



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

Report Nos.: 50-424/88-22 and 50-425/88-29

Licensee Georgia Power Company
P. O. Box 4545
Atlanta, GA 30302

Docket Nos.: 50-424 and 50-425

License Nos.: NPF-68 and CPPR-109

Facility Name: Vogtle 1 and 2

Inspection Conducted: May 16-19, 1988

Inspectors:

M. D. Hunt
M. D. Hunt

7/8/88
Date Signed

M. N. Miller
M. N. Miller

7/7/88
Date Signed

Approved by:

T. E. Conlon
T. E. Conlon, Chief
Plant Systems Section
Division of Reactor Safety

7/8/88
Date Signed

SUMMARY

Scope: This routine, unannounced inspection was in the areas of electrical cables, raceways, terminations installation records, instrumentation transmitters, associated sensing lines, as-build drawings, and an employee concern.

Results: No major weaknesses were found in the areas of instrumentation installation and testing. The procedures appeared adequate to install and test instrument loops as evidenced by the documentation and QA records. All records reviewed were complete and adequately reviewed. A problem identified in the employee concern portion of this report was subsequently resolved as noted.

No violations or deviations were identified.

REPORT DETAILS

1. Persons Contacted

Licensee Employees

- *J. E. Adams, Lead I&C Engineer Mechanical Discipline
- *A. B. Gallant, Project Compliance Coordinator
- *E. D. Groover, Quality Assurance Site Manager - Construction
- *R. E. Hollands, Electrical Construction Supervisor
- *R. H. Pinson, Vice President Construction
- *P. D. Rice, Vice President and Project Director
- *J. E. Sanders, Assistant Project Manager
- *D. W. Strohman, Project Q

Other licensee employees contacted during this inspection included craftsmen, engineers, technicians, and administrative personnel.

Other Organization

D. W. Strohman, Project Quality Assurance Engineer - Bechtel

NRC Resident Inspector

R. Schepens

*Attended exit interview

2. Inspection Background

The inspector planned a system based electrical and instrumentation inspection for the Auxiliary Feedwater (Aux FW) system. Included are the associated level instruments for the steam generators which provide the reactor trip signals and initiate the starting of the Aux FW pumps and opening of the control valves to the steam generators. The purpose of the inspection was to follow the paths from initiating instrumentation to actuation of the field control devices. This required a walkdown of the instrumentation, verification of the cable routes from the instruments to the process control cabinets, verification of the electrical control cables from the process control cabinets to the field control devices and a review of records and drawings.

The Functional Diagrams 72407 Sheet 7, Steam Generator Trip Signals and Sheet 15, Auxiliary Feedwater Pumps Startup were reviewed to select the instruments (low low level transmitters) which provide the actuating signals. Process and Instrumentation, P&I Diagram 2X4DB161-2, Revision 18, Auxiliary Feedwater System System No. 1302 was reviewed to

select the two motor driven feedwater pumps and injection valves to Steam Generators 3 and 4. P&I Diagram 2X4DB 159-1, Revision 19, Main Steam System System No. 1301 was reviewed and used for the walkdown of the level transmitters.

Details of the electrical control cables, instrumentation cables, cable terminations and records are provided in Paragraph 3. Details of the instrumentation are in Paragraph 4.

3. Electrical Component and Systems - Work Observation (51053), Electrical Cables - Work Observation (51063) and Record Review (51065)

The inspector examined electrical controls cables in the Auxiliary and Control Buildings for the safety-related Auxiliary Feedwater System. The cables were for the two motor driven feedwater pumps and the four motor operated control valves feeding Steam Generators 3 and 4. The control cables and termination for the pumps were verified from the process control cabinets in the control room to the motor control centers (MCC). The two pumps are:

Aux. Feedwater Pump 2-1302-P4-003 Train "A"
Aux. Feedwater Pump 2-1302-P4-002 Train "B"

The control cables and terminations for the four valves were verified from the process control cabinets in the control room to the MCC for each valve and from each MCC to the valves. The four valves selected in the Aux FW system are:

HV-5120 Train C	Steam Generator 4
HV-5137 Train A	Steam Generator 4
HV-5127 Train C	Steam Generator 3
HV-5134 Train A	Steam Generator 3

Note: Train C - Turbine Driven Aux FW pump feeds both Steam Generators 3 and 4.

Instrumentation cables and terminations for eight level transmitters (4 each for Steam Generators 3 and 4) were examined. The cables and terminations were verified from the instruments to the Electrical Penetration Assemblies (EPA) inside the Reactor Building. In addition, the cable for the signals were verified at the EPAs from outside containment (Reactor Building) to the process control cabinets in the control room.

The electrical control and instrumentation cables were examined to assure the requirements in Procedures ED-T-07, Cable Installation and ED-T-08, Cable Terminations were followed. The routing of various cables was reviewed and verified from the instruments, valves, MCCs and control

cabinets to the cable tray routing listed on the cable "pull cards." In certain instances, the routing was only verified to the point where the cable exited conduit and entered a cable tray containing similar cables or exited the cable tray to enter a cabinet.

In addition, the cables and raceways were inspected to assure proper identification and train or channel color coding was maintained. Special attention was given to assure channel separation and segregation of instrument, control, and power cables.

Cable terminations, including splices were examined to verify the points specified in the "cable termination cards" and elementary wiring diagrams were in agreement. Cable splices in the containment building were examined for instrument cables and the records specified a splice kit number. When the inspector was examining the splices in the EPA No. 23PY36 other termination were being performed. The craft were following Procedure ED-T-08 and a QC inspector was observing the work. The electrician was knowledgeable and performing his work in a professional manner.

For each cable and termination examined, the inspector reviewed wiring and cabling drawings, cable installation cards and cable termination cards. The cable inspection records and the termination inspections records were reviewed and signed by QC inspectors.

In general, the cables were inspected for various attributes, such as:

- The cable and termination have been installed according to the latest drawings
- The cables, wires and raceways have been properly identified
- Cable separation and independence has been maintained
- The junction boxes and cabinets are free of debris
- The cables are protected and free from damage
- QC inspections have been performed and documented

The following electrical control and instrumentation cables and associated devices were examined:

Electrical Control Cables

<u>Valves</u>	HV-5120	HV-5127	HV-5137	HV-5137
<u>Cable</u> (At Valve)	2CDIM015M	-----	2BBB39SD	2ABB37SD
<u>Cable</u> (From MCC)	2CDIM01SN	2C01M04SP	2BBB39SH	2ABB37SH

<u>Cable</u> (To MCC)	2CDIMOISB	2CDIMO4SB	2BBB39SB	2ABB37SB
<u>Cable</u> Control Room Panel Cabinet - Plug	2CDIMOISA 2CCQMCBBOI BI P-4	2CDIMO4SA 2CQMCBBOI BI P-7	2BBB39SA 2ACQMCBBOI B2 P-IL	2ABB37SA 2ACQMCBB02 B2 P-02
<u>FW Pump</u>	Train A	Train B		
<u>Cable</u> (at MCC)	2AA0217SB	2BA0321SB		
<u>Cable</u> Control Room Panel Plug	2AA0217SA 2ACQMCBB02 P-201	2BA0321SA 2BCQMCBBOI P-9		

Instrument cables, junction boxes, EPAs, and Control Room Panels

<u>Instrument</u>	<u>Cables</u>	<u>Termination</u> <u>Rox</u>	<u>EPAs</u>		<u>Control</u> <u>Room</u> <u>Panel</u>
			<u>Inside</u>	<u>Outside</u>	
2LT-537	24CQPS4AZD 24CQPS4AZE 24CQPS4AZF	2DTJB2456	24PY47	24PX47	24CQPS4
2LT-538	23CQPS3ZG 23CQPS3XK 23CQPS3XJ	2CTJB2457	23PY36	24PX36	23CQPS3
2LT-539	21CQPSIZ7 21CQPSIXU 21CQPSIXT	2ATJB2458	21PY20	21PX20	21CQPSI
2LT-553	22CPRS2XM 22CPRS2XL	Not Assessable	22PY48	22PX48	22CQPS2
2LT-547	24CQPS4YS 24CQPS4XM 24CQPS4XL	2DTJB2461	24PY47	24PX47	24CQPS4
2LT-548	23CPRS3AXD 23CPRS3AZE 23CPRS3AZF	2CTJB2462	23PY36	23PX36	23CQPS3
2LT-549	22CPRS2Z3 22CPRS2XI 22CPRS2XS	2BTJB2468	22PY48	22PX48	22CQPS2

2LT-554 21CQPSIZ5 2ATJB2467 21PY20 21PX20 21CQPSI
 21CQPSIXP
 21CQPSIXN

Within the areas examined, no violations or deviation were identified.

4. Instruments and Components - Work Observation (52053) and Records Review (52055)

The inspector performed walkdowns in the Reactor Building to examine the completed installations of level transmitters for Steam Generators 3 and 4. The instruments selected provide the trip signals, low low level, to the process control cabinets to start the Aux FW system. The work inspected included the sensing lines, tubing runs, instrument and root valves, and supports.

The sensing lines and tubing runs were inspected to ensure adequate separation for each channel. The pressure rating and range of each transmitter was verified. The as-built condition was verified and the as-built redline drawings were reviewed for the incorporation of design changes, Field Change Notices (FCN), and QC verifications. The FCNs were reviewed to ensure that design changes were evaluated, reviewed and approved by qualified engineering personnel.

Other attributes that were inspected are:

- The location, configuration and installation in accordance to the latest approved design drawings and construction specifications.
- The specified instruments and components have been used.
- The components and lines have been correctly and permanently identified and the channel identification color codes are as specified.
- The cleanliness and protection requirements have been maintained.

The instruments and as-built redline drawings that were inspected and reviewed are:

<u>Instrument</u>	<u>Instrument and Sensing Line Isometric As-Built Red-Line Drawing</u>	<u>QC Verification</u>
2LT-537	2X5DY00537-A 2SK5Y00537-N	10-28-87 10-15-87
2LT-538	2X5DY00538-A 2SK5Y00538-N	10-28-87 11-12-87
2LT-539	2X5DY00539-A 2SKSY00532-N	10-28-87 1-26-88

2LT-547	2X5DY00547-A 2SK5Y00547-N	11-02-87 12-07-87
2LT-548	2X5DY00548-A 2SK5Y00548-N	11-02-87 10-19-87
2LT-549	2X5DY00549-A 2SK5Y00543-N	11-02-87 1-28-88
2LT-553	2X5DY00553-A 2SK5Y00503-N	10-28-87 1-26-88
2LT-554	2X5DY00554-A 2SK5Y00504-N	11-02-87 2-11-89

Within the area examined, no deviations or violation were identified.

5. Employee Concern

The NRC is frequently contacted by individuals who express concerns relating to design, and construction and safe operation of nuclear plants. Followup inspections are performed by the staff to determine the significance of the concern and to insure that the health and safety of the public is protected.

Concern:

A serious electrical phasing problem has existed at Vogtle Nuclear Generation Station since the Summer of 1984 when main and auxiliary transformer connections were made to the 4160V bus with Calvert Bus (cable). Changes made to wiring diagrams had reversed the phase rotation on a number of 4160V delta/delta transformers without showing these changes on the main station phasing diagram and appropriate load center single line drawings.

Discussion:

Interviews were conducted with design, construction and operations personnel in an effort to determine the events and resultant actions surrounding this concern. Documentation reviews in the areas of design drawings, connection diagrams, construction procedures, construction specifications and operating plant maintenance procedures were conducted.

The concern arose in 1984 when Field Change Notices (FCN) E-FCRS-1103 and -FCRB-8349 were issued that revised the phase orientation for 480V switchgear, switchgear bus 1NBL2 transformer, and breakers 01 and 02 to provide clarification for terminating power cables to the high sides of the 4160/480V load center transformers. Drawing 2X3D-AA-B09B, Phasing Diagram Unit No. 2 was revised to show the proper phasing at transformers 2NXRB and 2NXRA. The connection diagrams indicated the phase orientation as ABC when viewed from the high side of the transformers and rear of the

switchgear. Corrections were made to properly locate the phases A-B-C, left-to-right when viewing the low side of the transformers and the front of the switchgear. The equipment was furnished with the phase requirements being A-B-C, left-to-right, top-to-bottom and front-to-back as specified. The connection diagrams were corrected to produce the A-B-C phase orientation at the switchgear high side terminals when viewed from the front. The 4160/480V and 13.8 KV transformers are wired such that the secondary winding terminals are connected phase A to Terminal X_1 , Phase B to Terminal X_2 and phase C to Terminal X_3 . The GPC electrical system phase rotation sequence is A-C-B. Standard notation for phase rotation sequence is A-B-C which is also the standard high side and low side winding notations. The sequence of rotation is governed by the system phase rotation. The GPC system phase rotation remains A-C-B but the standard rotation sequence A-B-C was retained for the project. The result is that care must be exercised in the connection of motors and generators. The motors must be connected to obtain the correct rotation for electrical phase A-C-B rotation sequence. To insure that proper connection requirements for motors was addressed and properly administered, maintenance procedures 25525-C (for motors) and 26836-E (for motor operated valves) were examined to verify that measures are taken to insure that correct motor rotation is verified when motor leads are connected. Construction Specification X3AR01-E2 Rev. 16 addresses the proper connection requirements for large motors and motor operated valves. Additionally, in support of the 580 terminations program, drawing 2X3D-AA-A000, General Notes and Symbols Connection Diagram contains a note advising that "the phase rotation of power distribution system is A-C-B. Field to verify motor rotation before terminating power cables to motors." Electrical Construction Specification X3AR01 Sections E2 and E9 were revised to provide for the phasing changes when terminating large three phase motor and motor operated valve drive units.

During this inspection, the inspector was advised that an Operations Deficiency Report (ODP) No. T-2-88-20-805 had been issued regarding a protective relaying condition on diesel generator (D/G) DG2A and DG2B. During a live relay test at the time of the D/G extended run, it was found that the Voltage Balance Relay responded backwards. The vendors instructions stated that the phase sequence should be A-B-C, however, the D/G phase sequence is A-C-B. An ODR No. 1-88-1292 was issued for the Unit 1 D/Gs A&B for the same deficiency. Until corrections are made the equipment (potential transformers) fuses will be verified every 24 hours.

Findings:

This concern is partially substantiated. The revision of the phasing and termination diagrams were necessary to correct what appeared to be an error in the orientation of the terminals for the high side of various 4160 V, 13.8 KV and 480V transformers, switchgear and bus connections. Since the transformers are passive, if the phasing is the same throughout the plant no problem is anticipated. There is no interconnection of transformers that would cause phasing mismatch, however, attention must be maintained when terminating 3 phase equipment.

The care in termination of 3 phase equipment not only requires the power leads be correctly connected but any protective relaying furnished with the equipment must be carefully reviewed for proper phase monitoring. In all instances this was not accomplished as noted by the two ODR's discussed above. Therefore, the concern that the drawing revision could cause problems if not followed properly is substantiated.

The licensee has agreed to perform an engineering review to examine the phase oriented protective relaying for proper electrical connections.

Note: The inspector was advised on July 7, 1988 that the engineering review had been completed and no other discrepancies were identified.

6. Exit Interview

The inspection scope and results were summarized on May 19, 1988, with those persons indicated in Paragraph 1. The inspector described the areas inspected and discussed in detail the inspection results. Dissenting comments were not received from the licensee.