Process Safety Management of Highly Hazardous & Explosive Chemicals

Technology of the Process & Equipment in the Process
Technology of the Process

1910.119(d)(2)
Information concerning the technology of the process shall include at least the following:

A block flow diagram or simplified process flow diagram (see Appendix B to this section), Process Chemistry, Maximum Intended Inventory, Safe upper and lower limits for such items as temperatures, pressures, flows or compositions; and an evaluation of the consequences of deviations, including those affecting the safety and health of employees.
Technology of the Process

- Block flow diagram or process flow diagram
- Summarizes the Chemical Process Operation in a Clear Form
- Can Be Simple or Complex Depending on the Covered Process
- Typically Performed by Process Engineers
Simple Block Flow Diagram

- **O₂ Storage**
- **O₂ to the atmosphere**
- **Electrolysis**
- **Pump** P= 200atm
- **H₂O**
- **H₂**
- **TANK HYDROGEN STORAGE**
- **FC**
- **O₂ from the atmosphere**
- **220/380/50Hz**
- **AC**
- **GRID**
Complex Block Flow Diagram

- Finished products are shown in blue.
- Sour waters are derived from various distillation tower reflux drums in the refinery.
- The "other gases" entering the gas processing unit includes all the gas streams from the various process units.
Block Flow Diagrams Can be Part of Automated Control Systems
Equipment in the Process

1910.119(d)(3)

Information pertaining to the equipment in the process shall include: Materials of Construction, piping & instrumentation drawings (P&ID’s), Electrical Classification, Relief System Design & Design Basis, Ventilation System Design, Design Codes & Standards Employed, Material & Energy Balance for processes built after May 26, 1992, Safety Systems
Equipment in the Process

- Materials of construction
- Process and instrument diagrams (P&ID’s)
- Electrical classification
- Relief system design
- Ventilation system design
- Design codes
- Material and energy balances
- Safety systems
Chemical processes are covered by many codes for design, construction, inspection & testing, quality assurance and other requirements.
Design Codes

- ANSI/API Std 2015-1994 Safe Entry and Cleaning of Petroleum Storage Tanks, Planning and Managing Tank Entry from Decommissioning Through Recommissioning
- ANSI/API Std 500-1992 Classification of Locations for Electrical Installations at Petroleum Facilities
Design Codes

- RP 752. Management of Hazards Associated With Location of Process Plant Buildings, CMA Manager's Guide,
- RP 2003. Protection Against Ignitions Arising Out of Static, Lightning, and Stray Currents,
- NFPA 70E- Electrical Code (Electrical Classifications Included)
Design Codes

- NFPA 30: Flammable and Combustible Liquid Code
- NFPA 2011 (Proposed) code for Hydrogen Gas

This is the Short List!
Equipment in the Process

Block Flow

Process & Instrumentation Diagram
P&ID

- An Exploded View of a Block in the Block Flow Diagram
- Provides the Detail of the Operations and Components of that Section of the Covered Process
Block Diagram

- $\text{H}_2\text{O}$ to $\text{H}_2$ via electrolysis
- $\text{O}_2$ to the atmosphere
- $\text{O}_2$ storage
- TANK HYDROGEN STORAGE
- FC
- DC to AC
- 220/380/50Hz
- GRID
covered processes will involve many P&ID’s

- Systems Engineers, Maintenance & Technicians will assist in the Development of P&ID’s

Now…
Equipment in the Process

- Now:
- Identify Each Piece of Equipment in the Covered Process by P&ID, Block Diagram and Number Them
- Remember - Must Follow Form
- Must be Able to Track Each Number Through the Entire Program
Equipment in the Process

- Can Use the Manufacturer's Model & Serial Number
- Can Use Your Own Numbering System
- Must be Able to Track Throughout the PSM Program
Examples of Equipment Numbering
Examples of Equipment Numbering
Equipment in the Process

- Lists of Equipment for Every Component of Every P&ID for Every Block in the Block Flow Diagram Must be Developed including the Corresponding Numbers Established in the PSM Program
Hazard Assessment & Equipment in the Process: Summary

Hazard Assessment (If over TQ, Must Proceed)

Develop Toxicity Information on Chemical in Covered Process

Develop information on Technology of the Process

Develop information on Equipment in the Process

Remember: Must be Able to Track Equipment Throughout the Entire Program
NASA High Pressure Gas Plant

Technology of the Process & Equipment in the Process
Case Study
Team Exercise
NASA High Pressure Hydrogen Gas Plant
Team Exercise

- With the Information to Follow in The NASA Case Study Video, Presentation & Notebook,

- With Your Team Members, Perform the Following Tasks
Case Study Facts

Remember:

- The High Pressure Gas Plant Uses
  - Helium
  - Nitrogen
  - Hydrogen

- The Nitrogen & Helium Plant is one Section of the Plant
- The Hydrogen Plant is remotely located from the Nitrogen & Helium Plant
- The Hydrogen is Piped from the Hydrogen Plant to the Engine Test Stands through a valved system
- There are approximately 100 miles of pipe at the NASA Stennis Space Center
Case Study Exploration

1. Find the Block Diagram in the Class Notebook Case Study Information and Draw a Block Diagram on the Hydrogen Covered Process
2. Highlight the Hydrogen Tank Area of the Block Flow Diagram
3. Find the Hydrogen Tank on the Process & Instrumentation Drawing in the Class Notebook Case Study Information & Handouts. Identify and Log the Number of the Hydrogen Tank in the Covered Process
4. Trace and Highlight the flow of Hydrogen through the PI&D

We will discuss Findings of Each Team in Class
What’s Next

- Mechanical Integrity
- Inspection & Testing
- Quality Assurance