NUPIC Presentation

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Columbia Fuel Fabrication Facility (CFFF)

One of the largest facilities of its kind in the world. Located here are the fuel manufacturing facilities, product engineering and testing laboratories, fuel marketing and contract administration. Covering 1,155 acres that include 550,000 square feet of manufacturing and office space, the Columbia Site employs about 1,200 personnel.

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Regulations & Licenses

10CFR Part 70 —DOMESTIC LICENSING OF SPECIAL NUCLEAR MATERIAL

"MANAGENT MEASURES"

10CFR 50 —DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

"Appendix B to 10CFR 50 & NQA-1"

Reactivity Avoidance

vs.

Reactivity Control

Components necessary for Criticality

- Mass: You need to have enough U_{235} to maintain a criticality, at CFFF that's about 33+kgs Special Nuclear Material (SNC) at 5% enrichment
- Moderator: neutron moderator is a medium (water, hydrogen, ect.) that reduces the speed of fast neutrons, thereby turning them into thermal neutrons capable of sustaining a nuclear chain reaction
- Geometry: Some shapes lend themselves to contributing to the ability of a mass to go critical (Ball, Cubes, Cylinder). Referred to as a non favorable geometry NFG

You must have all 3!

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Safety Significant Control Program

- Double Contingency – No single event can result in a criticality (independent, concurrent, unlikely)
- Criticality Safety Evaluations (CSE) – a documented analysis evaluating if a fissile material will become subcritical under both normal and credible abnormal conditions.
- Safety Significant Controls - Manufacturing process controls are evaluated and those meeting certain criteria are identified (Passive, Active, Administrative with Computer or Alarm, Purely Administrative).
- Item Relied On For Safety (IROFS)

If there is not a double contingency the control is a basic component.

Timeline

In May 2016, ~ 87 kilograms of uranium was discovered in the inlet elbow and transition area of the S1030 scrubber. The total accumulation and its relation to the criticality safety mass limit (29 kgU) was not recognized until July 13. The Nuclear Regulatory Commission (NRC) was notified on July 14 as required upon recognition that the mass limit was exceeded.

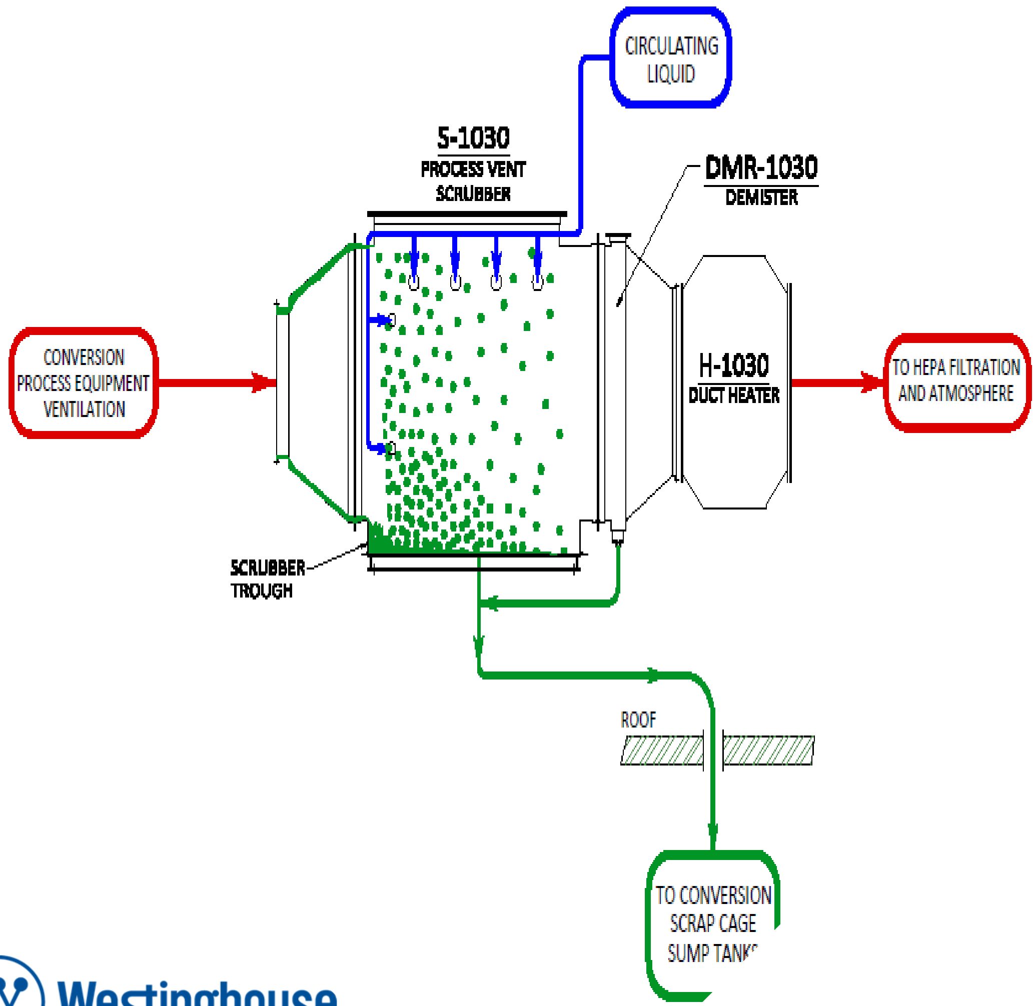
On July 20, following cleaning of the inlet elbow and transition, the scrubber was restarted. Investigating the potential for mass accumulations in the scrubber packing and body was not considered prior to restarting the scrubber.

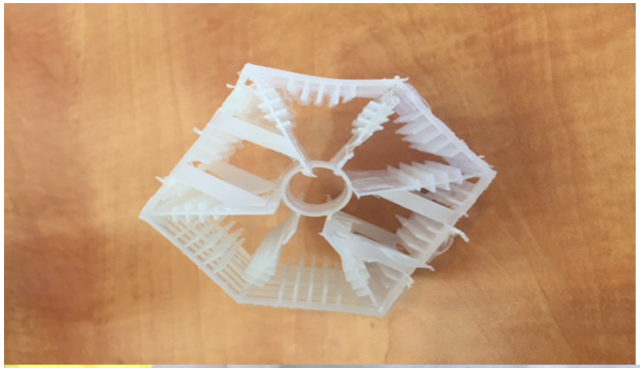
On July 28, CFFF management directed the scrubber to be shutdown to inspect and clean the packing and body. 177KgU were removed. This was 8.24 times the mass limit of 20.82kg.

On August 9, CFFF submitted planned corrective actions necessary to be completed to ensure safe restart of the S1030 scrubber and conversion operations to the NRC.

On August 11, CFFF received a Confirmatory Action Letter from the NRC that endorsed the need to complete the recommended actions submitted by CFFF. The scrubber and conversion operations remained shutdown until NRC authorization to restart was received on October 20.

Material Found Scrubber Inlet Transition And Body





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Consequences

- Exceedance of mass limits risked the potential for a criticality event.
- There were no impacts to the environment/public as a result of this event.
- Extended shutdown required to ensure necessary actions were taken to safely operate upon restart.
- Significant impact to customer delivery schedules for 2017 from this event.
- Significant regulatory (NRC), customer and public scrutiny.
- The aggregate impact of this and previous significant events is creating risk and long term concerns regarding the ability to reliably operate CFFF in the future.

Extent of Condition

- Accumulation of uranium in a ventilation component greater than the mass limit:
  - Wet ventilation system scrubbers
  - Wet ventilation systems with Non Favorable Geometry
  - Permanently removed from service ventilation systems
  - Dry ventilation systems – post restart

- S-1030 scrubber remains the only component for which the IROFS were not effective in limiting accumulation below the mass limits.

- The extent of condition at other Westinghouse locations has been investigated.

Scrubber/ventilation system improvements

Modifications:

- Inlet elbow spray modification
- Inlet transition inspection windows and baffles
- Packing basket design:
  - Ease of replacing/cleaning
  - Prevention of accumulation in scrubber body bottom
- Passive overflow
- Restoration of continuous blowdown
- Liquid level alarm/pH display
- Blue M oven filter media
- Ventilation ductwork inspection and viewports (wet ventilation systems)

Inspection Capabilities:

- New mass limit – 85.7 kgU aggregate
- Packing basket removal/replacement
- Packing accumulation assessment
- Inspection frequency/scope:
  - Weekly visual for inlet areas and packing face
  - 6 week full inspection
- Inspection engagement of necessary stakeholders, documentation rigor/timeliness and validation of as-found to limits.
- Certification of as-left to support running to next cleaning
- Enhanced visual inspection techniques for ventilation systems
- Gamma scan program

Corrective Actions to Ensure Safe Restart - Specified in the Confirmatory Action Letter (CAL)

- Complete the RCA investigation and complete restart corrective actions or compensatory actions identified in the RCA.
- Review the existing safety basis for S-1030 and other wet ventilation scrubbers and revise necessary controls, including modifications, procedure changes and training on these changes.
- Review the Criticality Safety Evaluations (CSE) for ventilation related non-favorable geometry (NFG) components and revise necessary items.
- Verify flow down of all administrative IROFS to implementing documents
- Confirm isolation for all and inspect and clean selected ventilation NFG components that are permanently removed from service.
- Perform a historical 10-year review of the corrective action program to identify recurring or longstanding issues and complete corrective actions.
- Revise procedures for internal escalation and event response.
- Retain an external nuclear criticality safety expert.
- Provide training on the lessons learned from the event.
- Conduct a work environment assessment of the NCS organization and develop corrective actions.

CFFF completed extensive corrective actions to ensure safe conversion restart.

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Root Cause

Rigor of programmatic controls for configuration management with respect to ensuring the preservation of the criticality safety basis.

Management did not scrutinize the content of CSE-1-E and as-found conditions in the S-1030 scrubber with the questioning attitude and conservative bias required for a healthy nuclear safety culture.

Gaps in procedures and training impacted ability to recognize and respond to deviations from the safety basis.

Operating experience and the corrective action processes were not effectively used.

The scope of internal and third-party criticality safety and environment, health, and safety (EHS) audits and assessments performed per the CFFF license have not provided a comprehensive review of the NCS Program with an appropriate level of intrusiveness applied to higher risk activities.

Nuclear Safety Culture Assessment

Four most prevalent weaknesses in nuclear safety traits

- Questioning attitude
- Decision-making
- Leadership safety values and actions
- Problem identification and resolution

Failure to recognize the special and unique aspects from a criticality safety perspective:

- Reliability and Availability of Administrative IROFS
- Validation of safety basis vs. a cleaning activity

Corrective actions were developed to address these gaps.

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S1030 Scrubber issue – current state

- Results of weekly and 6 week full inspections
- Inspection duration and frequency considerations
- Longer term considerations:
  - Criticality safety margin
  - Single point vulnerability
- Ventilation system inspection program improvements

Current results indicate our modifications and process improvements have been effective in providing significant margin to our new criticality safety basis

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3 Event Common Cause

Team included a senior operating plant nuclear executive and a previous INPO senior representative with extensive Policy Note 14 Special Focus plant oversight experience.

Main contributors:

- Leadership standards/expectations – "right picture of excellence"
- Long term vision and integrated plan for facility excellence commensurate with the risks, challenges and potential consequences of our operations.

- Emphasis will be placed in the following aspects of performance:
  - Leadership alignment on the right values and behaviors
  - Employee engagement
  - Organizational roles and responsibilities and capacity/efficiency improvements
  - Ability to self-identify and correct performance gaps
  - Shift from reactive to proactive focus:
    - Risk recognition and mitigation
    - Technical Conscience
    - Error-prevention practices
  - Equipment reliability improvements/asset management strategies
  - Industry engagement/benchmarking to stay aligned with best practices/operating experience
  - Ensuring repeatable outcomes:
    - Key process/program improvements
    - Procedure standards, use and adherence

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Facility Excellence plan activities

- Strategy/Plan Based upon INPO 12-011 guidance for significantly improving nuclear plant performance

- INPO 12-011 “Assessment Phase” work nearing completion:
  - Scrubber RCA causal factors
  - 3 event CCA causal factors
  - Consultant visits/observations
  - Employee/NSC survey information
  - Stages of a Power Plant Exercise and off-site leadership meeting results

- Leadership vision/values and expectations in finalization based upon results of off-site meeting to align on current/future state using “Stages of a Power Plant” exercise from INPO 12-011.

- Near term (1Q17) focus areas – emphasis on actions to help “prevent the next event”:
  - Alignment on values and behaviors
  - Employee engagement activities
  - Targeted organizational capacity improvements
  - Targeted program/process improvements
  - CAL Recovery items – Criticality safety metrics, NSC Monitoring Panel, Vent/Gamma scan program, SSC database development, Procedure upgrade project development, Crit safety training program development, Technical Conscience and Design Control process self assessments

Tools for Improvement

- Root Cause Analysis
- Common Cause Analysis
- Nuclear Safety Culture Assessment
- Nuclear Safety Culture Survey
- INPO 12-011 - An Implementation Framework to Significantly Improve Nuclear Plant Performance, 1.0 Assessment Phase
- INPO 12-011“Stages of a Power Plant” exercise
- Excellence Plan (identifying gaps and closing the gap)

Use of standard industry tools to understand the issues and drive correction

INPO 12-011 – Attachment E

Striving to meet these outcomes!

Essential Outcomes

LEADERSHIP EFFECTIVENESS			TEAM EFFECTIVENESS
LE 1 ESTABLISH A CLEAR VISION AND STRATEGY		SET DIRECTION	TE 1 Aligned On Common Purpose, Vision, & Goals
LE 2 DEVELOP TALENT	LE 3 FOSTER A LEARNING ORGANIZATION	MAXIMIZE COMPETENCE	TE 3 Team Talent, Roles, and Responsibilities Are Clear
LE 4 ALIGN AND ENGAGE THE WORKFORCE	LE 6 BUILD AND SUSTAIN TRUST	ENGAGE THE WORKFORCE	TE 4 Positive Atmosphere of Mutual Trust and Respect
LE 5 INSPIRE MOTIVATE COMMUNICATE	LE 7 COACH & FOSTER ACCOUNTABILITY		
LE 8 MAKE GOOD DECISIONS AND MANAGE RISK		COPE WITH RISK	TE 5 Decision-Making and Conflict Resolution Are Effective
LE 9 ACHIEVE SUSTAINABLE RESULTS		ACHIEVE RESULTS	TE 2 Committed to the Success of the Team

Questions