



U.S. Chemical Safety and Hazard Investigation Board

Philadelphia Energy Solutions (PES) Investigation

CSB Public Business Meeting

October 27, 2022



Safety Issues

- **Mechanical Integrity**
- **Verifying Safety of Equipment after Changes to RAGAGEP**
- **Remotely Operated Emergency Isolation Valves**
- **Safeguard Reliability in HF Alkylation Units**
- **Inherently Safer Design**



Safety Issue 1: Mechanical Integrity

- Failure of steel pipe elbow with high nickel and copper content
- Steel with high nickel and copper content is known to corrode faster from HF corrosion
- No requirement for 100% component inspection before incident
- API RP 751 has been revised to include new requirement for 100% component inspection





Safety Issue 2: Verifying Safety of Equipment after Changes to RAGAGEP

- 2003 NACE paper led to changes in industry guidance quantifying the levels of nickel and copper in steel considered safe for use in HF alkylation units
- API RP 751, Sunoco (previous refinery owner), and PES did not require all carbon steel piping circuit components be inspected before the incident
- OSHA and EPA regulations require companies to determine that their equipment is safe to use
- Companies and industry must take swift action to ensure process safety when new knowledge on hazards is published



Safety Issue 3: Remotely Operated Emergency Isolation Valves

- Jet flame from failed elbow impinged on vessel, causing vessel rupture
- Hydrocarbon sources near failed elbow could not be remotely or automatically isolated





Safety Issue 4: Safeguard Reliability in HF Alkylation Units

- PES water mitigation system was damaged during incident
- Water mitigation system pumps could not be remotely activated
- A PES employee manually turned on a water pump that supplied the HF mitigation water cannons 40 minutes into the release
- Incident is a demonstration that “active” safeguards have the potential to fail in major incidents involving fires and explosions



Safety Issue 5: Inherently Safer Design

- Technologies are being developed that could be a safer alternative to HF and sulfuric acid alkylation
- While EPA has previously issued requirements for companies to evaluate inherently safer technologies, there is currently no Federal regulatory requirement for petroleum refineries to evaluate inherently safer design strategies to reduce the risk of serious accidental releases.



Recommendations

EPA

- Prioritize inspections of refinery HF alkylation units to ensure units are complying with API good practice guidance
- Require petroleum refineries with HF alkylation units to evaluate inherently safer technology
- Initiate prioritization and, as applicable, risk evaluation of HF under the Toxic Substances Control Act

API

- Require protection of critical safeguards from fire and explosion hazards
- Require installation of remotely-operated emergency isolation valves on all hydrofluoric acid containing vessels, and hydrocarbon containing vessels meeting defined threshold quantities

ASTM

- Update ASTM A234 to contain requirements for piping used in HF service



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