

INPUT FOR ST. LUCIE INSPECTION REPORT 03-02

by  
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WORDS FOR COVER LETTER

The report documents one NRC-identified finding of very low safety significance (Green) which was determined to involve a violation of NRC requirements. However, because of the very low safety significance and because they were entered into your corrective action program and corrected, the NRC is treating this as a non-cited violation (NCV) consistent with Section IV.A of the NRC Enforcement Policy. Additionally a licensee identified violation is listed in Section 4AO7 of this report.

SUMMARY OF FINDINGS

A. Inspector Identified and Self-Revealing Findings

Cornerstone: Mitigating Systems

- Green. Lack of spacial separation or barriers to protect cables against fire damage in containment could result in spurious opening of the pressurizer power operated relief valve.

A non-cited violation of 10 CFR 50, Appendix R, III.G.2 was identified. This finding is greater than minor because it affected the mitigating system cornerstone objective of equipment reliability, in that spurious opening of the PORV during post-fire safe shutdown would adversely affect systems intended to maintain hot shutdown. The finding is of very low safety significance because the initiating event likelihood was relatively low, manual fire suppression capability remained unaffected and all mitigating systems except for the PORV and block valve were unaffected. (4OA5)

B. Licensee-Identified Violations

Violations of very low safety significance, which were identified by the licensee have been reviewed by the inspectors. Corrective actions taken or planned by the licensee have been entered into the licensee's corrective action program. These violations and corrective action tracking numbers are listed in Section 4AO7.

4OA3 Event Followup

1. (Closed) LER 50-335, 389/00-01, Outside Design Bases Appendix R Hi-Lo Pressure Interface and Separation Issues.

NW/SS

On March 9, 2003, the licensee identified seven cases where the plant was not in compliance with 10 CFR 50, Appendix R, Section III, G, 2, d and f. The first case, involving the pressurizer PORVs, applies to Units 1 and 2, and is discussed in Section 4AO5 of this report. The other six cases apply to Unit 2 only, and are discussed as follows.

#### Shutdown cooling valves

Shutdown cooling valves V3652 and V3481 could spuriously open due to fire induced cable-to-cable short circuits. The location of vulnerability was a pull box (JB-2031) in the annulus region of containment. The valves are motor operated type valves which are de-energized by procedure during normal plant operation. The problem however is that the power cables for both these valves were routed through a pull box together with other three-phase power cables. Therefore, the potential existed for fire induced cable to cable short circuiting which could inadvertently energize the motors to open these valves. Both valves would have to open to have a problem. Opening of these valves directly connects the RCS to piping that is not rated for RCS normal operating pressure. Should the valves open when the RCS is at operating pressure, a pressure relief valve would open and RCS coolant would flow from the RCS to the containment sump. This situation is essentially a large break LOCA. Valve V3545 is a normally open motor operated valve in series with V3652 and V3481. Theoretically, V3545 could be closed by the operator to stop the outflow, but the cables for V3545 could have been damaged by the same fire. The licensee resolved the problem by installing new power cables using armored cable. This precluded the possibility of cable to cable short circuits. Inspectors confirmed implementation of the modification through review of plant modification PCM01028.

The reported condition was a violation of Appendix R requirements of more than minor significance because it could adversely affect the equipment reliability objective of the cornerstones of mitigating systems and barrier integrity as described above. Using techniques described in NRC Procedure 0609, Appendix F, the inspectors determined that the finding was of very low safety significance (Green). Specifically the SDP worksheet for large break LOCA was evaluated. The conclusion was supported primarily by the negligible probability of the initiating event occurring and the fact that cables for mitigating systems for LOCA are located outside containment. The enforcement considerations for this violation are given in Section 4OA7.

#### Pressurizer pressure instrumentation affected by tray-conduit interaction

Lack of 20-foot separation or a radiant heat shield between a cable tray and two conduits in containment meant that a fire which could start in the cable tray due to cable self ignition could result in damage to a number of pressurizer pressure instrumentation loops. PT-1105, PT-1106 and PT-1107 are in cable tray L2224; and PT-1103, PT-1104 and PT-1108 are in conduits 25018Y and 23091A. PT-1107 and PT-1108 were the instruments specified in the post-fire shutdown procedure. These instruments also provide input to alarms, automatically initiate automatic actions, provide permissives, computer inputs, input to calculations and indications of pressure at various locations. The inspector reviewed the consequences and ramifications of instruments failing either

high or low. Also reviewed, was which pressurizer pressure instrumentations remain unaffected by the fire. This information was analyzed by the inspector, and it was concluded that the affected instrumentation would not lead to any transient nor to change in core damage frequency. The finding is therefore of very low safety significance. As corrective action, conduits 25018Y and 23091A were protected by a radiant heat shield for twenty feet either side of the tray L2224 by plant modification PCM99104, Supplement 1. The licensee reports the fact that both channels of pressurizer pressure instruments specified in the post-fire shutdown procedure could have been affected by one fire represents a violation of 10 CFR 50, Appendix R, Section III, G, 2. Refer to Section 4OA7 of this report for enforcement aspects.

#### Pressurizer level instrumentation affected by tray-conduit interaction

Lack of 20-foot separation or a radiant heat shield between a cable tray and two conduits in containment meant that a fire which could start in the cable tray due to cable self ignition could result in damage to all pressurizer level instrumentation loops. LT-1110X and LT-1105 are in tray L2213; and LT-1110Y and LT-1104 are in conduits 23320D and 23090A. LT-1110X & Y were specified in the post-fire shutdown procedure. It was determined that the failure mode for a short-circuit between the twisted pair or open circuit caused by fire exposure of the signal wires was level fails low. Level failing low initiates several automatic actions some of which tend to cause level to rise and some of which cause level to fall. The de-energization of pressurizer heaters dominates the situation and results in falling level. This leads to a reactor trip with safety injection on low pressurizer pressure. When the safety injection pumps start, the level will rise. Since the operator cannot see level, he may not turn off the safety injection pumps. So it follows that the pressurizer will go solid. The post-fire safe shutdown procedure directs the operator to place the PORVs in override due to concerns about spurious opening. Therefore, rising level and concomitant pressure rise would be relieved by the safety relief valves. To obtain the risk significance of the fire induced failure of pressurizer level instrumentation, the SDP worksheet for stuck open relief valve was evaluated. The results indicated the finding was of very low safety significance (Green) for the same reasons mentioned in Section 4AO5.1 which deals with spurious opening of PORVs. The licensee reports the fact that both channels of pressurizer level instruments specified in the post-fire shutdown procedure could have been affected by one fire represents a violation of 10 CFR 50, Appendix R, Section III, G, 2. Refer to Section 4OA7 of this report for enforcement aspects.

#### Pressurizer level instrumentation affected by conduit to conduit interaction

Lack of 20-foot separation or a radiant heat shield between two conduits in containment containing cables for redundant channels of pressurizer level instrumentation meant that the separation requirements of Appendix R were not met. The location of the interaction is in the annulus area at an elevation where there are no ignition sources other than the cables themselves. It is not considered credible that low voltage, low energy, instrumentation circuits could self-induce cable ignition, and even if such occurred within a conduit, the fire would not affect another conduit. The reported problem was a violation of Appendix R requirements with regard to separation of cables. The inspectors determined that, given the particular configuration at issue, it could not

credibly adversely affect any cornerstone. The licensee corrected the separation problem by installing a radiant heat shield on one of the conduits per plant modification PCM99104, Supplement 1. This licensee identified issue constitutes a violation of minor significance that is not subject to enforcement action in accordance with Section IV of the NRC's Enforcement Policy.

Circuits related to automatic pressurizer pressure control affected by conduit to conduit interaction

Lack of separation or a radiant heat shield between certain conduits in containment related to automatic pressurizer pressure control meant that the separation requirements of Appendix R were not met. The circuits involved were for the PORV and the auxiliary spray isolation valves. The concern was that, if one fire could affect both these circuits, two diverse subsystems designed to reduce pressure when necessary may not function. There are other ways to reduce pressure, but the above mentioned ones were the systems designated in the post-fire shutdown procedure for this function. The location of the interaction is in the annulus area at an elevation where there are no ignition sources other than the cables themselves. It is not considered credible that a fire starting within one conduit would expand to affect other nearby conduits. The reported problem was a violation of Appendix R requirements with regard to separation of cables. The inspectors determined that, given the particular configuration at issue, it could not credibly adversely affect any cornerstone. The licensee corrected the separation problem by installing a radiant heat shield on a sufficient number of the conduits per plant modification PCM99104, Supplement 2. This licensee identified issue constitutes a violation of minor significance that is not subject to enforcement action in accordance with Section IV of the NRC's Enforcement Policy.

Radiant heat shields not installed per Appendix R accepted deviation

Inside containment in the area between the containment wall and the bioshield four groups of cable trays are installed. There are five trays in each group. These trays run horizontally along the circumference of the containment to carry cables from the penetration area to their various ultimate destinations in the containment. Train B cables are in trays near the containment wall, and Train A cables are in trays near the bioshield. There is at least seven foot horizontal separation between these two sets of trays in the area of interest. Both the Train A set and the Train B set consists of a group running above the 45-foot elevation grating and a group running above the 23-foot elevation grating. Examples of cable trays involved are instrumentation trays L2223 (Train A) and L2224 (Train B); or control trays C2223 (Train A) and C2224 (Train B). According to the safety evaluation report each of the four groups should have had a radiant heat shield installed directly below the group. This is actually an accepted deviation, or exemption, from the requirement to have a heat shield between the redundant cables. The licensee reported in the LER that the radiant heat shields below the groups at the 45-foot elevation were not installed. The missing radiant heat shields have now been installed per PCM01028.

The inspector evaluated the risk significance of the lack of radiant heat shield below the 45-foot elevation groups of trays. The conclusion of this evaluation was that the

problem was of very low safety significance (Green). Some of the dominant factors considered were:

- Fire brigade capability for a fire in containment was not impaired.
- In-situ ignition sources were negligible, and transient ignition sources and combustibles are not present during normal plant operation.
- Only the top tray in each group contains power cables (480 volt) carrying sufficient energy capable of self ignition of IEEE 383 flame tested cable. Most of the power cables in containment are not energized during normal plant operation. These trays are solid metallic bottom and cover type trays. This construction inherently limits the spread of internal tray fire, and effectively provides a shield limiting the radiant heat energy.
- The "target" cable trays have a minimum spatial separation of 15 feet vertical and 7 feet horizontal from the potentially burning cable tray. The target trays have solid metallic bottoms. Radiant energy flowing between source and target is blocked to a great extent by intervening HVAC ducts, large pipes, tanks and building steel. Hot gas layer is not a factor in the part of containment under consideration.
- The target cables would be instrumentation cables, and various scenarios involving damage to these same instrumentation cables discussed in relation to other findings within this report Section were shown to be of very low safety significance.
- A very similar configuration in the Unit 1 containment was analyzed by the licensee and reviewed by the NRC in great detail, and found to be an acceptable configuration from the fire protection viewpoint. The Unit 1 study had a safety factor of at least two, which provides margin to account for geometry and other unknown differences between the two units.

Failure to adhere to the configuration of cable trays and radiant heat shields described in an exception to 10 CFR 50, Appendix R, Section III, G, 2 represents a licensee identified violation. Refer to Section 4AO7 of this report for enforcement aspects.

.2 (Closed) LER 50-335/00-04, Pressurizer Level Instrumentation Conduit Separation Outside Appendix R Design Bases

Lack of 20-foot separation or a radiant heat shield between a cable tray and a conduit in Unit 1 containment meant that a fire which could start in the cable tray due to cable self ignition could result in damage to all pressurizer level instrumentation. The discussion of risk significance and requirements for this issue would be identical to the discussion of essentially the same issue on Unit 2 in Section .1 above under the heading: Pressurizer level instrumentation affected by tray-conduit interaction. Refer to Section 4AO7 of this report for enforcement aspects.

#### 4OA5 Other Activities

##### .1 (Closed) URI 335,389/99-08-03, PORV Cabling May Not be Protected from Hot-Shorts Inside Containment

Introduction: A Green NCV was identified for failure to comply with 10 CFR 50, Appendix R, Section III, G, 2.d and f, related to spurious opening of the pressurizer PORV.

Description: During conduct of an inspection in the area of fire protection (NRC Inspection Report 50-335, 389/99-08, dated January 31, 2000) the inspectors identified the possibility that the PORV cables inside containment were not protected from fire induced cable to cable short circuits. The issue was identified through review of the licensee's analysis. However, the analysis referred to a study which showed that the cable to cable short circuit leading to spurious opening of the PORV was not credible. Since the study could not be located at the time of the inspection, an unresolved item was initiated to track this issue. Subsequently LER 50-335, 389/00-01 reported that the pressurizer PORVs could open due to fire induced short circuits that could occur in a cable tray in containment. In addition, cables for the associated block valve were routed in the same cable tray. This meant the block valve may not be available to counter the spurious opening of the PORV. Cables for one PORV and its block valve were in a tray near the containment wall and cables for the other set were in a tray near the bioshield. The condition applied to both units.

The licensee resolved the problem by installing new PORV cables using armored cable. This precluded the possibility of cable to cable short circuits. The potential for spurious opening due to spurious pressure signal had already been offset by having the operator place the control switch in override in response to a fire in containment. Inspectors confirmed the modification was implemented through review of plant modification package PCM00059 (Unit 1) and PCM99104, Rev 4 (Unit 2).

LER 00-01 mentioned above also reported licensee identified findings in the area of Appendix R. In addition, Unit 1 LER 00-04 reported similar problems. Refer to Section 4OA3 for discussion of these findings.

Analysis: The finding was a performance deficiency because it represented a violation of Appendix R requirements. It was considered greater than minor because it could adversely affect the cornerstones of mitigating systems and barrier integrity. It affects mitigating systems in the sense that systems designated for post-fire shutdown would be adversely affected by an open PORV during the early stages of post-fire shutdown. It affects the cornerstone of barrier integrity in the sense that a spuriously open PORV represents a breach of the RCS pressure boundary which is one of the barriers. Using techniques described in NRC Procedure 0609, Appendix F, the inspectors determined that the finding was of very low safety significance (Green). Specifically, the SDP worksheet for stuck open relief valve was evaluated. A key factor leading to this conclusion was that the initiating event likelihood was relatively low. It was less likely than the likelihood for stuck open PORV due to non-fire induced causes. Manual suppression of fires in the containment was in the normal state because the plant had

fire detectors, a fire plan and there were no automatic valves in the water source that could be affected by the fire. Even though no credit could be given for the block valve, other mitigating systems were unaffected. This was primarily due to the fact that the associated cables were all outside containment.

Enforcement: Because this violation of 10 CFR 50, Appendix R, Section III, G.2.d. and f, is of very low safety significance, has been entered into the CAP (CR00-0386) and the problem has been corrected through a plant modification it is being treated as an NCV, consistent with Section VI.A of the NRC Enforcement Policy. The number and title of this NCV are: NCV 50-335, 389/03-02-01, Failure to Meet 10 CFR 50, Appendix R, Section III, G, 2, for Protection of the PORV Cables in Containment.

#### 40A7 Licensee-Identified Violations

The following findings of very low safety significance (Green) were identified by the licensee and are violations of NRC requirements which meet the criteria of Section VI of the NRC Enforcement Policy, NUREG-1600, for being dispositioned as NCVs.

- 10 CFR 50, Appendix R, Fire Protection Program, Section III, Specific Requirements, Subpart G, Fire protection of safe shutdown capability, requires that for cables, that could prevent operation or cause maloperation due to hot shorts, open circuits or shorts to ground, of redundant trains of systems necessary to achieve and maintain hot shutdown conditions and located inside noninerted containments, one of the following fire protection means shall be provided:

1. Separation of cables of redundant trains by a horizontal distance of more than 20-feet with no intervening combustibles or fire hazards; or
2. Separation of cables of redundant trains by a non-combustible radiant energy shield.

Contrary to this, since the requirement became effective, the required fire protection was not provided for the following redundant cables:

1. Shutdown cooling valves V3652 and V3481 on Unit 2.
2. Pressurizer pressure instrumentation PT-1107 and PT-1108 on Unit 2
3. Pressurizer level instrumentation LT-1110X and LT-1110Y on Units 1 & 2.
4. Cables contained in cable trays L2223 (Train A) and L2224 (Train B).

These findings have been entered into the CAP (99-1963, Rev. 2, and 00-0386), corrected by plant modifications, and are of very low safety significance for reasons given in Sections 4AO3.1 and .2.

## LIST OF ITEMS OPENED, CLOSED AND DISCUSSED

### Opened

50-335, 389/03-02-01      NCV    Failure to Meet 10 CFR 50, Appendix R, Section III, G, 2,  
for Protection of the PORV Cables in Containment  
(Section 4OA5)

### Closed

50-335, 389/99-08-03      URI    PORV Cabling May Not be Protected from Hot-Shorts  
Inside Containment (Section 4OA5.1)

50-335, 389/00-001      LER    Outside Design Bases Appendix R Hi-Lo Pressure  
Interface and Separation Issues (Section 4OA3.1)

50-335/00-004      LER    Pressurizer Level Instrumentation Conduit Separation  
Outside Appendix R Design Bases (Section 4OA3.2)

## LIST OF DOCUMENTS REVIEWED

### Sections 4AO3: Event Followup and Section 4AO4: Other Activities

#### Drawings

2998-G-078, Sheet 131, Unit 2 Flow Diagram Safety Injection System, Rev. 16  
2998-G-424-S07, Unit 2 Reactor Containment Fire Detectors and Emergency Lights, Rev 1  
2998-G-084, Unit 2 Flow Diagram Domestic & Make-up Water Systems, Rev. 33

#### Design Basis Document

Component Functions for Pressurizer Wide Range Pressure Instrument Loop, Section 7.22  
Component Functions for Pressurizer Instrument Loop P-1100X&Y, Section 7.23  
Component Functions for Pressurizer Pres./Safety Injection Instrument Loop, Section 7.28

#### Miscellaneous

0711206, Reactor Operator Lesson Pressurizer Pressure and Level Control, Rev.12  
NRC Supplemental Safety Evaluation Report SSER 3, for Unit 2, Pages 9-14 through 16

## LIST OF ACRONYMS

CAP	corrective action program
CFR	<u>Code of Federal Regulations</u>
IEEE	Institute of Electrical and Electronics Engineers
LER	licensee event report
LOCA	loss of coolant accident

NCV non-cited violation  
NRC U.S. Nuclear Regulatory Commission  
PCM plant change or modification  
PORV power operated relief valve  
RCS reactor coolant system  
SDP significance determination process