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

**Paducah Gaseous Diffusion Plant (PGDP) - Docket No. 70-7001 - Preliminary Event Reports ER 97-002 and ER 97-005**

Pursuant to 10CFR 76.120(c)(2), Enclosure 1 is the required 30-day written Preliminary Event Report covering Events 97-002 and 97-005 at PGDP. These events relate to the Criticality Accident Alarm System (CAAS) cluster meter readings which were observed to be lower than Engineering requirements. The Nuclear Regulatory Commission (NRC) was verbally notified of the events March 5, 1997 and March 18, 1997, respectively The investigation activities are continuing with a final report targeted for January 28, 1998. Enclosure 2 is a list of commitments made in the 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

SP:WES:mcl

Enclosures (2)

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NRC Senior Resident Inspector, PGDP

NRC

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EVENT REPORTS
ER-97-02 and ER-97-05
Preliminary Report

## BACKGROUND

The Criticality Accident Alarm System (CAAS) at Paducah Gaseous Diffusion Plant (PGDP) is designed to detect gamma radiation levels that would result from the minimum criticality accident of concern and to warn plant personnel by activating evacuation alarms. The CAAS consists of clusters of three detector modules and one logic module. According to the Safety Analysis Report (SAR), Section 3.12.6, "The clusters consist of three detector modules which alarm when a gamma dose-rate of 10 millroentgen per hour (mR/hr) above background is detected." Each detector module has an internally generated signal to maintain a constant operational check of the detection circuits. Currently, the background reading of the detector is initially adjusted to display a nominal 10 mR/hr on the front panel of the detector module. The alarm setpoint of each detector module is currently set at a nominal 20 mR/hr so that the detector module will go into alarm status if it receives radiation of 10 mR/hr or greater above background. The fault setpoint of each detector module is currently set at a nominal 5 mR/hr so that the detector module will go into fault status if the background reading drops significantly. A fault status is indicative of equipment problems and causes the CAAS to transmit a trouble signal to the central control room. Each detector module will detect radiation independently of each other. The cluster is designed to minimize the number of false audible evacuation alarms that plant personnel experience by applying the following logic to interpret detector module alarm status. To receive an audible CAAS alarm, one of two conditions must exist: (1) at least two of the three detector modules must be in alarm status simultaneously; or (2) only one detector module may be in alarm status while the other two detector modules are in fault status.

On November 6, 1996, under regulation of the Department of Energy, two CAAS detector modules in Cluster X in the C-337 building were observed with low background readings of 9 mR/hr and 8.5 mR/hr. (Event Report PAD-1996-0058). While the actual background radiation level would be essentially zero, the CAAS indicating meter is set to indicate a background of 10 mR/hr $\pm$ 0.5 mR/hr. This means at an actual radiation field of 10 mR/hr, the meter will indicate 20 mR/hr $\pm$0.5 mR/hr. The alarm is set to initiate at 10 mR/hr above background. (10 mR/hr background setpoint plus 10 mR/hr radiation field equals 20 mR/hr alarm setpoint nominal values.) A low background reading on a module could prevent the module from going into alarm status even though it has detected a 10 mR/hr increase in radiation. As stated above, in order to generate an audible alarm, the cluster logic requires either (a) two detectors to be in alarm status; or (b) one detector to be in alarm status while the other two detector modules are in fault status. Therefore, low background readings on two detector modules simultaneously could prevent an

audible alarm from being generated even though one or more modules has detected 10 mR/hr radiation. For that reason, clusters are currently declared inoperable if two of the three detector modules have background readings below 9.5 mR/hr. As a result of the above event, long term orders (LTO) were issued to establish weekly field monitoring of CAAS clusters to determine if the low background readings constitute a system problem. The LTO instructs operators that "modules with readings found below 9.5 mR/hr are to be promptly reported to the Plant Shift Superintendent and a work order initiated for ngeout." On February 4, 1997, another incident of two CAAS modules with low background ings occurred (Problem Report: PR-CO-97-0556). CAAS clusters U and AK located in the C-337 building were observed with two modules each reading 9.0 mR/hr. The clusters were declared inoperable and the LCO action steps as defined by Operational Safety Requirements, KY/D-3971, Section 3.1.2.3, were implemented. The modules were replaced by Instrument Maintenance and Clusters U and AK were declared operable on February 4 and 7, respectively.

DESCRIPTION OF EVENT

On March 4, 1997, during the weekly field monitoring of the CAAS clusters, Cluster V in C-337 process building was found with two of the three detector modules displaying background readings below 9.5 mR/hr. Detector Module Serial No. 580054 and Detector Module Serial No. 580105 were both reading 9.0 mR/hr. The cluster detector units are Model GCM-650 gamma criticality monitors, manufactured by Nuclear Research Corporation. Cluster V was declared inoperable. Since the Technical Safety Requirement (TSR) Section 2.4.4.2a defines the Limiting Condition for Operation (LCO) as "Criticality accident detection shall be operable" and since Cluster V does not have complete overlapping coverage from adjacent clusters, the LCO action steps as defined by the TSR Section 2.4.4.2 were implemented. Due to this "as found" inoperable condition, an event notification was made on March 4, 1997, pursuant to 10CFR76 120(c)(2)(i).

An investigation team was established to determine the root cause and corrective actions that will prevent recurrence. The team focused on two primary areas: (1) determination of the proper setpoints for the detectors; and (2) determining the cause(s) of the changes in the detector readings.

The selection of the proper alarm setpoint for detectors is necessary to ensure that the detector will detect the level of radiation generated during the minimum criticality accident of concern, while not generating excessive false audible alarms. The setpoint also determines the radius of coverage for detection. While the detectors may still function for a nearby criticality, the distance at which the minimum criticality would be detected, decreases as the background reading decreases. The detectors have a fault alarm; however it currently does not come in until

the reading falls to a nominal 5mR/hr. At this level, the detectors would not alarm at a 10 mR/hr increase in radiation level (15 mR/hr total is less than the radiation alarm setpoint of 20 mR/hr) An Engineering Evaluation is being prepared to support the changing of these setpoints to ensure the alarm/fault setpoint combination results in acceptable detection capability and timely awareness of detector modules which may not be able to meet their intended function. This awareness of a low background reading on a detector module will allow timely replacement of that single module, thereby reducing the probability of clusters being inoperable due to low background readings. In support of this Engineering Evaluation, Instrument Maintenance has completed testing to verify that a linear relationship exists between background settings and radiation levels. Additionally, the selection of the proper alarm setpoint and fault setpoint combination shall ensure that the defined range of acceptable background readings has adequately considered equipment/calibration constraints and limits of error. Based on the hypothesis that variations in background readings currently being experienced are actually within the expected limitations of the equipment/calibrations, proper setpoint changes which increase the range of acceptable background readings while maintaining acceptable detectability may resolve the current problem. This will not be known until an Engineering Evaluation is complete to support the setpoint changes.

To evaluate possible cause(s) of fluctuations in background readings, several initiatives are being pursued concurrently. Data bases are being developed using data from both the weekly field monitoring of the CAAS clusters and from maintenance records in the Instrument Shop to provide trending of CAAS data by such fields as building and module serial number. Based on the results of this trending, additional testing will be defined, as required. The detector modules which exhibited the low readings were checked in the Instrument Maintenance shop; no cause of the low reading could be determined. Additionally, detector modules which have exhibited problems in the field were sent to the vendor for evaluation related to the low background incident. Trending data has also been provided to the vendor to assist in the troubleshooting. An environmental chamber is on order which will allow the Instrument Maintenance shop to do more extensive testing of detector modules under simulated conditions similar to the temperatures which may be experienced in the field. Issues which result from the above testing/trending initiatives will be tracked to completion through the Corrective Action Program.

During the course of the investigation, another cluster was observed with two modules exhibiting background readings below 9.5 mR/hr. On March 18, 1997, at 1305, Cluster N in C-337A building was observed by the NRC Inspector with two detector modules reading 9.0 mR/hr (Detector Module Serial No. 580133 and Detector Module Serial No. 580142). Cluster N was declared inoperable and the the LCO action steps as defined by TSR Section 2.4.4.2 were implemented. Due to this "as found" inoperable condition, an event notification was made on March 18, 1997, pursuant to 10CFR76 120(c)(2)(i). The modules were replaced by Instrument

Maintenance and Cluster N was declared operable at 1710 on March 18, 1997. The modules were returned to the Instrument Maintenance Shop for testing.

## CAUSES OF EVENT

The direct cause(s) and associated root cause(s) have not been determined at this time. Therefore, this report will be supplemented when the root cause has been determined. Target date for a supplemental report is January 26, 1998.

## CORRECTIVE ACTIONS

A. Corrective Actions Taken

1. On January 2, 1997, Operations issued Long Term Orders to perform weekly checks of the CAAS clusters to check for low background readings. Modules with readings found below 9.5 mR/hr were to be promptly reported to the Plant Shift Superintendent and a work order issued for changeout.

2. On March 4, 1997, Instrument Maintenance replaced two modules in Cluster V and the cluster was returned to an operable status at 2330.

3. On March 7, 1997, Instrument Maintenance returned three detector modules to the vendor for further diagnostic tests and evaluation.

4. On March 18, 1997, Instrument Maintenance replaced two modules in Cluster N and the cluster was returned to an operable status at 1710.

B. Corrective Actions Planned

1. By May 23, 1997, Engineering will complete an Engineering Evaluation to support a change in CAAS detector module setpoints. Engineering will also generate required documentation to support associated procedure changes.

2. By September 23, 1997, Instrument Maintenance will complete changes on setpoints of all CAAS detector modules as defined in the Engineering Evaluation in Planned Corrective Action No. 1. Affected Instrument Maintenance procedures will be modified, as required, prior to changing setpoints.

3. By December 19, 1997, Engineering will complete an end-point assessment to determine the effectiveness of the corrective actions.

EXTENT OF EXPOSURE OF INDIVIDUALS TO RADIATION OR TO RADIOACTIVE MATERIALS

No criticality accident occurred during the time period that the two detector modules were reading low. Therefore, there was no exposure of individuals to radiation as a result of this event.

NUCLEAR SAFETY SIGNIFICANCE

A low background reading on a detector module could prevent the module from alarming at a 10 mR/hr radiation increase. Two modules in a cluster with low background readings could prevent the cluster from alarming at a 10 mR/hr radiation increase. To reach the alarm setpoint of the cluster, the detector would have to receive radiation which exceeded 10 mR/hr by an amount that would offset the low background reading. While the cluster may still detect and alarm upon a criticality, the distance at which it will detect the minimum criticality is reduced if the background reading drifts down.

LESSONS LEARNED

The selection of the proper values for the fault and the alarm setpoints is necessary to ensure that the CAAS can (a) adequately detect the required radiation level; (b) provide indications when it cannot perform its intended function; and (c) minimize the number of false alarm activations. Proper values for fault and alarm setpoints must adequately consider equipment/calibration constraints and limits of error.

Event Reports ER-97-02 and ER-97-05
List of Commitments

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