



United States  
Enrichment Corporation

Paducah Site Office  
P.O. Box 1410  
Paducah, KY 42001

Tel: 502 441-5803  
Fax: 502 441-5801

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United States Nuclear Regulatory Commission  
Attention: Document Control Desk  
Washington, DC 20555-001

SERIAL: GDP 97-1022

**Paducah Gaseous Diffusion Plant (PGDP) - Docket No. 70-7001 - Event Report ER-97-13**

Pursuant to 10CFR 76.120(c)(2), Enclosure 1 is the required 30-day written Event Report covering ER-97-13. This event involves the interruption, on two occasions, of direct current (DC) power to Technical Safety Requirement (TSR) required equipment. The Nuclear Regulatory Commission (NRC) was notified of the event on July 1, 1997, and July 13, 1997 (NRC No. 32571 and 32622). Enclosure 2 is a list of commitments made in this report.

Should you require further information on this subject, please contact Bill Sykes at (502) 441-6796.

Sincerely,

Steve Polston  
General Manager  
Paducah Gaseous Diffusion Plant

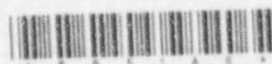
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Enclosures (2)

cc: NRC Region III  
NRC Senior Resident Inspector, PGDP

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EVENT REPORT  
ER-97-13

BACKGROUND

The reaction of uranium hexafluoride ( $UF_6$ ) and water (free atmospheric humidity) in the case of a  $UF_6$  release produces uranyl fluoride ( $UO_2F_2$ ) as particulates, and hydrogen fluoride (HF) as gas which will hydrate. The  $UO_2F_2$  and  $HF \cdot x(H_2O)$  are highly visible as "smoke". The  $UF_6$  release detection system detects the presence of "smoke" which generates an alarm to alert operating personnel to initiate corrective/mitigative actions. The  $UF_6$  release detection system heads are "test fired" twice each shift if operating in mode 2 or 3 (when  $UF_6$  pressure is above atmospheric pressure). Additionally, a functional test by actuating the  $UF_6$  release detection system heads with "smoke" is performed quarterly. The  $UF_6$  detection system is used to monitor condensers, accumulators, and piping heated housings.

On July 1, 1997, and again on July 13, 1997,  $UF_6$  detection system alarm audibility for building C-310 was lost for approximately five minutes and one minute, respectively; however, all the design safety detection functions were not affected during the DC power loss. Only the audibility and indication functions in the area control room (ACR) were inoperable. The building C-331 ACR operator notified the building C-310 ACR operator that he (building C-331 operator) had received an annunciator direct current (DC) power failure in building C-310. The building C-310 ACR operator tested his ACR alarms and received no response.

The Paducah Gaseous Diffusion Plant (PGDP) Technical Safety Requirements (TSR) Limiting Conditions For Operations (LCO), Section 2.3.4.4 states "the high voltage (old)  $UF_6$  release detection heads monitoring the subject equipment shall be operable."

The temporary loss of alarming to the C-310  $UF_6$  detection system is reportable in accordance with 10CFR 76.120(c)(2). On July 1, 1997, and July 13, 1997, the Nuclear Regulatory Commission (NRC) headquarters was notified of the events (see NRC Event No. 32571 and 32622).

On May 18, 1997, a similar event occurred when power was lost to the C-310 Criticality Accident Alarm System (CAAS) and  $UF_6$  leak detection system. For additional information relative to this event, please see Event Report ER-97-10 (NRC Event No. 32381).

DESCRIPTION OF EVENT (Reference NRC No. 32571)

On July 1, 1997, at approximately 1635 the Building C-331 area control room (ACR) operator notified the C-310 ACR operator that he (building C-331 operator) had received an annunciator DC power failure alarm. The C-310 operator attempted an alarm lamp test; however, there was no alarm power. At approximately 1637 one operator was sent to test fire the  $UF_6$  detector heads and another operator was sent to the equipment control center to manually trip the rectifier breaker to disengage the normal power to the rectifier on the alternating current (AC) electrical distribution panel A-4-4. By disengaging normal power to the rectifiers this caused the transfer switch to throwover to emergency (battery) restoring DC power. At approximately 1640, after tripping the breaker on the AC distribution panel A-4-4, the C-310 ACR, DC alarm power and C-331 DC alarm was restored.  $UF_6$  detector heads were tested and audible and visual alarms were received.

DESCRIPTION OF EVENT (Reference NRC No. 32662)

On July 13, 1997, at approximately 1935 the C-331 ACR operator notified the C-310 ACR that he (building C-331 operator) had received an annunciator DC power failure alarm. At approximately 1936 the C-331 operator manually tripped the rectifier area control room breaker to disengage the normal power to the rectifiers on the AC electrical distribution panel A-4-4. By disengaging normal power to the rectifiers this caused the transfer switch to throwover to emergency (battery) restoring DC power. After tripping the breaker on the AC distribution panel A-4-4, the C-310 ACR, DC alarm power and C-331 DC alarm was restored.  $UF_6$  detector heads were tested and audible and visual alarms were received.

There are a pair of rectifiers (north and south) located in building C-310. The loss of one rectifier results in the loss of one leg of 250 volt (V) DC capability. Without the transfer (throwover) switch transferring properly to battery supply there is only 125 VDC on one half of the electrical distribution panel. The transfer switch did not function properly because of the existence of 125 VDC on one side of the transfer relay coil and the existence of a ground on the other side of the coil. The existence of the 125 VDC across the coil is sufficient to prevent the 250 VDC transfer relay from sensing a loss of voltage to the rectifier. This 125 VDC power is necessary to operate the C-310  $UF_6$  detector annunciators which were rendered inoperable due to the loss of DC power. If  $UF_6$  detection had occurred the alarm would have annunciated when DC power was restored.

The following was determined during trouble-shooting:

- A. The main contactor/overloads for the north rectifier tripped; a ground on the positive leg of the alarm power 125/250 VDC was discovered; and low DC voltage was supplied from the north rectifier.

- B. Contactor/overloads were tested and results indicate that the component performed as designed.
- C. The ground was found to be a high resistance ground and one path of the ground was located in the alarm relays for an out-of-service piece of equipment. Wiring was lifted on the alarm relays to eliminate the source of the ground.

The primary component failure was the original selenium rectifier bridge, which is obsolete. A new three-phased diode bridge, with new wiring and associated parts was installed to replace the obsolete and degraded components.

A concern which was developed during this investigation was an apparent lack of understanding relative to what functions, such as CAAS howlers and UF<sub>6</sub> detection alarms, are affected by the inoperability of the north, or south, rectifiers. An operator's aid would eliminate any confusion and probably enhance efficiency.

During the DC power interruption the CAAS remained operational because electrical power continued from the south rectifier.

None of the actions directed by TSR, LCO 2.3.4.4 were implemented because power was restored within the one hour time limit as prescribed by the LCO.

On July 14, 1997, Engineering Service Order (ESO) Z98990 was submitted requesting that an engineering design be performed to replace the existing 250 VDC transfer switch relay with two 125 VDC relays; one sensing each rectifier leg to neutral (- 125 V to neutral and + 125 V to neutral). The existing transfer relay is incapable of reliably sensing the loss of one rectifier from the pair; therefore, half of the DC distribution power may be lost. The transfer relay should be capable of sensing the loss of partial power and transfer to battery.

#### CAUSE OF THE EVENT

- A. Direct Cause (NRC No. 32571, 32622)

The direct cause of both events was the inability of the transfer switch relay to sense the loss of voltage from the rectifier.

- B. Root Cause (NRC No. 32571, 32622)

The root cause of both events was inadequate transfer switch relay design specifications. The design specifications failed to anticipate, as currently configured, voltage sensing problems

during the loss of a rectifier. The existing transfer switch relay is incapable of reliably sensing the loss of one rectifier from the pair. The transfer relay switch should be capable of sensing the loss of partial power and transfer to battery.

C. Contributing Cause (NRC No. 32571, 32662)

A contributing cause of both events was the corrective action recommended in Event ER-97-10 relative to preventive maintenance (PM) has not been implemented. These latest events occurred prior to the scheduled date for implementing corrective action No. 4 contained in ER-97-10.

CORRECTIVE ACTIONS

A. Completed Corrective Actions

1. On July 14, 1997, Engineering Service Order (ESO) Z98990 was submitted for approval.
2. On July 25, 1997, Maintenance replaced the existing rectifier bridge on the north and south rectifiers in building C-310 with a three-phase diode bridge rectifier.

B. Previously Approved Corrective Actions (NRC No. 32381)

The following commitments were previously approved (NRC No. 32381) and are applicable to these two events (NRC No. 32571, 32662):

1. By July 31, 1997, Engineering will inspect, with the assistance of Electrical Maintenance, all DC power transfer systems in C-331, -333, -335, -337. The inspection will determine the current condition of the transfer relay and associated fuses to the rectifier of the DC power transfer systems and will identify deficiencies. A copy of the findings will be provided to Reliability Engineering.
2. By August 15, 1997, Operations will ensure a system of communication of preventive maintenance (PM) status/clear ownership and approval of PM deferral exists.
3. By August 29, 1997, Operations will develop a schedule to correct deficiencies, as required, identified in corrective action No. 1, above.
4. By September 30, 1997, Reliability Engineering will evaluate (taking into account the results of corrective action No. 1, above) and determine the PM requirements for the transfer relays in C-310, -331, -333, -335, and -337. This evaluation will also include determining the adequacy of the frequency of the DC power switch test.
5. By September 30, 1997, Operations will issue an off-normal procedure for loss of DC power in C-310.

6. By September 30, 1997, Operations will issue off-normal procedures for loss of DC power in C-331, -333, -335, and -337.

C. Planned Corrective Actions (NRC No. 32571, 32662)

1. By September 25, 1997, Operations will develop and disseminate an operator aid for appropriate operators and front-line managers which will clarify the functions of the rectifiers and what systems are affected by the inoperability of ACR rectifiers.
2. By November 14, 1997, Engineering, in conjunction with Maintenance, will evaluate replacement of the existing 250 VDC transfer switch relay with two 125 VDC relays as described in ESO Z98990 in C-310.
3. By February 20, 1998, Engineering, in conjunction with Maintenance, will evaluate replacement of the existing 250 VDC transfer switch relay with two 125 VDC relays as described in ESO Z98990 in C-331, -333, -335, and -337, if a similar system exists as discovered in C-310.
4. By October 15, 1997, Engineering will identify any additional DC rectifier/transfer systems supplying power directly to safety systems which may have similar automatic throwover characteristics that are subject to the common mode failure.
5. By January 30, 1998, Engineering will inspect any additional DC rectifier/transfer systems identified in corrective Action 4, above.
6. By March 5, 1998, Reliability Engineering will evaluate results in corrective Action 5, above and determine preventive maintenance requirements for the transfer relays.

LESSONS LEARNED

The repetitive loss of DC power is indicative of a failure to understand the depth of the problem and a failure to rigorously correct deficiencies.

EXTENT OF EXPOSURE OF INDIVIDUALS TO RADIOACTIVE MATERIALS

None

ER-97-13  
List of Commitments

PREVIOUS COMMITMENTS (NRC No. 32381)

1. By July 31, 1997, Engineering will inspect, with the assistance of Electrical Maintenance, all DC power transfer systems in C-331, -333, -335, -337. The inspection will determine the current condition of the transfer relay and associated fuses to the rectifier of the DC power transfer systems and will identify deficiencies. A copy of the findings will be provided to Reliability Engineering.
2. By August 15, 1997, Operations will ensure a system of communication of preventive maintenance (PM) status/clear ownership and approval of PM deferral exists.
3. By August 29, 1997, Operations will develop a schedule to correct deficiencies, as required, identified in corrective action No. 1, above.
4. By September 30, 1997, Reliability Engineering will evaluate (taking into account the results of corrective action No. 1, above) and determine the PM requirements for the transfer relays in C-310, -331, -333, -335, and -337. This evaluation will also include determining the adequacy of the frequency of the DC power switch test.
5. By September 30, 1997, Operations will issue an off-normal procedure for loss of DC power in C-310.
6. By September 30, 1997, Operations will issue off-normal procedures for loss of DC power in C-331, -333, -335, and -337.

CURRENT COMMITMENTS (NRC No. 32571, 32662)

1. By September 25, 1997, Operations will develop and disseminate an operator aid for appropriate operators and front-line managers which will clarify the functions of the rectifiers and what systems are affected by the inoperability of ACR rectifiers.
2. By November 14, 1997, Engineering, in conjunction with Maintenance, will evaluate replacement of the existing 250 VDC transfer switch relay with two 125 VDC relays as described in ESO Z98990 in C-310.
3. By February 20, 1998 Engineering, in conjunction with Maintenance, will evaluate replacement of the existing 250 VDC transfer switch relay with two 125 VDC relays as

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Enclosure 2

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described in ESO Z98990 in C-331, -333, -335, and -337, if a similar system exists as discovered in C-310.

4. By October 15, 1997, Engineering will identify any additional DC rectifier/transfer systems supplying power directly to safety systems which may have similar automatic throwover characteristics that are subject to the common mode failure.
5. By January 30, 1998, Engineering will inspect any additional DC rectifier/transfer systems identified in corrective Action 4, above.
6. By March 5, 1998, Reliability Engineering will evaluate results in corrective Action 5, above & determine preventive maintenance requirements for the transfer relays.