

## NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50–369 and 50–370]

### Duke Power Company, McGuire Nuclear Station, Units 1 and 2; Exemption

#### 1.0 Background

Duke Power Company (the licensee) is the holder of Facility Operating License Nos. NPF–9 and NPF–17 that authorizes operation of the McGuire Nuclear Station, Units 1 and 2 (McGuire). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the U.S. Nuclear Regulatory Commission (NRC, the Commission) now or hereafter in effect.

The facility consists of two pressurized water reactors located in Mecklenburg County, North Carolina.

#### 2.0 Request/Action

Title 10 of the Code of Federal Regulations (10 CFR) section 50.60(a), requires that the fracture toughness and material surveillance requirements of Appendix G to part 50 must be met for the reactor coolant pressure boundary. Appendix G to part 50 requires that pressure and temperature (P/T) limits be established for reactor pressure vessels (RPVs) during normal operating and hydrostatic or leak rate testing conditions. Specifically, section IV.A.2.a of Appendix G to 10 CFR part 50 states that “The appropriate requirements on both the pressure-temperature limits and the minimum permissible temperature must be met for all conditions.” Further, section IV.A.2.b of Appendix G to 10 CFR part 50 requires that these P/T limits must be at least as conservative as limits obtained by following the methods of analysis and the margins of safety of Appendix G to section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code). The current ASME Code of Record for McGuire is the 1995 edition through 1996 addenda of the ASME Code. The McGuire Code of Record does not incorporate the provisions of ASME Code Case N–641. Although the provisions of ASME Code Case N–641 were incorporated into Appendix G to section XI of the ASME Code in the 1998 edition through 2000 addenda, which is the latest edition and addenda codified in 10 CFR 50.55a, McGuire has not adopted this edition and consequently must meet its Code of Record to comply with Appendix G to part 50. Therefore, in this case, the

licensee is still required to obtain an exemption to apply Code Case N–641.

In order to address provisions of amendments to the McGuire Technical Specification (TS) P/T limit curves, the licensee requested in its submittal dated December 12, 2002, as supplemented by letters dated March 27 and April 23, 2003, that the NRC staff exempt McGuire from application of specific requirements of 10 CFR 50.60 and Appendix G to 10 CFR part 50, and substitute the use of ASME Code Case N–641. ASME Code Case N–641 permits the use of an alternate reference fracture toughness curve for RPV materials and permits the postulation of a circumferentially-oriented flaw for the evaluation of circumferential RPV welds when determining the P/T limits. The proposed exemption request is consistent with, and is needed to support, the McGuire TS amendment that was contained in the same submittal. The proposed McGuire TS amendment will revise the P/T limits for heatup, cooldown, and inservice test limitations for the reactor coolant system (RCS) through 34 effective full power years of operation.

#### Code Case N–641

The licensee has proposed an exemption to allow the use of ASME Code Case N–641 in conjunction with Appendix G to ASME section XI, 10 CFR 50.60(a) and 10 CFR part 50, Appendix G, to establish the P/T limits for the McGuire, Units 1 and 2 RPVs.

The proposed TS amendment to revise the P/T limits for McGuire, Units 1 and 2, relies in part, on the requested exemption. These revised P/T limits have been developed using the lower bound  $K_{IC}$  fracture toughness curve shown in ASME, section XI, Appendix A, Figure A–2200–1, in lieu of the lower bound  $K_{IA}$  fracture toughness curve of ASME, section XI, Appendix G, Figure G–2210–1, as the basis fracture toughness curve for defining the McGuire P/T limits. In addition, the revised P/T limits have been developed based on the use of a postulated circumferentially-oriented flaw for the evaluation of RPV circumferential welds in lieu of the axially-oriented flaw that would be required by Appendix G to section XI of the ASME Code. The other margins involved with the ASME section XI, Appendix G, process of determining P/T limit curves remain unchanged.

Use of the  $K_{IC}$  curve as the basis fracture toughness curve for the development of P/T operating limits is technically correct. The  $K_{IC}$  curve appropriately implements the use of a relationship based on static initiation

fracture toughness behavior to evaluate the controlled heatup and cooldown process of a RPV, whereas the  $K_{IA}$  fracture toughness curve codified into Appendix G to section XI of the ASME Code was developed from more conservative crack arrest and dynamic fracture toughness test data. The application of the  $K_{IA}$  fracture toughness curve was initially codified in Appendix G to section XI of the ASME Code in 1974 to provide a conservative representation of RPV material fracture toughness. This initial conservatism was necessary due to the limited knowledge of RPV material behavior in 1974. However, additional knowledge has been gained about RPV materials that demonstrates the lower bound on fracture toughness provided by the  $K_{IA}$  fracture toughness curve is well beyond the margin of safety required to protect the public health and safety from potential RPV failure.

Likewise, the use of a postulated circumferentially-oriented flaw in lieu of an axially-oriented one for the evaluation of a circumferential RPV weld is more technically correct. The size of flaw required to be postulated for P/T limit determination has a depth of one-quarter of the RPV wall thickness and a length six times the depth. Based on the direction of welding during the fabrication process, the only technically reasonable orientation for such a large flaw is for the plane of the flaw to be circumferentially-oriented (*i.e.*, parallel to the direction of welding). Prior to the development of ASME Code Case N–641 (and the similar ASME Code Case N–588), the required postulation of an axially-oriented flaw for the evaluation of a circumferential RPV weld has provided an additional, unnecessary level of conservatism to the overall evaluation.

In addition, P/T limit curves based on the  $K_{IC}$  fracture toughness curve and postulation of a circumferentially-oriented flaw for the evaluation of RPV circumferential welds will enhance overall plant safety by expanding the P/T operating window with the greatest safety benefit being in the region of low temperature operations. The operating window through which the operator heats up and cools down the RCS is determined by the difference between the maximum allowable pressure determined by Appendix G of ASME section XI, and the minimum required pressure for the reactor coolant pump seals adjusted for instrument uncertainties. A narrow operating window could potentially have an adverse safety impact by increasing the possibility of inadvertent overpressure protection system actuation due to