UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
OFFICE OF NEW REACTORS
WASHINGTON, DC 20555-0001
March 5, 2013

NRC INFORMATION NOTICE 2013-03: RECENT ISSUE WITH THE DEFINITION OF CORE QUADRANT

## ADDRESSEES

All holders of an operating license or construction permit for a nuclear power reactor under Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

All holders of or applicants for an early site permit, standard design certification, standard design approval, manufacturing license, or combined license under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

## PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of a recent issue regarding the definition of "core quadrants" as it applies to source range monitors (SRMs) in the context of fuel movement and core alterations. The NRC expects recipients to review the information within this IN for applicability to their facilities and consider actions, as appropriate. However, suggestions contained in this IN are not NRC requirements; therefore, no specific action or written response is required.

## BACKGROUND

SRMs monitor the neutron level at very low flux levels in the core during refueling and startup. As such, the SRM indication is used to monitor the approach to criticality and to determine when criticality is achieved. The SRMs are maintained fully inserted until the count rate is greater than a minimum allowed count rate (a control rod block is set at this condition). After SRM-to-intermediate range monitor overlap is demonstrated during startup, the SRMs are normally fully withdrawn from the core. During refueling operations, SRM operability is important to monitoring the state of the core. Revision 4.0 of Standard Technical Specifications (STS) Bases state, "The SRMs provide monitoring of reactivity changes during fuel and control rod movement and give control room operators early indication of unexpected subcritical multiplication that could be indicative of an approach to criticality."

## DESCRIPTION OF CIRCUMSTANCES

During an NRC inspection at the James A. FitzPatrick Nuclear Power Plant (FitzPatrick) located in Scriba, New York, NRC inspectors reviewed the control and monitoring of core alterations during refueling activities. The FitzPatrick plant is a boiling-water reactor design facility. The reactor core contains four installed SRMs to monitor reactivity changes during fuel or control rod movement. During the refueling operations, the NRC inspectors observed that one of the four installed SRMs was inoperable. When the inspectors inquired with the FitzPatrick staff on how

the fuel movement was being controlled such that no movements would be performed in the core quadrant that contained the inoperable SRM, the plant staff responded that, in accordance with their plant procedure, refueling operations could proceed in any of the core locations with any single SRM out of service based on a definition of "core quadrant" that was developed and adopted by the plant staff in 2004. The inspectors reviewed the issue of SRM operability requirements during refueling operations to determine whether the FitzPatrick definition of a core quadrant, was consistent with the plant's technical specification (TS) requirements.

The FitzPatrick reactor core consists of 560 fuel assemblies arranged symmetrically in an octagonal configuration. Due to this symmetry, the core can be divided into four equal quadrants, using two perpendicular axes (000°–180° and 090°–270°) that cross at the geometric center of the core. The reactor core also contains four installed SRMs, with one in each of the quadrants, as described above. This definition of core quadrant is consistent with that described in the Task Interface Agreement (TIA) 2012-01, "James A. Fitzpatrick Nuclear Power Plant Definition of Core Quadrant," dated November 8, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12290A287). The NRC staff believes this definition ensures quadrants are symmetric and that installed SRMs will be capable of effectively monitor reactivity changes throughout the core.

During core alterations (movement of fuel or control rods within the reactor vessel), FitzPatrick's TS surveillance requirement 3.3.1.2.2 requires that an operable SRM be located in the core quadrant where core alterations are being performed and that a second operable SRM be located in an adjacent core quadrant. FitzPatrick's TS bases state that the two required SRMs provide redundant monitoring of reactivity changes during fuel or control rod movement and give the control room operators early indication of unexpected subcritical multiplication that could be indicative of an approach to criticality. The TS bases indicate that while the SRMs have no safety function and are not assumed to function during any design basis accident or transient analysis, these instruments provide on-scale monitoring of neutron flux levels during refueling and startup. The FitzPatrick's TS bases also require one operable SRM in the quadrant where core alterations are being performed and one operable SRM in an adjacent quadrant, which addresses the local nature of reactivity changes and ensures that core reactivity will be continuously monitored during alterations. However, the TS currently do not define the term "core quadrant."

The inspectors identified that core quadrant, as defined in FitzPatrick's plant procedures, is based on the axes of the SRM locations rather than the geometric center of the core. This orientation resulted in quadrant axes that are rotated approximately 16° clockwise from the arrangement that was described above, and it resulted in quadrant boundaries that bisect individual fuel assemblies. FitzPatrick's personnel determined that such fuel assemblies could be considered to reside in either of the adjacent quadrants. The inspectors reviewed specific documents referenced by the plant personnel as support for its definition of core quadrant, and determined that there did not appear to be any analytical support for the plant's definition of core quadrant as implemented in procedure changes. Additional information is available in TIA 2012-01.

**DISCUSSION**

Because there was no specific definition of core quadrant found in FitzPatrick's TS, technical requirements manual (TRM), or final safety analysis report, the plant personnel developed and incorporated into the plant procedures, its own primary and alternate core quadrant definitions, which are designed to minimize the impact of an inoperable SRM on refueling operations.

The two core quadrant definitions, as defined in the plant procedures, are (1) the quadrant boundaries are rotated around the geometric center of the SRMs 16° clockwise from the north-south and east-west axes and (2) the alternate definition consists of quadrant boundaries rotated 70° counterclockwise from the major axis. FitzPatrick's licensee claims that these rotations leave the SRM within the redefined quadrant and that application of these two definitions simultaneously allows the refueling operations to proceed in any core location with any single SRM inoperable.

The NRC staff conducted a detailed evaluation of the licensee's definition of the core quadrant issue based on technical, regulatory, and safety criteria using available documents at the NRC that were obtained from the licensee. The NRC staff, upon evaluating this information, concluded that the SRM quadrant rotation results in asymmetric quadrants with unequal areas. Due to the asymmetry in quadrants, the NRC staff found that the SRMs' ability to monitor reactivity changes during core alterations will be adversely affected.

In the case described in this IN, the licensee has interpreted the definition of TS core quadrants without considering seeking a license amendment or obtaining clarification from the NRC to define the core quadrant. The licensee indicated that the definition of quadrant, in absence of any specific guidance, is based on engineering judgment. The NRC staff maintains that neither the plant's TS nor its design documents provide authority to the licensee to define the "core quadrants," in a situation(s) when one or more SRMs is found to be inoperable, without performing a supporting neutronics calculation.

The NRC staff, on evaluation of the licensee documentation supporting the core quadrant redefinition, concluded that the licensee's definition will result in asymmetric core quadrants with an adverse effect on the SRMs' ability to monitor reactivity changes. Furthermore, when the quadrant axes are rotated, the distance between the SRM and the location of possible core alterations within the quadrant would be increased, further reducing the SRMs' ability to detect reactivity changes and monitor for unexpected subcritical multiplication during refueling. The NRC staff also determined that no neutronics calculations were performed by the licensee to support the licensee's position that when one core SRM is found to be inoperable, the functional SRMs will remain coupled to the area of the core where alterations are being performed and will be capable of detecting increases in subcritical multiplication.

<u>The NRC staff review of the Licensee's 10 CFR 50.59 Screening</u>

As discussed in TIA 2012-01, the NRC staff reviewed the licensee's 10 CFR 50.59 screen control form establishing the licensee's definition of core quadrant for FitzPatrick. The NRC staff identified that the licensee answered the 10 CFR 50.59 screening question: "Does the proposed activity invalidate, render incorrect or otherwise require a change to an existing Technical Specification or the Facility Operating License?" with a "NO" for TS change and proceeded to perform the core quadrant rotation during the refueling mode. For questions, "Does the proposed activity: (1) Invalidate or render incorrect an existing Technical

Specification Bases?, (2) Require a change to Technical Specification Bases?, (3) Affect the TRM or program described in TRM?" the licensee also answered "NO". As stated in the TIA, the NRC staff noted that, "(a) the Entergy definition of core quadrant represents a change to the plant TS that requires prior review and approval by the NRC staff as specified in 10 CFR 50.59 before it could be implemented and is therefore not acceptable, and (b) implementing the Entergy definition of core quadrant does not satisfy TS 3.3.1.2 SRM operability requirements during core alterations."

The NRC staff determined that by answering "NO" to the 10 CFR 50.59 screening questions described above, the licensee proceeded to define the core quadrants, thereby implementing a new interpretation of TS, without also performing a supporting neutronics calculation. Therefore, the NRC staff concluded that the licensee's use of the 10 CFR 50.59 process resulted in the licensee implementing a new definition for the TS plain language meaning of the term "core quadrant." Additional information on the licensee's subject 10 CFR 50.59 screening is available in TIA 2012-01.

**CONCLUSION**

As documented in TIA 2012-01, the NRC staff found that the licensee's definition of core quadrant that places SRMs near the quadrant edge will increase the distance between the SRM and reactivity changes due to refueling activities within the quadrant. This distance increase is compounded by the portion of the definition wherein the center of the quadrant axes is not the geometric center of the core, resulting in asymmetric quadrants with unequal areas. In the absence of supporting neutronics calculations, the NRC staff concluded that the asymmetric definition of quadrants will adversely affect the ability of the SRMs to monitor reactivity changes in the core. Moreover, the NRC staff concluded in TIA 2012-01 that the licensee's definition of core quadrant is not acceptable, and that implementing the licensee's definition of "core quadrant" does not comply with the TS 3.3.1.2 SRM operability requirements during core alterations.

**CONTACTS**

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or to the appropriate NRC project manager.

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Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under NRC Library.

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