

James A. FitzPatrick
Nuclear Power Plant
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Harry P. Salmon, Jr.
Resident Manager

April 19, 1993
JAFF-93-0227

United States Nuclear Regulatory Commission
Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

SUBJECT: DOCKET NO. 50-333
LICENSEE EVENT REPORT: 92-044-01 - Identification
of Non-Conformance to the
FSAR Design Criteria for
Electrical Cable Separation

Dear Sir:

This final report is submitted in accordance with 10 CFR
50.73(a)(2)(ii)(B).

Questions concerning this report may be addressed to
Mr. David Holliday at (315) 349-6359.

Very truly yours,

A handwritten signature in cursive script, appearing to read 'Harry P. Salmon, Jr.'.

HARRY P. SALMON, JR.

HPS:DAH:tld
Enclosure

cc: USNRC, Region I
USNRC Resident Inspector
INPO Records Center

Cent No 1064705772

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LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 500 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT - NRC (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

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TITLE (4) Identification of Non-Conformance to the FSAR Design Criteria for Electrical Cable Separation																							
EVENT DATE (5)			LER NUMBER (6)				REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)													
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME				DOCKET NUMBER (5)										
1	0	1	0	9	2	9	2	0	4	4	0	1	0	4	1	9	9	3	0	5	0	0	0
OPERATING MODE (9) N			THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5 (Check one or more of the following) (11)																				
POWER LEVEL (10) 0 0 0			20.402(b)				20.405(c)				50.73(e)(2)(iv)				73.71(b)								
			20.405(a)(1)(i)				50.36(c)(1)				50.73(e)(2)(iv)				73.71(c)								
			20.405(a)(1)(ii)				50.36(c)(2)				50.73(e)(2)(iv)				OTHER (Specify in Abstract below and in Text, NRC Form 306A)								
			20.405(a)(1)(iii)				50.73(e)(2)(i)				50.73(e)(2)(iv)(A)												
			20.405(a)(1)(iv)				50.73(e)(2)(ii)				50.73(e)(2)(iv)(B)												
			20.405(a)(1)(v)				50.73(e)(2)(iii)				50.73(e)(2)(k)												
LICENSEE CONTACT FOR THIS LER (12)																							
NAME Mr. David Holliday, Senior Licensing Engineer										TELEPHONE NUMBER AREA CODE 3 1 5 3 4 9 - 6 3 5 9													
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)																							
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRC													
SUPPLEMENTAL REPORT EXPECTED (14)										EXPECTED SUBMISSION DATE (15)		MONTH DAY YEAR											
YES (If yes, complete EXPECTED SUBMISSION DATE)										X NO													

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single space typewritten lines) (16)

EIIIS Codes are in []

The plant was shutdown and in the cold condition for maintenance and refueling. On 10/10/92, during a walkdown with an NRC Inspector, examples of apparent deviations from the Electrical Cable Separation Criteria were noted in the Cable Spreading Room [NA], the Relay Room [NA], and inside Control Room [NA] panels. The Final Safety Analysis Report requires a minimum horizontal distance of three feet, or a minimum vertical distance of seven feet, be maintained between cable trays, conduits, and armor cables not in trays, which carry redundant circuits, with exceptions allowed in certain protected areas. Subsequent review found a non-conformance associated with the Analog Transmitter/Trip System Panel where an electrical conduit installed in 1986 ended approximately three feet short of the ceiling penetration allowing the exposed cables to be within seven feet vertically from redundant cables. On 10/10/92, the Emergency Core Cooling Systems were declared inoperable because the electrical conduit was not installed in accordance with approved design. A review team was assembled to look for any additional deviations and to develop an Electrical Cable Separation Assessment Program. Safety evaluations addressing the separation issues were prepared and transmitted to the NRC on 12/24/92. A Root Cause Analysis was performed indicating inadequacies in documents, design control, and training as primary causes.

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TEXT (If more space is required, use additional NRC Form 366A's) (17)

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Description

The James A. FitzPatrick Nuclear Power Plant (JAFNPP) was shutdown and in the cold condition for maintenance and refueling. On October 10, 1992, during a walkdown with an NRC Inspector, examples of apparent deviations from the Electrical Cable Separation Criteria were noted in the Cable Spreading Room [NA], the Relay Room [NA], and inside Control Room [NA] panels.

The Final Safety Analysis Report (FSAR), Section 7.1.9, Part A, states:

The separation criteria, at the time of construction for all areas of the plant, required that a minimum horizontal distance of three feet or a minimum vertical distance of seven feet be maintained between cable trays, conduits, and armor cables not in trays which carry redundant circuits if a reinforced concrete wall or floor slab does not exist between these raceways which carry redundant circuits.

These requirements apply in all areas of the plant, with specific exceptions allowed in certain protected areas, such as the Relay Room, Cable Spreading Room, and others.

Subsequent review found one non-conformance associated with the Analog Transmitter Trip System (ATTS) Panel which could potentially affect Emergency Core Cooling System (ECCS) Actuation Logic Circuit [JE] operability. The non-conformance consisted of a set of cables which by design should have been entirely enclosed by conduit due to their proximity to a redundant cable tray. However, the conduit actually ended approximately three feet short of the ceiling penetration allowing the exposed cables to be within seven feet vertically from redundant cables. The conduit and cables were installed in 1986 by a modification designed by an outside consultant.

At 1600 hours on October 10, 1992, Emergency Core Cooling Systems were declared inoperable because the electrical conduit was not installed in accordance with approved design. Secondary Containment [NG] was verified to be operable. An Emergency Notification System (ENS) call was made to the NRC at 1657 hours.

A review team was assembled to develop an Electrical Cable Separation Assessment Program in conjunction with GE (the Nuclear Steam Supply System vendor) and Stone & Webster Engineering Corporation (the original Architect Engineer).

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This assessment program covered: preparation of walkdown criteria; walkdown and identification of apparent deviations; evaluation and review of apparent deviations; determination of operability; determination of acceptance or corrective action; determination of reportability; root cause evaluation; and preparation of updated criteria for future use.

The walkdown criteria were conservative; an item identified by a walkdown still required further review and evaluation and did not necessarily deviate from the actual separation criteria. Over 500 items were identified which required further review, evaluation, and screening.

The screening process separated the identified items into three (3) groups for further evaluation. The screening process also eliminated some identified items which were not actual deviations or where configurations actually met FSAR criteria. The three groups were:

- Group (a) Items which involve the use of a common support for potentially redundant conduits;
- Group (b) Items which involve potentially redundant cables, conduits, or trays separated by one (1) foot or greater but less than the FSAR requirements; and
- Group (c) Items which involve potentially redundant cables, conduits, or trays separated by less than one (1) foot.

Items falling into groups (a) and (b) were reviewed and found acceptable, with no operability issues identified. The results of the reviews were documented in two (2) Nuclear Safety Evaluations performed in accordance with 10CFR50.59. Industry testing was utilized as a basis for developing the Nuclear Safety Evaluation for group (b) items to justify a relaxed, alternate separation criteria on an interim basis for assessing cable separation issues.

The eighty-one (81) items in group (c) were further segregated into four categories to assist in review:

1. Twenty-two items which, upon further review, either: do not represent deviations from the design criteria; or involve spatial separation of one foot or greater between cable, conduit, or trays which potentially carry redundant circuits and, therefore, are covered by the Nuclear Safety Evaluation for the relaxed, alternate criteria for group (b) items which were transmitted to the NRC on December 24, 1992.

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2. Thirty-five apparent deviations* involving enclosed-to-enclosed raceway configurations only (typically conduit-to-conduit configurations);
3. Thirteen apparent deviations* involving enclosed-to-open raceway configurations (typically conduit-to-cable or conduit to-tray configurations); and
4. Eleven apparent deviations involving open-to-open raceway configurations (either cable-to-cable or cable to tray configurations).

(* Note - four deviations involved both configuration types.)

The items falling into the last three categories were reviewed and found acceptable, with no operability issues identified. The results of the reviews were documented in a Nuclear Safety Evaluation performed in accordance with 10CFR50.59 and transmitted to the NRC on December 24, 1992.

Another requirement of the relaxed, alternate criteria is that the involved cables be sized 2/0 AWG or less. On February 3, 1993, a non-safety related power cable (sized 350 MCM), which had met the relaxed, alternate separation criteria, was found which exceeded the maximum size criteria covered in the approved Nuclear Safety Evaluations. Larger cables are normally associated with power distribution and could potentially create more of an electrical fault. The power cable could potentially affect other control circuits even though the one foot separation criteria was maintained. Tray covers were installed in selected locations to eliminate the cable as a concern.

Cause

The Root Cause Analysis was performed based on guidance contained in INPO 90-004, "Root Cause Analysis". Two primary causal factors were identified: inadequate written procedures and documents (Cause Code B) and inadequate design configuration control and analysis (Cause Code E). Two secondary causal factors were: inadequate training and inadequate change management.

The Root Cause Analysis found there was a failure to clearly identify and disseminate the electrical cable separation criteria for JAFNPP to New York Power Authority personnel in a uniform and controlled fashion, sometimes resulting in misapplication or misinterpretation of codes and standards, commitments, and design criteria. As a result, outside consultants, engineers, designers, training and installation personnel did not consistently use the proper criteria.

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The Root Cause Analysis also found there was a failure to consistently specify the proper electrical cable separation criteria to outside consultants, engineers, and installation personnel, either contractually or through modification design input and installation documents. As a result, design and installation documents did not clearly identify separation requirements and some conduit and cable installations did not meet the FSAR separation criteria.

The Root Cause Analysis also found that there was inadequate training of engineering, design, and installation personnel in the applicable codes and standards, regulatory commitments, design, and installation requirements for electrical cable separation. The training which was given to NYPA personnel was generic and did not discuss the more conservative JAFNPP criteria. As a result, NYPA personnel were not always familiar with (or sometimes misinterpreted) the JAFNPP criteria while performing design work or approving field changes.

The non-safety related power cable (sized 350 MCM) found on February 3, 1993, which exceeded the maximum cable size covered in the Nuclear Safety Evaluations, had been reviewed, evaluated, and accepted earlier based on the relaxed, alternate "distance between cables" criteria. This review should have also included a simultaneous review of cable size as a constraint instead of performing the two different reviews in series.

Analysis

This event is reportable under the provisions of 10CFR50.73 (a)(2)(ii) since cable and raceway installations did not conform to approved design, potentially making ECCS subsystems vulnerable to single failures during design basis events.

The cable separation deviations were evaluated and the results were documented in Nuclear Safety Evaluations which utilized guidance from Generic Letter 91-18 and were then transmitted to the NRC on December 24, 1992. The following paragraphs discuss the analyses and conclusions.

The FSAR separation criteria for JAFNPP are very conservative when compared to many other plants that received Construction Permits in the 1970 time frame. This conservative approach was taken by the original designers to address uncertainties regarding separation requirements at the time of construction in the early 1970's.

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In 1974, the industry produced a draft standard (IEEE-384) which was adopted by the NRC via Reg. Guide 1.75. It provided specific guidance for physical separation of safety related circuits and those circuits which were not safety related but, due to their physical or electrical relationships, could affect the safety function. The distances that were given for separation between redundant Class 1E cable trays (located in areas having limited hazards potential) are conservatively based on practices which were believed to provide an adequate degree of separation. Lesser separation distances can be established by testing the cable types being used to determine the actual degree of potential damage to adjacent cables.

In some 23 other plants, the industry and the NRC has found the establishment of lesser separation distances by analysis and tests of proposed cable installations to be acceptable. Extensive industry cable separation testing programs were conducted over the past decade to justify lesser separation distances. Several published test reports provide adequate justification for the reduction of separation criteria for many configurations that exist at JAFNPP. Specifically, cable testing was done for configurations, cable types, and voltage levels that bound the JAFNPP configurations and provide acceptable results for separation distances that are less than the one foot horizontal and one foot vertical for trays and one inch separation between conduits which potentially carry redundant circuits. Therefore, the JAFNPP relaxed, alternate criteria has adequate margin to the separation distances used in the tests and is conservative.

Also, the cable configurations of concern at JAFNPP (with the one exception found in February) are low voltage, where separation distances may be reduced further in accordance with testing and/or analyses. The relaxed, alternate separation criteria was applied to cable sizes of 2/0 AWG and less in limited and non-hazard areas in low to medium voltage service classes. The one exception involved a non-safety-related cable (sized 350 MCM) routed in the Cable Spreading Room in a safety-related tray. The open tray contains armored safety-related cables which are inherently protected in their own armored sheath. The installation of tray covers in selected locations eliminated the 350 MCM cable as a source of concern.

The industry raceway and cable configuration tests were designed to duplicate plant conditions as closely as possible, using actual materials (cable, tray, and conduit) supplied by utilities and arranging them in configurations to simulate actual plant installations. Based on a review of the eighty-one apparent deviations, these tests bound the configurations at JAFNPP.

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In summary, the relaxed, alternate separation distances of one (1) foot may be utilized as an interim criteria for group (b) items at JAFNPP since the configurations tested are similar to cable installations at JAFNPP. The reduction in separation distances was based on reviews of the test data that indicated reduced separation distances would still result in adequate separation and a conservative design.

Of the eighty-one apparent deviations in group (c) involving less than one (1) foot separation, nine (9) were found to have separated distances greater than one (1) foot and thirteen (13) were found not to represent violations of the JAFNPP design criteria. The fifty-nine (59) remaining apparent deviations were evaluated for single failure potential either by detailed functional assessment (based on the specific affected cable) or by comparison of the field configurations to previous industry tests. The evaluations were documented in a Nuclear Safety Evaluation which concluded that operation of the facility did not involve an unreviewed safety question. Further functional analysis may determine that some installations are not actual deviations. In comparing JAFNPP configurations to industry test results it was determined:

- (1) Industry test involved cable qualified to IEEE-383. JAFNPP cables (except lighting cable) are either qualified to IEEE-383 or have been evaluated to be equivalent.
- (2) The separation distances for each of the fifty-nine apparent deviations are bounded by the test conditions.

Corrective Actions

1. Initially, the Authority concentrated on identifying and evaluating deviations to the separation criteria. The Authority developed inspection, evaluation, and review methodologies in concert with GE and SWEC in order to consistently characterize and classify deviations. Generic resolutions were developed to quickly resolve deviations.
2. Deviations were then evaluated and were accepted as-is or corrected through approved plant modifications. These deviations were resolved in December, 1992, prior to plant start-up.

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3. Short Term Corrective Actions - NYPA will: Formulate and consolidate electrical separation criteria and related guidance in a controlled document; update the FSAR if necessary to reflect any changes to the separation criteria; develop and conduct electrical separation training for engineers and designers responsible for plant modifications. Completion Date: December 31, 1994.
4. Long Term Corrective Actions - NYPA will: Consolidate electrical separation design basis documentation; enhance integration of electrical separation into the overall configuration management program for plant design changes; update the cable and raceway schedule system, as necessary, with evaluated field information; update drawings, as necessary, with validated field information; update and issue electrical separation design criteria and installation specifications; Long Term Corrective Actions Completion Date: to be determined after all the long-term activities have been defined and the Electrical Separation Program Plan has been initialized but no later than December, 1996.
5. The installation of tray covers in selected locations eliminated the 350 MCM cable as a source of concern. Long Term Corrective Actions - NYPA will address this cable in its entirety to ensure that there will be no conflict with the new/proposed electrical separation design criteria.

Additional Information

Failed Components:

None

Previous Similar Events:

LER-79-056, HPCI/ADS Cabling Does Not Meet Separation Criteria

Related Industry Experience:

1. NRC Information Notice 85-11, Licensee Programs for Inspection of Electrical Raceway and Cable Installations
2. NRC Information Notice 84-09, Lessons Learned from NRC Inspections of Fire Protection Safe Shutdown Systems
3. NRC Information Notice 79-32, Separation of Electrical Cables for HPCI and ADS

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Reason for Update:

An interim LER dated November 9, 1992, described the event based on information known at that time. The majority of this LER has been updated based on technical information obtained from the draft Electrical Cable Separation Program Plan and the results of the Root Cause Analysis. Changes to the LER are noted with a vertical line in the right margin.