UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
101 MARIETTA STREET, N.W., SUITE 2900
ATLANTA, GEORGIA 30323-0199

Report Nos.: 50-413/95-20 and 50-414/95-20

Licensee: Duke Power Company
422 South Church Street
Charlotte, NC 28242

Docket Nos.: 50-413 and 50-414 License Nos.: NPF-35 NPF-52

Facility Name: Catawba Nuclear Station Units 1 and 2

Inspection Conducted: September 3, 1995 - October 7, 1995

Inspectors: _____ 11/2/95
R. J. Freudenberger, Senior Resident Inspector Date Signed

P. A. Balmain, Resident Inspector
R. L. Watkins, Resident Inspector

Approved by: _____ 11/3/95
R. W. Crlenjak, Chief Date Signed
Projects Branch 1
Division of Reactor Projects

SUMMARY

Scope: This resident inspection was conducted in the areas of plant operations, maintenance, engineering and plant support. As part of this effort, backshift inspections were conducted.

Results: In the plant operations area, licensee management effectively assessed several recent events involving continuing human errors and provided timely feedback to the plant staff of cases where expectations were not met (paragraph 3.a).

In the maintenance area, Violation 413,414/95-20-01 was cited because the licensee failed to incorporate vendor recommendations into an emergency diesel generator turbocharger maintenance procedure, resulting in the failure of three of four turbocharger mounting bolts on the 2B diesel generator. The procedure inadequacy introduced a potential common mode failure into the remaining station emergency diesel generators (paragraph 4.c). A maintenance crew identified an error in a modification package that would have resulted in the closure of a Main Feedwater Isolation Valve and subsequent plant trip (paragraph 4.b). The operability evaluation of gas entrainment in the residual heat removal system identified during inservice testing was appropriate (paragraph 4.e).

Enclosure 2

In the engineering area, a more thorough initial engineering evaluation may have prevented the use of an inappropriate heat shrink material in a splicing application for the emergency diesel generators (paragraph 4.a). Non-cited Violation 413,414/95-20-02 was identified because instrumentation affected by a service water strainer modification was not restored to its correct alignment before the system was returned to service (paragraph 5).

In the plant support area, a Semi-Annual Emergency Organization Drill and critique were effective in identifying areas for improvement (paragraph 6.a). Response to a positive random fitness for duty screening test was appropriate (paragraph 6.b).

REPORT DETAILS

1. **PERSONS CONTACTED**

Licensee Employees

B. Addis, Training Manager
S. Coy, Radiation Protection Manager
J. Forbes, Engineering Manager
W. Funderburk, Work Control Superintendent
T. Harrall, IAE Superintendent
D. Kimball, Safety Review Group Manager
W. McCollum, Catawba Site Vice-President
A. Bhatnagar, Operations Superintendent
* K. Nicholson, Compliance Specialist
M. Patrick, Safety Assurance Manager
* G. Peterson, Station Manager
R. Propst, Chemistry Manager
D. Rogers, Mechanical Superintendent
Z. Taylor, Regulatory Compliance Manager
* D. Tower, Regulatory Compliance Engineer

* Attended exit interview.

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

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

2. **PLANT STATUS**

a. Unit 1 Summary

Unit 1 operated at or near full power for the report period.

b. Unit 2 Summary

Unit 2 operated at or near full power until October 6, when the licensee initiated a power decrease for the EOC7 refueling outage. The unit entered mode 5 (cold shutdown) on October 7.

c. Inspections and Activities of Interest

On October 4, an NRC/licensee management meeting was conducted on site. The Regional Administrator and the Deputy Division Director for the Division of Reactor Projects, Region II, attended the meeting to discuss the licensee's human performance improvement initiatives.

3. **PLANT OPERATIONS** (NRC Inspection Procedures 40500, 71707 and 92901)

Throughout the inspection period, control room observations and facility tours were conducted to observe operations activities in progress. During these inspections, discussions were held with operators, supervisors, and plant management. Some operations activity observations were conducted during backshifts. Licensee meetings were attended by the inspector to observe planning and management activities. The inspections evaluated whether the facility was being operated safely and in conformance with license and regulatory requirements. In addition, the inspection assessed the effectiveness of licensee controls and self-assessment programs in achieving continued safe operation of the facility.

a. Site-Wide Communication on Human Performance Issues

On September 19, the licensee conducted a site-wide communication to discuss several recent station events which indicated a continued lack of consistent use of the six tools for Flawless Human Performance. The six tools for Flawless Human Performance were developed by licensee management to reinforce existing techniques and communicate newly identified methods which, when used collectively, could minimize the occurrence of human errors. A previous violation documented in NRC Inspection Report 50-413,414/95-12 included four examples of human errors which resulted in non-compliance with NRC regulations. The six tools for Flawless Human Performance were implemented shortly after the occurrence of these errors.

The purpose of the site-wide communication was to reinforce that the use of the six tools for Flawless Human Performance was no less important than the use of any other tool used on the site and they were expected to be used on every job. Examples were provided which occurred between August 23 and September 16, 1995. The examples included several events where using the tools could have prevented problems from occurring and one example (described in paragraph 4.b, below) in which use of one of the tools prevented a plant transient and potential unit trip.

The inspector reviewed the communication package and attended a communication session with a shift operating crew. The inspector noted that the examples discussed were of minimal safety significance compared to previous events and included events from the operations, maintenance and engineering areas, some of which were addressed individually in NRC Inspection Report 50-413,414/95-19, this report, or LER 50-413/95-04. The inspector concluded that licensee management effectively assessed the events and provided timely feedback of cases where expectations were not met.

b. (Closed) VIO 50-413/90-05-01: Inoperability of the 1B Containment Air Return Fan due to its power lockout breaker being open for an indeterminate amount of time (EA-90-15).

This issue involved the mispositioning of a breaker associated with tne 1B Containment Air Return Fan for an indeterminate period of time in late 1989 and January 1990. The corrective actions to avoid similar events were reviewed by the NRC in June 1991 and the LER associated with the issue was documented as closed in NRC Inspection Report 50-413,414/91-15. Although the violation and the license's response to the violation were referenced in the report, closure of the violation was not documented. Based on the review documented in the above reference, the violation is closed.

c. (Closed) VIO 50-413/90-17-01: Failure to Follow Procedure which caused an inadvertent transfer of reactor coolant to the Fueling Water Storage Tank (EA 90-118).

This issue involved an operator error which resulted in the improper sequencing of valve manipulations during the performance of a surveillance test. A flow path from the reactor coolant system to the Fueling Water Storage Tank was created which resulted in the inadvertent transfer of approximately 5000 gallons of reactor coolant inventory to the tank in a short time period. This event occurred in June of 1990. The corrective actions to avoid similar events were reviewed by the NRC in October 1991 and the LER associated with the issue was documented as closed in NRC Inspection Report 50-413,414/91-23. Although the review to close the LER was sufficient to also close the violation, closure of the violation was not documented. Based on the review documented in the above reference, the violation is closed.

4. **MAINTENANCE** (NRC Inspection Procedures 62703, 61726 and 92902)

Throughout the inspection period, maintenance and surveillance testing activities were observed and reviewed. During these inspections, discussions were held with operators, maintenance technicians, supervisors, engineers and plant management. Some maintenance and surveillance observations were conducted during backshifts. The inspections evaluated whether maintenance and surveillance testing activities were conducted in a manner which resulted in reliable, safe operation of the facility, and in conformance with license and regulatory requirements.

The following items were reviewed in detail:

a. Failed splice resulted in Diesel Generator Invalid Failure

On August 15, 1995, an invalid failure of the 1A DG was incurred because a main bearing high temperature trip signal was generated.

A failed splice in the RTD circuitry caused the trip signal. The high main bearing temperature trip would have been bypassed if an emergency start signal had initially actuated the DG. Therefore, the failure of this splice would not have prevented the DG from performing its safety function.

The licensee determined that the splice had been made on October 21, 1994, when the RTD had been replaced because it had failed high during an engine run. A FIP team, initiated to investigate the recent bearing temperature alarm, speculated that a bad splice from previous installation might have caused the indication. An IAE crew opened the DG and found that the Raychem heat shrink, which covered three butt splices to insulate and protect the internal crimps from the harsh lube oil environment, had softened and expanded on the wire. The degraded heat shrink material allowed lube oil to migrate to the splice location and loosen electrical tape that had been applied to each of the splices. When the technicians removed the tape from the splices, they found that the butt splice for one of the wires had a broken wire on one side.

The inspector questioned the licensee about the appropriateness of the heat shrink material, polyolefin, in oil environments. A General Office Engineering evaluation of the material indicated that polyolefin was good for oil environments. However, an alternative heat shrink material was described in the literature as excellent in oil. The vendor was not contacted for guidance during the engineering evaluation; however, the licensee notified the vendor that the polyolefin material had degraded in the hot, synthetic oil.

The licensee removed spliced cables associated with bearing temperature alarms on two other DG crankcases to avoid similar occurrences. They distributed a communication sheet to all electrical maintenance technicians to apprise them of the problem of using heat shrink in an oil environment. They plan to incorporate a change to IP/O/A/3890/08C, Controlling Procedure for Wire Termination and Splicing, to ensure that heat shrink is not used in oil applications in the future. The procedure change should be effective by February 1996. Because a broken splice contributed to the RTD failure, the licensee also evaluated the splicing procedure to determine if guidance is effective in ensuring that appropriate connectors, as well as crimping tools and techniques, are used in splicing applications. The inspector considered these corrective actions to be adequate; nevertheless, a more thorough initial engineering evaluation involving the vendor could have assisted the licensee in selecting the best material for the DG crankcase environment.

b. Main Feedwater Isolation Valve Control Circuitry Modification

On September 15, 1995, the licensee identified a defective digital optical isolator (DOI J143) in the control circuit of Main Feedwater Isolation Valve 1CF-033. Engineering initiated Corrective Minor Modification CE-7290 to replace the component with an upgraded model. No existing procedure provided steps to isolate the DOI for replacement, therefore engineering was to provide an electrical isolation sheet in the modification package.

The modification was scheduled to be implemented on September 16, 1995. The maintenance crew reviewed the package in preparation for the work and found that the isolation prescribed in the electrical isolation sheet would have caused the Main Feedwater Isolation Valve to close and potentially cause a unit trip.

The inspector reviewed the PIP which documented the occurrence, discussed the issue with licensee personnel involved, and assessed the licensee's investigation of the issue.

The licensee identified two instances of inappropriate work practices on the part of the originator and the modification package checker as the primary root cause. In the first instance, the originator had misread the circuitry diagram associated with the DOI. In the second instance, the checker developed the electrical isolation sheet in conjunction with the originator, thereby compromising the independence and objectivity of the package review.

These human errors were examples of human performance issues addressed in a site-wide communication described in section 3.a of this report. The inspector concluded that proper implementation of independent verification (one of the 6 tools of the licensee's Flawless Human Performance program) may have prevented the error in the electrical isolation sheet. The inspector also noted that a questioning attitude demonstrated by the maintenance crew (one of the other tools of Flawless Human Performance) prevented a potential unit trip.

c. Failure of Emergency Diesel Generator Turbocharger Mounting Bolts

On September 19, during a routine 2B DG surveillance test, licensee engineering personnel monitoring the test identified a broken mounting bolt beneath the right bank turbocharger. The licensee's subsequent inspection found that a total of 3 out of 4 mounting bolts on this turbocharger were sheared or missing. The fourth bolt was observed to be intact and tightened. A visual inspection of the turbocharger installations on the station's remaining DGs found that their respective mounting bolts were intact. The inspector subsequently reviewed the results of the

licensee's investigation and immediate actions taken to resolve the bolting failures.

Metallurgical examination of the failed bolts by an off site laboratory determined that the cause of the failure was due to vibration induced fatigue cracking that resulted from loosening of the bolts. The licensee's failure investigation team determined that lockwashers were not installed in the turbocharger mounting bolt arrangement as specified on the vendor drawing for the turbocharger mounting brackets (drawing CNM 2301.00-023-001). By keeping the mounting bolts in tension at all times, the lockwashers would have prevented looseness from developing from such causes as improper shim engagement or thermal expansion and contraction during operation. The licensee inspected the turbocharger mounting bolt installations on all the DGs and found that none of the turbocharger mounting bolts had lockwashers installed. In addition to the lack of lockwashers, the inspections identified that several of the DG turbocharger mounting bolt arrangements incorporated washer plates that were not specified on the vendor drawing to compensate for elongated mounting bracket holes.

The inspector reviewed the licensee's revisions to procedure MP/O/A/7400/42, Turbocharger Removal and Replacement, and verified that requirements to install lockwashers per vendor drawing requirements had been incorporated. The procedure also incorporated requirements to provide for the installation of washer plates and longer mounting bolts on turbocharger mounting brackets that have elongated holes. Through review of Corrective Minor Modification CNCE-7308, the inspector verified that the washer plate configuration with a longer mounting bolt option was acceptable and that the vendor drawings were revised to include this additional mounting bolt arrangement. The licensee also obtained a DG consultant to observe the installation of the turbochargers and review the installation procedure.

Based on this review the inspector determined that the incomplete DG turbocharger mounting bolt arrangement resulted from the licensee's failure to include vendor information into procedure MP/O/A/7400/42. Consequently, this introduced a potential common mode failure into the Unit 1 and 2 DGs. This is considered a violation of TS 6.8.1 for failing to establish provisions to install and maintain lockwashers in the DG mounting bolt arrangement. Accordingly, it is identified as Violation 50-413,414/95-20-01: Inadequate Incorporation of Vendor Information Into Diesel Generator Maintenance Instructions.

d. Service Water Pump Discharge Valve Failure to Open

On September 26, during an attempted start of the 1A Service Water pump for normal equipment rotation, the pump discharge valve (1RN-28A) failed to open following the pump start. The pump was secured, declared inoperable, and investigation of the failure was initiated using the licensee's Failure Investigation Process.

Troubleshooting identified a failed relay in the circuit which provides an open signal to the valve when the pump breaker is closed. The failed relay was manufactured by Struthers Dunn (Model 219BBXP). Visual inspection of the relay revealed water intrusion and severe corrosion. Evaluation of the valve failure to open was documented in PIP C95-1557. Evaluation of the generic implications of the relay failure was documented in PIP C95-1589.

The inspector discussed the issue with FIP team members, observed the affected relays, and reviewed the associated PIPs. The inspector concluded that timely and appropriate actions were taken by the licensee to identify the cause of the failure and evaluate and resolve the potential generic implications raised by the failure.

e. Gas Entrainment In RHR Heat Exchangers

During this inspection period, while performing inservice testing and operator rounds, the licensee identified several abnormal indications associated with the Unit 2 RHR and Containment Spray systems which were attributed to the effects of gas entrainment in the Unit 2 RHR heat exchangers. These indications included a higher than normal 2A Containment Spray pump suction pressure during standby conditions and unexpected pressurization of the RHR pump suction piping during inservice testing. The inspector reviewed the licensee's evaluations of these conditions to determine if there was a potential impact on the operability of the RHR system.

The licensee's evaluation determined that the pressurization of the RHR systems was due to compression of a small gas void in the top of the RHR heat exchanger tube bundles that allowed the introduction of a volume of water from the fueling water storage tank equivalent to the gas volume that was compressed. The licensee estimated this volume as approximately 5 gallons. Since the RHR pump operates in recirculation mode during the inservice test, the additional volume of water acts to increase the pressure indicated by the pump suction pressure test gauges. As the test progressed, heat added to the recirculated water by the operating pump also served to increase the RHR pump suction pressure further. The licensee determined that the pressure increase observed on the containment spray system was due to a small water

leak through a valve in a portion of suction piping which is shared by the two systems.

The inspector reviewed the licensees's operability evaluation (PIP 2-C95-1492) and observed that the recent test acceptance criteria revisions decreased the allowable measured flow range. Installed process instrumentation was not accurate enough to measure repeatedly in this tighter band and resulted in recent abnormal test results which prompted the licensee's investigation of this issue. Subsequent inservice tests of the RHR pumps performed using test instrumentation with a greater accuracy achieved repeatable results. The inspector also observed that the emergency core cooling function of the RHR system was determined to be unaffected by the presence of a small gas volume since the gas would not impair injection capability during design basis accident conditions. The licensee is evaluating long-term corrective actions to eliminate future gas entrainment in the RHR heat exchangers, including the development of a RHR system vacuum fill method. Based on this review the inspector determined that the licensee's operability evaluation and planned long-term corrective actions were appropriate.

f. (Closed) IFI 50-413,414/93-26-04: Controls for Amount of Leak Sealing Material Injected

This issue involved the use of a 2:1 compression ratio factor when calculating the amount of leak sealant material to be injected for a given leak repair activity. The compression ratio was applied universally to all leak repair activities. Based on the differences in viscosity of the variety of sealant materials used and diverse applications under which leak sealant repairs may be conducted, the inspector determined that the use of the compression ratio factor in all applications may not be conservative in limiting the possibility that sealant might be extruded into a system. This issue was previously reviewed and documented in NRC Inspection Report 50-413,414/95-19 as an open item pending further review of the basis for the 2:1 compression ratio factor.

In order to address this issue, the licensee re-evaluated the use of the 2:1 compression ratio factor. The licensee determined that the wording of procedure MP/O/A/7650/063, On-Line Leak Repair Corrective Maintenance, incorrectly implied that the factor was based on sealant material compressibility alone. The maximum volume to be injected is influenced by several factors which are evaluated as part of the engineering evaluation of specific leak repair applications. Therefore, a procedure change was initiated to delete the 2:1 compression ratio factor and document the basis for the maximum volume specified on a case by case basis. This item is considered closed.

5. **ENGINEERING** (NRC Inspection Procedures 37551 and 92903)

Throughout the inspection period, the inspectors reviewed engineering evaluations, root cause determinations, and modifications. During these inspections, discussions were held with operators, engineers, and plant management. The inspection evaluated the effectiveness of licensee controls in identifying and appropriately documenting problems, as well as implementing corrective actions.

Service Water Instrumentation Alignment Following Modification

During the past year, Nuclear Station Modification CN-50443 has been performed on the piping associated with the station's Service Water pump strainers to replace corroded backflush piping with stainless steel piping. The strainers are provided (one per pump) to remove debris and large particles from the nuclear service water. An automatic backflush initiates on high strainer differential pressure, as well as on a set time frequency (every eight hours), to prevent or correct clogging. On September 18, 1995, a modification (included in NSM CN-50443) was performed on the 2B Service Water pump strainer. This modification involved replacing the pressure instrument root valves and associated tubing for strainer differential pressure.

While reviewing a PIP associated with the modification, operations personnel questioned the position of the instrument root valves. Concerned that they may not have been opened before the Service Water system was returned to service, the valves were checked and found in the closed position. Because the same modification had already been performed on the 1A and 2A strainers, the position of the corresponding valves were checked and found closed as well. Because these root valves had been closed, the strainer's high differential pressure switch for automatic backflush had not been functional. All root valves were immediately opened.

The Design Basis Documentation indicates that safety-grade instrumentation is required to initiate strainer backflush cycle on high differential pressure to prevent the strainers from clogging and restricting Service Water flow. Backflush can also be initiated manually; however, the pressure transmitters that had been valved out provide input to the Service Water strainer high differential pressure annunciator in the control room as well as to the automatic control circuitry for the backflush function. Local indication of strainer differential pressure remained available. The licensee evaluated the potential strainer degradation from the loss of the automatic backflush on high differential pressure function. Since the timed backwash function was available, pond and lake conditions have not induced significant strainer clogging in the past two years, and system flow balance testing performed during the time period in question met acceptance criteria, the isolation of the differential pressure instruments had not resulted in an inoperable Service Water system.

The licensee identified an inadequate Modification Test Plan (MTP) as the primary root cause. The MTP did not require a post-modification functional verification of the instrument loop. The valves would have been opened for the leak test to have been performed, and therefore would have been open when the system was returned to service. The licensee relies upon post-modification functional testing to ensure that system alignment is correct before the system is returned to service. A contributing root cause was an assumption made by the IAE craft that Operations would align the valves before returning the equipment to service, although this responsibility was not assigned to Operations. The corrective actions include a review of MTP guidelines to ensure that expectations for returning equipment to service are clear. In addition, the licensee plans to address responsibilities for ensuring that instruments are aligned and functioning after modification work is complete. The inspector considered these corrective actions to be appropriate to the specific root cause identified.

The inspector reviewed the circumstances of a similar issue documented in NRC Inspection Report 50-413,414/95-07 and determined that the root cause was not the same. Therefore, the corrective actions for that issue would not have been expected to have prevented this occurrence. This licensee-identified and corrected violation is being treated as a Non-Cited Violation, consistent with Section VII of the NRC Enforcement Policy. This item is identified as Non-cited Violation 50-413,414/95-20-02: Service Water Strainer Instrumentation not Properly Aligned Following Modification.

6. **PLANT SUPPORT** (NRC Inspection Procedures 71750 and 92904)

Throughout the inspection period, facility tours were conducted to observe activities in progress. Some tours were conducted during backshifts. The tours included entries into the protected areas and the radiologically controlled areas of the plant, including emergency response facilities. Observations included assessments of radiological postings and work practices. During these inspections, discussions were held with radiation protection and security personnel. The inspections evaluated the effectiveness of the programs to assess whether activities were performed safely and in conformance with license and regulatory requirements.

The following items were assessed.

a. Emergency Organization Drill

On September 6, a Semi-Annual Emergency Organization Drill was conducted. The inspector participated in the drill, attended the post drill critique, and reviewed PIP C95-1526, which documented observations from the critique for action item tracking and trending. The inspector noted that the drill and critique process were effective in identifying areas for improvement.

b. Fitness For Duty - Confirmed Positive Random Screen

On September 12, a licensee employee tested positive for alcohol in a random screening test. The individual was a licensed reactor operator, currently an instructor in the operator training program. Previously the individual had been a shift supervisor.

The licensee terminated the individual's protected area access, reviewed all work performed by the individual on the day of the screen, appropriately reported the event, and initiated an assessment in accordance with the employee assistance program.

## 7. EXIT INTERVIEW

The inspection scope and findings were summarized on October 11, 1995, with those persons indicated in paragraph 1. The inspector described the areas inspected and discussed in detail the inspection findings the the Summary and listed below. No dissenting comments were received from the licensee. The licensee did not identify as proprietary any of the materials provided to or reviewed by the inspectors during this inspection.

| Item Number | Status | Description and Reference |
|---|---|---|
| VIO 50-413,414/95-20-01 | Open | Inadequate Incorporation of Vendor Information Into Diesel Generator Maintenance Instructions (paragraph 4.c). |
| VIO 50-413/90-05-01 | Closed | (EA-90-15) Inoperability of the 1B Containment Air Return Fan due to its power lockout breaker open for an indeterminate amount of time (paragraph 3.b). |
| VIO 50-413/90-17-01 | Closed | (EA 90-118) Failure to Follow Procedure which caused an inadvertent transfer of reactor coolant to the Fueling Water Storage Tank (paragraph 3.c). |
| IFI 50-413,414/93-26-04 | Closed | Controls for Amount of Leak Sealing Material Injected (paragraph 4.f). |
| NCV 50-413,414/95-20-02 | Closed | Service Water Strainer Instrumentation not Properly Aligned Following Modification (paragraph 5). |

## 8. ACRONYMS AND ABBREVIATIONS

| | | |
|---|---|---|
| CFR | - | Code of Federal Regulations |
| DG | - | Diesel Generator |
| DOI | - | Digital Optical Isolator |
| EA | - | Enforcement Action |
| EOC7 | - | End-of-Cycle 7 |
| FIP | - | Failure Investigation Process |
| IAE | - | Instrument and Electrical |
| IFI | - | Inspector Followup Item |
| LER | - | Licensee Event Report |
| MTP | - | Modification Test Plan |
| NCV | - | Non-Cited Violation |
| NSM | - | Nuclear Station Modification |
| PIP | - | Problem Identification Process |
| psid | - | pounds per square inch differential |
| RN | - | Nuclear Service Water System |
| RTD | - | Resistance Temperature Detector |
| SPOC | - | Single Point of Contact |
| RHR | - | Residual Heat Removal |
| R&R | - | Removal and Restoration (Tagging Order) |
| TS | - | Technical Specifications |
| URI | - | Unresolved Item |
| VIO | - | Violation |
| WO | - | Work Order |