Commonwealth Edison
Zion Generating Station
101 Shiloh Blvd.
Zion, Illinois 60099
Telephone 312/746-2084

November 3, 1989

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

Dear Sir:

The enclosed supplemental Licensee Event Report number 89-04-01, Docket No. 50-295/DPR-39 from Zion Generating Station is being transmitted to you to clarify the root cause of the event.

Very truly yours,

T. P. Joyce
Station Manager
Zion Generating Station

TPJ/jlc

Enclosure: Licensee Event Report

cc: NRC Region III Administrator
NRC Resident Inspector
INPO Record Center
CECo Distribution List

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LICENSEE EVENT REPORT (LER)

Form Rev 2.0

Facility Name (1)	Docket Number (2)	Page (2)
Zion Unit 1	0 5 0 0 0 2 9 5	1 of 0 4

Title (4)

Forced Shutdown due to Inoperable Control Rod Position Indication Due to Regulator Failure

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(s)
0 3	0 8	8 9	8 9	0 0 4	0 1	1 1	0 3	8 9	N/A	

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10CFR (Check one or more of the following) (11)					
POWER LEVEL (10)	0 9 9	___ 20.402(b)	___ 20.405(c)	___ 50.73(a)(2)(iv)	___ 73.71(b)		
		___ 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)	___ Other (Specify		
		___ 20.405(a)(1)(iii)	X 50.73(a)(2)(i)	___ 50.73(a)(2)(viii)(A)	in Abstract		
		___ 20.405(a)(1)(iv)	___ 50.73(a)(2)(ii)	___ 50.73(a)(2)(viii)(B)	below and in		
		___ 20.405(a)(1)(v)	___ 50.73(a)(2)(iii)	___ 50.73(a)(2)(x)	Text)		

LICENSEE CONTACT FOR THIS LER (12)

Name	TELEPHONE NUMBER
	AREA CODE
John Parker, Engineer ext. 305	3 1 2 7 4 6 - 2 0 8 4

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
X	A A	R G	S 2 4 5	Y					

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)

On March 8, 1989, all Unit 1 Rod Position Indicators dropped to a reading of approximately 220 steps. It was found that a line voltage regulator, in series with the power source for the Rod Position Indication System, had failed. All indicator channels were declared inoperable, and operators prepared to ramp the unit down as required by Technical Specifications. Because of the uncertainty of actual rod position, and the concern for maintaining adequate shutdown margin, the unit operator was instructed to ramp down in power using only chemical shim. At one point in the shutdown, due to the difficulties inherent in using only boron to control reactivity, reactor power dropped below turbine power enough to cause coolant pressure to fall below the DNB operating limit defined in plant Technical Specifications.

The failed regulator was replaced with a new one; the old regulator was returned to the manufacturer and analyzed for the cause of the failure. This was determined to be a failed capacitor and zener diode.

A. CONDITION PRIOR TO EVENT

MODE 1 - Power Operation RX Power 99.0% RCS [AB] Temperature/ Pressure 559 °F/2235 psig

B. DESCRIPTION OF EVENT

On March 8, 1989, at approximately 0305 hours, Unit 1 operators received "ROD CONTROL BANK LOW" and "ROD CONTROL BANK LOW LOW" annunciator alarms. It was noticed that all Individual Rod Position Indicators (RPI's) [AA], on the control board, had dropped to an indication of about 220 steps. Computer point indication of RPI's had dropped to about 200 steps. Normal indication for RPI's, with all rods out, should have been 231 steps. Technical Staff, Instrument Maintenance, and Electrical Maintenance personnel were called to investigate.

Investigation of the power input to the RPI circuitry cabinet in the Auxiliary Electric room revealed that a reduced voltage of approximately 100 VAC was being received by the cabinet. The RPI system requires a power input of 118 VAC +/- 1%. Power is fed to the RPI system from the RPI inverter; output from this inverter was measured to be the normal output of 120 VAC. The RPI regulator, in series between the RPI inverter and the balance of the RPI system, located in the cable spreading room, was then checked, and found to be smoking heavily. The regulator was deenergized by opening the local circuit breaker near the regulator; this action also eliminated all power to Rod Position Indication.

At approximately 0500 hours, all RPI channels were declared inoperable and operators began ramping power down in preparation for going to the hot shutdown condition, as required by the plant Technical Specifications. Due to the uncertainty in rod position, and concern for maintaining adequate shutdown margin, the Shift Engineer directed the unit operator to decrease reactor power using chemical shim only. After referring to the Unit 1 Curve Book to determine the amount and rate of boration needed to follow the turbine ramp rate of 1% per minute, the operator initiated boration. As the turbine ramped down, the reactor power began to exceed turbine power, causing primary coolant temperature to rise. In order to further reduce reactor power, the operator injected boron directly into the reactor coolant system by using the Emergency Boration valve. At 0519 hours, reactor power decrease had overrun turbine power decrease, and Reactor Coolant System (RCS)[AB] pressure dropped to approximately 2200 pounds per square inch (psig), which is below the Technical Specification DNB parameter limit of 2205 psig. The operator increased the turbine ramp rate in order to match the turbine to reactor power. At 0523 hours, RCS pressure was returned to within Technical Specification limits. At 0649 hours the unit operator opened the reactor trip breakers to bring the unit to the hot shutdown condition. The RPI regulator was briefly reenergized to power the rod bottom lights to verify that all control rods had fully inserted.

On March 9, 1989, the RPI regulator, and an accompanying tuned harmonic filter, were replaced with a new regulator that contains an internal harmonic filter. Output of the new regulator was tested, and adjusted to 118 VAC. At 1144 hours, the RPI system was declared operable, and unit startup began. The calibration and proper operation of RPI's was checked as control rods were being withdrawn during the startup; all RPI's operated acceptably. At 1535 hours Unit 1 was brought critical, with all RPI channels in operation.

C. CAUSE OF EVENT

A root cause of this event was the failure of the RPI regulator. The RPI regulator provides the consistent "clean" power needed by the RPI system to ensure accurate rod position indication. The regulator failed in such a manner that it had a reduced voltage output, which caused RPI's to indicate a reduced value. All RPI's were declared inoperable due to their uncertain output. The reactor was shut down as required under plant Technical Specifications when more than two RPI channels in one bank are inoperable.

The RPI regulator was returned to the manufacturer, Sola Electric, on March 31, 1989. Investigation by Sola revealed that the regulator failed due to the failure of two components: a Zener diode and a capacitor located on the controlling circuit board. Sola was unable to determine the cause of failure of the two components.

The reduction in RCS pressure below the DNB parameter limit was caused by a mismatch between reactor power and turbine power. As reactor power fell below turbine power, more energy was drawn off of the reactor than was being produced. As energy was drawn off, RCS temperature and pressure began to drop. Reactor power was mismatched with turbine power because of the difficulties inherent in controlling the reactor with chemical shim only. With this method, reactor power is reduced by injecting negative reactivity, in the form of soluble boron, into the reactor coolant system. Because of the time needed for the boron to mix with the reactor coolant and reach a uniform concentration, the chemical shim method of reactivity control is not as accurate or as immediately responsive as the use of control rods.

D. SAFETY ANALYSIS OF EVENT

This event is reportable under 10CFR 50.73 (a)(2)(i) as a plant shutdown required by plant Technical Specifications.

No safety consequences resulted from this event. Actual control rod position was not changed as a result of the failure of the RPI regulator; all rods remained in the fully withdrawn position. All rods retained their ability to be tripped into the reactor core at all times. As an added precaution, in order to ensure that adequate shutdown margin was available at all times, operators ramped the reactor down to 50 percent power without using control rods, by adding boron to the reactor coolant system.

RCS pressure fell approximately five psi below the Technical Specification DNB parameter limit of 2205 psig for about four minutes. This is not a violation of Technical Specifications, however, as two hours are allowed in which to bring reactor operating parameters back within the DNB limit. The DNB parameters ensure that steady state operation of the reactor is kept within the limits of the initial conditions assumed by the Safety Analysis. The Safety Analysis initial conditions assume the worst case combination of the DNB parameters, that is, low RCS pressure in combination with high reactor power and high coolant average temperature. At the time that pressure fell below the DNB parameter limit, both Reactor power and coolant average temperature were at a reduced level (55% of full power and 549 degrees Fahrenheit, respectively). Pressure was restored to greater than 2205 psig within 4 minutes. The brief residence of only one of these parameters outside of the assumed envelope of values, particularly during a power change, does not constitute a safety concern.

At no time during this event was the limiting DNB Ratio (DNBR) of 1.3 approached. If the DNBR had been approached, then the reactor protective system would have safely tripped the reactor.

E. CORRECTIVE ACTIONS

The RPI regulator has been replaced, and tested for proper operation.

The old RPI regulator has been returned to the manufacturer for analysis to determine the cause of its failure. The results of this analysis are described above.

This event has been referred to the Zion Event Frequency Reduction Committee for review.

During the ramp down in power, operators effectively used the tools available to them to control reactor power, temperature, and pressure. When pressure fell below the DNB limit, operators returned it to an acceptable level in a timely fashion. Considering the inherently difficult nature of controlling the reactor without the use of control rods, and operators' demonstrated ability to accomplish that task, no further action is necessary in this matter.

F. PREVIOUS EVENTS

There have been no previous occurrences of an RPI regulator failure, or of all RPI's being declared inoperable, at Zion for either Unit 1 or Unit 2.

Three previous occurrences of Pressurizer (PZR) pressure below 2205 psig were found. Zion Deviation Report 2-86-45 documents an event where spiking on the PZR pressure loop caused PZR spray valves to open, resulting in pressure below 2205 psig for eight minutes. LER 304/86-024 describes an event where PZR pressure control inadvertently shifted to manual, resulting in pressure below 2205 psig for more than the 2 hours permitted by Technical Specifications. Zion Deviation Report 2-89-106 documents an event where RCS pressure fell to 2198 psig due to excessive delay in shutting down the Turbine Generator while performing a Reactor Shutdown. A review of these events showed them to have different root cause from the event documented in this report.

G. COMPONENT FAILURE DATA

MANUFACTURER	NOMENCLATURE	MODEL NUMBER	MFG. PART NUMBER
Sola Electric	Line Voltage Regulator	31-16-250	S/N: OK10