

# ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

## REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9112060191 DOC.DATE: 91/11/27 NOTARIZED: NO DOCKET #  
 FACIL:50-261 H.B. Robinson Plant, Unit 2, Carolina Power & Light C 05000261  
 AUTH.NAME AUTHOR AFFILIATION  
 BAUCOM,C.T. Carolina Power & Light Co.  
 CHAMBERS,R.H. Carolina Power & Light Co.  
 RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 91-009-01:on 910816, overtemp/delta temp channels  
 declared inoperable due to inconsistent values within  
 accident analyses.Caused by incomplete vendor-supplied  
 design basis.Temp summators modified.W/9112002 ltr.

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 TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

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INTERNAL:	ACNW		2	2		AEOD/DOA		1	1
	AEOD/DSP/TPAB		1	1		AEOD/ROAB/DSP		2	2
	NRR/DET/ECMB 9H		1	1		NRR/DET/EMEB 7E		1	1
	NRR/DLPQ/LHFB10		1	1		NRR/DLPQ/LPEB10		1	1
	NRR/DOEA/OEAB		1	1		NRR/DREP/PRPB11		2	2
	NRR/DST/SELB 8D		1	1		NRR/DST/SICB8H3		1	1
	NRR/DST/SPLB8D1		1	1		NRR/DST/SRXB 8E		1	1
	REG FILE 02		1	1		RES/DSIR/EIB		1	1
	RGN2 FILE 01		1	1					
EXTERNAL:	EG&G BRYCE,J.H		3	3		L ST LOBBY WARD		1	1
	NRC PDR		1	1		NSIC MURPHY,G.A		1	1
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Carolina Power & Light Company

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H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2  
DOCKET NO. 50-261  
LICENSE NO. DPR-23  
LICENSEE EVENT REPORT 91-009-01

Gentlemen:

The enclosed Supplemental Licensee Event Report (LER) is submitted in accordance with 10CFR50.73 and NUREG-1022 including Supplements No. 1 and 2. As committed in our original submittal of LER 91-009, this Supplement provides the results of investigative efforts and root cause analysis, and includes specific corrective actions intended to preclude recurrence.

Revised portions of this LER are indicated by a right-hand margin bar. This Supplement should replace existing copies of the original report dated September 16, 1991.

Very truly yours,

R. H. Chambers  
Plant General Manager  
H. B. Robinson S. E. Plant

CTB:sgk

Enclosure

cc: Mr. S. D. Ebnetter  
Mr. L. W. Garner  
INPO

9112060191 911127  
PIR ADDCK 05000261  
S PDR

NRC FORM 366  
(6-89)

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104

EXPIRES: 4/30/92

## LICENSEE EVENT REPORT (LER)

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (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.

FACILITY NAME (1)

H. B. ROBINSON STEAM ELECTRIC PLANT, UNIT NO. 2

DOCKET NUMBER (2)

0 5 0 0 0 2 6 1 1 OF 0 7

PAGE (3)

TITLE (4)

OVERTEMPERATURE DELTA TEMPERATURE CHANNELS INOPERABLE DUE TO SUMMATOR MODULE LAG CONSTANTS

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)					
0	8	1	6	9	1	9	1	1	0	5	0	0	0		
0	8	1	6	9	1	9	1	1	0	5	0	0	0		

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)

OPERATING MODE (9)	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
POWER LEVEL (10) 1 0 0 0	20.406(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
	20.406(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	OTHER (Specify in Abstract below and in Text, NRC Form 366A)
	20.406(a)(1)(iii)	X 50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
	20.406(a)(1)(iv)	X 50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	
	20.406(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME

C. T. BAUCOM - SENIOR SPECIALIST

TELEPHONE NUMBER

AREA CODE

8 0 3 3 8 3 - 1 2 5 3

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

CAUSE	SYSTEM	COMPONENT	MANUFAC- TURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFAC- TURER	REPORTABLE TO NPRDS

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)

In August of 1991, an on-going analysis and review was in progress regarding delay times and lag constants associated with Overtemperature Delta Temperature (OTAT) instrumentation and circuitry. The overall response time of reactor coolant system hot and cold leg temperature instrumentation and circuitry was revised by a 1988 modification. However, certain summator modules within this circuitry contained capacitors (lag circuits) that were not consistent with the values assumed within the accident analyses. The three OTAT channels were declared inoperable at 1200 hours on August 16, 1991 and Technical Specification 3.0 was entered. Since repairs could not be completed within eight hours as required by the Technical Specifications, a unit shutdown was initiated at 1345 hours, with the reactor being made subcritical at 1845 hours. The capacitors were removed and the OTAT channels were declared operable at 0630 hours on August 18, with the unit being placed on line at 1432 hours. An independent team of onsite and offsite personnel completed an investigation and root cause analysis of this occurrence. One of the root causes identified by the team was the failure of the vendor who developed and designed the 1988 modification to identify the removal of the lag circuits as a design basis requirement. A second identified root cause was the failure of internal reviews to identify the omission by the vendor. Certain corrective actions to prevent recurrence have already been implemented, and others will be in place by the due dates specified within the report.

NRC Form 364A  
(9-83)

## LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0164

EXPIRES: 8/31/86

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (8)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
H.B. ROBINSON, UNIT NO. 2	0 5 0 0 0 2 6 1	9 1	- 0 0 9	- 0 1	0 2	OF 0 7	

TEXT (If more space is required, use additional NRC Form 364A's) (17)

## I. Description of Event

In August of 1991, H. B. Robinson Unit No. 2 (HBR2) was operating at steady-state conditions with reactor power at 100%.<sup>1</sup> An on-going analysis and review was in progress regarding delay times and lag constants associated with Overtemperature Delta Temperature (OTAT) instrumentation and circuitry. During the course of this review, it was determined that certain summator modules within reactor coolant system (RCS) hot leg temperature instrumentation circuitry contained lag times that were not considered in the assumed channel response time, and were not consistent with values assumed within the accident analyses.

The overall system and channel response time was revised by a 1988 Refueling Outage modification that removed the RCS Resistance Temperature Detector (RTD) bypass manifold piping. This modification, MOD-959, "RCS Bypass RTDs", replaced direct-immersion RTDs with thermowell-mounted RTDs, and modified instrumentation and circuitry associated with the measurement and processing of RCS hot and cold leg temperatures. The modified system had a different response time from the previously installed system, which necessitated reanalysis of OTAT trip events. This reanalysis only considered the following delay times and lag constants:

1. Thermal lag representing both thermal transport through the thermowell and RTD response time. 4.0 seconds
2. Electronics delay representing electronic signal processing, trip breaker operation, and control rod drive gripper release. 0.75 seconds

RCS delta temperature ( $\Delta T$ ) and average temperature (TAVG) summator modules within the existing OTAT circuitry were not directly affected by MOD-959. These summator modules contained capacitors that were used as noise filters, which introduced a lag constant of up to 2 seconds into the channel response time. The presence of these capacitors was not recognized as an impact to MOD-959 or to the channel response time assumed within the OTAT trip event reanalysis.

Actual ramp test data, taken during Refueling Outage 13 and listed as follows, provides the measured lag times associated with each summator module:

RCS Loop A	TM-412J( $\Delta T$ )	1.05 seconds
	TM-412K(TAVG)	1.5 seconds
RCS Loop B	TM-422J( $\Delta T$ )	1.7 seconds
	TM-422K(TAVG)	1.59 seconds
RCS Loop C	TM-432J( $\Delta T$ )	1.8 seconds
	TM-432K(TAVG)	1.5 seconds

<sup>1</sup> H. B. Robinson Steam Electric Plant Unit No. 2 is a Westinghouse pressurized water reactor in commercial operation since March 1971.

NRC Form 366A  
(9-83)

## LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0164

EXPIRES: 8/31/86

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
H. B. ROBINSON, UNIT NO. 2	0 5 0 0 0 2 6 1 9 1	—	0 0 9	—	0 1	0 3	OF 0 7

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

These summator module lag times were not included in the assumed "electronic signal processing" time, and in all cases exceeded the total assumed "electronics delay" time of 0.75 seconds. Therefore, it could not be assured that the OTAT channels would operate as assumed within the accident analyses.

On this basis, all OTAT protection channels were declared inoperable at 1200 hours on August 16, 1991. Technical Specification 3.0 was entered due to the inability to comply with the Minimum Channels Operable (MCO) requirements provided by Technical Specification Table 3.5-2, Item 5. This condition was reported to NRC via the Emergency Notification System (ENS) at 1235 hours as an unanalyzed condition pursuant to 10CFR50.72(b)(1)(ii)(A). Due to the inability to complete repairs to the OTAT circuitry within the required time, a unit shutdown was initiated at 1345 hours. The initiation of the unit shutdown as required by the Technical Specifications was reported to NRC via the ENS at 1405 hours pursuant to 10CFR50.72(b)(1)(i)(A). At 1845 hours, the reactor was made subcritical and Technical Specification 3.0 was exited based on the unit being in Hot Shutdown as required by Technical Specification Table 3.5-2, Item 5.

## II. Cause of Event

In response to the identification of the summator module lag constants and the subsequent unit shutdown, an independent team was assembled to review this occurrence and perform a root cause analysis. This team included representatives from both onsite and offsite organizations, with a majority of the team members having been trained in the performance of root cause analysis. The team's investigative effort and root cause analysis were completed on October 30, 1991, with the associated investigation report documenting the root causes and secondary causal factors that contributed to this occurrence.<sup>2</sup> Two root causes were identified, along with several secondary causal factors, which are described in detail as follows:

### Root Causes

1. The primary responsibility for development and design of MOD-959 was assigned to the Nuclear Steam Supply System (NSSS) vendor under contract to Carolina Power and Light Company (CP&L). The vendor supplied the safety analysis and licensing report defining the design basis requirements, and also supplied the design, installation, and testing of the new system, including associated safety evaluations and independent review of design. During the course of their activities, however, the vendor failed to incorporate the design basis requirement for removal of the lag circuits into the design, installation and testing of the modification.

NRC Form 366A  
(9-83)

## LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-2104

EXPIRES: 8/31/86

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (8)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
H. B. ROBINSON, UNIT NO. 2	0 5 0 0 0 2 6 1 1	91	-0 0 9	-0 1	0 4	OF	0 7

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2. The omission of the design basis requirement for removal of the lag circuits was not identified by CP&L during review and installation of the modification package, or during the subsequent calibration and operation of the OTAT circuitry. Weakness in the technical overview of the OTAT design and associated setpoints is primarily attributed to the lack of an adequate technical basis for design information associated with the complex OTAT process electronics and associated setpoints. Instrument scaling calculations would have provided a correlation between the response time characteristics assumed in the design and safety analysis of the system, and the instrument setpoints provided in the plant calibration procedures. However, the vendor did not supply the OTAT instrument scaling calculations for the design. Further, CP&L did not establish a contractual requirement for the vendor to supply the technical basis for the OTAT electronics design.

Secondary Causal Factors

1. A weakness was identified in the coordination of technical information by the plant individual responsible for MOD-959. This is attributed to the individual's limited knowledge of the OTAT electronics design.
2. A weakness was identified in that a turnover of the Reactor Protection System (RPS) System Engineer occurred during the development and implementation of MOD-959. This discontinuity in assignment resulted in a lack of technical involvement by the plant system engineering group.
3. An indirect causal factor was associated with the development and review of MOD-959. Due to outage constraints, the development of MOD-959 was expedited, with some preliminary/planning reviews being waived by the CP&L design organization, and certain other reviews lacking sufficient depth to detect the omission of the design basis requirement.

## III. Analysis of Event

As stated above, actual OTAT channel response time may have exceeded the value assumed within the accident analyses by as much as 2 seconds. This condition had existed since unit startup from the 1988 Refueling Outage until the removal of the summator module capacitors in August of 1991. To address the safety significance of this condition, the response times and parameters associated with actual unit operation during this time were evaluated against the values assumed within the accident analyses.

The Updated Final Safety Analysis Report (UFSAR) Chapter 15 includes three event analyses which take credit for the OTAT trip function:

1. Loss of External Load.
2. Uncontrolled Control Rod Assembly Withdrawal at Full Power.
3. Full Length Rod Control Cluster Assembly (RCCA) Drop.

NRC Form 365A  
(9-83)

## LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104

EXPIRES: 8/31/86

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (8)			PAGE (3)	
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER		
H. B. ROBINSON, UNIT NO. 2	0 5 0 0 0 2 6 1	9 1	- 0 0 9	- 0 1	0 5	OF 0 7

TEXT (If more space is required, use additional NRC Form 365A's) (17)

The key criteria associated with the analyses of these events is maintaining the Departure from Nucleate Boiling Ratio (DNBR) greater than the required safety limit.

The nuclear fuel vendor for HBR2 performed a review of the actual plant configuration over the specified time interval against the values assumed within the analyses of the OTAT trip events listed above. The results of this review show that there was sufficient DNBR margin to support a 2.0 second delay in the system response time. This margin was achieved by using actual RCS flow rate values for Cycles 13 and 14, and the Technical Specification value or actual value of the Moderator Temperature Coefficient (MTC) for Cycles 13 and 14. No additional analyses are required. In summary, sufficient margin was available to compensate for the additional channel response time, such that the OTAT trip function would have performed as required to maintain DNBR within the safety limit.

This condition was reported to NRC via the ENS at 1235 hours on August 16, 1991, as an unanalyzed condition pursuant to 10CFR50.72(b)(1)(ii)(A). Due to the inability to complete repairs to the OTAT circuitry within the required time, a unit shutdown was initiated at 1345 hours. The unit shutdown as required by the Technical Specifications was reported to NRC via the ENS at 1405 hours pursuant to 10CFR50.72(b)(1)(i)(A). This Licensee Event Report is submitted pursuant to the requirements of 10CFR50.73(a)(2)(ii)(A) as an unanalyzed condition and 10CFR50.73(a)(2)(i)(A) due to the completion of a plant shutdown required by the plant's Technical Specifications.

#### IV. Corrective Actions

On August 16, 1991 at 1345 hours, a unit shutdown was initiated with the reactor being made subcritical at 1845 hours. While the unit was shutdown, a change to MOD-959 was prepared, approved, and implemented to remove the lag circuits (capacitors) from the affected summator modules. The modification to the temperature summators was implemented, and all three OTAT loops were declared operable at 0630 hours on August 18, 1991. Following completion of the modification to the summator modules, the reactor was made critical at 1152 hours on August 18, with the unit being placed on-line at 1432 hours. These actions constitute the immediate corrective actions taken in response to the identification of this condition.

The investigation and root cause analysis performed by the independent team identified certain corrective actions which are intended to prevent recurrence of a similar event or condition. The corrective actions are described as follows, with their associated due dates, and are organized to correlate with the Root Causes and Secondary Causal Factors provided within the "Cause of Event" above.

NRC Form 364A  
(9-83)

## LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMB NO. 3150-0104

EXPIRES: 8/31/88

FACILITY NAME (1)  H. B. ROBINSON, UNIT NO. 2	DOCKET NUMBER (2)  0 5 0 0 0 2 6 1	LER NUMBER (8)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
		9 1	- 0 0 9	- 0 1	0 6	OF	0 7

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Corrective Actions for Root Causes

1. Develop OTAT instrumentation scaling calculations. These calculations will be completed by March, 1992.
2. Appropriate plant personnel will be trained on the use of the OTAT scaling calculations. This document and the associated training will provide an additional source of technical knowledge relative to the OTAT feature. This training will be completed by June, 1992.
3. A modification design basis document will be required for modifications to the RPS. Further, design basis information supporting modifications will be compatible with the existing Design Basis Document for affected systems. This corrective action is already in place. In 1989, the Nuclear Engineering Department (NED) was designated as the Central Design Organization (CDO) and "Engineer of Record" responsible for control of plant design. The requirement for a technical basis of design for plant modifications is provided within NED Procedure 3.1, "Design Control Procedure."

Corrective Actions for Secondary Causal Factors

1. To address the issue of limited technical knowledge by the plant individual responsible for MOD-959, supervisory practices and management policy will reinforce the assignment of personnel to projects commensurate with their job function and job skill. This will be an on-going process and dialogue involving working level engineers and the appropriate level(s) of engineering management. These practices and policies, resulting from prior management initiatives directed at improvements to the engineering function, are periodically reinforced by policy statement, memorandum, or procedure change, as deemed appropriate.
2. Corrective actions are completed regarding the continuity of assignment of the RPS System Engineer. An individual has been assigned and is functioning as the RPS System Engineer.
3. Corrective actions are already in place to address the outage constraints and lack of depth associated with the technical reviews of MOD-959. The importance of complete, in-depth and rigorous technical reviews of procedures and modifications has been reemphasized to personnel who perform technical review activities. NED reviews are governed by NED Procedure 3.3, "Design Verification/Technical Review," which delineates the requirements for technical reviews and design verification of modifications. For plant Technical Support personnel, guidance regarding the requirements for technical, system/component, environmental qualification, and in-service inspection reviews is provided by Technical Support Guidelines TSG-200, TSG-202, TSG-204, and TSG-205.

NRC Form 364A  
10-831

## LICENSEE EVENT REPORT (LER) TEXT CONTINUATION

U.S. NUCLEAR REGULATORY COMMISSION

APPROVED OMS NO. 3150-3164

EXPIRES: 8/31/88

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)		
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER			
H. B. ROBINSON, UNIT NO. 2	0   5   0   0   0   2   6   1	9   1   -	0   0   9   -	0   1   0   7	OF	0   7	

TEXT (If more space is required, use additional NRC Form 364A's) (17)

## V. Additional Information

## A. Failed Component Identification

None.

## B. Previous Similar Events

The following Licensee Event Reports have been generally identified as previous similar events based on their relationship to either the OTAT instrumentation and circuitry, or to MOD-959. Although the causal/contributing factors associated with these events may be similar, there is no direct linkage between these previous events and the occurrence described within this LER.

1. Licensee Event Reports 88-002 and 88-002-01, dated February 19, 1988 and June 6, 1988, respectively, described the potential for unanalyzed reactor operation due to a nonconservative Overtemperature Delta Temperature trip setpoint.
2. Licensee Event Report 89-007, dated May 17, 1989, described inconsistencies in the reactor coolant system core differential temperature process parameters used as inputs to reactor protection circuitry. These inconsistencies introduced a degree of nonconservatism into the Overtemperature and Overpower Delta Temperature setpoints.