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March 30, 2011

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Subject: Duke Energy Carolinas, LLC (Duke Energy)
Catawba Nuclear Station, Unit 2
Docket Number 50-414
Request for Relief Number 10-CN-001
Alternative Requirements for Temporary Acceptance of a Through-Wall Flaw in Boric Acid Tank Nozzle Weld

Reference: Letter from Duke Energy to NRC, same subject, dated July 22, 2010

The reference letter submitted the subject Request for Relief from ASME Code, Section XI requirements to perform an immediate repair of a through-wall leak in the Unit 2 Boric Acid Tank Nozzle Mk. M.

On March 2, 2011, the NRC electronically transmitted a Request for Additional Information (RAI) concerning the subject Request for Relief. The purpose of this letter is to formally respond to this RAI. The response is contained in the enclosure to this letter. The format of the response is to restate each RAI question, followed by our response.

If you have any questions concerning this information, please call L.J. Rudy at (803) 701-3084.

Very truly yours,

James R. Morris

LJR/s

Enclosure

A047
NRR

xc (with enclosure):

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NCEMC
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ENCLOSURE

RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

REQUEST FOR ADDITIONAL INFORMATION
RELIEF REQUEST 10-CN-001
ALTERNATIVE REQUIREMENTS FOR TEMPORARY ACCEPTANCE OF
A THROUGH-WALL FLAW IN BORIC ACID TANK NOZZLE WELD
CATAWBA NUCLEAR STATION, UNIT 2
DUKE ENERGY CAROLINAS, LLC
DOCKET NUMBER 50-414

By letter dated July 22, 2010, (Agencywide Documents Access and Management System No. ML102110043), Duke Energy Carolinas, LLC the licensee, submitted for the U.S. Nuclear Regulatory Commission (NRC) review and approval relief request (RR) 10-CN-001. The licensee is requesting relief from the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code* (the Code), Section XI, requirements to perform an immediate repair of a through-wall leak in the Catawba Nuclear Station, Unit 2, (Catawba 2), boric acid tank nozzle Mk. "M." To complete its review, the US Nuclear Regulatory Commission staff requests the following additional information:

1. The licensee stated that it plans to perform an ASME Code-compliant repair of the degraded boric acid tank nozzle Mk. "M" during the Catawba 2 refueling outage scheduled for the fall of 2010. Discuss whether the degraded weld was repaired in accordance with the ASME Code, Section XI, in the Fall 2010 refueling outage.

Duke Energy Response:

The Boric Acid Tank nozzle Mk. "M" was repaired during refueling outage 2EOC17 (Fall, 2010). The Owner's Report for Repair/Replacement Activity, Form NIS-2, was completed on November 30, 2010, signifying completion of the repair/replacement activity.

2. Provide the weld material (e.g., stainless steel weld, ER304).

Duke Energy Response:

The Boric Acid Tank nozzle Mk. "M" weld is a stainless steel weld using ER308 weld filler material.

3. The licensee stated that two 1/16 inch rounded indications were detected on the 7 o'clock position on the subject weld.

   a. Discuss the degradation mechanism for the indications.

   Duke Energy Response:

   The metallurgical analysis performed on the sectioned weld determined that the two rounded indications were not associated with the defect that resulted in leakage, and that the defect resulting in leakage was caused by transgranular stress corrosion cracking (TGSCC).

   b. Discuss whether the indications were located in the heat-affected zone.

   Duke Energy Response:

   The metallurgical analysis determined that the two rounded indications were not located in the heat affected zone. However, the defect that resulted in leakage initiated at the surface of the nozzle (threaded coupling) on the vessel interior and

propagated through the coupling base metal and its connecting weld (including the heat-affected zone on the coupling).

c. Discuss whether the indications were initiated from the inside surface or outside surface.

Duke Energy Response:

As indicated above, the defect and resulting leakage was caused by TGSCC initiated from the interior of the tank.

d. Discuss any corrosive environment that may have affected the weld.

Duke Energy Response:

Sulfur and traces of chloride contaminants were detected within the surface breaking cracks in the coupling and weld. These contaminants, in addition to the presence of dissolved oxygen in the tank contents, are suspected of causing the corrosive environment leading to TGSCC in this weld.

e. Discuss the thickness of the weld.

Duke Energy Response:

The weld is a full penetration weld through the thickness of the tank shell (¼") with a ¼" reinforcing fillet.

f. Discuss whether the weld was repaired during the construction.

Duke Energy Response:

Duke Energy does not believe that this weld was repaired during construction, and the metallurgical analysis did not identify any obvious repairs in the weld. Because a construction defect is no longer suspected of contributing to the leakage, Duke Energy believes that confirmation of weld repairs during construction is no longer warranted.

4. Section 5.1.1 of RR 10-CN-001 states that a visual examination of the subject nozzle will be performed weekly during operations rounds to confirm that the leakage has not increased significantly. ASME Code Case N-513 requires a 30-day inspection (i.e., ultrasonic testing) and a daily walkdown.

   a. Discuss why a weekly visual inspection is sufficient to monitor the structural integrity of the tank when ASME Code Case N-513 requires a 30-day inspection (i.e., ultrasonic testing) and a daily walkdown.

Duke Energy Response:

i. **Use of ASME Code Case N-513-3 (currently approved for use in Regulatory Guide 1.147, Rev. 16) is not mandatory and, because this case applies only to piping, it cannot be used for vessels (including vessel nozzle welds) without seeking regulatory authorization via 10 CFR 50.55a(a)(3)(i). Rather than seek relief in accordance with 10 CFR 50.55a(a)(3)(i) to use this Code Case, Duke Energy chose to propose the alternative documented in our initial request.**

ii. **The leakage rate through the nozzle Mk."M" weld was nearly imperceptible and evidence of leakage was detected only by subsequent visual examinations performed over a period of weeks that revealed only dried boric acid crystalline deposits. Liquid penetrant (PT) examinations performed on these flaws revealed that they satisfied the applicable ASME Code, Section XI acceptance standards. Ultrasonic testing was not proposed because the weld geometry does not allow for a meaningful examination. For these reasons, Duke Energy believes that the specified examination frequency provided reasonable assurance that increased leakage would be detected before flaw growth could result in unacceptable leakage from the Boric Acid Tank.**

5. Discuss the design pressure and the normal operating pressure and temperature of the tank.

Duke Energy Response:

The Boric Acid Tank is an atmospheric storage tank whose design and operating pressure is atmospheric pressure. At nozzle Mk. "M", the internal static pressure is due to approximately 7.25 feet of borated water.

The Boric Acid Tank normally operates at ambient room temperature (approximately 70° F - 80° F).

6. Section 5.3.4 of RR 10-CN-001 states that the leakage is likely the result of a fabrication defect. The licensee does not believe that the through-wall leakage is the result of service-induced degradation. The staff believes that the fact that a leakage occurred demonstrates that it is service-induced degradation. The degradation may be initiated from the fabrication defect which has grown to two through-wall flaws during the service.

   a. Discuss why this leakage is not the result of service-induced degradation.

   Duke Energy Response:

   Based on the results of the recently completed metallurgical analysis, Duke Energy now believes that the leakage was the result of service-induced degradation caused by TGSCC. Although Duke Energy initially suspected that the leakage was the result of a fabrication defect, the metallurgical analysis did not support this initial conclusion.

   b. Discuss the root cause of the through-wall flaws.

   Duke Energy Response:

   The metallurgical analysis of the nozzle weld defect included destructive examination (sectioning) of the nozzle and its weld at multiple locations and subsequent analysis using a scanning electron microscope (SEM) and energy-dispersive X-ray spectroscopy (EDS). The cause of the defect was attributed to TGSCC and the metallurgical report provided the following conclusions related to the defect and resulting leakage.

   1. **"The leak in the CNS Unit 2 BAT [Boric Acid Tank] thermocouple nozzle weld 2NVTW-5720 was caused by ID-initiated, axially oriented, transgranular stress corrosion cracking (TGSCC). The very small leak rate observed at this nozzle**

is consistent with the tight, tortuous path provided by this type of defect, and also the relatively low fluid pressure (i.e., static head only) on the weld."

2. **"Weld spatter and other weld residues consistent with residual SMAW [shielded metal arc welding] flux were found on the internal surface of the coupling where the crack initiated. The crack was highly branched, suggesting the cracking was more corrosion-driven rather than stress-driven. Contaminants detected at the crack origin and within the deeper crack deposits included both sulfur and occasional traces of chlorine. The presence of the weld spatter and associated weld deposits likely created a crevice on the interior of the coupling providing an opportunity for low levels of contaminants to concentrate and initiate the cracking. Both sulfur compounds and chlorides are implicated as corrodents in this case due to their presence in the deep crack deposits."**

3. **"Although the source(s) of the sulfur and chlorine are not known, they may have been introduced during plant construction. Also, of particular interest with regard to the environment in the BAT is that in August 1988, V.C. Summer detected abnormal amounts of magnesium and sulfates in their "B" boric acid tank; subsequently it was found that the binder material in the rubber diaphragm was failing, allowing small particles to come off of the diaphragm and become suspended in the tank fluid. If similar degradation of the rubber diaphragms had occurred at CNS [Catawba Nuclear Station], this could possibly explain the relatively high levels of sulfur associated with the pitting and crack deposits. Furthermore, at CNS it was also noted that the diaphragms in both BATs were floating on top of the boric acid solution; since the solution was in direct contact with the rubber there may have been opportunity for leaching of aggressive species from the rubber, including the potential for chlorine."**

c. Discuss whether the fabrication defect was shown on the original nondestructive examination record during the construction.

Duke Energy Response:

As indicated in our response above, Duke Energy now believes that the leakage was not the result of a fabrication defect. As indicated in the metallurgical report, the defect initiated from the ID surface of the nozzle, likely resulting from a crevice produced by weld spatter and associated weld deposits. Because the defect is not suspected of being caused during construction, any nondestructive examination performed during construction of the tank would not have detected the defect.