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

DATE October 7, 1994

LTR: BYRON 94-0400
FILE: 3.03.0800 (1.10.0101)

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 in accordance with the requirements of 10CFR50.73(a)(2)(iv).

This report is number 94-009; Docket No. 50-454.

Sincerely,

G.K. Schwartz
Station Manager
Byron Nuclear Power Station

GKS/DSK/bl

Enclosure: Licensee Event Report No. 94-009

cc: J. Martin, NRC Region III Administrator
NRC Senior Resident Inspector
INPO Record Center
CECo Distribution List

170045

(9923R/WPF/092994-8)

IE22

SIGNATURE PAGE FOR LICENSE EVENT REPORT

LER Number
454:94-009

Title of Event: Reactor Trips during planned shutdown due to Solid State Protection System Failure

Occurred: 9-8-94 / 0125 and 1452
Date Time

OSR DISCIPLINES REQUIRED: ABFGm

SES / 10/4/94
SES DATE

Acceptance by Station Review:

OE / 10/7/94
OE Date

SES / 10/4/94
SES Date

RAS / 10/6/94
RAS Date

OTHER / 10-7-94
OTHER Date

Approved by: Station Manager / 10/8/94
Station Manager Date

(9923R/WPF/092994)

LICENSEE EVENT REPORT (LER)

FACILITY NAME	DOCKET NUMBER	PAGE
BYRON NUCLEAR POWER STATION	0 5 0 0 0 4 5 4	1 OF 0 7

TITLE

Reactor Trips during planned shutdown due to Solid State Protection System failure.

EVENT DATE			LER NUMBER			REPORT DATE			OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQ. NUMBER	REVISION	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
0 9	0 8	9 4	9 4	- 0 0 9	- 0 0				None	0 5 0 0 0
										0 5 0 0 0

OPERATING MODE		THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (CHECK ONE OR MORE OF THE FOLLOWING)					
1		20.402(b)		20.405(e)	X	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL		20.405(a)(1)(i)		50.36(c)(1)		50.73(a)(2)(v)	73.71(c)
0 1 0		20.405(a)(1)(ii)		50.36(c)(2)		50.73(a)(2)(vii)	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)	
		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

NAME	TELEPHONE NUMBER
R. Choinard, System Engineering Department ext. 2041	8 1 5 2 3 4 - 5 4 4 1

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
X	J G		W 1 2 0	Y							

SUPPLEMENTAL REPORT EXPECTED		EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
X YES. (If yes, complete EXPECTED SUBMISSION DATE)	NO		1 2	1 5	9 4

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

Abstract

Event 1: On September 8, 1994 at 01:25, Byron Unit 1 unexpectedly tripped at approximately 10 percent power. The event occurred during a controlled shutdown for the sixth refueling outage on Byron Unit 1 (B1R06). The unit tripped from high flux on source range (SR) nuclear instrument channel 31 (N31) [IG]. SR N31 re-energized when permissive P10 energized. Both intermediate range (IR) nuclear instrumentation channels (N35, N36)[IG] were above P6. The probable cause of the reactor trip was a faulty logic card in the Solid State Protection System (SSPS)[JG]. This generated a P6 signal for SR N31 before both IR channels were below the setpoint for P6. The Permissive Signal P6 setpoint for re-energizing the SR channels is less than 1.0 E-10 amps on both IR channels.

Event 2: On September 8, 1994, at 14:52, a second reactor trip signal occurred. The signal was from high flux on SR N31. Station personnel inadvertently generated the signal during trouble shooting activities. The personnel were investigating the spurious P6 signal that caused the 01:25 reactor trip. Unit 1 was in Mode 3 with all control rods fully inserted. The cause of this event was a personnel error during the trouble shooting activities.

These events are reportable under 10CFR50.73(a)(2)(iv) as a Reactor Protection System Actuation.

TEXT Energy Industry Identification System (EIIS) codes are identified in the text as [XX]

A. PLANT CONDITIONS PRIOR TO EVENT:

Event Date/Time 09/08/94 / 0125

Unit 1 MODE Mode 1 - Power Operation Rx Power 10% RCS [AB] Temperature/Pressure NOT/NOP

Unit 2 MODE Mode 1 - Power Operation Rx Power 99% RCS [AB] Temperature/Pressure NOT/NOP

B. DESCRIPTION OF EVENT:

Event 1

On September 8, 1994, Unit 1 was in a controlled shutdown for its sixth refueling (B1R06). The following messages printed on the alarm printer.

01:25:02 Power Range Channel N42 Below P7/P10 - Set
01:25:12 Power Range Channel N43 Below P7/P10 - Set
01:25:27* Power Range Channel N41 Below P7/P10 - Set

* At this point the permissive P10 was satisfied.

Once the P10 permissive set or activated, the 25% power range reactor trips for Solid State Protection System (SSPS) Train A and Train B (RP)[JG] were unblocked. In addition, the P10 permissive unblocked the Intermediate Range (IR) high flux trips for SSPS Train A and B. However, the Source Range (SR), high flux, reactor trip for SSPS Train A also unblocked when P10 activated. This trip is not supposed to unblock until the P6 permissive setpoint is satisfied for energizing the SR detectors. The P6 setpoint for energizing the SR channels is less than 1.0 E-10 amps on both IR channels. The SSPS most likely generated a faulty signal that caused SR N31 to energize.

At 01:25:27, the reactor tripped from about 10 percent power. The operating shift entered the emergency procedure for a reactor trip. The reactor trip breakers opened and all control rods fully inserted. A feedwater isolation occurred because of the trip as expected. The operating shift entered the Limiting Condition for Operations Action Requirement (LCOAR) for P6. The operating shift also entered the LCOAR for IR channel N36 for the reason described below. All equipment responded as expected and the operators responded correctly.

Before this event, IR N36 was inoperable due to a failure related to Technical Specification, Table 4.3-1, "Reactor Trip System Instrumentation Surveillance Requirements," Table Notation 5a. A high voltage plateau was not achievable. The operating shift made plans to enter the Limiting Condition for Operations Action Requirement for an inoperable IR channel once reactor power went below P10 or 10%. They did this after the reactor trip. The outage schedule called for replacement of the IR detector on September 11, 1994. This occurred and Operating personnel tested IR N36 and declared it operable on September 11, 1994. The inoperable IR channel was not a result of and did not contribute to this event.

At 01:28:38, the shift pulled the instrument fuses on SR N31 as a precautionary measure. They took this measure since the SR channel energized prematurely. Removal of the fuses made SR N31 inoperable and the shift entered the LCOAR for the channel. Removal of the fuse also made Train A of the Boron Dilution Protection System (BDPS) inoperable and the shift entered the LCOAR for BDPS.

TEXT Energy Industry Identification System (EIIS) codes are identified in the text as [XX]

B. DESCRIPTION OF EVENT: (continued)

At 01:34, IR N35 went below the P6 setpoint. The operating shift installed the instrument power fuses on SR N31 and exited the LCOARs for SR N31 and the BDPS.

This event is reportable under 10CFR50.73(a)(2)(iv) an actuation of the Reactor Protection System.

Event 2

After the trip, an Instrument Maintenance Technician suggested using a partial surveillance to test the SSPS. Operating personnel initiated a partial surveillance for 1BOS 3.1.1-20, "Unit 1 Train A Solid State Protection System Bimonthly Surveillance." The partial surveillance consisted of Sections F.1 through F.6, and F.13.

At 13:30, NSO #1 started the BOS.

At 13:36, NSO #1 began section F.1. NSO #1 completed section F.1 with no problems. This section established the initial conditions for the subsequent sections.

Next the NSO did section F.2. This section tested the Train A Bypass Breaker and closed it. At 13:54, NSO # 2 closed the Train A, Bypass Breaker from the Main Control Room. This started a two-hour time limitation allowed by Technical Specification Table 3.3-1, Action 12.b. The action requirement allows bypassing a reactor trip breaker for up to two hours during surveillance testing. NSO #1 completed section F.2 with no problems.

After section F.2, NSO #1 started section F.3. This section placed SSPS Train A into a test condition. At step F.3.a, NSO #1 placed the "Input, Error, Inhibit" switch in 1PA09J to Inhibit. This step caused the high voltage for N31 to de-energize. NSO #1 completed section F.3 with no problems.

Next, the NSO did section F.4. This section checked the semiautomatic tester in SSPS. He completed the section with no problems. He also completed sections F.5 and F.6. These two sections tested the SSPS logics, permissives, and memories. NSO #1 completed both sections with no problems. The total time elapsed was approximately forty-five minutes. This completed item A of the Work Planning Log. The BOS found no problems with the SSPS.

Next, IM #1 did item B of the Work Planning Log. The IM measured voltage across terminals 7 and 8 on terminal board 506 in 1PA09J. This verified that the SR Manual Block - Train A switch contacts were closed.

Based on the results of the BOS and the other testing, a discussion of what to do next began. The discussion included the SSPS engineer, NSO #1, and the IM assigned to trouble shoot the SSPS failure. The SSPS Engineer and IM #1 had anticipated that they would find no problems. The next logical step in the trouble shooting effort would be replacement of suspect logic cards in 1PA09J.

The cards the engineer and the IM technician wanted to replace were A406 and A408 in panel 1PA09J. Card A406 was the logic card for the manual block/unblock for Train A SR trips. Card A408 was the logic card for the SR high flux trips and for energizing and de-energizing the SR detectors.

TEXT Energy Industry Identification System (EIIS) codes are identified in the text as [XX]

B. DESCRIPTION OF EVENT: (continued)

The engineer said that pulling card A406 would re-energize SR N31 detector. He was concerned that the detector might spike and cause a reactor trip signal. As a precaution, he wanted to pull the instrument power fuses on the instrument drawer for N31 to prevent the detector from energizing. The IM questioned the need to pull the fuses, since on a normal shutdown the SR detectors automatically energize and do not spike and cause a reactor trip. The engineer replied that he wanted to be extra conservative by pulling the fuses. The IM accepted this response. NSO #1 also felt the request was reasonable. He has experienced spiking on other electrical equipment when it energizes. The group also decided to leave SSPS in test because the new cards would have to be tested using the BOS. The group left the U1 Auxiliary Electrical Equipment Room (AEER) to talk to the SCRE regarding the plans to replace the cards.

Next, the engineer brought up the concern of energizing the SR detector and causing a spike when the IM pulled card A406. He told the SCRE he wanted to pull the instrument power fuses on the drawer to prevent N31 from energizing. The SCRE assumed that, since SSPS was in Inhibit and SR N31 was de-energized, there was no chance of a problem. The SCRE gave permission to pull the fuses.

NSO #1 also believed it was safe to pull the fuses since N31 was de-energized. He thought of placing the Level Trip switch to Bypass, but felt it was unnecessary for the same reason.

NSO #1 went to the SR instrumentation panel, looked at the Unit 1 NSO, indicating he was ready to pull the fuses, then pulled the fuses.

At 14:52:15, a Source Range High Flux Trip signal occurred. The trip signal resulted when the NSO pulled the instrument power fuses with the Level Trip switch in Normal. When he pulled the fuses, he removed instrument power to the level trip bistable. With power removed to the bistable, it de-energized. The bistable is in its tripped condition when it is de-energized.

A feedwater isolation and BDPS actuation occurred because of the reactor trip signal. The shift responded and reset the feedwater isolation and BDPS actuation. All equipment responded as expected and the operators responded correctly.

This event is reportable under 10CFR50.73(a)(2)(iv) as an actuation of the Reactor Protection System.

At 15:02:36, the NSO installed the instrument power fuses and began section F.13, "System Restoration." The Unit 1 NSO closed Reactor Trip Breaker A and at 15:23, racked Bypass Breaker A to the disconnect position. This ended the two hour time limitation. NSO #1 completed the BOS at 15:37.

Trouble shooting activities continued over the next several weeks. A listing of the activities completed and the results is given below.

On September 9, the SSPS engineer wrote SPP 94-068, "Unit 1 Train A SSPS P6 Repairs." The engineer and IM#1 performed the SPP on September 19. IM #1 replaced three cards in SSPS panel 1PA09J. The three cards were A406, A408, and A411. Card A411 developed the P6 logic using inputs from both IR channels. After replacing the cards, operating personnel tested the logic and memory permissives using the SPP.

TEXT Energy Industry Identification System (EIIS) codes are identified in the text as [XX]

B. DESCRIPTION OF EVENT: (continued)

On September 22 and 23, IM#1 visually inspected the wiring in panel 1PA09J. He cut and reterminated the wire connected to pin 29 on card A406 and the wire connected to pin 3 on card A408. The IM then inspected the cut portions of wire to see if the wires' insulation was damaged and caused a short. The inspection showed no problems. In addition, the IM put the three cards removed on the 19th into the SSPS panel for the Byron Control Room Simulator. He did this to test the cards under conditions similar to those they would see in the plant. The results of additional testing and trouble shooting activities will be in a supplemental report.

C. CAUSE OF EVENT:

Event 1

The station will write a supplemental report detailing the trouble shooting activities and causes of Event 1.

Event 2

The SSPS engineer, SCRE, NSO #1, and IM #1 made wrong assumptions on pulling the instrument fuses for SR N31. The individuals did not completely identify or assess the risks and consequences of the decision. They did not completely verify their decision to pull the fuses before the action.

The SCRE, NSO #1, and the SSPS engineer assumed, that since the detector for SR N31 was de-energized and SSPS was in test, pulling the fuse would be safe to do. Neither individual verified or validated that pulling the fuses to the SR channel was needed and would not cause a problem under the specific plant conditions that existed at the time. The SCRE and the NSO received training on SSPS and NIS. The SSPS engineer has not been trained on NIS. The SSPS engineer assumed that pulling the fuses would be a conservative and safe action since this would keep the SR detector from energizing with the SSPS card pulled. The other individuals agreed with this assessment.

IM #1 questioned the need to pull the fuses based on what normally occurs during a plant shutdown. Nonetheless, he agreed that pulling the fuses was acceptable. IM #1 is a Control System Technician and has been trained on NIS.

None of the individuals reviewed any electrical schematics for NIS, referred to any training information for NIS, or contacted the NIS engineer for the SR channel to determine the impact on the system with the fuses pulled. There was a placard on the NIS panel that gives the logic for pulling instrument and control power fuses and whether or not a reactor trip occurs. This placard shows that a reactor trip results if the instrument fuses are pulled and the Level Trip Switch is not in Bypass. NSO #1 said he was aware of the placard but, felt it did not apply since the SR detector was de-energized and SSPS was in test. IM #1 was not aware of the placard but, indicated that had he known about it, he very likely would have realized that pulling the fuses was a bad decision.

TEXT Energy Industry Identification System (EIIS) codes are identified in the text as [XX]

D. SAFETY ANALYSIS:

Event 1

The early energizing of Source Range detector N31 resulted in no safety concerns. A failure of the P6 permissive results in a reactor trip when ascending or descending in power if a source range detector energizes above its trip point.

The source range high neutron flux trip is automatically reinstated when both intermediate range channels decrease below the P-6 setpoint value. The source range trip point (at 1.0 E5 cps) is set above the P-6 setpoint but below the maximum source range power level. Therefore, a failure of the P6 permissive results in a reactor trip when descending in power if power is above the source range trip point.

Once critical, the power escalation must be sufficiently slow to allow the operator to manually block the source range reactor trip after receiving P-6 from either intermediate range. Failure to perform this manual action or failure of the P6 permissive during startup results in a reactor trip and immediate shutdown of the reactor when power reaches the source range trip point.

Event 2

This event occurred while in Mode 3. The safety analysis for Event 1 bounds this event since it occurred while in mode 1.

E. CORRECTIVE ACTIONS:

Event 1

Three cards were replaced in the SSPS. The station is continuing an investigation into the root cause and will determine if additional corrective actions are needed.

Event 2

During the root cause investigation into the second event, it was determined that _BOS 3.1.1-20, "Unit _ Train A Solid State Protection System Bimonthly Surveillance" and _BOS 3.1.1-21, "Unit _ Train B Solid State Protection System Bimonthly Surveillance" have a potential problem. This problem could cause a reactor trip similar to Event 2. This problem did not impact the event. The Operating Department will revise the BOS to place the channel in bypass instead of pulling fuses. NTS item 454-180-94-00900-01 will track the procedure revisions.

The root cause investigation also found a problem with process computer point ND0014. This problem did not impact this event. SED wrote a process computer software change for point ND0014, "PWR RNG CH44 BELOW P7/P10." The software change will make the zero and one states for this computer point agree with the three other power range computer points. NTS item 454-180-94-00900-02 will track the software change.

E. CORRECTIVE ACTIONS: (continued)

This event will be placed into Required Reading for the System Engineering Department, Maintenance Department, and Operating Departments. The lesson learned to be stressed is that individuals need to verify decisions or information before acting, especially when working on systems outside their areas of expertise. Individuals should continue to use an independent means of verification such as referring to prints, training material, and system experts. NTS items 454-180-94-00900-03, 04, and 05 will track this action.

F. RECURRING EVENTS SEARCH AND ANALYSIS:

A search of Byron events found no previous events in the last two years.

A search of industry events also found no related events in the last two years.

G. COMPONENT FAILURE DATA:

MANUFACTURER	NOMENCLATURE	MODEL NUMBER	MFG PART NUMBER

Event 1

TO BE DONE AFTER THE CAUSE FOR EVENT 1 IS KNOWN.

Event 2

Not Applicable.