



Florida Power & Light Company, P.O. Box 128, Fort Pierce, FL 34954-0128

August 29, 1996

L-96-216
10 CFR 50.73

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: St. Lucie Unit 1
Docket No. 50-335
Reportable Event: 96-010
Date of Event: July 30, 1996
Operation Prohibited by Technical Specifications Due
to Linear Range Nuclear Instrumentation Out of Service

The attached Licensee Event Report is being submitted pursuant to the requirements of 10 CFR 50.73 to provide notification of the subject event.

Very truly yours,

J. A. Stall
Vice President
St. Lucie Plant

JAS/REN

Attachment

cc: Stewart D. Ebnetter, Regional Administrator, USNRC Region II
Senior Resident Inspector, USNRC, St. Lucie Plant

9609050329 960829
PDR ADDCK 05000335
S PDR

JE22/1

LICENSEE EVENT REPORT (LER)

(See reverse for required number of
digits/characters for each block)ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY
INFORMATION COLLECTION REQUEST: 60.0 HRS. REPORTED LESSONS
LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED
BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE
TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33),
U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20565-0001,
AND TO THE PAPERWORK REDUCTION PROJECT (3160-0104), OFFICE OF
MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)

ST LUCIE UNIT 1

DOCKET NUMBER (2)

05000335

PAGE (3)

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TITLE (4)

Operation Prohibited by Technical Specifications due to Linear Range Nuclear Instrumentation Out of Service

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
07	30	96	96	-- 010	-- 00	08	29	96	N/A	N/A
OPERATING MODE (9)			THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
1			<input type="checkbox"/> 20.2201(b) <input type="checkbox"/> 20.2203(a)(2)(v) <input checked="" type="checkbox"/> 50.73(a)(2)(i) <input type="checkbox"/> 50.73(a)(2)(viii)							
POWER LEVEL (10)			20.2203(a)(1) <input type="checkbox"/> 20.2203(a)(3)(i) <input type="checkbox"/> 50.73(a)(2)(iii) <input type="checkbox"/> 50.73(a)(2)(x)							
100			20.2203(a)(2)(i) <input type="checkbox"/> 20.2203(a)(3)(ii) <input type="checkbox"/> 50.73(a)(2)(iii) <input type="checkbox"/> 73.71							
			20.2203(a)(2)(ii) <input type="checkbox"/> 20.2203(a)(4) <input type="checkbox"/> 50.73(a)(2)(iv) <input type="checkbox"/> OTHER							
			20.2203(a)(2)(iii) <input type="checkbox"/> 50.36(c)(1) <input type="checkbox"/> 50.73(a)(2)(v) <input type="checkbox"/> Specify in Abstract below or in NRC Form 366A							
			20.2203(a)(2)(iv) <input type="checkbox"/> 50.36(c)(2) <input checked="" type="checkbox"/> 50.73(a)(2)(vii) <input type="checkbox"/>							

LICENSEE CONTACT FOR THIS LER (12)

NAME

Rick Noble, Licensing Engineer

TELEPHONE NUMBER (Include Area Code)

(561) 467-7022

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

YES

(If yes, complete EXPECTED SUBMISSION DATE).

X

NO

EXPECTED
SUBMISSION
DATE (15)

MONTH

DAY

YEAR

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

St. Lucie Unit 1 was operating at 100 percent power after starting up from the cycle fourteen refueling outage. Following power ascension, at 1300 on July 30, 1996, the Unit 1 Assistant Nuclear Plant Supervisor (ANPS) was informed by the Operations Manager that the upper and lower detector leads for the (RPS) linear range nuclear instrumentation (NI) were reversed on RPS channels A, C and D. During the St. Lucie Unit 1 refueling outage for cycle fourteen, a plant change/modification was implemented which replaced the power range NI drawers for the RPS with new Gamma Metrics drawers. Additionally during the outage, RPS channel B linear power range excor neutron detector and non-safety control channel 9 were replaced as a separate maintenance activity. The ANPS immediately declared the three linear range safety channels out of service, and following a review of applicable Technical Specifications (TS), entered TS 3.0.3. Concurrent with the actions required by TS 3.0.3, steps were taken to restore the RPS channels to operable status. Channel A and D were returned to operable status at 1350 and 1400 respectively. With three channels operable (A, B, and D), TS 3.0.3 was exited.

The principle cause of the event was that the modification package for the replacement of the RPS NI drawers contained a design error which was not detected prior to power operation. This error and subsequent failure to detect it during the verification process are the result of cognitive personnel error by utility engineers involved in the development, verification and post modification testing of the design change. Additionally, changes in the cable designations of the new channel B (and control channel 9) detectors resulted in their being installed with the upper and lower detector leads connected in reverse.

Corrective Actions Include: 1) RPS NI drawers (channels A, C, and D) were reconnected and retested. 2) A self assessment and training session was conducted on 8/7/96. 3) Engineering procedures will be revised to emphasize design and verification requirements. 4) Walk downs will be conducted on all NI cables to revise the documentation or cable tagging as required. 5) ASI targets for power ascension will be established. 6) A review of Unit 2 ASI data confirmed that the detectors were operating correctly. 7) Training will be provided to I&C maintenance personnel.

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ST. LUCIE UNIT 1	05000335	96	-- 010	-- 00	2 OF 8

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

DESCRIPTION OF THE EVENT

BACKGROUND

The Reactor Protection System (RPS)(EIS:JC) nuclear instrumentation (NI)(EIS:IG) consists of four redundant and independent class 1E channels. These channels monitor the reactor neutron flux during power operation. The neutron flux signals originate from uncompensated ion chamber (UIC) assemblies, mounted external to the reactor core, each containing two (2) UIC detector tubes; one monitoring the top half of the core and the second monitoring the lower half. Independent coaxial signal cables from the two sections allow independent signal processing of the upper and lower signals at safety channel drawers located in the RPS cabinets.

During the St. Lucie Unit 1 refueling outage for cycle fourteen, a plant change/modification (PC/M) was implemented which replaced the power range NI drawers for the RPS (PC/M - 009-195). The drawers were replaced with new Gamma Metrics drawers to enhance overall system operation and maintenance. Additionally, during this outage, the UIC assemblies for RPS channel B linear power range and non-safety control channel 9 were replaced as separate maintenance activities.

EVENT DESCRIPTION

On July 30, 1996, St. Lucie Unit 1 was operating at 100 percent power after starting up from the cycle fourteen refueling outage. Low power physics testing was completed on July 25, 1996, and the Unit had entered Mode 1 at 1138 on July 25. Following power ascension startup testing, full reactor power was reached on July 29, 1996, at 1145 hours.

At 1300 on July 30, 1996, the Unit 1 Assistant Nuclear Plant Supervisor (ANPS) was informed by the Operations Manager that the upper and lower detector leads for the (RPS) linear range nuclear instrumentation were reversed on RPS channels A, C and D. This condition was discovered by reactor engineers during the evaluation of data obtained for shape annealing factor (SAF) testing during the Unit power ascension. The data showed that for RPS channels A, C and D, and control channel 9, the axial shape index (ASI) trend during power ascension was not in the expected, positive direction. The ASI trend for RPS channel B was as expected. The information was reviewed with plant engineering and operations management and the determination was made that the A, C and D upper and lower RPS linear power range NIs were connected to the wrong leads at the drawers.

The ANPS immediately declared the three affected linear range safety channels out of service, and following a review of applicable Technical Specifications (TS), entered TS 3.0.3. This TS requires that when a limiting condition for operation (LCO) is not met, except as provided in the associated action requirements, within 1 hour, action shall be initiated to place the Unit in a Mode in which the specification does not apply by placing it in at least Hot Standby within the next six hours. Additionally, the TS states that where corrective measures are completed that permit operation under the action requirements, the action may be taken in accordance with the specified time limits as measured from the time of failure to meet the LCO.

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DESCRIPTION OF THE EVENT Continued

At 1305 the ANPS began briefing the control room operating crew for the TS required down power. Concurrently, steps were taken by Instrument and Control (I&C) maintenance personnel to restore the RPS channels to operable status. The electrical leads on NI channels A and D were reconnected in the correct configuration and functionally tested in accordance with approved plant procedure. At 1350 the RPS channel A linear range NI was returned to operable status. At 1400 channel D RPS linear range NI was declared back in service and, with three channels operable (A, B and D), TS 3.0.3 was exited. The channel C linear range NI was declared back in service at 1515.

At 1404, operators reduced reactor power to 99.6 percent to allow for control element assembly (CEA) insertion to verify Axial Shape Index (ASI) response on all four RPS channels. This test was performed satisfactorily and at 1825 reactor power was returned to 100 percent.

CAUSE OF THE EVENT

Safety Channels A, C and D

The principle cause of the event was that the modification package (PC/M-009-195) for the replacement of the RPS nuclear instrumentation drawers contained a design error which was not detected until full power operation. Specifically, the error resulted from the revision of a controlled wiring diagram (CWD) which reversed the connections for the upper and lower linear range excore NI leads at the RPS cabinet drawers. This error was the result of a design error by the PCM preparer, which was not detected during design verification or post modification testing. Contributing factors to the error are discussed below.

The original CWDs contained differences in nomenclature and internal inconsistencies regarding the terminal connections at the cabinet drawers. This required the designers to make assumptions regarding the correct terminal connections for the replacement NI drawers. One underlying assumption made by both the PC/M preparers and verifiers was that the Unit 1 PC/M was essentially a replication of an earlier Unit 2 PC/M. The Unit 2 PC/M successfully supported a similar NI drawer replacement. The CWD revision was therefore based in part on CWDs from Unit 2. However, the Unit 2 CWDs contained differences in labeling and design that contributed to the error. Additionally, the assumption that the Unit 1 PC/M was a simple replication of the successful Unit 2 PC/M led to insufficient time and emphasis being placed on the design verification.

Another contributing factor to the error was the nomenclature used in the labeling of the NI detector cables. The NI detectors are supplied with the cable connections labeled as "Bottom" and "TOP" referring to top and bottom of the detector and not to their installed configuration relative to the reactor core. In fact at St. Lucie these detectors are installed inverted with the detector cable labeled as "TOP" actually monitoring the bottom of the reactor core. This fact was not understood by the designers or PC/M verifiers. It was incorrectly assumed that the cable identified on the CWD as "BOT SIG" feeding "SIGNAL 2" was the cable from the lower detector that should connect to terminal J13 (refer to Figure 1). Similarly, it was assumed that the cable identified on the CWD as "TOP SIG" feeding "SIGNAL 1" was the cable from the upper detector that should be connected to terminal J12. The correct terminal

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CAUSE OF THE EVENT Continued

connections are shown in Figure 2.

Post modification testing (PMT) also failed to identify the design error. The engineering procedures require that PMT sufficiently overlap the modification boundaries. Contrary to this, the PC/M did not identify the upper and lower NI inputs to ASI as critical functions to be verified by PMT. The principle cause of this omission was cognitive personnel error. Contributing factors to this failure were: (1) The engineering procedures did not require that all critical aspects verified by PMT be identified in the PC/M; (2) The Unit 1 PMT replicated the PMT conducted previously for Unit 2, based on an assumed similarity of configuration. The Unit 2 modification did not have the same potential for inverting the NI inputs and, therefore, had not identified the upper and lower detector inputs to ASI as a critical affected function to be verified by PMT.

Safety Channel B and Control Channel 9

The NI detectors for RPS channel B and the non-safety related channel 9 were replaced in the cycle fourteen refueling outage as a maintenance activity. The cable designations on these new detectors were different from the nomenclature used on the existing drawings. Instrumentation and control maintenance personnel did not identify this as a discrepancy requiring technical assistance to resolve. Consequently, the leads for the upper and lower detectors were reversed during installation. The cables were also reversed at the NI drawer for RPS channel B, during implementation of PC/M 009-195 (as discussed previously for channels A, C, and D above). Consequently, the two errors associated with channel B were compensating and channel B read correctly. Post maintenance testing was conducted on the detector replacement. This testing failed to identify the error, because there is no practical way to test the ASI inputs prior to criticality. The failure to detect the error during power ascension is discussed below.

Identification of the Design Error During Power Ascension

At low power levels it is difficult to detect the discrepancies in RPS ASI trends caused by the design error. Although ASI was monitored to verify compliance with Technical Specification limits, the power ascension startup program did not identify discrepant trends in ASI until after full power was reached. The initial cycle startup power ascension program does not require specific ASI monitoring and consequently ASI trending was not required to assure a target ASI was reached. The lack of a requirement to trend and monitor ASI during power ascension is an identified weakness in the power ascension program and resulted in not identifying the design error until after reaching full reactor power. However, the operators did identify a discrepancy between channel B and channels A, C, and D, during the power ascension. Resolution of this discrepancy failed to identify the design error at that time. This was due to a belief that the observed discrepancy was a result of the recent channel B detector replacement.

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ANALYSIS OF THE EVENT

This event is reportable under 10 CFR 50.73 (a)(2)(i)(B), as "Any operation or condition prohibited by the plant's Technical Specifications." Additionally, the event is reportable under 10 CFR 50.73 (a)(2)(vii), as "Any event where a single cause or condition caused at least ... two independent trains or channels to become inoperable in a single system designed to shutdown the reactor and maintain it in a shutdown condition."

It was determined during review of the shape annealing factor (SAF) test data that the excore detectors for RPS nuclear instrumentation channels A, C, and D had connections in the RPS cabinet with inverted leads. This configuration provided incorrect axial shape index (ASI) trends in the opposite direction to the actual behavior. These excore detector channels, therefore, provided incorrect ASI input signals to the RPS.

An engineering evaluation was performed to assess the safety implications of the inverted excore detector signals configuration during cycle fourteen operation of St. Lucie Unit 1 at beginning of cycle (BOC) conditions. The inverted signals resulted in incorrect ASI inputs to the RPS for channels A, C and D. The evaluation reviewed the setpoint and safety analyses and determined that the reversed wiring configuration would potentially impact only the setpoint analyses. The specific setpoint analyses potentially impacted are; the local power density (LPD) trip, the LPD limiting condition for operation (LCO), the thermal margin/low pressure (TM/LP) trip, and the departure from nucleate boiling (DNB) LCO.

Impact on LPD trip and LCO

The LPD trip monitors core power and ASI to initiate a reactor scram to prevent exceeding fuel centerline melt conditions. It was determined that operation of the LPD trip at BOC with the incorrect ASI inputs would not have resulted in exceeding any safety analysis limits. The LPD LCO provides protection against exceeding the linear heat rate limit when the incore detectors are out of service. Since the incore detectors were in service during the event, the LPD LCO was not impacted by the excore NI wiring errors.

Impact on TM/LP trip and DNB LCO

A re-analysis of the TM/LP trip was performed to account for the incorrect ASI inputs. This analysis determined that operation of the TM/LP trip with the incorrect ASI inputs would have been within the DNB acceptance criteria for the applicable plant transients. Because ASI was monitored by the incore detector system during the power ascension, and was well within the ASI limits, the excore wiring errors had no impact on the DNB LCO. In addition, the DNB LCO analysis limiting events do not rely on any ASI related trips and, therefore, are unaffected by the ASI input errors.

Based on the above evaluation it has been determined that the health and safety of the public were not adversely affected.

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CORRECTIVE ACTIONS

1. RPS linear safety channel nuclear instrumentation drawers (channels A, C and D) were reconnected in accordance with a revised drawing and testing was performed to verify proper NI signal response.
2. A self assessment and training meeting for the Engineering Department and other impacted personnel was conducted on August 7, 1996, which emphasized the importance of proper design verification and the importance of maintaining a questioning attitude.
3. Engineering Quality Instructions will be revised by 9/30/96 to: (1) require that all critical aspects to be verified during PMT be identified in the PC/M, (2) emphasize that the same level of verification is required to be performed for PC/Ms duplicated for the second unit, (3) reinforce the verification requirements for safety related drawings. For the interim period, Engineering has issued a Technical Alert to all engineering personnel.
4. Walkdowns will be conducted on all linear NI safety related and control cables to revise the design documentation and tagging as necessary for both units during their next refueling outage.
5. ASI targets will be established for trending ASI during power ascension for the next and all subsequent restarts from a refueling outage.
6. A review of Unit 2 ASI data was conducted which confirmed there were no similar errors associated with the Unit 2 design.
7. Instrumentation and Control Maintenance will provide training to personnel on the detector cabling designation issue to increase awareness and emphasize the importance of obtaining the proper technical guidance in unclear situations
8. The excore NI detector vendor is evaluating the detector cable labeling issue and the need to issue a technical bulletin.

ADDITIONAL INFORMATION

Component Failure

none

Previous Similar Event

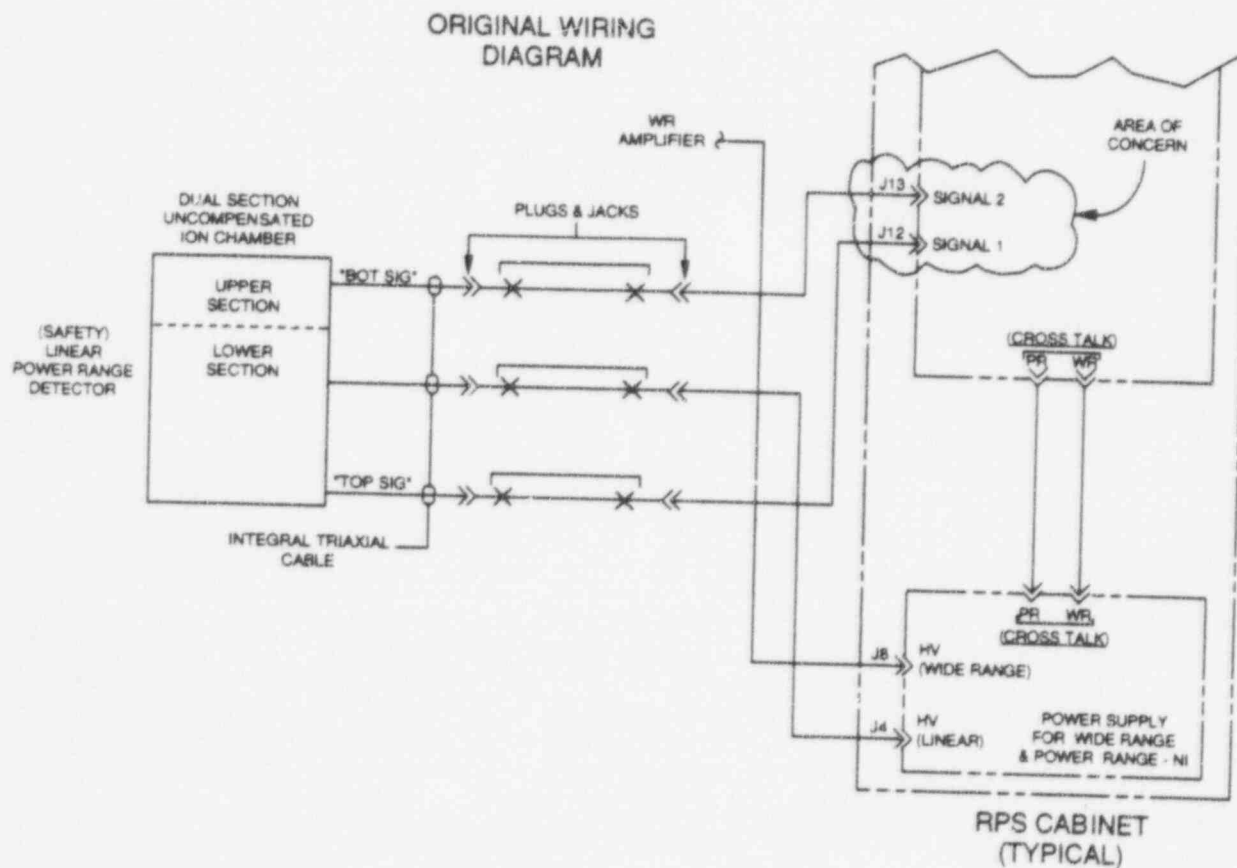
none

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FIGURE 1



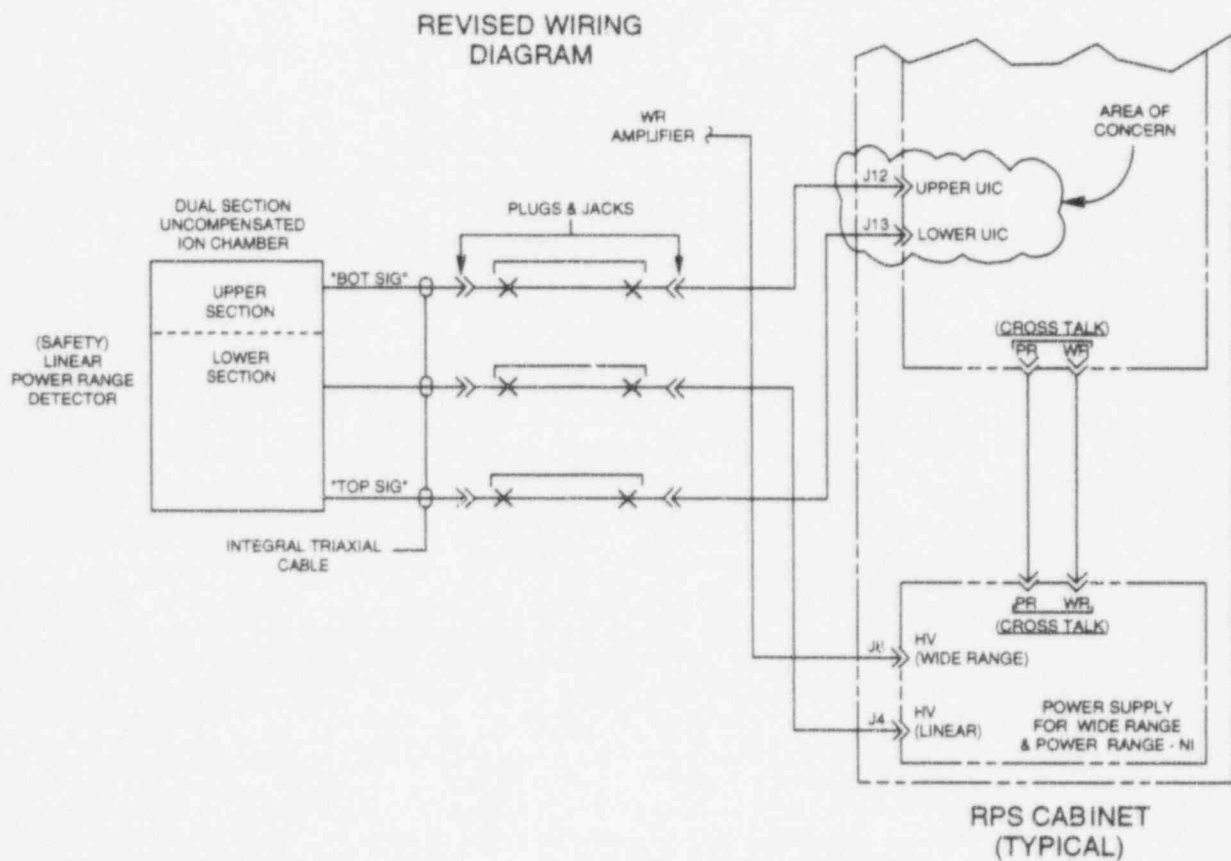
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FIGURE 2



(D/LIC/960303-F2-R0)