UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
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ATLANTA, GEORGIA 30303-8931

MAY 12, 2000

Tennessee Valley Authority
ATTN: Mr. J. A. Scalice
Chief Nuclear Officer and
Executive Vice President
6A Lookout Place
1101 Market Street
Chattanooga, TN 37402-2801

SUBJECT: NRC SUPPLEMENTAL INSPECTION REPORT NOS. 50-327/00-04 AND 50-328/00-04

Dear Mr. Scalice:

On April 7, 2000, the NRC completed a Reactor Oversight Program supplemental inspection at your Sequoyah 1 & 2 reactor facilities. The results of the inspection were discussed with Mr. P. Salas and other members of your staff on April 6, 2000. The enclosed report presents the results of this inspection.

This supplemental inspection was an examination of the extent of condition, root cause evaluation, and corrective actions relating to a finding identified to be outside the NRC Significant Determination Process licensee response band in the initiating events cornerstone. The finding involved a June 30, 1999 event, during which flooding of the turbine building railroad bay affected electrical components, and created the increased potential for a loss of offsite power and a dual unit trip.

Based on our inspection results, we determined that your root cause analysis of the event only focused on a temporary modification which routed the discharge from the bus duct coolers into the storm drainage system adjacent to the turbine building railroad bay door. Your root cause analysis did not consider that the existing site storm drainage system was not consistent with the original design standards which specified that the system would have the capacity for the design flow from a storm with a 25-year recurrence. Consequently, due to changes made to the site topography and site characteristics, rainfall runoff collects adjacent to the turbine building railroad bay entrance door. We also noted that planned corrective actions for previous flooding events had not been completely implemented prior to the 1999 event.

We agree that the temporary modification was a contributing cause of the event. In addition, although your root cause analysis did not address the inconsistency with the original design, the installation of curbs around the 6.9 KV electrical cabinets provides increased assurance that plant equipment will be protected from future flooding events and thus reduce the risk of a loss of offsite power from a recurrence of flooding within the turbine building railroad bay.

Considering the risk reduction provided by the installation of the curbs around the 6.9 KV electrical cabinets, this finding is no longer outside of the licensee's response band in the initiating events cornerstone. We evaluated imposing a regulatory requirement for installation of the curbs. However, we concluded such action would be inappropriate under 10 CFR 50.109

since the overall protection of the public would not be substantially changed. Future removal of the curbs would raise the threshold for this finding to be outside the licensee response band and would require evaluation at that time by the NRC staff under 10 CFR 50.109.

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be placed in the NRC Public Document Room.

Sincerely,

/RA/

Charles A. Casto, Director
Division of Reactor Safety

Docket Nos. 50-327, 50-328
License Nos. DPR-77, DPR-79

Enclosure: NRC Inspection Report

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U.S. NUCLEAR REGULATORY COMMISSION

Enclosure

REGION II

Docket Nos:	50-327, 50-328
License Nos:	DPR-77, DPR-79
Report No:	50-327/00-04, 50-328/00-04
Licensee:	Tennessee Valley Authority (TVA)
Facility:	Sequoyah Nuclear Plant, Units 1 & 2
Location:	Sequoyah Access Road Hamilton County, TN 37379
Dates:	April 3 - 7, 2000
Inspector:	J. Lenahan, Senior Reactor Inspector
Approved by:	E. Girard, Acting Chief Engineering Branch Division of Reactor Safety

Enclosure

SUMMARY OF FINDINGS

Sequoyah Nuclear Plant, Units 1 & 2
NRC Inspection Report 50-327/00-04, 50-328/00-04

This supplemental inspection was performed to assess the licensee's evaluation associated with a site flooding event which occurred on June 30, 1999. This performance issue was initially documented in NRC Inspection Report 50-327, 328/99-04 and was characterized as a finding in the NRC Significance Determination Process increased regulatory response band in a letter to TVA dated January 26, 2000. During this supplemental inspection, which was performed in accordance with Inspection Procedure 95001, the inspector identified deficiencies in the licensee's root cause evaluation. The licensee attributed the root cause of the event to a temporary modification which had routed the bus duct coolers discharge (approximately 800 gpm) into storm drain 21, but did not address previously identified deficiencies in the capacity of the existing site storm drainage system. However, corrective actions implemented by the licensee provides increased assurance that plant electrical equipment in the turbine building will be protected from future flooding events, and thus reduce the risk of a loss of offsite power from a recurrence of flooding within the turbine building railroad bay.

Cornerstone: Initiating Events

- The results of the supplemental inspection of the licensee's investigation into the flooding event determined that the root cause analysis of the event focused only on a temporary modification and did not consider that the existing site storm drainage system does not meet the original design standards. Although the licensee did not adequately address the root cause of the turbine building flooding, the installation of curbs around the 6.9 KV electrical cabinets provides increased assurance that plant equipment will be protected from future flooding events and thus reduce the risk of a loss of offsite power from a recurrence of flooding within the turbine building railroad bay.

Enclosure

Report Details

01 Inspection Scope

The inspector reviewed the licensee's root cause assessment and actions to correct the turbine building flooding and to decrease the risk of loss of offsite power as a result of turbine building flooding.

02. Evaluation of Inspection Requirements

02.01 Problem Identification

a. Determine that the evaluation identified who and under what conditions the issue was identified.

During the initial pilot inspection, documented in NRC Inspection Report No. 50-327, 328/99-04, an issue was identified as a result of flooding of the turbine building railroad bay during a heavy rainfall on June 30, 1999. The flooding in the railroad bay caused water to rise over the base of the 6.9 KV electrical cabinets and drain through open conduits in the base of the cabinets. The electrical conduits penetrate the floor of the railroad bay and bend 90 degrees, ending near the 250 volt DC control power panels and the 480 volt motor-operated valve (MOV) boards. The water flowed through the conduits and sprayed onto the 250 volt DC control power panels and the MOV boards. This caused a ground indication in the 250 volt panels and also initiated a control room annunciator which indicated undervoltage or breaker trips in the MOV boards. Although alarms were received and DC grounds were reported, the equipment remained functional due to prompt actions by the plant operations staff. These actions included closing of the rolling steel door to the railroad bay which prevented any additional rainfall runoff from entering the railroad bay, and covering the 250 volt control power panels with plastic sheets to prevent direct impingement of water on the electrical components. No trip, transient, or engineered safety feature (ESF) actuation occurred. Both units operated at 100 percent power throughout the event. The licensee initiated Problem Evaluation Report (PER) 99-006863 to document and disposition this issue.

b. Determine from the evaluation documents how long the issue existed, and prior opportunities for identification.

Two previous events were identified which resulted in flooding of electrical components by rainfall runoff. These occurred in 1990 and 1994. The 1990 event concerned flooding of electrical manholes and the subsequent effect on electrical cables submerged by the water. The cause of this issue was attributed to a clogged yard drainage system, changes in the site grading, and inoperable sump pumps in the manholes. Corrective actions included repairs to the sump pumps, placement of curbs to prevent rainfall runoff from flowing into the manholes, and initiation of preventative maintenance procedures to clean the site storm drainage system.

The 1994 event was similar to the June 30, 1999 event, and resulted in water entering the turbine building railroad bay and wetting the 250 volt DC control power panels and the 480 volt MOV boards. Several other structures on the site, primarily office buildings, were also affected by the flooding. Unit 2 was in a refueling outage when this event

occurred. Power was reduced to 80 percent in Unit 1 while the wetted equipment was dried and inspected. The cause of this event was attributed to blockage of the site storm drainage system with debris. An additional cause was attributed to a weakness in the design of the storm drainage system in that a single drain line provided the only drainage from the area adjacent to the turbine building railroad bay door. Since the entrance area to the railroad bay is at a low point, overflow of this drain line caused water to accumulate at the railroad bay entrance area. The licensee determined that while the preventative maintenance inspections of the storm drains were performed in response to the 1990 event, debris had not been cleaned from the storm drain system. Planned corrective actions for the 1994 event included:

- Restoring the full function of the storm drainage system by cleaning the pipes and catch basins.

- Inclusion of acceptance criteria in the preventative maintenance procedures regarding actions to be taken if debris is found in the storm drainage system during inspections.

- Performing an evaluation of the storm drainage system.

- Addition of curbs around the 6.9 KV boards or sealing the open conduit penetrations in the base of the 6.9 KV boards to prevent water from spraying on the control power and MOV panels.

- Cleaning of floor drains in the turbine building railroad bay.

The licensee completed cleaning of the site storm drainage system on February 28, 1995. Licensee engineers recorded rainfall data for 15 minute periods after the 1994 event to determine the effectiveness of corrective actions. On September 1, 1995, a rainfall amount of 1.39" was recorded. No flooding was observed in the turbine building during this storm which was about the same intensity as the 1994 storm. Licensee engineers concluded that since the turbine building had not flooded during this storm, no additional corrective actions were required. They subsequently canceled the corrective action for sealing the conduit penetrations and/or addition of the curbs around the 6.9 KV electrical cabinets.

c. Determine that the evaluations document the plant's specific risk consequences (as applicable) and compliance concerns associated with the issue.

The NRC assessment of the event performed concluded that this event was in the NRC Significance Determination Process (SDP) increased regulatory response (White) band. The results of the NRC's assessment were reported to the licensee in a letter dated September 7, 1999, Subject: Sequoyah Flooding Event Risk Determination. The licensee conducted an assessment of the specific risk consequence of the flooding event. They determined that the event was classified in the SDP licensee response (Green) band. The licensee's evaluation compared the risk associated with the effect of the flooding and the risk associated with the compensatory measures which included operator actions and restoration of offsite power. In a letter dated September 27, 1999, the licensee submitted their evaluation of the event in which they concluded the event

was classified in the Green band. In this letter the licensee requested a meeting with the NRC staff, if the NRC did not agree with the licensee's conclusions. A meeting was held in the Region II offices on

October 21, 1999, to discuss the evaluation of the flooding event and its risk significance. The minutes of the meeting were documented in an October 28, 1999 letter to TVA, Subject: Meeting Summary - Sequoyah Nuclear Plant. The results of the NRC's final significance determination for the flooding event were documented in an NRC letter to TVA dated January 26, 2000, Subject: Final Significance Determination For Sequoyah Flooding Event and Notice of Violation. NRC concluded in the final determination that performance for the flooding event was in the White band.

02.02 Root Cause and Extent of Condition Evaluation

a. Determine that the problem was evaluated using a systematic methods to identify root causes and contributing causes.

The licensee used the event critique and root cause analysis technique referenced in the TVA corrective action procedure to evaluate the problems relating to the flooding event. This compared present and prior circumstances to determine the root cause of the 1999 flooding event. The licensee concluded that the root cause was due to an inadequate review of a temporary modification which routed the discharge from the switchyard bus duct coolers to catch basin 21, which is located near the railroad bay door. The root cause evaluation was performed considering the effect of rainfall amounts recorded at the plant site since 1994, and the impact of corrective actions completed in response to the 1994 event. The results of the licensee's analysis indicated that the flooding would not have occurred if the temporary modification had not been installed. The inspector disagreed with the licensee's root cause determination as discussed below.

b. Determine that the root cause evaluations were conducted at a level of detail commensurate with the significance of the problem.

The inspector determined that the root cause evaluation was focused on the temporary modification without consideration of other possible causes. The temporary modification had rerouted 800 gpm of cooling water from the bus duct coolers into a catch basin which is located in close proximity to the turbine building railroad bay door. The inspector disagreed with the licensee's conclusions that the temporary modification was the only cause of the turbine building railroad bay flooding. Licensee engineers performed a cursory analysis of the event and determined that a "hydraulic block" caused by the 800 gpm flow from the discharge of the temporary modification "might or could have caused" the flooding. These conclusions were documented in a report titled: Overflow of Stormdrains at Sequoyah Nuclear Plant, Attachment 1 to SQ 99-06863-000 PER, dated August 11,1999. The licensee also performed a change analysis review which concluded that the only change made to the drainage system was the temporary modification. Background information in the report stated that a 1993 calculation (number SCG1S506, Revision 0) which evaluated the capacity of the storm drainage system indicated that the drainage system should be adequate to pass a storm rainfall intensity of 5.75 inches/hour (1.44 inches in 15 minutes). This was equivalent to a storm

occurring with a frequency of once every 25 years and was the original design standard for the storm drainage system. However, Revision 1 of Calculation SCG1S506, dated July 26, 1995, which evaluated changes to the site drainage patterns, concluded that the portion of the storm drainage system which drains the turbine railroad bay area is only adequate to pass a storm with a 5 to 7 year frequency.

The inspector reviewed the rainfall data which has been recorded at the site environmental station since 1975. This data has some limitations in accurately reflecting rainfall amounts which may have occurred at the turbine building for short duration
(15 minutes) intense rainstorms since the station is located 0.75 miles from the turbine building. The recorded rainfall data shows the 1994 storm was a 25 year frequency storm. The rainfall data shows that in the 24 year period one additional ten year storm occurred in 1975, and six storms with a two year frequency (one in 1975, 1976, 1988, two in 1994, and one in 1995). The June 30, 1999 storm intensity of 0.67" would be classified as a two year storm.

Design and construction of the storm drain system was not a safety related activity. The inspector concluded that changes to the site since design of the storm drain system, including paving, regrading, and addition of structures, have decreased the efficiency of the existing system. Existing catch basins and other drainage structures are not in optimum locations to intercept surface runoff. As a result, during periods of intense rainfall, a quantity of rainfall runoff bypasses the drainage collection system and collects at the lowpoint adjacent to the turbine building railroad bay. The rainfall runoff from the turbine building area, which includes roof drainage, is transported by an 18 " diameter culvert to catch basin 23. Three other drainage pipes, one 15" diameter and two 18" diameter, also discharge into catch basin 23. The outlet from catch basin 23 is one 24" diameter pipe with a flat slope of only approximately 0.5 percent. In times of very intense rainfalls, the 24" diameter pipe is not capable of carrying the water from the four pipes discharging into catch basin 23. This causes a backwater effect to occur which limits the discharge from catch basin 21 since catch basin 21 is lower than the drainage areas from the other three pipes.

c. Determine that the root cause evaluations included consideration of potential common cause(s) and extent of condition of the problems.

The licensee's root cause evaluation was focused on the temporary modification without consideration of other possible causes. The licensee determined that inadequate review of the temporary modification was the root cause of the flooding issue. Review of the licensee's root cause investigations disclosed that the licensee's extent of condition consideration concerned a review of other open temporary modifications to ensure that no other installed temporary modifications had the potential to create design problems. The licensee's review had not considered any common causes or extent of condition related to the inadequate yard drainage system to control rainfall runoff. The site grading and topography which results in rainfall collecting in the proximity of the railroad bay doorway also was not considered in the root cause analysis.

02.03 Corrective Actions

a. Determine that appropriate corrective action(s) are specified for each root/contributing cause or that there is an evaluation that no actions were necessary.

The inspector determined that the licensee's corrective actions had adequately addressed the root cause of the event identified by the licensee by installing separate curbs 9½ inches high around the Unit 1 and 2 6.9 KV electrical cabinets. The configuration of the curbs provide physical separation of equipment in Unit 1 and Unit 2. The installed curbs will therefore also reduce the risk of a dual unit loss of offsite power in the event of internal flooding.

b. Determine that corrective actions have been prioritized with consideration of the risk significance and regulatory compliance.

The inspector concluded that the licensee's corrective actions were properly prioritized to address the risk. These corrective actions were as follows:

- Removed the discharge of the bus duct coolers from catch basin 21.

- Changed the temporary modifications procedures to require design engineers to perform a followup on completed temporary modifications to assure the temporary modification is functioning as expected.

- Trained design engineering personnel which included a review of the event.

- Revised the maintenance procedures to add acceptance criteria for storm drain cleanliness.

- Installed curbs 9½ inches high around the 6.9 KV electrical cabinets. Portions of the curbs are removable for maintenance activities.

- Included the storm drain system in the maintenance rule.

- Operators have become aware of the necessity to close the turbine building railroad bay door

c. Determine that a schedule has been established for implementing and completing the corrective actions.

The inspector verified that the licensee's corrective action program identified assigned individuals, completion dates, and reference numbers to the licensee's corrective action tracking program to ensure that the actions taken. The inspector verified the corrective actions had been completed.

d. Determine that quantitative or qualitative measures of success have been developed for determining the effectiveness of the corrective actions to prevent recurrence.

The licensee does not have an analysis (calculations) to support the cause of the June 30, 1999 flooding event or the adequacy of their corrective actions. Installation of the curbs around the 6.9 KV boards was the most significant corrective action item to

prevent recurrence of the flooding event. The licensee selected the height of the curbs at 9½ inches based on engineering judgement by reasoning that since the maximum depth of water observed in the turbine building railroad bay during the June 30, 1999 event was 2 inches, setting the curb height at more than four times the water depth should be sufficient to prevent recurrence. The licensee had not demonstrated analytically by use of calculations or other methods that the curb height was adequate. However, the inspector determined that the curbs would prevent recurrence of a future flooding event from a storm of the same intensity which occurred on June 30, 1999.Another corrective action which should also assist in prevention of recurrence is inclusion of the storm drainage system in the Maintenance Rule which should assure the system is unobstructed by debris. The effectiveness of these measures will be determined through direct observation of the impact of future rain storms on flooding in the turbine building railroad bay. The inspector concluded that the effectiveness of these corrective actions are dependent on operators actions to assure the turbine building railroad bay rolling steel door is kept closed during periods of heavy rainfall, maintenance of the existing site drainage system, and maintaining the curbs in good condition. It will also be necessary to maintain the rolling steel door in good condition so that it prevents water from entering the turbine building railroad bay.

4OA5 Management Meetings

The inspector presented the inspection results to members of licensee management at the conclusion of the inspection on April 6, 2000. The licensee acknowledged the findings presented.

The inspectors asked the licensee whether any of the material examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

H. Butterworth, Operations Manager
D. Cliff, Special Projects Manager
D. Koehl, Plant Manager
M. Lorek, Site Engineering Manager
R. Rogers, Systems Engineering Manager
P. Salas, Manager of Licensing and Industry Affairs
K. Wilkes, Operations Superintendent

ITEMS OPENED AND CLOSED

NONE

Opened and Closed

NONE

LIST OF BASELINE INSPECTIONS PERFORMED

The following procedure was used to perform the inspection during the report period. Documented findings are contained in the body of the report.

IP 95001 Supplemental Inspection For One Or Two White Inputs In A Strategic Performance Area.

APPENDIX

LIST OF DOCUMENTS REVIEWED

Problem Evaluation Report (PER) 99-0006863-000

PER SQ 94-050711

PER SQP90508 PER

Rainfall Intensity - Duration - Frequency Curves, Chattanooga, TN, 1903 - 1948.

Sequoyah Nuclear Plant - Annual Maximum Rainfall Amount, 1975 -1999.

Calculation Number SCG1S506, Revision 1, dated July 26, 1995, SQN West Side Site Drainage Review.

TVA Report titled: Overflow of Stormdrains at Sequoyah Nuclear Plant, Dated August 11, 1999.

Work Order 97-006777-000, Turbine Building Railroad Bay Rollup Door, dated April 9, 1997.

TVA Report titled: Risk Determination Evaluation of Flooding of the Turbine Building Railroad Bay Due to Intense Rainfall, dated August 31, 1999.

TVA Drawing number 10N224, Revision 28, Drainage Details - Plant Area.

TVA Drawing number 10N250, Revision19, Finished Grading and Paving.