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GDP 08-1007

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

Paducah Gaseous Diffusion Plant (PGDP)
Docket No. 70-7001, Certificate No. GDP-1
USEC Event Report ER-07-10

Pursuant to 10 CFR 76.120 (d)(2), enclosed is the final written event report involving the actuations of the C-337 Unit 5 Cell 3 and Unit 5 Cell 5 Process Gas Leak Detector (PGLD) safety system on December 6, 2007. The Nuclear Regulatory Commission (NRC) was verbally notified of the two events on December 7, 2007, at 1542 CST. The NRC assigned Nos. 43828 and 43829 to the notifications. The two events are being combined into one final report due to their common cause and corrective actions.

Any questions regarding this event report should be directed to Vernon Shanks, Regulatory Affairs Manager, at (270) 441-6039.

Sincerely,

Steven R. Penrod
General Manager
Paducah Gaseous Diffusion Plant

SRP:TAS

Enclosure: As Stated

cc: NRC Region II
NRC Resident Inspector – PGDP

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EVENT REPORT
ER-07-10

A. Description of Event

Prior to the occurrence of the event, on December 6, 2007 at 0208 hours, Operations personnel started C-337 Unit 5 Cell 3 and placed the cell on-stream following maintenance. Unit 5 Cell 5, adjacent to this cell, was already running on-stream. At 1040, Operations initiated a routine power change which had the effect of raising process gas pressures in both Cells 3 and 5 in C-337 Unit 5.

At 1532, a UF_6 Release Detection System alarm actuated when Process Gas Leak Detection Head (PGLD) YE-14 actuated on Unit 5 Cell 3. PGLD head YE-14 serves the inter-cell housing where cell block valves are located between Cell 3 and Cell 5. Operations notified the Plant Shift Superintendent (PSS) regarding the YE-14 alarm actuation, and initiated operator actions according to step 3.3.1 of procedure CP4-CO-CE5017b, "Potential UF_6 Release in C-331, C-333, C-335, or C-337 Operating Above Atmospheric Pressure." Incident investigation found no indication of UF_6 or hydrogen fluoride (HF) (a byproduct of UF_6 reaction with moisture in the air) near the Unit 5 Cell 3 local cell panel; however, PGLD head YE-14 could not be reset.

At 1553, during the response to the PGLD alarms in Unit 5 Cell 3, another alarm actuated on Unit 5 Cell 5 PGLD detector YE-9. During atmospheric sampling following this alarm, no HF was discovered in the breathing zone. However, 2 parts per million of HF were detected at the entrance of the instrument duct fan serving Unit 5 Cell 5. Instrument ducts are heated, in part, by warm air from the cell housing area. Positive detection of HF in this area normally indicates a presence of UF_6 in the duct and, therefore, in the cell housing.

In accordance with section 3.4 of procedure CP4-CO-CE5017b, Operations decreased pressure in Unit 5 Cells 1, 3 and 5 to below atmospheric pressure. Pressure was decreased in all three cells since the source of the leak had not been identified. However, based on the detection of HF at the Unit 5 Cell 5 cell panel, Cell 5 was taken off-stream. By 1627, Unit 5 Cell 5 was running off-stream, and detector head YE-9 was reset. Unit 5 Cell 3 detector head YE-14 was reset at 1632.

Operations investigation of the release on the cell floor found no visual indications of a release and samples for HF were negative. At this time, the initial investigation revealed no obvious source of the release. Procedure CP4-CO-CE5017b provided no additional guidance regarding how the investigation should proceed if no positive indicators of a release were discovered.

With PSS concurrence, the Front-line Manager (FLM) and two operators inspected the equipment nearest the PGLD detectors that had actuated. During the inspections, Operations personnel noted that Unit 5 Cell 3 block valve 5-3BB1 had what appeared to be a visible thin uranyl fluoride coating (UO_2F_2, a by-product of UF_6 reaction with moisture in the air), consisting of both old and new dusting from the same area. This release point would explain the YE-14 detector head firing but not the others. Further inspections noted that a section of the bulk head was missing in the cell housing that

divides Cell 3 and Cell 5, and there appeared to be indications of UO_2F_2 at PGLD head YE-9 in Unit 5 Cell 5. The missing bulkhead did not conform to plant drawings, and Assessment and Tracking Report (ATRC)-08-0037 was initiated to address this issue.

Based on the observations by the FLM and operators and the proximity of 5-3BB1 to the first detector that actuated, Operations concluded the release originated from the 5-3BB1 valve and not from Unit 5 Cell 5. In addition, Operations leak rated Unit 5 Cell 5 and determined the leak rate was within acceptable limits. As a result, Operations management decided to take Unit 5 Cell 3 off-stream and to charge Unit 5 Cell 5 and place it on-stream.

At 2042, Operations personnel put Cell 5 on-stream and almost immediately a UF_6 Release Detection System alarm actuated on Cell 5 PGLD detector head YE-9. Operators responded by taking Cell 5 off-stream resulting in the cell pressure going below atmospheric pressure. During operator response to the YE-9 alarm, PGLD head YE-10 actuated at 2049.

At 2100, operators performed another inspection of the Unit 5 Cell 5 housing area and noted a light dusting of uranyl fluoride on some cell piping components located in an area not readily accessible without removing the cell housing. HF samples taken in the area indicated no detectable HF. Operators reset all active UF_6 Release Detection Alarms at 2147.

Subsequent cell housing removal and inspection revealed the UF_6 release originated from the Unit 5 Cell 5 B-Outlet balanced elbow, specifically on the balancing portion of the expansion joint, which had two cracks in the joint and obvious damage to the struts used to provide support to this joint. While there was significant degradation in the support struts and the convolutions of the expansion joint, the release was small and localized. The inspection also found the buffer flow to the B-balanced elbow expansion joint valved-out inside the cell housing.

B. Description of Equipment Failure

The plant metallurgist conducted failure analysis of the three strut rods and T-bars associated with the event. The analysis indicated one of the strut rod welds failed under stress conditions. The welds of the two other rods failed with approximately five separate torsional stress cycles. The failure was identified on the first weld which had very little metal contact area (that is, the bulk of the weld did not penetrate the base metal). These welds were completed during the 1978 to 1982 timeframe when the requirements for inspection of welds on the struts that support the B-balanced elbows did not meet today's standards or requirements.

A review of previous operating experience found that a similar event occurred on February 7, 1994, when a small UF_6 leak occurred in the C-333 Unit 2 Cell 4 bypass housing. The leak was determined to come from a B-balanced elbow in the bypass line around Unit 2 Cell 6. The 1994 Event Team recommended that any cells that have similar piping configurations be visually inspected to ensure there were no broken support struts on the B-balanced elbows before these cells were operated above atmospheric pressure. The scope of this inspection was less than adequate in that only

the B-balanced elbows in the cell by-pass housings were inspected. The scope of the inspection was isolated to the bypass housing and did not consider all similar joints in the cell housings because the unique flow arrangement of the joints in the bypass were believed to be a significant contributor to the failure mode of the 1994 event.

C. Exact Location of the Event

C-337 Unit 5 Cell 5 and Cell 3.

D. Description of Isotopes, Quantities, and Chemical and Physical Form of the Material Involved

The event involved a small, localized quantity of gaseous uranium hexafluoride and its reaction products (HF and UO_2F_2) that were contained inside the cell housing. Health Physics inspection of the areas adjacent to the release found no contamination outside the equipment housing.

E. Causes of the Event

1. Direct Cause of the Event: Failure of the B-outlet balanced elbow expansion joint.

The direct cause of the event was failure of the B-outlet balanced elbow expansion joint in C-337 Unit 5 Cell 5. Evaluation of the failed expansion joint revealed cracks in the inner and outer convolutions of the balancing portion of the expansion joint.

2. Root Cause (s) of the Event

Root Cause #1: Poor quality welds on the C-337 Unit 5, Cell 5 B-outlet balanced elbow expansion joint support struts.

The investigation concluded that poor quality welds on the support struts caused the first UF_6 release. The poor quality welds resulted in all three struts being broken over time. One of the support struts was found detached and the two remaining struts were loose and did not provide adequate support for the expansion joint. These struts were installed from approximately 1978 to 1982 when there were no requirements to inspect welds on support structures. This root cause is a legacy issue. Inspection requirements for performance of similar work are addressed in the PGDP Quality Assurance Program (QAP). No corrective action is planned to address this root cause since current QAP and procedural requirements are adequate to prevent recurrence.

Root Cause #2: Protocols for positive identification of UF_6 leak sources were less than adequate.

The investigation concluded that inadequate protocols for the positive identification of leak sources caused the second release. C-337 Unit 5 Cell 5 was placed back on-stream after the first UF_6 release without positively identifying the source of the leak.

3. **Contributing Cause(s) of the Event**

Contributing Cause #1: Cell buffer flow to the expansion joint was valved-out.

Operations personnel found the buffer flow to the B-balanced elbow expansion joint valved-out inside the cell housing. During subsequent evaluations and extent of condition assessments, the buffers to two other expansion joints also were found valved-out. Positive control of the cell buffer alignment is a contributing cause to both releases. Current procedures for operation of cascade buffer systems and cell start-up do not require checks of the buffer line peanut valves inside the cell housings.

Contributing Cause #2: Corrective Actions from ER # PAD-1994-0012 were less than adequate.

The 1994 Event Team recommended that any cells that have similar piping configurations and that have been off-stream and bypassed for an extended period of time be visually inspected to ensure there were no broken support struts on the B-balanced elbows before these cells were operated above atmospheric pressure. The scope of this inspection was less than adequate in that only the B-balanced elbows in the cell by-pass housing were inspected. The scope of the inspection was considered less than adequate since it was isolated to the bypass housing and did not consider all similar joints at PGDP.

F. Corrective Actions Taken

1. December 8, 2007 – Engineering initiated visual inspections of cell B-balanced elbows for those cells planned to be taken above historical gradient pressures.

2. December 12, 2007 - Plant Manager issued Functional Directive PM-07-001. This directive limited the planned gradient pressures of the enrichment cascade pending the outcome of the investigation and analysis of the significance of the structural defects.

3. December 12, 2007 – Cascade Operations Group Manager issued a memorandum to Cascade Operations personnel regarding the importance of maintaining buffers on components. The memorandum also provided requirements for Cascade Operations management approval for isolation of buffer flow on operating equipment.

4. December 13, 2007 – Operations personnel began walk-downs of the buffer isolation valves internal to the cell housings to determine which valves may be isolated.

5. December 13, 2007 – Operations Manager Functional Directive OP-07-002 was issued to require Operations personnel to obtain the Operations Functional Manager and Cascade Operations Group Manager approval prior to putting cells on-stream following a release.

G. Corrective Actions Planned

1. By April 30, 2008, Operations will develop procedural controls and implement buffer valve alignment status and control protocols.

2. By June 1, 2008, Operations will implement protocols for identification of sources of a UF_6 release prior to putting cells on-stream.

3. By December 31, 2008, Engineering will complete a one-time visual inspection of B-balanced elbow expansion joints on "00" and "000" cells capable of running at this time.

4. By December 31, 2008, Engineering will develop a program to conduct follow-on visual inspections for B-balanced elbow expansion joints at intervals determined by the results of the initial one-time inspection.

H. Results of Any Evaluations or Assessments

Engineering Evaluation EV-C-821-08-042, Rev. 1 documented there is no negative nuclear safety impact as a result of this condition, provided that the joint is not permitted to experience multiple high pressure excursions (above the TSR limit). Therefore, the current accident analysis and statements are valid as follows:

- The B-balanced elbow deficiencies do not constitute a condition that has the potential to invalidate any assumptions of the accident analysis discussed in the PGDP SAR.
- The deficiencies do not increase the probability or consequences of an accident currently analyzed in the SAR.
- The condition does not introduce the potential for a new or different kind of initiating event or failure mode than that already considered in the SAR accident analysis.

I. Extent of Exposure of Individuals to Radiation or to Radioactive Material

Bioassay samples were provided by all personnel responding to the event and no personnel received exposure to radioactive material.

J. Lessons Learned

It is imperative for Operations personnel to positively identify the source of a UF_6 release prior to returning equipment to service.

LIST OF COMMITMENTS
EVENT REPORT-07-10

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