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GDP 05-2022

Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Portsmouth Gaseous Diffusion Plant (PORTS)
Docket No. 70-7002
Certificate No. GDP-2
Event Report 05-01

Pursuant to SAR Section 6.9.5 and Table 6.9-1 J(1), Enclosure 1 provides the required Event Report for the actuation of a high condensate level steam shutdown alarm and trip during a cylinder heating evolution. The high condensate level steam shutdown alarm is a Q safety system in the Feed and Transfer Facility. Enclosure 2 contains a list of commitments made in the report.

Should you require additional information regarding this event, please contact Toni Brooks at (740) 897-2555.

Sincerely,

S L Fort
for Patrick D. Musser
General Manager
Portsmouth Gaseous Diffusion Plant

Enclosures: As Stated

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IE72

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Description of Event

On April 21, 2005, X-343 Autoclave Number 2 experienced an automatic steam shutdown due to a high condensate level alarm; the autoclave was in TSR Mode II (heating) at the time. Steam had been turned on at 2105 hrs, and the high level condensate alarm was received at 2113; both the A and B condensate probe channels had tripped. Upon investigating, the autoclave shell pressure was observed to be 0 psi, with no indication of a vacuum. One quart of clear water was drained from the isolated drain lines. No debris was observed in the drained condensate.

At the time of the alarm and steam shutdown, 14-ton cylinder No. 4G 113885 was being heated. This cylinder contained approximately 1,253 pounds of normal assay (0.711% ^{235}U) material. There was no release of radioactive material.

Following the incident, the Shift System Engineer checked the autoclave temperature recorder and collected A and B thermocouple time histories through the incident. He concluded that the thermocouples read 194.6 and 194.68 respectively at the time of the incident and that the cylinder temperature rose smoothly from an ambient temperature of approximately 65°F. Thermocouples A and B tracked together and came to equilibrium at about 194°F, approximately six minutes into the heating cycle. The Shift System Engineer reported that based on the temperature-time history, the condensate alarm occurred approximately 8 minutes after steam initiation.

Causes of Event

As background information, steam is used to heat UF_6 cylinders inside the autoclave shell. The condensate drain lines are provided to drain condensate from the autoclave shell. The high condensate level steam shutdown system is provided to limit the accumulation of condensate in the autoclaves to prevent shell over-pressurization and/or nuclear criticality due to mixing of water and UF_6 in the event of a cylinder rupture within the autoclave. High condensate levels may develop due to excessive condensation within the autoclaves that exceed the capacity of the drain lines, blocked drain lines that impede condensate flow, or a decrease or loss of motive (pressure differential) force for the drain flow. As indicated below, conditions causing a loss of motive force were identified in this incident.

The direct cause of the event was an accumulation of condensate inside the operating autoclave causing a valid high level condition and safety system actuation to shutdown the autoclave. This was the result of the failure of containment valve FV-213 to fully open. The partially opened valve restricted steam flow to the autoclave which resulted in low shell pressure and an inadequate motive force (differential pressure) to drive the flow of condensate from the autoclave.

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The root cause of this equipment failure was determined to have been that "PM for equipment needs improvement." Periodic surveillances and PMs for the valve existed to ensure that the valve was capable of performing its safety functions (pressure integrity and full closure), but not to ensure the valve opening function. The valve failure itself appears to be the result of in-service wear and use; not defective equipment or parts.

There were no systems, structures, or components that were inoperable at the start of the event that contributed to the event. Upon receipt of the high condensate system alarm, all safety systems functioned as expected.

There were two contributing factors to this incident. The first was an absence of Operator expectations to mitigate the autoclave low pressure conditions. There was no procedural direction to monitor shell pressure during the initial cylinder heating cycle nor was there an adequate awareness of the potential for condensate accumulation that could result from a low autoclave shell pressure. Since the Operators were unaware of the potential problem, they were not monitoring all the appropriate autoclave conditions during the initial heat up that would have enabled corrective actions (e.g., manual steam shutdown) before the autoclave safety system took automatic action to terminate the condition. This was determined to be a human performance issue with root causes of "Learning Objectives Need Improvement" and "SPAC Confusing or Incomplete".

The second contributing factor was the reduced free volume within the autoclave with the 14-ton cylinder installed. There are three different size autoclaves in the X-343 and X-344 Facilities. When 14-ton cylinders are installed for heating, X-343 Autoclave Numbers 1 and 2 each have an autoclave shell-to-cylinder void volume of 407 ft^3. Under the same circumstances, X-343 Autoclave Numbers 5 through 7 have 656 ft^3 void volumes, and X-344 Autoclave Numbers 1 through 4 have 943 ft^3 void volumes. X-343 Autoclaves 3 and 4 are not used for cylinder heating. This smaller volume means that shell pressure responds more rapidly to perturbations in steam demand and/or steam flow so that system or operator actions would have less time to react and compensate for steam demand and flow. In this case, shell pressure dropped because restricted steam flow could not keep up with the condensation rate during phase change for the cylinder contents. A larger free volume may have allowed more time for the autoclave to reach an acceptable equilibrium condition and avoid a high condensate level. The root cause of this factor was determined to be "Equipment Environment not Considered".

Safety Significance

The consequences of this failure had low safety significance since actuation of the high level condensate steam shutdown system results in transition of the autoclave to its safe, shutdown condition. Also, because the containment system relies on redundant, fail-close valves, and because of the inherently safe design of the autoclave systems, no single failure during the

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transition to the safer shutdown condition has the potential for placing the autoclave in an unsafe or compromised condition. Hence, the action, although significant as an actuation of a safety system, has no adverse safety consequences nor does it impact the future capability of the system to perform its intended safety function.

Corrective Actions

1. On April 25, 2005, Feed valve FV-213 was repaired.

2. On April 29, 2005, a Daily Operating Instruction (DOI) was issued requiring monitoring of shell pressure for X-343 Autoclave Number 2 during initial TSR Mode II heating and to take appropriate actions to prevent autoclave shell pressure from going sub-atmospheric.

NOTE: X-343 Autoclave Number 1 was inoperable at the time of the event and was kept inoperable pending event evaluation. On May 22, 2005, due to previously planned reconfigurations, X-343 Autoclave Numbers 1 and 2 were made inoperable for TSR Mode II heating operations. A return to Mode II operation will require development of additional procedural guidance. (See item 5, below.)

3. By July 9, 2005, complete a Required Reading for X-340 Complex Operators detailing the incident and the relationship between low shell pressure and high condensate level. Include a discussion of AC shell volume and pressure response.

4. By September 30, 2005, for valves identified by Engineering, valve timing surveillance test procedures will be revised for both X-343 and X-344 autoclaves as needed to require confirmation of full valve travel open as well as close.

5. By November 18, 2005, revise operating procedures for 72-inch autoclaves to document that monitoring of autoclaves during initial heat up is to include shell pressure and temperature as well as cylinder pressure. Include typical ranges and actions for atypical conditions. Note especially expected sensitivity of 72-inch autoclaves to pressure changes.

6. Engineering also intends to evaluate the cost and feasibility of installing an autoclave shell pressure control system to replace the current steam regulators with set loading pressures as a means of better controlling transient shell pressures for normal heating. Additional actions would be determined pending the outcome of this evaluation.

Extent of Exposure of Individuals to Radiation or Radioactive Materials

There was no release of radioactive material nor any personnel exposures associated with this event.

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Lessons Learned

Although the root cause of this event was an unexpected equipment failure, areas of operational improvement were noted. Additional Operator system awareness or additional procedural detail may have prevented this safety system actuation; both of these are being addressed.

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List of Commitments

1. By July 9, 2005, complete a Required Reading for X-340 Complex Operators detailing the incident and the relationship between low shell pressure and high condensate level. Include a discussion of AC shell volume and pressure response.

2. By September 30, 2005, for valves identified by Engineering, valve timing surveillance test procedures will be revised for both X-343 and X-344 autoclaves as needed to require confirmation of full valve travel open as well as close.

3. By November 18, 2005, revise operating procedures for 72-inch autoclaves to document that monitoring of autoclaves during initial heat up is to include shell pressure and temperature as well as cylinder pressure. Include typical ranges and actions for atypical conditions. Note especially expected sensitivity of 72-inch autoclaves to pressure changes.

*Regulatory commitments contained in this document are listed here. Other corrective actions listed in this submittal are not considered regulatory commitments in that they are either statements of actions completed, or they are considered enhancements to USEC's investigation, procedures, programs, or operations.