

## EQUIPMENT DESIGN BASIS

### I. SUMMARY

*<Sample Design Basis is provided for reference. Edit as required per specific project.>*

This section summarizes the design criteria of new equipment in the project. All process conditions for equipment design are based on material balances included in this report. Materials of construction and design temperatures and pressures shall be in accordance with the Materials of Construction (MOC) section of this report and the MOC Diagram.

### II. EQUIPMENT DESIGN CRITERIA

#### A. Vessels (General)

1. ASME Section VIII Division I.
2. 6' minimum support height for skirted vessels.
3. 5 minutes minimum holdup to normal liquid level; 2 minutes LLL to HLL.
4.  $K = 0.1$  maximum for vapor-liquid separation by gravity in open vessels.

#### B. Tower Trays

1. H2S Stripper
  - a. Float-valve type to minimize weeping and improve operating range.
  - b. Utilize existing tray and downcomer supports.
  - c. 1-psi vertical uplift.
  - d. Tray decks shall be 14-gauge minimum thickness, 410S SS construction.
2. Recycle Hydrogen Amine Contactor
  - a. Single-pass with float-valves to maximize operating range.
  - b. Tray decks shall be 14 gauge minimum thickness, 316L SS construction.
  - c. Arranged on 24" spaces.

#### C. Pumps

1. Design flow rate for new pumps shall be a minimum of 10% greater than the normal operating requirement.
2. New pumps in sour service shall be equipped with tandem seals.
3. New pumps in sour service shall be NACE MR0175-99 compliant (minimum).

#### **D. Shell & Tube Exchangers**

1. ASME Section VIII Division 1, TEMA Class R.
2. New exchangers: 15% excess surface area over that required for normal operation.
3. Minimum velocity of 3 fps for cooling water in carbon steel exchanger tubes.
4. Fouling factors for exchangers per TEMA standards (cooling water = 0.002).

#### **E. Air Coolers**

ASME Section VIII Division 1 and API-661

#### **F. Recycle Gas Filter/Coalescer**

1. Two-stage horizontal type filter coalescer
2. Minimum performance to remove 95% of 0.3 micron diameter solid and liquid particles.
3. Maximum pressure drop to be 10 psi in dirty service.

#### **G. Diesel Product Coalescer**

1. Horizontal type with water phase boot.
2. Product at 120-wppm soluble and 200-wppm insoluble water content at design rate.

#### **H. Diesel Product Salt Dryer**

1. Feed stream based on coalescer product specification.
2. Single dryer vessel sized to handle 100% design rate.
3. Product with 70-wppm soluble water content and 100% removal of insoluble water.
4. Vessel sizing based on 60-days of salt volume and nominal 50-fph superficial flow velocity (calculated velocity is 51 fph).

#### **I. Cold Charge Filters**

1. Horizontal cartridge-type liquid filters.
2. Normal feed rate is 20% of charge with a maximum rate of 100% charge at design rate.
3. Maximum pressure drop of 5 psid (clean) and 15 psid (dirty).
4. Removal efficiency at 100% of 75 micron (to be confirmed in detail design engineering).

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## PIPING DESIGN BASIS

### I. SUMMARY

The following section summarizes the primary design basis for the specification and installation of process and utility piping for this project.

### II. SPECIFICATIONS AND STANDARDS

#### A. Applicable Standards

ASME Code for Pressure Piping, Chemical Plant and Petroleum Refinery Piping, ASME B31.3

#### B. Piping Services

Piping services and associated specifications for this project are summarized in Table \_\_\_\_.

#### C. Piping Specifications

Table \_\_\_\_ . Summary of Process Industries Practices (PIP) Specifications

PIP SPEC	SERVICE
1CH2S01H	Amine
3CH2S01H	Amine
6CH2S01H	Amine
12CB2T01	Cooling Water
12CB2T01	Cooling Water
3CB2S01	H2 and H2/HC Mix (H2 PP > 100 psia)
6CB2S01	H2 and H2/HC Mix (H2 PP > 100 psia)
6CB4S01	H2 and H2/HC Mix (H2 PP > 100 psia)
6CJ1S01	H2 and H2/HC Mix (H2 PP > 100 psia)
9SL1S01	H2 and H2/HC Mix (H2 PP > 100 psia)
3CB4S01	HC Liq (Non-coking) (Corrosive)
1CB2S01	HC Liq/Gas/Vap
6CB4S01	HC Liq/Gas/Vap
9CB2S01	HC Liq/Gas/Vap
1CB2S01	HC Liq/Gas/Vap (Non-coking)
3CB2S01	HC Liq/Gas/Vap (Non-coking)
1CB1S01	Nitrogen
12CG1G01	Instr / Plant Air
1CH2S01H	Sour Water
6CH2S01H	Sour Water
3CB1S02	Strm/Cond/BFW/PrW (Non-corrosive)

### III. PROCESS LINES

#### A. Process Line List

Process lines for the project are indicated in the Process Line List.

#### B. Hydraulics

Velocity & Pressure drop guidelines per Burns&McDonnell standards.

#### C. Piping Tie-Ins

The Tie-In List indicates key information about each piping tie-in. Work Notes identify construction activities required to complete the tie-in. Approximate tie-in locations are indicated on the preliminary piping One-Line drawing.

#### D. Piping Specials

1. Steam Tracing:
  - a. Installed in accordance with PIP.
  - b. Steam tracing and trap manifolds shall be tagged and fully documented with provisions for 20% spare capacity.
  - c. Instrumentation and controls shall be steam traced and insulated to meet the minimum temperatures specified in the Instrument Design Basis.
  - d. Tracing runs shall be pre-insulated stainless steel tubing.
2. Steam traps:
  - a. Installed in steam lines in accordance with PIP standards, a minimum of every 350' linear distance.
  - b. Armstrong Series 2011 stainless steel traps for 20-psig and 250-psig steam systems
  - c. Instruments require 20-psig steam tracing.
  - d. Pre-Assembled tracer & trap manifolds require design for replacement of individual valves.
3. Safety Shower/Eye Wash Stations shall be in accordance the Owner's requirements.

4. Utility Hose Stations to include:

- a. 250-psig Steam
- b. Plant air
- c. Service Water
- d. 110V Electrical receptacle

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# CIVIL / STRUCTURAL / ARCHITECTURAL DESIGN BASIS

## I. SUMMARY

*<Sample Design Basis is provided for reference. Edit as required per specific project.>*

The following is a brief description of the design codes, loads, basis and assumptions used for the Civil/Structural design and for installation and construction of equipment and structures for the FEL Scope.

## II. DESIGN

### A. Applicable Building Codes

1. 1999 BOCA National Building Code.
2. 2000 Life Safety Code (NFPA 101 – 2000)

### B. Structural Design Codes

1. ASCE 7-98, Minimum Design Loads for Buildings and Other Structures. (The more stringent provisions of the 1999 BOCA Code shall apply)
2. ACI, American Concrete Institute.  
318, Building Code Requirements for Structural Concrete, 1989  
301, Specifications for Structural Concrete for Buildings
3. 3. AISC Manual of Steel Construction, Allowable Stress Design, 9th Edition, 1989

### C. Civil/Structural Standards, Specifications, Drawings and Guidelines

The following Process Industry Practices (PIP) are to be included in the Civil/Structural/Architectural design basis.

1. STC01015-OVLY Structural Design Criteria, Issue 1, Date 10/2001, and PIP STC01015 Structural Design Criteria dated December 1998.
2. CVS02100-OVLY Site Preparation, Excavation, and Backfill Specification, Issue 1, Date 10/2001, and PIP CVS02100 Site Preparation, Excavation, and Backfill Specification dated May 2001.
3. CVS02010-OVLY Geotechnical Engineering Investigation Specification, Issue 1, Date 10/2001, and PIP CVS02010 Geotechnical Engineering Investigation Specification, dated July 1997.
4. STF05501-OVLY Fixed Ladders and Cages, Issue 1, Date 11/2001, and PIP STF05501 Fixed Ladders and Cages, dated December 1999 (Technical Correction August 2000.)
5. STS05120-OVLY Fabrication of Structural and Miscellaneous Steel Specification, Issue 1, Date 10-2001, and PIP STS05120 Fabrication of Structural and Miscellaneous Steel

Specification, dated January 2000.

6. STS05130-OVLY Erection of Structural and Miscellaneous Steel Specification, Issue 1, Date 10-2001, and PIP STS05130 Erection of Structural and Miscellaneous Steel Specification, dated December 1998.
7. STS02360-OVLY Driven Piles Specification, Issue 1, Date 10-2001, and PIP STS02360 Driven Piles Specification, dated June 2001.
8. STS02380-OVLY Standard Specification for the Construction of Drilled Piers, Issue 1, Date 10-2001, and PIP STS02380 Standard Specification for the Construction of Drilled Piers, dated July 1996.
9. STS02465-OVLY Augered Cast-In-Place Pile Specification, Issue 1, Date 10-2001, and PIP STS02465 Augered Cast-In-Place Pile Specification dated April 1999.
10. STS03001-OVLY Plain and Reinforced Concrete Specification, Issue 1, Date 10-2001, and PIP STS03001 Plain and Reinforced Concrete Specification, dated December 1995.
11. STS03600-OVLY Cementitious Grout Specification, Issue 1, Date 10-2001, and PIP STS03600 Cementitious Grout Specification, dated November 1996.
12. STS03601-OVLY Epoxy Grout Specification, Issue 1, Date 10-2001, and PIP STS03601 Epoxy Grout Specification dated November 1996.
13. PIP CVS02700 Underground Gravity Sewers, April 1995.
14. PIP CVE02705 Engineering Guide Double Contained Sewers (Pipe in Pipe Systems), dated December 1995.

#### **D. ADA Criteria**

ADA guidelines for this project are not applicable, nor pertinent, and no accommodations will be included in or as part of the design.

## **E. Wind Loads**

1. Basic Wind Speed = 90 MPH.
2. Occupancy Category III, Importance Factor I = 1.15.
3. Exposure Category = C.
4. Wind loads shall be determined per the referenced Building Codes, and the ASCE Guidelines for Wind Loads and Anchor Bolt Design for Petrochemical Facilities.

## **F. Seismic Loads**

1. Occupancy Category III, Seismic Use Group II, Importance Factor I = 1.25.
2. Seismic Soil Profile Type D has been assumed for the site.
3. The design requirements of the applicable Building Codes shall govern the design, detailing requirements, and structural component load effects, and the requirements for foundation, steel and structural concrete.

## **G. Snow Load**

Ground Snow Load  $P_g = 10$  psf.

## **H. Live Loads**

1. Walkways and operating platform live load = 75 psf
2. Fixed stairway and equipment maintenance flooring = 100 psf.
  - a. Fixed stairways shall be designed to carry a moving concentrated load of 1000 pounds or five times the normal live load anticipated, whichever is greater.
  - b. Platforms and structures used for storage = 150 psf minimum or actual load.
3. Roads and site paving loading per ASHTTO-24, or 6 inch minimum concrete paving thickness.



## **I. Equipment Loads**

1. Equipment structures and foundations shall be designed for equipment empty, operating, test or hydrotest, thermal, bundle pulling, impact, dynamic, and other loads, appropriate for the type of equipment and the petrochemical industry standards.
2. No hoists, cranes or davits are included.

## **J. Pipe Rack and Equipment Structure Loads**

1. Pipe racks and T-stands shall be designed for piping and cable tray dead loads as follows:
  - a. A uniformly distributed load of 40 psf for each pipe level, unless actual pipe loads are greater.
  - b. For any pipe 12 inches or larger, use actual concentrated load.
  - c. Environmental loads, thermal, pipe anchor loads, and other special loads shall be included.
  - d. Hydrotest of specific large diameter pipes will be included as appropriate.
2. Additional loads for equipment, platforming, etc. supported by pipe racks shall be considered.
3. No specific designs are included for reinforcements, modifications or repairs to the existing pipe racks and pipe/electrical supports. New supports, brackets, tiers and attachments have been added to the existing supports on the assumption that the existing supports and their foundations will adequately support the added loads, based on preliminary assessments and evaluations of these supports.

## **K. Foundations**

1. Allowable net soil bearing capacity of 4000 psf for foundations will be used.
2. Minimum frost depth shall be 2 feet below grade.
3. Drilled pier type foundations may be used, using the following assumed design parameters:  
An allowable pier bearing capacity of 10 kips per square foot, at a minimum depth of 35 feet, plus the frictional strength of 500 psf along the length of the shaft.
4. Additional new foundations are included for pumps to replace existing or for new services.

## **III. DETAILS & MATERIALS OF CONSTRUCTION**

### **A. Structural Steel**

1. Structural steel shall be ASTM A572 or A992 Grade 50, hot dipped galvanized after fabrication.
2. Bolts shall be ASTM A325 bolts, Type 1.
3. Fireproofing of structural steel shall be shop-applied concrete and/or proprietary lightweight Pyrocrete. Fireproofing is included for the following structures:
  - a. Equipment support structures, pipe racks and piping/electrical supports in the Flare Gas

Recovery Unit and Flare Gas Knockout Drum areas.

- b. No other areas or structures and supports shall be fireproofed.
4. All elevated exterior flooring shall be serrated galvanized bar grating.
5. Structural connections, ladders and cages, handrails, stairs, etc. shall comply with the referenced Standards, Specifications, and Drawings.

## **B. Concrete**

1. Minimum compressive strength ( $f_c$ ) shall be 4000 psi for structures, and 3,000 psi for paving and foundations.
2. Reinforcing steel shall be ASTM A615, Grade 60, and welded wire fabric shall be ASTM A185.
3. Anchor bolts shall be ASTM A307 or fabricated from ASTM A36 grade material, hot dipped galvanized after fabrication.

## **IV. SITE WORK**

### **A. Demolition and Site Preparation**

1. Demolition, site preparation, excavation, backfill, earthwork, grading, exploratory excavations and backfill is required.
2. Field surveying for elevations and coordinates per plant datum of existing above and underground structures and obstructions, including utilities and sewers is required.
3. No site work, demolition, site preparation, paving and curbing, storm drainage or sewers, etc. is included for OSBL areas where piping tie-ins are to be made, or adjacent plant areas.
4. Sitework for the Heavy Lift Construction Crane will include temporarily blocking off of storm sewer inlets, backfilling, compaction, and placement of crushed rock surfacing. Included also will be the removal of the temporary fill, and returning the area to its present elevations and surface conditions.

### **B. Paving and Containment**

1. New concrete paving will be provided within the operating equipment areas for containment and for repair of areas that are damaged by demolition work. Adjacent areas will be surfaced with crushed rock.
2. Concrete containment curbing will be provided for oil containment in the areas with new pumps. No special coatings are included for contained fluids.

## **V. SEWERS**

### **A. Storm Sewer**

1. No tie-ins or modifications to the storm water system are included.

**B. Oily Water Sewer**

1. No underground tie-ins, additions or modifications to the oily water sewer system are included.

**C. Sanitary Sewer**

1. No underground tie-ins, additions or modifications are included.

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# ELECTRICAL DESIGN BASIS

## I. SUMMARY

*<Sample Design Basis is provided for reference. Edit as required per specific project.>*

This section summarizes the design, manufacturing, and installation requirements of electrical systems and equipment in the project.

## II. APPLICABLE STANDARDS

- NFPA 70 - National Electrical Code (NEC), 2002
- Underwriters Laboratories, Inc. (UL) – 1277 Power and Control Tray Cables
- Sinclair Oil Corporation Standards and Details

## III. DESCRIPTION OF SYSTEMS

### A. Power Distribution Systems

#### 1. Primary Power Distribution

- a. The connected load added by this project is estimated at 1000 kVA.
- b. New Loads consist of the following:
  - P-001A/B - Lean Amine Booster Pumps
  - P-002A/B – Stripper Reflux Pumps
  - P-003A/B – Recycle Wash Water Pumps
  - EA-003A/B/C/D – Cooler Fans
  - Emergency and normal lighting panel systems.
  - Welding Outlets (2).

#### 2. 480V Power Distribution

Power for process motors and facilities will be distributed through 480V SWITCHRACK, 1LCL (B)-004 located locally.

#### 3. 120/208V Power Distribution

Receptacles, general lighting and miscellaneous 120/208V loads will be served from a new panelboard located on 480V SWITCHRACK, 1LCL (B)-004. A new 480-120/208V dry type distribution transformer will be supplied near the panelboard to step the voltage down.

#### 4. 120/208V Emergency Power Distribution

Emergency lighting will be served from a new emergency lighting system located on 480V SWITCHRACK, 1LCL (B)-004.

5. 480V Area Lighting
6. Instrument Power Distribution
  - a. 120V Power – Instrument power will be served from a panelboard located on 480V SWITCHRACK 001, 1LCL (B)-001.
  - b. Analog loop wiring
    - (1) The 4-20 mA instrument loops will be wired to a local field junction box using No. 16 AWG twisted shielded pair cabling.
    - (2) The local field junction box will be wired to terminal strips in the I/P cabinet located in the Control Room using multi-conductor cable using No. 18 AWG twisted shielded pair cabling.
    - (3) Shields will be grounded in the I/P cabinets, terminated at the field junction box and taped at the instruments. Shield continuity will be maintained throughout.
  - c. Digital Instrument Wiring
    - (1) All digital instrumentation wiring will be 120VAC or 24V DC.
    - (2) Digital instrumentation will be wired to a local field junction box using No. 14 AWG conductor.
    - (3) The local digital junction box will be wired to terminal strips in the Digital cabinet located in the Control Room using No. 16 AWG multi-conductor cable.
    - (4) Wiring for all 120-volt circuits will be kept separate from wiring for 24-volt signal circuits.

## **B. Electrical Area Classification**

Class I, Division 2, Group D

## **C. Grounding**

1. Grounding will consist of a complete grid system for the new equipment. The grid system will tie into the existing grid system at two locations. Refer to Drawing 11S-2372-4.
2. Driven rods, 3/4" x 10' copper, refer to Figure 5 on drawing 11S-1181-7.
3. Ground rods will be interconnected with 1/0 bare copper conductor. All connections below grade will be mechanical crimp compression type.
4. Structural steel equipment and pipe columns will be connected to the ground loop with 1/0 AWG risers, using mechanical crimp compression type connections to the ground grid and bolted connections to the structural steel.
5. A ground test wells will be provided, refer to Figure 6 on drawing 11S-1181-7.

## **D. Lighting**

1. Outdoors – General Task Lighting
  - Fixture Type: RIG-A-LITE type SAF
  - Fixture Type: 175-Watt Metal Halide
  - Fixture Voltage: 120VAC
  - Illumination Level: 7 - 10 fc
  - Options: Globe and guard, standard dome reflector
  - Switching: At panelboard
2. Outdoors – Emergency Lighting
  - Fixture Type: RIG-A-LITE type SAF
  - Fixture Type: 175-Watt Metal Halide
  - Fixture Voltage: 120VAC
  - Illumination Level: 1 - 3 fc
  - Options: Globe and guard, ballast housing painted red.
  - Switching: At panelboard
3. Outdoors – Area Floods
  - Fixture Type: RIG-A-LITE type AFL
  - Fixture Type: 400-Watt Metal Halide
  - Fixture Voltage: 480VAC
  - Illumination Level: 1 - 3 fc
  - Switching: Photocell/lighting contactor
  - Pole Height: 20 feet
  - Pole Material: Galvanized Steel

## **E. Communication Systems**

- 1 Telephone – None
- 2 Paging System – None
- 3 Fire Alarm – None

## **F. Electric Heat Trace**

1. Electrical heat tracing will be provided for freeze protection of process piping and impulse tubing lines as required.
2. Heat trace cable will be self-regulating type, controlled by an ambient sensing thermostat.

## G. Installation

1. The 480V feeders to Switchracks will be installed using conduit.
2. Wiring for process motors and instrumentation will be installed using conduit.
3. Galvanized rigid steel conduit will be used in all areas.
4. Minimum conduit size is ¾”.
5. For determining convenience receptacle location assume a 50-foot extension cord.
6. Refer to drawing 11S-1183-11 for typical stanchion light installation details.
7. Top entry to electrical enclosures in process areas will be avoided. Myers hubs or sealing locknuts will be used where top or side entry is necessary.
8. Conductors will be sized for maximum allowable voltage drop of 5% with 3% maximum on branch circuits.
9. Minimum Conductor size
  - a. Power and lighting circuits: No. 12 AWG.
  - b. Control circuits: No. 14 AWG.
  - c. Instrumentation: No. 18 AWG.
10. Single conductor cables and multiple conductor cables for power and control will be stranded copper, rated 600V, Type TC with PVC insulation as follows:
  - a. No. 4 AWG and larger: XHHW-2
  - b. No. 6 AWG and larger: THHN/THWN
11. Multiconductors will be Type TC or PLTC, stranded copper, with PVC jacket.  
Insulation level will be 600V for power and control, and 300V for instrumentation.
12. Enclosures in process area will be NEMA 4X, aluminum with stainless steel clamps and a continuous hinge door.
13. Refer to drawing 11S-1186-9 for installation details for motors and local motor control pushbutton stations.

## H. Equipment

1. 480-volt Switchrack
  - a. Manufacturer: OZ/Gedney
  - b. Class 497 Switchrack: Structural Steel, hot-dip galvanized.
  - c. Class 640 Sheet Metal Ducts
    - (1) Enclosure hot-dip galvanized.
    - (2) Three-phase, with ground bus.
    - (3) Drain and breather fittings.

- (4) Type 3R enclosure fully gasketed.
2. Switchrack Motor Starters
    - a. Manufacturer: OZ/Gedney, Type NEB.
    - b. 480V, 3 phase, 60 Hz rated.
    - c. NEMA Type 7 bolted enclosure.
    - d. Full voltage combination type.
    - e. Size as indicated.
    - f. Explosionproof, dust-ignitionproof, and watertight.
    - g. Square D starter and circuit breaker.
    - h. Circuit breaker to be thermomagnetic.
    - i. No solid state electronic devices allowed.
    - j. Operating voltage is 120Vac using an internal CPT.
    - k. Drain and breather fittings.
  3. Circuit breakers.
    - a. Manufacturer: OZ/Gedney, Type NEAB.
    - b. 600V, 3 phase, 60 Hz rated.
    - c. Size as indicated.
    - d. NEMA Type 7 bolted enclosure.
    - e. Explosionproof, dust-ignitionproof, and watertight.
    - f. Square D circuit breakers.
  4. Receptacles
    - a. Welding Receptacles:
      - Manufacturer: Crouse-Hinds
      - Model: EPC-61042-WT100-3.
      - Rated 100-amperes, 3-wire, 4-pole, with spring door.
    - b. Convenience Receptacles:
      - Manufacturer: Crouse-Hinds
      - Model: CES-2213.
      - 30-amperes, 2-wire, 3-pole, 1-phase.
  5. Local "START/STOP" Control Stations for Motors.
    - a. Manufacturer: Crouse-Hinds.
    - b. Model: EFS with padlock feature.
    - c. Explosionproof, dust-ignitionproof, and watertight.



- d. Green pushbutton – START.
  - e. Red pushbutton – STOP.
  - f. Refer to drawing 11S-1186-9 for installation instructions.
6. Junction Boxes
- a. The analog and digital field junction termination boxes are to be identical.
  - b. Enclosures will be NEMA 4X aluminum.
  - c. Enclosure dimensions are 30" x 24" x 6".
  - d. Continuous hinge door.
  - e. Stainless steel door clamps.
  - f. Terminals to be numbered consecutively.
  - g. Include subpanel.
  - h. Drain and breather fittings.
7. 120/208-volt Panelboards
- Lighting and Receptacle Panelboard and Emergency Lighting Panelboard
- a. Manufacture: OZ/Gedney
  - b. Class 613
  - c. 120/208-volt, 3-phase, 4-wire, 60-hertz.
  - d. 24-circuit, main lugs only.
  - e. Twenty-four 1-pole, 20 ampere circuit breakers.
  - f. Options: Drain and Breather fittings.
8. 480-volt Area Lighting Panelboard
- a. Manufacturer: OZ/Gedney
  - b. Class 612
  - c. 600-volt, 3-pole, 60-hertz.
  - d. 24 pole.
  - e. Twelve 2-pole, 600-volt, 20-ampere circuit breakers type EHD.
  - f. Options: Drain and Breather fittings.
9. Lighting Contactor and Photocell
- a. Contactor: OZ/Gedney Type NEB with HOA switch.
  - b. Control voltage 120-volts ac.
  - c. Contactor rated for 480-volts, 3-phase, and 100-amperes.
  - d. Photo cell: Precision Model ST-15EP, explosion proof, 120-VAC, 1800VA

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# INSTRUMENT AND CONTROLS DESIGN BASIS

## I. SUMMARY

*<Sample Design Basis is provided for reference. Edit as required per specific project.>*

The purpose of this section is to summarize the design, manufacturing, and installation requirements of the process instrumentation and controls systems in the project.

## II. APPLICABLE STANDARDS

- NFPA 70 - National Electrical Code (NEC), 2002
- Instrumentation, Systems, and Automation Society (ISA)
- Sinclair Oil Corporation Standards and Details

## III. INSTRUMENTATION

### A. General

1. Smart transmitters when available for the specific application.
2. Wetted parts of instruments same material as associated piping and vessels, unless specified otherwise.
3. Units:
  - Temperature deg. F
  - Flow (Gas) SCFH, SCFM
  - Flow (Liquid, Solids/Steam) GPM, lb/hr
  - Pressure psig, psia, inH2O
  - Density (Liquid) Sp.Gr.
  - Viscosity Centipoise
4. Hazardous Area Classifications: See Electrical Design Basis.
  - a. Field mounted devices in unclassified areas: NEMA 4 or 4X enclosures.
  - b. Devices in classified areas conform to Code requirements.
5. Instrumentation designed for future control system upgraded to a system capable of handling the following signals:
  - Analog 4-20mA @ 24-volts DC
  - Discrete 24-volts DC
  - Temperature Type-J Thermocouples

6. Transmitter ranges: normal operating conditions within 50 to 85 percent of calibrated range and factory calibration.
7. Indicator and gauge ranges: normal operating condition is indicated at approximately mid-scale and conform to manufacturer's standards.
8. Permanently attached stainless steel tag.
9. Preferred instrument manufacturers are shown in Table \_\_\_\_.

## **B. Valves**

1. Modulating control valves:
  - a. Globe-style or Angle, single-port, plug- or cage-style trim: Clean process fluids, steam, water, and condensate.
  - b. Butterfly: Low pressure drop process fluids and utilities.
  - c. Ball: Erosive or viscous fluids and slurries.
  - d. Spring and diaphragm type actuator (except where high force requires piston type).
  - e. Connections and Materials
    - (1) Globe – flanged
    - (2) Butterfly and ball – flangeless or wafer style.
    - (3) Materials to conform to the piping specifications and as required for the service conditions.
  - f. Positioners:
    - (1) Electro-pneumatic type, with gauges and air filter regulator
    - (2) Tubed and mount on actuator.
    - (3) Applications
      - Slow responding systems
      - Split-range control
      - Where increased thrust is required
      - For improved response to rapid disturbances
      - No positioner for fast systems.
  - g. No brass or copper alloy is allowed in the valve construction
2. Actuators sized for maximum air supply pressure of 60 psig.

## **C. Flow Measurement**

1. Flow Monitoring Service:
  - Process (Conductive)      Magnetic Flowmeter
  - Hydrocarbon Oil          Orifice Plate

- Steam, Gas                      Orifice Plate or Vortex Flowmeter
  - Process Water                 Orifice Plate or Magnetic Flowmeter
  - Well Water or Alcohol       Positive Displacement Flowmeter
  - Air                                 Pitot Tube or Thermal Dispersion
  - Slurries                          Mass Flowmeter
2. Orifice plates for use with flange taps.
  3. Flow switches will not be used.
  4. Rotameters on seal water for pumps and seal air for rotary valves and conveyors. Needle valves for flow control dependent on the size of the rotameter and the service.
  5. Mass flow Coriolis-type meters when both flow and density measurements are required.

#### **D. Level Measurement**

1. Flange-mounted, magnetic level gauges with attached magnetostrictive level transmitters. 2" flange process connection. Gauge and valve materials in accordance with applicable pipe specification.
  - a. Extended diaphragms for slurry service.
  - b. Flush diaphragms for clean service.
  - c. Remote capillary connection for top of pressurized vessels.
2. For applications with varying density fluids or where a non-contacting method is required – ultrasonic or radar technology (3"/4" nozzle process connection).
3. Level switches not permitted.

#### **E. Temperature Measurement**

1. Temperature elements direct-connected to (future) DCS for indication purposes. Transmitters not permitted.
2. Thermowells – materials and process connections in accordance with applicable pipe specification.
3. Primary elements – Type J thermocouples.
4. Local indicators
  - a. Bi-metallic type with every-angle stem
  - b. 5-inch dial size
  - c. White background with black marking.
5. Multi-point thermocouples – flex type (to maximize the amount of measuring points possible)

## **F. Pressure Measurement**

1. Manifolds for pressure transmitters with non-sealed systems. Manifolds for remote-mounted transmitters to include mounting bracket for pipe-stand mount.
2. Chemical seals furnished as an integral part of the pressure device.
3. Pressure switches not permitted.
4. Local indicators
  - a. Bourdon tube type with 1/2" lower back connection and 4 1/2" dial
  - b. White background with black marking
  - c. Gauge root valve for isolation from the process
  - d. Primary element – 316SS

## **G. Analytical Instrumentation**

Sulfur Analyzer complete with shelter

# **IV. INSTRUMENT INSTALLATION**

## **A. Tubing and Piping**

1. Instrument Air
  - a. Main air header within 25 feet of the instruments.
  - b. Branch or subheader with isolation valve to supply a maximum of five instruments.
  - c. Pipe to within four feet of the user; stainless steel tubing (3/8" minimum) to instrument.
2. Stainless steel tubing process sensing lines for remoted mounted instruments.
3. Piping materials in accordance with applicable piping specifications
4. Tubing, fittings, and valves will be according to instrument installation specifications.
5. Tubing fittings – multi-piece, compression type.

## **B. Special Considerations**

1. Temperature, level, and pH transducers located near the bottom of the straight wall of tanks.
2. In-line pH analyzers located in pipe tees where velocities permit (max of 8 fps).
3. Instruments accessible from a standing position on floor or platform.

\* \* \* \* \*

# INSULATION DESIGN BASIS

## I. SUMMARY

This section describes the design basis for insulation of equipment and piping.

## II. REFERENCE

- PIP INEG1000 Insulation Design and Type Codes

## III. EQUIPMENT

Vessels (head and shells) shall be insulated with calcium silicate material and clad with aluminum jacket. Insulation thickness to be in accordance with PIP practice.

## IV. PIPING

Piping shall be insulated with calcium silicate material and clad with aluminum jacket. Insulation thickness is indicated on the Line List.

\* \* \* \* \*

# PROTECTIVE COATINGS DESIGN BASIS

## I. SUMMARY

This section describes the design basis for protective coatings; i.e., painting, galvanizing, and fireproofing, for structural steel, piping, and equipment. The coatings for this project shall be in accordance with Process Industry Practices (PIP) Coatings, Insulation and Refractory practices.

## II. REFERENCES

- PIP CTCE1000 External Coating System Selection Criteria
- PIP CTCE1001 Severe Environment Selection Criteria
- PIP CTSE2001 External Coating Systems Data Sheet Inorganic Zinc
- PIP CTSE2004 External Coating Systems Data Sheet - Epoxy Phenolic
- PIP CTSE2012 External Coating Systems Data Sheet - Heat-Cured Silicone (2 Coats)
- PIP CTSE2013 External Coating Systems Data Sheet - Epoxy Mastic for Mfr's Standard
- PIP CTSE2015 External Coating Systems Data Sheet - Inorganic Zinc/Epoxy Mastic/Urethane
- PIP CTSE2018 External Coating Systems Data Sheet - Epoxy Mastic (2 Coats)/Urethane
- PIP CTSE2020 External Coating Systems Data Sheet - Epoxy Phenolic (2 Coats)
- PIP CTSE2024 External Coating Systems Data Sheet - Epoxy Mastic/Urethane

## III. STRUCTURAL STEEL

### A. Galvanizing

Structural steel, miscellaneous steel, pipe shoes, vessel clips, and surfaces shall be galvanized to the maximum extent in accordance with PIP CTCE1000 External Coating System Selection Criteria and PIP CTCE1001 Severe Environment Selection Criteria.

### B. Fireproofing

Fireproofing shall be based on a 2.5-hour fire resistive rating in accordance with Underwriters Laboratory 1709. All vessel skirts and supporting structural steelwork shall have fireproofing up to 35 feet above grade. Vertical and horizontal members of pipe racks shall be fireproofed up to 50 feet.

#### **IV. PIPING AND EQUIPMENT**

Piping and equipment to be painted in accordance with PIP CTCE1000 External Coating System Selection Criteria and PIP CTCE1001 Severe Environment Selection Criteria.

\* \* \* \* \*



# **COST ESTIMATE BASIS**

## **I. SUMMARY**

The Factored Cost Estimate was developed using the project definition documents including, Project Description, Piping and Instrument Diagrams (P&IDs), General Arrangements, Equipment Data Sheets and associated supplier proposals. The estimate includes a contingency of 15-20%. Owner costs are not included.

## **II. EQUIPMENT**

Equipment costs are based on process data sheets and competitive proposals from multiple suppliers during the period of this FEL-2 project. Selected equipment costs are typically the HIGH price of the multiple proposals plus a design allowance of 10-15% to account for items which are not specified in the preliminary data sheets<sup>1</sup>.

## **III. FACTORED COSTS**

Factored costs for equipment installation are based on selected equipment prices and in-house experience for similar projects. The Factored Cost Estimate Backup Sheet, Table \_\_, includes a "breakdown" of the installation factor by contractor trade; e.g., piping, concrete, steel, and etc.

## **IV. OUTSIDE OF FACTOR COSTS**

## **V. INDIRECT COSTS**

Indirect costs include Engineering, Construction Management, General Conditions, Contingency, and etc. Total contingency is estimated at 15-20% of the total project cost.

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<sup>1</sup> Due to widely fluctuating materials pricing indices when this report was published, materials costs should be closely evaluated at the time of project approval.