



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**

REGION III  
2443 WARRENVILLE ROAD, SUITE 210  
LISLE, IL 60532-4352

June 30, 2011

EA-11-148

Mr. Mark Bezilla  
Site Vice President  
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Perry Nuclear Power Plant  
P. O. Box 97, 10 Center Road, A-PY-A290  
Perry, OH 44081-0097

**SUBJECT: PERRY NUCLEAR POWER PLANT, UNIT 1 NRC SPECIAL INSPECTION  
TEAM (SIT) REPORT 05000440/2011013 AND PRELIMINARY WHITE FINDING**

Dear Mr. Bezilla:

On May 25, 2011, the U.S. Nuclear Regulatory Commission (NRC) completed a Special Inspection at your Perry Nuclear Power Plant (PNPP), Unit 1, to evaluate the circumstances surrounding an event, where workers who were removing a Source Range Monitor (SRM) detector and cable from the reactor vessel encountered unexpected high radiation dose rates. This radiological event occurred on April 21, 2011. Based on the risk and deterministic criteria specified in Management Directive 8.3, "NRC Incident Investigation Program," a Special Inspection was initiated in accordance with Inspection Procedure 93812, "Special Inspection." The basis for initiating the special inspection and the focus areas for review are detailed on the Special Inspection Charter (Enclosure 1).

The enclosed report documents the results of this inspection, which were discussed on May 25, 2011, with you and other members of your staff.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. The inspectors reviewed selected procedures and records, observed activities, and interviewed selected personnel. This report documents a finding associated with the retraction of a stuck source range monitor SRM-C from the reactor vessel that has preliminarily been determined to be a finding with low-to-moderate safety significance (White). The finding is also associated with three apparent violations of NRC requirements and is being considered for escalated enforcement action in accordance with the NRC Enforcement Policy. The current Enforcement Policy can be found at the NRC's Web site at <http://www.nrc.gov/readingrm/doc/collections/enforcement>.

In accordance with Inspection Manual Chapter (IMC) 0609, "Significance Determination Process," we intend to complete our evaluation using the best available information and issue our final determination of safety significance within 90 days of the date of this letter. The Significance Determination Process encourages an open dialogue between the NRC staff and

the licensee; however, the dialogue should not impact the timeliness of the staff's final determination.

Before the NRC makes its enforcement decision, we request that you either: (1) present to the NRC your perspectives on the facts and assumptions used by the NRC to arrive at the finding and its significance at a Regulatory Conference; or (2) submit your position on the finding to the NRC in writing. In either case, we request that you address why this issue occurred, and what corrective actions were taken.

If you request a Regulatory Conference, it should be held within 30 days of the receipt of this letter and we encourage you to submit supporting documentation at least one week prior to the conference in an effort to make the conference more efficient and effective. If a conference is held, it will be open for public observation. The NRC will also issue a press release to announce the conference. If you decide to submit a written response, such submittal should be sent to the NRC within 30 days of the receipt of this letter. If you decline to request a Regulatory Conference or submit a written response, you relinquish your right to appeal the final SDP determination, in that by not doing either, you fail to meet the appeal requirements stated in the Prerequisite and Limitation sections of Attachment 2 of IMC 0609.

Additionally, this report documents an inspector identified finding associated with a previous unsuccessful attempted retraction of the SRM-C that was preliminarily determined to be Green, a finding of very low safety significance. The finding was determined to involve a violation of NRC requirements. However, because the finding was of very low safety significance and because the issue was entered into your corrective action program, the NRC is treating the finding as a non-cited violation (NCV) consistent with Section 2.3.2 of the NRC Enforcement Policy.

If you contest the subject or severity of the NCV, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Regional Administrator, U.S. Nuclear Regulatory Commission - Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532-4352; the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and the Resident Inspector Office at the Perry Nuclear Power Plant. In addition, if you disagree with the cross-cutting aspect assigned to any finding in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region III, and the NRC Resident Inspector at the Perry Nuclear Power Plant.

Please contact Mr. Billy Dickson at (630) 829-9827 within 10 days of the date of this letter to notify the NRC of your intended response to the preliminary White finding and the associated apparent violations. The final resolution of this matter will be conveyed in separate correspondence.

Since the NRC has not made a final determination in this matter, no Notice of Violation is being issued for the inspection finding and associated apparent violations at this time. Please be advised that the number and characterization of the apparent violations described in the enclosed inspection report may change as a result of further NRC review.

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system

(ADAMS), accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html> (the Public Electronic Reading Room).

Sincerely,

***/RA by Kenneth G. O'Brien Acting for/***

Steven A. Reynolds, Director  
Division of Reactor Safety

Docket Nos. 50-440  
License Nos. NPF-58

Enclosure: Inspection Report 05000440/2011013  
w/Attachments:  
1. Supplemental Information  
2. Attachments 1-10  
3. Special Inspection Team Charter  
4. Timeline of Events

cc w/encl: Distribution via ListServ

U.S. NUCLEAR REGULATORY COMMISSION  
REGION III

Docket Nos: 50-440  
License Nos: NPF-58

Report No: 05000440/2011013

Licensee: FirstEnergy Nuclear Operating Company

Facility: Perry Nuclear Power Plant, Unit 1

Location: Perry, OH

Dates: April 25, 2011 – May 25, 2011

Inspectors: M. J. Phalen, Senior Health Physicist, DRS  
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Approved by: S. Reynolds, Director  
Division of Reactor Safety

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## SUMMARY OF FINDINGS

IR 05000440/2011013; 04/25/2011 – 05/25/2011; Perry Nuclear Power Plant, Unit 1; Special Inspection for the April 21, 2011, elevated undervessel radiation dose rates.

This report covers the review of the elevated undervessel radiation dose rates. Specifically, the inspectors identified one finding and three apparent violations (AVs) with a preliminary significance of White associated with the retraction of a source range monitor from the reactor vessel. Another finding with a significance of Green and an associated non-cited violation (NCV) was also identified by the inspectors involving an earlier unsuccessful attempted retraction of a source range monitor from the reactor vessel. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process" (SDP). Findings for which the SDP does not apply may be Green or be assigned a severity level after NRC management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

### A. NRC-Identified and Self-Revealed Findings

#### Cornerstone: Occupational Radiation Safety

- Preliminary White. The NRC identified a finding and three apparent violations of NRC requirements associated with the removal of a source range monitor from the reactor vessel. Specifically, the inspectors identified an apparent violation of Title 10 of the Code of Federal Regulations (CFR) part 20.1501 "Surveys and Monitoring," because licensee failed to appropriately evaluate and assess the radiological hazards associated with retracting a source range monitor from the reactor vessel. The inspectors also identified examples of apparent violations of Technical Specifications requirements 5.4. "Procedures" and 5.7. "High Radiation Area" associated with this finding. Following this event, the licensee instituted several corrective actions including procuring a new shielded retrieval and transport cask, retracting the source range monitor (SRM) detector and cable into the cask from the carousel instead of the sub-pile room floor, and implementing changes to plant procedures and the plant planning process to more effectively control this work. Additionally, a root cause evaluation was initiated under condition report (CR) 11-932471.

The inspectors reviewed the guidance in NRC Inspection Manual Chapter (IMC) 0612, Appendix E, "Examples of Minor Issues," and did not identify any examples similar to the performance deficiency. However, in accordance with IMC 0612, the inspectors determined that the performance deficiency was more than minor because it could be viewed as a precursor to a significant event. Therefore, the performance deficiency was a finding. The finding did not involve "as low as reasonably achievable" (ALARA) planning or work controls and there was no overexposure. However, the inspectors determined that a substantial potential for an overexposure did exist, in that, it was fortuitous that the resulting exposure did not exceed the limits of 10 CFR Part 20. The event did not occur in a very high radiation area, nor was the licensee's ability to assess dose compromised. Consequently, the inspectors concluded that the finding was preliminarily determined to be of White safety significance. The finding had a cross-cutting aspect in the area of human performance related to the cross-cutting component of decision making, in that, the licensee did not use conservative assumptions when

developing the work package and authorizing the work for the removal of SRM-C (H.1.b). (Section 40A5.7)

- Green: The NRC identified a finding of very low safety significance and a non-cited violation (NCV) of regulatory requirements contained in TS 5.4. "Procedures." Specifically, the licensee had insufficient detail in its instructions to workers, to ensure that the SRM-C cable take-up cartridge was installed correctly. Additionally, the workers failed to follow procedure in removing a nominal nine feet of excess SRM detector cable. The licensee entered this issue into its corrective action program (CAP) as CR 11-93247.

The inspectors reviewed the guidance in IMC 0612, Appendix E, "Examples of Minor Issues," and did not identify any examples similar to the performance deficiency. However, in accordance with IMC 0612, the inspectors determined that the performance deficiency was more than minor because if left uncorrected the performance deficiency had the potential to lead to a more significant safety concern. Therefore, the performance deficiency was a finding. The finding did not involve ALARA, did not involve an overexposure or a substantial potential for an overexposure, and did not compromise the licensee's ability to assess dose. Consequently, the inspectors concluded that the finding was of very low safety significance (Green). The finding was also a non-cited violation (NCV) of regulatory requirements contained in Technical Specification 5.4. "Procedures." The finding had a cross-cutting aspect in the area of human performance related to the cross-cutting component of work practices, in that, work instructions lacked sufficient detail to ensure appropriate radiological controls were in place and the licensee did not ensure that personnel followed procedures (H.4. b). (Section 40A5.6)

## **B. Licensee-Identified Violations**

None.

## REPORT DETAILS

### Event Summary

On April 21, 2011, the licensee was performing an undervessel maintenance activity involving the removal of the Source Range Monitor-C (SRM-C). SRM detector 'C' is a component of the SRM system, which is a subset of the station's neutron monitoring system. The SRM system provides neutron flux information to the operating staff during reactor startup and low flux level operations. The SRM system monitors thermal neutron flux in the reactor core over a range sufficient to observe the core shutdown-source level, the approach to criticality, and the overlap into the intermediate range monitoring system. The SRM detector assembly is located within a dry tube, which is within the drywell and penetrates the lower reactor vessel head. The dry tube extends through the reactor core region, and attaches to the upper core grid. [Attachment 1 "SRM Assembly," shows a SRM assembly.] There are four SRM detectors assemblies (A, B, C and D) in the SRM system. During normal full power operations, the SRM detectors are withdrawn to about 30 inches below the top of the bottom core plate (outside of the active core). If the SRM detectors remain in the active core during full power operations, the detectors are exposed to full neutron flux, resulting in the SRM detectors and associated detector cabling becoming highly irradiated. The licensee had declared SRM-C detector inoperable in May of 2010 when operators were unable to withdraw the detector from the reactor core during a reactor startup. The SRM-C detector was left inserted in the reactor core the remainder of the operating cycle.

During the April 21, 2011, maintenance activity, workers in the undervessel area experienced an unexpected increase in dose rates while attempting to remove SRM-C from the reactor vessel. The workers immediately left the work area once notified of the elevated dose rates by the RP technicians. The highest dose recorded by the electronic dosimeter (ED) worn by each individual was 98 milliRem (mRem). The highest dose rate recorded by one of these EDs was 16.3 Rem/hour. As part of the work activity, the licensee had attached remote dose rate monitoring instrumentation to a section of the SRM detector drive tube that was in the accessible portion of the undervessel area. This remote monitoring instrumentation indicated dose rates greater than 1000 Rem/hr during this event. Prior to this event occurring, the licensee had posted and controlled the work area as a locked high radiation area.

The maintenance activity consisted of using a disposal cask and associated drive mechanism from the sub-pile floor elevation of drywell. The drywell undervessel area consists of the carousel work platform and the sub-pile room area. Refer to Attachment 2, "Undervessel Sketch," for a drawing of the undervessel area; Attachment 3, "Keyway," shows the sole entrance to the undervessel area; Attachment 4, "Carousel," shows the carousel; and Attachment 5, "Ladder to Sub-Pile Room," shows the ladder access from the carousel to the sub-pile room floor.

The licensee's work plan was to remotely operate a take-up cartridge that would withdraw the SRM detector and cabling from the drive tube into the disposal cask. In preparation for the SRM detector and cabling retraction, the licensee disconnected instrument cabling from the detector cabling. The procedure instructed the workers to pull the SRM cable by hand from the drive tube until the licensee measured increased radiation levels in the area and/or there was approximately 30 feet of cable left in the drive tube. The procedure then instructed the workers to cut the excess cable. (Refer to Attachment 6, "Take-Up Cartridge," for a picture of the take-up cartridge and Attachment 7, "Open Grating with SRM-C Drive Tube," for a picture of the SRM-C drive tube passing through the carousel into the sub-pile room area.) The licensee then



planned to connect the SRM cable to the take-up cartridge leader cable, exit the sub-pile room area, and remotely operate the drive mechanism to spool the SRM cable onto the take-up cartridge until the SRM detector was in the disposal cask.

During the SRM removal activity individuals tasked with removing the SRM-C did not adequately track and measure the amount of detector cable length retracted from the reactor vessel. Consequently, the individuals withdrew about twenty two feet of cable instead of the desired nine feet of cable. The withdrawal of this length of cable resulted in irradiated sections of cable increasing ambient radiation levels in the work area. This was the licensee second attempt at performing retracting the SRM detector and cable.

### **Inspection Description**

A Special Inspection was initiated following the NRC's review of the deterministic and conditional risk criteria in Management Directive 8.3 "NRC Incident Investigation Program." The inspection was conducted in accordance with NRC Inspection Procedure (IP) 93812 "Special Inspection." The Special Inspection Charter, dated April 25, 2011, is included as Enclosure 2.

The NRC inspection team interviewed selected licensee and contractor personnel; reviewed applicable licensee procedures, work instructions, ALARA planning meeting minutes, maintenance records, corrective action documents, vendor source term documentation, vendor manuals regarding radiation monitoring instrumentation, and vendor cask manuals; and performed physical walkdowns of the undervessel area. A list of specific documents reviewed is provided at the end of this report.

### **40A5 OTHER ACTIVITIES – SPECIAL INSPECTION (93812)**

#### **.1 SIT Charter Item - Timeline**

##### **a. Inspection Scope**

The inspectors reviewed applicable documents and obtained information necessary to establish a timeline and sequence of events, including the sequence of work planning, job briefings, and the determination of event classification. A detailed timeline and sequence of events surrounding the unexpected increase in work area dose rates is included in Enclosure 2.

##### **b. Findings and Observations**

No findings of significance were identified. However, the inspectors reviewed and assessed four entries of interest into the drywell undervessel area. Specifically:

- 04/21/2011 - Dayshift 1st attempt at SRM retraction;
- 04/21/2011 - Nightshift 2nd attempt at SRM retraction;
- 04/22/2011 - Day Shift to reinsert the SRM; and
- 04/26/2011 - Successful SRM retraction.

Specific issues associated with selected undervessel entries are addressed later in this report. The event was document in the licensee's corrective action program (Condition Report 11-93247).

.2 SIT Charter Item - Planning

a. Inspection Scope

Review and assess the licensee's work planning, including the application of operating experience, expected radiological conditions, lessons learned, contingency and ALARA planning, and the interfaces among operations and work planning staff during the planning process.

b. Findings and Observations

No findings of significance were identified. However, the inspectors identified the following observations.

Hazards Assessment and Work Planning

The licensee had approximately 11 months to plan and schedule the replacement of the SRM-C cable and detector. Knowledgeable personnel within various groups in the licensee's work control process (i.e., operations, engineering, and work control) were aware of the potential radiological hazards associated with the irradiated SRM-C replacement. However, this information was not integrated into the work package or the radiation work permit (RWP)/ALARA plan that was developed to support this work.

Additionally, the work area was set up without appropriate industrial safety controls, the absence of which could have impacted the radiation doses received by the workers. Specifically, there was an open, unbarricaded, unguarded hole in the grating (floor) that was a nominal 6 foot deep and 36 inches long by 34 inches wide. Several trip hazards were also present at the work site, including a rope, a wire, and a cord on the grating. (Refer to Attachment 8 "Trip Hazards" for pictures of the trip hazards.) Access to the ladder to the sub-pile room was over a hand rail, and conduit was interfering with the ladder rungs. (Refer to Attachment 5 for pictures of the ladder rung interferences.)

Radiological Conditions and Exposure Controls

The radiation protection staff failed to fully recognize the radiological risk associated with retracting an in-core radiation detector and cabling after an 11-month neutron flux residence time. Consequently, work was authorized to begin on the removal of the SRM-C detector without a full understanding or full radiological characterization of the potential radiological hazards.

Inadequacies in ALARA planning included:

- Radiological controls for the SRM-C change-out were copied from a previous change-out of an intermediate range monitor (IRM-C) that occurred in RFO10 (2005). However, the licensee did not recognize or account for the different radiological hazards (e.g., residence time in the reactor core and source

composition). The licensee did not develop or establish any radiological controls to address the actual or potential radiological concerns specific to SRM-C;

- The RWP and ALARA plan had stop-work conditions established at 150 percent of the 2005 (IRM-C) values without any technical basis for the stop-work limits;
- Some of the radiation survey meters used during the SRM-C detector replacement work did not have sufficient ranges for the potential radiological fields that could have been present. The teletector and AMP-100 used on the guide tube went off-scale high during the work activities. (Refer to Attachment 9 “AMP-100 Location” for a picture of the AMP-100 on the drive tube);
- The work order was directed toward non-highly irradiated in-core detector change-outs;
- The licensee did not implement sufficient controls to ensure that the length of cable removed did not exceed its plan. The techniques employed to determine the actual length of cable pulled were historically left to the individual as a “skill of the craft” activity at PNPP and were not adequate to prevent the rapid increases in ambient dose rates while the detector was being retracted;
- The licensee did not institute radiological hold points to identify rapidly changing radiation levels, thereby limiting the withdrawal of the SRM-C cable and detector to a point that had minimal impact on workers’ ambient radiation area;
- The RWP and ALARA plan for the SRM-C change-out did not have detailed instructions to control the work as required by procedure (NOP-OP-4107, Revision 05, “Radiation Work Permit”); and
- Licensee Procedure HPI-C0015, Revision 00, “Radiological Controls for Highly Radioactive and Irradiated Components or Materials,” states that the intent of the procedure was to control highly radioactive objects and materials removed from the reactor vessel. However, the focus of the procedure appears to be limited to controlling work on the refueling floor verses undervessel work activities.

### Operating Experience

Operating experience was available but not effectively utilized. Specifically, Regulatory Guide 8.38, “Control of Access to High and Very High Radiation Areas in Nuclear Power Plants,” indicated that irradiated SRM detectors and cables are capable of dose rates of up to 100,000 Rem/hr. NRC Information Notice 88-63, “High Radiation Hazards from Irradiated In-core Detectors and Cables,” also alerted licensees to the potential radiological hazards associated with irradiated SRM detectors and cables. Additionally, industry operating experience associated with irradiated in-core neutron monitoring detectors and cables was also readily available. Although this information was available to the licensee, effective radiological controls were not incorporated into the work packages for the SRM change-out.

## Interfaces (Operations, Engineering, Radiation Protection, and Work Planning Departments)

Interviews with selected staff members suggested that each organization was focused on their specific job function in their review of the work order and defaulted to RP to establish any necessary radiological controls. Radiation protection management did not take a leadership role to ask other departments for assistance such as, engineering for a source term evaluation or dose calculations. Other departments such as operations, maintenance, and work control missed an opportunity to highlight to RP that SRM-C had been stuck in the neutron flux area of the core for almost a year and that there may be distinctive radiological challenges associated with the change out of this detector.

## Contingencies

Pre-planned contingency actions were limited, providing only an instruction to the workers to immediately leave the sub-pile area if/when the dose rates increased to an unacceptable level. The licensee did not consider other options such as re-inserting the detector to lower dose rates or establishing alternate escape paths or waiting areas. As a result, the escape path placed the workers within about 18 inches of an uncharacterized radiological source (i.e., the retracted SRM-C cable in the detector drive tube).

### .3 SIT Charter Item – Management and Work Execution

#### a. Inspection Scope

Review and assess the experience of the staff involved in the work activity and the management involvement and oversight of the actual work.

#### b. Findings and Observations

No findings of significance were identified. However, the inspectors determined that there was limited management involvement and oversight of this work activity. Specifically, management oversight for the first two SRM retraction attempts was limited to the intermittent observations that were conducted remotely from the radiation protection central monitoring station (CMS). There was no licensee supervision in the field for either of these undervessel entries. The inspectors concluded that the SRM retraction and change-out was regarded as a routine work activity. The contractor supervisors acted as task performers during the second SRM retrieval effort. Consequently, there was no one fulfilling the position of craft management and supervisory oversight.

No findings of significance were identified with the experience or training level of the staff involved in this event.

### .4 SIT Charter Item - Engineering/Operations

#### a. Inspection Scope

Review and assessment of the engineering or operational factors that caused or contributed to the event including equipment design or use issues.

b. Findings and Observations

No findings of significance were identified. However, the inspectors identified that the licensee had used a site-designed disposal cask for several years. When using the site-designed disposal cask, the workers retracting the SRM from the vessel worked from the sub-pile room floor. The non-standard designed disposal cask used by the licensee had inherent radiological safety issues. The standard designed retrieval and transfer cask would have positioned the workers on the carousel to retract the SRM. The detector cable length was approximately 39 feet long and the take-up cartridge was designed to hold 30 feet of cable. Consequently, a nominal nine feet of detector cable had to be removed prior to connecting the detector cable to the take-up cartridge in the disposal cask, thereby lowering the SRM detector and irradiated cabling inside the reactor vessel. Working from the sub-pile room floor further lowers the detector and irradiated cabling an additional nominal eight feet. This action effectively eliminated approximately eight feet of margin and compromised the benefit of shielding gained by keeping the SRM and irradiated cable inside the reactor vessel as much as possible.

.5 SIT Charter Item - Corrective Action Program

a. Inspection Scope

Review and assessment of the preliminary cause determination and assess the adequacy of short term corrective actions.

b. Findings and Observations

No findings of significance were identified. The licensee initiated a root cause evaluation (RCE) for this event. The RCE was in-progress during the inspection, so the inspection team did not develop conclusions regarding the adequacy of this evaluation. However, the licensee had initiated immediate corrective actions that included:

- Procuring a standard designed shielded retrieval and transport cask which improved the configuration of the evolution;
- Retracting the SRM into the shielded retrieval and transport cask from the carousel instead of the disposal cask on sub-pile room floor, thereby limiting the amount of irradiated cable exposed in the carousel work area by a nominal eight feet;
- Obtaining an independent dose assessment such that the licensee had an understanding of the upper limit on the radioactive material being removed from the reactor vessel;
- Improving communication by placing all workers on headsets;
- Installing a radiation monitor with a range (scale) capable of measuring the potential dose rates to be encountered (i.e., an AMP-200); and
- Controlling the work as an Infrequently Performed Task/Evolution.

The inspectors identified no findings of significance with the corrective actions taken to date.

.6 SIT Charter Item – Human Performance

a. Inspection Scope

Review and assess the human performance impacts, and contributing factors, including procedure adequacy, and procedure adherence.

b. Findings and Observations

Introduction:

The NRC identified a finding of very low safety significance and a NCV of regulatory requirements contained in TS 5.4 “Procedures.” Specifically, the licensee had insufficient detail in their instructions to workers, to ensure that the SRM-C cable take-up cartridge was installed correctly. Additionally, the workers failed to follow procedure in removing a nominal nine feet of excess SRM detector cable.

Description:

The disposal cask was designed with an internal take-up cartridge. The detector cable length was approximately 39 feet long, and the take-up cartridge was designed to hold 30 feet of cable. In order to work correctly, the take-up cartridge needed to be installed at zero degrees. However, the design of the disposal cask and the take-up cartridge assembly allowed the take-up cartridge to be installed correctly at zero degrees or at 180 degrees out of position. Specifically, licensee Procedure IMI-E2-28, Revision 09, “Source Range Monitor/Intermediate Range Monitor Installation and Removal” Procedure Step 5.2.1 (8) stated, in part, to “check that the cartridge is installed correctly (rotation is in the right direction).” However, there is no specificity in guidance to the workers on how to install the take-up cartridge correctly.

Additionally, according to procedure, the licensee was to pull the SRM cable by hand through the drive tube until radiation level rises and/or there was approximately 30 feet of cable left in the drive tube and then cut off the excess cable. During the initial attempt to remove the SRM-C detector, the steps in the procedure were not followed to ensure that the necessary nine feet of SRM-C detector cabling was removed prior to initiating detector retraction. In fact, no excess detector cabling was cut during this undervessel entry. Given the radiological risk involved in this activity, the instructions to the workers as provided by the procedure lack specificity and detail on how to accomplish this task (i.e. how to measure that amount of cabling removed). Specifically, licensee Procedure IMI-E2-28, Revision 09, “Source Range Monitor/Intermediate Range Monitor Installation and Removal,” Procedure Step 5.2.1 (12) states, in part, that “when radiation level raises and/or there is approximately 30’ of cable left in drive tube, cut cable and fiberglass sleeve using bolt cutters.”

When the drive mechanism was operated, the cable was cut by the incorrectly installed take-up cartridge. This stopped the work activity. It was fortuitous that the take-up cartridge was installed incorrectly and the cable was cut shortly after retraction because this left the SRM-C detector and irradiated portion of the cable still inside the reactor vessel. However, if the cable had not been cut, the potential would have existed to retract the detector deep into the drive tube or into the sub-pile/carousel work area.

### Analysis:

The inspectors determined that the finding was more than minor in accordance with IMC 0612 "Power Reactor Inspection Reports," Appendix B, "Issue Screening," because if left uncorrected the performance deficiency had the potential to lead to a more significant safety concern. The finding impacted the Occupational Radiation Safety Cornerstone objective for ensuring adequate protection of worker health and safety from exposure to radiation in the attribute of program and process for ALARA planning. Specifically, not controlling the retraction of the irradiated in-core radiation monitoring detector and cabling would have resulted in unnecessary radiation exposure had the detector been retracted into the drive tube or to the sub-pile room floor and recovery actions been necessary. This activity was within the licensee's ability to foresee and should have been prevented, in that, the need to control irradiated in-core radiation monitoring detectors and cabling was well documented industry experience. The finding was not subject to traditional enforcement since the incident did not impact the NRC's ability to perform its regulatory function and was not willful.

Since the finding involved occupational radiation safety, the inspectors utilized IMC 0609, Appendix C, "Occupational Radiation Safety SDP," to assess its significance. The inspectors determined that the finding did not involve ALARA planning or work controls. There was no overexposure nor was there a substantial potential for an overexposure. There was no compromised ability to assess dose. Consequently, the inspectors determined that the finding was of very low safety significance.

The finding had a cross-cutting aspect in the area of human performance related to the cross-cutting component of work practices, in that, work instructions lacked sufficient detail to ensure appropriate radiological controls were in place and the licensee did not ensure that personnel followed procedures (H.4. b).

### Enforcement:

Technical Specification 5.4.1 requires that written procedures be established, implemented, and maintained covering the activities in Regulatory Guide 1.33, Revision 2, Appendix A, dated February 1978.

Procedures specified in Regulatory Guide 1.33 include procedures for performing safety related maintenance, which are provided, in part, by licensee procedure IMI-E2-28, Revision 09, "Source Range Monitor/Intermediate Range Monitor Installation and Removal."

- Procedure Step 5.2.1 (8) stated, in part, to "check cartridge is installed correctly (rotation is in the right direction)."
- Procedure Step 5.2.1 (12) stated, in part, that "when radiation level raises and/or there is approximately 30' of cable left in drive tube, cut cable and fiberglass sleeve using bolt cutters."

Contrary to the above, on April 21, 2011, the licensee failed to establish, implement and maintain written procedures covering the repair and replacement of safety related equipment. Specifically, the licensee began work on SRM-C with work instructions that lacked sufficient detail to ensure appropriate radiological controls were in place, and the

licensee did not ensure that personnel followed procedures. The licensee had insufficient detail in its procedure to ensure that the SRM-C cable take-up cartridge was installed correctly. Additionally, the workers failed to follow the procedure in removing a nominal nine feet of excess SRM detector cable. This was a violation of regulatory requirements. Since the licensee documented this issue in its corrective action program (CAP) (Condition Report 11-93247) and because this finding is of very low safety significance, it is being treated as an NCV in accordance with the NRC enforcement policy. (05000440/2011013-01)

.7 SIT Charter Item - Radiation Safety

a. Inspection Scope

Review and assess the actual and potential radiological consequences.

b. Findings and Observations

Introduction:

The inspectors identified a finding and three apparent violations of NRC requirements associated with the removal of a source range monitor from the reactor vessel. Specifically, the inspectors identified an apparent violation of Title 10 of the Code of Federal Regulations (CFR) part 20.1501 "Surveys and Monitoring," because licensee failed to appropriately evaluate and assess the radiological hazards associated with retracting a source range monitor from the reactor vessel. The inspectors also identified examples of apparent violations of Technical Specifications requirements 5.4. "Procedures" and 5.7. "High Radiation Area" associated with this finding.

Description:

After the first unsuccessful SRM-C retraction attempt, the licensee resumed work on the nightshift, April 21, 2011. The reactor drywell was posted and controlled as a locked high radiation area at the start of work. Two contract workers were stationed in the sub-pile room to retract the SRM detector cable. One contract worker was stationed in the undervessel keyway as a support person. One RP technician was also in the keyway to monitor radiological dose rates and to be able to communicate with the workers. Another RP technician was positioned outside the carousel area to remotely monitor dose rates on the AMP-100 radiation monitor as the SRM was retracted from the reactor vessel. There were two AMP-100 radiation monitors in service. One was positioned in the sub-pile room on the disposal cask. The other was attached to the SRM drive tube in the carousel area (Refer to Attachment 9). The workers were wearing teledosimetry that was being remotely monitored in the radiation protection CMS. Communication among the workers was challenged because headset communication equipment was limited to RP personnel.

The work plan instructed the workers to retract the SRM cable by hand from the drive tube until the radiation level rises and/or there was approximately 30 feet of cable left in the drive tube and then to cut the excess cable. The workers manually withdrew approximately 22 feet of detector cable instead of the desired 9 feet to 12 feet of detector cable. The inadvertent withdrawal of the excessive length of detector cable resulted in the SRM detector and about seven and a half feet of radiologically activated



cable being withdrawn to outside of the reactor vessel. This resulted in increased radiation fields of from 2 Rem/hr to >1000 Rem/hr (the remote instrumentation saturated at 999.9 Rem/hr) in the open area of the carousel work platform.

The workers immediately left the work area once notified of elevated dose rates by the RP technicians and there were no overexposures. However, in order to leave the sub-pile floor and undervessel area, the workers were required to first climb a ladder and crossover a handrail that was adjacent to the SRM drive tube that contained a radioactive source and activated cable of an unknown magnitude (Refer to Attachments 5 and 7). The AMP-100 on the drive tube was off scale high as was the teletector being used by the RP technician. There were several industrial hazards present in the work area, including cords, ropes, and an un-barricaded open pit with a nominal 6-foot fall. Additionally, the licensee instituted no physical barriers that would have prevented access to the highly radioactive source during the work activities.

The radiation fields on the carousel work platform were initially from 0.090 to 0.300 Rem/hr with higher dose rates at head height and increased after the initiation of work activities to a range of approximately 2 Rem/hr to >1000 Rem/hr, with the higher dose rates nearer the SRM drive tube. The sub-pile room general area dose rates were initially a nominal 0.100 Rem/hr and increased to approximately 0.550 Rem/hr. The highest dose recorded by the electronic dosimeter (ED) worn by each individual worn was 98 mRem. The highest dose rate recorded by one of these EDs was 16.3 Rem/hour. The SRM-C detector and cable had a measured radiation level of 8600 Rem/hr on contact (surveyed underwater) [(143.333 Rem/min) and (2.388 Rem/sec)]. The inspectors reviewed additional radiological survey data provided by the licensee. Additionally, the NRC performed independent dose calculations as a follow up to this event that demonstrated that with seven and a half feet of activated cable present, a significant exposure would have occurred within a nominal two seconds to two minutes, depending upon the workers proximity to the source. (Refer to Attachment 10 for additional radiological information).

#### Analysis:

The inspectors determined that the licensee's failure to appropriately identify and assess the radiological hazards associated with retracting the highly irradiated SRM-C from the reactor vessel was a performance deficiency. As a result, the licensee failed to implement effective engineering or administrative controls necessary to prevent the retraction of the SRM detector and irradiated cable into the general work area.

The inspectors determined that the finding was more than minor in accordance with IMC 0612 "Power Reactor Inspection Reports," Appendix B, "Issue Screening", because it could be viewed as a precursor to a significant event. Additionally, the finding impacted the Occupational Radiation Safety Cornerstone objective for ensuring adequate protection of worker health and safety from exposure to radiation in the attribute of program and process for ALARA planning, in that, not controlling the retraction of irradiated in-core radiation monitoring detectors and cabling resulted in unnecessary and unplanned elevation of ambient radiation fields with workers present.

This activity was within the licensee's ability to foresee and should have been prevented, in that, it was well documented industry experience that in-core radiation monitoring detectors and cabling was likely to become highly irradiated when exposed to neutron

flux. The finding was not subject to traditional enforcement since the incident did not impact the NRC's ability to perform its regulatory function and was not willful.

Since the finding involved occupational radiation safety, the inspectors utilized IMC 0609, Appendix C, "Occupational Radiation Safety SDP," to assess its significance. The inspectors determined that the finding did not involve ALARA planning or work controls. Given the immediate evacuation of the work area by the workers, there was no overexposure.

However, the inspectors determined that a substantial potential for an overexposure did exist in that, it was fortuitous that the resulting exposure did not exceed the limits of 10 CFR Part 20. The SDP states that the concern is not the significance of the resulting exposure, but whether the licensee provided adequate controls over the situation to ensure workers were protected from significant radiological hazards. The key element of this event was the distance from the source. There were several industrial hazards present in the work area. A reasonable alteration of circumstances such as a trip or fall that had the workers moving to the right verses the left on the carousel platform demonstrate that a regulatory over exposure would have occurred within seconds to a couple of minutes of exposure time, depending upon the worker's proximity to the source. Additionally, no physical controls were in place to prevent contact with the radiation source. The event did not occur in a very high radiation area, nor was there a compromised ability to assess dose. Consequently, the inspectors determined that the finding was of potentially greater-than-green safety significance.

The finding had a cross-cutting aspect in the area of human performance related to the cross-cutting component of decision making, in that, the licensee did not use conservative assumptions when developing the work package and authorizing the work (H.1.b). Specifically, the licensee assumed that the radiological conditions associated with the replacement of SRM-C would be analogous to those of intermediate range monitor (IRM) 'C' replacement in 2005. The licensee did not give consideration to the distinctive radiological characteristics associated with SRM-C residing in the neutron flux area of the reactor core since May 17, 2010.

Enforcement:

- a) As of April 21, 2011, the licensee failed to conduct surveys to evaluate the potential radiological hazards incident to the removal of in-core SRM-C to ensure that the workers dose rates remained below the limits of 10 CFR 20.1201. Specifically, the licensee authorized the removal of an irradiated in-core detector, (SRM-C) on April 21, 2011, without a complete radiological evaluation of the work activity. This is an apparent violation of 10 CFR 20.1501 and 20.1201, which requires that licensees make surveys that are reasonable under the circumstances to evaluate the magnitude and extent of radiation levels to ensure that occupational doses are maintained below NRC limits.
- b) On April 21, 2011, workers were required to enter into a high radiation area without the dose rate levels in the area being established and personnel being made aware of them. Specifically, work was performed on the SRM-C without a complete radiological characterization of the source which was being pulled down toward the sub-pile room and carousel work area, and with the workers escape path being up

the ladder and past a radiological source of an unknown magnitude. This is an apparent violation of TS 5.7.1.b, that establish controls for high radiation area entries.

- c) As of April 21, 2011, the licensee failed to establish a procedure for access control to radiation areas. Specifically, procedure HPI-C0015 only addressed work activities on the refueling floor and did not address access control to the undervessel radiation area which was performed on April 21, 2011. Additionally, on the same date, the licensee failed to implement procedure NOP-OP-4107, in that the ALARA plan for work on SRM-C lacked sufficient detail about the requirements, consideration, and actions to ensure that the work activity was performed in an ALARA manner. Specifically, the ALARA plan did not ensure that the work activity to retract the irradiated SRM-C contained steps to ensure that the ambient radiation field in the work area in the carousel and sub-pile room areas was being controlled and that the worker actions were in accordance with ALARA considerations. This is an apparent violation of TS 5.4.1, which requires that the licensee establish, implement, and maintain procedures contained in Regulatory Guide 1.33, Revision 2, Appendix A, which include radiation protection procedures.

The finding and three associated apparent violations were of preliminary White significance (AV 05000440/2011013-02).

.8 SIT Charter Item - Resources

a. Inspection Scope

Review and assess any unique characteristics that may have contributed to the event such as schedule pressure or work distractions.

b. Findings and Observations

No findings of significance were identified.

**40A6 Management Meetings**

Exit Meeting Summary

On May 25, 2011, the team presented the results of the special inspection with you and other members of your staff. The team acknowledged that some information discussed was considered proprietary. Additionally, the staff is in possession of some proprietary information that will either be returned to the licensee or destroyed, once the regulatory issues associated with this inspection are complete.

ATTACHMENT: SUPPLEMENTAL INFORMATION

## SUPPLEMENTAL INFORMATION

### KEY POINTS OF CONTACT

#### Licensee

M. Bezilla, Site Vice President  
K. Krueger, Plant General Manager  
P. McNulty, Radiation Protection Manager  
F. R. Smith, Emergency Planning Manager  
C. Elberfeld, Regulatory Compliance Supervisor  
J. Pelcic, Regulatory Compliance Engineer  
S. Thomas, Undervessel Project Manager

#### USNRC

G. Shear, Deputy Division Director, DRP  
R. Pedersen, Senior Health Physicist, NRR  
S. Garry, Senior Health Physicist, NRR

### LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

#### Opened and Closed

05000440/2011013-01;      NCV      Insufficient detail in work instructions when retracting a Source Range Monitor. (Section 4OA5.6)

#### Opened

05000440/2011013-02;      AV      The Licensee Failed to Appropriately Identify and Assess the Radiological Hazards when retracting a Source Range Monitor. (Section 4OA5.7)

## LIST OF DOCUMENTS REVIEWED

The following is a list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspectors reviewed the documents in their entirety, but rather, that selected sections or portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the inspection report.

### **4OA5 Other Activities – Special Inspection (93812)**

ALARA Action Reviews; 11-001, 11-004, 11-005, 11-006, 11-007, 11-008, 11-009, 11-016, 11-0022, and 11-023

ALARA Plan Nos. 11-6013, 11-6037, and 11-6038

Area Monitor Probes; AMP 50-100-200; Operation and Maintenance Manual; Revision 05

CR 11-93223; Detector Take-Up Reel Installed 180 Degrees Out; dated April 21, 2011

CR 11-93247; High Radiation Levels during SRM-C Removal; dated April 21, 2011

CR 11-93252; 5 Workers Receive Dose Rate Alarms; dated April 21, 2011

CR 11-93254; PY-PA-11-01; SRM-C Detector Transport Cask Concerns; dated April 22, 2011

CR 11-93300; Dose Rate Alarm Received While Re-Inserting SRM-C; dated April 22, 2011

CR 11-93371; SRM-C Disposal Cart Program Violation; dated April 25, 2011

CR 11-93380; Cart Used for Previous LPRM Change Outs Not Rated for Mini-Cask & Cutter Weight; dated April 25, 2011

CR 11-93668; Improvement Opportunities Identified from IPTE Post Job Brief; dated April 26, 2011

Disposal Cask 919D532; GEK-13928 and GEK13928I

HPI-C0008; In-Line Review of Work Orders; Revision 09

HPI-C0015; Radiological Controls for Highly Radioactive and Irradiated Components or Materials; Revision 00

HPI-J0053; Calibration and Operation of the MG AMP Area Monitor Probe; Revision 06

IMI-E2-28; Source Range Monitor/Intermediate Range Monitor Detector Installation and Removal; Revision 09

NOPB-LP-2604; Effective Job Briefs; Revision 05

NOPB-OP-0007; Conduct of Infrequently Performed Test or Evolutions; Revision 03

NOBP-4008; Response to Radiological Events; Revision 02

NOBP-4008-01; Radiological Event Investigation Form; Selected Individuals; Selected Dates

NOP-LP-2001; Corrective Action Program; Revision 27

NOP-NF-3001; Special Nuclear Material Control and Accounting Program; Revision 06

NOP-OP-1007; Risk Management; Revision 08

NOP-OP-4002; Conduct of Radiation Protection; Revision 01

NOP-OP-4005; ALARA Program; Revision 01

NOP-OP-4101; Access Controls for Radiologically Controlled Areas; Revision 03

NOP-OP-4102; Radiological Postings, Labeling, Markings; Revision 06

NOP-OP-4104; Job Coverage; Revision 00

NOP-OP-4107; Radiation Work Permit; Revisions 05

NOP-OP-4204; Special External Exposure Monitoring; Revision 05

NOP-OP-4204-03; Multiple Whole Body Exposure Monitoring Record; Selected Individuals; Selected Dates

NOP-WM-0001; Work Management Process; Revision 06

NOP-WM-1001; Order Planning Process; Revision 13

NOP-WM-2001; Work Management Scheduling/Assessment/Seasonal Readiness Process; Revision 11

Perry Engineering Evaluation; 60067929; SRM-C Source Term; dated April 25, 2011

PYBP-RPS-020; Radiation Work Permit Guide; Revision 05

RWP 056414; Under-Vessel Activities during RFO10; Including IRM-C Change-out; Revision 00

RWP 116013; RFO13 Under-Vessel Activities; Revision 01

RWP 116037; RFO13 SRM-C Cable Reinsertion, Revision 00

RWP 116038; RFO13 SRM Cable/Detector Removal, Transport, Storage in the FHB Pool and Support Work, Revision 0

Selected Outage Control Center, Radiation Protection, and Operations Department Logs and Interview Records; dated April 21 through May 05, 2011

Source Range Monitoring System; System Description Manual; Revision 08

Selected Radiological Surveys Related to SRM-C Change-out; dated April – May 2011

Selected Staff Qualification Records (Licensee and Contractor Craft and Radiation Protection Personnel) dated April 2011

Station ALARA Committee Minutes; Selected Dates Related to RFO13 Undervessel Work

Technical Report; Perry SRM-C Neutron Activation after In-Core Exposure; TR2011-07; dated April 28, 2011

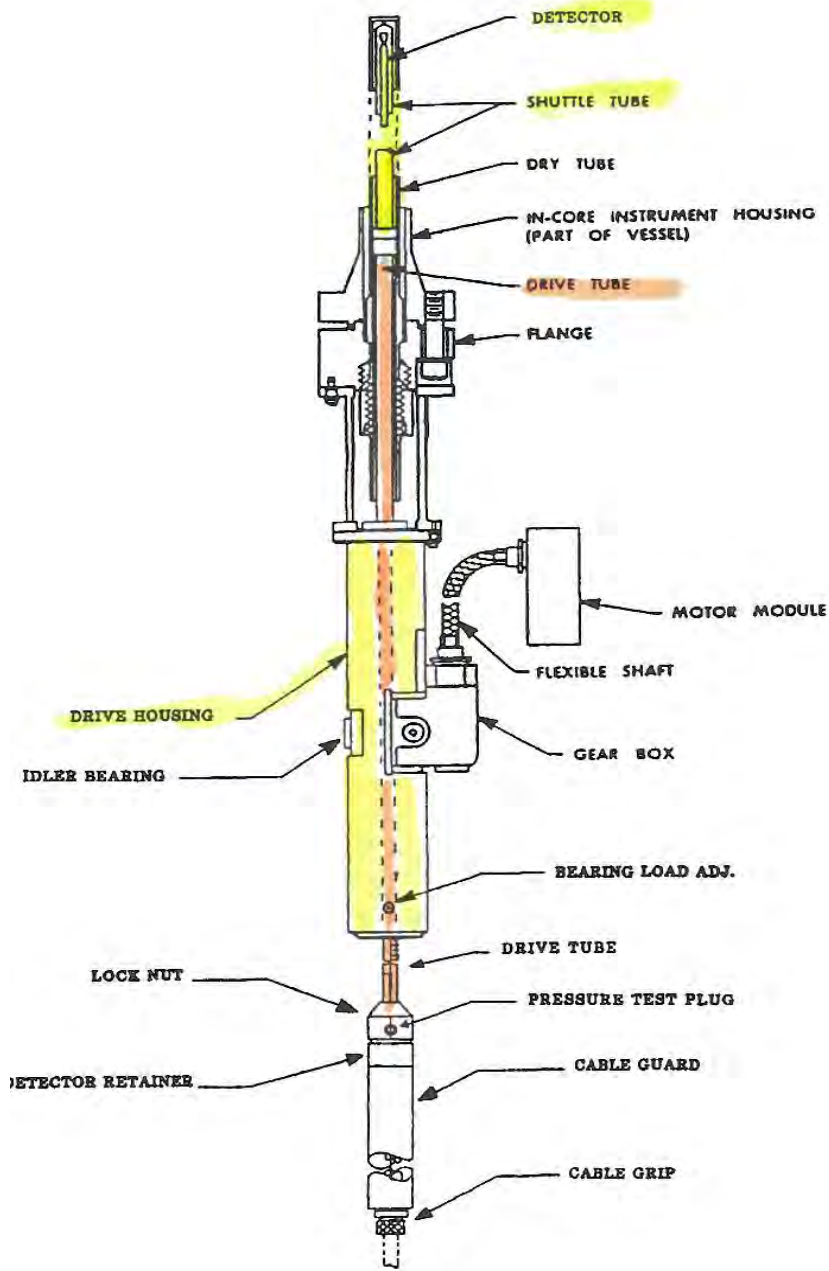
Work Order 200416219; Replace SRM-C Detector; Revision 01

## LIST OF ACRONYMS USED

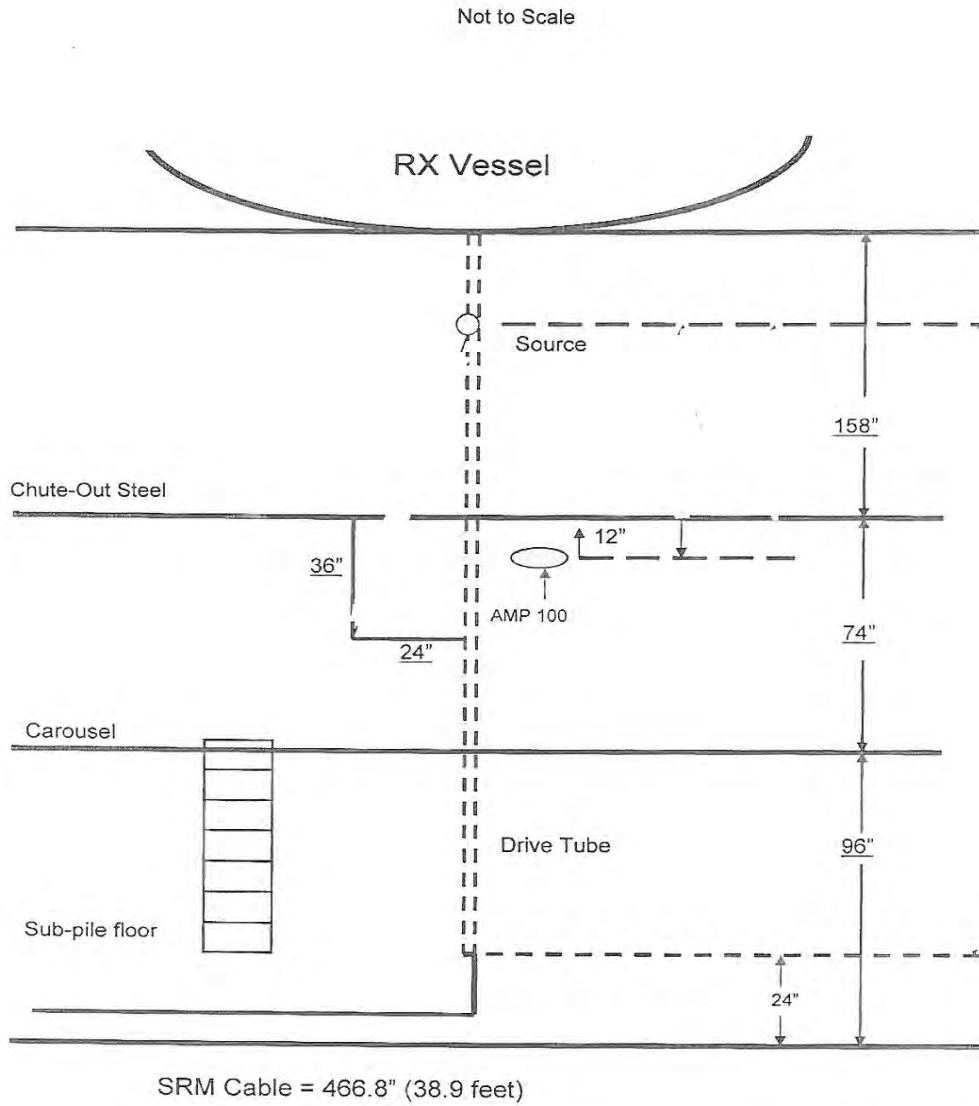
|       |                                    |
|-------|------------------------------------|
| ACE   | Apparent Cause Evaluation          |
| ALARA | As Low As Reasonably Achievable    |
| AV    | Apparent Violation                 |
| CAP   | Corrective Action Program          |
| CAQ   | Condition Adverse to Quality       |
| CFR   | Code of Federal Regulations        |
| CMS   | Central Monitoring Station         |
| CR    | Condition Report                   |
| ED    | Electronic Dosimeter               |
| IMC   | Inspection Manual Chapter          |
| IP    | Inspection Procedure               |
| IRM   | Intermediate Range Monitor         |
| LHRA  | Locked High Radiation Area         |
| NCV   | Non-Cited Violation                |
| NRC   | Nuclear Regulatory Commission      |
| OE    | Operating Experience               |
| PARS  | Publicly Available Records System  |
| PNPP  | Perry Nuclear Power Plant          |
| RCE   | Root Cause Evaluation              |
| RFO10 | Refuel Outage 10                   |
| RP    | Radiation Protection               |
| RWP   | Radiation Work Permit              |
| SDP   | Significance Determination Process |
| SIT   | Special Inspection Team            |
| SRM   | Source Range Monitor               |
| TS    | Technical Specification            |
| WO    | Work Order                         |



# ATTACHMENT 1 – SRM ASSEMBLY



# ATTACHMENT 2 – UNDERVESSEL SKETCH



ATTACHMENT 3 - KEYWAY



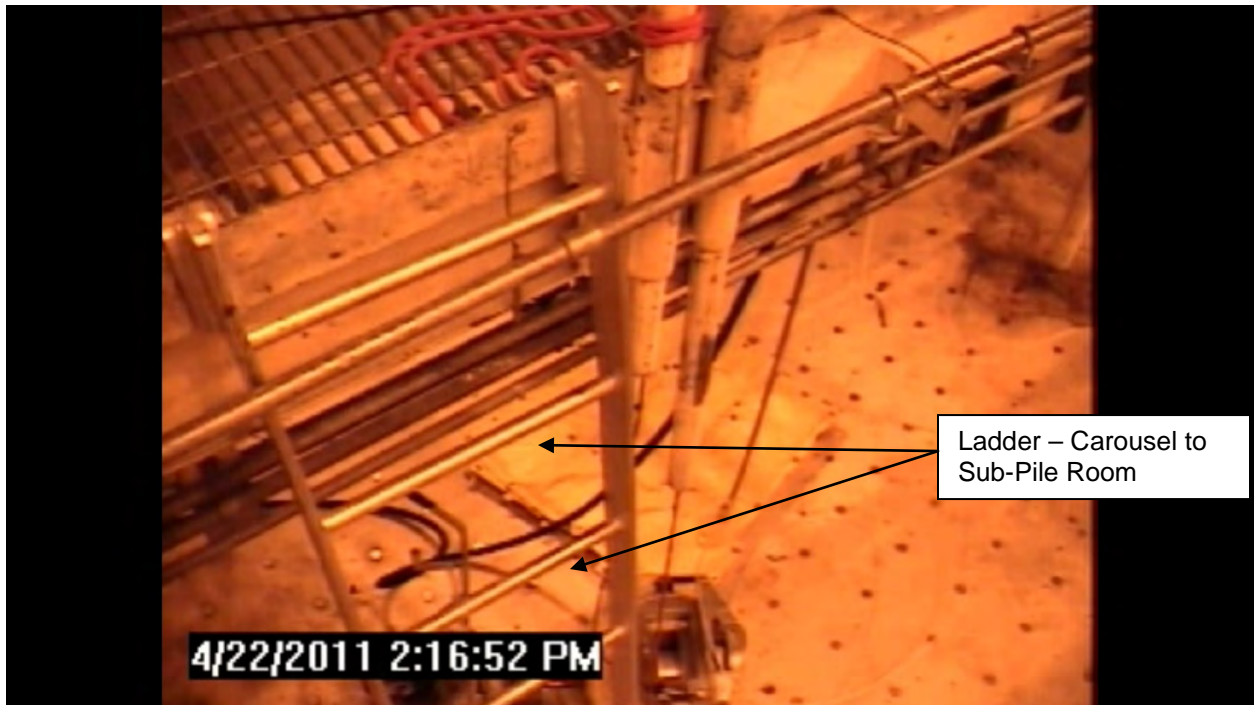
ATTACHMENT 4 - CAROUSEL



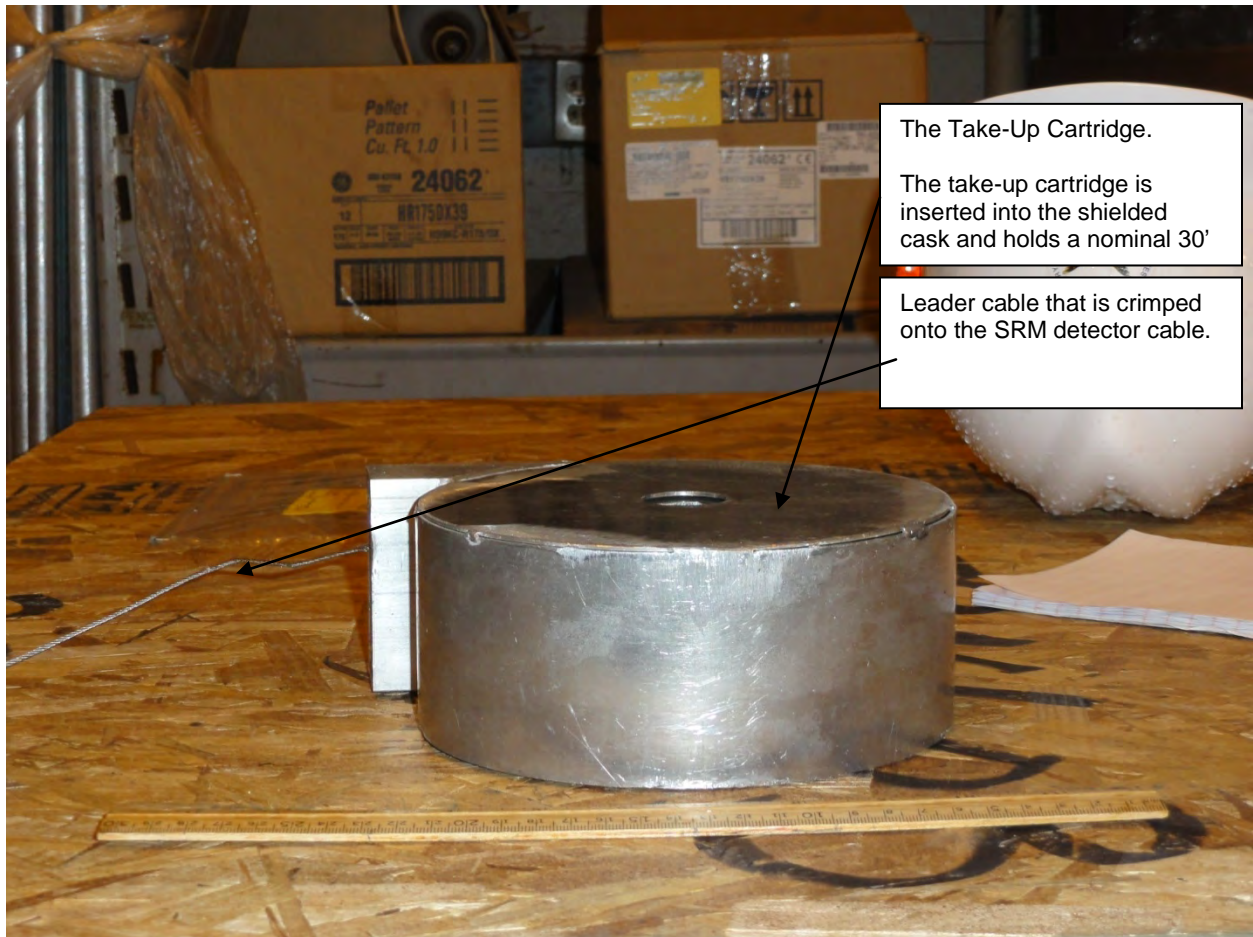
Undervessel Area

Sub-Pile Room Access Ladder Was Installed

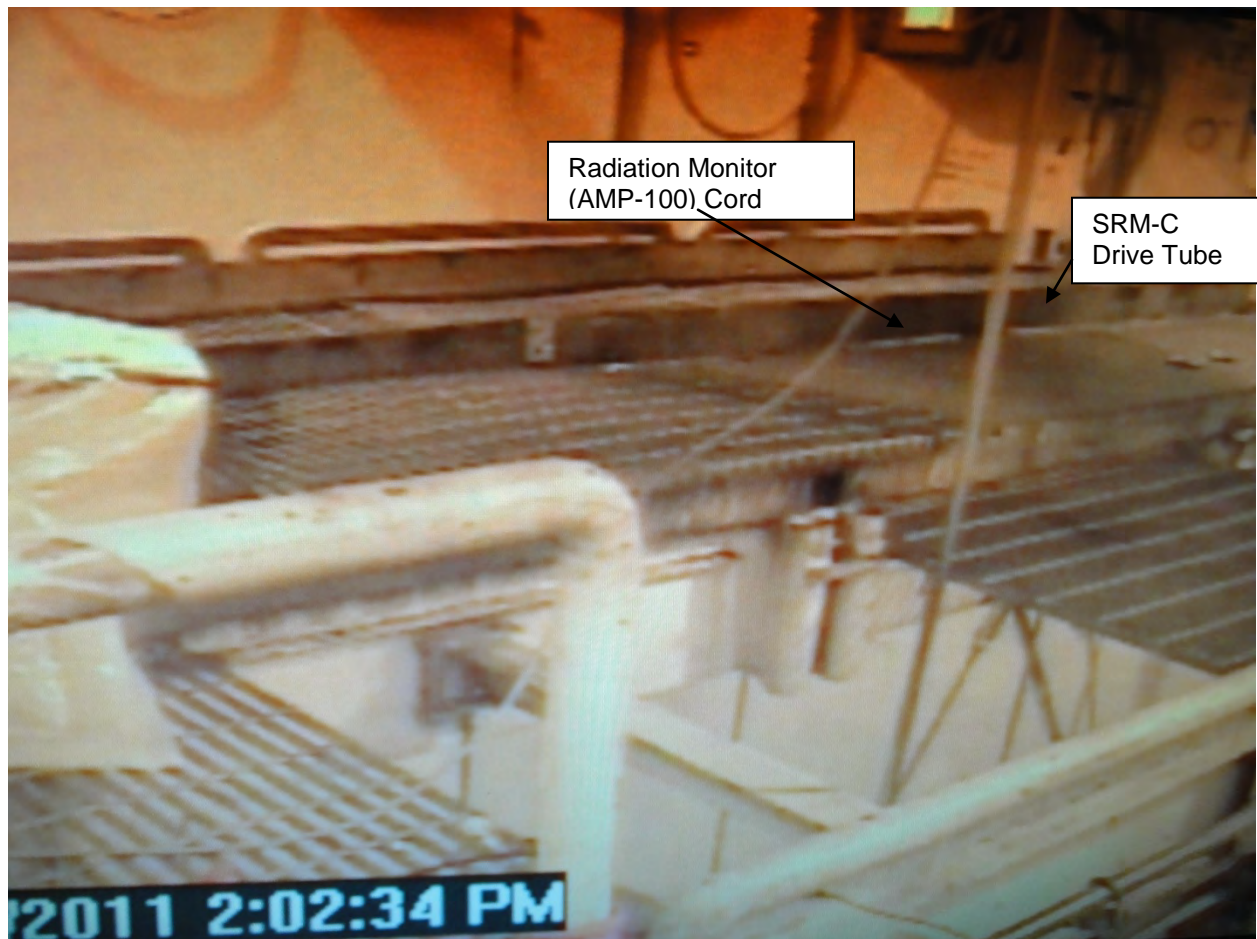
ATTACHMENT 5 - LADDER TO SUB-PILE ROOM



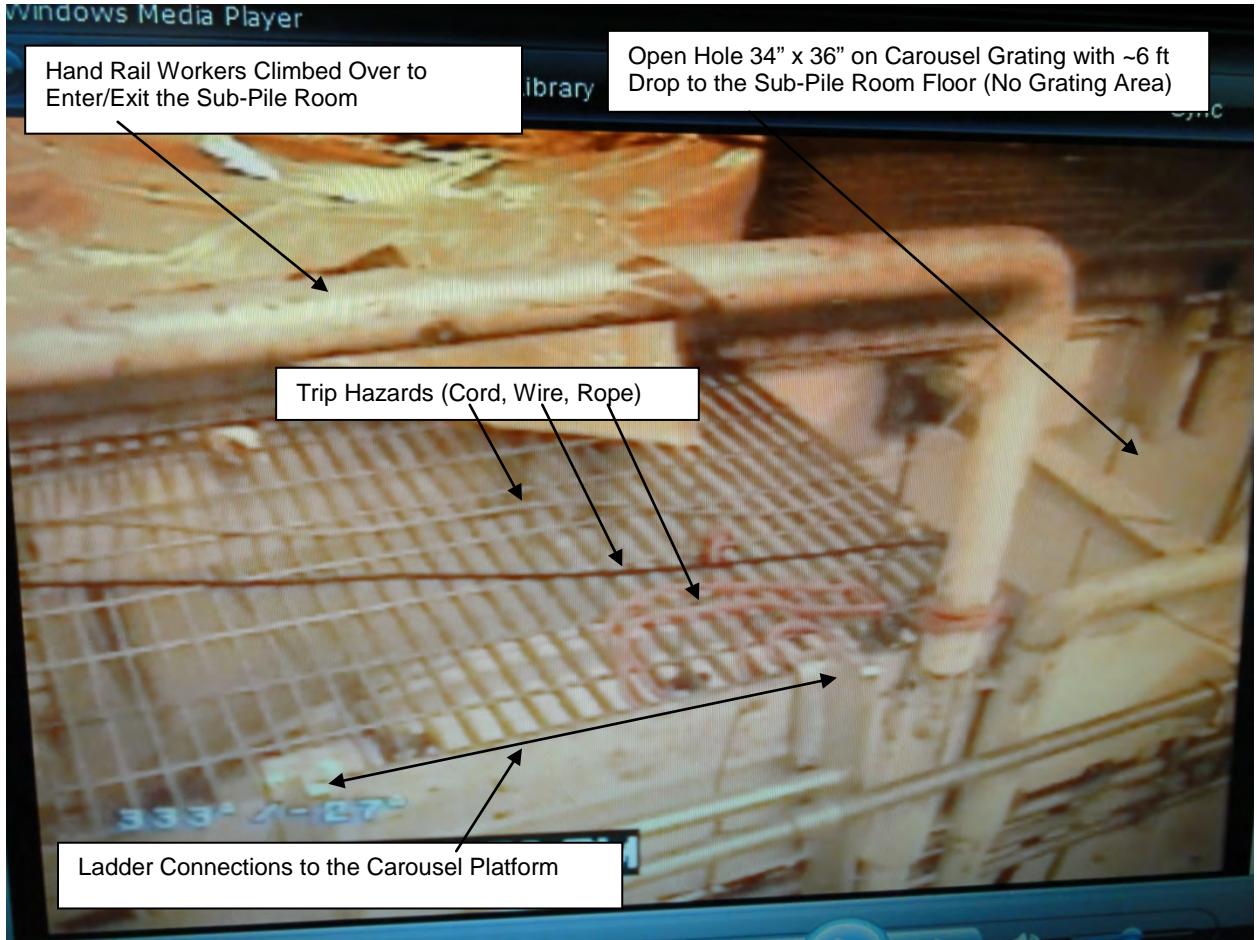
## ATTACHMENT 6 - TAKE-UP CARTRIDGE



**ATTACHMENT 7 - OPEN GRATING WITH SRM-C DRIVE TUBE**



**ATTACHMENT 8 - TRIP HAZARDS**





**ATTACHMENT 9 - AMP-100 LOCATION**



Radiation Detector Location  
AMP-100  
(Head Height ~5.5' Off Grating)

## ATTACHMENT 10 - POST SRM-C RETRACTION RADIOLOGICAL DATA:

After the SRM-C cable and detector were retracted, the radiological source was characterized by the licensee. The inspectors reviewed licensee survey data including surveys of SRM-C detector and cable, selected surveys of the work areas, and electronic dosimeter (ED) histogram data (i.e. computer printout of the dose rates to which the ED was exposed). The inspectors also reviewed the calculated source term for the SRM-C detector and cable that was provided to the licensee from a vendor (General Electric/Reuter-Stokes). The NRC performed independent dose calculations and a radiological assessment of the work area, based on both point and line source geometries. In order to facilitate the regulatory review, the NRC calculated dose rates based on 2, 3, and 4 day decays for both line and point source geometries. A review of the available survey data indicated that the characteristics associated with the source of radioactivity were more indicative of a line source.

The inspectors determined that given a review of the available data in the aggregate, an uncontrolled exposure to a radiation source of this magnitude would have resulted in a federal overexposure from within seconds to a few minutes, based upon the workers' proximity to the radiation source.

Radiological dose rates are documented as dose equivalent and not absorbed dose.

### Measured Data

8600 Rem/hr at contact (surveyed underwater)

### Licensee [Reuter-Stokes/GE (Calculated Data - 2 and 4 Day Decay – Point Source)]

88 to 110 Rem/hr at 1 Meter (1.5 Rem/min)

976 to 1229 Rem/hr at 30 cm (20 Rem/min)

219,639 to 276,655 Rem/hr at 2 cm (4000 Rem/min) (66 Rem/sec)

### NRC Calculated Data – 3 Day Decay – Line Source – Line Source Geometry

121 Rem/hr at 24 inches (2 Rem/min)

178 Rem/hr at 18 inches (3 Rem/min)

303 Rem/hr at 12 inches (5 Rem/min)

4360 Rem/hr at 1inch (73 Rem/min) (>1Rem/sec)

### Radiological conditions on the carousel with SRM-C in the drive tube

3 to >1000 Rem/hr

### Radiological conditions on the sub-pile room floor

Nominal 0.550 Rem/hr

Worker ED Histogram

79.900 Rem/hr – Highest Dose-Rate on Right Upper Arm – Reinserting SRM-C



**UNITED STATES  
NUCLEAR REGULATORY COMMISSION**

REGION III  
2443 WARRENVILLE ROAD, SUITE 210  
LISLE, IL 60532-4352

April 25, 2011

MEMORANDUM TO: Martin Phalen, Senior Health Physicist  
Plant Support Team  
Division of Reactor Safety

FROM: Gary Shear, Acting Director /RA/  
Division of Reactor Safety

SUBJECT: SPECIAL INSPECTION CHARTER TO EVALUATE UNPLANNED  
CHANGES TO RESTRICTED AREA DOSE RATES AT PERRY  
NUCLEAR POWER PLANT

Unexpected changes to restricted area dose rates were identified at the Perry Nuclear Power Plant during the removal of a stuck Source Range Monitor (SRM) and is the subject of the Special Inspection that you have been selected to lead. A short discussion of these events follows.

Unplanned Changes to Restricted Area Dose Rates at Perry Nuclear Power Plant during Removal of the Stuck Source Range Monitor

On April 22, 2011, licensee workers commenced a work activity to remove the Source Range Monitor-C (SRM-C). The SRM had been stuck in the core since startup from the previous outage. The licensee planned to use a cask to remove the cable and the SRM remotely. However, using this cask required removal of 10 to 15 feet of cable from the SRM to ensure the assembly would fit into the cask. While licensee workers hand pulled the cable, dose rates in the area increased significantly. The radiation protection technician stopped the job and ordered the crew to leave the area to develop an alternate plan for removal. As the crew ascended a ladder to leave the area, the travel path brought the crew near the dry tube that contained the SRM. Each worker received a dose rate alarm while leaving the area, with a maximum dose rate of 16.3 R/hour identified on a workers electronic dosimeter. The maximum dose received by any worker was 98 millirem. An area radiation monitor placed on the dry tube indicated dose rates exceeded 1000 R/hour. The area monitor detector was approximately 15 feet above the workers and 15 feet below the SRM.

Subsequently, the licensee decided to send another team to the area to push the cable back into the tube to eliminate the elevated dose rates. The electronic dosimeter alarm settings were increased to 20 R/hour and 500 millirem for this activity. The cable was pushed up, the SRM was returned to the vessel, and dose rates returned to the normal levels of approximately 100 millirem/hour in the work area. After the workers left the area, it was identified that short term dose rate alarms occurred for the workers. The maximum dose rate observed was over 79R/hour measured on the electronic dosimeter located on the upper arm of a worker. The electronic dosimeter indicated the maximum dose received was approximately 150 millirem.

CONTACT: B. C. Dickson, DRS  
(630) 829-9827

M. Phalen

-2-

The sequence of events and the root and contributing causes of the problem are being investigated by the licensee. Based on the deterministic criteria provided in Management Directive 8.3, "NRC Incident Investigation Program," a Special Inspection will commence at Perry on April 25, 2011. The Special Inspection Team will be led by you and will include Valerie Myers, NSPDP, Plant Support Team, Division of Reactor Safety.

The special inspection will determine the sequence of events, and will evaluate the facts, circumstances, and the licensee's actions surrounding the April 22, 2011, incident. The Special Inspection Charter for you and the Team is enclosed.

Docket No. 50-440

Enclosure: Perry Special Inspection Charter

cc w/encl: S. West  
G. Shear  
S. Reynolds  
K. O'Brien  
D. Roberts, RI  
J. Clifford, RI  
P. Wilson, RI  
S. Weerakkody, RI  
R. Croteau, RII  
W. Jones, RII  
J. Munday, RII  
H. Christensen, RII  
K. Kennedy, RIV  
T. Pruett, RIV  
A. Vogel, RIV  
J. Lara, RIII  
V. Mitlyng  
P. Chandrathil  
J. Cameron  
M. Marshfield  
T. Hartman  
A. Garmoe  
D. Merzke  
RidsNrrPMPerry Resource  
RidsNrrDorLpI3-2 Resource  
RidsNrrDirslrib Resource  
NRR Reactive [Inspection@nrc.gov](mailto:Inspection@nrc.gov)

## PERRY SPECIAL INSPECTION CHARTER

This Special Inspection Team is being chartered in response to a work activity that resulted in unplanned changes to restricted area dose rates at the Perry Nuclear Power Plant on April 22, 2011. Martin Phalen is designated as the Special Inspection Team Lead and will be assisted by Valerie Myers, who is currently onsite performing data gathering and follow-up inspections for these radiological issues. The Special Inspection will be conducted in accordance with Inspection Procedure 93812, "Special Inspection," and will include, but not limited to, the items listed below. The charter may be revised based on the results and findings of the inspection.

The inspection is expected to perform data gathering and fact-finding in order to address the following:

1. Establish a timeline and Sequence of Events including the sequence of the work planning and job briefings and the licensee's determination of event classification.
2. Review and assess the work planning, including the application of operating experience, expected radiological conditions, lessons learned, contingency and ALARA planning, and the interfaces among operations and work planning staff during the planning process.
3. Review and assess the experience of the staff involved in the work activity and the management involvement/oversight of the actual work.
4. Review any preliminary cause determination the licensee has completed and assess adequacy of short term corrective actions.
5. Evaluate the engineering or operational factors that caused or contributed to the event including equipment design or use issues.
6. Evaluate the human performance impacts, and contributing factors, including procedure, adequacy, and adherence.
7. Evaluate the actual and potential radiological consequences.
8. Identify any unique characteristics which may have contributed to the event such as schedule pressure or work distractions.
9. Collect data necessary to support completion of the significance determination process.

The inspection should emphasize fact-finding in its review of the circumstances surrounding the events. Safety concerns identified that are not directly related to the event should be reported to the Region III office for appropriate action.

The team will report to the site, conduct an entrance, and begin inspection no later than April 26, 2011. While onsite, you will provide daily status briefings to Region III management, who will coordinate with the Office of Nuclear Reactor Regulation to ensure that all other parties are kept informed. Depending on the outcome of the inspection, inspection results will be documented in U. S. Nuclear Regulatory Commission (NRC) Special Inspection Report No. 5000440/20110013. This report will be issued within 45 days of the completion of the inspection.

This Charter may be modified should the team develop significant new information that warrants review. Should you have any questions concerning this charter, please contact Billy Dickson at (630) 829-9827.

Charter Approval

        /RA/ 4/25/2011   Billy C. Dickson, Chief, Plant Support  
Team, DRS

        /RA/ 04/25/2011   Gary Shear, Acting Director, DRS

The sequence of events and the root and contributing causes of the problem are being investigated by the licensee. Based on the deterministic criteria provided in Management Directive 8.3, "NRC Incident Investigation Program," a Special Inspection will commence at Perry on April 25, 2011. The Special Inspection Team will be led by you and will include Valerie Myers, NSPDP, Plant Support Team, Division of Reactor Safety.

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 H. Christensen, RII  
 K. Kennedy, RIV  
 T. Pruett, RIV  
 A. Vogel, RIV  
 J. Lara, RIII  
 V. Mitlying  
 P. Chandrathil  
 J. Cameron  
 M. Marshfield  
 T. Hartman  
 A. Garmoe  
 D. Merzke  
 RidsNrrPMPerry Resource  
 RidsNrrDorlLp13-2 Resource  
 RidsNrrDirslrib Resource  
 NRR Reactive [Inspection@nrc.gov](mailto:Inspection@nrc.gov)

DOCUMENT NAME: G:\DRSIII\DRS\Work in Progress\Memo 04\_\_11 PERRY SI Charter BCD.docx

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|--------|--------------|-----|----------|-----|----------|-----|------|-----|
| NAME   | BCDickson:ls |     | GShear   |     | SWest    |     |      |     |
| DATE   | 04/25/11     |     | 04/25/11 |     | 04/25/11 |     |      |     |

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## TIMELINE OF EVENTS

2/25/2009

Source Range Monitor (SRM) detector S/N 00S02239 was installed in core location 40-21.

5/17/2010

During start up activities from a forced outage, the SRM-C became stuck and would not retract. CR 10-76980 and WO 200416219 were written.

1/24/2011

WO 200416219 Radiation Protection review authorization was completed. No comments noted.

WO 200416219 Instrument and Control review authorization was completed. No comments noted.

2/14/2011

WO 200416219 Lead Work Group review authorization was completed. No comments noted.

3/7/2011

WO 200416219 Operations review authorization was completed. No comments noted.

The 1RFO13 Undervessel Project Challenge Meeting was held. Based on interviews with the project manager, no challenges or precautions were identified regarding risk associated with SRM-C detector removal.

3/15/2011

ALARA Action Plan (AAP) 11-011 "SRM/IRM Removal When Stuck In Core During Operations," was prepared by RP to support WO 200416219.

3/17/2011

ALARA Plan 11-6013 (RFO-13 Undervessel Activities) was prepared by RP.

4/11/2011

RWP 11-6013 "RFO-13 Undervessel Activities," was prepared and reviewed by the RP Supervisor, the Work Supervisor, and RP Planning. Task #7 was for SRM-C removal and replacement activities and established dose / dose rate alarm setpoints.

ALARA Plan 11-6013 "RFO-13 Undervessel Activities" was approved by Work Supervisor.

AAP-11-011 "SRM/IRM Removal When Stuck In Core During Operations," was reviewed by Work Supervisor to support WO 200416219.

4/12/2011

ALARA Plan 11-6013 "RFO-13 Undervessel Activities," was approved by ALARA Supervisor.

4/13/2011

ALARA Plan 11-6013 "RFO-13 Undervessel Activities," was approved by Station Sub-ALARA Chairman.

ALARA Brief for ALARA Plan 11-6013 "RFO-13 Undervessel Activities," was held.

4/14/2011

ALARA Plan 11-6013 "RFO-13 Undervessel Activities," was approved by Station ALARA Committee Chairman.

AAP-11-011 "SRM/IRM Removal When Stuck In Core During Operations," was approved by ALARA Supervisor.

4/15/2011

RWP-11-6013 "RFO-13 Undervessel Activities," was approved by RP Manager.

4/18/2011

Refueling Outage 1RFO13 commences. The 0001 Turbine tripped. Reactor scram inserted 0031.

4/20/2011

WO 200416219 was approved to start work.

4/21/2011 Dayshift

0930-1100 hours - The disposal cask and associated equipment were staged under the vessel in the sub-pile area.

1000-1100 hours - Pre-job brief for WO 200416219. No discussion of the need to cut 9 feet from the end of the detector cable was made at the pre-job brief.

1100-1200 hours - RP high radiation area access briefing conducted for WO 200416219. The briefing was attended by the craft supervisor, three craft technicians, and three RP technicians.

The brief was given by an RP Supervisor. Communications equipment was limited and two of the three RP Technicians had head-set communications with the RP Central Monitoring Station (CMS) console. Craft technician #1 was assigned as the performer and craft technician #2 was assigned as procedure reader and place-keeper due to the limitations of communication equipment.

1200-1415 the craft supervisor and one of the RP technicians were stationed at the CMS console. Craft technician #3 was available nearby as a tool/equipment runner. Craft technician #1 and craft technician #2 and three RP technicians proceeded to the undervessel area to perform SRM-C removal activities. Two of RP technicians were in head-set communications with CMS.

The detector cable take-up cartridge was installed 180 degrees out of position within the disposal cask.

Both craft technicians missed procedure (IMI-E2-28) step 5.2.2.12, which requires cutting at least 9 feet from the end of the detector cable.

1442 SRM/IRM disposal cask take up cartridge did not retract the SRM-C detector/cable. Indications were that the take-up cartridge move approximately ¾ turns and then stopped. The motor shaft continued to rotate. Workers attempted to correct several times unsuccessfully. Personnel left the area to regroup and will develop a recovery plan.

#### 4/21/2011 Nightshift

1830-1945 WO 200416219 pre-job brief conducted.

1945 WO 200416219 high radiation area access brief conducted.

Assignments:

3 RP technicians supporting the work:

- 1 under vessel at keyway
- 1 in drywell outside sub-pile area monitoring radiation monitoring equipment (amp-100).
- 1 at telemetry monitoring station CMS.

3 Craft technicians:

- 2 under vessel in sub-pile room to lower SRM-C detector cable and attach the detector cable to the take-up cartridge.
- 1 on under vessel carousel for support as needed.

RP stop work criteria are > 540 R/hr on drive tube during removal or > 45 R/hr on the SRM/IRM disposal cask.

2241 Drywell control point reported several dose rate alarms undervessel while retracting SRM-C. Personnel immediately left the area AMP-100 pegged high (>1000R/hr). All work in drywell suspended. No one allowed in drywell without RP Manager and Shift Operations Director permission.

Fact finding and recovery team established.

#### 4/22/2011

RWP 11-6037 "RFO-13 1C51K0600C SRM Cable Reinsertion/Securing and RP Support," was prepared, reviewed, and approved.

AAP-11-022 "Reinsert SRM/IRM Due to High General Area Dose Rates during Removal Preparations," was prepared, reviewed, and approved by RP.

#### 4/22/2011 Dayshift

0930 SRM-C: ALARA Committee meeting held to review SRM-C reinsertion plan.

0930 ALARA briefing held for installing SRM-C.

1330 High radiation area access briefing held for installing SRM-C.

1400 While re-inserting SRM-C, a dose rate alarm was incurred by the contractor worker. The SRM was pulled down on nightshift, and dose rates on the AMP-100 located on the upper drive tube were in excess of 1000 Rem/hr. (AMP-100 was in an overflow condition). Dose rates up to 17 Rem/hr were noted on the lower level ladder access.

The recovery plan detailed re-inserting the SRM-C cable by hand. A dose rate alarm of 79.900 Rem/hr was observed on the right upper arm dosimeter, and 48.600 Rem/hr on the head dosimeter.

The worker exited the area as briefed when the alarm occurred. A total dose for this individual was 0.132 Rem was received, with a dose alarm setting 0.500 Rem.

The SRM-C cable was inserted successfully, and dose rates returned to previous levels. The worker stated that he installed approximately 9 feet of detector cable. Follow-up entries had a worker measure 13 feet of cable remaining withdrawn in the sub pile area. This would indicate that approximately 22 feet of cable had been initially withdrawn.

#### 4/25/2011 Dayshift (0600 – 1800)

0904 The Engineering SRM-C source term calculation was complete. Based on the readings in the undervessel area, the dose rate at 1 inch from the SRM was estimated to be on the order of 4,800 Rem/hr. The contribution from the irradiated cable is also expected to be a factor, but will be significantly less than the detector. Therefore, based on the above, it is conservatively estimated that the combined SRM detector and cable would be on the order of 5,000 Rem/hr.

#### 4/26/2011

WO 200416219 "Remove SRM-C," was authorized to start.

WO 200416219 "Remove SRM-C," was completed and the SRM was withdrawn into the shielded retrieval and transport cask.

what corrective actions were taken, and why the NRC should have confidence in the radiation safety program at PNPP, such that a similar issues is improbable to reoccur.

If you request a Regulatory Conference, it should be held within 30 days of the receipt of this letter and we encourage you to submit supporting documentation at least one week prior to the conference in an effort to make the conference more efficient and effective. If a conference is held, it will be open for public observation. The NRC will also issue a press release to announce the conference. If you decide to submit only a written response, such submittal should be sent to the NRC within 30 days of the receipt of this letter.

Additionally, this report documents an inspector identified finding associated with the attempted retraction of a source range monitor was preliminarily determined to be Green, a finding of very low safety significance.

Please contact Billy Dickson at (630) 829 9827 in writing within 10 days of the date of this letter to notify the NRC of your intended response. The final resolution of this matter will be conveyed in separate correspondence.

Since the NRC has not made a final determination in this matter, no Notice of Violation is being issued for this inspection finding at this time. Please be advised that the number and characterization of the apparent violation described in the enclosed inspection report may change as a result of further NRC review.

Sincerely,

**/RA by Kenneth G. O'Brien Acting for/**

Steven A. Reynolds, Director  
Division of Reactor Safety

Docket Nos. 50-440  
License Nos. NPF-58

Enclosure: Inspection Report 05000440/2011013  
w/Attachments:  
1. Supplemental Information  
2. Attachments 1-10  
3. Special Inspection Team Charter

cc w/encl: Distribution via ListServ

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| NAME   | BDickson for<br>MPhalen:jb |  | BDickson |  | SOrth    |  | KO'Brien for<br>SReynolds |  |  |
| DATE   | 06/28/11                   |  | 06/28/11 |  | 07/06/11 |  | 06/30/11                  |  |  |

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Letter to Mark Bezilla from Steven Reynolds dated June 30, 2011.

SUBJECT: PERRY NUCLEAR POWER PLANT, UNIT 1  
NRC SPECIAL INSPECTION TEAM (SIT) REPORT 05000440/2011013

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