UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

GROUNDWATER ALARM IN WELL Mk. GWA-2

DUKE ENERGY CORPORATION

MCGUIRE NUCLEAR STATION, UNITS 1 AND 2

DOCKET NOS. 50-369 AND 50-370

BACKGROUND

This safety evaluation addresses Special Report (SR) No. 96-04 dated November 14, 1996, and subsequent revisions, which were submitted by Duke Energy Corporation (the licensee), as required by Selected Licensee Commitment (SLC) No. 16.9-8, "Groundwater Level Monitoring System." The plant grade level is at elevation (El) 760 feet above mean sea level (msl). The maximum groundwater level (GWL) is considered to be at El 760 feet msl, based on a full level of 760 feet at Lake Norman, which borders the north side of the plant site (Ref. 1).

Since the elevations of several Category I structures, including the Reactor Buildings (RBs) and the Auxiliary Building (AB), are below the natural GWL, a seismic Category I permanent dewatering underdrain system (UDS) was installed during initial construction to lower the water table. A detailed description of the UDS is given in Section 2.4.13 of the Final Safety Analysis Report (FSAR), and in the staff's Safety Evaluation Reports (SERs), dated March 1978 (Ref. 2), and March 2, 1989 (Ref. 3). The UDS incorporates a grid of interconnected flow channels on approximately 20-foot centers, located at the top of rock or fill concrete below the foundation slabs (Refs. 1, 2, and 3). These flow channels were formed by embedding wooden drain boxes[1] in concrete as shown in FSAR Figure 2-63. All channels drain by gravity to three sumps in the AB. In addition to these flow channels, there are exterior wall drains consisting of zoned sand and stone filter and an 8-inch perforated metal pipe.

At the licensing stage, the staff concluded that the dewatering system provided an acceptable method of controlling the ground water levels at the site. However, the staff requested and the license committed to provide a comprehensive monitoring network (11 monitors) to assure early detection of UDS malfunction. The monitors in the immediate vicinity of the exterior wall drains were designed to sound an alarm in the control room when the groundwater level reached the level specified in the Technical Specifications (TS).

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[1] During a recent teleconference, the licensee stated that the wooden drain boxes were not load-bearing structural members, and that they were protected from collapse by placing the concrete in thin layers on top of the boxes and on their sides so that the load from subsequent pours would be mostly borne by the concrete below.

In October 1984, the licensee applied for changes in TS Section 3/4.7.13 "Groundwater Level," and submitted a revised application in January 1988 seeking significant modification of the UDS monitoring program. The modification involved: (1) the deletion of 6 of the 11 monitoring wells from the TS, and (2) the requirement for 3 of the 5 remaining wells (shown in FSAR Figure 2-62) to exceed the Hi-Hi alarm level (El 731 feet msl), before the initiation of the plant shutdown. The licensee requested this TS change based on the results of its detailed structural analyses of the RBs and the AB (Ref. 3).

The NRC staff audited the calculations in April 1988 and found them acceptable. Therefore, the staff agreed that it was not necessary to continue monitoring the groundwater monitors next to the RBs or the interior groundwater monitors inside the Diesel Generator Buildings (DGBs). The five remaining monitors (one exterior monitor on the west exterior wall of the AB, one exterior monitor on the east exterior wall of the AB, and three interior monitors along the north exterior wall of the AB) were deemed sufficient to monitor all sides of the AB that are not bordered by the Turbine Building and the RBs. However, the licensee committed to maintain all 11 monitors in operable condition, even though the TS action statements would be based on five monitors, and included the six non-TS monitors in SLC 16.9-8 (Ref. 1, page 2-49). At the time of approving the above changes in the TS, the staff had determined that localized groundwater rise on a segment of the building perimeter was no longer a significant safety concern, and that it was an indication of a partial system degradation that called for maintenance or corrective action in accordance with the licensee's administrative procedures.

On October 6, 1996, the licensee received a groundwater alarm for Well Mk. GWA-2, which is located 66 inches away from the Unit 2 RB, and entered this incident in the TS Action Item List for tracking, even though it was not a TS monitor. The alarm cleared within 7 days, but returned on October 11, 1996, and cleared after 22 days. Since the alarm stayed on for more than 7 days, the licensee submitted to NRC, SR No. 96-04, in accordance with SLC 16.9.8 (Ref. 4), and subsequently submitted revisions 1 and 2 to the SR 96-04 as the alarm came on again and stayed on for more than 7 days in December 1996, and in March 1997. Also, in response to a staff request during a teleconference, the licensee furnished additional information in June 1997 and July 1997 (Refs. 5 and 6).

EVALUATION

The staff's previous safety evaluation (Ref. 3) related to the GWL monitoring. The licensee had analyzed the RBs of Units 1 and 2 and qualified them for a maximum GWL of 760 feet msl without adverse effects from lateral pressures, uplift, or overturning due to buoyancy. Although the DGBs were not specifically designed for lateral pressures due to hydrostatic loading caused by the GWL of 760 feet msl, they were designed for loading cases that exceeded the groundwater loadings. The DGBs were analyzed for uplift and overturning due to buoyancy and were found to be safe for GWL up to 760 feet msl. The AB was analyzed for lateral

pressures, uplift, and overturning due to buoyancy, and was found safe for hydrostatic loading due to a maximum GWL of 760 feet msl. However, the licensee determined that the governing failure mode of the AB was overturning due to buoyancy, and that such overturning would require an increase in GWL around the entire perimeter or a large portion of the perimeter of the AB to cause overturning. Elevation 737 feet msl was the maximum level that the groundwater could rise before overturning would be initiated (Ref. 3).

On the basis of this analysis, the licensee committed to maintain groundwater level below 731 feet msl (with a margin of 6 feet below the potential failure limit of 737 feet msl, which is called the "structural distress" level), and to initiate action to place both McGuire units in Cold Shutdown within 42 hours after three of the five groundwater alarms are activated at 731 feet msl.

The rise in the GWL recorded by the monitor at Well Mk. GWA-2 is only about 1 to 2 inches above the setpoint El 731 feet msl, as determined by the typical height by which the detector is lifted to clear the alarm (Ref. 6). Since the setpoint elevation of 731 feet msl has a margin of 6 feet relative to the "structural distress" level of [illegible] feet msl, and the rise in the level above El 731 feet is minimal, the staff agrees with the licensee's conclusion that there is no safety concern due to the groundwater alarm received at this well.

Even though the small rise in GWL recorded by the non-TS monitor at Well Mk. GWA-2 does not affect the structural integrity of the RB, the staff has examined the reasons given by the licensee for the rise in the GWL, and reviewed the water table contour plan (FSAR Figure 2B-2), a typical section showing the ground surface elevations, and the slope of the phreatic surface of the groundwater table at the McGuire site (FSAR Figure 2B-3). On the basis of this review, the staff agrees with the following conclusions arrived at by the licensee after its internal review, performed as part of its corrective action requirements (Ref. 5):

1. The rise in GWL recorded at Well Mk. GWA-2 is a natural phenomenon caused by the rise in the level in Lake Norman and by the increased rainfall in the area. A field survey of the surrounding areas showed no water percolating to the surface which indicates that the rise in groundwater level is not due to a pipe break or leak. The alarms at the Well Mk. GWA-2 have been observed to occur whenever the Lake Norman level rose or there was substantial rainfall in the area.

2. The rise in GWL at Well Mk. GWA-2 is localized, since no alarm was received from any other monitors, indicating the proper functioning of the underground drainage system. There could be several reasons for this localized phenomenon at Well Mk. GWA-2, such as: (1) the local draining of the groundwater toward the Unit 2 RB, and (2) the possible changes in the subsoil characteristics caused by recent construction projects near the Unit 2 side of the site. Further, these projects (e.g., Equipment Staging Building with caisson foundations) have altered the topography of the site in this area, allowing more

precipitation to soak into the soil instead of draining into the surface drain system. Based on those observations, the resulting small rise of about 1 to 2 inches in the groundwater level at Well Mk. GWA-2 does not jeopardize the safety of the plant or the public, as evidenced by the lack of alarms at any of the TS wells (Ref. 5). Further, the staff agrees with the licensee's proposed action under 10 CFR 50.59 (conveyed to the staff during a recent telephone conversation) to set the GWL alarm level at a higher elevation than the current level of El 731 feet, but below the structural distress level of El 737 feet to avoid the frequent activation of the alarm even when the GWL rises only by a couple of inches above El 731 feet.

3. The nearest underground structures, systems, or components are the diesel fuel oil tank and condenser circulating water piping, which are approximately 40 feet away from Well Mk. GWA-2. Based on the distance, the small rise in the groundwater level at Well Mk. GWA-2 does not affect the safety of any underground structures, systems, or components.

CONCLUSION

On the basis of its review of the referenced information, concerning the groundwater level monitoring, the staff is satisfied that the GWL alarm received at Well Mk. GWA-2 near the Unit 2 RB does not pose any safety hazard either for the safety-related structures, systems, or components or for the public. Further, the staff agrees with the licensee's proposed action to set the GWL alarm level at a higher elevation than the current level of El 731 feet, but below the structural distress level of El 737 feet to avoid the frequent activation of the alarms.

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References:

1. McGuire Nuclear Station, Units 1 and 2, FSAR Section 2.4.13.5, Design Bases for Subsurface Hydrostatic Loadings, May 14, 1996.

2. Safety Evaluation Report (NUREG-0422) related to operation of McGuire Nuclear Station, Units 1 and 2, Duke Power Company (DPC), Docket Nos. 50-369 and 50-370, dated March 1978.

3. Safety Evaluation related to Amendment No. 93 to Facility Operating License NPF-9 and Amendment No. 74 to Facility Operating License NPF-17, Duke Power Company, Docket Nos. 50-369 and 50-370, McGuire Nuclear Station, Units 1 and 2, dated March 2, 1989.

4. Letter dated November 14, 1996, from T. C. McMeekin, DPC, to NRC, subject: McGuire Nuclear Station, Units 1 and 2, Docket No. 50-369, Special Report No. 96-04, Problem Investigation Process No. 2-M96-2898.

5. Letter dated June 9, 1997, from H. B. Barron, DPC, to NRC, subject: McGuire Nuclear Station, Units 1 and 2, Docket No. 50-369, Special Report No. 96-04 Revision 3, Problem Investigation Process No. 2-M96-2898.

6. Letter dated July 24, 1997, from H. B. Barron, DPC, to NRC, subject: McGuire Nuclear Station Units 1 and 2, Docket No. 50-369, Special Report No. 96-04, Rev. 3, Groundwater Well Mk. GWA-2, Response to Follow-up Questions.