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June 11, 1997

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

SERIAL: GDP 97-1012

Paducah Gaseous Diffusion Plant (PGDP) - Docket No. 70-7001 - Event Report ER-97-07, Rev. 1

Pursuant to Safety Analysis Report (SAR), Section 6.9, Table 6.9-1, J(2), enclosed is the final report for two water inventory control system actuations (WICS) at PGDP which were reported on April 10, 1997 (Nuclear Regulatory Commission [NRC] Event Report [ER] No. 32128), and April 23, 1997 (NRC ER No. 32212). This report provides supplemental information for Event Report 97-07, issued to the NRC on May 9, 1997. 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

SP:WES:MLB:mcl

Enclosures (2)

cc: NRC Region III
NRC Senior Resident Inspector, PGDP

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EVENT REPORT
ER-97-07 (Rev. 1)

BACKGROUND

The C-360 autoclave Water Inventory Control System (WICS) provides the means to limit the water inside an autoclave such that upon a UF_6 release from a UF_6 cylinder, over pressurization of the autoclave or a nuclear criticality cannot occur. This is accomplished by two electrically powered sonic probes located slightly below the autoclave in the 3-inch drain line. The probes actuate upon the presence of excessive condensate in the autoclave and send a signal through electrical interlocks to remove power from the solenoid valves which remove air from two steam isolation valves and the vent steam valve. These valves are air powered and fail closed upon loss of air (thus fail closed). The system function is to isolate the sources of steam from the autoclave upon detecting a level of water accumulating in the condensate drain line. The WICS is designed as a "Q" safety system and required to be operable by Technical Safety Requirement (TSR) 2.1.4 when in Mode 5 (heating).

In C-360, unlike C-337-A and C-333-A Feed Vaporization Facilities, autoclaves Nos. 1 and 2 share common steam supply and condensate drain systems as do autoclaves Nos. 3 and 4.

This report provides supplemental information on two WICS actuation events which occurred at the C-360 toll transfer and sampling facility on April 9, 1997, and April 23, 1997, respectively.

DESCRIPTION OF EVENT (Reference NRC No. 32128)

On April 9, 1997, C-360 UF_6 sampling and transfer facility operators prepared autoclaves Nos. 1 and 2 for the heating and sampling of UF_6 cylinders.

At 1955, steam was simultaneously valved to both autoclaves. At 2030, a WICS actuation occurred on autoclave No. 1 which automatically isolated the steam supply to the autoclave. All safety system components functioned as designed with the exception of one of the condensate level probes which did not show alarm status. Facility operators responded by entering alarm response procedure (ARP) CP4-CO-AR8360-15. The front line manager (FLM) and Plant Shift Superintendent (PSS) were notified. The operators reported that only one of the two duplicate condensate level probes was in alarm at the time of the actuation and that after jetting the steam and opening the autoclave they did not see any water standing in the bottom of the autoclave. They concluded that, based on this, the actuation was caused by a spurious invalid signal. The PSS agreed and the autoclave was returned to service at 2130, April 9, 1997.

On April 10, 1997, the responsible system engineers reviewed the facts known about the actuation and concluded that the WICS actuation appeared to be valid and requested a WICS Functional Test to be run. The PSS was notified of this conclusion. The NRC-HQ Operations Office was notified at 1755 (CDT) on April 10, 1997, of the Safety System Actuation per SAR 6.9 Table 1, Criteria J.2 (reference NRC ER No. 32128).

The failure of the facility operators and the PSS to recognize the WICS actuation as being valid and subsequently returning the autoclave to service without a true understanding of the actuations cause is a violation of ARP step No. 9. This step states, "When any condensate is drained and cause of alarm has been determined and corrected, go to CP4-CO-ON3039, "C-360 Interrupted Heat Cycle," to return autoclave to service. The operators felt that they had determined the actuation to be spurious and invalid, based on the fact that no free standing water was found in the bottom of the autoclave when opened and only one of the two probes actuated.

Past experience has shown that this is not always an indication of a false alarm. Even if the actuation was determined to be false, returning the autoclave without determining why the false alarm occurred is inconsistent with the ARP requirement (step No. 9), and the conduct of operations philosophy of treating alarms as real and valid until a definitive cause for the alarm is determined. As a compensatory measure, a Long Term Order (LTO) was issued that requires the involvement of the shift or system engineer when determining the validity of all safety system actuations. Corrective actions No. 1, 2, 3 and 4 will provide procedural guidance to help facility operators determine the validity of WICS actuations.

On April 11, 1997, Instrument Maintenance performed the WICS functional test and found one of the two condensate ultra-sonic probes to be inoperative due to a coating of steam contaminates. Both probes were cleaned, the system functionally tested and operability restored. The condensate level probes are "Q" components. Currently, there is no procedure in place to direct the cleaning of the probes. This will be addressed by action No. 13 of the report. Additionally, action No. 9 and 10 will increase the frequency of condensate probe cleaning from the current annual schedule to semiannual.

DIRECT CAUSE (NRC No. 32128)

The direct cause of the WICS actuation is attributed to the C-360 autoclave loading and heating procedure which did not preclude the simultaneous initiation of the heat cycle for a companion pair of autoclaves, in this case autoclaves Nos. 1 & 2. This caused the flow of condensate from autoclave No. 1 to be restricted by the condensate flow from autoclave No. 2 which, due to the design of the system, has the advantage over autoclave No. 1 for both steam supply and condensate drainage. The condensate from autoclave No. 1 backed up and contacted the condensate level probes which actuated the WICS. Procedure CP4-CO-CN2051a, "C-360 Autoclave Loading and Heating," Rev. 1, was revised on April 18, 1996, to establish a one-hour minimum stagger of the initiation of the heat cycle for a companion pair of autoclaves. This provides a compensatory measure until the event investigation is completed and the root cause determined. Autoclave No. 1 was tested, declared operable, and returned to service under the revised procedure on April 18, 1997.

DESCRIPTION OF EVENT (NRC No. 32212)

Prior to the determination of the root cause of the event on April 9, 1997, on April 23, 1997, at 1542 CDT, while heating a cylinder in preparation for liquid sampling, a second WICS actuation occurred on autoclave No. 1. Facility operations responded per ARP CP4-CO-AR8360-7 and subsequently removed the autoclave from service. The NRC-HQ Operations Office was notified of the event at 2300 CDT on April 23, 1997 (reference NRC No. 32212).

DIRECT CAUSE (NRC No. 32212)

Investigation by the System Engineer revealed that the direct cause of the actuation was related to the failure of the pressure to current transducer (PY115B) in the autoclave temperature/pressure control loop instrumentation. This failed transducer receives pressure input from the autoclave pressure transmitter (PT115A) and translates this signal from pressure input to an electrical current output to the temperature/pressure control loop. This causes the autoclave steam control valve to open or close to maintain the autoclave temperature and pressure at the desired set-points.

When the transducer failed, it read a pressure lower than actual and signaled the steam control valve to open. This, in turn, caused more steam to be admitted to the autoclave than necessary. This situation when combined with autoclave No. 2 in mode 5 (heating), caused an excessive amount of condensate in the drain which eventually contacted the condensate probes resulting in the WICS actuation. This failed transducer was subsequently replaced and the autoclave passed post-maintenance functional testing.

SUPPLEMENTAL INFORMATION (NRC No. 32212) (NRC No. 32128)

On May 2, 1997, with autoclave No. 1 out-of-service and open (mode 8), and with autoclave No. 2 in mode 5 (heating), a WICS actuation occurred on autoclave No. 1. System Engineering reviewed the facts of this alarm and concluded that condensate from autoclave No. 2 had backed up in the common drain and made contact with the sonic condensate probe on autoclave No. 1.

Following this false WICS actuation on autoclave No. 1, the upper section of the autoclaves drain line was removed for visual inspection. When the line was removed, an in-line check valve was discovered in the 1 ½-inch section of the line just below the steam trap. This check valve is not shown on any of the current system design drawings. A more detailed inspection of this check valve revealed that foreign material buildup on the valve seat was holding the valve open causing a flow restriction and allowing back flow of autoclaves No. 2 into No. 1. Further inspection determined that check valves were installed in all four autoclave drains at the same location Action Nos. 5, 6 and 7 will ensure that drain system drawings are revised.

These check valves would stop condensate, created by the heating companion autoclave, from flowing up into the other autoclave causing a WICS actuation. This is what caused the May 2, 1997, WICS actuation of autoclave No. 1 when it was open in mode 8. These valves were replaced on autoclaves Nos. 1 and 2 and the drain lines reinstalled. Corrective action No. 11 will ensure replacement of the drain check valves on autoclaves Nos. 3 and 4.

At this point an internal inspection of the rest of the drain line was conducted using a video probe. This video probe was inserted in the top of the line and pushed through the drain. This revealed a substantial amount of corrosion material buildup on the inner walls of the drain, this buildup was further restricting the condensate flow from the autoclave. This material was cleaned out and the line flushed with water. Action No. 12 will ensure that similar inspections are completed on autoclaves Nos. 3 and 4. Due to differences in the design of the drain systems this action is not necessary at the C-333-A and C-337-A feed facilities.

CONTRIBUTING CAUSES (NRC No. 32212) (NRC No. 32128)

A contributing factor related to both of the subject WICS actuations is the fact that the C-360 autoclave drain system drawings did not show the in-line check valves located just below each autoclaves drain steam trap. Thus, no preventive maintenance (PM) has been done on the valves over the years of operation. Without proper PM the valves ability to function as designed was degraded. Additionally, the lack of a scheduled PM task to inspect and clean out the autoclave drain system lead to an abnormal amount of foreign material buildup in the drain lines which further reduced the ability of the drain system to accommodate free flow of condensate from the autoclaves.

ROOT CAUSE (NRC No. 32128) (NRC No. 32212)

The root cause of the subject WICS actuations is attributed to the original design of the autoclave drainage system which failed to provide adequate system venting. This design was completed and system drawings issued for construction in November 1977. The design and drawings were completed by a consulting engineering subcontractor as part of Architect-Engineer (AE) project No. 2370.

During our review of the drain systems design we discovered that the autoclave redundant conductivity cells which constantly monitor a sample of the autoclave atmosphere, in the form of steam condensate, also drains into the autoclave common drain by way of small diameter copper lines. These lines are run into the top of an open 2-inch PVC pipe which is connected into the autoclave drain manifold. Interviews with Facility Maintenance personnel revealed that approximately 4 years ago this open pipe was closed by placing thick pipe putty around the conductivity copper drain lines where they enter the PVC drain pipe. This was done to keep dirt and other foreign material from entering the drain system and did not effect the operability of the conductivity monitoring system.

Additionally, further inspection of the drain system revealed a similar condition where the 3-inch autoclave common drain line drops into the top of the 4-inch building drain system header. The approximated ½-inch gap between the outside wall of the 3-inch drain line and the inside wall of the 4-inch building drain line had been filled with a type of oil absorbing material. The material used to seal the openings around the conductivity drain lines and the 4-inch building drains were removed. Although not intended to be a drain system vent, the open conductivity drain lines and the opening at the 3-inch to 4-inch drain line junction would provide the necessary system venting. The plugging of these openings would be considered an unauthorized modification to the system under current configuration management and design control procedures. These controls ensure that such modifications will not occur in the future. System engineering has concluded that the removal of this material will provide the venting, that the original design lacked, to ensure free flow of condensate from the autoclaves. Thus, the modification of the drain system vent is not recommended.

CORRECTIVE ACTIONS COMPLETED

1. On April 18, 1997, the C-360 autoclave loading and heating Procedure No. CP4-CN2051a was revised to exclude the simultaneous initiation of companion autoclave heat cycles.

2. On April 14, 1997, a LTO (300-97-003) was issued which required the involvement of a shift or system engineering in the evaluation of safety systems actuations.

3. On May 6, 1997, the check valves located in autoclaves Nos. 1 and 2 were replaced under work package 9702982-02.

PLANNED CORRECTIVE ACTION

1. By August 25, 1997, guidance on determining the validity of autoclave WICS actuations will be provided to operations for inclusion in applicable C-360 alarm response procedures.

2. By August 25, 1997, guidance and determining the validity of autoclave WICS actuations will be provided to operations for inclusion into applicable C-333-A and C-337-A alarm response procedures.

3. By September 26, 1997, the C-360 alarm response procedure CP4-CO-AR8360-15 will be revised to include guidance on determining the validity of WICS actuations (when this action is completed LTO 300-97-003 can be deleted).

4. By September 26, 1997, C-333-A and C-337-A alarm response procedure CP4-CO-AR8333A/O/K and CP4-CO-AR8337A/O/K will be revised to include guidance on determining the validity of WICS actuations (when this action is completed LTO 300-97-003 can be deleted).

5. By August 25, 1997, Engineer Notice ENC-82197100 will be issued to the design engineering group requesting the revision of C-360 drawings P5E-14443-3011 and I5E-14443-0002B.

6. By October 27, 1997, the C-360 autoclave condensate drain system drawings. P5E-14443-3011 will be revised per Engineer Notice ENC-82197100.

7. By October 27, 1997, the C-360 autoclave condensate drain system drawing I5E-14443-0002B will be revised per Engineer Notice ENC-82197100.

8. By July 15, 1997, a preventive maintenance (PM) task order schedule will be initiated for the annual internal inspection of the C-360 autoclave condensate drain system and the drain line check valves.

9. By July 15, 1997, the current PM schedule for cleaning of the C-333-A and C-337-A autoclave ultra sonic condensate level probes will be changed to semiannual.

10. By July 15, 1997, the current PM schedule for the cleaning of the C-360 autoclave ultra sonic condensate level probes will be changed to semiannual.

11. By July 15, 1997 the C-360 condensate drain check valves will be replaced on autoclaves Nos. 3 and 4.

12. By July 15, 1997 C-360 autoclaves Nos. 3 and 4 condensate drain systems will be internally inspected and cleaned of foreign material.

13. By August 29, 1997, procedures CP4-GP-IM4119 and CP4-GP-IM6126 will be revised to incorporate the method to be used to clean the autoclave condensate level probes.

EXTENT OF EXPOSURE OF INDIVIDUALS TO RADIATION OR RADIOACTIVE MATERIALS

There were no releases of radioactive materials as a result of these events.

LESSONS LEARNED

- An uncontrolled modification of any system can effect its operability.
- Building design drawings must accurately reflect the systems configuration.
- Periodic inspection and preventive maintenance is essential to maintaining the full flow of autoclave condensate.
- Operators must be able to determine the validity of alarms.

Event Report 97-07 (Rev. 1)
List of Commitments

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