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APPENDIX B

INCIDENT INVESTIGATION FORM **QA RECORD**

INCIDENI INVESTIGATION EVENT REPORT

CATEGORY 1 [X]
CATEGORY 2 [ ]

II No. S-91-~~75~~ 075 8-8-91

Problem Title: Unit 1 Lower Containment Radiation Monitor in service with Inlet Valve Closed

Cause Codes _____

LER No. _____

Event Manager Signature R E Richie Date 7-26-91

Responsible Organization Chemistry

Plant Manager Signature _____ Date 8-7-91

Site ~~Director~~ V.P. Signature _____ Date 8-7-91
(Category I events)

C/A PROGRAM MANAGER

Problem Resolution Sheet Closeout:

- [ ] Investigation Report distribution listing completed.
- [ ] Open Corrective Action entered into tracking system.
- [ ] Causes entered into tracking system.
- [ ] Report review and approval complete.
- [ ] Open items listing issued to actionees.

RECEIVED
AUG 12 1991
Nuclear Experience Review Staff

CAP Manager _____ Date _____

TVA 40004 (ONP-12-88)

8-8-91

TVAX 130

TVAX130

Template = SECY-028

SECY-02

NUCLEAR REGULATORY COMMISSION

Docket No. 50-390 Official Exh. No. TVA 130

In the matter of TVA

Staff	IDENTIFIED ✓
Applicant ✓	RECEIVED ✓
Intervenor	REJECTED
Other	WITHDRAWN
DATE 6/11/02	Witness
Reporter BHM	

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USNRC

2003 MAR 11 AM 9:01

OFFICE OF THE SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Form STD-10 1 3-1

075

INCIDENT INVESTIGATION FORM

II No. S-91-~~75~~ 8/8/91

Location: Unit 1 (Plant Units)

Event Time: ~~7/15/91 0815~~ AKB 7-15-91 (Date/Time) 7/14/91 1020

Discovery Time: ~~7/14/91 1020~~ AKB 7-15-91 (Date/Time) 7/15/91 0815

INITIATOR

Initiator: Name: Alan K. Barringer Organization: Chemistry Extension: 7237

Description of Problem: 1-RM-90-106 inlet isolation valve discovered closed. This monitor had been declared operable since 7/14/91 @ 1018.

Activities in Progress. 1-RM-90-106 declared inoperable.

SUPERVISOR

Proposed Category? ☑ 1 ☐ 2 ☑ Deliver to SOS ☐ N/A

Initiator's Supervisor RE Richie Organization Chem Extension: 7436

Cause (if known):

Corrective Action Plan: Monitor returned to service. Attempted to duplicate closed valve with no alarms, alarms functioned normally. Notified SOS of problems with monitor. SOS had Opps reenter lower cont via 1-112

Plant Condition at Discovery U-1 Mode 1 U-2 Mode 1 Documents Initiated

SOS

Determination Operability Affected ☑ Yes ☐ No

Comments: Due to the time that the suction valve was closed, the 1-RM-90-106 was declared inop and WR CO54009 written to check the monitor and prove it operable. LCO 3.4.6.1 AND 3.0.3 was entered also due to the time that the suction valve was closed AND 1-RM-90-112 aligned to lower containment.

Shift Operations Supervisor Loyd M. Hodges Date/Time 7-15-91 1154

PLANT MGR

Reportability Determination

☒ Notification Not Required

☐ Corporate Notification Required Date/Time call made

☐ NRC Notification Required per 10 CFR 50.72 Date/Time

☐ NRC Notification Required per 10 CFR 50.73 Date/Time

☐ Other Notification Required (specify)

☐ Tech. Spec. Action Entered Date/Time

Investigation Responsibility Category ☐ 1 ☐ 2

Investigation Required

Event Manager ROB RICHIE Report Due Date 7/29/91

Team Members

☐ Problem Not Valid – Return to Corrective Action Program Manager

Plant Manager For RJ. BEECKEN By D. Lowe 7/15/91 1210 Date: 7/15/91

TE

Identify Appropriate Immediate Actions:

TMGR

Action Complete

8-8-91

Executive Summary

On 7/15/91 at 0820, The Unit 1 lower containment radiation monitor (1-RM-90-106) inlet plug valve was discovered closed with no alarms activated. The root cause was determined to be personnel lack of attention/carelessness (TROI Code BA).

The investigation resulted in several findings which contributed to the occurrence and duration of the event. These findings are as follows:

- Procedure provided inadequate verification, did not sufficiently verify radiation monitor operability, and contained confusing/ ambiguous valve nomenclature.
- Incorrect assumptions were made regarding plant operation and radiation monitor response.
- Radiation monitor design is such that an alternate leak path may be established due to improper gasket seal.

Corrective actions include procedure revision to provide independent verification of valve alignment including detailed check-off steps for individual valves, and will contain extra steps to verify proper operation of radiation monitor. Verification of plant conditions and instrument response will be emphasized to Chemistry and Operations personnel.

II. Description of the Event

A. Initial Conditions

Unit 1 in Mode 1 near 100% power.

B. Sequence of Events

The following sequence of events was compiled from Unit 1 Operations and Chemistry logs. These events are also outlined in the Events and Causal Factors Flowchart (Section VII).

Date	Time	Occurrence
07/14/91	1010	Operations blocks 1-RM-90-106 for filter changeout by Radiochemical Laboratory Analysts (RLA's). Enter LCO's 3.3.3.1, 3.4.6.1.
07/14/91	1010-1018	RLA's perform filter changeout and return 1-RM-90-106 to service.
07/14/91	1018	Operations unblocks 1-RM-90-106. Exit LCO's 3.3.3.1, 3.4.6.1.

I. Description of the Event (continued)

B. Sequence of Events (continued)

Date	Time	Occurrence
07/14/91	2356	Operations blocks 1-RM-90-106 for Vent Package sampling by RLA's. Enter LCO's 3.3.3.1, 3.4.6.1.
07/15/91	0013	Sampling completed by RLA's. Operations unblocks 1-RM-90-106. Exit LCO's 3.3.3.1, 3.4.6.1.
07/15/91	0048	Operations completes Unit 1 SI-137.1.
07/15/91	0123	Operations blocks 1-RM-90-106 for Vent Package resample by RLA's. Enter LCO's 3.3.3.1, 3.4.6.1.
07/15/91	0216	Sampling completed by RLA's. Operations unblocks 1-RM-90-106. Exit LCO's 3.3.3.1, 3.4.6.1.
07/15/91	0806	Operations blocks 1-RM-90-106 for filter changeout by RLA's. Enter LCO's 3.3.3.1, 3.4.6.1.
07/15/91	0820	Chemistry notifies Operations that 1-RM-90-106 inlet plug valve was found closed. Operations enters LCO 3.0.3.
07/15/91	0828	Operations unblocks 1-RM-90-106. LCO's 3.0.3, 3.3.3.1, 3.4.6.1 still in effect.
07/15/91	1000	Operations aligns Upper Containment Radiation Monitor (1-RM-90-112) to Lower Containment. 1-RM-90-112 operability cannot be verified due to insufficient source to overcome elevated baseline. Operations enters LCO 3.3.2.1.
07/15/91	1030-1230	1-SO-90-2 revised via PCF 91-0123 to waive source check on 1-RM-90-112.
07/15/91	1239	Operations declares 1-RM-90-112 operable. Exit LCO's 3.0.3, 3.3.2.1, 3.3.3.1, 3.4.6.1.
07/15/91	1438	Operations determines Unit 1 SI-137.1 performance on 7/15/91 at 0048 is invalid. Enter LCO 4.0.3.
07/15/91	1537	Unit 1 SI-137.1 performance complete. Exit LCO 4.0.3.
07/15/91	1810	SI-302 (monitor operability) completed on 1-RM-90-106. Operations realigns 1-RM-90-106 to Lower Containment and places monitor in service.

II. Description of the Event (continued)

C. Immediate Corrective Actions

Operations entered LCO 3.0.3 on 7/15/91 at 0820 after learning that 1-RM-90-106 inlet plug valve was closed. 1-RM-90-112 was then aligned to Lower Containment. When 1-RM-90-112 could not be verified operable due to insufficient source response, 1-SO-90-2 was immediately revised to waive source check as a criteria for verifying radiation monitor operability. LCO 4.0.3 was entered when Operations determined Unit 1 SI-137.1 was obviously invalid due to isolated inlet plug valve on 1-RM-90-106. Unit 1 SI-137.1 was then immediately scheduled and performed.

III. Analysis of the Event

A. Evaluation of Plant Systems/Components

1-RM-90-106 has a low-flow/high-vacuum alarm which apparently failed to actuate when monitor sample pump was started with the inlet plug valve closed. A similar event had previously occurred on 7/14/89 involving 1-RM-90-112 (II-89-031). A missing "o"-ring on the prefilter assembly of 1-RM-90-112 (See diagram, Section VII) allowed sufficient Auxiliary Building air to be pulled through the monitor to prevent actuation of the low-flow/high-vacuum alarm.

Inspection of 1-RM-90-106 strip chart verified that the inlet plug valve was indeed isolated since detector response for all three channels (particulate, iodine, and noble gas) dropped drastically on 7/14/91 at approximately 1020. 1-RM-90-106 response remained at the lower level until the inlet plug valve was reopened on 7/15/91 at 0820, at which time the count rate rapidly increased to that consistent with plant conditions.

Since 1-RM-90-106 and 1-RM-90-112 are of same design, all seals and gaskets on 1-RM-90-106 were inspected to determine if any were missing or degraded. All seals were in place and in good condition.

Performance of the high-vacuum/low-flow alarm was then investigated. The inlet plug valve was closed repeatedly with the monitor sample pump in operation. The alarm actuated each time the inlet plug valve was closed, verifying the alarm to be operable.

Work Request No. C054009 was written to verify proper function of 1-RM-90-106. The Instrument Mechanic (IM) performed monitor alarm and pump operability, then changed the filters per SI-302. When attempting to verify pump and alarm operation after filter changeout, the high-vacuum/low-flow alarm failed to actuate with the inlet plug valve closed. The IM noticed that the pump was only pulling 7" vacuum with the valve closed as opposed to a normal reading of 19" vacuum. Since the alarm trip is set at 12" vacuum, it was apparent that an alternate leak path existed through the monitor. All filter

AJL 8-8-91

III. Analysis of the Event (continued)

A. Evaluation of Plant Systems/Components (continued)

assemblies were inspected. The IM postulated that an improperly aligned iodine filter assembly allowed Auxiliary Building air to be pulled around the filter assembly gaskets into the monitor. The pump and alarm performed satisfactorily after proper filter assembly alignment was verified.

Chemistry personnel familiar with the design of the iodine filter assembly stated that the assembly tends to "tip out" of its support assembly during installation (See figure, Section VII). The iodine filter assembly mounts vertically in the support assembly and is aligned by fitting the filter mounting plate holes into four short pins. The filter assembly is held in place by a shielded, latched door. The center of gravity on the filter mounting plate is such that it overbalances when inserted into the mounting assembly, resulting in a possible misalignment.

B. Evaluation of Personnel Performance

Event Occurence

The two RLA's who performed the 1-RM-90-106 filter changeout on 7/14/91 apparently failed to adequately verify proper valve alignment. Both analysts stated that no procedure was present while work was being performed (not currently required for routine tasks per SSP-2.3), and that second-party verification was performed on both filter installation and valve alignment. Both analysts completed and signed TI-16 Worksheet C.3 which documents second-party verification. This worksheet was not completed and signed until after both 1-RM-90-106 and 1-RM-90-112 filter changouts were complete and the monitors were back in service. Both analysts were familiar with the procedure and with the radiation monitor design, and both successfully completed a walkdown by pointing out the correct valves to be manipulated and verified.

One of the two RLA's who performed filter changeout which initiated the event was also instrumental in discovery of the problem and assisted in immediate notification of proper plant personnel.

Contributing Causes to Event Occurrence

Several procedural inadequacies may have contributed to the error. TI-16 Appendix C.13, "Containment Radiation Monitors - Filter Sampling" allows completion of filter changeout(s) before documenting second-party verification on Worksheet C.3 (See Section VII). Since verification is documented after performance rather than during performance, the analyst may not remember the exact valves manipulated and verified, particularly if more than one filter changeout is performed.

II. Analysis of the Event (continued)

B. Evaluation of Personnel Performance (continued)

Contributing Causes to Event Occurrence (continued)

The TI-16 procedure may provide inadequate verification of monitor operability as evident in the Section III.A discussion. The procedure does not provide steps needed to prevent an alternate leak path through the monitor.

The TI-16 procedure provided valve descriptions in the text which were inconsistent with those in the diagram. In this case, the problem did not directly contribute to the error since the analysts were cognizant of the valves to be manipulated; however, any attempt to follow the procedure exactly as written would have resulted in monitor inoperability. The procedure was immediately revised to correct the problem.

Event Duration

Evidence shows that a problem existed several hours before the problem was actually discovered. The data sheet from 1-SI-OPS-000-002.0 and SI-137.1 on 7/14/91 shows a drastic decrease in 1-RM-90-106 response (40,000 CPM to 900 CPM) between day and evening shifts. Furthermore, analysis of samples on midnight shift showed a much lower noble gas activity than usually observed at the plant operating conditions.

Contributing Causes to Event Duration

The Operations ASOS noticed the large decrease in monitor reponse and assumed the activity decrease was due to a recent filter changeout, but failed to recognize that a filter changeout does not affect noble gas activity.

The Chemistry Shift Supervisor originally assumed the first noble gas analysis to be incorrect and requested another sample and analysis. When both analyses agreed, the Chemistry Shift Supervisor further assumed that the lower noble gas activity was due to a recent purge, but failed to check if a purge was actually performed.

C. Safety Implications

Assessment of Safety Consequences and Implications

A primary function of Lower Containment Radiation Monitors is to detect unidentified leakage from the RCS pressure boundary as described in Technical Specification Basis 3/4.4.6.1. This monitor provides immediate determination of small RCS leaks (less than 1 gpm). Other monitoring devices provide redundant leakage detection functions. These devices include upper containment radiation monitors, containment humidity monitors, reactor vessel flange leakoff temperature detectors, containment sump level monitoring, charging pump flowrate and unscheduled Chemical and Volume Control Tank level decrease (gross losses).

PLS 8-8-91

II. Analysis of the Event (continued)

C. Safety Implications (continued)

Assessment of Safety Consequences and Implications (continued)

The Lower Containment Radiation Monitors also initiate Containment Vent Isolation (CVI) when containment activity exceeds 80% of the Technical Specification limit. CVI initiation by these monitors is not considered a safety function. The safety function CVI is served by the Containment Exhaust Purge Monitors. CVI initiation by Lower Containment Monitors pre-dates the provisions of Containment Purge Exhaust Monitors in the plant design.

The absence of lower containment monitoring ability limits the Operator in early identification of low-level leakage. The only other method for low-level leak detection is containment pocket sump inventory monitoring. Containment pocket sump inventory is performed once every 12 hours via SI-137.1. Pocket sump inventory is a calculated value rather than an online reading.

Pressure boundary leakage of any magnitude is unacceptable since it may be indicative of an impending gross failure of the pressure boundary. Therefore, the presence of any pressure boundary leakage requires the unit to be placed in Cold Shutdown. Industry experience has shown that while a limited amount of leakage is expected from RCS, the unidentified portion of this leakage can be reduced to a threshold value of less than 1 gpm. Capability of monitoring low-level leakage ensures that the threshold value is sufficiently accurate to ensure early detection of additional leakage.

In summary, other methods were available to provide Operators indication of increases in pressure boundary leakage. Other indicators and safeguard features were also available to monitor and isolate radioactive releases to the environment. Consequently, this event did not adversely impact the health and safety of the public or plant personnel.

Elapsed Time

4 hours and 19 minutes elapsed between the time 1-RM-90-106 inlet plug valve was found isolated and 1-RM-90-112 was aligned to Lower Containment and declared operable (7/15/91 0820 - 7/15/91 1239). During this timeframe, LCO's 3.0.3, 3.3.2.1, 3.3.3.1, and 3.4.6.1 were in effect.

22 hours elapsed between the time 1-RM-90-106 inlet plug valve was closed and the time it was discovered closed (7/14/91 1020 - 7/14/91 0820); therefore, 1-RM-90-106 was inoperable for this length of time as evidenced by the monitor response decrease recorded on the strip chart.

AH 8-8-91

III. Analysis of the Event (continued)

Assessment of Safety Consequences and Implications (continued)

Redundancy

There are no redundant radiation monitors continually aligned to Lower Containment. The Upper Containment radiation monitor may be realigned to Lower Containment providing a backup function in the event of Lower Containment radiation monitor inoperability.

IV. Root Cause Statements

The Primary cause of the event was system alignment, tagout, restoration not verified.

Contributing causes are as follows:

Work Practices

- o Documents not followed correctly.
- o Not having proper information/instructions at job site before starting job.

Written Procedures and Documents

- o Inadequate documentational provisions.
- o Instructional presentation deficiencies.

Supervisory Methods

- o Job performance and self-checking standards not properly communicated.

V. Findings and Corrective Actions

1. Chemistry personnel apparently did not reopen 1-RM-90-106 inlet plug valve and performed inadequate verification of valve alignment.

   Chemistry personnel will be cautioned and instructed regarding proper verification techniques. Personnel will also be disciplined according to appropriate plant procedures.

   R. E. Richie, Chemistry, will complete this action by 8/1/91.

2. TI-16 does not provide adequate verification of valve alignment.

   TI-16 will be revised to provide second-party verification for proper filter installation and independent verification for valve alignment. The procedure will be formatted so that verification will be documented upon performance of each step requiring verification.

   R. E. Richie, Chemistry, will complete this action for all Upper and Lower Containment radiation monitors by 9/14/91.

Findings and Corrective Actions (continued)

3. TI-16 does not provide adequate verification of radiation monitor operability.

   TI-16 will be revised to include verified steps for checking radiation monitor pump and alarm operability. These steps will include (1) a sequence of steps to isolate inlet plug valve, energize sample pump, verify alarm actuation, and record sample pump vacuum reading (See SI-302 for an example), and (2) steps to record radiation monitor channel responses prior to inlet plug valve isolation and after monitor placed in service following filter changeout.

   R. E. Richie, Chemistry, will complete this action for all Upper and Lower Containment Radiation Monitors by 9/14/91.

4. Incorrect assumptions were made by Chemistry and Operations personnel regarding plant operation and radiation monitor response. Communication necessary to verify accuracy of these assumptions did not occur. Operations personnel also failed to realize the significance of the radiation monitor noble gas channel response in this event.

   The need for communication to verify the accuracy of assumptions will be emphasized to Chemistry and Operations personnel. This incident will also be covered in future Chemistry and Operations training.

   R. E. Richie, Chemistry, and S. M. Childers, Operations, will complete these actions by 8/9/91.

5. Radiation monitor design and/or inadequate maintenance of seals and gaskets may increase chances of filter misalignment and establishment of a leak path through the monitor.

   Radiation monitor design and maintenance procedures will be evaluated to determine if additional maintenance and/or a design change is needed.

   J. K. Gates, Systems, will complete this action by 9/30/91.

6. The NRC commitment requiring daily filter changeouts for containment radiation monitors may no longer be appropriate.

   The commitment will be evaluated to determine its applicability to present plant operation and revised if appropriate.

   J. K. Gates, Systems, will complete commitment evaluation by 9/30/91.

   R. E. Richie, Chemistry, will complete any required revisions by 12/31/91.

7. SSP-2.3 may be subject to misinterpretation of the definition of "routine task" and associated procedural requirements.

V. Findings and Corrective Actions (continued)

SSP-2.3 will be evaluated to determine if there are conflicting/ confusing statements, and to recommend changes if such statements are determined to exist.

W. R. Lagergren, Operations, will complete this action by 8/16/91.

8. The incident investigation (II-89-031) of a previous, similar event provided inadequate corrective action to prevent reoccurance.

This finding is being addressed through establishment of the PERP committee, Root Cause Analysis training, and HPES training.

VI. Description of Investigation

A. Investigation Team Composition

Robert E. Richie, Chemistry - Event Manager
Alan K. Barringer, Chemistry - Root Cause Analysis
Joe M. Hereford, Technical Support - HPES Evaluation
Danny W. Cross, Operations
Melissa A. Meade, Licensing

B. Investigation Plan

Robert E. Richie coordinated efforts of all team members, obtained statements from key personnel, and assisted in preparation of sequence of events and root cause analysis.

Alan K. Barringer interviewed key personnel, obtained evidence (strip charts, logs, etc.), assisted in preparation of sequence of events, hazard-barrier-target chart and root cause analysis, and prepared report.

Joe M. Hereford interviewed key personnel, investigated human performance aspects of incident, assisted in preparation of hazard-barrier-target chart and root cause analysis.

Danny W. Cross provided Operations analysis regarding incident and assisted in root cause analysis.

Melissa A. Meade evaluated event in terms of significance and technical specification requirements, and assisted in root cause analysis.

VII. Additional Supporting Information/Documentation

Sequence of events diagram, radiation monitor diagrams, hazard-barrier target chart, evidence, statements, interviews, and procedures are attached.

8-8-91