NRC Form 366
(9-83)

U.S. NUCLEAR REGULATORY COMMISSION
APPROVED OMB NO. 3150-0104
EXPIRES: 8/31/85

LICENSEE EVENT REPORT (LER)

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BYRON, UNIT 1	0 5 0 0 0 4 5 4	1 OF 0 6

TITLE (4)
SOURCE RANGE CHANNEL SPIKING

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 NAMES	DOCKET NUMBER(S)
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1 1	0 7	8 4	8 4	— 0 0 3	— 0 1	0 1	1 7	8 4		0 5 0 0 0

OPERATING MODE (9)		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
6		20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10)	0 0 0	20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	Supplemental Report
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
WILLIAM SMITH, TECHNICAL STAFF ENGINEER, EXT. 607	AREA CODE 8 1 5 — 2 3 4 - 5 4 4 1

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	
B	I G	D E T	W 1 2 0	N							

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)

During initial core loading of Byron Station Unit 1, signal spiking began to be seen on both Source Range channels. The signal spiking was determined to be caused by electrical noise generated on the system or induced onto the system. The Source Range channels were declared inoperable due to the spiking problem. Modifications and improvements were performed on the Source Range channels, reducing the spiking problem so that core loading could be completed. Additional improvements have been made since core loading as the result of a comprehensive investigation and the Byron Source Range channels are now performing acceptably.

IE22

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

Background:

During initial core loading of Byron Station Unit 1 and while in Mode 5, signal spikes were seen on the Source Range Channels. The spikes occurred on one or both channels and varied in magnitude and duration. Preliminary functional checks performed by the Station Instrument Maintenance Department indicated that the Source Range channels' electronics from the preamplifier outside containment through the main control room channel drawer were functioning properly and were accurately indicating the number of counts received. The fast transient nature of the signal spikes, the inconsistency between the installed Source Range's indications during a spike (spikes occurred on both channels simultaneously with different magnitudes, and separately on one channel while the other channel indicated no change in counts), the RCS boron concentration measurements and the temporary core loading instrumentation response all indicated the signal spikes were electrical noise being picked up by the Source Range channels. It was determined by Station management and shift personnel that the spiking was not an indication of actual core flux behavior, and the solution to the problem was in finding and eliminating/ minimizing the electrical noise sources.

The Source Range channels were declared inoperable in accordance with Technical Specification 3.9.2 as the signal spiking became a significant problem. The spikes were forcing core loading personnel to continually evacuate containment as spikes exceeded the evacuation alarm setpoint. Core alterations were suspended to meet the Limiting Condition for Operation.

Investigation:

A comprehensive and multifaceted approach was implemented by Byron Station to resolve the noise spiking problems - first, in order to obtain satisfactory Source Range channel performance to allow completion of core loading and second, to find long term solutions to prevent recurrence of the noise problem. Key elements of the investigation/correction plan were the following:

1) Electromagnetic interference experts were brought to the Station from the Commonwealth Edison Company Maywood Technical Center. These experts helped to trace down and identify noise sources affecting the Source Range channels, and offered their advice on corrective actions when such sources were identified.

2) A Westinghouse site engineer with extensive Nuclear Instrumentation System (NIS) experience was brought to the Station. He provided a thorough evaluation of our NIS installation based on his walkdown of the system, offered recommendations for improvements and likely problem areas, and provided technical/vendor input at strategy, progress, and planning meetings. Primarily, he provided Byron Station with both broad and in depth knowledge of the NIS, comparative installations, other plants' experiences and past solutions.

3) Station Instrument Maintenance Department troubleshooting was supplemented with both technical and physical support from Project Operational Analysis Department engineers. They provided a wealth of troubleshooting experience to draw upon and 24-hour physical support with both manpower and equipment.

4) Information was requested from the Nuclear Operations and Maintenance Information Service (NOMIS) subscribers about similar problems at other plants, and their corrective actions.

5) A tour group of Commonwealth Edison personnel was sent from Byron Station to McGuire, Callaway, and Sequoyah plants and to Westinghouse in Monroeville to make a first-hand comparison of the Byron NIS installation and performance with other plants' systems, and to talk to cognizant personnel at each location concerning Source Range noise problems.

6) A design change has been initiated through Westinghouse to modify the Boron Dilution Protection System (BDPS) to be less susceptible to actuations caused by noise spiking. This design change was discussed with Union Electric Co. personnel at the Callaway plant and Westinghouse design engineers in Monroeville as part of the tour described in (5) above. Numerous Source Range spikes have resulted in spurious flux doubling signals and charging pump suction switchover actuations at Byron (see LER 84-010-00 and LER 84-019-00). These actuations are the result of noise spikes and not a contributing factor in their occurrence. As such, this design change is intended to lessen the impact of noise spikes when they occur, and will not lessen the spikes themselves. A longer and more detailed coverage of the BDPS actuations resulting from spikes and the proposed Westinghouse system modification will be provided in the supplemental report for LER's 84-010-00 and 84-019-00.

Corrective Action:

Information gained by Commonwealth Edison Company from Westinghouse, NOMIS, and the NRC showed that approximately thirty other plants had experienced, or still do experience Source Range noise problems. These plants are both PWR's and BWR's. A summary of the corrective actions taken at other plants include:

1) Clean, repair, or replace triaxial cable connectors.

2) Repair or replace triaxial cables.

3) Remove inadvertant system grounds.

4) Improve the system design ground.

5) Replace aged Source Range detectors.

6) Replace the Source Range preamplifier with a new low-noise type preamplifier.

Per Westinghouse engineers, ninety plus percent of the Source Range noise problems they see are caused by humidity or dirt in the triaxial cable connectors in containment or at the penetrations.

Based on the above information, Byron Station undertook the disassembly, cleaning, and retermination of all Source Range triaxial connectors as the first step in improving Source Range channel response sufficiently to complete core loading. Although several connectors were found that appeared to be affected by moisture, and all were corrected, no significant Source Range channel improvement resulted from this.

The next steps were in parallel paths. The NIS system ground was improved via a modification package. Individual cabinet grounds of heavier gauge were installed between the NIS rack and the ground grid. Temporary triaxial cables used in troubleshooting were routed away from identified noise sources to determine the effects, and when a suitable path was identified, new conduit and cable runs were installed between the containment penetrations and the preamplifier junction boxes. In addition, the preamplifiers for both Source Range channels were moved adjacent to their respective penetrations to shorten the electrical path distance from detector to preamplifier.

Spare NIS cables which run in parallel with the in-use cables were grounded at one end to reduce inductive coupling between cables. The preamplifiers for the Source Range were grounded in accordance with Westinghouse recommendations when it was determined that grounding the preamplifiers significantly increased Source Range channel performance and resistance to noise spikes.

One Source Range detector (N31) which exhibited the largest and most consistent noise spikes was replaced even though the detector was new. No change in channel response occurred as a result of the detector change, but it did remove any question whether the detector could be the source of the problem. The new detector was left in place, and before the Source Range was returned to operable status, the alignment procedure was reperformed.

The preamplifiers at Byron were already the low-noise type and so no change was performed. However, the channel preamplifiers were replaced like-for-like to eliminate defective preamps as a noise source. As expected, no improvement resulted from the like-for-like change.

Equipment was electrically shutdown in the vicinity of the Source Range channels to try to identify which electrical loads were causing electrical noise generation. No positive results came from these tests. However, the electrical interference experts walked down the entire Source Range cable run to identify areas of significant noise and particular cables, where possible, which carried the noise. Where identified, the noisy cables were separated from the Source Range cables.

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A correlation was noted between a defective vapor light in the vicinity of the Source Range preamplifiers trying to start (it had a bad ballast and continually cycled though its startup) and noise pickup. The light was powered-down and a significant decrease in noise resulted. Per Westinghouse recommendation, vapor lights should not be used in the vicinity of the preamplifiers as they can radiate large amounts of RF interference if there are voltage transients or malfunctions. Currently, at Byron Station, replacement of the vapor lights with incandescent lighting has been initiated, but has not yet been completed.

The noise waveform on the Source Range channel cables was monitored and found to be particularly excessive on the cables between the process computer and NIS rack. The cables ran in close proximity to a cable from the Condensate-Condensate Booster Pump 1A stator temperature RTD which had 4-5 ampere peak-to-peak noise. When the pump was stopped the noise level dropped to zero. It was determined that grounding the preamplifier removed the noise when the pump was running. At this time, the excessive noise currents on the RTD cable have not been corrected, but the preamplifier grounding has removed the problem for the NIS.

Another correlation noted during troubleshooting was between opening doors on the 7300 process instrumentation racks and noise spikes. The doors are equipped with switches to alarm that the cabinets are open. When these switches were operated they caused noise spikes by contact noise. This noise source is suspected to have caused the majority of the noise spikes seen on the NIS. Each morning when the Instrument mechanics went out to perform surveillances on the 7300 racks, they would open the cabinets. For lunch and at the end of the work day they closed the cabinets. When the times of the occurrences of spikes are plotted, it can be seen that the majority of the events occurred when morning work began, at lunch and at the end of the day's shift. Electrocube noise suppression modules were installed across the 120 VAC feeds to the aux relays picked up by the switches, and the actuation of the switches no longer causes spikes on the Source Range channels.

The efforts of the personnel involved in the Source Range channel noise problem improved the channel response markedly. The channels were returned to service and core loading completed when system performance was acceptable. Several of the solutions still continue at this time as they are longer term system improvements.

Preventative Action:

Several items were noted during the thorough NIS evaluation which properly fall under the heading of preventative maintenance. These include the following:

1) Eliminating a fifty (50) pound pull test on completed triaxial connectors. Per Westinghouse, this test is to be used in qualifying assembly personnel only, and that production connections need not be subjected to the test. This prevents damage to the cable shield.

2) All NIS drawers were thoroughly inspected and cleaned.

3) The detector cables in the detector wells (for Source, Intermediate, and Power Range channels) were all protectively taped with type 69 fiberglass tape (3M product) at Westinghouse's recommendation. This will prevent damage to the fragile cables during detector replacement and movement. This was done after finding damaged outer shields on the Source Range N31 detector when it was replaced.

4) The triaxial connectors in the NIS rack were heat shrunk to the cable to provide additional torsional rigidity. This should alleviate connector failures in the future caused by drawer movement, calibrations, etc. where the cables are disconnected and reconnected.

Conclusions:

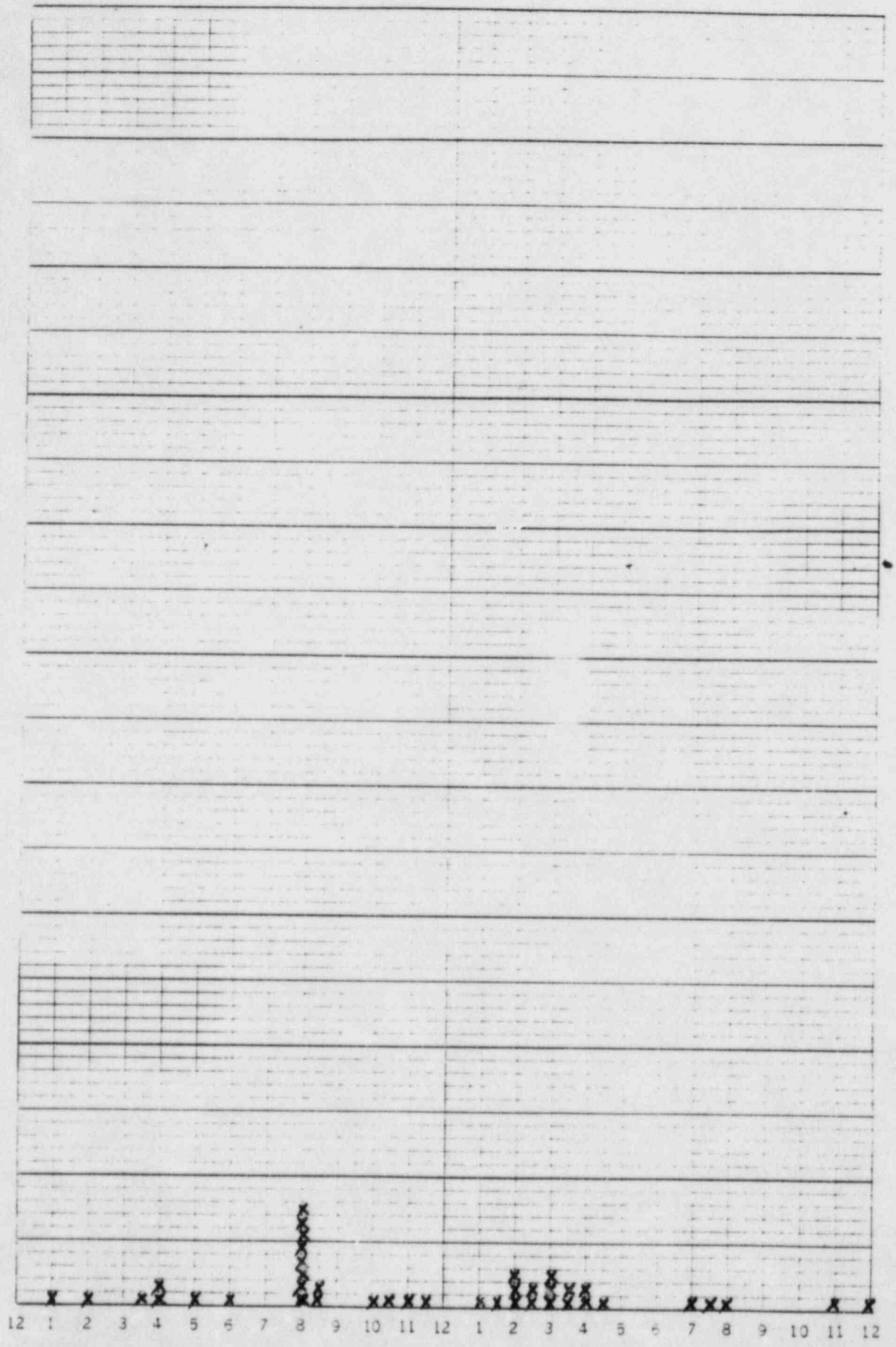
Byron Station requested an evaluation of our Source Range channels, after the system improvements had been made, by a Westinghouse design engineer. The conclusion was that " The noise levels on the source range were normal for a plant that had not been critical and the statistical fluctuation of the level was also normal. The variation due to statistical fluctuation will decrease some after initial operation as the normal source level is a decade higher after the plant has been critical."

The Byron task force that visited the plants described in this report concluded that Byron's Source Range channels, after the improvements had been made, operate as good or better than the other plants. The frequency and magnitude of the noise spikes has been very substantially reduced.

It is the Byron Station position that the noise spiking problem was not an "abnormal" occurrence as it was due to initial system operations at the low count rate levels. Other plants have experienced similar events, and it is not an unexpected condition. Byron Station experienced initial problems, took effective corrective action, and has a fully operable Source Range instrumentation system.

Byron Station also is of the opinion that the noise spiking presented minimal safety significance. The spikes did cause a suspension of core alterations and several inadvertant BDPS actuations, but these are conservative events and do not decrease the margin of safety for the plant or public.

Number of Source Range Spikes versus Time of Occurrence (to closest half hour)



SUPPLEMENT TO DVR

DVR NO.

	STA	UNIT	YEAR	NO.
D-	6	01	84	17

PART 1 TITLE OF EVENT

Source Range Channel Spiking

OCCURRED 11/7/84 DATE 0747 TIME

REASON FOR SUPPLEMENTAL REPORT

Required by LER 84-003-00

APPROVED
AUG 31 1984
B. O. S. R.

PART 2

ACCEPTANCE BY STATION REVIEW [signatures]

DATE 1/18/85 1/18/85

SUPPLEMENTAL REPORT APPROVED AND AUTHORIZED FOR DISTRIBUTION

[signature] STATION SUPERINTENDENT

1/18/85 Date

(4680P)

FINAL

Commonwealth Edison
Byron Nuclear Station
4450 North German Church Road
Byron, Illinois 61010

January 17, 1985

LTR: BYRON 85-0073

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

Dear Sir:

The enclosed Licensee Event Report from Byron Generating Station is being transmitted to you as a Supplemental Report to LER 84-003-00.

This report is numbe: 84-003-01, Docket No. 50-454.

Very truly yours,

R. E. Querio
Station Superintendent
Byron Nuclear Power Station

REQ/vda

Enclosure: Licensee Event Report No. 84-003-01

cc: J. G. Keppler, NRC Region III Administrator
J. Hinds, NRC Resident Inspector
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