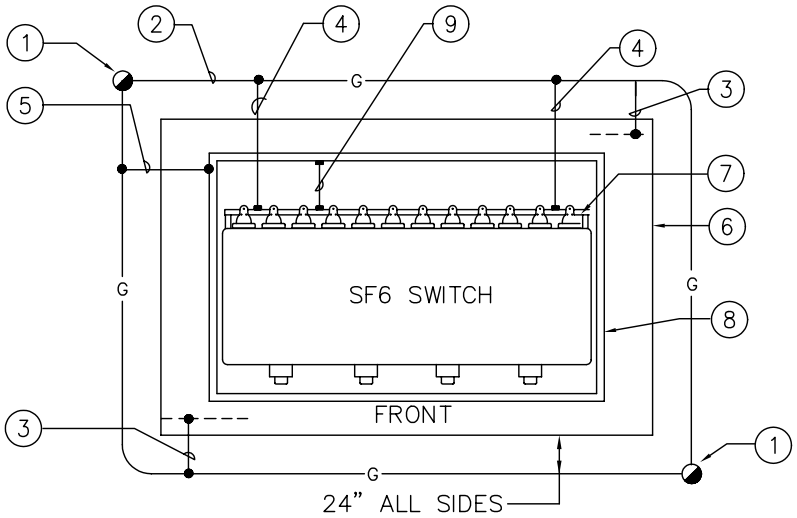
1. 1/8" THICK LAMINATED WHITE MELAMINE (WITH BLACK CORE), PLASTIC TAG WITH MATTE WHITE FINISH WITH CHARACTERS CUT THROUGH THE WHITE PLASTIC INTO THE BLACK CORE.
2. USE LOCK-ON TYPE NYLON TIES TO ATTACH TAG TO CABLES.
3. ALL LETTERS AND NUMBERS SHALL BE 1/4" HIGH.
4. REFER TO ELECTRICAL DRAWING CABLE TAG SCHEDULE FOR INFORMATION TO BE ENGRAVED. ABOVE INFORMATION IS ONLY A SAMPLE.
5. PLACE TAGS TO LEGIBLE FROM CENTER OF MANHOLE.

DETAIL- CABLE IDENTIFICATION TAG

SCALE: NOT TO SCALE

NPWC-32

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD REV.1/2001 SF6 SWITCH PAD GROUNDING



NOTES:

1. GROUND ROD, 3/4" X 10'–0", COPPER CLAD STEEL. TOP OF ROD 6" BELOW GRADE.
2. BARE COPPER WIRE, #4/0 TYP. 24" BELOW GRADE.
3. #4/0 BARE COPPER WIRE GROUND CONNECTION TO STEEL REBARS.
4. #4/0 BARE COPPER WIRE GROUND CONNECTION TO SWITCH GROUND BUS.
5. #4/0 BARE COPPER WIRE GROUND CONNECTION TO SWITCH ENCLOSURE FROM GROUND LOOP.
6. 4" HIGH CONCRETE SWITCH PAD. PAD SHALL EXTEND 6" BEYOND EQUIPMENT IN EACH DIRECTION.
7. SWITCH GROUND BUS.
8. SWITCH ENCLOSURE.
9. #4/0 BARE COPPER WIRE CONNECTION FROM SWITCH GROUND BUS TO ENCLOSURE.

DETAIL – SF6 SWITCH PAD GROUNDING

SCALE: NONE

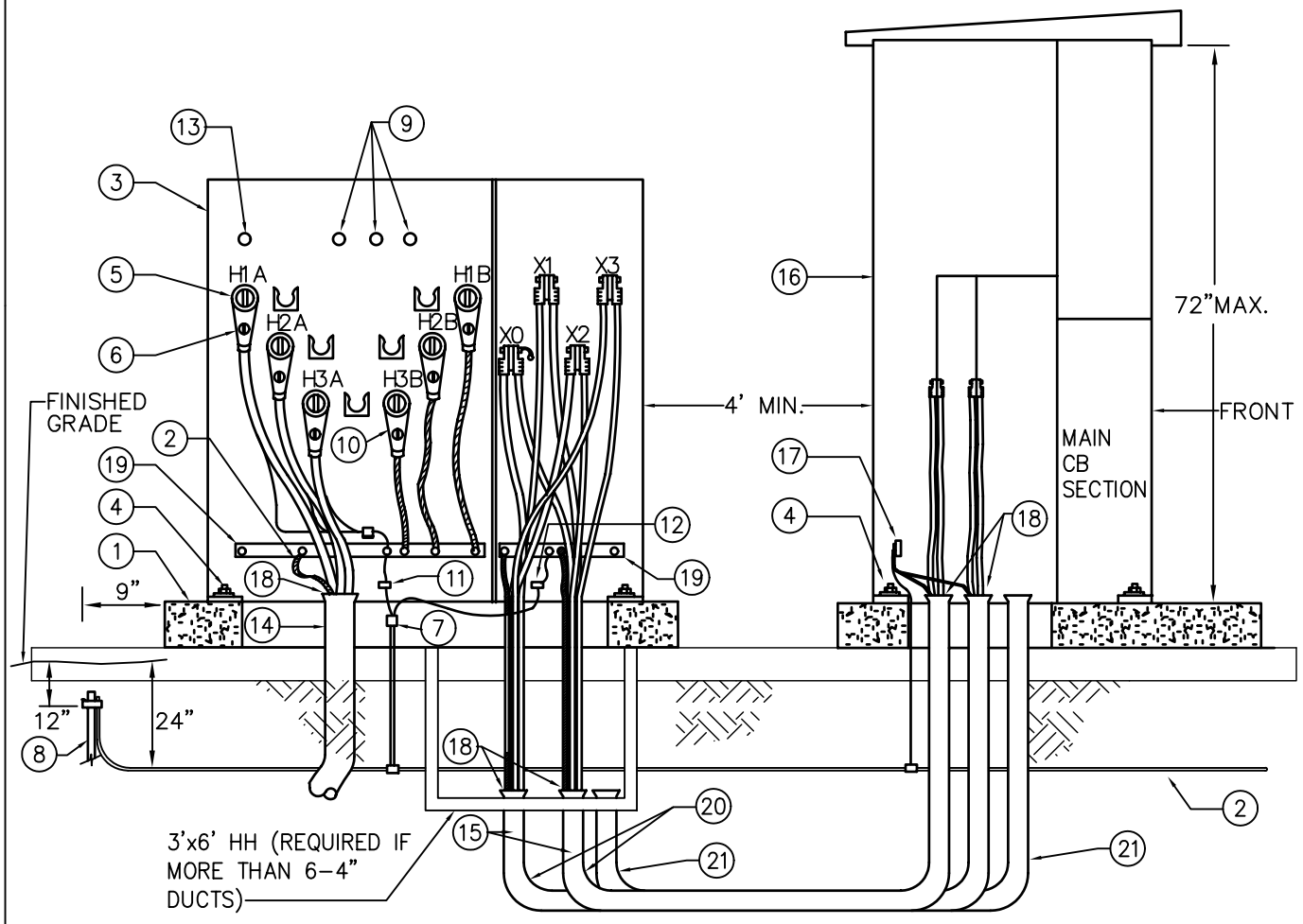
NPWC–33DB

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD

REV.1/2001

PAD MTD TRANSFORMER AND SWITCHBOARD



NOTES

1. PRECAST CONCRETE PAD, SIZE FIT 6" LARGER THAN TRANSFORMER FOOTPRINT.
2. BARE COPPER GROUND WIRE, #4/0 AWG.
3. PAD MOUNTED TYPE TRANSFORMER (THRU 1000 KVA @ 208V, 1500KVA @ 480V).
4. ANCHOR BOLTS, ANCHORING TO CONFORM WITH SEISMIC ZONE 4.
5. LOADBREAK SEPARABLE ELBOW, 15KV.
6. PROVIDE ELBOW TEST POINT.
7. COMPRESSION TYPE CONNECTOR.
8. COPPERCLAD STEEL GROUND ROD, 3/4" X 10'.
9. FUSE, OIL IMMERSED BAYONET TYPE
10. ELBOW TYPE SURGE ARRESTER.
11. TRANSF HV SECTION GROUND STUD.
12. TRANSF. LV SECTION GROUND STUD
13. TAP CHANGER, PAD LOCKABLE.
14. PRIMARY CONDUIT RISER, 5" PVC SCH.40 AND SHOW CONDUIT FOR FIBER OPTIC CABLE FROM MANHOLE TO SECONDARY SWITCHBOARD.
15. SECONDARY CONDUITS (SIZE AND QTY AS REQ'D) RISERS, PVC SCH.40
16. SECONDARY VOLTAGE SWITCHBOARD, OUTDOOR TYPE W/HINGED FRONT AND REAR DOORS AND SLOPED DROP ROOF.
17. SWITCHBOARD GROUND BUS
18. PROVIDE CONDUIT SEALS AFTER CABLE INSTALLATION IN PRIMARY AND SECONDARY CONDUITS.
19. PROVIDE 1/4" X 2" GROUND BUS AND TIED TO TRANSF. PRIMARY AND SECONDARY GROUND STUDS.
20. 36" RADIUS MINIMUM REQUIRED ON 3", 4", 5" CONDUIT.
21. PROVIDE 2" CONDUITS AS REQUIRED FOR STATUS TO UCS CABINET.

DEAIL – PAD MTD. TRANSFORMER AND SWITCHBOARD

SCALE: NONE

NPWC–34DB

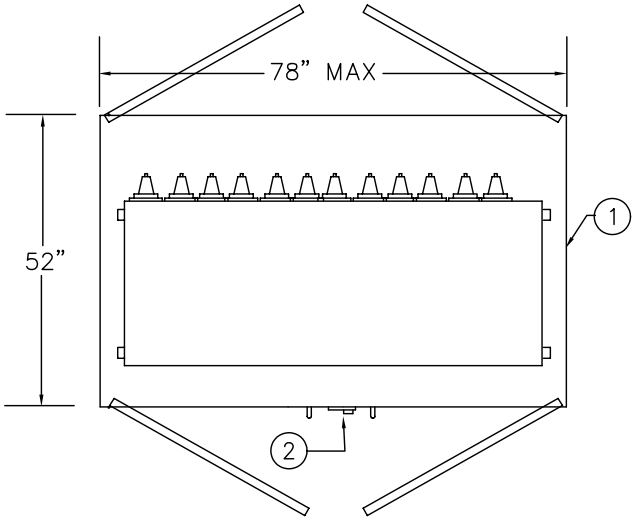
11ND–PWC 4856/38 (REV. 12–79)

DEPT OF THE NAVY NAV FAC ENG COM
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA

PWC UTILITIES STANDARD

SELECTOR SWITCH (15kV)

REV.1/2001

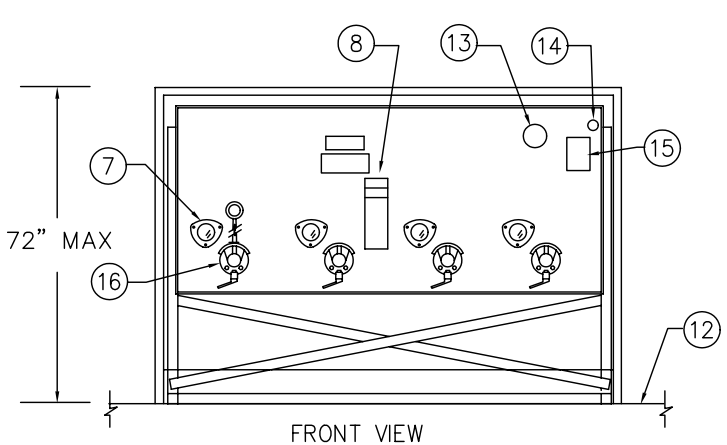


NOTES:

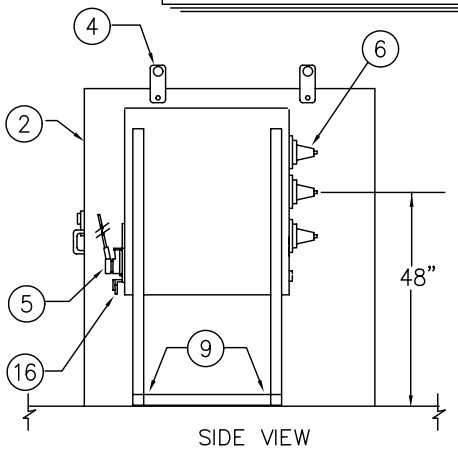
1. SWITCH ENCLOSURE, NEMA 3R.
2. DOUBLE FRONT DOORS, HINGED, TAMPER–PROOF WITH PROVISIONS FOR PADLOCKING.
3. DOUBLE REAR, HINGED, TAMPER–PROOF DOORS SHOWN REMOVED FOR CLARITY.
4. LIFTING EYES (TYPICAL)
5. REMOVABLE SWITCH OPERATING HANDLE (TYPICAL)
6. APPARATUS BUSHING 600A, 25KV FOR SEPARABLE ELBOW CONNECTORS (TYPICAL).
7. BLADE VIEWING WINDOW (TYPICAL)
8. NAME PLATE
9. PROVIDE ANCHORING PER SEISMIC ZONE 4 REQUIREMENTS.
10. COPPER GROUND BUSS
11. PARKING STAND
12. CONCRETE PAD
13. PRESSURE GAUGE
14. FILL VALVE
15. SF6 PRESSURE TEMPERATURE CHART
16. OPERATING SHAFT AND LOCKING ASSEMBLY

NOTE: SWITCH SHALL BE A FREE STANDING UNIT MOUNTED WITHIN A SEPARATE NEMA 3R ENCLOSURE

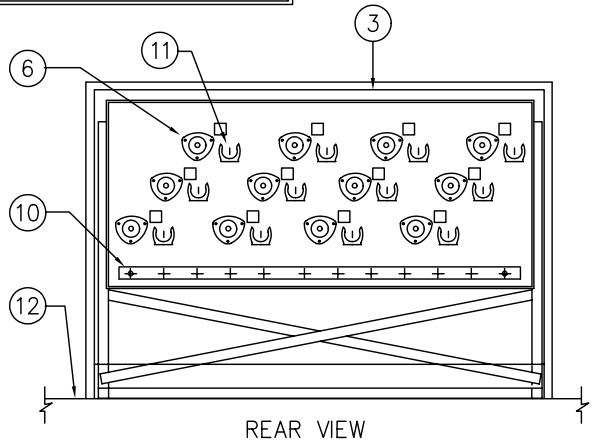
PLAN VIEW



FRONT VIEW
(DOORS SHOWN REMOVED)



SIDE VIEW



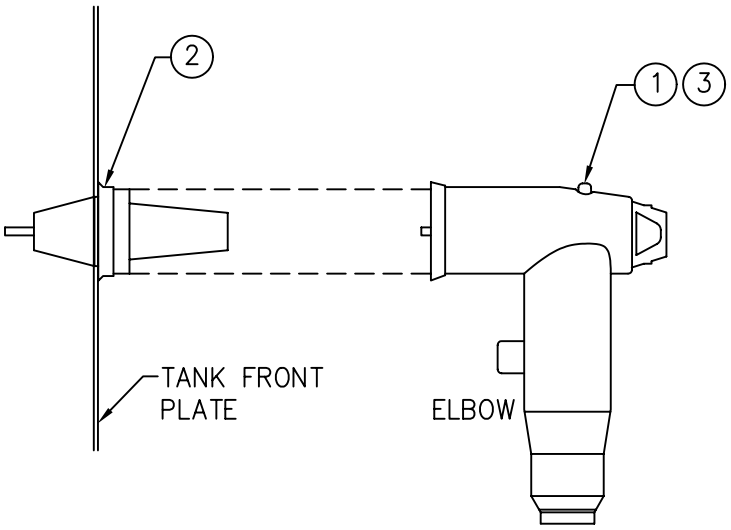
REAR VIEW
(DOORS SHOWN REMOVED)

DETAIL– 4–WAY SF6 SELECTOR SWITCH (15kV)

SCALE: NOT TO SCALE

NPWC–35DB

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD PAD MOUNTED H.V. CONNECTOR – 200A		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



(1) 200A LOAD BREAK ELBOW

(2) 200A BUSHING

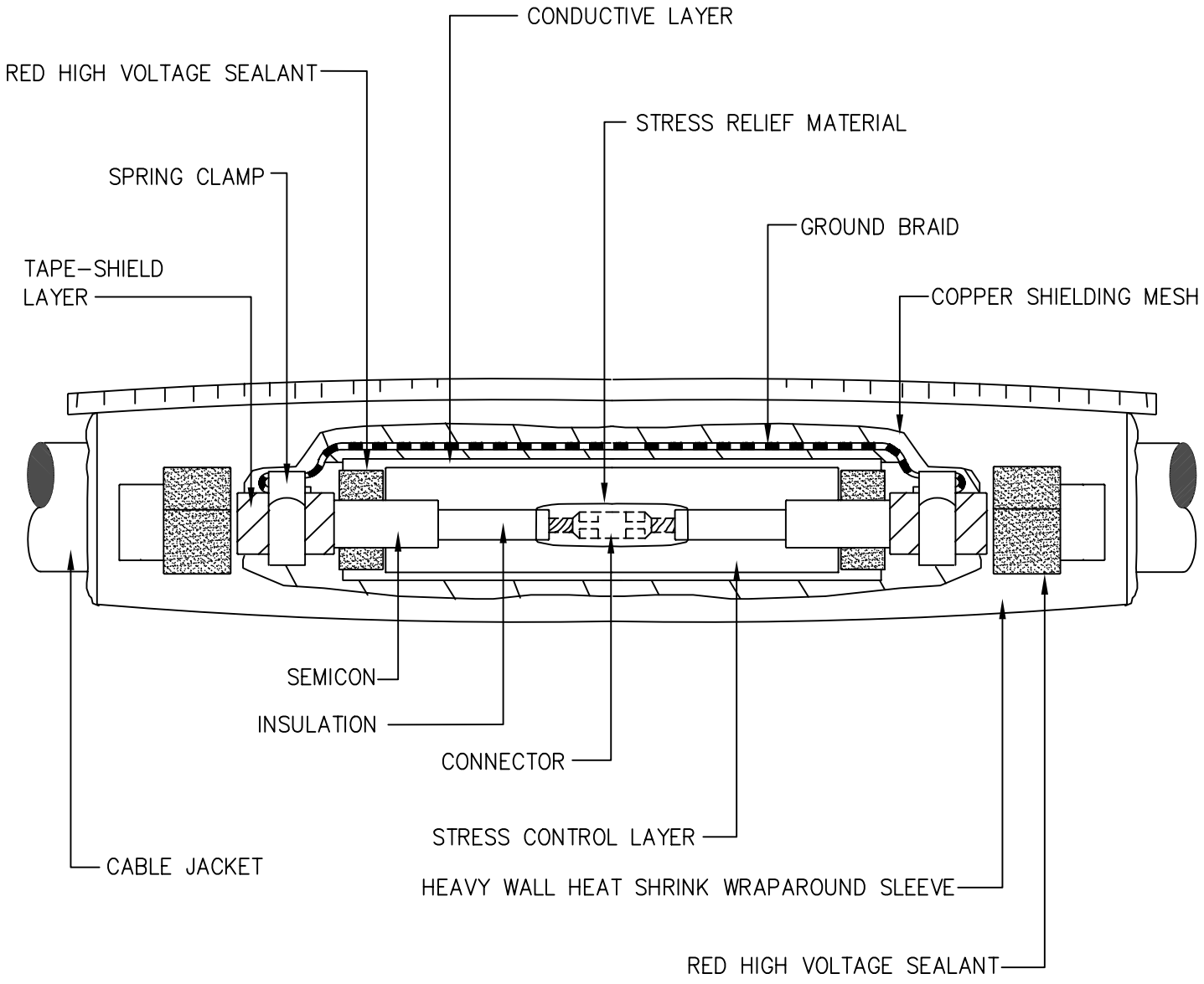
(3) 12 kV SURGE ARRESTOR ON OPPOSITE SIDE. TRANSFORMER SET UP FOR LOOP CONFIGURATION

DETAIL–PAD MOUNTED H.V. CONNECTOR – 200A

SCALE: NOT TO SCALE

NPWC–36

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD MEDIUM VOLTAGE SPLICE		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTE:

CABLE SPLICE SHALL BE RATED FOR 25KV.

DETAIL–MEDIUM VOLTAGE SPLICE

SCALE: NOT TO SCALE

NPWC–38

GENERAL

(2) NOTE REFERENCE

A / E-30 — SECTION LETTER DESIGNATION; SHEET SECTION APPEARS ON.

1 / E-20 | E-20 — DETAIL NUMBER DESIGNATION; SHEET DETAIL APPEARS (ILLUSTRATED) ON; SHEET DETAIL OCCURS ON.

3/E39 — DETAIL OR SECTION REFERENCES IN NOTES.

+48" — INDICATES MOUNTING HEIGHT ABOVE FINISHED FLOOR.

INDICATES SURFACE MOUNTED BOX FOR ITEM SHOWN.

INDICATES FLUSH MOUNTED BOX FOR ITEM SHOWN.

LUMINAIRE SYMBOLS

SUBSCRIPT ADJACENT TO LIGHTING FIXTURE INDICATE :
1,2,3 etc. = CIRCUIT NUMBERS
a,b,c etc. = SWITCH IDENTIFICATION
N = NIGHT/SECURITY LIGHT

CEILING WALL — BATTERY POWERED EMERGENCY LIGHTING UNIT .

POLE OR POST TYPE LUMINAIRE.

LUMINAIRE(S) MOUNTED ON POLE.

FLUORESCENT LIGHTING FIXTURE, PENDANT, CHAIN OR STEM MOUNTED AT HEIGHT NOTED. "O" INDICATES FEED POINT.

FLUORESCENT LIGHTING FIXTURE, WALL MOUNTED AT HEIGHT NOTED.

DOWNLIGHT FIXTURE, SURFACE MOUNTED ON CEILING OR PENDANT MOUNTED AT HEIGHT NOTED.

LIGHTING FIXTURE, WALL MOUNTED AT HEIGHT NOTED.

RECEPTACLES OUTLETS

DUPLEX RECEPTACLE, WALL MOUNTED AT +15" UON.

TWO DUPLEX RECEPTACLES (FOURPLEX) IN TWO GANG BOX AT +15" UON.

DUPLEX RECEPTACLE TOP HALF SWITCHED.

SINGLE RECEPTACLE WALL MOUNTED AT +15" UON.

DUPLEX ISOLATED GROUND RECEPTACLE AT +15" UON.

FOURPLEX ISOLATED GROUND RECEPTACLE AT +15" UON.

DUPLEX RECEPTACLE AND TOGGLE SWITCH MOUNTED IN 2 GANG BOX WITH COMMON COVER PLATE AT + 48" UON.

POWER EQUIPMENT

DISTRIBUTION PANEL OR SWITCHBOARD.

SURFACE FLUSH — PANELBOARD.

MOTOR STARTER

T — TRANSFORMER, FLOOR MOUNTING TYPE. (PLAN VIEW)

T — TRANSFORMER, WALL MOUNTING TYPE. (PLAN VIEW)

1/4 HP — MOTOR CONNECTION WITH HP NOTED.

JUNCTION OR OUTLET BOX. CEILING OR WALL MOUNTED AS

M — METER SOCKET OR PANEL.

GROUND ROD.

E — UNDERGROUND MANHOLE. "E" INDICATES ELECTRICAL,

T — "T" INDICATES TELEPHONE/ COMMUNICATIONS.

SWITCHING DEVICES:

SUBSCRIPT ADJACENT TO SWITCHES INDICATE: a,b,c ETC. = FIXTURE CONTROLLED, 2 = DOUBLE POLE, 3 = THREE WAY, 4 = FOUR WAY, P = PILOT LIGHTED, K = KEY OPERATED, M =MANUAL MOTOR SWITCH WITH THERMAL OVERLOADS.

TOGGLE SWITCH, SPST AT +48"UON.

a,b,c — INDICATES MULTIPLE SWITCHES IN GANGED BOX W/COMMON COVERPLATE. [PROVIDE BARRIERS BETWEEN 120VOLT & 277VOLT, TWO DIFFERENT 277 VOLT CIRCUITS] "a, b, c" INDICATES NUMBER OF INDIVIDUAL SWITCHES AND FIXTURES CONTROL.

a, b — INDICATES SWITCHES a,b MOUNTED IN SEPARATE BOXES WITH SEPARATE COVERPLATES.

M — MANUAL MOTOR STARTER

HOA — HAND-OFF-AUTO SELECTOR SWITCH AT +48" UON.

MOTOR STARTER. MAGNETIC UON.

F — FUSED SAFETY DISCONNECT SWITCH.

NON FUSED SAFETY DISCONNECT SWITCH.

CB — ENCLOSED CIRCUIT BREAKER.

CB F — COMBINATION FUSED OR CB, DISCONNECT AND STARTER.

CONTACTOR.

R — RELAY.

TC — TIME CLOCK.

PC — PHOTOCELL.

WIRING \ RACEWAY SYSTEMS:

WIRING OR CONDUIT CONCEALED IN WALL OR CEILING.

WIRING OR CONDUIT EXPOSED.

WIRING OR CONDUIT CONCEALED UNDERGROUND, OR IN FLOORS ABOVE GRADE LEVEL.

ELECTRICAL UNDERGROUND DUCT BANK.

-T- TELEPHONE/ COMMUNICATIONS SYSTEM UNDERGROUND DUCTBANK

FLEXIBLE CONDUIT.

LIA-1,3 — CONDUIT HOMERUN TO PANELBOARD. LETTER AND NUMERALS INDICATE ELECTRICAL PANEL AND CIRCUIT NUMBER.

CROSS LINES ON CONDUIT RUNS INDICATE NUMBER OF #12 CURRENT CARRYING CONDUCTORS CONTAINED THEREIN. TWO #12 AND ONE #12 GROUND WIRE ARE INDICATED WHEN CROSS LINES ARE NOT SHOWN. NUMERALS ADJACENT TO CROSS LINES ON CONDUIT RUNS INDICATE SIZE OF CONDUCTORS IN LIEU OF #12. ALL CONDUITS SHALL CONTAIN ONE GROUND WIRE SIZED PER N.E.C. TABLE 250-95, BUT NOT SMALLER THAN #12.

3 #12, 1/2" C. — 6 #12, 3/4" C.
4 #12, 1/2" C. 3/4" C. — 7 #12, 3/4" C.
5 #12, 3/4" C.

CONDUIT TURNED UP. — CONDUIT TURNED DOWN.

CONDUIT CHANGE IN HORIZONTAL ELEVATION.

CONDUIT TERMINATED AND CAPPED. PULL LINE IN PLACE

G — GROUNDING CONDUIT, OR WIRE.

OVERHEAD LINE WORK:

EXISTING POLE

NEW POLE

REMOVE POLE

OVERHEAD LINE: NUMBER INDICATES NUMBER OF SINGLE CONDUCTORS OR MULTICONDUCTOR CABLES. LETTERS INDICATES: P = OVER 600 VOLTS S = UNDER 600 VOLTS, T = TELEPHONE, F = FIRE ALARM, L = STREET LIGHTING, C = CABLE TV, M = FMS OR EMCS, G = OVERHEAD GUY.

NEW LINE

EXISTING LINE

REMOVE LINE

EXISTING POLE MOUNTED TRANSFORMER

NEW OR RELOCATED TRANSFORMER

REMOVE OR RELOCATE TRANSFORMER

R — INDICATES RELOCATE(D) TRANSFORMER

T2 — TRANSFORMER IDENTIFICATION NUMBER, SEE SCHEDULE.

25 — DOWN GUY, LEAD INDICATED

6 — SIDEWALK GUY, LENGTH OF ARM INDICATED.

SINGLE LINE DIAGRAM:

CIRCUIT BREAKER, MOLDED CASE BOLT-ON WHEN LESS THEN 2000 AMP. PROVIDE EACH BREAKER WITH AUX . "A" AND "B" CONTACTS. FOR BREAKERS 2000A OR GREATER, PROVIDE INSULATED CASE.

DRAW OUT TYPE CIRCUIT BREAKER. PROVIDE BREAKER WITH "A" AND "B" AUX. CONTACTS.

15KV VACUUM CIRCUIT BREAKER DRAWOUT TYPE - WITH CELL

3 — FUSE, DRAWOUT INDICATED. NUMBER INDICATES QUANTITY.

3 PT (3) — POTENIAL TRANSFORMER, QUANTITY INDICATED, AND PRIMARY DRAWOUT FUSING INDICATED.

3 CPT — CONTROL POWER TRANSFORMER WITH PRIMARY FUSING INDICATED.

CT'S 3 — CURRENT TRANSFORMERS, MULTI RATIO WITH QUANTITY INDICATED, SET PER CIRCUIT BREAKER TRIP SETTING.

SA — SURGE (LIGHTNING) ARRESTER

POWER TRANSFORMER

WYE

DELTA

GROUND

GROUND ROD.

OVERLOAD

KNIFE SWITCH

CABLE SPLICE

25KV ELBOW CONNECTOR.

25KV TERMINATION (PORCELAIN) UON.

MR — MOTOR RELAY

TC — TRIP COIL

T — THERMOSTAT

H — HUMIDISTAT

HTR — HEATER

K — KEY LOCK

K — KIRK KEY INTERLOCK.

200A C — AUTOMATIC TRANSFER SWITCH 200A SIZE INDICATED

(XXX) — WIRE NUMBER IN PARENTHESIS

FA — XFMR FAN MOTOR

52a — BRKR. CONTACT - OPEN WHEN BRKR. IS OPEN

52b — BRKR. CONTACT - CLOSED WHEN BRKR. IS OPEN

BATTERY — RES RESISTOR

G — GREEN PILOT LIGHT

R — RED PILOT LIGHT

W — WHITE PILOT LIGHT

2 — MOTOR STARTER WITH THERMAL OVERLOADS (NUMBER INDICATES STARTER SIZE.)

V-12/P2/J-2 — CABLE TAG SEE SCHEDULE.

SWITCH AND FUSE DESIGNATION
3P — NUMBER OF POLES
100 — SWITCH SIZE
60 — FUSE SIZE
RK5 — FUSE CLASS

DISCONNECT SWITCH 'F' INDICATES FUSED TYPE
F 3P — NUMBER OF POLES
100 — SWITCH SIZE
60 — FUSE SIZE
RK5 — FUSE CLASS

HOOK STICK FUSE BREAKER

OIL FUSE CUT-OUT

CIRCUIT BREAKER
3P — NUMBER OF POLES
225AF — AMPS FRAME
225AT — AMPS TRIP
22KAIC — KAIC RATING

CIRCUIT BREAKER, ["M" DENOTES MOTOR PROTECTOR TYPE.] ["E" DENOTES ELECTRONIC TRIP TYPE.] ["L" INDICATES CURRENT LIMITING TYPE.]
NO SUBSCRIPT INDICATES THERMAL MAGNETIC

REVISIONS

SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED

RELAYS SINGLE LINE DIAGRAM:

85L	PILOT WIRE RELAY	50/51	INST. & TIME OC RLY.
87B	BUS DIFFERENTIAL RELAY	86C3	LOCKOUT RELAY
86B	BUS LOCKOUT RELAY		
87T	TRANSFORMER/ DIFFERENTIAL RELAY	63SPX	SUDDEN PRESS AUX RLY
51N	TIME OVERCURRENT GROUND RELAY		
51	TIME OVERCURRENT CURRENT RELAY	VAR	VAR METER
50N/51N	INST. & TIME OC GND. RLY.	94	SC CLOSE RLY
C	CLOSING COIL	Y	ANTI PUMP RELAY
ICS	RLY SEAL-IN COIL	49T	THERMAL RELAY
FR	XFMR FAN CONTROL RELAY		

METERING :

A	AMMETER	V	VOLTMETER
AS	AMMETER SWITCH	VS	VOLTMETER SWITCH
KWH/DM	KILOWATT HOUR DEMAND METER	STB	SHORTING TERMINAL BLOCK
KW	KILOWATT METER	MA	MILLI-AMPERE METER
K VAR	KILOVAR METER	PF	POWER FACTOR METER

ENERGY MONITORING :

VX 3	VOLTAGE TRANSDUCER NUMBER INDICATES QUANTITY	UCS	UTILITY CONTROL SYSTEM
AX 3	CURRENT TRANSDUCER NUMBER INDICATES QUANTITY	DGP	DATA GATHERING PANEL
TB	TERMINAL BLOCK		
PFX	POWER FACTOR TRANSDUCER		

NPWC-39

IF SHEET IS LESS THAN 28" x 40", IT IS A REDUCED PRINT. SCALE REDUCED ACCORDINGLY

ENGINEERING DRAWING NUMBER

DRAWN
DSGN.
E.I.C.
FIRE
SECURITY
SAFETY
DIV. HD.
APPROVED DATE
PUBLIC WORKS OFFICER
FILE NO.

DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
NAVAL COMMAND CONTROL AND OCEAN SURVEILLANCE CENTER
RDT&E DIVISION
SAN DIEGO, CALIFORNIA

NAVY PUBLIC WORKS CENTER

ELECTRICAL STANDARDS

SYMBOLS

SIZE F | CODE IDENT. NO. 80091 | NAVFAC DRAWING NO.

CONSTR. CONST. NO. N/A

SCALE NONE | SPEC. N/A | SHEET OF

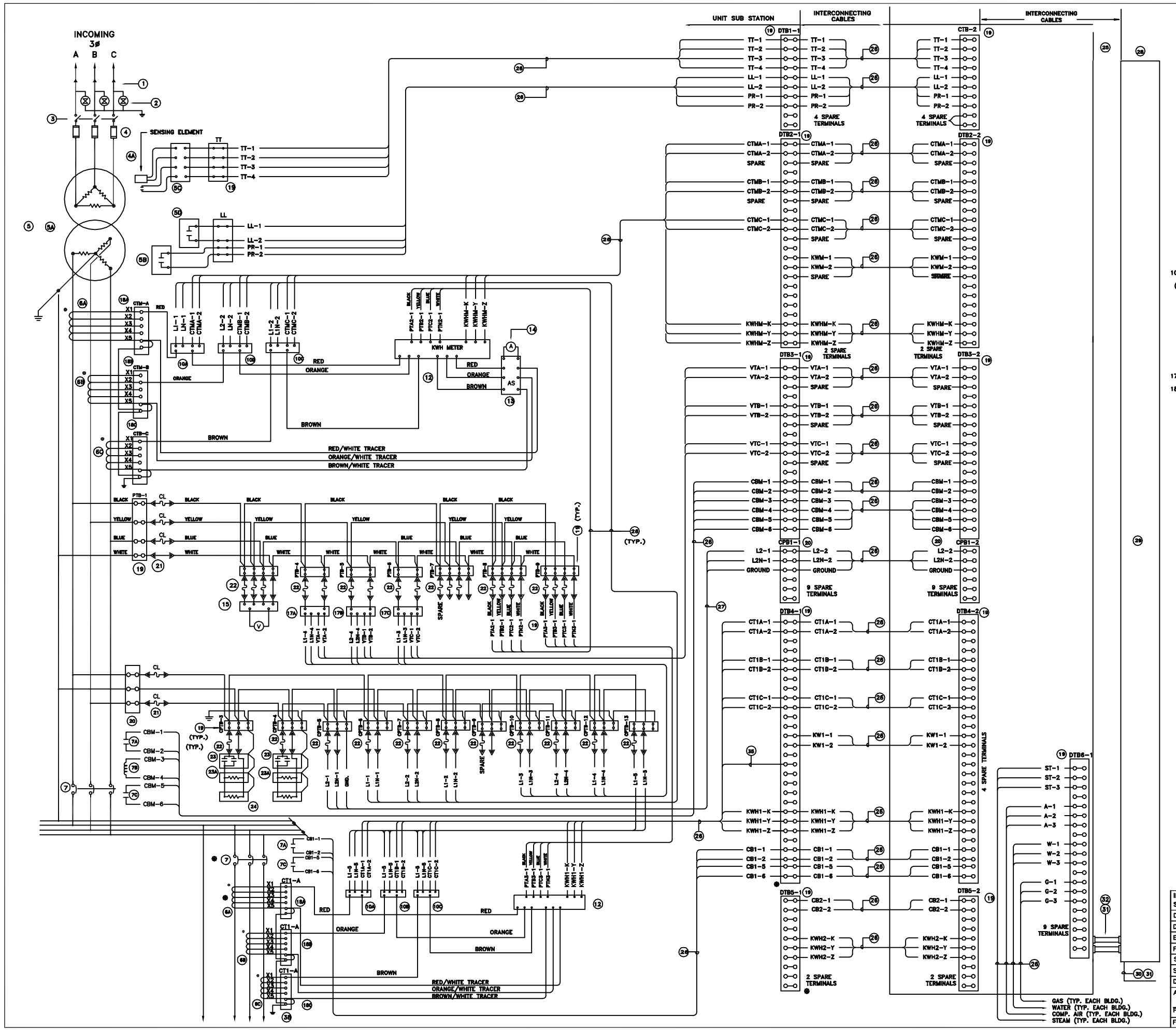
REVISIONS				
SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED

ABBREVIATIONS

A	AMPERE
ADA	AMERICAN DISABILITIES ACT
AC	ALTERNATING CURRENT
AF	AMP FRAME
AFF	ABOVE FINISHED FLOOR
AM	AMMETER
AIC	AMPERE INTERUPTING CAPACITY
ARCH	ARCHITECTURAL
APPROX	APPROXIMATE
AR	AUXILIARY RELAY
AS	AMMETER SWITCH
AT	AMPS TRIP
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AUX	AUXILIARY
AWG	AMERICAN WIRE GAGE
BATT	BATTERY
B.C.	BARE COPPER
BRKR	BREAKER
BLDG	BUILDING
BS	BARE STRANDED
BT	BUS TIE
BIL	BASIC IMPULSE LEVEL
C	CONDUCTOR, CONDUIT
CB	CIRCUIT BREAKER
CHGR	CHARGER
CKT	CIRCUIT
CL	CLOSE
CLF	CURRENT LIMITING FUSE
CBN	CLOSE BUS NEGATIVE
CBP	CLOSE BUS POSITIVE
CONC	CONCRETE
CPT	CONTROL POTENTIAL TRANSFORMER
CS/T	CONTROL SWITCH-TRIP
CS/C	CONTROL SWITCH-CLOSE
CSFM	CALIF. STATE FIRE MARSHELL
CT	CURRENT TRANSFORMER
CU	COPPER
DS	DISCONNECT SWITCH
DC	DIRECT CURRENT
DWG	DRAWING
EA	EACH
EL	ELEVATION
ELECT	ELECTRICAL
EMH	ELECTRICAL MANHOLE
EPR	ETHYLENE PROPYLENE RUBBER
EXH	EXHAUST
EB	ENCASED BURIAL
FA	FIRE ALARM
FDR	FEEDER
FT	FEET
FIN	FINISHED
FLR	FLOOR
FUT	FUTURE
FLUOR	FLUORESCENT
GALV	GALVANIZED
GND, G	GROUND
GFCI	GROUND FAULT CIRCUIT INTERRUPTER
HP	HORSEPOWER
HTR	HEATER
HPS	HIGH PRESSURE SODIUM
HT	HEIGHT
HV	HIGH VOLTAGE
ICS	SEAL IN CONTACT
IND	INDICATION
INST	INSTANTANEOUS
INSUL	INSULATING
INT	INTERRUPTING
KV	KILOVOLTS
KVA	KILOVOLT-AMPERE
KVAR	KILOVAR METER
KW	KILOWATT
KWHDM	KILOWATT HOUR DEMAND METER
KCMIL	THOUSAND CIR MILS
LBS	POUNDS
LO	LOCKOUT
LT SW	LIGHT SWITCH
LTG	LIGHTING
LV	LOW VOLTAGE
mA	MILLI-AMPERES
MAX	MAXIMUM
MFD	MANUFACTURED
MH	MANHOLE
MIN	MINIMUM
MON	MONITOR
MON	MONITORING
MRCT	MULTI-RATIO CURRENT TRANSFORMER
MTD	MOUNTED
MVA	MEGAVOLT AMPERE
MCOV	MAXIMUM CONTINOUS OPERATING VOLTAGE
MECH	MECHANICAL
MFR	MANUFACTURER
N	NORTH
NC	NORMALLY CLOSED
NO	NORMALLY OPEN
NO.	NUMBER
NP	NAME PLATE
NTS	NOT TO SCALE
NFPA	NATIONAL FIRE PROTECTION
NEC	NATIONAL ELECTRIC CODE
O C B	OIL CKT BRKR
OA	SELF COOLED
OA/FA	SELF COOLED/FORCE AIR
OC	OVER CURRENT
OL	OVERLOAD
OH	OVERHEAD
OA/FA/ FAA	SELF COOLED/FORCE AIR/FORCE AIR
P	POLE
PH	PHASE
PNL	PANEL
PT	POTENTIAL TRANSFORMER
PVC	POLYVINYL CHLORIDE
RC	RESET COIL
RCPT	RECEPTACLE
RES	RESISTOR
RFA	RECTIFIER FAILURE ALARM
RGS	RIGID GALV STEEL
RLVA	RECTIFIER LOW VOLTAGE ALARM
RLY	RELAY
RM	ROOM
SA	SURGE (LIGHTNING) ARRESTER
SB	SWITCHBOARD
SC	SUPERVISORY CONTROL
SHT	SHEET
SWT	SWITCH
SPDT	SINGLE POLE DOUBLE THROW
SCC	SUPERVISORY CONTROL CLOSE
SCHEM	SCHEMATIC
SCS	SUPERVISORY CONTROL
SW	SWITCH
SCT	SUPERVISORY CONTROL TRIP
SDG&E	SAN DIEGO GAS & ELECTRIC
SEL SW	SELECTOR SWITCH
SPP	SUMP PUMP PANEL
SPR	SUDDEN PRESSURE RELAY
SPS	STANDARD PIPE SIZE
SUBSTA	SUBSTATION
SWBD	SWITHBOARD
SWGR	SWITCHGEAR
SYM	SYMMETRICAL
TP	TRIP
T	TRANSFORMER
TBN	TRIP BUS NEGATIVE
TBP	TRIP BUS POSITIVE
TEL	TELEPHONE
TEMP	TEMPERATURE
TERM	TERMINAL
TL	TIE LINE
TOC	TOP OF CONCRETE
TS	TEST SWITCH
TYP	TYPICAL
UL	UNDERWRITER'S LABORATORY
UPS	UNINTERUPTED POWER SUPPLY
UCS	UTILITY CONTROL SYSTEM
UG	UNDERGROUND
UON	UNLESS OTHERWISE NOTED
V	VOLTAGE
VAR	VARS
VCB	VACUUM CIRCUIT BREAKER
VM	VOLTMETER
VS	VOLTMETER SWITCH
W	WIRE
WHD	WATT HOUR DEMAND
WM	WATTMETER
WP	WEATHERPROOF
W/	WITH
XFMR	TRANSFOMER
XDCR	TRANSDUCER

NPWC-40

IF SHEET IS LESS THAN 28" x 40", IT IS A REDUCED PRINT. SCALE REDUCED ACCORDINGLY	ENGINEERING DRAWING NUMBER
DRAWN	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND NAVAL COMMAND CONTROL AND OCEAN SURVEILLANCE CENTER RDT&E DIVISION SAN DIEGO, CALIFORNIA
DSGN.	
E.I.C.	
FIRE	NAVY PUBLIC WORKS CENTER
SECURITY	ELECTRICAL STANDARDS
SAFETY	ABBREVIATIONS
DIV. HD.	
APPROVED DATE PUBLIC WORKS OFFICER	SIZE F · CODE IDENT. NO. 80091 · NAVFAC DRAWING NO. CONSTR. CONST. NO. N/A
FILE NO.	SCALE NONE · SPEC. N/A · SHEET OF



REVISIONS				
SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED
		ROBERTA E. FRANKLIN	5/13/93	
			2/7/95	
			2/22/95	
	REVISION TO RTU		7/26/95	
			8/10/95	

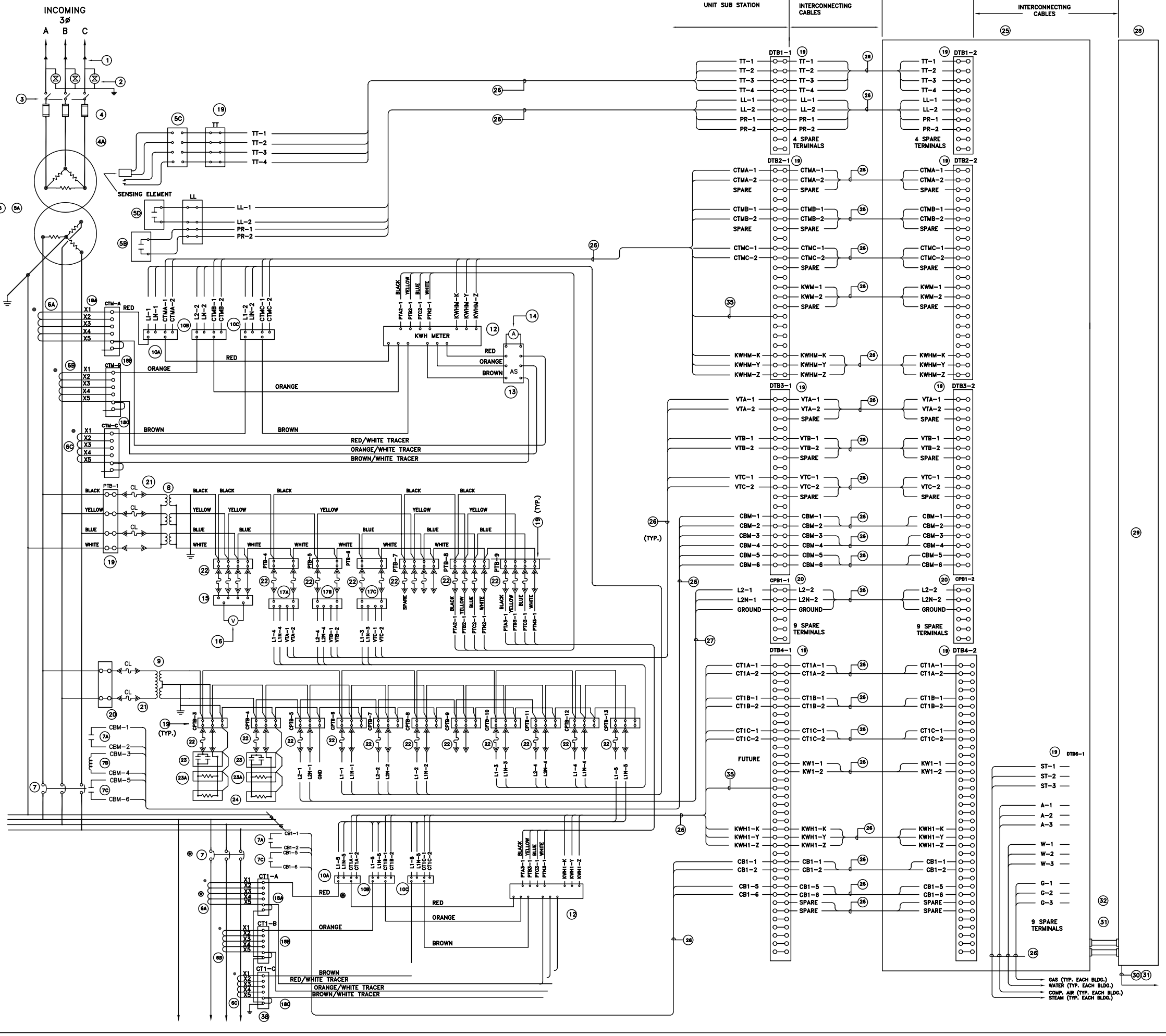
NOTES

1. CABLE TERMINATORS, PORCELAIN, 15KV, WITH AERIAL LANDING LUGS.
2. SURGE ARRESTERS.
3. DISCONNECT SWITCH, 3-PHASE, 15KV,600A.
4. FUSES AS REQUIRED. PROVIDE 3 SPARE FUSES.
4A. COPPER BUS.
5. TRANSFORMER, 208Y/120
5A. MANUAL TAP CHANGER TWO 2-1/2% ABOVE AND TWO 2-1/2% BELOW NORMAL.
5B. PRESSURE RELIEF DEVICE WITH CONTACT.
5C. TRANSFORMER OIL TEMPERATURE TRANSMITTER WITH SENSING ELEMENT AND TRANSMITTER (4-20MA LOOP), OIL TEMPERATURE GAUGE WITH ALARM CONTACTS.
5D. ALARM CONTACT ON LIQUID LEVEL GAUGE.
6A,6B,6C. CURRENT TRANSFORMER, MULTI-RATIO TYPE. SIZE AND RATIO PER ONE-LINE DIAGRAM.
7. SECONDARY CIRCUIT BREAKERS. SIZE, VOLTAGE, AIC RATING WITH AUXILIARY CONTACT.
7A. AUXILIARY SWITCH ON CIRCUIT BREAKER. 'CLOSED' WHEN CIRCUIT BREAKER IS 'ON' AND 'OPEN' WHEN CHIRCUIT BREAKER IS 'OFF'. A AND B CONTACT.
7B. REMOTE ON/OFF. CONTROL RELAY.
7C. REMOTE TRIP.
8. NOT USED.
9. NOT USED.
10A,10B,10C. CURRENT TRANSDUCER, INPUT 0-5 AMPS, OUTPUT 4-20MA, ACCURACY0.25% EXTERNALLY POWERED. VOLTAGE RANGE OF 85 TO 150V.
(FUTURE)11. WATT/WATTHOUR TRANSDUCER, 3-PHASE, 4-WIRE.
12. KILO-WATT HOUR METER WITH PROGRAMMABLE DEMAND ATTACHMENT. 3-PHASE, 4WIRE, 5 DIAL - 3 STATOR METER, SWITCHBOARD TYPE WITH PULSE INITIATOR, DRAWOUT TYPE, SEMI-FLUSH, 120 VOLT.
13. AMMETER SWITCH 4-POSITION, READING L-1, L-2, L-3 AND 'OFF'.
14. AMMETER, FOR USE WITH CURRENT TRANSFORMER, 5-AMP FULL SCALE. SCALE SHALL BE MATCHED TO CURRENT TRANSFORMER RATIO. SWITCHBOARD TYPE, 4-1/2" SQUARE, MINIMUM 250 DEGREE SCALE ARC, ACCURACY 1%. PROVIDE SPARE SCALES TO MATCH CT RATIOS.
15. VOLTMETER SWITCH, 7-POSITION, READING PHASE TO PHASE VOLTAGES 1-2, 2-3, 3-1 AND LINE TO NEUTRAL VOLTAGES 1, 2, 3 AND 'OFF'.
16. VOLTMETER, FOR USE WITH POTENTIAL TRANSFORMERS. SCALE SHALL BE MATCHED TO SWCONDARY VOLTAGE OF TRANSFORMER. SWITCHBOARD TYPE, 4-1/2" SQUARE, MINIMUM 250 DEGREE SCALE ARC, ACCURACY 1%.
17A,17B,17C. VOLTAGE TRANSDUCER, INPUT 0-150 VOLTS, OUTPUT 4-20MA. ACCURACY 0.25% EXTERNALLY POWERED. VOLTAGE RANGE OF 85-150V.
18A,18B,18C. SHORT CIRCUITING TERMINAL BLOCKS. NUMBER OF TERMINALS AS REQUIRED.
19. TERMINAL BOARDS, WITH DOUBLE ROW 20-AMP TERMINALS, 250V RMS. NUMBER OF TERMINALS AS REQUIRED.
20. TERMINAL BOARD WITH DOUBLE ROW 30-AMP TERMINALS, 250 RMS. NUMBER OF TERMINALS AS REQUIRED.
21. FUSES, PULLOUT TYPE NEMA CLASS J, WITH CURRENT LIMITING FUSES. FUSE SIZE AS REQUIRED. PROVIDE 3 SPARE FUSES.
22. FUSE BLOCK, PULLOUT TYPE, 30-AMP RATING, NEMA CLASS J WITH FUSES. FUSE SIZE AS REQUIRED.
23. THERMOSTAT SPST, 20-AMP, 120V, CONTROL RANGE 40 DEGREES TO 80 DEGREES F, SWITCH CLOSE ON TEMPERATURE FALL. MOUNTING HEIGHT, 4 FEET.
23A. HUMIDITY CONTROLLER, DEHUMIDIFIER, CONTROL RANGE 20% TO 80% OF RELATIVE HUMIDITY (RH), 22-AMP 120V.
24. HEATERS, STAINLESS STEEL SHEATH, 240V, 1000 WATTS MINIMUM. CONNECT TO OPERATE ON 120 VOLTS. TWO PER SECTION.
25. CABINET, WEATHERPROOF WITH GASKETED DOOR, AND 3/4" MARINE PLYWOOD BACKBOARD, PAINTED WHITE FOR INSTALLATION OF TERMINAL BOARDS. SIZE BACK-BOARD TO ALLOW 2 INCH SPACE FROM SIDES OF CABINET.
26. CABLE 2 OR 3-CONDUCTOR, TWISTED, SHIELDED, #18 COPPER STRANDED MINIMUM, 600V INSULATION SUITABLE FOR INSTALLATION.
27. 3-1/C-#12, COPPER THWN, 600V IN CONDUIT.
28. UTILITIES CONTROL SYSTEM (UCS) PANEL ENCLOSURE, WEATHERPROOF WITH GASKETED DOOR AND 3/4" MARINE PLYWOOD BACKBOARD, PAINTED WHITE FOR INSTALLATION OF UCS PANEL EQUIPMENT. SIZE BACKBOARD TO ALLOW 2 INCHES SPACE FROM SIDES OF CABINET.
29. UTILITIES CONTROL SYSTEM (UCS) EQUIPMENT SHALL BE PER SERVICES AND CONNECTION POINTS INSTALLED AND SHALL COVER ALL DEVICES AND FUTURE DEVICES. THEY SHALL INCLUDE BUT NOT BE LIMITED TO ALL ANALOG INPUTS, ALL DIGITAL INPUTS, ALL TOTALIZER INPUTS (KWHM, KYZ), POWER SUPPLY, FIBER OPTICS INTERFACE, HEATERS, VENTS, FANS, TERMINAL BOARDS, WIRING, BATTERIES, THERMOSTAT AND HUMIDISTAT.
30. 6-1/C FIBER OPTICS CABLE.
31. CONDUIT. 2-4 INCH CONDUIT.
32. INTERCONNECTING WIRES FROM #25 TO #28 AND #29 SHALL BE INSTALLED.
33. WIRING SHALLL BE TYPE SIS COPPER 600V INSULATION:
    A. CT, PT AND CPT USE #12 COPPER, STRANDED 600V INSULATION, MINIMUM SIZE.
    B. TRANSDUCER OUTPUT USE 3/C #18 STRANDED COPPER TWISTED SHIELDED CABLE, 600V INSULATION.
    C. CPT - #12 AWG COPPER STRANDED TYPE THWN 600V INSULATION.
34. COLOR CODE FOR METER WIRING (TYPICAL):
    CURRENT CIRCUITS:
    A-PHASE POLARITY - RED
    NON-POLARITY - RED/WHITE TRACER
    B-PHASE POLARITY - ORANGE
    NON-POLARITY - ORANGE/WHITE TRACER
    C-PHASE POLARITY - BROWN
    NON-POLARITY - BROWN/WHITE TRACER
    VOLTAGE CIRCUITS:
    A-PHASE - BLACK
    B-PHASE - YELLOW
    C-PHASE - BLUE
    NEUTRAL - WHITE
35. PROVIDE 6-3 CONDUCTOR, TWISTED, SHIELDED, #18 COPPER STRANDED MINIMUM, 600V INSULATION AS SPARES TO MEET FUTURE REQUIREMENTS.
36. ALL TERMINAL BLOCKS SHALL BE LABELED
37. ALL WIRES SHALL BE LABELED ON EACH END.
38. ALL ONE-LINE DIAGRAMS PER THIS CONTRACT SHALL BE WIRED PER THIS DRAWING.
39. ALL WIRING, EQUIPMENT AND WORK IS NEW UNLESS OTHERWISE NOTED.
40. ALL DEVICES SHALL BE LABELED.

* TYPICAL FOR ALL BRANCH CIRCUITS (SPARES/FUTURE), CIRCUIT BREAKERS, CT'S, INSTRUMENTATIONS AND TERMINAL BOARDS. SEE ONE-LINE DIAGRAM FOR QUANTITY.

NPWC-41

IF SHEET IS LESS THAN 28" x 40", IT IS A REDUCED PRINT. SCALE REDUCED ACCORDINGLY	ENGINEERING DRAWING NUMBER
DRAWN	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND
DSGN.	NAVAL COMMAND CONTROL AND OCEAN SURVEILLANCE CENTER
E.I.C.	RDT&E DIVISION SAN DIEGO, CALIFORNIA
FIRE	NAVY PUBLIC WORKS CENTER
SECURITY	ELECTRICAL STANDARDS
SAFETY	
DIV. HD.	UCS SYSTEM DIAGRAM-208V WYE SYSTEM
APPROVED DATE	SIZE F CODE IDENT. NO. 80091 NAVFAC DRAWING NO.
PUBLIC WORKS OFFICER	CONSTR. CONST. NO. N/A
FILE NO.	SCALE SPEC. N/A SHEET OF



REVISIONS				
SYM	DESCRIPTION	PREP'D BY	DATE	APPROVED
		ROBERTA E. FRANKLIN	4/3/92	
			5/10/93	
			2/7/95	
	REVISION TO RTU		2/22/95	
			7/26/95	

NOTES

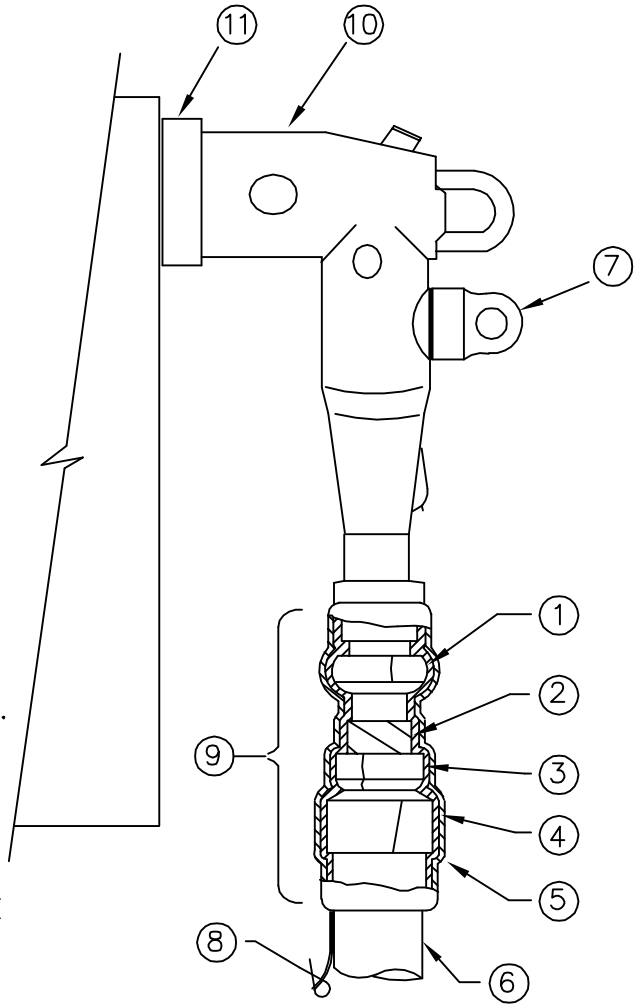
1. CABLE TERMINATORS, PROCELAIN, 15KV, WITH AERIAL LANDING LUGS.
2. SURGEARRESTERS.
3. DISCONNECT SWITCH, 3-PHASE.
4. FUSES AS REQUIRED. PROVIDE 3 SPARE FUSES.
4A. COPPER BUS.
5. TRANSFORMER,480Y/277V.
5A. MANUAL TAP CHANGER TWO 2-1/2% ABOVE AND TWO 2-1/2% BELOW NORMAL.
5B. PRESSURE RELIEF DEVICE WITH CONTACT.
5C. TRANSFORMER OIL TEMPERATURE TRANSMITTER WITH SENSING ELEMENT AND TRANSMITTER (4-20MA LOOP), OIL TEMPERATURE GAUGE WITH ALARM CONTACTS.
5D. ALARM CONTACT ON LIQUID LEVEL GAUGE.
6A,6B,6C. CURRENT TRANSFORMER, MULTI-RATION TYPE. SIZE AND RATIO PER ONE-LINE DIAGRAM.
7. SECONDARY CIRCUIT BREAKERS. SIZE, VOLTAGE, AIC RATING WITH AUXILIARY CONTACT.
7A. AUXILIARY SWITCH ON CIRCUIT BREAKER. 'CLOSED' WHEN CIRCUIT BREAKER IS 'ON' AND 'OPEN' WHEN CIRCUIT BREAKER IS 'OFF'. A AND B CONTACT.
7B. REMOTE ON/OFF. CONTROL RELAY.
7C. REMOTE TRIP.
8. POTENTIAL TRANSFORMERS, 3 EACH, 288V/120/. CONNECTED WYE-WYE THERMAL RATING 500VA EACH
9. CONTROL POWER TRANSFORMER, SINGLE PHASE, 480-120/240V, 3-KVA MINIMUM, WITH TWO 2-1/2% TAPS ABOVE AND TWO 2-1/2% TAPS BELOW NORMAL.
10A,10B,10C. CURRENT TRANSDUCER, INPUT 0-5 AMPS, OUTPUT 4-20MA, ACCURACY0.25% EXTERNALLY POWERED. VOLTAGE RANGE OF 85 TO 150V.
(FUTURE)11. WATT/WATTHOUR TRANSDUCER, 3-PHASE, 4-WIRE.
12. KILO-WATT HOUR METER WITH PROGRAMMABLE DEMAND ATTACHMENT. 3-PHASE, 4WIRE, 5 DIAL - 3 STATOR METER, SWITCHBOARD TYPE WITH PULSE INITIATOR, DRAWOUT TYPE, SEMI-FLUSH, 120 VOLT.
13. AMMETER SWITCH 4-POSITION, READING L-1, L-2, L-3 AND 'OFF'.
14. AMMETER, FOR USE WITH CURRENT TRANSFORMER, 5-AMP FULL SCALE. SCALE SHALL BE MATCHED TO CURRENT TRANSFORMER RATIO. SWITCHBOARD TYPE, 4-1/2" SQUARE, MINIMUM 250 DEGREE SCALE ARC, ACCURACY 1%. PROVIDE SPARE SCALES TO MATCH CT RATIOS.
15. VOLTMETER SWITCH, 7-POSITION, READING PHASE TO PHASE VOLTAGES 1-2, 2-3, 3-1 AND LINE TO NEUTRAL VOLTAGES 1, 2, 3 AND 'OFF'.
16. VOLTMETER, FOR USE WITH POTENTIAL TRANSFORMERS. SCALE SHALL BE MATCHED TO SWCONDARY VOLTAGE OF TRANSFORMER. SWITCHBOARD TYPE, 4-1/2" SQUARE, MINIMUM 250 DEGREE SCALE ARC, ACCURACY 1%.
17A,17B,17C. VOLTAGE TRANSDUCER, INPUT 0-150 VOLTS, OUTPUT 4-20MA. ACCURACY 0.25% EXTERNALLY POWERED. VOLTAGE RANGE OF 85-150V.
18A,18B,18C. SHORT CIRCUITING TERMINAL BLOCKS. NUMBER OF TERMINALS AS REQUIRED.
19. TERMINAL BOARDS, WITH DOUBLE ROW 20-AMP TERMINALS, 250V RMS. NUMBER OF TERMINALS AS REQUIRED.
20. TERMINAL BOARD WITH DOUBLE ROW 30-AMP TERMINALS, 250 RMS. NUMBER OF TERMINALS AS REQUIRED.
21. FUSE, PULLOUT TYPE, 30 AMP RATING, WITH CURRENT LIMITING FUSES,, FUSE SIZE AS REQUIRED. PROVIDE 3 SPARE FUSES.
22. FUSE BLOCK, PULLOUT TYPE, 30 AMP RATING WITH FUSES. FUSE SIZE AS REQUIRED.
23. THERMOSTAT SPST, 20-AMP, 120V, CONTROL RANGE 40 DEGREES TO 80 DEGREES F, SWITCH CLOSE ON TERMPERATURE FALL. MOUNTING HEIGHT, 4 FEET.
23A. HUMIDITY CONTROLLER, DEHUMIDIFIER, CONTROL RANGE 20% TO 80% OF RELATIVE HUMIDITY (RH), 22-AMP 120V.
24. HEATERS, STAINLESS STEEL SHEATH, 240V, 1000 WATTS MINIMUM. CONNECT TO OPERATE ON 120 VOLTS. TWO PER SECTION.
25. CABINET, WEATHERPROOF WITH GASKETED DOOR, AND 3/4" MARINE PLYWOOD BACKBOARD, PAINTED WHITE FOR INSTALLATION OF TERMINAL BOARDS. SIZE BACK-BOARD TO ALLOW 2 INCH SPACE FROM SIDES OF CABINET.
26. CABLE 2 OR 3-CONDUCTOR, TWISTED, SHIELDED, #18 COPPER STRANDED MINIMUM, 600V INSULATION SUITABLE FOR INSTALLATION WHERE SHOWN.
27. 3-1/C-#12, COPPER THWN, 600V IN CONDUIT.
28. UTILITIES CONTROL SYSTEM (UCS) PANEL ENCLOSURE, WEATHERPROOF WITH GASKETED DOOR AND 3/4" MARINE PLYWOOD BACKBOARD, PAINTED WHITE FOR INSTALLATION OF UCS PANEL EQUIPMENT. SIZE BACKBOARD TO ALLOW 2 INCHES SPACE FROM SIDES OF CABINET.
29. UTILITIES CONTROL SYSTEM (UCS) EQUIPMENT SHALL BE PER SERVICES AND CONNECTION POINTS INSTALLED AND SHALL COVER ALL DEVICES AND FUTURE DEVICES. THEY SHALL INCLUDE BUT NOT BE LIMITED TO ALL ANALOG INPUTS, ALL DIGITAL INPUTS, ALL TOTALIZER INPUTS (KWHM, KYZ), POWER SUPPLY, FIBER OPTICS INTERFACE, HEATERS, VENTS, FANS, TERMINAL BOARDS, WIRING, BATTERIES, THERMOSTAT AND HUMIDISTAT.
30. 6-1/C FIBER OPTICS CABLE.
31. CONDUIT. 2-4 INCH CONDUIT.
32. INTERCONNECTING WIRES FROM #25 TO #28 AND #29 SHALL BE INSTALLED.
33. WIRING SHALL BE TYPE SIS COPPER 600V INSULATION:
    - A. CT, PT AND CPT USE #12 COPPER, STRANDED 600V INSULATION, MINIMUM SIZE.
    - B. TRANSDUCER OUTPUT USE 3/C #18 STRANDED COPPER TWISTED SHIELDED CABLE, 600V INSULATION.
    - C. CPT - #12 AWG COPPER STRANDED TYPE THWN 600V INSULATION.
34. COLOR CODE FOR METER WIRING (TYPICAL):
    - CURRENT CIRGUITS:
      - A-PHASE POLARITY - RED
      - NON-POLARITY - RED/WHITE TRACER
      - B-PHASE POLARITY - ORANGE
      - NON-POLARITY - ORANGE/WHITE TRACER
      - C-PHASE POLARITY - BROWN
      - NON-POLARITY - BROWN/WHITE TRACER
    - VOLTAGE CIRCUITS:
      - A-PHASE - BLACK
      - B-PHASE - YELLOW
      - C-PHASE - BLUE
      - NEUTRAL - WHITE
35. PROVIDE 6-3 CONDUCTOR, TWISTED, SHIELDED, #18 COPPER STRANDED MINIMUM, 600V INSULATION AS SPARES TO MEET FUTURE REQUIREMENTS.
36. ALL TERMINAL BLOCKS SHALL BE LABELED
37. ALL WIRES SHALL BE LABELED ON EACH END.
38. ALL ONE-LINE DIAGRAMS PER THIS CONTRACT SHALL BE WIRED PER THIS DIAGRAM.
39. ALL WIRING, EQUIPMENT AND WORK IS NEW UNLESS OTHERWISE NOTED.
40. ALL DEVICES SHALL BE LABELED.

* TYPICAL FOR ALL BRANCH CIRCUITS (SPARES/FUTURE), CIRCUIT BREAKERS, CT'S, INSTRUMENTATIONS AND TERMINAL BOARDS. SEE ONE-LINE DIAGRAM FOR QUANTITY.

NPWC-42

IF SHEET IS LESS THAN 28" x 40", IT IS A REDUCED PRINT. SCALE REDUCED ACCORDINGLY	ENGINEERING DRAWING NUMBER
DRAWN	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND NAVAL COMMAND CONTROL AND OCEAN SURVEILLANCE CENTER RDT&E DIVISION SAN DIEGO, CALIFORNIA
DSGN.	NAVY PUBLIC WORKS CENTER
E.I.C.	ELECTRICAL STANDARDS
FIRE	
SECURITY	
SAFETY	
DIV. HD.	UCS SYSTEM DIAGRAM-480V WYE SYSTEM
APPROVED DATE	SIZE F; CODE IDENT. NO. 80091; NAVFAC DRAWING NO.
PUBLIC WORKS OFFICER	CONSTR. CONST. NO. N/A
FILE NO.	SCALE; SPEC. N/A; SHEET OF

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD		REV. 6/2001
	200AMP TAP FROM 600AMP SELECTOR SWITCH		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



NOTES:

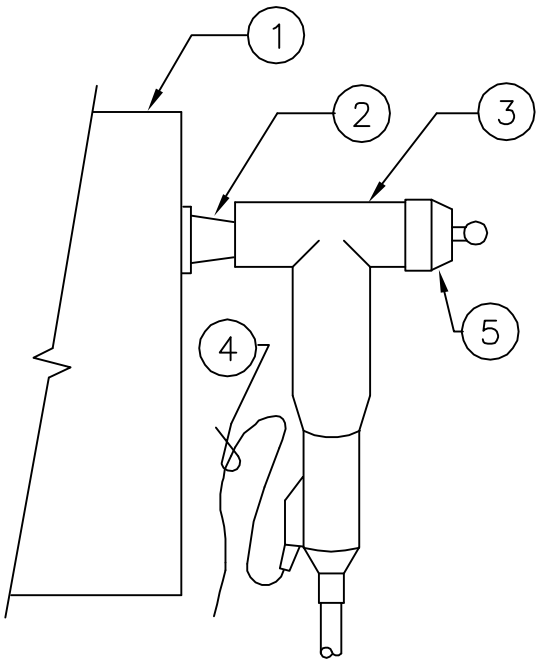
1. RETAINING CAP.
2. MOLDED RUBBER HOUSING OR SEALING TUBE.
3. SOLDERLESS GROUND CLAMP ACCESSORY.
4. SEALANT.
5. ONE–PIECE HEAT SHRINK REJACKETING TUBE LINED WITH A HOT MELT ADHESIVE, HIGH VOLTAGE SEALANT.
6. TYPICAL CABLE TO TRANSFORMER.
7. PROTECTIVE CAP FOR CAPACITIVE TEST POINT.
8. #6 GROUNDING CONDUCTOR EXTENDED TO THE GROUND ROD IN OIL SWITCH ENCLOSURE.
9. TYPICAL CABLE TERMINATION GROUNDING ASSEMBLY WITH #6 STRANDED COPPER CONDUCTOR. PROVIDE 3 FEET OF SLACK.
10. TYPICAL 200A., 25KV CLASS LOAD BREAK ELBOW CONNECTOR WITH INTEGRAL TEST POINT.
11. INTEGRAL 600A., 25KV CLASS NON–LOAD BREAK BUSHING INSTALLED AND 600/200A REDUCER ON THE EQUIPMENT BY THE MANUFACTURER.

200AMP TAP FROM 600AMP SELECTOR SWITCH

SCALE: NOT TO SCALE

NPWC–44

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD		REV. 6/2001
	600A DEAD BREAK ELBOW DETAIL		
PREPARED BY M. LONG DATE: 5/98	EIC R.QUILON	BR.HD T. BRULE	DIV.DIR.



(1) TYPICAL SWITCH.

(2) INTEGRAL 25KV CLASS, 600 AMP NON-LOAD BREAK BUSHING INSTALLED ON EQUIPMENT BY MANUFACTURER.

(3) TYPICAL 25KV CLASS, 600 AMP NON-LOAD BREAK CONNECTOR WITH INTEGRAL TEST POINT.

(4) #6 GROUNDING CONDUCTOR EXTENDED TO THE GROUND BUS.

(5) PROTECTIVE CAP COVERING CAPACITIVE TEST POINT.

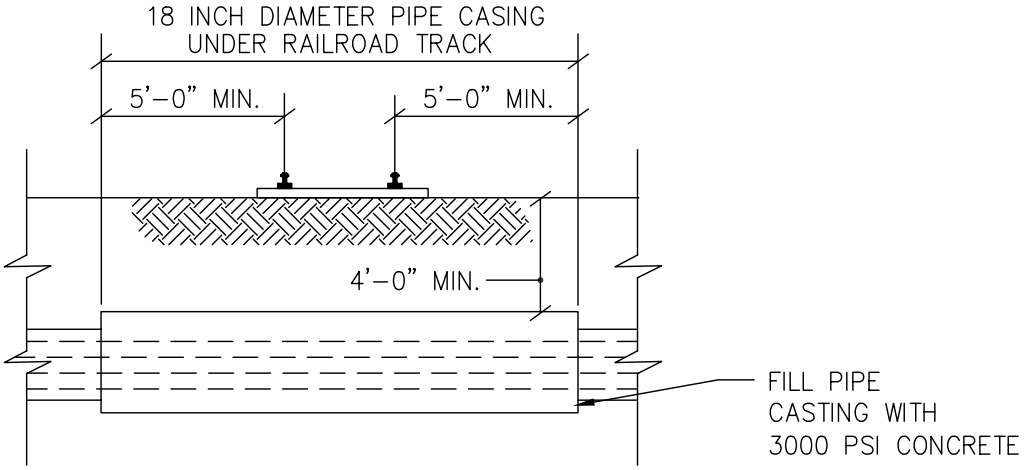
(6) PROVIDE A 25KV CLASS RUBBER PROTECTICE CAP (SEE DETAIL) FOR EACH BUSHING AND PROVIDE A 25KV CLASS RUBBER ELBOW CONNECTOR (INSERT TYPE) INSULATOR (SEE DETAIL) FOR EACH NON-LOAD BREAK ELBOW CONNECTOR. CAP AND INSERT INSULATORS TO BE SAME MFGR AS ELBOW CONNECTOR.

600A DEAD BREAK ELBOW DETAIL

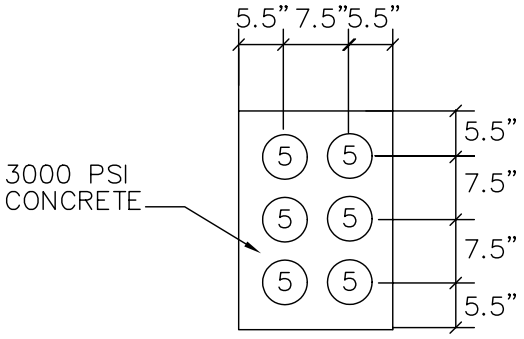
SCALE: NOT TO SCALE

NPWC-46

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD DUCTBANK DETAILS		
PREPARED BY M. LONG DATE: 9/97	EIC K. DO	BR.HD T. BRULE	DIV.DIR.



DETAIL - DUCTBANK UNDER RAILROAD TRACK



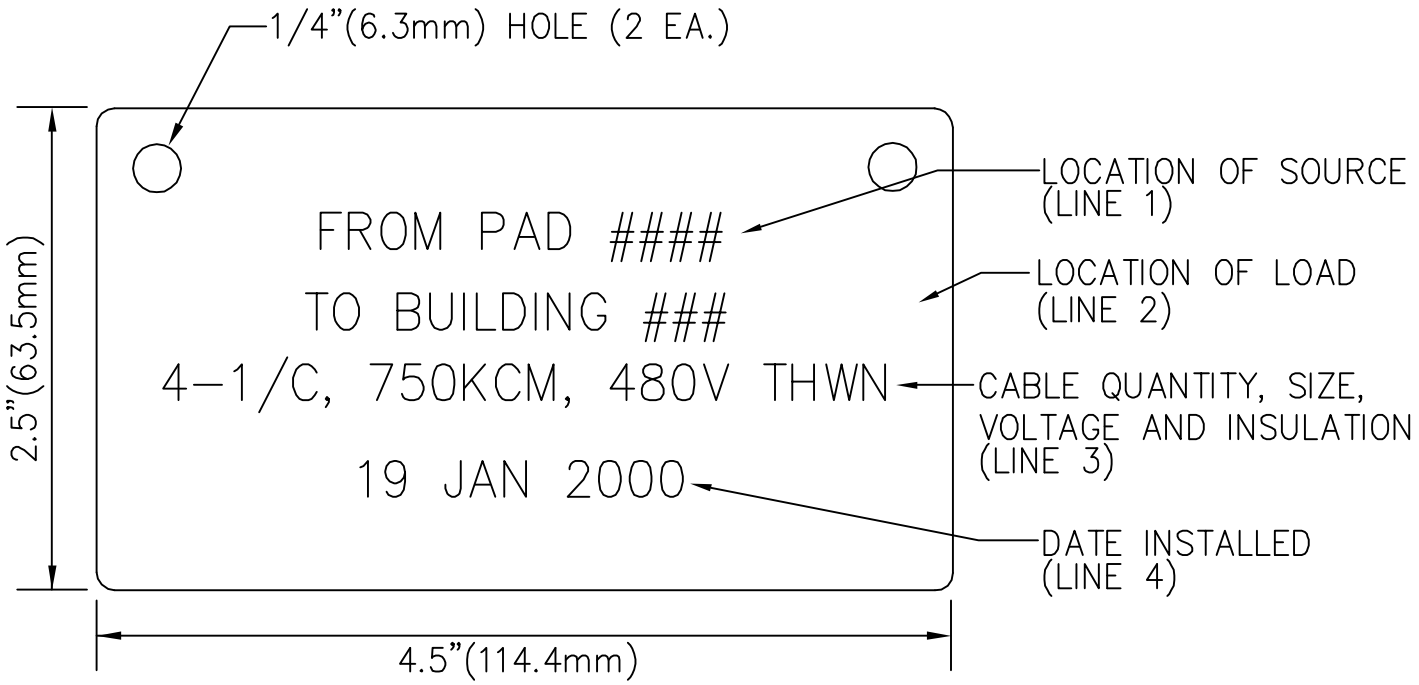
DETAIL - DUCTBANK SECTION (6-5"C)

DUCTBANK DETAILS

SCALE: NOT TO SCALE

NPWC-50

DEPT OF THE NAVY NAV FAC ENG COM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	PWC UTILITIES STANDARD LOW VOLTAGE CABLE IDENTIFICATION TAG		
PREPARED BY: M. LONG DATE: 9/97 REV.8/2000	EIC: R. QUILON	BR.HD: T. BRULE	DIV.DIR.



NOTES:

1. 1/8"(3.2mm) THICK LAMINATED WHITE MELAMINE (WITH BLACK CORE), PLASTIC TAG WITH MATTE WHITE FINISH WITH CHARACTERS CUT THROUGH THE WHITE PLASTIC INTO THE BLACK CORE.
2. USE LOCK-ON TYPE NYLON TIES TO ATTACH TAG TO CABLES.
3. ALL LETTERS AND NUMBERS SHALL BE 1/4"(6.3mm) HIGH.
4. REFER TO ELECTRICAL DRAWING CABLE TAG SCHEDULE FOR INFORMATION TO BE ENGRAVED. ABOVE INFORMATION IS ONLY A SAMPLE.
5. PLACE TAGS TO LEGIBLE FROM CENTER OF MANHOLE OR OPENING SIDE OF PULL BOX.

DETAIL - LOW VOLTAGE CABLE IDENTIFICATION TAG

NOT TO SCALE

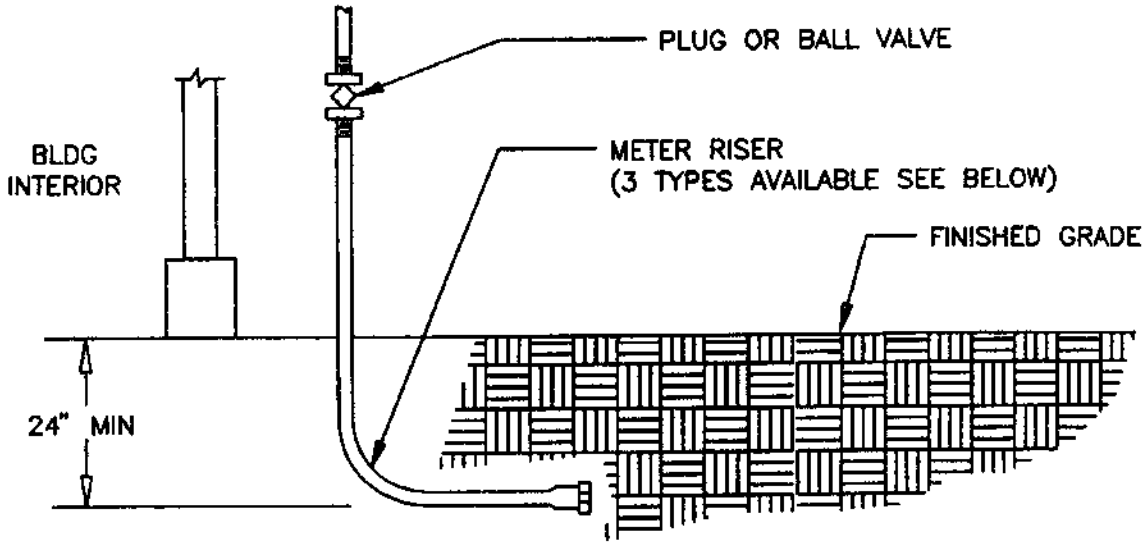
(NOTE: PROVIDE CABLE TAG SCHEDULE)

NPWC-53R

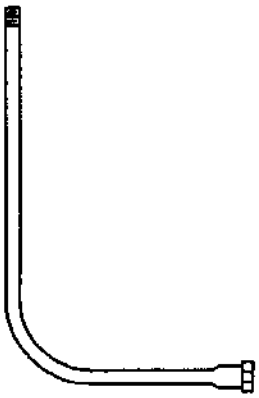
PUBLIC WORKS CENTER
SAN DIEGO, CALIFORNIA
UTILITIES ENGINEERING

GAS METER RISER

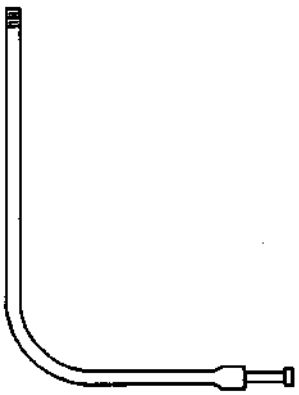
PREPARED BY:	BR. HD.	DIV. DIR.	DATE:
NDO	G.W. CALBOW, P.E.	T. BRULE, P.E.	JUN. 28, 1994



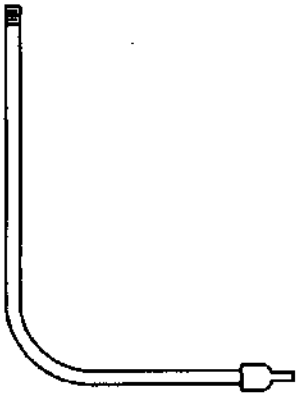
PREMANUFACTURED RISER
SCHEDULE 40 STEEL EPOXY COATED CASING



COMPRESSION



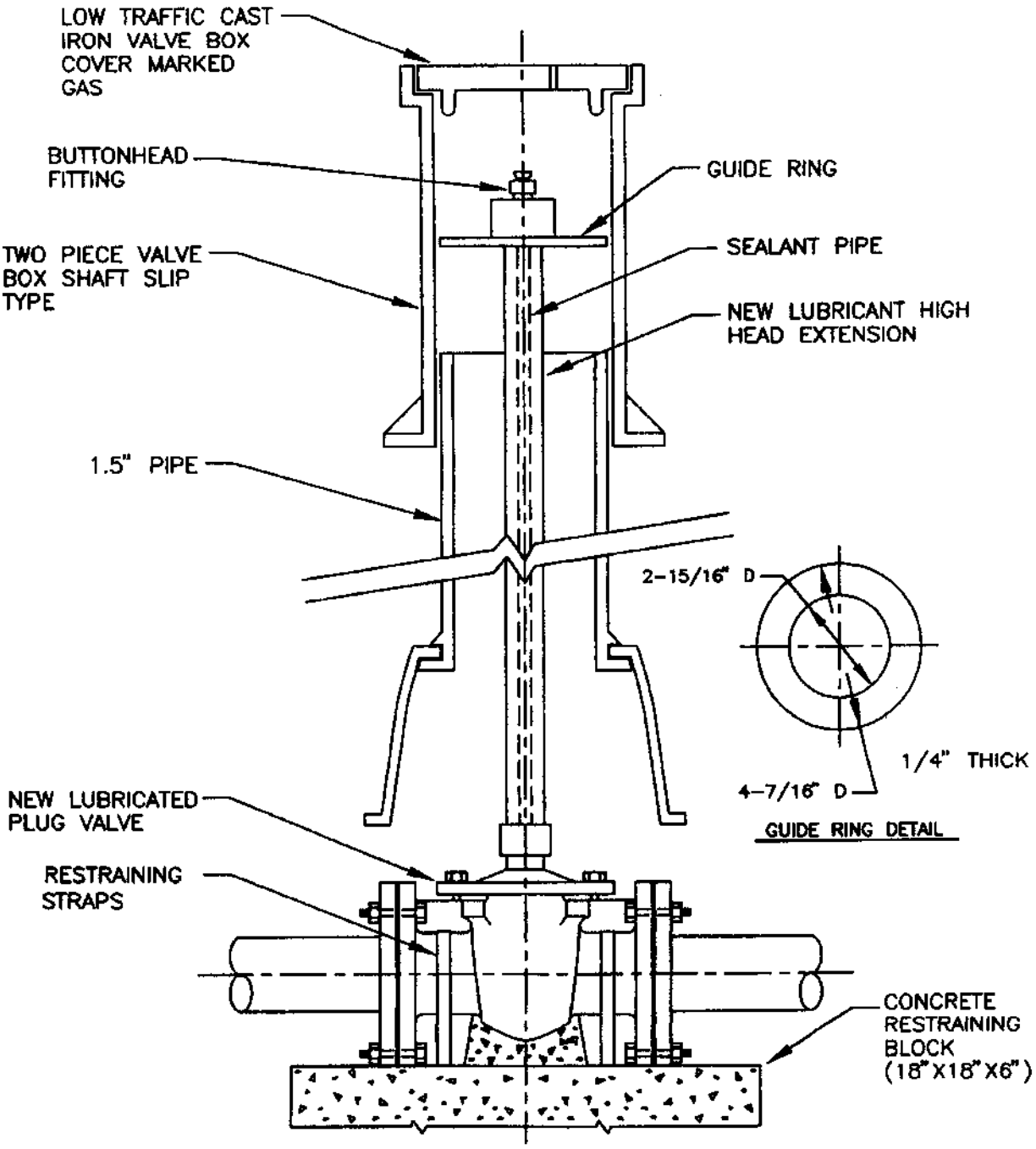
TRANSITION



ANODELESS

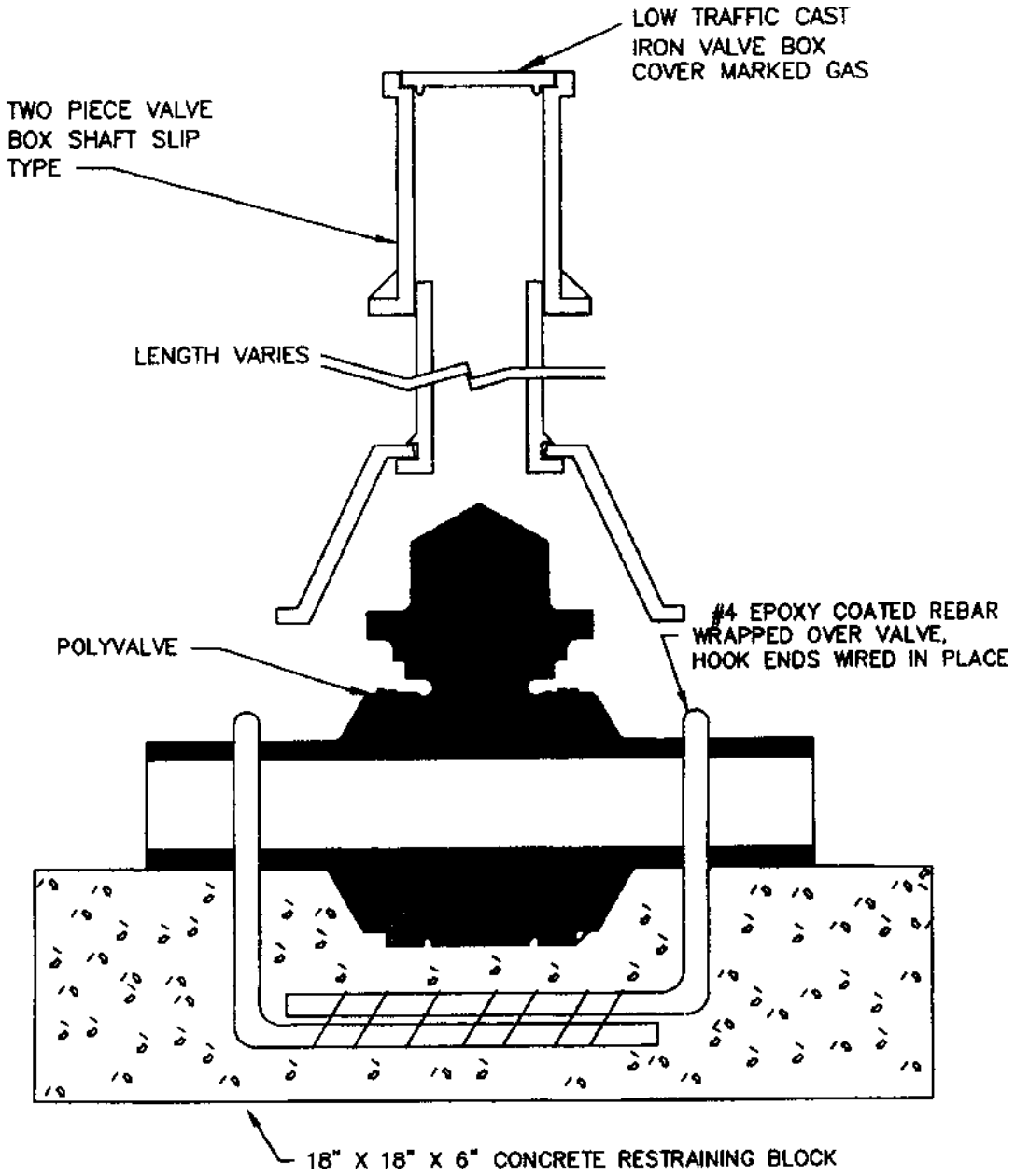
GS-1

PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA UTILITIES ENGINEERING	# GAS VALVE AND VALVE BOX DETAIL		
REPARED BY: A. SOLORZANO	BR. HD. G.W. CALBOW, P.E.	DIV. DIR. T. BRULE, P.E.	DATE: JUN. 28, 1994



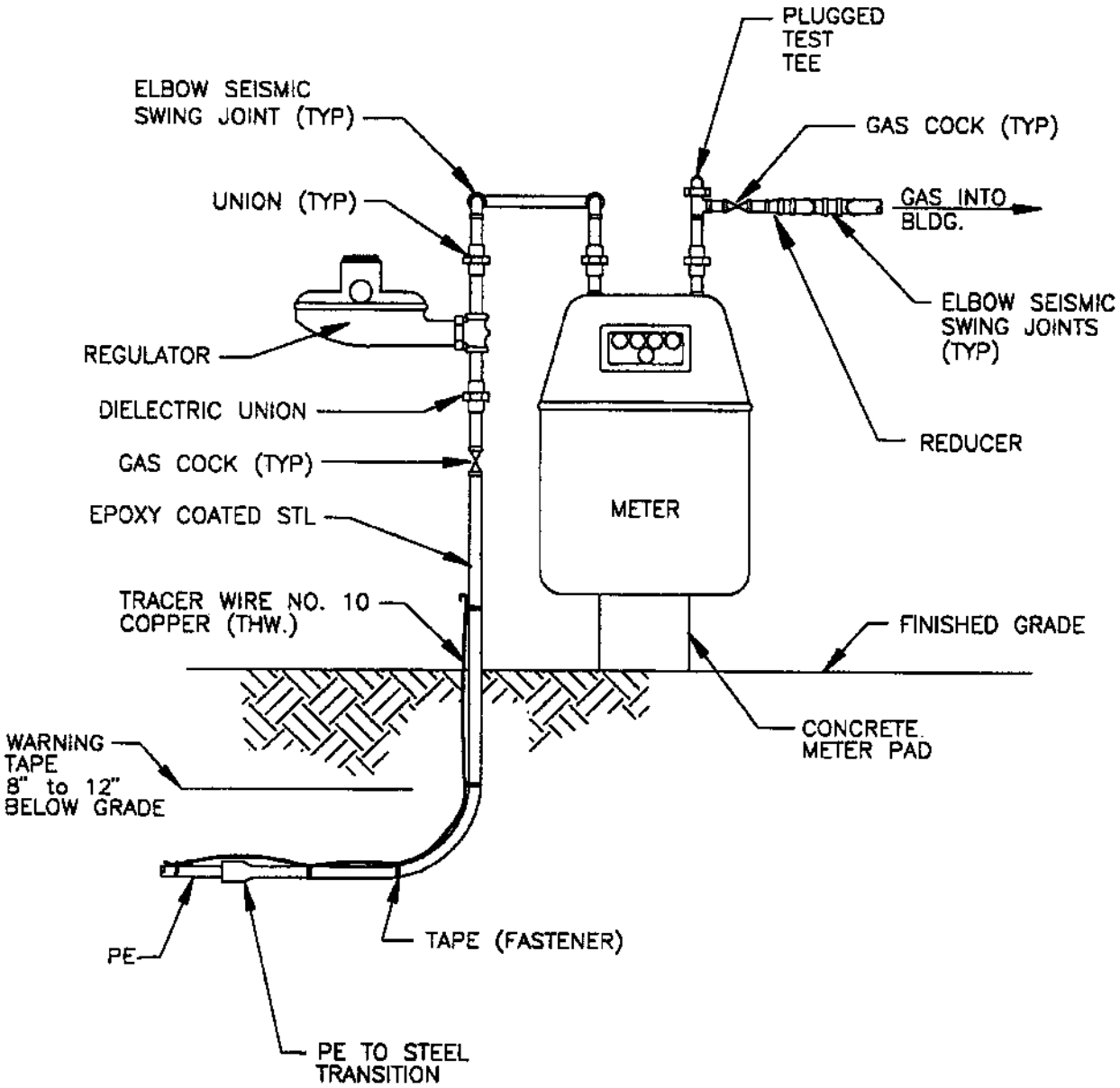
GS-2

PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA UTILITIES ENGINEERING	# POLYVALVE ANCHOR		
REPARED BY: H. ROMO	BR. HD. G.W. CALBOW, P.E.	DIV. DIR. T. BRULE, P.E.	DATE: JUN. 28, 1994



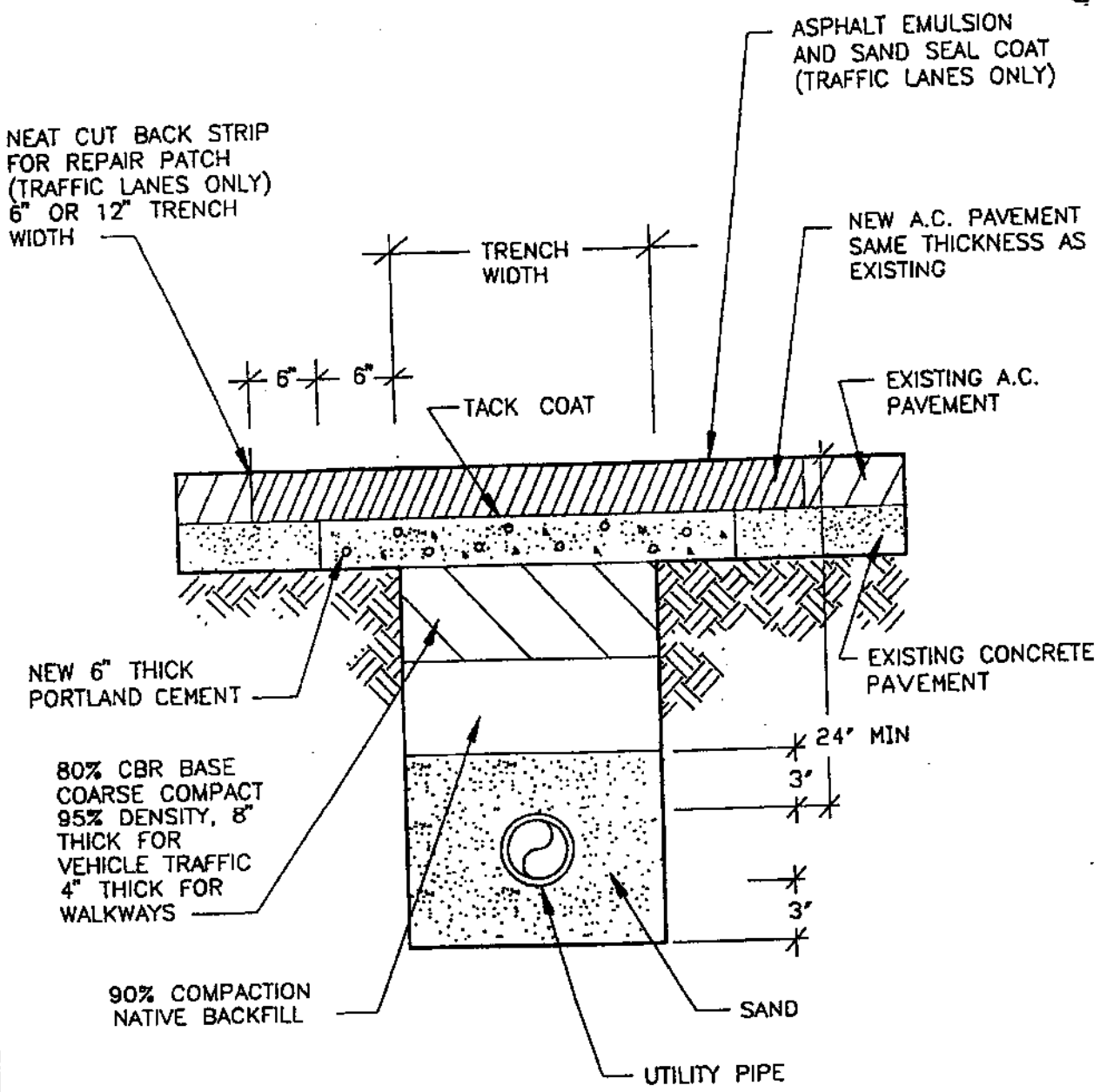
GS-3

PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA UTILITIES ENGINEERING	# GAS METER DETAIL		
PREPARED BY: M. JUDKINS	BR. HD. G.W. CALBOW, P.E.	DIV. DIR. T. BRULE, P.E.	DATE: JUNE 23, 1997



GS-4

PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	A.C. PAVEMENT REPAIR		
PREPARED BY: M. JUDKINS	BR. HD. G.W. CALBOW P.E.	DIV. DIR. T. BRULE P.E.	DATE: MAR. 17, 1992

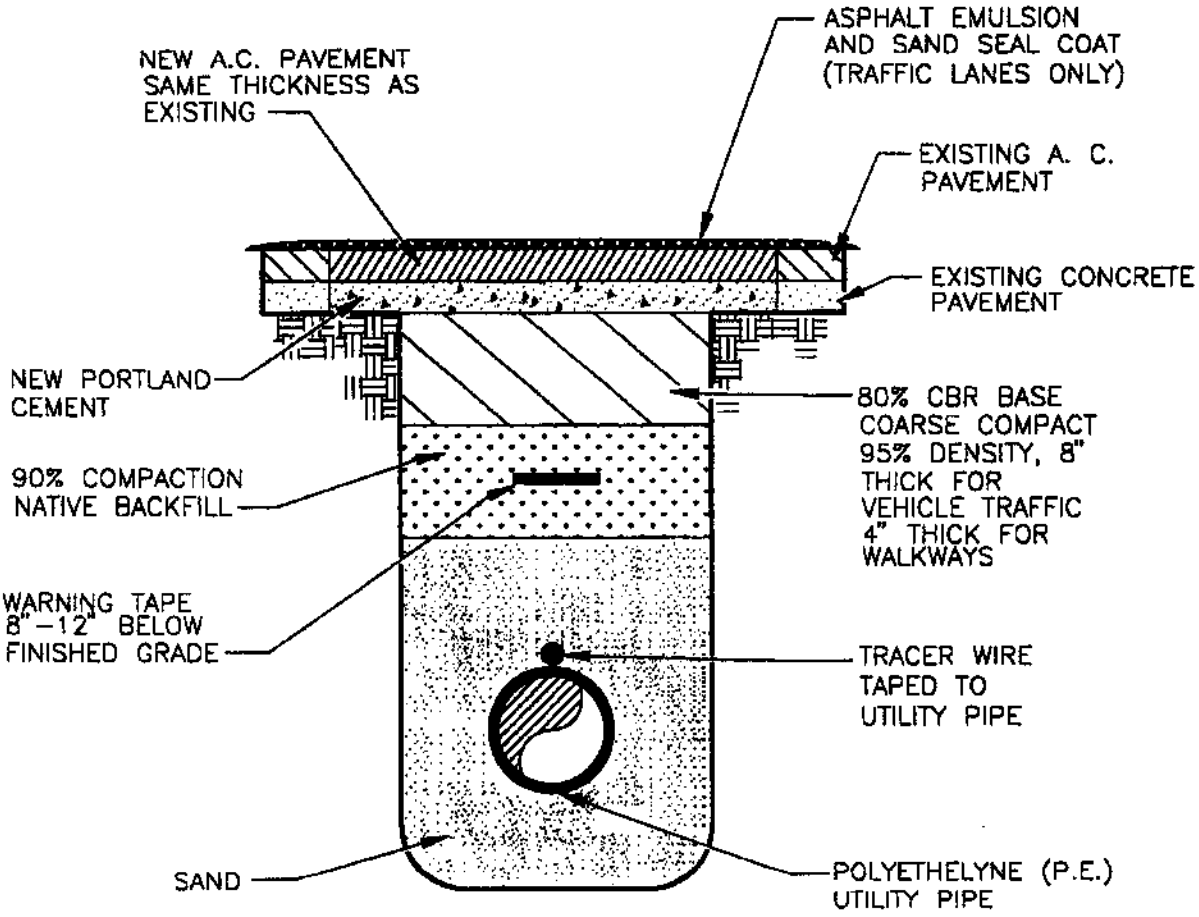


NOTE:

- –PIPE TO LIE ON 3" OF SAND AT THE BOTTOM OF TRENCH
- –TOP OF PIPE TO BE 24" MIN BELOW GRADE
- –SAND TO BE 3" ABOVE PIPE
- –TRACER WIRE 8"–12" ABOVE PIPE
- –WARNING TAPE 8"–12" BELOW FINISHED GRADE

GS-5

PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA UTILITIES ENGINEERING	# GAS TRENCH DETAIL		
PREPARED BY: M. JUDKINS	BR. HD. G.W. CALBOW, P.E.	DIV. DIR. T. BRULE, P.E.	DATE: MAR 25, 1997

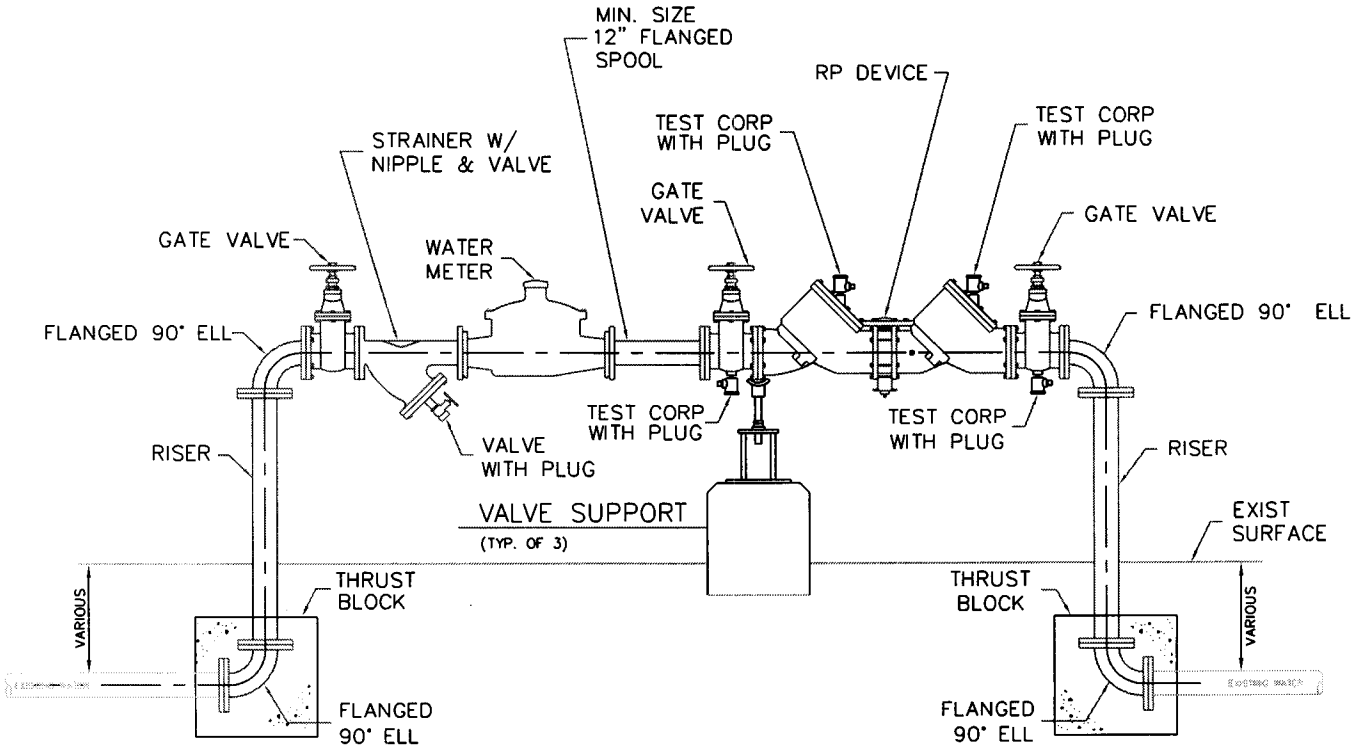


NOTE:

PIPE TO BE INCASED IN A MINIMUM OF 3 INCHES OF SAND.
TOP OF PIPE TO BE MINIMUM 24 INCHES BELOW GRADE.

GS-6

DEPT OF THE NAVY NAVFACENGCOM PUBLIC WORKS CENTER SAN DIEGO, CALIFORNIA	NEW WATER METER INSTALLATION	
PREPARED BY CODE 611	EIC METER SHOP	DATE: 3/26/02



DETAIL OF WATER RISER WITH RP DEVICE.
1 1/2" AND 2" POSITIVE DISPLACEMENT METER

NOT TO SCALE

POSITIVE DISPLACEMENT TYPE, OPERATING PRESSURE 150 PSI.

FLOW RANGES:	1 1/2" METER	1 1/2 TO 100 GPM
	2" METER	2 1/2 TO 160 GPM

DETAIL B

NOT TO SCALE

NOTES

1. ANY INSTALLATION REQUIRING A BACKFLOW PREVENTER MUST UTILIZE A REDUCED PRESSURE PRINCIPLE (RPP) BACKFLOW PREVENTION DEVICE

2. ALL RPP DEVICES MUST BE APPROVE BY THE U.S.C. FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR) AND MUST BE ON THE CURRENT APPROVAL LIST.

3. RPP BACKFLOW PREVENTERS MUST HAVE ALL RESILIENT SEATED VALVES AND TEST COCKS IN ORDER TO BE AN APPROVED ASSEMBLY PER THE U.S.C. FCCCFR.

4. RPP BACKFLOW PREVENTERS MUST HAVE U.S. MADE, SINGLE CAST, INTERNALLY PORTED, BRONZE BODIES WITH BRONZE AND/OR STAINLESS STEEL WORKING PARTS AND STAINLESS STEEL SPRINGS

5. BEFORE INSTALLING THE DEVICE, PIPELINES SHOULD BE THOROUGHLY FLUSHED TO REMOVE FOREGN MATERIAL

6. DEVICE MUST BE INSTALLED IN A HORIZONTAL POSITION ABOVE GROUND OR FLOOR LEVEL.

7. DEVICE MUST BE INSTALLED IN AN ACCESSIBLE LOCATION WITH AMPLE CLEARANCE TO FACILITATE TESTING AND REPAIRS.

8. IN NO CASE SHOULD THE RELIEF VALVE DISCHARGE BE SOLIDLY PIPE INTO ANYTHING. THERE ARE AIR GAP DRAIN FITTINGS AVAILABLE FOR MOST MODELS THAT CAN BE INSTALLED FOR CONNECTION TO DRAIN LINES.

9. RPP MUST BE PROPERLY SUPPORTED.

10. PROVIDE PROTECTIVE BARRIERS IN TRAFFIC AREAS.

11. "EACH REDUCED PRESSURE PRINCIPLE ASSEMBLY INSTALLED SHALL BE FIELD TESTED FOR PROPER OPERATION IN ACCORDANCE WITH THE FIELD TEST PROCEDURES CONTAINED IN THE LATEST EDITION OF THE "MANUAL OF CROSS CONNECTION CONTROL", PUBLISHED BY THE FOUNDATION FOR CROSS CONNECTION CONTROL AND HYDRAULIC RESEARCH OF THE UNIVERSITY OF SOUTHERN CALIFORNIA, PRIOR TO PLACING IT INTO SERVICE. INSPECTION REPORT FORMS ARE AVAILABLE FROM NAVY PUBLIC WORKS CENTER (PWC), CODE 665, PHONE NUMBER 556-7353. SAID TESTS SHALL BE PERFORMED BY A CERTIFIED BACKFLOW ASSEMBLE TESTER. A COPY OF THE TESTER'S CERTIFICATE AND THE UNIT'S PASSING TEST RESULTS MUST BE SUBMITTED TO THE PWC, UTILITIES DEPARTMENT, CODE 665."

12. THE CONTRACTOR SHALL SUPPLY REPAIR KITS FOR WATER METERS AND RP DEVICES AS FOLLOWS: ONE REPAIR KIT FOR EACH SIZE FOR EVERY TEN METERS AND RP DEVICES INSTALLED. (KITS ARE TO BE TURN INTO PWC, CODE 665.)

13. PIPE MATERIAL SHALL BE AS FOLLOWS:
    A. 5/8" THRU 2 1/2" BELOW GROUND SHALL BE TYPE K COPPER.
    B. 5/8" THRU 2 1/2" ABOVE GROUND SHALL BE COPPER TYPE K.
    C. 3" THRU 6" BELOW GROUND SHALL BE POLY WRAPPED D.I.P.
    D. 3" THRU 6" ABOVE GROUND SHALL BE PAINTED D.I.P.

14. ALL METERS FOR LANDSCAPE SHALL BE TURBINE TYPE. (2" AND ABOVE.

15. ALL RISERS SHALL BE THE SAME SIZE AS THE METER AND RP DEVICE TO BE INSTALLED.

16. ALL CI AND DI PIPE AND FITTINGS SHALL BE CEMENT LINED PER AWWA STANDARDS.

17. ALL CI AND DI PIPE AND FITTINGS INSTALLED BELOW GROUND SHALL BE POLY WRAPPED. THE POLY WRAP ON RISERS SHALL EXTEND TO A MINIMUM OF 2" ABOVE GROUND OR PAVED SURFACE.

18. ALL PIPE AND FITTING INSTALLED IN CONCRETE SHALL BE POLY WRAPPED.

CLEARANCES (FROM OUTERMOST POINT OF DEVICE)

SIZE OF RP DEVICE	VERTICAL CLEARANCE	HORIZONTAL CLEARANCE
2" AND UNDER	18"	24"
2 1/2" - 4"	24"	24"
OVER 4"	30"	24"