INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: Facilitator - [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
1A1	Reduce hazardous raw materials inventory?	#4 Crude Unit chemical inventory is kept to a minimum. Includes aqueous ammonia, anti-foam, demulsifier.	
1A2	Reduce intermediate storage and inventory?	There are no intermediate products stored in #4 Crude Unit.	
1A3	Reduce finished product inventory?	Finished product inventory is sent to other units from #4 Crude Unit.	
1B1	Reduce hazardous material inventory by using alternate equipment?	Equipment used is standard for crude processing.	
1B2	Minimize length of hazardous material piping runs?	Piping runs in #4 Crude Unit are minimized as designed.	
1B3	Use smallest diameter piping?	Piping sizes are the smallest possible for the capacity of the unit	
1B4	Reduce pipeline inventories by changing hazardous materials from liquid to gas?	N/A	
1B5	Reduce production of hazardous waste or by-products?	Desalter effluent and sour water are minimized per standard operation.	

INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: Facilitator - [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
2A1	Use an alternative process or chemistry to completely eliminate hazardous raw materials, intermediates or by-products?	No alternative processes are available to eliminate any hazards presented by the raw materials.	
2B1	Use an altermative chemistry or process conditions to completely eliminate in-process solvents and flammable heat transfer media?	Industrial standard processes used.	
2C1	Substitute less hazardous raw materials?	Raw materials in use are of minimal hazard.	
2D1	Substitute less hazardous final product solvents?	N/A	
3A1	Limit supply pressure to less than MAWP of vessels?	Existing vesels are protected by PSVs when needed	
3B1	Use a different catalyst?	Catalyst is not used in #4 Crude Unit	
3C1	Improve thermodynamics or kinetics to reduce operating pressures and temperatures?	Current operating conditions are currently at the lowest possible temperature and pressure	
3C2	Change reaction phase to reduce operating pressures and temperatures – liquid/liquid, liquid/gas, gas/gas?	Not a possible alternative in this application	

INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: **Facilitator -** [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
3C3	Change order of raw material addition to reduce operating pressures and temperatures?	Raw material addition sequence minimizes operating temperature.	
3D1	Dilute hazardous raw materials?	Raw materials currently diluted where applicable	
3E1	Avoid operating conditions where materials are subject to high temperature instability or freezing?	Current operation does not operate near any temperature range that would lead to unstable operation	
3F1	Change process conditons to avoid handling flammable liquids above their flash point?	Use industrial standards for crude operations	
3G1	Design equipment to contain process on temperature rise from loss of cooling?	Equipment uses PSVs to protect from overpressure, relieves to a contained system.	
3H1	Layout equipment to minimize congested and confined spaces to limit potential for blast overpressure in the event of a flammable release?	#4 Crude Unit equipment is spaced to provide sufficient circulation.	
3I1	Locate adjacent hazardous installations to minimize impact on unit?	Other units are spaced to allow for emergency access and minimize impact on, or from, adjacent units	
3I2	Minimize off-site impacts?	#4 Crude Unit is located at a distance from public areas	

INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: **Facilitator -** [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
3I3	Minimize on-site impacts?	Other units are spaced to allow for emergency access and minimize impact on, or from, adjacent units	
3J1	Select pump with maximum capacity lower than safe rate of addition?	Pump capacity is appropriate for the feed rate of this operating unit	
3J2	Pipe size selected to prevent unsafe flow rates in gravity feed systems?	Piping is appropriately sized in the #4 Crude Unit	
3K1	Prevent hazardous material liquid spill from entering storm drainage system or sewer?	All drains in #4 Crude Unit are routed to API separators	
3L1	Prevent flammable material liquid spill from pooling under adjacent equipment causing a BLEVE in the event of fire?	In general, plant grade is sloped to area drains. No known problem areas	
3M1	Use passive safety design to prevent or reduce fire damage?	Passive safety design is used where applicable to prevent or reduce fire damage.	
3N1	Flammable material release from PSV routed to flare header?	All flammable materials that may be released from PSVs are routed to the flare system	
4A1	Easy operation of valves designed to prevent inadvertent error?	In general, valves are arranged in a logical manner	

INHERENTLY SAFE SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: Facilitator - [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
4A2	Simplified control displays?	Concern is that some control displays are cluttered, and finding a necessary screen may be time-consuming, especially during an upset.	Consider evaluating simplifying individual DCS screens, and organization of screens to improve control navigation within the #4 Crude Unit. Examples include, but are not limited to: Process Overview, Flash Drum V-1102, Long Loop, Short Loop, Vacuum Column
4A3	Design temperature-limited heat transfer equipment?	Heat transfer media are appropriate for the applications	
4A4	Use corrosion resistant materials?	Vessel specifications and piping classifications include a conservative wall thickness and an appropriate corrosion allowance for each service	
4A5	Operate at lower pressure?	Plant currently operates at the lowest possible pressure	
4A6	Operate at higher temperature to prevent cryogenic effects, like embrittlement failure?	There are no problems with cryogenic effects in #4 Crude Unit.	
4A7	Operate at lower temperature to prevent runaway reaction or material failure?	Currently operate at the lowest temperature possible	
4A8	Passive rather than active controls?	T-1108 Ammonia Tank, V-1106A Demulsifier Chemical Injection Drum, T-1104 Caustic Injection Tank have no spill containment.	Consider spill containment for T-1108 Ammonia Tank, V-1106A Demulsifier Chemical Injection Drum, T-1104 Caustic Injection Tank.

INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: **Facilitator -** [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
4A9	Use buried or shielded tanks?	No buried or shielded tanks in #4 Crude Unit	
4A10	Use fail-safe controls on loss of utilities?	Control valves are designed to go to the safest position on loss of signal or instrument air	
4A11	Limit complexity and degree of instrument redundancy?	The instrumentation in the #4 Crude Unit is appropriate for the complexity/severity of the process. Alarm objectives Analysis have been conducted on the #4 Crude Unit to eliminate the nuisance alarms	
4A12	Use refrigerated storage vs. pressurized storage?	No pressurized storage in #4 Crude Unit	
4A13	Electrical feed spread over independent or emergency sources?	#4 Crude Unit power is supplied from two different feeders	
4A14	Reduce wall area to minimize corrosion or fire exposure?	Vessel size, and therefore wall area, is minimized as designed	
4A15	Minimize connections, paths and number of flanges?	Connections, paths and number of flanges are minimized as currently designed	
4A16	Fewer bends in piping?	Bends and elbows in piping systems are minimized as designed.	

INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: **Facilitator -** [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
4A17	Expansion loops in piping in lieu of bellows?	No expansion bellows used in #4 Crude Unit.	
4A18	Isolation mechanisms for maintenance on equipment?	Double block and bleed or blinds are used to isolate equipment for maintenance for LOTO RI9900	
4A19	Limit manual operations – like sampling, hose handling, filter cleaning?	Concern is that the current resid and desalter sampling methods may result in personnel exposure/injury to hot material containing benzene.	Consider evaluating current resid and desalter sampling procedures and replacing with safer alternatives. Reference MOC 19620, improvement of desalter triline sampling, in progress.
4A20	Full vacuum design for vessels?	Vessels are designed for full vacuum if needed, others are designed for 7.5 Psi external pressure	
4A21	Heat exchangers designed for maximum pressure on both shell and tube sides?	Heat exchangers are protected by PSVs.	
4A22	Equipment designed to prevent incorrect assembly?	Maintenance procedures showing correct assembly are available for all equipment	
4A23	Clear identification of equipment status – valves with rising stems, spectacle blinds, check valves with flow arrow?	Rising stem gate valves, check valves with flow arrows and spectacle blinds are used in #4 Crude Unit	
4A24	Equipment designed to contain maximum pressure in the "worst credible event"?	Equipment protected by PSVs if needed to prevent loss of containment	

INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description: -

Design Conditions: **Hazards:**

Review Team: Facilitator - [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
4B1	Blowout resistant gaskets?	All gaskets in the #4 Crude Unit are blowout resistant - spiral wound, ring joint, Kampro	
4B2	Increasing wall strength?	Piping classifications include a conservative wall thickness and an appropriate corrosion allowance for each service	
4B3	Using fewer seams and joints?	Seams and joints are minimized as currently designed	
4B4	Providing extra corrosion allowance?	Piping classifications include a conservative wall thickness and an appropriate corrosion allowance for each service	
4B5	Reducing vibration?	No vibration issues in #4 Crude Unit	
4B6	Minimizing the use of open-ended, quick-opening valves?	No open-ended valves in use in #4 Crude Unit	
4B7	Eliminating open-ended, quick-opening valves in hazardous service?	No open-ended valves in use in #4 Crude Unit	
4B8	Improving valve seating reliability?	No valve seating reliabilty issues in #4 Crude Unit	

INHERENTLY SAFER SYSTEMS REVIEW

Location: Chevron Richmond Refinery **ABU:** D&R **Unit:** #4 CRUDE UNIT

PFD Number: **PFD Title:** **PFD Revision Date:**

Node Description:

Design Conditions: **Hazards:**

Review Team: **Facilitator -** [redacted] **Process Engineer -** [redacted]

OPS - [redacted] **Design Engineer -** [redacted]

Question ID:	Question	Discussion/Existing Safeguards	Recommendation
4B9	Eliminating unnecessary expansion joints, hoses, and rupture disc?	Rupture disks used in DEBRU. Hose use is limited to temporary activities (e.g., cleanup, truck offloading)	
4B10	Eliminating unnecessary sight glasses and glass rotameters?	Gage glasses and rotameters have metal protection around glass element	
5A1	Plant located to minimize need for transportation of hazardous materials?	Transportation of hazardous material is minimized	
5B1	Can materials be transported in less hazardous form; in a safer transport method; or by a safer route?	Materials are transported in the safest method	