



UNITED STATES
 NUCLEAR REGULATORY COMMISSION
 REGION II
 101 MARIETTA STREET, N.W.
 ATLANTA, GEORGIA 30323

Report No.: 50-261/91-19

Licensee: Carolina Power and Light Company
 P. O. Box 1551
 Raleigh, NC 27602

Docket No.: 50-261

License No.: DPR-23

Facility Name: H. B. Robinson

Inspection Conducted: August 10 - September 6, 1991

Lead Inspector: *L. W. Garner* 9/29/91
 L. W. Garner, Senior Resident Inspector Date Signed

Other Inspector(s): K. R. Jury, Resident Inspector

Approved by: *H. O. Christensen* 9/20/91
 H. O. Christensen, Section Chief Date Signed
 Division of Reactor Projects

SUMMARY

Scope:

This routine, announced inspection was conducted in the areas of operational safety verification, surveillance observation, maintenance observation, and onsite review committee activities.

Results:

The unit was shut down on August 16, 1991, to correct concerns associated with excessive time delays in the reactor protection system (RPS) OT Delta-T circuitry. This excessive time delay placed the plant outside its analyzed RPS response times for certain protective plant trips (paragraph 2).

The reactor tripped on August 16 and 30, 1991. The August 16 trip was due to source range high flux level and occurred while the plant was in hot shutdown conditions. The August 30 trip occurred due to inadequate feedwater flow and low steam generator level, which resulted from a sheared condensate pump shaft (paragraph 2).

REPORT DETAILS

1. Persons Contacted

- *R. Barnett, Manager, Outages and Modifications
- *C. Baucom, Senior Specialist, Regulatory Compliance
 - D. Bauer, Regulatory Compliance Coordinator, Regulatory Compliance
 - J. Benjamin, Shift Outage Manager, Outages and Modifications
 - C. Bethea, Manager, Training
- *W. Biggs, Manager, Nuclear Engineering Department Site Unit
- *R. Chambers, Plant General Manager
- *T. Cleary, Manager - Balance of Plant Systems and Reactor Engineering, Technical Support
 - D. Crook, Senior Specialist, Regulatory Compliance
- *C. Dietz, Manager, Robinson Nuclear Project
- *D. Dixon, Manager, Control and Administration
 - W. Doorman, Acting Manager, Nuclear Assessment Department Site Unit
 - J. Eaddy, Manager, Environmental and Radiation Support
 - S. Farmer, Manager - Engineering Programs, Technical Support
 - R. Femal, Shift Supervisor, Operations
- *W. Gainey, Manager, Plant Support
 - B. Harward, Manager - Mechanical Systems, Technical Support
- *J. Kloosterman, Manager, Regulatory Compliance
 - D. Knight, Shift Supervisor, Operations
 - A. McCauley, Manager - Electrical Systems, Technical Support
 - R. Moore, Shift Supervisor, Operations
 - A. Padgett, Manager, Environmental and Radiation Control
- *M. Page, Manager, Technical Support
- *R. Reynolds, Nuclear Assessment Department
 - D. Seagle, Shift Supervisor, Operations
- *R. Smith, Manager, Maintenance
- *D. Stadler, Onsite Licensing Engineer, Nuclear Licensing
 - W. Stover, Shift Supervisor, Operations
 - G. Walters, Operating Event Follow-up Coordinator, Regulatory Compliance
 - D. Winters, Shift Supervisor, Operations

Other licensee employees contacted included technicians, operators, mechanics, security force members, and office personnel.

*Attended exit interview on September 9, 1991.

Acronyms and initialisms used throughout this report are listed in the last paragraph.

2. Operational Safety Verification (71707)

The inspectors evaluated licensee activities to confirm that the facility was being operated safely and in conformance with regulatory requirements. These activities were confirmed by direct observation, facility tours,

interviews and discussions with licensee personnel and management, verification of safety system status, and review of facility records.

To verify equipment operability and compliance with TS, the inspectors reviewed shift logs, Operation's records, data sheets, instrument traces, and records of equipment malfunctions. Through work observations and discussions with Operations staff members, the inspectors verified the staff was knowledgeable of plant conditions, responded properly to alarms, adhered to procedures and applicable administrative controls, cognizant of in-progress surveillance and maintenance activities, and aware of inoperable equipment status. The inspectors performed channel verifications and reviewed component status and safety-related parameters to verify conformance with TS. Access to the control room was controlled, proper control room staffing existed, and Operations personnel carried out their assigned duties in an effective manner. Control room demeanor and communications were appropriate.

Plant tours and perimeter walkdowns were conducted to verify equipment operability, assess the general condition of plant equipment, and to verify that radiological controls, fire protection controls, physical protection controls, and equipment tagging procedures were properly implemented.

Plant Shutdown Due To OT Delta-T Circuitry Time Delays

On August 16, 1991, while evaluating the accuracies of RTD response times, the licensee determined there were lag filters (capacitors) in the Delta-T and Tavg circuitry for all three RCS loops. These filters acted as noise suppression for the OT Delta-T and OP Delta-T protection circuitry and were installed as an optional RPS feature. The filters physically imparted an approximate two second "time constant" delay on the temperature signals after RTD response output. Upon recognition that this two second delay was inherent to the OT Delta-T and OP Delta-T circuitry, the licensee determined there was discrepancy between the RTD's "system response time" and that analyzed in the accident analyses. TS section 2.3.3 requires that the RCS narrow range temperature sensors response time shall be less than or equal to a 4.0 second lag time constant. The additional two second delay imposed by the lag filters increased the sensors response time to a value outside that required by TS. As a result, the licensee entered TS 3.0; the plant was subsequently shut down as required later that day. During the shutdown process, the reactor tripped (discussed below). After the shutdown, the licensee removed the capacitors per DCN-34 to modification M-959, RCS Bypass RTDs. The unit was returned to service on August 18, 1991, upon successful DCN implementation and surveillance testing which was performed by MST-003, Tavg and Delta-T Protection Channel Testing. The inspectors witnessed portions of the DCN's implementation, subsequent surveillance testing, and the plant start-up.

The issue of RTD response times had previously been of concern and was discussed in detail in LER 88-002 and inspection report 88-03. The 1988 problem related to the fact that a system response time of 2.3 seconds was used in the accident analyses versus the correct 4.75 second system response time. The licensee determined that the difference of 2.45 seconds had minimal safety impact on the analyses. During RO-12 (late 1988), the RTD bypass manifold piping was removed per M-959. A startup (interim) calibration of the temperature sensing instruments and process rack components was performed. However, these capacitors were not removed and the calibration performed did not detect their presence.

Modification M-959 installed direct immersion RTDs into thermowells in the RCS piping. As required by TS, the new RTDs' response times are required to be less than or equal to a 4.0 second lag time constant with a .75 second electromechanical delay (i.e., the time from bistable output to initiation of rods dropping). This new system response time was to be equal to the system response time for the previously installed bypass manifold RTD system. However, the 2.0 second "time constant" delay lag filters were not removed from the circuitry as intended by Westinghouse. As a result, the RTD system response time was approximately two seconds longer than that analyzed (approximately 6.75 seconds versus the analyzed 4.75 seconds). This condition existed from initial plant startup from RO 12 on February 25, 1989, until the capacitors' removal on August 17, 1991.

After identifying this concern, the licensee initiated ACR-286 to document the issue and to determine root cause(s). The licensee, recognizing the relationships of this issue to the early 1988 issue and other OT Delta-T and OP Delta-T issues (e.g., LER 89-007) and their root causes, established a team to investigate why these capacitors were not removed and to evaluate potential corollaries to the previous issues for corrective action. The inspectors reviewed extensive historical records including: the RTD Bypass Elimination Licensing Reports (WCAPs 11890 and 11889 with addendum), M-959, and associated correspondence to determine why these capacitors were not removed as intended.

Although the licensee had not completed their formalized evaluation/root cause analysis by the end of the report period, it appeared that several factors contributed to the failure to remove the capacitors. The first contributor was the fact that Westinghouse did not provide the licensee explicit direction, in FCN CPL0 40519, to remove the capacitors. While the FCN provides the "guidelines" for modification development, the licensee did not recognize the need for capacitor removal during modification development, review, implementation, or testing. The licensee developed and prepared the actual modification using the Westinghouse FCN. Another contributor appears to have been the failure to change the maintenance calibration sheets even though the PLS document changed the time delay constant imparted by the capacitor modules to zero. These modules are calibrated each RO with the associated time delays being measured. As such, the Maintenance department was aware of the capacitors presence.

The team assigned to determine root cause(s) and the relationship to previous events is scheduled to complete the review/evaluation during September. The fuel vendor (Siemens) is performing an analysis/evaluation of the issue's historical safety significance. This evaluation is scheduled for completion in mid-September. Pending the results of the team's investigation and the fuel vendor's evaluation, this item is considered to be an URI: Determine Safety Significance and Root Cause(s) of OT Delta-T and OP Delta-T Protection Circuitry Excess Time Delay, 91-19-01.

August 16, 1991, Reactor Trip

On August 16, 1991, the Unit experienced a reactor trip. This trip occurred during performance of GP-006, Section 5.3, Reactor Shutdown to Subcritical Conditions. As discussed above, the plant was being shut down to resolve concerns with time delays associated with OT Delta-T RPS circuitry. The reactor tripped due to SR high flux level when the operators attempted to reenergize the SR detectors (N-31 and N-32) during the shutdown process. All rods had been inserted with the exception of shutdown bank "A" and the operator was attempting to clear the "Power above P-6" annunciator based upon the reading of the IR detectors (N-35 and N-36). IR detectors N-35 and N-36 were indicating $4.0E-11$ amperes and $1.1E-10$ amperes, respectively. At the time of the trip, the reactor had been subcritical for over an hour and it appeared the IR detectors were "hanging up", thus preventing reenergization of the SR detectors. Operating Procedure, OP-002, Nuclear Instrumentation System, Section 4.5, cautions to not operate "Permissive P-6 Defeat" push buttons when either intermediate range level meter is indicating greater than $4.0E-10$ amperes as this could cause an undesirable reactor trip. Since the IR detectors were both indicating less than the value identified in the procedure and the reactor had been subcritical for some time, the "Permissive P-6 Defeat" push buttons were manipulated. The reactor subsequently (and unexpectedly to the operators) tripped as N-31 was indicating $1.1E+5$ cps, which is above the SR high flux level trip of $1.0E+5$ cps.

Path 1 was entered which led into EPP-4; three control bank control rods indicated as not being on the core bottom prior to the trip and due to the high flux, boration was initiated for the worth of rod K-2 which indicated 60 inches out. The trip was reported as required. The problems with the control rods not indicating as being on core bottom was determined to be an indication problem only. IRPI K-2 was found to have a faulty signal conditioning module and IRPIs L-9 and F-14 had apparently drifted. After replacement of rod K-2's signal conditioning module and adjustment to the IRPIs which drifted, the rods were successfully tested and returned to service per OST-011, Rod Cluster Control Exercise and Rod Position Indication.

The licensee initiated ACR 91-285 to determine the root cause of the event. It appears several factors contributed to the trip. The first is that both the SR and IR detectors were replaced during RO 13. These detector channels were calibrated using the first fuel assembly loaded (a

twice burned assembly with a depleted neutron source). This assembly was the only active neutron source available at the time. The relative neutron-gamma flux at the detectors when calibrated differed enough from those present on August 16, such that the SR discriminator setting had been set too low. This lower discriminating setting could have allowed an excessive number of gamma induced pulses to be counted by the SR channels, resulting in an artificially high indicated count rate.

Additionally, two new neutron sources containing eight source rodlets were installed (versus one four rodlet source previously installed) during RO 13. The eight rodlet sources represented a significant increase in available source strength especially considering the 158 day continuous plant operation which would have helped the source approach their equilibrium strength. As this was the first shutdown since source installation, this phenomenon (i.e., increased source strength) was not detected and could not be trended prior to the shutdown. Corrective actions performed prior to plant restart included: (1) the SR channels were recalibrated using the shutdown core as the source, which resulted in significant increases in discriminator levels; (2) the compensating voltages were readjusted for both IR channels; and (3) the SR and IR detectors were retracted approximately two feet from the reactor vessel per SP-1029, Nuclear Instrumentation Detector Adjustments, to reduce detector outputs by a factor of approximately two. These corrective actions should prevent the situation from occurring during future plant shutdowns. The inspectors will monitor ACR root cause determination and corrective actions as part of routine ACR reviews.

August 30, 1991, Reactor Trip

The August 30, 1991 trip resulted when the B condensate pump shaft sheared while the unit was at 100 percent power. Following the loss of the pump at 6:57 a.m., the plant experienced inadequate feedwater flow and implemented the immediate actions of AOP-10, Inadequate Feedwater Flow. At approximately 7:00 a.m., a reactor trip occurred due to steam generator low level coincident with steam flow/feed flow mismatch. The operators performed immediate actions and entered Path 1; after exiting Path 1, the plant was stabilized upon completion of EPP-4, at 7:11 a.m..

The plant was returned to approximately 60 percent power on August 31, while diagnostics/potential corrective actions were being evaluated. The shaft apparently sheared due to fatigue failure with several failure initiation sites. The unit remained at approximately 60 percent power through the remainder of the report period. The unit was to be returned to rated power pending anticipated pump reinstallation the week of September 7, 1991.

No violations or deviations were identified.

3. Monthly Surveillance Observation (61726)

The inspectors observed certain safety-related surveillance activities on systems and components to ascertain that these activities were conducted in accordance with license requirements. For the surveillance test procedures listed below, the inspectors determined that precautions and LCOs were adhered to, the required administrative approvals and tagouts were obtained prior to test initiation, testing was accomplished by qualified personnel in accordance with an approved test procedure, test instrumentation was properly calibrated, the tests were completed at the required frequency, and that the tests conformed to TS requirements. Upon test completion, the inspectors verified the recorded test data was complete, accurate, and met TS requirements; any test discrepancies were properly documented and rectified; and that the systems were properly returned to service. Specifically, the inspectors witnessed/reviewed portions of the following test activities:

OST-051	Reactor Coolant System Leakage Evaluation (Daily)
OST-908	Component Cooling System Component Test (Quarterly)
OST-924	Radiation Monitoring System (Quarterly)
MST-003	Tavg and Delta-T Protection Channel Testing (Bi-Weekly)
SP-1029	Nuclear Instrumentation Detector Adjustments

No violations or deviations were identified.

4. Monthly Maintenance Observation (62703)

The inspectors observed safety-related maintenance activities on systems and components to ascertain that these activities were conducted in accordance with TS, approved procedures, and appropriate industry codes and standards. The inspectors determined that these activities did not violate LCOs and that required redundant components were operable. The inspectors verified that required administrative, material, testing, radiological, and fire prevention controls were adhered to. In particular, the inspectors observed/reviewed the following maintenance activities:

WR/JO 91-ALRX1	Implement DCN Which Removes Time Delay Capacitors From TM-412/422/432 J and K Summaters
WR/JO 91-AIJQ1	Disassembly, Removal And Repair of Valve V2-16C, AFW Header to SG C

WO/JO 91-AIJQ3

Electrical Disconnection and Reconnection of
V2-16C Limitorque Operator

CM-103

Pressure Seal Valves Seal Section
Maintenance

No violations or deviations were identified.

5. Onsite Review Committee (40500)

The inspectors evaluated certain activities of the PNSC to determine whether the onsite review functions were conducted in accordance with TS and other regulatory requirements. In particular, the inspectors attended the September 6, 1991, PNSC which evaluated the potential safety impact of condensate pump repair/reinstallation activities. It was determined that provisions of the TS dealing with membership, review process, frequency, and qualifications were satisfied.

No violations or deviations were identified.

6. Exit Interview (30703)

The inspection scope and findings were summarized on September 9, 1991, with those persons indicated in paragraph 1. The inspectors described the areas inspected and discussed in detail the inspection findings listed below and in the summary. Dissenting comments were not received from the licensee. Although proprietary material was reviewed during the inspection, proprietary information is not contained in this report.

Item Number

Description/Reference Paragraph

91-17-01

URI - Determine Safety Significance And
Root Cause(s) of OT Delta-T and OP
Delta T Protection Circuitry Excess
Time Delay

7. List of Acronyms and Initialisms

a.m.	Ante Meridiem
ACR	Adverse Condition Report
AFW	Auxiliary Feedwater
AOP	Abnormal Operating Procedure
CM	Corrective Maintenance
CPS	Counts Per Minute
CST	Condensate Storage Tank
DCN	Design Change Notice
e.g.	For Example
EPP	End Path Procedures
FCN	Field Change Notice
FW	Feedwater

GP	General Procedure
i.e.	That is
IR	Intermediate Range
IRPI	Individual Rod Position Indication
LCO	Limiting Condition for Operation
LER	Licensee Event Report
MST	Maintenance Surveillance Test
OP	Operations Procedure
OST	Operations Surveillance Test
OT Delta-T	Overtemperature Delta Temperature
PLS	Precautions Limitations and Setpoints
PNSC	Plant Nuclear Safety Committee
RCS	Reactor Coolant System
RDT	Resistance Temperature Detector
RO	Refueling Outage
SG	Steam Generator
SP	Special Procedure
SR	Source Range
SRO	Senior Reactor Operator
Tavg	Temperature Average
TM	Temporary Modification
TS	Technical Specification
URI	Unresolved Item
WCAP	Westinghouse Corporate Atomic Power
W/R	Work Request
WR/JO	Work Request/Job Order