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November 24, 1997

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

GDP-97-2036

Portsmouth Gaseous Diffusion Plant (PORTS) - Docket No. 70-7002 - Event Report 97-22

Pursuant to 10 CFR 76.120 (d) (2), Enclosure 1 provides the required 30 day written Event Report (ER) for an event involving a failure of the UF_6 Cylinder High Pressure Autoclave Steam Shutoff safety system at the Portsmouth Gaseous Diffusion Plant. Enclosure 2 is a list of commitments made in the report.

Should you require additional information regarding this event, please contact Scott Scholl at (614) 897-2373.

Sincerely,

James B. Morgan
Acting General Manager
Portsmouth Gaseous Diffusion Plant

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cc:
NRC Region III
D. Hartland, NRC Resident Inspector, PORTS

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Description of Event

October 25, 1997, at 1800 hours, X-344 Autoclave (AC) #3 was in Mode II, heating a Uranium Hexafluoride (UF_6) cylinder. The cylinder had been heating for approximately 25 minutes when the operator noted that pressure indicator PI-165 indicated an internal UF_6 cylinder pressure of -50 psia. Since a reading of -50 psia indicated the instrument had malfunctioned, the operator immediately initiated steam shutdown manually, utilizing the local steam isolation controls to place the autoclave in a shutdown condition until the cause of the -50 psia instrument indication could be determined.

After the faulty PI-165 reading was first observed on October 25, 1997, Maintenance personnel initially observed that PI-165 was reading the expected pressure when they arrived to investigate. Maintenance personnel checked the instrument loop and determined that the "as-found" instrument readings for the loop were within tolerance. While Maintenance personnel were performing closeout activities they noticed that the PI-165 cylinder pressure, PI-169 sample loop pressure and PI-186 manifold pressure were all reading -50 psia. Further investigation indicated that the power cord to the transducer cabinet, which supplies power to all three systems, was loose. The plug was tightened and all PI readings returned to normal. Maintenance personnel believed that the loose power cord was the cause for the faulty PI readings. Operations then performed the Cylinder High Pressure Test and Cylinder Low Pressure Test successfully and returned the autoclave to service.

On October 27, 1997, Operations Management recognized that the condition that caused the erroneous reading on PI-165 may have also caused the UF_6 Cylinder High Pressure Autoclave Steam Shutoff (CHPASS) safety system to be inoperable. A similar pressure indicator failure at X-343 AC #7 had occurred on October 22, 1997, and caused the CHPASS to be inoperable (reference Event Report 97-21). Since investigation activities were unable to determine if the CHPASS would still function with the identified deficiencies, it was determined that the system may not have been able to perform its design function as a result of this event. The failure of the CHPASS safety system is reportable in accordance with 10CFR 76.120 (c) (2).

The CHPASS system is a single channel system. The heating of a UF_6 cylinder containing an excessive amount of 'light' gases at normal heating temperatures could result in the internal cylinder pressure exceeding the hydrostatic test pressure and possibly create a UF_6 release in the autoclave. The safety system function of the CHPASS ensures the pressure in the cylinder does not exceed the maximum allowable working pressure of the lowest rated cylinder that could be heated in the autoclave. The UF_6 cylinder pressure instrument loop is required to alarm if the cylinder pressure at any time reaches 115 psia.

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Cause of Event

The direct cause of the event was inadequate electrical connections between the pressure transducer and the CHPASS safety system circuitry. During investigation activities conducted by Maintenance and Engineering, it was observed that movement of the wiring and terminal strip that connects the pressure transducer to PI-165 caused the PI to read -50 psia. This terminal strip also provides the connections between the pressure transducer and the CHPASS circuitry. Although it is not known for certain that the loose electrical connections affected the CHPASS circuitry, the investigation was not able to prove that the CHPASS was operable when this condition was discovered. As a result, it was conservatively determined that the loose wiring could have prevented the CHPASS from performing its design function.

PI-165 is the pressure indicator for cylinder pressure on X-344 AC #3. The cylinder pressure loop contains a pressure transmitter, a pressure transducer, a pressure indicator, and high and low pressure switches. The pressure transmitter is located on the UF_6 drain line just outside the head of the autoclave. The pressure transmitter converts UF_6 pressure to a mV signal. The pressure transducer converts the mV signal to a mA signal and consist of two cards. One card converts the mV signal to 0-5 Volts DC. The other card converts 0-5 Volts DC to 4-20 mA and contains the high and low pressure switches. The pressure indicator converts the mA signal to a pressure reading in psia.

Engineering determined that a -50 psia reading on PI-165 was a result of a signal loss to the PI. The PI design is such that it interprets a 0 mA reading as -50 psia. The signal loss can result from inadequate electrical connections from the transducer to the PI, signal loss within the transducer, a loss of signal within the pressure transmitter or a power loss to the pressure transducer.

The loss of power to the transducer was eliminated as a possible cause because the CHPASS did not alarm when the faulty PI-165 reading was first observed. The design of the system will cause an alarm if power is lost. The pressure transmitter was also eliminated as a cause because the transmitter performed as designed through all pressure ranges during testing. The transmitter is a mechanical device and any failure of the transmitter would be repeatable.

During the investigation Engineering and Maintenance observed that jiggling the wiring and terminal strips that connect the transducer to PI-165 would cause the readings to change from -50 psia to the expected reading. The associated wiring was re-terminated and the two transducer boards were replaced as a precautionary measure. After calibration was performed on the equipment, PI-165 was again observed to read -50 psia. Since replacement of the transducer cards did not correct the problem, it was suspected that the problem was caused by faulty electrical connections.

The root cause for the event was determined to be inadequate design of the transducer housing

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mounting which resulted in faulty electrical connections. During the investigation it was noted that the transducer housing was placed on a small pedestal without any method of attachment. To access the terminal strips on the transducer, the housing is turned or rotated on the pedestal. It was observed that when the transducer was rotated, erroneous readings were obtained on PI-165.

The lack of permanent mounting also allowed stress to be placed on the terminal strips. The wires exit from the bottom of the housing such that the weight of the housing is allowed to exert force on the wires. This creates stress on the wires that can degrade the electrical connection. The transducer cards also plug into the terminal strip and could be affected by movement of the wires. With this type of arrangement, any movement of the transducer housing can affect the integrity of the electrical connections. Since the transducer connections are part of the CHPASS safety system, it was concluded that the CHPASS may have been affected by this deficiency.

An engineering walkdown was conducted to determine if this mounting deficiency exists at other autoclave installations. No additional mounting problems were noted.

Corrective Actions

1. The autoclave cylinder pressure transducer cards and terminal strip connecting the transducer to PI-165 were replaced. Pressure indicator PI-165 and its associated wiring were replaced. These actions were completed by October 30, 1997.

2. On October 30, 1997, the pressure transducer housing was temporarily mounted to the pedestal table to prevent inadvertent movement and to prevent the housing from exerting force on the wires and terminal connections.

3. By February 4, 1998, a design modification will be completed to provide permanent mounting of the UF_6 cylinder pressure transducer housing.

Extent of Exposure of Individuals to Radiation or Radioactive Materials

There were no exposures to individuals from this incident to radiation or radioactive materials.

Lessons Learned

Safety systems must be properly mounted and secured to ensure they will remain capable of performing their design function.

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List of Commitments

1. By February 4, 1998, a design modification will be completed to provide permanent mounting of the UF_6 cylinder pressure transducer housing.