Section 33 - Electrical and Instrumentation

I. Introduction – The HRSD Operations Department has an Electrical and Instrumentation Division that provides electrical and instrumentation support for all of HRSD. The Engineering Department is responsible for coordinating the electrical review of plans and specifications and coordinating with the Operations Department on design and start-up issues. Based upon HRSD's history with various products and manufacturers, we have developed requirements and needs for certain specific products. Manufacturers of equipment and products are listed in the tables that follow.

II. General – Unless otherwise agreed upon, the FIRM shall design facilities and specify equipment around the names listed in this Section. In all cases NEMA is preferred over IEC rated components. IEC and NEMA/IEC components are not acceptable. Place all electric/electronic equipment indoors whenever possible. The following sections provide independent tables of products and manufacturers for pump stations, interceptor system controls and treatment plants in order to accommodate the different requirements of the various operating departments within HRSD.

   A. All equipment that is not NEMA rated must be approved by Engineer or Owner.

III. Pump Station and Interceptor Systems – Refer to following Table "Pump Station."

IV. Treatment Plant – Refer to following Table "Treatment Plant." Equipment Numbering Sequences shall be in accordance with the Treatment Plant Section of this document.

V. HRSD's Electrical & Instrumentation Division developed a **Quick Manufacturers Reference Guide.** The quick reference guide was created for engineering design consultants/contractors to utilize as a too so that approved manufacturers can easily be identified without having to search the entire document. These manufacturers have been vetted based upon criteria including, but not limited to, cost, application, performance, reliability, service, and support. If the manufacturer's name is not listed for a specific product, process, or application, then please contact the E&I Division for further guidance

Quick Manufacturer's Guide

Electrical and Instrumentation Requirements Index

Distributive Control System (DCS)

Pump Station – Electrical & Instrumentation Requirements

I. Item No. 1

A. Switchgear and MCCs

1. Manufacturers

a. Eaton

b. Square D

c. Allen Bradley

2. Specific Criteria

a. Design to meet arc flash standard; Reduce incident energy to 12 Cal/Cm2 or lower (MCC and VFD's incident energy should be designed to meet 1.2 Cal/Cm2 if attainable);Reference HRSD Arc Flash Mitigation Document Dated July 9-10, 2013 and additional Power Study Specifications example by SKM Power Systems Analysis, Inc. *(refer to Attachment A)*

b. MCCs must be placed indoors in NEMA 12 enclosures (gasketed).

c. Switchgear must be placed indoors in NEMA 1 enclosure (gasketed).

d. MCC's providing rear access is not acceptable.

e. All horizontal / vertical bus must be accessible.

f. Everything to be face-mounted, motor controls in the MCC are to be marked, lead, 1st lag, 2nd lag selectable, (any combination) with automatic failover (This may be part of the bubbler panel).

g. Bottom entry versus Top entry routing must be evaluated for application.

h. Provide with tin-plated copper bus.

i. Provide feeder breakers with digital trip units.

j. Provide extra fasteners for door cover.

k. Provide phenolic labels with black backgrounds and white lettering.

l. Provide spare terminals for intermediate terminal blocks for controls. Provide feeder breakers with digital trip units.

m. Provide grounding for Switchgear (Ball type)

n. The size of the electrical gear is based on the ampacity of the

bus within. Typically, electrical rooms are designed to accommodate equipment layout without future considerations for growth, therefore electrical buildings should be sized adequately to accommodate where wall space is needed for future equipment.

o. Electrical rooms should be conditioned to increase the life of sensitive electrical and electronic equipment. Thermostat should be set up to 80 F to control condensation/moisture. Also include a hydrogen sulfide (H2S) removal system if needed.

p. Wiring – internal wiring for control circuits is 16 AWG standard. In some applications the control wiring of 14 AWG can be requested from the manufacturer but, will result in additional cost per vertical section.

q. Preferred minimum of 65 KAIC (Kilo Ampere Interrupting Current) for Switchboards, Switchgear, Panelboards, MCC's (Motor Control Centers), and ECB's (Enclosed Circuit Breakers).

B. Breakers / Solid State Breakers

1. Manufacturers

a. Eaton

b. Square D

2. Specific Criteria

a. Provide 20 amp minimum

b. Provide remote open/close operator to protect personnel from Arc Flash Incident; operator should be outside of arc flash boundary where possible. (refer to Attachment M)

c. Provide ARMS "Arc Reduction Maintenance Switch" or equal, when activating downstream breakers incident energy levels will be reduced. Also, add separate pi- lot light to indicate when maintenance mode is enabled or disabled.

d. Provide LSIG digital trip unit if =/> 1000 amps and LSI if < 1000 amps

C. Provide trip units with fault indication to determine status (i.e., overloads or fault conditions) Metering Package.

1. Manufacturers

a. Schweitzer Engineering Laboratories (SEL)

b. Eaton

c. Schneider Electric (Square D)

d. GE

e. Basler

2. Specific Criteria

a. Volt Meter 3 phase & off

b. Ammeter 3 phase & off

c. kW

d. Provide 3 phase undervoltage & overcurrent protection

D. CT Cabinet

1. Manufacturers

a. Provided by Utility

2. Specific Criteria

a. Locate meter base and CT cabinet on outside of pumping station

E. Selector Switches, Push Buttons, Lighted Push Buttons (NEMA 30mm)

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. Expandable contact blocks on operator IEC and NEMA/IEC rated switches are not acceptable.

b. 20mm is acceptable for specific applications if Approved by Owner/Engineer. i.e. Master Control Panel

F. Contactors

1. Manufacturers

a. Eaton

b. Square D (Contactor must be able to reclose after short power blips)

c. Allen Bradley

2. Specific Criteria

a. Provide with expandable auxiliary contacts for 120-volt control

circuits

b. IEC and NEMA/IEC rated contractors are not acceptable.

G. Fuses & Fuse Holders

1. Manufacturers

a. Bussmann

b. Shawmut

2. Specific Criteria

a. Shall be locally available

H. Transformers

1. Manufacturers

a. Square D

b. Eaton

c. ACME

2. Specific Criteria

a. Copper coils

b. Aluminum coils are unacceptable

I. Terminal Strips

1. Manufacturers

a. Phoenix Contact

b. Square D

c. Weidmuller

d. Panduit Panduct DIN Rail Wiring Duct

2. Specific Criteria

a. DIN Rail mount if possible

b. Industrial rated

c. Provide compression type screws terminals on jumpers

J. Combination Starters (buckets)

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. Provide standalone combination starters in the proper enclosures (see junction/pull boxes and miscellaneous enclosures).

b. 120-volt control voltage

c. Run light – red

d. Stop light – green

e. Fault light – Amber

f. Power available light – white

g. Provide push to test indicator lights

h. Elapsed time meters (Crompton, ENB)–pump motors graduated in 1/10 hours, non- resettable

i. Externally mounted resets, operational from the front

j. Provide with adjustable thermo-magnetic breakers

k. Fused control transformer

l. MCC mounted lighting panels shall be provided with 25% spare breakers

m. Provide spare buckets (minimum 2)

n. Provide connections for motor leads directly from the motors to the starters. Do not use intermediate terminal blocks.

o. No IEC or NEMA/IEC rating (NEMA only).

K. Panel Meters

1. Analog

a. Manufacturers
(1) GE/Yokogawa
(2) Simpson

2. Digital

a. Manufacturers
(1) Yokogawa
(2) Red Lion
(3) Simpson

3. Elapsed Time

a. Manufacturers
(1) Crompton

(2) ENB
(3) Yokogawa

b. Specific Criteria
(1) Non resettable / resettable (plant site specific)

4. Pulse Counters

a. Manufacturers
(1) Acromag
(2) Omron

5. Isolators

a. Manufacturers
(1) Acromag
(2) AGMPhoenix

b. Specific Criteria
(1) Isolate 4-20 MA and 1-5 volt signals
(2) Powered 4-20 MA isolator splitter
(3) Terminal relay
(4) Compact panel temp sensor 4-20 MA

6. Signal Converters

a. Manufacturers
(1) AGM
(2) RIS
(3) Acromag

b. Specific Criteria
(1) Isolate 4-20 MA and digital

7. Surge Protectors

a. Manufacturers
(1) Phoenix
(2) MTL-Crouse Hinds

b. Specific Criteria
(1) Provide 120v AC power supply surge protectors

L. Rubber Mats (in front of gear)

1. Manufacturers

a. Grainger

b. Chesapeake Bay Rubber

2. Specific Criteria

a. Contractor will provide and install at substantial completion (OSHA approved electric safety rubber matting: Type II ASTM

D178)

M. Pilot Lights

1. Manufacturers

a. Square D

b. Eaton

2. Specific Criteria

a. Provide LED type pilot lights

b. Provide push to test lamp

c. LED color and light cover color will be specified by HRSD

d. No IEC or NEMA/IEC Rating (NEMA Only)

e. 30mm preferred

N. Voltage Test Points

1. Manufacturer

a. Safeside- Grace Engineered Products (Load side of Main Breaker) (600 Volt or less equipment)

b. Panduit VeriSafe

II. Item No. 2

A. Emergency Generators

1. Manufacturers

a. Caterpillar

b. Cummins Onan

c. Kohler

2. Specific Criteria

a. Diesel generators

b. Propane or natural gas-powered engine generators are site specific

c. Engines to be of domestic manufacture whenever possible

d. Standby rated

e. 4-stroke

f. Parts must be available in 48 hours or less

g. Must meet current U.S. EPA and Virginia DEQ air standards

h. Low emission units

i. 48 hours of runtime/Fuel at full load

j. Remote Emergency stop pushbuttons at doorways (Pilla Model GS120 w/clear, hinged plastic cover)

B. Generator

1. Manufacturers

a. Stamford Newage

b. Caterpillar

c. KATO

d. LIMA

e. Marathon

f. Cummins

2. Specific Criteria

a. Provide permanent magnet exciters

b. The rectifier shall be a brushless, full-wave bridge

c. All stator winding leads are to be brought out to the terminal box

d. Neutrals shall be sized to full rating

e. Temperature rise shall not exceed Class B rating with 105□□C ambient rise

f. Alternator shall have a space heater that switches off when running

g. Provide for 2/3 winding pitch; 5/6 pitch is not acceptable

h. Minimum Class H insulation (epoxy) with tropicalization (anti-fungus) temperature requirements as specified by NEMA

i. Provide voltage regulation less than +/- 1%

j. Provide 150% minimum overspeed capability

k. Provide amortisseur winding

l. Provide less than 5% THD (Total Harmonic Distortion)

m. Provide less than 50 TIF (Telephone influence factor)

n. Provide Square D/Eaton main breaker of domestic manufacture

o. Provide elapsed time meter graduated in 1/10 hours (analog or digital), non-resettable

p. Voltage regulators shall be 3-phase.

q. Provide 12 leads to switch voltages

r. Provide flap at the end of exhaust to keep rain, birds, etc. out.

s. The type of bird screen is site specific.

t. Sound attenuation is site specific

u. Provide separate room for indoor generator to reduce heat and noise.

C. Diesel Engine

1. Manufacturers

a. Caterpillar

b. Cummins

c. John Deere

2. Specific Criteria

a. Heavy-duty, direct-injected, 4-stroke diesel engine.

b. Provide electronically controlled engines with an electronic control system to meet

(1) current EPA emissions regulations

c. State the control system

d. Provide isochronous frequency regulation (no load to full load)

e. Provide +/- .25% steady state frequency regulation (minimum)

f. Size air, fuel, and oil filters to provide a minimum of 250 hours of operation before servicing

g. Engine manufacturers shall provide fuel separators

h. The heavy-duty air filter is to be a dry type with a restriction indicator

i. Provide a Racor heavy duty crankcase vapor coalescer

j. Provide a battery charging alternator 12V/65 amp, 24v/35amp minimum – negative ground)

k. Skid-mounted radiator sized to prevent overheating in the most severe conditions (122°F ambient)

l. Exhaust system and muffler shall be residential grade muffler (lowest DB reductions available). All insulation must be blanket type (non-asbestos), removable for servicing of exhaust system

m. Provide 12/24-volt DC starting system

n. Provide all diagnostic equipment for complete trouble shooting and training; operational training must be included (software/technical manuals/hardware etc.)

o. Provide speed sensing to protect against accidental starter engagement into a moving flywheel. (Battery charging alternator voltage output will not be accepted for this purpose)

p. Provide an adjustable (0-15 minutes) cool down time

q. Provide a large red emergency stop push button

r. Generator Alarms and shutdowns

(1) Low oil pressure

(2) Not in auto

(3) High coolant temperature

(4) Overspeed

(5) Low fuel (Pre shutdown)

(6) Generator running and over-crank shall shut down the engine and provide indicator lights.

(7) All generator alarms/shutdowns provide indicator lights

(8) Separate alarms and shutdowns based on HRSD recommendation and not tie everything to common alarm

s. Provide analog or digital displays for coolant temperature, oil pressure, service hours, engine RPM, system DC volts and system diagnostic code

t. Provide Kim Hot-Start engine block heater (thermostatically controlled); isolation valves must be included.

u. Provide vibration isolators between generator set base and floor

v. Provide lifting eyes bolt

w. Provide break mean effective pressure (BMEP) calculations

x. Provide SCADA interface/data monitoring for HRSD

generators

D. Battery Chargers

1. Manufacturers

a. LaMarche

b. Cummins

c. SENS

2. Specific Criteria

a. 12/24-volt chargers or equal

b. Automatic, solid state, provide continuous taper charging

c. UL listed, provide with under/over voltage, current failure, and loss of power acknowledgment

d. Evaluate full float charge versus trickle charge

E. Starting Batteries

1. Manufacturers

a. Exide

2. Specific Criteria

a. Use 8D series lead acid batteries (4D is not acceptable)

b. Provide 2 minimum

c. Each battery shall provide 1200 CCA each

d. Provide with insulated battery rack

e. Provide with 2-year full replacement guarantee

f. Provide as a minimum 2 cranking cycles at a minimum of 30 seconds each

g. Consult engine manufacturer for sizing

F. Day Tanks

1. Manufacturers

a. Pryco

b. Tramont

2. Specific Criteria

a. UL Listed – double wall

b. Provide with Oberndorfer bronze gear type pump. All pumps must be mounted on Day Tank.

c. Pumps with rubber or nitrile impellers will not be accepted

d. Provide with a low-level alarm and light

e. Size for 2-hour minimum running time

f. Provide a fuel level indicator on the day tank

g. Provide a 2-pump system. Each pump shall be capable of pumping 100% fuel oil throughout the entire system.

h. Provide “Not in Auto” lamp or other warning device

i. Use momentary switch for tank fill/test

G. Transfer Switches

1. Manufacturers

a. Eaton

b. ASCO

2. Specific Criteria

a. Provide with a metering package

b. Provide with an exercise cycle of 4 hours, field adjustable from 10 minutes to 4 hours

c. Provide with a utility power available light normal/emergency, phase indicator lights

d. Zenith transfer switches are not acceptable.

e. VFD compatible

f. Time delay normal to emergency

g. Time delay engine start

h. Time delay emergency to normal

i. Time delay engine cool down

j. Three phase over voltage (Source 1 & 2)

k. Phase reversal (normal)

l. Three phase under frequency (Source 2)

m. 4 NO / NC form C contacts for (Source 1 & 2)

n. Manual Push to test button which automatically returns to

utility & adjustable run timer (0- 600 minutes) (Note: This is not an exercise function)

o. Time delay neutral position

p. Three phase UV protection (Source 1 & 2)

q. Normal position light

r. Emergency position light

s. Normal source available light

t. Emergency source available light

H. Underground Storage Tanks (UST) Leak Detection

1. Manufacturers

a. Veeder Root TLS450 PLUS

b. Xerxes

2. Specific Criteria

a. Provide with leak detection system

b. Provide in accordance with EPA and all applicable state and local standards

c. Provide tank monitoring system

d. Provide a graduated stick for level measuring

e. Provide for refueling and stick access

f. Provide with electronic tank level indicating system

g. Provide with 48-hour fuel tank capacity

h. Provide AMI Model 8CH-DAC 8 channel digital/analog converter (4-20ma)

I. Louvers and Dampers

1. Manufacturers

a. Greenheck

b. Ruskin

2. Specific Criteria

a. Provide gravity damper

b. Provide anodized aluminum louvers and dampers with nylon bushings or ball bearings

c. Provide with bird screens readily removable without removing louvers or dampers

d. Designed to limit rainwater in the building

e. All hardware & components must be the same material and non-corrosive.

f. Where louvers and dampers are required provide (inside) recessed damper and (outside)

g. flange mounted louvers

J. Meter or monitoring package

1. Specific Criteria

a. Provide standard metering package

b. Frequency

c. Provide a voltage adjust rheostat

d. Provide 3 phase undervoltage and over-current protection

e. Provide automatic and manual start and stop

K. Start Up and Testing - Diesel Generator Tests

1. Specific Criteria

a. Provide factory test data

b. Contractors shall verify and provide fuel prior to start up and testing

c. Simulate and test all safety equipment. Using a reactive load bank > 500kW or a resistive load bank <500kW (0.8pF) run the generator:

(1) 15 minutes at idle speed

(2) 30 minutes at 25% load

(3) 30 minutes at 50% load

(4) 60 minutes at 75% load

(5) 120 minutes at 100% load

(6) 15 minutes at 25% load

(7) 15 minutes at 0% load

(8) off-Record stator, bearing, oil, ambient, and water temperatures every 15 minutes

d. Provide load bank receptacle boxes (site specific – Refer to Attachment B)

e. Design in such that the station load is not included during load bank test.

f. Take power factor (pF) into consideration for resistive load bank test to ensure generator is not overloaded.

g. Demonstrate all warnings and shutdown alarms (simulation with laptop).

h. Record speed, voltage and amperage at 15-minute intervals as well as just prior to and after the load change

i. Hook up the generator and cycle through the light loading cycles as well as heavy loading cycles (3 each). Record same parameters every 15 minutes and before and after changing load. Tests to be witnessed by HRSD Automotive Superintendent and HRSD Electrical Engineer/Superintendent or designee

j. Create and attach to the switchgear detailed instructions. The instructions shall be laminated. The instructions shall be simple enough for anyone to pick them up and operate the diesel generator set.

k. Group A, B, and C phase cable together to cancel out EMF (Electromagnetic Field)

L. Load Bank Test Box (in Attachment B “Leviton”)

1. Fabricated Load Bank Test Box

2. Alternative Load Bank Test Box

3. Manufacturers

a. ESL Power Systems

III. Item No. 3

A. Energy Efficient Motors

1. Specific Criteria

a. HRSD Electric Motor Specifications in Attachment E “HRSD Electric Motor Specifications”.

b. Emergency stop push buttons

IV. Item No. 4

A. Sump Pumps

1. Manufacturers

    a. Zoeller Co.

2. Specific Criteria

    a. 120-volt

    b. Plug into receptacle

    c. Float controlled

V. Item No. 5 - Level Sensing Systems

A. Bubbler Type, Ultrasonic (Rosemount), and Submersible

1. Specific Criteria

    a. Complete purged air bubbler system for sensing wetwell liquid level which generates and transmits level signals to a separate PLC which controls pump operations

    b. Provide UPS for power failure

    c. Power light – white

    d. Provide with low pressure switch with normally closed dry contacts downstream of the regulator

    e. Provide externally mounted duplex air compressors mounted on 30-gallon horizontal receiving tank (Model 3HBB-10-M300 AX) with lead/lag rotation control

    f. Provide oil-less compressors with 120-volt 60 cycle, single phase motors with integral thermal overload protection

    g. Provide manual purging of bubbler piping

    h. Provide manual alternation of air compressors

    i. Mount air compressors outside of the panel whenever possible

    j. Provide high level alarm in wetwells. Provide with micro (non-mercury) switch backup (float ball)

    k. Provide high wet well light and pressure switch

    l. Provide overflow light and pressure switch

    m. Provide high wet well and overflow push to test lights

    n. All alarm contacts are closed in a normal operating state (Closed loop system)

    o. Provide high level Floatball for alarms

B. Ultrasonic (site specific)

1. Manufacturers

a. Siemens

2. Specific Criteria

a. Microprocessor

b. FM approved (frequency modulation)

C. Level Transducer (site specific)

1. Refer to HRSD Standard Details 707A and 707B for Stilling Well Detail

2. Manufacturers

a. Waterpilot FMX-21 (refer to Attachment P)

D. Pressure Sensing Systems

1. Manufacturers

a. Foxboro

b. Rosemont

c. Siemens

2. Specific Criteria

a. Provide either an Ashcroft or Red Valve (series 40) brand pressure seal with Viton boot

b. Provide 0-100psi gauge (Ashcroft)

c. Provide a Foxboro IDPT 10 absolute pressure electronic transmitter

d. See Standard Detail “Pressure Reducing Station Pressure Sensor Detail”

e. Suction and discharge transmitters to be mounted in dry well area

E. Float Balls

1. Manufacturers

a. Flygt

b. Opti Float (Intrinsically Safe – Fiber Optic)

c. CSI Controls

2. Specific Criteria

a. Locate near sump pump in dry well and wet well

b. Alarm on high level

c. Support float ball cable to bottom of well; must be rigid and removable from top

VI. Item No. 6 – Variable Frequency Drives (VFDs)

A. Variable Frequency Drives (VFDs)

1. Manufacturers

a. YASKAWA

b. Allen Bradley

2. Specific Criteria

a. Provide thermal/mag breakers for the drive input power

b. Install equipment with the idea of keeping it clean and the temperature regulated

c. Provide thumbscrews for removable/washable filters or thumb screws replaced by snap in grills that are removable from the front of the cabinet (reusable)

d. Provide a programmable ramp time

e. Provide input reactors (MTE Corp) or TCI

f. Pulse Width Modulated (PWM)

g. IGBTs

h. Automatic restart on power disruption

i. Tune out a minimum of 3 frequencies

j. Hand/Off/Automatic (HOA) selector switch

k. Manual speed pot door mounted (in addition to keypad control)

l. Mount the resets and appropriate indicator lighting on the front of the drive or outside of the box to prevent employees from opening the panel

m. Tune drive to motor with a harmonics meter

n. Provide an input circuit breaker for short circuit protection (Fuses are not acceptable)

o. The controller electronics shall contain indicators of the

following conditions:

(1) Undervoltage

(2) Overvoltage

(3) Over temperature

(4) Memory failure

(5) Emergency Stop

(6) Ground fault

(7) Instantaneous overcurrent

p. Provide auxiliary run contacts wired to run command for ventilation fan

q. Provide a NEMA 12 flanged disconnect free standing enclosure

r. Mount the resets and the appropriate indicator lighting on the front of the drive or the outside of the box

s. Provide four contact outputs for run status, power failure, VFD failure, not in auto status

t. The following are site specific options:

u. VFD must be able to be isolated and bypassed (auto/manual operation) allowing the motor to operate across the line at full load speed and current

v. Provide manual isolation and bypass capability

w. Provide three contactors for bypass operation

x. 6 Pulse Drive

y. Bypass contactors are site specific; consult with Interceptor Systems & Electrical Shop

3. Additional Design Considerations

a. All electrical components must be NEMA only. IEC or NEMS/IEC is not acceptable.

b. Filters to HVAC units must be maintained and free from dust during construction phase.

c. VFD parameters must be included on as built prints (i.e., momentary power loss ride thru, energy savings, and fault reset)

d. Specify coil locks (Power Quality Solutions) on control relays

for power dip ride thru capabilities.

e. Provide Bypass mode for critical VFD's. Soft start or across the line depending on application.

f. Specify main circuit breaker cable operators for breaker operation instead of standard door operating mechanisms.

g. Provide One reset button to reset VFD and control circuit faults.

h. Provide finger safe barriers for main sideline breaker lugs.

i. Provide enough fans to replace each fan within a VFD (spare parts) where several VFD's of the same size and model are specified.

j. Provide paper copies of VFD manuals.

k. To support large and heavy VFD's 60 HP and above, provide a pedestal with a flat plate mounted inside the enclosure for VFD to rest for easy removal. Also provide a lift table to remove VFD.

l. Provide external air filter for easy access on cabinets.

m. Contractor to perform static tuning for optimal performance during startup. Contractor to supply panel shop with motor data sheets including the number of poles per motor. Also, include number of motor poles on motor nameplate.

n. Provide extended warranty by VFD manufacturer where replacement cost is justified.

o. Need all switches to indicate when not in auto

p. Need indication when control power is loss in addition to VFD fault.

q. Evaluate best routing method for bottom versus top entry of wire.

r. VFD shall be sized to provide current necessary for motor to produce continuous rated horsepower and service factor horsepower at highest carrier frequency.

s. Provide VFD Cable with copper shielding, XLPE insulation manufacture by Belden or equal.

(1) Consider these factors when designing motor HP, motor voltage and motor full load current, ambient temperature, VFD cable and connector ratings, and number of cables in raceway.

t. A Harmonic Study Analysis should be performed for all VFD applications by using IEE 519 guidelines. The design engineer should evaluate the best solution to reduce

(1) Harmonic Distortion (ie. passive and active filters or active front end included as part of the VFD).

(2) Refer to Attachment C “Variable Frequency Drive” Specs

u. Provide auxiliary (AUX) to remove run command of VFD before opening contact. Refer to Disconnect – Aux Contact

B. Eddy Current Brake Systems/DC Drives – UNACCEPTABLE

VII. Item No. 7

A. Watt Hour Meter (for MCCs or individual motors) – Meter base and meter

1. Specific Criteria

a. Provided by utility. Locate outside of pump station.

VIII. Item No. 8

A. PLC/RTU

1. Manufacturers

a. Emerson / Control Wave /OCC100

b. Allen Bradley

2. Specific Criteria

a. Provide functional descriptions, the application program, the job-specific program data and a copy of the as-built software documentation

b. Include control & alarms

c. Controls accommodate automatic purge and latch output to current state during bubbler purge

d. Program must be provided using Function Block Programming

e. Control Wave Micro

f. PLC’s and RTU’s shall be equipped with isolation relays for all digital inputs. Example: (Idec 5-blade – 24 VDC coils- with a form C configuration contactor) relays mounted on DIN rail for the purpose isolating relay inputs. Whether a junction box is used or control panel a 24 VDC power supply with sufficient capacity to energize all of the 24 VDC relay coils

simultaneously when necessary for all PLC or RTU inputs.

IX. Item No. 9

A. Exhaust Fans

1. Manufacturers

a. ILG

b. Dayton

c. Greenheck

d. Airovent

e. MK Plastics

2. Specific Criteria

a. Corrosion resistant including hardware

b. Must be explosion proof in wet wells and metering vaults

c. Direct drive

d. Belt drive not acceptable unless approved by Owner (Air detection is required if approved).

X. Item No. 10

A. Lighting

1. Manufacturers

a. Holophane

b. Hubbell

c. Thomas

d. Crouse Hinds

2. Specific Criteria

a. Provide proper levels of lighting over major equipment including switchgear, generators, pump motors, and controls. Lighting levels should conform to the IES lighting handbook as a minimum.

b. Provide exterior lighting at doorways and yard lighting required by building con- figuration.

c. Consider operation by photo electric cell.

d. Replace all light fixtures with LEDs if non-LED style fixture cannot be repaired.

(1) Refer to Attachment D - Lighting Policy

(2) HPS, LPS, and Mercury Vapor – NOT ACCEPTABLE FOR ANY APPLICATION

B. Emergency Lighting

1. Specific Criteria

a. Dual Lite GMM-EL-W2 in admin areas

b. Emerg Lite PRO-2 in corrosive areas

c. Wall-paks are provided by HRSD

(1) Note: Install dual input inverters if applicable

C. Exit Lighting

1. Specific Criteria

a. Highly visible 24 hours/day for life of material

D. LED

1. Specific Criteria

2. To reduce maintenance

3. Perform payback analysis

XI. Item No. 11

A. Concrete Housekeeping Pads

1. Specific Criteria

a. Provide a minimum of 4-inch thickness under MCCs, generators, transformers, and other general electrical equipment and around conduits at floor penetration.

b. Chamfer all edges

XII. Item No. 12

A. Conduit and Conduit Systems

1. Specific Criteria

a. Ream and chamfer all edges

b. EMT or IMC are not allowed

c. All flexible conduits shall be metallic liquidtite or equal.

d. Flexible conduit must not be installed to complete one small run between RGS.

e. Provide ¾ inch minimum size. (Where specifically approved or when the instrumentation restricts this size, ½ inch can be used)

f. Do not use plastic anchors.

g. Seal conduits with a silicone product as necessary

h. See Miscellaneous section of these standards for markings and coatings.

i. Seal conduits with OZ Gedney conduit and cable seals or with silicone where seals are not available.

j. Cable trays must be approved by Owner or Engineer.

k. Label all conduits inside of building (Engineer must provide conduit schedule)

l. Circuit # must be brought back to the panel/breaker.

m. Paint RGS conduits red if requested by owner.

B. Spare Conduit Feeder

1. Specific Criteria

a. Provide with service entrance.

b. Add appropriate spares with pull wire.

C. PVC Coated Rigid Steel (inside and out)

1. Manufacturers

a. Robroy

b. OCAL

c. Perma-Cote

d. Gafco Industries

e. Plastibond

f. KorKap

2. Specific Criteria

a. Provide in wet wells, underground (not encased), chemical areas, outside, and damp areas. Provide with PVC coated fittings, boxes and touch-up material.

b. Provide 8” of PVC coated conduit were stubbed up through concrete (washdown areas)

D. Galvanized Rigid Steel

1. Specific Criteria

a. Provide with applications other than PVC coated above.

E. PVC

1. Specific Criteria

a. Underground/encased reinforced concrete, Schedule 40 can be substituted for galvanized conduit in duct banks where EMI is not a threat.

F. Tools Used

1. Specific Criteria

a. Use suitable tools with conduit.

G. Patching/Repair

1. Specific Criteria

a. Use appropriate material to patch and repair.

H. Flex – Liquidtite & Fittings

1. Manufacturers

a. Crouse Hinds

2. Specific Criteria

a. Use fittings to suit installed conduit.

b. Shall be metallic stainless steel, aluminum or equal.

I. Fixtures & Fittings (pull boxes)

1. Specific Criteria

a. Use appropriate fittings and materials.

J. Struts and Straps

1. Specific Criteria

a. To suit conduit materials

b. Use matching fasteners.

c. In outside, wet or damp areas use stainless steel fasteners.

d. PVC coated channel or unistrut are not acceptable.

e. Stainless Steel Straps are preferred over PVC Coated Straps. For certain applications please contact owner/engineer for

approval.

K. Pull Boxes (wire pulled through) and Junction Boxes (wires terminated inside)

1. Specific Criteria

a. In outside, wet or damp areas, use stainless steel fasteners.

b. Over 6-inch x 6 inch are to be hinged

c. Gasketed

d. Use stainless steel or aluminum in outside or damp areas.

L. Red Dye (Duct bank)

1. Specific Criteria

a. Provide red dye in concrete duct banks.

(1) See typical duct bank details in Attachment I

XIII. Item No. 13

A. Wire

1. Specific Criteria

a. Provide copper stranded wire only.

b. Provide separation of power, signal and telephone services

c. Use compression type lugs only.

d. Do not splice wire – Splicing not allowed unless approved by Owner/Engineer

e. Telephone

(1) Provide conduit and wiring for telephone.

f. Welding cable (DLO) – Design based on intermittent duty vs. continuous duty.

g. THHN, THWN, XHHW (for duct banks)

(1) Follow NEC color coding.

(2) All wire shall be stranded wire, rated for 600 volts.

(3) #12 minimum wire size for typical applications

h. Instrumentation

(1) All wire (MTW) or signal wire shall be rated at 600 volts.

(2) DC wire shall be color-coded blue #16 AWG minimum.

(3) AC wire shall be color-coded red #16 AWG minimum.

(4) Analog signals shall be #18-2 with a shield (minimum), tinned.

(5) Provide Ethernet cable/CAT 6 for communications to equipment.

i. Tracer Wire - Do not splice wire – Splicing not allowed unless approved by Owner/Engineer
Note: Cabinets with multiple sources must be clearly marked as such

XIV. Item No. 14 - Relays

A. Industrial

1. Manufacturers

a. Allen Bradley

b. Eaton

2. Specific Criteria

a. Fixed base

B. Electronic

1. Manufacturers

a. IDEC

b. Potter-Brumfield

c. Agastat

2. Specific Criteria

a. Plug in ice cube type with pilot lights.

XV. Item No. 15 - Lockout / Tagout (Safety) Refer to Section 22 – HRSD Safety Program in this manual for specifics.

XVI. Item No. 16

A. Switches / Receptacles / Plugs

1. Manufacturers

a. Pass & Seymour

b. Hubbell

c. Crouse Hinds

2. Specific Criteria

a. Provide compression type screw terminals on receptacles. Wire binding receptacles or switches are not acceptable.

b. Provide for dedicated circuits for sump pumps.

c. Provide one weatherproof (WP)/watertight receptacle with lockable cover on exterior wall of the pump station on a separate circuit; separately switches and should not be hot at all times.

d. Provide a receptacle on each wall of the PS, upper & lower levels.

e. Lower levels shall be mounted at 48 inches above finished floor -Provide one

f. weatherproof/watertight receptacle on exterior walls on a single circuit, separately switched (Should be “hot” all the time)

g. Provide ground fault receptacles and breakers where required.

h. Provide power receptacles in control cabinets.

i. Provide “in use” covers for indoor sump applications.

XVII. Item No. 17 – Electric Unit Heaters

A. Not used, do not supply unless a condition requires it.

XVIII. Item No. 18

A. Electrical Drawings

1. Specific Criteria

a. Process and Instrumentation Diagrams (P&IDs) are to conform to ISA modified standards (Consulting engineer to provide.

b. Provide functional descriptions with the P&IDs (Consulting engineer to provide)

c. Provide Point-to-Point connection drawings. Contractor shall develop.

d. Review and approval by the engineer shall be prior to installation.

e. Label all conduits inside building.

f. Place metal tags on cables in manholes.

g. Provide final conduit & cable schedule on disk (AutoCAD, PDF or VISIO)

XIX. Item No. 19

A. Safety Switches (fused or unfused)

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. Light duty safety switches are unacceptable.

b. Must be pad lockable.

XX. Item No. 20

A. Transformers (Dry)

1. Manufacturers

a. Square D

b. Eaton

c. GE

2. Specific Criteria

a. No aluminum wires.

b. Provide 220° C insulation system for 15 kVA and larger.

c. Provide 180° C insulation system for transformers less than 15 kVA.

d. Transformers shall handle a 15% overload without exceeding the insulation rating.

XXI. Item No. 21 – Metering Vaults / Pits

A. Dehumidifiers

1. Specific Criteria

a. Provide receptacle and location for HRSD installation.

B. Power Requirements

1. Specific Requirements

a. Provide two receptacles with weatherproof covers.

C. Exhaust Fans

1. See Exhaust Fans (item#9)

D. Sump Pumps

1. Provide “in use” receptacle with a remote GFCI breaker located in station power panel.

2. Provide explosion proof sump pump in Class 1 division 1 areas.

E. Lighting

XXII. Item No. 22

A. Pressure Sustaining/Regulating Valves

1. Manufacturers

a. KTM

b. Foxboro

c. Clow

2. Specific Criteria

a. No butterfly valves or pinch valves with controls

b. Provide 4-20 mA operated valves. Do not use pulsed control valves.

c. Automatic Controls of Virginia or Valve Automation for actuator applications

B. Valve Actuators

1. Manufacturers

a. EIM/Bettis

b. Limitorque (refer to Attachment P)

2. Specific Criteria

a. Auma and Rototorque are not acceptable.

XXIII. Item No. 23

A. Manufacturer

1. Pure Air or approved equal Alarm Systems

B. Specific Criteria

1. HRSD will provide and install the alarm system. Contractor shall provide sensors and wiring to a junction box and terminate on a terminal strip adjacent to the alarm panel location

2. HRSD will provide alarm points.

C. Station Bypass Alarm Systems (Refer to Attachment F)

1. Specific Criteria

a. A minimum of two (2) weeks' notice is required to set up temporary alarms for a scheduled station bypass operation.

b. HRSD will provide and install the temporary alarm system. Contractor shall provide sensors and wiring to a junction box and terminate on a terminal strip adjacent to the alarm panel location.

c. HRSD will provide alarm points.

d. Contractors to provide contact names and numbers for alarming purposes.

XXIV. Item No. 24 – Flow Meters (Size for average flows)

A. Magnetic

1. Manufacturers

a. Rosemount

b. Foxboro

2. Specific Criteria

a. Use for control or billing applications.

b. Ensure vendor is clear on application.

c. Provide with remote head, display and keyboard.

B. Ultrasonics (strap on)

1. Manufacturers

a. Fuji

b. Flexim (refer to Attachment N) (Concrete pipe application)

c. Pulsar

2. Specific Criteria

a. Do not use for control.

b. Locate inside station.

C. Venturi

1. Specific Criteria

a. Generally, not used in most applications.

XXV. Item No. 25 – Antenna

A. Mobil Mark

1. Specific Requirements – Contractor to provide ALL OTHER Antenna components not limited to the Antenna, Antenna Mast, Antenna Cable, Lighting Arrestors, Connectors, Supports, Fasteners, and appropriate Coax Cable. HRSD will provide the Cisco Router and Telog if needed (project specific)

B. Shark Fin Type

C. Omni Directional

XXVI. Item No. 26

A. Louvers/Dampers

1. Specific Criteria

a. See Emergency Diesel Generator Louvers and Dampers (Item #2)

XXVII. Item No. 27

A. Cathodic Protection (Test Stations)

1. Specific Criteria

a. Use Flush Fink Test Stations

XXVIII. Item No. 28

A. Junction Boxes and Misc. Enclosures

1. Manufacturers

a. Hoffman

b. Saginaw

c. Hammond

2. Specific Criteria

a. Provide PVC coated boxes and/or fittings when using with PVC coated conduit. Use “like” materials.

3. Inside

a. Specific Criteria

(1) Stainless steel, fiberglass reinforced plastic (FRP), NEMA 4x

4. Outside

a. Specific Criteria

(1) Stainless steel, NEMA 4x with Myers hubs

5. Wet

a. Use with PVC coated conduit and PVC coated hubs.

(1) Stainless steel, fiberglass reinforced plastic, NEMA 4x with watertight fittings (Myers)

XXIX. Item No. 29

A. Panel Boards/Control Panels

1. Manufacturers

a. Eaton

b. Square D

c. GE

2. Specific Criteria

a. Provide with tin-plated copper bus.

b. Provide 25% spares (minimum)

c. Provide bolt-in breakers.

d. Do not provide cans with pre-stamped knockouts.

e. Provide with hinged panel cover with a latching door.

f. Provide heavy duty industrial grade panel boards.

g. Breaker operator should be outside of panel.

h. Breaker should be located inside of panel.

i. HOA switches should be on the outside of panel.

j. Dead front Hinge panel cover if available.

k. Provide LED work light, if warranted

l. Provide phenolic labels with black backgrounds and white lettering.

XXX. Item No. 30 – Miscellaneous Electrical

A. Electrical Equipment Testing

1. Specific Criteria

a. Provide testing in off-peak hours or switch off an equivalent amount of load prior to testing.

B. One Line Diagram

1. Specific Criteria

a. Provide an update to the one-line diagram with significant changes in the electrical system.

C. Thermographic Inspection

1. Specific Criteria

a. Provide a thermographic inspection of the new systems upon completion.

D. Short Circuit / Coordination Study / Arc Flash

1. Specific Criteria

a. Provide a coordination study short circuit, coordination, and arc flash analysis for new systems or systems with significant changes.

b. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum

(1) contribution from the utility and will assume the maximum number of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable. Include Arc flash analysis results for generator protective device.

c. Contractor must adhere to NFPA 70E Electrical Safety requirements when working on electrical equipment in HRSD facilities.

d. Engineer must design electrical systems in accordance with NFPA 70E.

Refer to Attachment A

XXXI. Item No. 31- Lightning Protection Refer to NFPA 820 and NFPA 780. - Lightning Protection applications will be site specific (Discuss with HRSD Electrical Staff).

XXXII. Item No 32 - SCADA Site Drawing (Refer to Attachment G)

A. For sites without generators should provide battery charger and batteries to maintain reliability.

XXXIII. Item No 33 – SCADA Flowchart (refer to Attachment K)

XXXIV. Item No 34 – Dominion Energy Coordination (refer to Attachment J)

A. Easements

1. It is imperative that the design engineer contacts the utility company (i.e., Dominion Energy, Rappahannock Power, Prince George Electric Cooperative, etc.) to determine the responsible territory.

2. Design Engineer and HRSD should inquire with the utility company if single phase or 3- phase power is available at the proposed site.

3. Design Engineer should incorporate right-of-way (ROW), multi-use utility easements, identify property owners, and VDOT requirements as part of the preliminary engineering report (PER) to prevent delays and cost increase during the construction phase of the project. The items listed above should be explored in advance especially in rural communities where 3-phase electrical service is not available.

a. See Attachment J for Dominion Project Workflow Brochure "HRSD Interface on New Projects with Dominion Energy Virginia (DEV)"

XXXV. Item No. 35

A. Analyzers/Monitors: Process

1. pH

2. Manufacturers

a. Foxboro

b. E&H Memosens CPS16D pH probe (Incinerator scrubber water process) (Site Specific/Specific applications)

c. M4 Knick (Site Specific/Specific applications)

B. Conductivity

1. Manufacturers

a. Hach

XXXVI. Item No. 36

A. Grounding

"50.53 Grounding Electrode System Installation.
(A) Rod, Pipe, and Plate Electrodes. Rod, pipe, and plate electrodes shall meet the requirements of 250.53(A)(1) through (A)(3).
(1) Below Permanent Moisture Level. If practicable, rod, pipe, and

plate electrodes shall be embedded below permanent moisture level. Rod, pipe, and plate electrodes shall be free from nonconductive coatings such as paint or enamel.
(2) Supplemental Electrode Required. A single rod, pipe, or plate electrode shall be supplemented by an additional electrode of a type specified in 250.52(A)(2) through (A)(8). The supplemental electrode shall be permitted to be bonded to one of the following:

(1) Rod, pipe, or plate electrode
(2) Grounding electrode conductor
(3) Grounded service-entrance conductor
(4) Nonflexible grounded service raceway
(5) Any grounded service enclosure

Exception: If a single rod, pipe, or plate grounding electrode has a resistance to earth of 25 ohms or less, the supplemental electrode shall not be required.
(3) Supplemental Electrode. If multiple rod, pipe, or plate electrodes are installed to meet the requirements of this section, they shall not be less than 1.8 m (6 ft) apart."

XXXVII. Item No. 37

A. NFPA 820 Classification –

"1. Purpose to provide explosion and fire protection for life property, and operations.
2. Reduce or mitigate the effects of fire or explosion
3. Consult with AHJ (Authority Having Jurisdiction) to ensure that the NFPA 820 standard will be enforced.

NFPA 70 – Article 500

Class I: Flammable Gases/Vapors Class

II: Combustible Dust

Class III: Ignitable Fibers

Wastewater/Treatment/Collections Systems

Class I, Div 1 or 2, Group D (Methane)

Class I, Div 1 or 2, Group G (Sludge)

Wet Well Pump Station

Less than 12 air changes – Division 1

Greater than 12 air changes – Division 2

Typical classified areas: Barscreen, Headworks or Preliminary Treatment Facility, Grit Removal, Odor Control, Sludge Handling and Thickening, etc.

Evaluate equipment type (i.e., explosion proof, conduit seals, etc.)

NFPA 820 4.2.2 – Collections Systems – See Attachment Y

NFPA 820 5.2.2 – Liquid Streaming – See Attachment Z

NFPA 820 6.2.2 – Solids Treatment Processes – See Attachment S

Consideration requirements: exhaust fans, continuous ventilation, alarming, air flow and monitoring."

XXXVIII. Item No. 38 – Standard Details

A. For detailed drawings go to Section 36

Series 700: Electrical and Instrumentation Details
700 - Wet Well Pump Wiring Electrical Backboard Detail
701A/B - Antenna Installation Detail
702A/B - Intrinsic Safety Panel
703 - Temporary Pump Enclosure Detail
704 - Actuator Vault Electrical Backboard Detail
705 - Instrument Vault Electrical Plan
706 - Actuator Vault Electrical Plan
707A/B - Wet Well Instrumentation Installation Detail

B.

XXXIX. Item No. 39 – Air Purification – Hydrogen Sulfide (H2S) Mitigation for Electrical Room – See Attachment AA

A. ManufacturerPure Aire or approved equal.

XL. Item No 40 – Backup Battery Systems

A. Manufacturer

1. Liebert (See Attachment BB)

XLI. Item No. 41 – I&C System Subcontractors

A. Instrumentation and control system subcontractors shall be regularly engaged in the detailed design, fabrication, installation, and startup of instrumentation and control systems for water and wastewater treatment

facilities and remote telemetry systems for wastewater collection systems. Instrumentation and control system subcontractors shall have a minimum of five years of such experience and shall have completed a minimum of three projects of similar type and size as that specified herein. Where specific manufacturers/models of major hardware or software products (PLC, HMI software, network, etc.) are specified to be used on this project, the instrumentation and control system subcontractor shall have completed at least three projects using that specified hardware or software. As used herein, the term “completed” shall mean that a project has been brought to final completion. In addition to the requirements listed above, the instrumentation and control system subcontractor shall have adequate staff that are experienced in the programming of Emerson ControlWave ® Micro – Hybrid RTU/PLC (i.e. ACCOL III FBL and BSAP). The instrumentation and control system subcontractor shall generator documentation showing that these requirements have been met and provide them to the Contractor during the bid phase.

B. Acceptable instrumentation and control system subcontractors shall be CEC controls Company, Inc; Systems East, Inc; or approved equal as qualifier per requirements herein.

XLII. Item 42 – Cable Routing/Disconnect – See Attachment CC

Treatment Plant – Electrical & Instrumentation Requirements

I. Item No. 1

A. Switchgear

1. Manufacturers

a. Eaton

b. Square D

2. Specific Criteria

a. Design to meet arc flash standard; Reduce hazard category rating to 2 or lower (MCC and VFD's should be designed to meet incident energy of 1.2 Cal/Cm2 or below if attainable); Reference HRSD Arc Flash Mitigation Document Dated July 9-10, 2013.

b. Provide two 48 VDC control voltage. 48 VDC redundant battery systems for control voltage per incoming primary voltage source. Use 1 Best Battery Selector to switch between each set of batteries (per primary source side) for control voltage.

c. Stored charge breaker systems are unacceptable.

d. Sealed Lead acid (VRLA)

e. NiCAD are not acceptable unless approved by Owner.

f. Provide tin-plated copper bus.

g. Provide switchgear indoors in a NEMA 1 (gasketed) enclosure.

h. Switchgear to be located indoors.

i. Provide with push to test lights.

j. Bottom entry versus top entry must be evaluated for application.

k. Provide in a room strictly for switchgear.

l. Install 3- or 4-inch windows on switchgear for IR testing for new installations (consult with Electrical Manager)

m. Equipment should be designed to be double end fed with tie breakers.

n. Rack out breakers must be racked in and out remotely without opening doors.

o. Provide remote open/close operator to protect personnel from Arc Flash Incident; operator should be outside of arc flash boundary where possible. (refer to Attachment M)

p. Provide ARMS “Arc Reduction Maintenance Switch” or equal, when activating downstream breakers incident energy levels will be reduced. Also, add separate pilot light to indicate when maintenance mode is enabled or disabled.

q. Provide hinged doors if available.

r. Design electrical gear/equipment to achieve an arc flash rating of Cat 2 or less.

s. Provide trip units with fault indication to determine status (i.e., overloads or fault conditions)

t. Provide LSIG digital trip unit if =/> 1000 amps and LSI if < 1000 amps

u. Provide extra fasteners for door cover.

v. Provide phenolic labels with black backgrounds and white lettering.

w. The size of the electrical gear is based on the ampacity of the bus within. Typically, electrical rooms are designed to accommodate equipment layout without future considerations for growth, therefore electrical buildings should be sized adequately to accommodate where wall space is needed for future equipment.

x. Electrical rooms should be conditioned to increase the life of sensitive electrical and electronic equipment. Thermostat should be set up to 80 F to control condensation/moisture. Also include a hydrogen sulfide (H2S) removal system if needed.

y. Mimic Bus is not required if there is graphical representation of the system displayed on the HMI Touchscreen.
Note: 1. For reliability and the ability to safely troubleshoot and perform maintenance on switchgear and MCC’s, the main switchgear should be double ended with a Bus tie. (The main gear shall provide each piece of major electrical equipment with an A and B feeder from each end.) Each MCC shall have a double ended configuration with Bus ties and Kirk Key interlocks to allow isolation of ½ the electrical gear at the MCC level.

2. When this is not possible, alternatives shall be

investigated for critical electrical equipment for critical processes. (Return to MCCs)

Reference HRSD Arc Flash Mitigation Document Dated July 9-10, 2013, and additional Power Study Specifications example by SKM Power Systems Analysis, Inc.

Refer to Attachment A

B. Breakers/Solid State Breakers

1. Manufacturers

a. Eaton

b. Square D

c. Provide breaker/trip testing report from startup and commissioning.

2. Specific Criteria

a. Provide appropriate spares and spaces.

C. Metering or Monitoring Package (Utility Grade Metering)

1. Manufacturers

a. Schweitzer Engineering Laboratories (SEL)

b. Eaton

c. Schneider Electric (Square D)

d. GE

e. Basler

2. Specific Criteria

a. Provide utility grade metering.

b. Volt Meter 3 phase & off

c. Ammeter 3 phase & off

d. kW

e. PF

f. kVA

g. kVAR

h. Utility grade CTs & PTs

i. Metering packages (See Item No. 8)

j. Provide 3 phase undervoltage & overcurrent protection (open

Delta PTs are unacceptable)

k. Provide testing that trips the main with a loss of any of the three legs.

l. Generator must be designed to be manually initiated to return to utility.

D. Selector Switches, Push Buttons, Lighted Push Buttons

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. Expandable contact blocks on operators

b. NEMA/IEC rated switches are not acceptable.

E. Contactors

1. Manufacturers

a. Eaton

b. Square D

c. Allen Bradley

2. Specific Criteria

a. Provide with expandable auxiliary contacts for 120-volt control circuits.

b. NEMA/IEC rated contactors are not acceptable.

F. Fuses & Fuse Holders

1. Specific Criteria

a. Must be locally available.

G. Switchgear Control Transformers

1. Specific Criteria

a. Provide copper coils.

b. Aluminum coils are unacceptable.

H. Terminal Strips / DIN Rail (Space Saver)

1. Manufacturers

a. Phoenix

b. Contact

c. ILSCO

d. Square D

e. Weidmuller

f. Panduit Panduct

2. Specific Criteria

a. Rail mount if possible

b. Industrial rated

c. Finger safe

d. Provide compression type screws terminals on jumpers.

I. Rubber Mats

1. Specific Criteria

a. Contractor will provide and install at substantial completion (OSHA Approved: Type II ASTM D178)

b. Add matting in front of gear.

J. Pilot Lighting

1. Specific Criteria

a. Provide LED type pilot lights.

b. 30mm preferred but 22mm is acceptable for specific applications if Approved by Owner/Engineer. i.e. Master Control Panel

K. Protective Relays

1. Manufacturers

a. Schweitzer Engineering Laboratories

b. GE

c. Basler

2. Specific Criteria

a. Provide 10-year warranty.

b. Solid State

c. Provide integral remote racking system of breakers from

control room via HMI to ensure the safety of employees by removing the breaker on and off bus safely and out of the Arc Flash boundary.

L. MCCs

1. Manufacturers

   a. Eaton

   b. Square D

   c. Allen Bradley

2. Specific Criteria

   a. Provide with tin-plated copper bus.

   b. MCCs to be placed indoors in a NEMA 12 (gasketed) enclosure.

   c. Provide redundant feeders to either end of the MCCs with a bus tie in the middle whenever possible.

   d. Provide with Kirk key interlocks door (mounted)

   e. Do not provide in the same room with chemical tanks or pumps.

   f. Provide with “push to test” lights.

   g. Wiring – internal wiring for control circuits is 16 AWG standard. In some applications the control wiring of 14 AWG can be requested from the manufacturer but will result in additional cost per vertical section.

   h. Preferred minimum of 65 KAIC (Kilo Ampere Interrupting Current) for Switchboards, Switchgear, Panelboards, MCC’s (Motor Control Centers), and ECB’s (Enclosed Circuit Breakers).

   i. Bottom entry vs. top entry must be evaluated based on application.

   j. Provide with face mounted operators and resets.

   k. Design to meet arc flash standard.

   l. Provide extra fasteners for door cover.

   m. Provide phenolic labels with black backgrounds and white lettering.

   n. Provide spare terminals for intermediate terminal blocks for controls.

o. The size of the electrical gear is based on the ampacity of the bus within. Typically, electrical rooms are designed to accommodate equipment layout without future considerations for growth, therefore electrical buildings should be sized adequately to accommodate where wall space is needed for future equipment.

p. Electrical rooms should be conditioned to increase the life of sensitive electrical and electronic equipment. Thermostat should be set up to 80 F to control condensation/moisture. Also include a hydrogen sulfide (H2S) removal system if needed.

q. Wiring – internal wiring for control circuits is 16 AWG standard. In some applications the control wiring of 14 AWG can be requested from the manufacturer but, will result in additional cost per vertical section.

Notes: See General Notes, Item 1 – Switchgear

M. Breakers/Solid State Breakers

1. Manufacturers

a. Eaton

b. Square D

N. Metering/Monitoring Package (For applications other than utility grade metering)

1. Manufacturers

a. Eaton IQ SEL

b. Square D

c. Power Logic

d. Schweitzer Engineering Laboratories (SEL)

2. Specific Criteria

a. Volt Meter 3 phase & off

b. Ammeter 3 phase & off

c. kW

d. PF

e. kVA

f. kVAR

g. CTs & PTs

h. Metering packages (See Item No. 8)

O. Selector Switches, Push Buttons, Lighted Push Buttons

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. Expandable contact blocks on operators

P. Contactors

1. Manufacturers

a. Eaton

b. Square D (Contactor must be able to reclose after short power blips)

c. Allen Bradley

2. Specific Criteria

a. Provide with expandable auxiliary contacts for 120-volt control circuits.

Q. Fuses & Fuse Holders

1. Manufacturers

a. Bussmann

b. Shawmut

2. Specific Criteria

a. Must be locally available.

R. MCC CTs and PTs

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. Metering

b. Provide copper coils.

c. Aluminum coils are unacceptable.

S. Terminal Strips

1. Manufacturers

a. Pheonix

b. Contract

c. ILSCO

d. Square D

e. Weidmuller

2. Specific Criteria

a. Rail mount instrumentation if possible

b. Industrial rated

T. Combination Starters (Buckets)

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. 120-volt control voltage

b. Run light – red.

c. Stop light – green.

d. Fault light – amber

e. Power available light – white

f. Provide push to test indicator lights.

g. Elapsed time meters–graduated in 1/10 hours Resettable or Non-resettable (plant/site specific; incorporate time meters on DCS if available)

h. Provide overload resets operational from the front (external)

i. Provide with adjustable thermo-mag breakers.

j. Fused control transformer.

k. 25% spares and/or spaces for all sizes of buckets or expandable option

l. MCC mounted lighting panels shall be provided with 25% spare breakers.

m. Provide connections for motor leads directly from the motors to the starter. Do not use intermediate terminal blocks (50 HP and smaller)

n. Provide standalone combination starters in the proper enclosures (See Junction/Pull Boxes and Miscellaneous Enclosures)

U. Rubber Mats (to be placed in front of gear)

1. Manufacturers

a. Grainger

b. Chesapeake Bay Rubber

2. Specific Criteria

a. Contractor will provide and install at substantial completion (OSHA approved: Type II ASTM D178)

V. Voltage Test Points

1. Manufacturer

a. Safeside-Grace Engineered Products (Load side of Main Breaker) (600 Volt or less equipment)

b. Panduit VeriSafe

II. <u>Item No. 2</u>

A. MCCs

1. Manufacturers

a. Eaton

b. Square D

c. Allen Bradley

2. Specific Criteria

a. Provide with tin-plated copper bus.

b. MCCs to be placed indoors in a NEMA 12 (gasketed) enclosure.

c. Provide redundant feeders to either end of the MCCs with a bus tie in the middle whenever possible.

d. Provide with Kirk key interlocks door (mounted)

e. Do not provide in the same room with chemical tanks or pumps.

f. Provide with “push to test” lights.

g. Bottom entry vs. top entry must be evaluated based on application.

h. Provide with face mounted operators and resets.

i. Design to meet arc flash standard.

j. Provide extra fasteners for door cover.

k. Provide phenolic labels with black backgrounds and white lettering.

l. Provide spare terminals for intermediate terminal blocks for controls.

m. The size of the electrical gear is based on the ampacity of the bus within. Typically, electrical rooms are designed to accommodate equipment layout without future considerations for growth, therefore electrical buildings should be sized adequately to accommodate where wall space is needed for future equipment.

n. Electrical rooms should be conditioned to increase the life of sensitive electrical and electronic equipment. Thermostat should be set up to 80 F to control condensation/moisture. Also include a hydrogen sulfide (H2S) removal system if needed.

Notes: See General Notes, Item 1 – Switchgear

B. Breakers/Solid State Breakers

1. Manufacturers

a. Eaton

b. Square D

c. Provide breaker/trip testing report from startup and commissioning.

C. Metering/Monitoring Package (For applications other than utility grade metering)

1. Manufacturers
    a. Eaton IQ SEL
    b. Square D
    c. Power Logic
    d. Schweitzer Engineering Laboratories (SEL)
2. Specific Criteria
    a. Volt Meter 3 phase & off
    b. Ammeter 3 phase & off
    c. kW
    d. PF
    e. kVA
    f. kVAR
    g. CTs & PTs
    h. Metering packages (See Item No. 8)

D. Selector Switches, Push Buttons, Lighted Push Buttons
1. Manufacturers
    a. Square D
    b. Eaton
    c. Allen Bradley
2. Specific Criteria
    a. Expandable contact blocks on operators

E. Contactors
1. Manufacturers
    a. Eaton
    b. Square D (Contactor must be able to reclose after short power blips)
    c. Allen Bradley
2. Specific Criteria
    a. Provide with expandable auxiliary contacts for 120-volt control circuits.

F. Fuses & Fuse Holders

1. Manufacturers

a. Bussmann

b. Shawmut

2. Specific Criteria

a. Must be locally available.

G. MCC CTs and PTs

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. Metering

b. Provide copper coils.

c. Aluminum coils are unacceptable.

H. Terminal Strips

1. Manufacturers

a. Pheonix

b. Contract

c. ILSCO

d. Square D

e. Weidmuller

2. Specific Criteria

a. Rail mount instrumentation if possible

b. Industrial rated

I. Combination Starters (Buckets)

1. Manufacturers

a. Square D

b. Eaton

c. Allen Bradley

2. Specific Criteria

a. 120-volt control voltage

b. Run light – red.

c. Stop light – green.

d. Fault light – amber

e. Power available light – white

f. Provide push to test indicator lights.

g. Elapsed time meters–graduated in 1/10 hours Resettable or Non-resettable (plant/site specific; incorporate time meters on DCS if available)

h. Provide overload resets operational from the front (external)

i. Provide with adjustable thermo-mag breakers.

j. Fused control transformer.

k. 25% spares and/or spaces for all sizes of buckets or expandable option

l. MCC mounted lighting panels shall be provided with 25% spare breakers.

m. Provide connections for motor leads directly from the motors to the starter. Do not use intermediate terminal blocks (50 HP and smaller)

n. Provide standalone combination starters in the proper enclosures (See Junction/Pull Boxes and Miscellaneous Enclosures)

J. Rubber Mats (to be placed in front of gear)

1. Manufacturers

a. Grainger

b. Chesapeake Bay Rubber

2. Specific Criteria

a. Contractor will provide and install at substantial completion (OSHA approved: Type II ASTM D178)

K. Voltage Test Points

1. Manufacturer

a. Safeside-Grace Engineered Products (Load side of Main

Breaker) (600 Volt or less equipment)

b. Panduit VeriSafe

III. Item No. 3

A. Emergency Generators

1. Manufacturers

a. Caterpillar

b. Cummins

2. Specific Criteria

a. Diesel generators

b. Turbine generators are not acceptable unless approved by Owner.

c. Engines to be of domestic manufacture whenever possible.

d. 4-stroke diesels **ONLY**

e. Parts must be available in 48 hours or less.

f. Must meet current U.S. EPA and Virginia DEQ air standards.

g. Low emission units

h. All units shall be Standby Rated

i. Remote Emergency stop pushbuttons at doorways (Pilla Model GS120 w/clear, hinged, plastic cover)

j. Provide separate room for indoor generator to reduce heat and noise.

B. Generator

1. Manufacturers

a. Stamford

b. Newage

c. Caterpillar

d. KATO

e. LIMA

f. Marathon

g. Cummins

2. Specific Criteria

a. Generators 1 MWatt and larger require a two-bearing generator unless the manufacturer has engineered the engine main bearing to reliably withstand the dynamic rotor loads and weights

b. The rectifier shall be a brushless, full-wave bridge.

c. <400 kW and below at 480 volts bring all leads out to the terminal box.

d. 400 kW and above – bring out 3 leads and a neutral (minimum) to the terminal box.

e. Neutrals shall be sized to full rating (brought out to the terminal box)

f. Temperature rise on generator voltages 4160 & higher shall not exceed Class B rating with 80□ C ambient rise. All others shall not exceed 105□ C rating.

g. Alternator shall have a space heater that switches off when running.

h. Provide for 2/3 winding pitch.

i. Minimum Class H insulation (operating temperature class 180□ C) with topicalization (anti-fungus)

j. Provide voltage regulation less than +/- 1%

k. Provide 150% minimum overspeed capability.

l. Provide amortisseur winding.

m. Provide less than 5% THD (Total Harmonic Distortion)

n. Provide less than 50 TIF (Telephone influence factor)

o. Voltage regulator shall be 3-phase.

C. Diesel Engine

1. Manufacturers

a. Caterpillar

b. Cummins

2. Specific Criteria

a. Heavy-duty, direct-injected, 4-stroke diesel engine.

b. Provide electronically controlled engines.

c. Provide electronically controlled engines with an electronic control system.

d. Require vendor to identify the control system to be provided.

e. Provide system software and training to fully troubleshoot and operate the engine

f. Provide isochronous frequency regulation (no load to full load)

g. Provide +/- 0.25% steady state frequency regulation (minimum)

h. Air, fuel and oil filters shall be sized to provide a minimum of 250 hours of operation before servicing

i. Engine manufacturers shall provide fuel water separators.

j. The air filter is to be a dry type with a restriction indicator.

k. Provide RTD's for monitoring bearing and winding temperatures.

l. Add vibration monitoring if > 1000 KW.

m. Provide a Racor heavy duty crankcase vapor coalesce.

n. All radiators and supporting appurtenances are to be galvanized steel.

o. The radiator core shall have solder coated fins to prevent corrosion by hydrogen sulfide gas.

p. Size radiator to prevent overheating in the most severe conditions (122°F ambient)

q. Exhaust system and muffler shall be residential grade muffler (lowest DB reduction available). All insulation must be blanket type (non-asbestos), removable for servicing of exhaust system.

r. The starting system shall be 24-volt DC.

s. Provide all diagnostic equipment for complete trouble shooting (software/technical manuals/hardware etc.)

t. Speed sensing shall be provided to protect against accidental starter engagement into a moving flywheel.

u. Battery charging alternation output voltage will not be acceptable for this purpose.

v. Provide an adjustable (0-15 minutes) cool down time.

w. Provide a large red emergency stop push button.

x. Low oil pressure, high coolant temperature, overspeed, and over-crank shall shut down the engine and provide indicator

lights

y. Analog or digital displays shall be provided for coolant temperature, oil pressure, ser- vice hours, engine RPM, system DC volts and system diagnostic code

z. Provide Kim Hot-Start engine block heater (thermostatically controlled) set in accordance with manufacturer's recommendation (120□F – 140□F)

aa. Provide vibration isolators between generator set base and floor

bb. bb. Provide lifting eyes.

cc. Provide brake mean effective pressure (BMEP) calculations.

dd. Provide means of quantifying flows from the day tank to the diesel and from the diesel back to the main tank.

D. Battery Chargers

1. Manufacturers

a. LaMarche

b. Cummins

c. SENS

2. Specific Criteria

a. 24-volt chargers or LaMarche equal

b. Automatic, solid state, provide continuous taper charging.

c. UL listed, provide with under/over voltage, current failure and loss of power acknowledgment.

d. Full Float Charge versus trickle charge must be evaluated for application.

E. Starting Batteries

1. Manufacturers

a. Delco -DEKA

b. Exide Switch locations

2. Specific Criteria

a. Use 8D lead-acid batteries (4D is not acceptable)

b. Provide a minimum of 2. The batteries shall provide 1200 CCA each.

c. Provide with insulated battery rack.

d. Provide a 2-year full replacement guarantee.

e. Provide as a minimum 2 cranking cycles at a minimum of 30 seconds each.

F. Air Starter

1. Manufacturers

a. Ingersoll Rand

2. Specific Criteria

a. Site Specific

G. Day Tanks

1. Manufacturers

a. Pryco

b. Simplex

c. Tramont

2. Specific Criteria

a. UL Listed – double wall.

b. Provide with Oberndorfer bronze gear type pump. Pumps with rubber or nitrile impellers will not be accepted

c. Provide with a low-level alarm. Size for 2-hour minimum running time

d. Provide a fuel level indicator on the day tank.

e. Provide a two-pump system. Each pump shall be capable of pumping 100% of the fuel oil for all generators.

f. Fuel shall be returned to the day tank.

g. Provide Not in Auto lamp or other warning device.

h. Meet all VDEQ requirements.

H. Underground Storage Tanks (UST)

1. Manufacturers

a. Veeder Root TLS450 PLUS

b. Xerxes

2. Specific Criteria

a. Provide in accordance with EPA and all applicable state and local standards.

b. Provide with leak detection system.

c. Provide a graduated stick for level measuring.

d. Provide for stick access and refueling.

e. Provide with 7 days of fuel tank capacity.

f. Provide an electronic tank level indicating system with a 4-20 mA output calibrated to the tank or Ethernet connection (TCP/IP)

g. Provide AMI Model 8CH-DAC 8 channel digital/analog converter (4-20ma)

I. Sub-base Fuel Tanks

1. Provided by Generator Manufacturer.

2. Must meet all UL-142 requirements for double-walled fuel tanks (Site Specific).

3. Must provide generator 48 hours of runtime at 100% load.

4. Must include high level, low level, and leak detection alarms.

5. UL 142 Compliant

6. Must include lockable fill with spill bucket.

7. Mechanical Fuel Gauge.

8. Must include Tank Dip Chart measured in ¼" increments.

9. Capacity is site specific. It must allow generator to run 48 hrs. @ 100% load.

10. Subbase tanks are to be provided by the generator manufacturer.

11. Above ground tanks acceptable Manufacturer: Highland Tank and Manufacturing.

12. Must be installed according to manufacturer's requirements.

J. Enclosure

1. Sound level is site specific. Must not exceed 75dBA @ 23 ft.

2. Must have full access to engine, generator, and controls.

3. Must be able to operate at 100% load in all weather conditions.

K. Louvers and Dampers

1. Manufacturers
    a. Greenheck
    b. Ruskin
2. Specific Criteria
    a. Aluminum or PVC with hardware
    b. Provide for gravity dampers on emergency generator systems (For motor operated applications, must fail to open position if power loss)
    c. Provide anodized aluminum dampers with nylon bushings or ball bearings.
    d. Steel and/or steel shafts are not acceptable.
    e. Provide with bird screens readily removable without removing louvers or dampers.
    f. Designed to limit rainwater in building.
    g. Where louvers and dampers are required, provide recessed dampers (inside) and flange mounted louvers (outside)
    h. Manufacturer shall set and balance the system.

L. Metering/Monitoring Package
1. Specific Criteria
    a. Volt meter 3 phase & off
    b. Ammeter 3 phase & off
    c. Frequency
    d. kW
    e. PF
    f. kVA
    g. kVAR
    h. kWh
    i. Utility grade CTs & PTs
    j. Metering packages (See Item No. 8)
    k. Provide 3 phase undervoltage & overcurrent protection.
    l. Synchroscope

m. Sync lights

n. Supply a TCP/IP modbus link with an HRSD supplied IP address, subnet mask, and gateway to allow the Emerson DCS (or other monitoring system) to read all data registers from the generators and the associated MCC hardware. This includes run statuses, breaker statuses, voltage, current, diesel generator engine data, etc.

M. System Operation

1. Specific Criteria

a. Provide protection such that the two sources (utility & emergency generator) can never be closed out of phase

b. Provide approvals by Dominion Virginia Power on the paralleling protection scheme

c. Provide a selector switch to allow the operator to choose “curtailment” or “loss of power” (typically set to “loss of power”).

d. In the loss of power setting, the system shall have automatic and manual operation. The manual operation would be provided in the event the automatic functions failed.

e. If the operator switches to curtailment:

f. Depressing a single push button in the automatic mode will start the engine, parallel with the utility, ramp the plant load onto the generator and open the utility breaker.

g. Depressing a second push button will ramp the load back to the utility and shut down the generators.

h. Provide a detailed sequence of operation for generator and switchgear operation.

i. Monitor temporary generator master control panel connect to DCS for monitoring.

N. Start Up and Testing

1. Specific Criteria

a. Provide factory test data.

b. Simulate and test all safety equipment. Using a reactive load bank (0.8PF) run the generator:

(1) 15 minutes at idle speed

(2) 30 minutes at 25% load

(3) 30 minutes at 50% load

(4) 60 minutes at 75% load

(5) 120 minutes at 100% load

(6) 15 minutes at 25% load

(7) 15 minutes at 0% load (cool down) off record stator, bearing, oil, ambient, and water temperatures every 15 minutes.

c. Record speed, voltage and amperage at 15-minute intervals as well as just prior to and after a load change.

d. Demonstrate all warnings and shutdowns with laptop.

e. Hook up the generator to the main switchgear. Perform all automatic and manual functions a minimum of three times each. The plant will load the generators as much as possible. Particular attention should be observed to the larger starting loads. Record same parameters every 15 minutes and before and after changing load. Tests to be witnessed by HRSD Automotive Superintendent and HRSD Electrical Engineer or designee.

f. Create and attach to the switchgear detailed instructions. The instructions shall be laminated. The instructions shall be simple enough for anybody to pick them up and operate the diesel generator set.

g. Group A, B, and C phase cable together to cancel out EMF (Electromagnetic Field)

O. Stationary Fuel Filtering System.

1. Acceptable Manufacturers – Simplex or Tramont.

2. Water Filter/Separator – Required.

3. Particulate Filter – 2 Micron Required.

4. Automatic Timer with Manual Switch – Required.

5. System Size Site Specific to Accommodate Tank size.

6. Must be installed to manufacture's requirements.

P. Energy Efficient Motors

1. Specific Criteria

a. See HRSD Electric Motor Specifications in *Attachment E "HRSD Electric Motor Specifications".*

b. Provide ammeters on motors 50 HP & larger.

c. Local stop pushbuttons for VFDs, Use HOA for constant speed applications.

d. Add momentary push button at Motor.

Q. Sump Pumps

R. Specific Criteria

1. Provide with 120-volt plug and receptacle. Refer to Treatment Plant/Miscellaneous Items.

S. Level Sensing Systems

1. Specific Criteria

a. Provide 4-20 mA signal.

(1) See Treatment Plant No. 24

(2) See Chemical Systems Plants

T. Bubbler Type – Level Sensing Systems

1. Specific Criteria

a. Complete purged air bubbler system with time delay for sensing wet well liquid level which generates and transmits level signals to control pump operations.

b. Provide UPS backup for controls.

c. Provide power light – white.

d. Provide a pressure sensing device (Foxboro or equal)

e. Provide externally mounted duplex air compressors mounted on 30-gallon horizontal receiving tank

f. Provide push button for manual purging of bubbler piping.

g. Provide manual alternation of air compressors.

h. Provide lead/lag switch – on off.

i. Provide panel mounted 4 ½ inch 0 level gauge/Analog gauge.

j. Mount air compressors outside of panel whenever possible

k. Provide pressure activated switches for point applications (Barksdale)

U. Ultrasonic – Level Sensing Systems

1. Manufacturers

a. Rosemont

b. Siemens

2. Specific Criteria

a. Microprocessor

b. FM approved (frequency modulation)

V. Capacitance – Level Sensing Systems (Not Acceptable)

1. Manufacturers

a. Warrick

b. Drexelbrook

2. Specific Criteria

a. Provide with point applications only.

b. Not for 4-20 ma applications

W. Pressure Transmitters – Level Sensing Systems

1. Manufacturers

a. Foxboro

b. Rosemount

c. Air Monitor – Incinerator draft

d. Siemens

2. Specific Criteria

a. All other locations

X. FloatBalls

1. Manufacturers

a. Flygt

b. Optifloat

2. Specific Criteria

a. Non mercury

b. Fiber Optic

Y. Pressure Sensing System – Level Sensing Systems

1. Specific Criteria

a. Provide either an Ashcroft or Red Valve (series 40) brand

pressure seal with Viton boot.

b. Provide Ashcroft Gauges 100 psi.

c. Provide Foxboro IDPT 10 absolute pressure electronic transmitter.

d. See Standard Detail “Pressure Reducing Station Pressure Sensor Detail”

Z. Diaphragm – Level Sensing Systems

1. Manufacturers

a. Foxboro

b. Rosemont

2. Specific Criteria

a. Pressure Transmitter (Diaphragm Type)

AA. Radar – Level Sensing Systems

1. Manufacturers

a. Rosemont

2. Specific Criteria

a. Non-Contacting and Guided Wave types will be application dependent.

BB. Variable Frequency Drives (VFDs)

1. Manufacturers

a. Yaskawa

b. Allen Bradley

2. Specific Criteria

a. Install the equipment with the idea of keeping it clean and temperature regulated.

b. Provide thumbscrews for removable/washable filters or thumb screws replaced by snap in grills that are removable from the front of the cabinet (reusable)

c. Provide a programmable ramp time.

d. Provide input reactors (MTE Corp) or TCI

e. Pulse Width Modulated (PWM)

f. Use IGBTs

g. Automatic restart on power disruption

h. Tune out a minimum of 3 frequencies.

i. Hand/Off/Automatic (HOA) selector switch

j. Manual speed control by potentiometer (door mounted) in addition to keypad control.

k. Tune drive to motor with a harmonics meter

l. Provide an input circuit breaker for short circuit protection (Fuses are not acceptable)

m. The controller electronics shall contain indicators of the following conditions:

(1) Undervoltage

(2) Overvoltage

(3) Over temperature

(4) Memory failure

(5) Emergency Stop

(6) Ground fault

(7) Instantaneous overcurrent

n. Provide a NEMA 12 flanged disconnect free standing enclosure.

o. Provide auxiliary run contactor wired to run command for ventilation fan.

p. Mount the resets & appropriate indicator lighting on the front of the drive or the outside of the box to prevent employees from opening the panel.

q. Provide four contact outputs for run status, power failure, VFD failure, not in auto status.

r. The following are site specific options:

(1) VFD must be able to be isolated and bypassed (auto/manual operation) allowing the motor to operate across the line at full-load speed and current. Site specific

(2) Provide manual isolation and bypass capability.

(3) Provide three contactors for bypass operation.

s. VFD “T” leads in free air shall be run in RGS or PVC coated

RGS.

t. “T” leads can be run in PVC if in a duct bank.

u. Do not run “T” leads in conduit with any other conductors.

v. “T” leads shall be run in a separate conduit per each drive.

w. 6 pulse drive or Matrix drive or AB 755T

3. Additional Design Considerations

a. All electrical components must be NEMA only. IEC or NEMS/IEC is not acceptable.

b. Filters to HVAC units must be maintained and free from dust during construction phase.

c. VFD parameters must be included on as built prints (i.e., momentary power loss ride thru, energy savings, and fault reset)

d. Specify coil locks (Power Quality Solutions) on control relays for power dip ride thru capabilities.

e. Specify Baker SKF EP 1000 Dynamic motor link on all motor/VFD system 100HP and above or designated as critical equipment.

f. Provide Bypass mode for critical VFD’s. Soft start or across the line depending on application.

g. Specify main circuit breaker cable operators for breaker operation instead of standard door operating mechanisms.

h. Provide One reset button to reset VFD and control circuit faults.

i. Provide finger safe barriers for main sideline breaker lugs.

j. Provide enough fans to replace each fan within a VFD (spare parts) where several VFD’s of the same size and model are specified.

k. Provide paper copies of VFD manuals.

l. To support large and heavy VFD’s 60 HP and above, provide a pedestal with a flat plate mounted inside the enclosure for VFD to rest for easy removal. Also provide a lift table to remove VFD.

m. Provide external air filter for easy access on cabinets.

n. VFD shall be sized to provide current necessary for motor to

produce continuous rated horsepower and service factor horsepower at highest carrier frequency.

o. Contractor to perform static tuning for optimal performance during startup. Contractor to supply panel shop with motor data sheets including the number of poles per motor. Also, include number of motor poles on motor nameplate.

p. Provide extended warranty by VFD manufacturer where replacement cost is justified.

q. Need all switches to indicate when not in auto.

r. Need indication when control power is loss in addition to VFD fault.

s. Evaluate best routing method for bottom versus top entry of wire.

t. Provide VFD Cable with copper shielding, XLPE insulation manufacture by Belden or equal.

(1) Consider these factors when designing motor HP, motor voltage and motor full load current, ambient temperature, VFD cable and connector ratings, and number of cables in raceway.

u. A Harmonic Study Analysis should be performed for all VFD applications by using IEE 519 guidelines. The design engineer should evaluate the best solution to reduce Harmonic Distortion (ie. passive and active filters or active front end included as part of the VFD) (refer to Attachment C)

Provide auxiliary (AUX) to remove run command of VFD before opening contact. Refer to Disconnect – Aux Contact

IV. Item No. 4

A. Energy Efficient Motors

1. Specific Criteria

a. See HRSD Electric Motor Specifications in *Attachment E "HRSD Electric Motor Specifications".*

b. Provide ammeters on motors 50 HP & larger.

c. Local stop pushbuttons for VFDs, Use HOA for constant speed applications.

d. Add momentary push button at Motor.

V. Item No. 5

A. Sump Pumps

1. Specific Criteria

a. Provide with 120-volt plug and receptacle. Refer to Treatment Plant/Miscellaneous Items.

VI. Item No. 6

A. Level Sensing Systems

1. Specific Criteria

a. Provide 4-20 mA signal.

(1) See Treatment Plant No. 24

(2) See Chemical Systems Plants

B. Bubbler Type – Level Sensing Systems

1. Specific Criteria

a. Complete purged air bubbler system with time delay for sensing wet well liquid level which generates and transmits level signals to control pump operations.

b. Provide UPS backup for controls.

c. Provide power light – white.

d. Provide a pressure sensing device (Foxboro or equal)

e. Provide externally mounted duplex air compressors mounted on 30-gallon horizontal receiving tank

f. Provide push button for manual purging of bubbler piping.

g. Provide manual alternation of air compressors.

h. Provide lead/lag switch – on off.

i. Provide panel mounted 4 ½ inch 0 level gauge/Analog gauge.

j. Mount air compressors outside of panel whenever possible

k. Provide pressure activated switches for point applications (Barksdale)

C. Ultrasonic – Level Sensing Systems

1. Manufacturers

a. Rosemont

b. Siemens

2. Specific Criteria

a. Microprocessor

b. FM approved (frequency modulation)

D. Capacitance – Level Sensing Systems (Not Acceptable)

1. Manufacturers

a. Warrick

b. Drexelbrook

2. Specific Criteria

a. Provide with point applications only.

b. Not for 4-20 ma applications

E. Pressure Transmitters – Level Sensing Systems

1. Manufacturers

a. Foxboro

b. Rosemount

c. Air Monitor – Incinerator draft

d. Siemens

2. Specific Criteria

a. All other locations

F. FloatBalls

1. Manufacturers

a. Flygt

b. Optifloat

2. Specific Criteria

a. Non mercury

b. Fiber Optic

G. Pressure Sensing System – Level Sensing Systems

1. Specific Criteria

a. Provide either an Ashcroft or Red Valve (series 40) brand pressure seal with Viton boot.

b. Provide Ashcroft Gauges 100 psi.

c. Provide Foxboro IDPT 10 absolute pressure electronic

transmitter.

d. See Standard Detail “Pressure Reducing Station Pressure Sensor Detail”

H. Diaphragm – Level Sensing Systems

1. Manufacturers

a. Foxboro

b. Rosemont

2. Specific Criteria

a. Pressure Transmitter (Diaphragm Type)

I. Radar – Level Sensing Systems

1. Manufacturers

a. Rosemont

2. Specific Criteria

a. Non-Contacting and Guided Wave types will be application dependent.

VII. Item No. 7

A. Variable Frequency Drives (VFDs)

1. Manufacturers

a. Yaskawa

b. Allen Bradley

2. Specific Criteria

a. Install the equipment with the idea of keeping it clean and temperature regulated.

b. Provide thumbscrews for removable/washable filters or thumb screws replaced by snap in grills that are removable from the front of the cabinet (reusable)

c. Provide a programmable ramp time.

d. Provide input reactors (MTE Corp) or TCI

e. Pulse Width Modulated (PWM)

f. Use IGBTs

g. Automatic restart on power disruption

h. Tune out a minimum of 3 frequencies.

i. Hand/Off/Automatic (HOA) selector switch

j. Manual speed control by potentiometer (door mounted) in addition to keypad control.

k. Tune drive to motor with a harmonics meter

l. Provide an input circuit breaker for short circuit protection (Fuses are not acceptable)

m. The controller electronics shall contain indicators of the following conditions:

(1) Undervoltage

(2) Overvoltage

(3) Over temperature

(4) Memory failure

(5) Emergency Stop

(6) Ground fault

(7) Instantaneous overcurrent

n. Provide a NEMA 12 flanged disconnect free standing enclosure.

o. Provide auxiliary run contactor wired to run command for ventilation fan.

p. Mount the resets & appropriate indicator lighting on the front of the drive or the outside of the box to prevent employees from opening the panel.

q. Provide four contact outputs for run status, power failure, VFD failure, not in auto status.

r. The following are site specific options:

(1) VFD must be able to be isolated and bypassed (auto/manual operation) allowing the motor to operate across the line at full-load speed and current. Site specific

(2) Provide manual isolation and bypass capability.

(3) Provide three contactors for bypass operation.

s. VFD “T” leads in free air shall be run in RGS or PVC coated RGS.

t. “T” leads can be run in PVC if in a duct bank.

u. Do not run “T” leads in conduit with any other conductors.

v. “T” leads shall be run in a separate conduit per each drive.

w. 6 pulse drive or Matrix drive or AB 755T

3. Additional Design Considerations

a. All electrical components must be NEMA only. IEC or NEMS/IEC is not acceptable.

b. Filters to HVAC units must be maintained and free from dust during construction phase.

c. VFD parameters must be included on as built prints (i.e., momentary power loss ride thru, energy savings, and fault reset)

d. Specify coil locks (Power Quality Solutions) on control relays for power dip ride thru capabilities.

e. Specify Baker SKF EP 1000 Dynamic motor link on all motor/VFD system 100HP and above or designated as critical equipment.

f. Provide Bypass mode for critical VFD’s. Soft start or across the line depending on application.

g. Specify main circuit breaker cable operators for breaker operation instead of standard door operating mechanisms.

h. Provide One reset button to reset VFD and control circuit faults.

i. Provide finger safe barriers for main sideline breaker lugs.

j. Provide enough fans to replace each fan within a VFD (spare parts) where several VFD’s of the same size and model are specified.

k. Provide paper copies of VFD manuals.

l. To support large and heavy VFD’s 60 HP and above, provide a pedestal with a flat plate mounted inside the enclosure for VFD to rest for easy removal. Also provide a lift table to remove VFD.

m. Provide external air filter for easy access on cabinets.

n. VFD shall be sized to provide current necessary for motor to produce continuous rated horsepower and service factor horsepower at highest carrier frequency.

o. Contractor to perform static tuning for optimal performance

during startup. Contractor to supply panel shop with motor data sheets including the number of poles per motor. Also, include number of motor poles on motor nameplate.

p. Provide extended warranty by VFD manufacturer where replacement cost is justified.

q. Need all switches to indicate when not in auto.

r. Need indication when control power is loss in addition to VFD fault.

s. Evaluate best routing method for bottom versus top entry of wire.

t. Provide VFD Cable with copper shielding, XLPE insulation manufacture by Belden or equal.

(1) Consider these factors when designing motor HP, motor voltage and motor full load current, ambient temperature, VFD cable and connector ratings, and number of cables in raceway.

u. A Harmonic Study Analysis should be performed for all VFD applications by using IEE 519 guidelines. The design engineer should evaluate the best solution to reduce Harmonic Distortion (ie. passive and active filters or active front end included as part of the VFD) (refer to Attachment C)

Provide auxiliary (AUX) to remove run command of VFD before opening contact. Refer to Disconnect – Aux Contact

B. DC Drives

1. Specific Criteria

a. Unacceptable

C. Eddy Current Brake Systems

1. Specific Criteria

a. Unacceptable

D. DC Drives

1. Specific Criteria

a. Unacceptable

E. Eddy Current Brake Systems

1. Specific Criteria

a. Unacceptable

VIII. Item No. 8

A. Metering Packages for Switchgear

1. Manufacturers

a. Schweitzer Engineering Lab (SEL)

b. Xpert (Eaton)

c. Power Logic (Square D)

d. Multilin (GE)

2. Specific Criteria

a. Provide cumulative watt-hour meters on each MCC, or specific motor

b. Provide a meter on each MCC to indicate 3 phase parameters on the MCC, i.e., volts, amps, kW, PF, kVA, kWh, etc.

c. Provide with motors 200 HP and above.

IX. Item No. 9

A. PLCs

1. Manufacturers

a. Allen Bradley (i.e. –SLC 500, Compact Logix 5000, Micro Logix 5000)

2. Specific Criteria

a. Provide functional descriptions, the application program, the job- specific program data, and a copy of the as-built software documentation

b. Include PLC fail indicator.

c. Provide license, software, programmed files with labels (as Built)

d. PLC's and RTU's shall be equipped with isolation relays for all digital inputs. Ex- ample: (Idec 5-blade – 24 VDC coils- with a form C configuration contactor) relays mounted on DIN rail for the purpose isolating relay inputs. Whether a junction box is used or control panel a 24 VDC power supply with sufficient capacity to energize all the 24 VDC relay coils simultaneously when necessary for all PLC or RTU inputs.

X. Item No. 10

A. Exhaust Fans

1. Manufacturers

a. ILG

b. Dayton

c. Greenheck

d. Airovent

e. Mk Plastics

2. Specific Criteria

a. Corrosion resistant including hardware.

b. Must be explosion proof in hazardous areas.

c. Direct Drive

(1) Belt drive not acceptable unless approved by Owner (Air detection is required if approved).

XI. Item No. 11

A. Lighting

1. Manufacturers

a. Holophane

b. Hubbell

c. Thomas

d. Crouse-Hinds

2. Specific Criteria

a. Replace all light fixtures with LEDs if Non-LED style fixture cannot be repaired.

b. Provide proper levels of lighting over major equipment including switchgear, generators, pump motors, and controls. Minimum lighting levels should conform to the IES lighting handbook.

c. Exterior lights shall be placed on a single photocell (within reason)

Refer to Attachment D - Lighting Policy

3. Other

a. HPS

(1) Specific Criteria

(a) Not acceptable for any application

b. LPS

(1) Specific Criteria

(a) Not acceptable for any application

c. Mercury Vapor

(1) Specific Criteria

(a) Not acceptable for any application

d. Emergency Lighting

(1) Manufacturers

(a) Dual Lite

(b) Emergency Lite

(c) Note: Install dual input inverters if applicable

(2) Specific Criteria

(a) Dual Lite GMM-EL-W2 in admin areas

(b) Emerg Lite PRO-2 in corrosive areas

e. Exit Lighting

(1) Manufacturers

(a) Dual Lite

(b) Lithonia

(2) Specific Criteria

(a) Highly visible 24 hours/day for life (self-illuminating)

(b) Provide lighted only if required.

f. High-Mast Lighting

(1) Manufacturers

(a) Holophane

(2) Specific Criteria

(a) Site specific

g. LED

(1) Specific Criteria

(a) To reduce maintenance

(b) Perform payback analysis.

XII. Item No. 12

A. Concrete Housekeeping Pads

1. Specific Criteria

a. Provide a minimum of 4-inch thickness under Switchgear, MCCs, transformers, general electrical equipment, and around conduits at floor penetrations.

b. Chamfer all edges.

XIII. Item No. 13

A. Conduit and Conduit Systems

1. Specific Criteria

a. Provide three separate conduit systems. One for power circuits >600 volts, one for power circuits less than 600 volts, and one for communication circuits

b. Instrumentation (<25v) can be placed in the communication duct bank.

c. Use compression type lugs only.

d. Ream and chamfer all edges.

e. EMT or IMC are not acceptable unless approved by Owner.

f. All flexible conduits shall be heavy duty metallic liquidtite or equal.

g. Provide ¾ inch minimum size (when specifically approved or when instrumentation restricts this size, ½ inch can be used)

h. Do not use plastic anchors.

i. Seal conduits with a silicone product as necessary (in the manholes to the buildings)

j. Administrative areas (plenum) can use EMT down to ½ inch (lighting only)

k. Label all conduits inside of building (Engineer must provide conduit schedule)

l. Circuit # must be brought back to the panel/breaker.

m. Place metal tags on cables in manholes

n. See the Miscellaneous section of these standards for markings and coatings.

o. Provide Oz Gedney conduit and cable seals or silicone where seals are not available.

p. Cable trays must be approved by Owner or Engineer.

q. Evaluate cost of stainless steel or aluminum conduit vs. PVC coated rigid steel conduit (where applicable)

B. Spare Conduits

1. Specific Criteria

a. Provide with service entrance.

b. Add appropriate spares with pull wires.

C. Future Conduits

1. Specific Criteria

a. Some future conduits may become trip hazards, they must be cut flush and grouted at the finish floor in some cases.

D. PVC Coated Rigid Steel (inside and out)

1. Manufacturers

a. Robroy

b. Plasti-Bond

c. Perma-cote

d. Korkap

e. Ocal

f. Gafco Industries

2. Specific Criteria

a. Provide in corrosive areas, underground (not encased), chemical areas, chemical containment areas, outside and damp areas.

b. Provide with PVC coated fittings, boxes and touch-up material.

c. Provide 8” of PVC coated conduit were stubbed up through concrete (wash-down areas)

E. PVC

1. Specific Criteria

    a. Underground/encased reinforced concrete.

    b. Can replace RGS in duct banks where EMI is not a threat.

F. Rigid Galvanized Steel

1. Specific Criteria

    a. Provide in all other areas not covered by PVC and PVC coated.

G. Tools Used

1. Specific Criteria

    a. Use suitable tools with conduit.

H. Patching/Repair

1. Specific Criteria

    a. Use appropriate material to patch and repair.

I. Flex – Liquidtite & Fittings

1. Specific Criteria

    a. Use Myers hubs where suitable.

    b. Use coated fittings where appropriate.

    c. Heavy duty metallic fittings require.

    d. Shall be metallic stainless steel, aluminum or equal.

J. Explosion Proof Fittings

1. Manufacturers

    a. Crouse Hinds

    b. Appleton

2. Specific Criteria

    a. Use fittings to match installed conduit.

K. Fixtures & Fittings

1. Specific Criteria

    a. Use appropriate fittings and materials.

L. Struts and Straps

1. Specific Criteria

a. To suit conduit materials

b. Use matching fasteners.

c. In outside, wet or damp areas use stainless steel fasteners.

d. Stainless Steel Straps are preferred over PVC Coated Straps. For certain applications please contact owner/engineer for approval.

M. Pull Boxes (wire pulled through) and Junction Boxes (wires terminated inside)

1. Specific Criteria

a. Over 6-inch x 6 inch are to be hinged

b. Gasketed

c. Use stainless steel/aluminum in outside/wet areas.

d. Use PVC coated reinforced fiberglass in hazardous and chemical areas.

N. Wire Hangers

1. Specific Criteria

a. Appropriately locate above dropped ceilings.

O. Red Dye

1. Specific Criteria

a. Provide red dye in concrete duct bank.

b. 4000 psi

c. See typical duct bank details in Attachment I

XIV. Item No. 14

A. Wire

1. Specific Criteria

a. Provide copper stranded wire only.

b. Provide for separation of power, signal and telephone services.

c. Do not splice wire - Splicing not allowed unless approved by Owner/Engineer

d. Use compression type lugs only.

e. Place metal tags on cables in manholes

f. Welding cable (DLO) – Design based on intermittent duty vs. continuous duty.

g. Provide Ethernet cable/CAT 6 for communications to equipment.

B. Telephone – Wire

1. Specific Criteria

a. Minimum wire gauge #22-24 AWG

b. Provide plenum rated cable in return air plenums.

C. THHN, THWN, XHHW – Wire

1. Specific Criteria

a. Follow NEC color coding.

b. All shall be stranded wire, rated for 600-volt.

c. #12 minimum wire size for typical applications

D. Instrumentation – Wire

1. Specific Criteria

a. All wire MTW or signal wire shall be rated at 600-volt.

b. Do not combine analog circuits (twisted shielded pair-TSP) with other circuits in the same conduit.

c. Instrumentation control wires should be sized accordingly (#16 stranded wire recommended)

d. DC wire shall be color-coded blue #16 AWG minimum.

e. AC wire shall be color-coded red #16 AWG minimum.

f. Unless otherwise specified by the manufacturer, provide analog signals with #18-2 AWG with a shield, tinned

E. Tracer Wire - Do not splice wire – Splicing not allowed unless approved by Owner/Engineer

Note: Cabinets with multiple sources must be clearly marked as such

F. High Voltage Cable – Wire

1. Specific Criteria

a. Follow appropriate code.

G. Heat Tracing – Wire

1. Manufacturers
    a. Letco-Dual Controls
    b. Chromalox
2. Specific Criteria
    a. Provide terminations above the insulation.
    b. Provide thermostatically controlled constant watt tracing.
    c. Provide with insulation.
    d. Provide with protective outer coating.
    e. Provide a metal strip on PVC pipe to distribute heat.
    f. Provide with indicator light.
    g. Provide with stainless steel leads in corrosive areas.
    h. Provide coating for chemically corrosive areas.

XV. Item No. 15 - Relays

A. Industrial
1. Manufacturers
    a. Allen Bradley
    b. Eaton
2. Specific Criteria
    a. Fixed base

B. Electronic
1. Manufacturers
    a. IDEC
    b. Potter-Brumfield
    c. Agastat
2. Specific Criteria
    a. Plug-in/ice cube type with pilot lights

XVI. Item No. 16

A. Lockout / Tagout □ Safety
1. Specific Criteria
    a. Provided for in Section 22 – HRSD Safety Program in this

manual. Provide local lockout devices for all equipment.

XVII. Item No. 17

A. Switches / Receptacles / Plugs

1. Manufacturers

a. Pass & Seymour

b. Hubbell

c. Crouse Hinds

2. Specific Criteria

a. Provide compression type screw terminals on receptacles. Wire binding receptacles or switches are not acceptable.

b. Provide for dedicated circuits for sump pumps.

c. Provide power receptacle in control cabinets.

d. Provide a neutral for each circuit, multi wire circuits are not allowed without special approval and then with a two-pole breaker.

e. Provide “in use” covers for indoor sump area applications.

XVIII. Item No. 18 – Unit Heaters

A. Unit Heaters - Electric

1. Manufacturers

a. QMark

b. Dayton

2. Unit Heaters – Gas

a. Space Ray

b. Dayton

XIX. Item No. 19

A. Electrical Drawings

1. Specific Criteria

a. Process and Instrumentation Diagrams (P&IDs) are to conform to ISA modified standards (Consulting engineer to provide)

b. Provide functional descriptions with the P&IDs (Consulting engineer to provide)

c. Provide Point-to-Point connection drawings. Contractor shall

develop.

d. Review and approval by the engineer shall be prior to installation.

e. Label all conduits inside building.

f. Place metal tags on cables in manholes

g. Provide final conduit & cable schedule on disk (AutoCAD, PDF & VISIO)

XX. Item No. 20

A. Safety Switches (fused or unfused)

1. Manufacturers

a. Square D

b. Eaton

c. Westinghouse

d. Allen Bradley

2. Specific Criteria

a. Light duty safety switches are unacceptable.

b. Must be pad lockable.

XXI. Item No. 21 - Transformers

A. Dry Transformers

1. Manufacturers

a. Square D

b. Eaton

c. GE

d. ACME

2. Specific Criteria

a. No Aluminum Wire

b. Provide 220□ C insulation system for 15kVA and larger.

c. Provide 180□ C insulation system for transformers less than 15kVA.

d. Transformers shall handle a 15% overload without exceeding the insulation rating.

e. Place on 4” housekeeping pads

B. Oil Filled Transformers

1. Manufacturers

a. Square D

b. Eaton

c. GE

2. Specific Criteria

a. No PCBs allowed.

b. Provide with FR3 oil.

c. Provide housekeeping pad – elevate pad in places prone for flooding.

d. Require external sample ports.

XXII. Item No. 22

A. Metering Vaults/Pits

1. Specific Criteria

a. Provide receptacle and receptacle location per HRSD direction.

b. Provide sump pumps as needed with remote GFCI circuit breaker protection.

c. Provide explosion proof sump pump in Class 1 division 1 areas.

B. Other Metering Vaults/Pits

1. Power Requirements

a. Specific Criteria

(1) Provide two receptacles with weatherproof covers with remote GFCI circuit breaker protection

2. Exhaust Fans

a. See Exhaust Fans

b. Size for 12 air changes per hour (minimum)

c. Bring exhaust duct to within 6 inches above finished floor.

3. Lighting

a. Provide incandescent lighting with a vapor tight glove and guard.

b. Provide light switch at access.

XXIII. Item No. 23

A. Pressure Sustaining/Regulating Valves

1. Manufacturers

a. KTM

b. Foxboro

c. Clow

2. Specific Criteria

a. Provide 4-20 mA operated valves. Do not use pulsed control valves.

b. Automatic Controls of Virginia or Valve Automation for actuator applications

c. Use EIM /Bettis actuators.

d. Limitorque (refer to Attachment P)

B. Other

1. Butterfly Valves

2. V Notch Plug Valves

3. V Notch Ball Valves

XXIV. Item No. 24

A. Flow Meters – Size for average flows

1. Parshall flume

a. Specific Criteria

(1) Use ultrasonic level indicator (Siemens)

2. Magnetic

a. Manufacturers

(1) Rosemont

(2) Foxboro

b. Specific Criteria

(1) Use for control or billing applications.

(2) Ensure vendor is clear on application.

(3) Provide with remote head, display and keyboard.

3. Ultrasonics (strap on)

a. Manufacturers

(1) Fuji

(2) Flexim (refer to Attachment N) (concrete pipe application)

(3) Pulsar

b. Specific Criteria

4. Ultrasonics level

a. Manufacturers

(1) Siemens

(2) Rosemount

5. Insertion (mass flow)

a. Manufacturers

(1) Magnetrol

(2) Sierra

(3) Kurz

b. Specific Criteria

(1) Air

6. Venturi

a. Specific Criteria

(1) Generally, not used in most applications.

(2) Do not use for control.

XXV. Item No. 25

A. RTUs (Remote Terminal Unit)

1. Manufacturers

a. Allen Bradley

b. Emerson-Control Wave

c. Emerson-OCC100

2. Specific Criteria

a. HRSD shall provide.

b. Physical size 24”x24”x8” in a NEMA 4x enclosure

c. Physical size 12”x12”x8” in a NEMA 4x enclosure

XXVI. Item No. 26

A. Louvers/Dampers

1. Manufacturers

a. Greenheck b. Ruskin

2. Specific Criteria

a. Provide gravity dampers for all applications.

b. See Emergency Generators

XXVII. Item No. 27

A. Transfer Switches

1. Manufacturers

a. Eaton

b. Square D

c. ASCO

2. Specific Criteria

a. Nema 12 Enclosure unless required otherwise.

b. IQ Plus Monitoring Device

c. Provide BUS status (A or B) to the DCS

d. Zenith transfer switches are not acceptable.

XXVIII. Item No. 28

A. On-Line Vibration Monitors

1. Manufacturers

a. Bentley-Nevada

2. Specific Criteria

a. Application specific

XXIX. Item No. 29

A. Panel Meters

1. Analog

a. Manufacturers

(1) GE/Yokogawa

(2) Simpson

2. Digital

a. Manufacturers

(1) Yokogawa

(2) Red Lion

(3) Simpson

3. Elapsed Time

a. Manufacturers

(1) Crompton

(2) ENB

(3) Yokogawa

b. Specific Criteria

(1) Non resettable / resettable (plant site specific)

4. Pulse Counters

a. Manufacturers

(1) Acromag

(2) Omron

5. Isolators

a. Manufacturers

(1) Acromag

(2) AGMPhoenix

b. Specific Criteria

(1) Isolate 4-20 MA and 1–5-volt signals

(2) Powered 4-20 MA isolator splitter.

(3) Terminal relay

(4) Compact panel temp sensor 4-20 MA

6. Signal Converters

a. Manufacturers

(1) AGM

(2) RIS

(3) Acromag

b. Specific Criteria

(1) Isolate 4-20 MA and digital.

7. Surge Protectors

a. Manufacturers

(1) Phoenix

(2) MTL-Crouse Hinds

b. Specific Criteria

(1) Provide 120v AC power supply surge protectors.

XXX. Item No. 30

A. Analyzers/Monitors: Safety / Gas

1. Combustible LEL

a. Manufacturers

(1) Detronics

(2) MSA

2. O2

a. Manufacturers

(1) Detronics

(2) MSA

3. SO2

a. Manufacturers

(1) Detronics

(2) Bisulfite

4. H2S

a. Manufacturers

(1) Detronics

b. Specific Criteria

(1) ATI is not used for Safety.

B. Analyzers/Monitors: Process

1. pH
    a. Manufacturers
        (1) Foxboro
        (2) E&H Memosens CPS16D pH probe (Incinerator scrubber water process) (Site Specific/Specific applications)
        (3) M4 Knick (Site Specific/Specific applications)
2. ORP
    a. Manufacturers
        (1) Foxboro
    b. Specific Criteria
        (1) Provide only.
        (2) Stanco not acceptable
3. O2 (Incinerator)
    a. Manufacturers
        (1) COSA
    b. Specific Criteria
        (1) Provide only.
        (2) Operating temperature >1500°F
4. DO
    a. Manufacturers
        (1) Hach
        (2) Insite
    b. Specific Criteria
        (1) Optica
5. CL2
    a. Manufacturers
        (1) Rosemount
        (2) Prominent
        (3) Chemtrac

6. H2S

a. Manufacturers

(1) ATI

7. Conductivity

a. Manufacturers

(1) Hach

XXXI. Item No. 31

A. Miscellaneous Instrumentation

1. PID Controllers

a. Manufacturers

(1) Emerson Ovation

2. Electric Actuators

a. Manufacturers

(1) EIM/Bettis

(2) Limitorque (refer to Attachment P)

b. Note: Verify hazardous classification for small 120V actuators.

c. Specific Criteria

(1) 120 volts and 480 volts AC

3. Burner Actuators

a. Manufacturers

(1) Honeywell

(2) Barber Coleman

4. Alarm Panel

a. Manufacturers

(1) Ronan

5. Temperature Controllers

a. Manufacturers

(1) Yokogawa

XXXII. Item No. 32

A. Miscellaneous Electrical

1. Electrical Equipment Testing

a. Specific Criteria

(1) Provide testing in off-peak hours or switch off an equivalent amount of load prior to testing.

2. One Line Diagram

a. Specific Criteria

(1) Provide an update to the one-line diagram with significant changes in the electrical system.

3. Thermographic Inspection

a. Specific Criteria

(1) Provide a thermographic inspection of the new systems upon completion.

4. Coordination Study/Short Circuit/Arc Flash

a. Specific Criteria

(1) Provide a coordination study short circuit, coordination, and arc flash

(a) analysis for new systems or systems with significant changes.

(2) The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum number of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable. Include Arc flash analysis results for generator protective device.

(3) Contractor must adhere to NFPA 70E Electrical Safety requirements when working on electrical equipment in

HRSD facilities.

(4) Engineer must design electrical systems in accordance with NFPA 70E.

Refer to Attachment A

XXXIII. Item No. 33

A. Heating and Cooling

1. Manufacturers

a. Honeywell

b. Barber Coleman

2. Specific Criteria

a. Louver actuators to be used with building heating/ventilation systems.

b. Provide low head controllers on HVAC Units in MCC Electrical Rooms to prevent AC Unit from tripping during cooler months when the outdoor ambient temperature is low.

XXXIV. Item No. 34

A. Junction/Pull Boxes and Miscellaneous Enclosures

1. Manufacturers

a. Hoffman

b. Saginaw

c. Hammond

2. Specific Criteria

a. Provide PVC coated boxes and/or fittings when using with PVC coated conduit.

B. Administrative Areas

1. Manufacturers

a. Hoffman

b. Saginaw

c. Hammond

2. Specific Criteria

a. NEMA 4

C. Inside

1. Specific Criteria

a. Stainless steel, fiberglass reinforced plastic (FRP), steel, NEMA 4

D. Outside

1. Specific Criteria

a. Stainless steel, NEMA 4x with Myers hubs

E. Wet

1. Specific Criteria

a. Use with PVC coated conduit and PVC coated hubs.

b. Stainless steel, fiberglass reinforced plastic, NEMA 4x with watertight fittings (Myers).

XXXV. Item No. 35

A. Panel Boards/Control Panels

1. Manufacturers

a. Eaton

b. Square D

c. Siemens

d. GE

2. Specific Criteria

a. Provide PVC coated boxes and/or fittings when using with PVC coated conduit.

b. Provide with tin-plated copper bus.

c. Provide 25% spares minimum.

d. Provide bolt in breakers.

e. Do not provide cans with pre-stamped knockouts.

f. Provide with hinged panel cover with a latching door.

g. Provide heavy duty, industrial grade panel boards.

h. Breaker operator should be outside of panel.

i. Breaker should be located inside of panel.

j. HOA switches should be on the outside of panel.

k. Provide dead front hinged panel.

l. Provide LED work light, if warranted

XXXVI. Item No. 36

A. Distributed Control System (DCS)

1. Manufacturers

a. Emerson

2. Specific Criteria

a. Provide fail safe condition within the DCS located in the marshalling cabinet terminal strips.

b. Contact in the field must be wired to a normally closed contact in the energized position. When fault occurs, the contact will open and be displayed as a system failure. This prevents contacts which do not close properly to indicate a fault to the system. A digital status that equals 1 (one) indicates a closed contact and a 0 (zero) indicates an open contact. An open contact occurs when a fault occurs (fail open).

c. DCS DCU's and RIO's shall be equipped with isolation relay junction box(s) (interposing relays) adjacent to all the DCU's and RIO's. The junction box shall contain ample room to house relays; Example: (Idec 5-blade – 24 VDC coils- with a form C configuration contactor) relays mounted on DIN rail for the purpose isolating relay junction box. This junction shall be equipped with a 24 VDC power supply with sufficient capacity to energize all the 24 VDC relay coils simultaneously when necessary for all DCS inputs.
Note: The following HRSD design standards shall be adhered to colors for graphical screens, graphics design, and control functionality. The current HRSD DCS standards are maintained by Industrial Automation within the E&I division. These standards are available upon request.

XXXVII. Item No. 37 - Lightning Protection Refer to NFPA 820 and NFPA 780. - Lightning Protection applications will be site specific (Discuss with HRSD Electrical Staff).

XXXVIII. Item No. 38 - SWIFT (*Refer to Attachment H)*

XXXIX. Item No. 39 - Dominion Energy Coordination (refer to Attachment J)

A. Easements

1. It is imperative that the design engineer contacts the utility company (i.e., Dominion Energy, Rappahannock Power, Prince George Electric Cooperative, etc.) to determine the responsible territory.

2. Design Engineer and HRSD should inquire with the utility company if single phase or 3-phase power is available at the proposed site.

3. Design Engineer should incorporate right-of-way (ROW), multi-use utility easements, identify property owners, and VDOT requirements as part of the preliminary engineering report (PER) to prevent delays and cost increase during the construction phase of the project. The items listed above should be explored in advance especially in rural communities where 3-phase electrical service is not available.

4. See Attachment J for Dominion Project Workflow Brochure "HRSD Interface on New Projects with Dominion Energy Virginia (DEV)

XL. Item No. 40

A. Grounding

"50.53 Grounding Electrode System Installation.
(A) Rod, Pipe, and Plate Electrodes. Rod, pipe, and plate electrodes shall meet the requirements of 250.53(A)(1) through (A)(3).
(1) Below Permanent Moisture Level. If practicable, rod, pipe, and plate electrodes shall be embedded below permanent moisture level. Rod, pipe, and plate electrodes shall be free from nonconductive coatings such as paint or enamel.
(2) Supplemental Electrode Required. A single rod, pipe, or plate electrode shall be supplemented by an additional electrode of a type specified in 250.52(A)(2) through (A)(8). The supplemental electrode shall be permitted to be bonded to one of the following:
(1) Rod, pipe, or plate electrode
(2) Grounding electrode conductor
(3) Grounded service-entrance conductor
(4) Nonflexible grounded service raceway
(5) Any grounded service enclosure

Exception: If a single rod, pipe, or plate grounding electrode has a resistance to earth of 25 ohms or less, the supplemental electrode shall not be required.

(3) Supplemental Electrode. If multiple rod, pipe, or plate electrodes are installed to meet the requirements of this section, they shall not be less than 1.8 m (6 ft) apart."

XLI. Item No. 41 – NFPA 820 Classification

"1. Purpose to provide explosion and fire protection for life property, and operations.
2. Reduce or mitigate the effects of fire or explosion
3. Consult with AHJ (Authority Having Jurisdiction) to ensure that the NFPA 820 standard will be enforced.

NFPA 70 – Article 500

Class I: Flammable Gases/Vapors

Class II: Combustible Dust

Class III: Ignitable Fibers

Wastewater/Treatment/Collections Systems

Class I, Div 1 or 2, Group D (Methane)

Class I, Div 1 or 2, Group G (Sludge)

Wet Well Pump Station

Less than 12 air changes – Division 1 Greater than 12 air changes – Division 2

Typical classified areas: Barscreen, Headworks or Preliminary Treatment Facility, Grit Removal, Odor Control, Sludge Handling and Thickening, etc.

Evaluate equipment type (i.e., explosion proof, conduit seals, etc.)

NFPA 820 4.2.2 – Collections Systems – See Attachment Y

NFPA 820 5.2.2 – Liquid Streaming – See Attachment Z

NFPA 820 6.2.2 – Solids Treatment Processes – See Attachment S

Consideration requirements: exhaust fans, continuous ventilation, alarming, air flow and monitoring."

XLII. Item No. 42 – Standard Details

A. For detailed drawings go to Section 36

Series 700: Electrical and Instrumentation Details

700 – Wet Well Pump Wiring Electrical Backboard Detail
701A/B – Antenna Installation Detail
702A/B – Intrinsic Safety Panel
703 – Temporary Pump Enclosure Detail
704 – Actuator Vault Electrical Backboard Detail
705 – Instrument Vault Electrical Plan
706 – Actuator Vault Electrical Plan
707A/B – Wet Well Instrumentation Installation Detail

XLIII. Item No. 43 - Air Purification – Hydrogen Sulfide (H2S) Mitigation for Electrical Room - See Attachment AA

A. Manufacturer

1. Pure Air or approved equal.

XLIV. Item No. 44 – Backup Battery Systems

A. Manufacturer

1. Liebert (See Attachment BB)

DISTRIBUTED CONTROL SYSTEM (DCS) Electrical and Instrumentation Requirements

I. Strategic Automation Configuration

A. Refer to Attachment Q

Attachments

I. Attachments:

A. Arch Flash Mitigation & Power Study Specifications

B. Load Bank Connections

C. Variable Frequency Drive Specs.

D. Lighting Policy

E. HRSD Electric Motor Specifications

F. Temporary Portable Pump Alarms & Setup Standards

G. SCADA Site Drawings

H. SWIFT Requirements

I. Ductbank Directions

J. Dominion Energy Coordination

K. SCADA Flowchart

L. Remote Switch Operator

M. Remote Open-Close Operator Panel

N. Ultrasonics Technical Information

O. Limitorque

P. Waterpilot FMX-21 Technical Information

Q. Strategic Automation Configuration Guide

R. Controlwave & Telog Wiring Details

S. Solids Treatment Processes

T. Wet Well Pump Wiring Electrical Backboard Detail

U. Antenna Installation Detail

V. Intrinsic Safety Panel Details

W. Actuator Vault Electrical Backboard Detail

X. Wet Well Instrumentation Installation Detail

Y. Collections Systems

Z. Liquid Streaming

AA. Hydrogen Sulfide Mitigation for Electrical Room

BB. Backup Battery Systems

CC. Cable Routing Disconnect

DD. Manufacturers List