

UNITED STATES OF AMERICA  
NUCLEAR REGULATORY COMMISSION

In the Matter of	)	
	)	
ALL POWER REACTOR	)	Docket Nos. (as shown in Attachment 1)
LICENSEES AND HOLDERS	)	License Nos. (as shown in Attachment 1) or
OF CONSTRUCTION PERMITS IN	)	Construction Permit Nos. (as shown in
ACTIVE OR DEFERRED STATUS	)	Attachment 1)
	)	
	)	EA-12-XXX

**ORDER MODIFYING LICENSES  
WITH REGARD TO RELIABLE SPENT FUEL POOL INSTRUMENTATION  
(EFFECTIVE IMMEDIATELY)**

I.

The Licensees and construction permit (CP) holders<sup>1</sup> identified in Attachment 1 to this Order hold licenses issued by the U.S. Nuclear Regulatory Commission (NRC or Commission) authorizing operation and/or construction of nuclear power plants in accordance with the Atomic Energy Act of 1954, as amended, and Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," and Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants."

II.

On March 11, 2011, a magnitude 9.0 earthquake struck off the coast of the Japanese island of Honshu. The earthquake resulted in a large tsunami, estimated to have exceeded 14 meters (45 feet) in height, that inundated the Fukushima Dai-ichi Nuclear Power Plant site.

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<sup>1</sup> CP holders, as used in this Order, includes CPs, in active or deferred status, as identified in Attachment 1 to this Order (i.e., Watts Bar, Unit 2; and Bellefonte, Units 1 and 2)

The earthquake and tsunami produced widespread devastation across northeastern Japan and significantly affected the infrastructure and industry in the northeastern coastal areas of Japan.

When the earthquake occurred, Fukushima Dai-ichi Units 1, 2, and 3 were in operation and Units 4, 5, and 6 were shut down for routine refueling and maintenance activities. The Unit 4 reactor fuel was offloaded to the Unit 4 spent fuel pool. Following the earthquake, the three operating units automatically shut down and offsite power was lost to the entire facility. The emergency diesel generators (EDGs) started at all six units providing alternating current (ac) electrical power to critical systems at each unit. The facility response to the earthquake appears to have been normal.

Approximately 40 minutes following the earthquake and shutdown of the operating units, the first large tsunami wave inundated the site, followed by additional waves. The tsunami caused extensive damage to site facilities and resulted in a complete loss of all ac electrical power at Units 1 through 5, a condition known as station blackout. In addition, all direct current electrical power was lost early in the event on Units 1 and 2 and for some period of time at the other units. Unit 6 retained the function of one air-cooled EDG. Despite their actions, the operators lost the ability to cool the fuel in the Unit 1 reactor after several hours, in the Unit 2 reactor after about 70 hours, and in the Unit 3 reactor after about 36 hours, resulting in damage to the nuclear fuel shortly after the loss of cooling capabilities.

The Unit 4 spent fuel pool contained the highest heat load of the six units with the full core present in the spent fuel pool and the refueling gates installed. However, because Unit 4 had been shut down for more than 3 months, the heat load was low relative to that present in spent fuel pools in the United States following shutdown for reactor refueling. Following the earthquake and tsunami, the operators in the Units 3 and 4 control room focused their efforts on stabilizing the Unit 3 reactor. During the event, concern grew that the spent fuel was

overheating, causing a high-temperature reaction of steam and zirconium fuel cladding generating hydrogen gas. This concern persisted primarily due to a lack of readily available and reliable information on water levels in the spent fuel pools. Helicopter water drops, water cannons, and cement delivery vehicles with articulating booms were used to refill the pools, which diverted resources and attention from other efforts. Subsequent analysis determined that the water level in the Unit 4 spent fuel pool did not drop below the top of the stored fuel and no significant fuel damage occurred. The lack of information on the condition of the spent fuel pools contributed to a poor understanding of possible radiation releases and adversely impacted effective prioritization of emergency response actions by decision makers.

Following the events at the Fukushima Dai-ichi nuclear power plant, the NRC established a senior-level agency task force referred to as the Near-Term Task Force (NTTF). The NTTF was tasked with conducting a systematic and methodical review of the NRC regulations and processes and determining if the agency should make additional improvements to these programs in light of the events at Fukushima Dai-ichi. As a result of this review, the NTTF developed a comprehensive set of recommendations, documented in SECY-11-0093, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," dated July 12, 2011. These recommendations were modified by the NRC staff following interactions with stakeholders. Documentation of the NRC staff's efforts is contained in SECY-11-0124, "Recommended Actions To Be Taken Without Delay From the Near-Term Task Force Report," dated September 9, 2011, and SECY-11-0137, "Prioritization of Recommended Actions To Be Taken in Response to Fukushima Lessons Learned," dated October 3, 2011.

As directed by the Commission's Staff Requirements Memorandum (SRM) for SECY-11-0093, the NRC staff reviewed the NTTF recommendations within the context of the NRC's existing regulatory framework and considered the various regulatory vehicles available to

the NRC to implement the recommendations. SECY-11-0124 and SECY-11-0137 established the NRC staff's prioritization of the recommendations based upon the potential safety enhancements.

Current regulatory requirements and existing plant capabilities allow the NRC to conclude that a sequence of events such as the Fukushima Dai-ichi accident is unlikely to occur in the United States. Therefore, continued operation and continued licensing activities do not pose an imminent threat to public health and safety. However, the NRC's assessment of new insights from the events at Fukushima Dai-ichi leads the NRC staff to conclude that additional requirements must be imposed on Licensees and CP holders to increase the capability of nuclear power plants to mitigate beyond-design-basis external events. These additional requirements are needed to provide adequate protection to public health and safety, as set forth in Section III of this Order.

Additional details on an acceptable approach for complying with this Order will be contained in final interim staff guidance (ISG) scheduled to be issued by the NRC in August 2012. This guidance will include a template to be used for the plan that will be submitted in accordance with Section IV, Condition C.1 below.

### III.

Reasonable assurance of adequate protection of public health and safety and assurance of the common defense and security are the fundamental NRC regulatory objectives. Compliance with NRC requirements plays a critical role in giving the NRC confidence that Licensees and CP holders are maintaining an adequate level of public health and safety and common defense and security. While compliance with NRC requirements presumptively ensures adequate protection, new information may reveal that additional requirements are warranted. In such situations, the Commission may act in accordance with its statutory authority

under Section 161 of the Atomic Energy Act of 1954, as amended, to require Licensees and CP holders to take action in order to protect health and safety and common defense and security.

To protect public health and safety from the inadvertent release of radioactive materials, the NRC's defense-in-depth strategy includes multiple layers of protection: (1) prevention of accidents by virtue of the design, construction, and operation of the plant; (2) mitigation features to prevent radioactive releases should an accident occur; and (3) emergency preparedness programs that include measures such as sheltering and evacuation. The defense-in-depth strategy also provides for multiple physical barriers to contain the radioactive materials in the event of an accident. The barriers are the fuel cladding, the reactor coolant pressure boundary, and the containment. These defense-in-depth features are embodied in the existing regulatory requirements and thereby provide adequate protection of public health and safety.

In the case of spent fuel pools, compliance with existing regulations and guidance presumptively provides reasonable assurance of the safe storage of spent fuel. In particular, Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50 establishes the general design criteria (GDC) for nuclear power plants. All currently operating reactors were licensed to the GDC or meet the intent of the GDC. The GDC provide the design features of the spent fuel storage and handling systems and the protection of these systems from natural phenomena and operational events. The accidents considered during licensing of U.S. nuclear power plants typically include failure of the forced cooling system and loss of spent fuel pool inventory at a specified rate within the capacity of the makeup water system. Further, spent fuel pools at U.S. nuclear power plants rely on maintenance of an adequate inventory of water under accident conditions to provide containment, as well as the cooling and shielding safety functions.

During the events in Fukushima, responders were without reliable instrumentation to determine water level in the spent fuel pool. This caused concerns that the pool may have boiled

dry, resulting in fuel damage.<sup>2</sup> Fukushima demonstrated the confusion and misapplication of resources that can result from beyond-design-basis external events when adequate instrumentation is not available.

The spent fuel pool level instrumentation at U.S. nuclear power plants is typically narrow range and, therefore, only capable of monitoring normal and slightly off-normal conditions. Although the likelihood of a catastrophic event affecting nuclear power plants and the associated spent fuel pools in the United States remains very low, beyond-design-basis external events could challenge the ability of existing instrumentation to provide emergency responders with reliable information on the condition of spent fuel pools. Reliable and available indication is essential to ensure plant personnel can effectively prioritize emergency actions.

Accordingly, the NRC has concluded that there is a need to redefine the level of protection of public health and safety regarded as adequate under the provisions of the backfit rule, 10 CFR 50.109(a)(4)(iii), and is requiring actions of Licensees and CP holders to meet the new level of protection. In addition, pursuant to 10 CFR 2.202, the NRC finds that the public health, safety and interest require that this Order be made immediately effective.

The Commission has determined that adequate protection of public health and safety requires that all power reactor Licensees and CP holders have a reliable means of remotely monitoring wide-range spent fuel pool levels to support effective prioritization of event mitigation and recovery actions in the event of a beyond-design-basis external event. These new requirements provide a greater capability, consistent with the overall defense-in-depth philosophy, and therefore greater assurance that the challenges posed by beyond-design-basis external events to power reactors do not pose an undue risk to public health and safety. In order

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<sup>2</sup> See *Institute of Nuclear Power Operations (INPO) 11-005, "Special Report on the Nuclear Accident at the Fukushima Daiichi Nuclear Power Station," Revision 0, issued November 2011, p. 36.*

to provide reasonable assurance of adequate protection of public health and safety, all operating reactor licenses and CPs under Part 50 identified in Attachment 1 to this Order shall be modified to include the requirements identified in Attachment 2 to this Order. All combined licenses (COLs) under Part 52 identified in Attachment 1 to this Order shall be modified to include the requirements identified in Attachment 3 to this Order.

IV.

Accordingly, pursuant to Sections 161b, 161i, 161o, and 182 of the Atomic Energy Act of 1954, as amended, and the Commission's regulations in 10 CFR 2.202, and 10 CFR Parts 50 and 52, IT IS HEREBY ORDERED, EFFECTIVE IMMEDIATELY, THAT ALL LICENSES AND CONSTRUCTION PERMITS IDENTIFIED IN ATTACHMENT 1 TO THIS ORDER ARE MODIFIED AS FOLLOWS:

- A.
  1. All holders of CPs issued under Part 50 shall, notwithstanding the provisions of any Commission regulation or CP to the contrary, comply with the requirements described in Attachment 2 to this Order except to the extent that a more stringent requirement is set forth in the CP. These CP holders shall complete full implementation **prior to issuance of an operating license.**
  2. All holders of operating licenses issued under Part 50 shall, notwithstanding the provisions of any Commission regulation or license to the contrary, comply with the requirements described in Attachment 2 to this Order except to the extent that a more stringent requirement is set forth in the license. These Licensees shall promptly start implementation of the requirements in Attachment 2 to the Order and shall complete full implementation **no later than two (2) refueling cycles after submittal of the overall integrated plan, as required in Condition C.1.a, or December 31, 2016, whichever comes first.**

3. All holders of COLs issued under Part 52 shall, notwithstanding the provisions of any Commission regulation or license to the contrary, comply with the requirements described in Attachment 3 to this Order except to the extent that a more stringent requirement is set forth in the license. These Licensees shall promptly start implementation of the requirements in Attachment 3 to the Order and shall complete full implementation prior to initial fuel load.
- B.
1. All Licensees and CP holders shall, **within twenty (20) days** of the date of this Order, notify the Commission (1) if they are unable to comply with any of the requirements described in Attachment 2 or Attachment 3, (2) if compliance with any of the requirements is unnecessary in their specific circumstances, or (3) if implementation of any of the requirements would cause the Licensee or CP holder to be in violation of the provisions of any Commission regulation or the facility license. The notification shall provide the Licensee's or CP holder's justification for seeking relief from or variation of any specific requirement.
  2. Any Licensee or CP holder that considers that implementation of any of the requirements described in Attachment 2 or Attachment 3 to this Order would adversely impact safe and secure operation of the facility must notify the Commission, **within twenty (20) days** of this Order, of the adverse impact, the basis for its determination that the requirement has an adverse impact, and either a proposal for achieving the same objectives specified in the Attachment 2 or Attachment 3 requirement in question, or a schedule for modifying the facility to address the adverse condition. If neither approach is appropriate, the Licensee or CP holder must supplement its response to Condition B.1 of this Order to

identify the condition as a requirement with which it cannot comply, with attendant justifications as required in Condition B.1.

- C. 1. a. All holders of operating licenses issued under Part 50 shall **by February 28, 2013**, submit to the Commission for review an overall integrated plan, including a description of how compliance with the requirements described in Attachment 2 will be achieved.
- b. All holders of CPs issued under Part 50 or COLs issued under Part 52 shall, **within one (1) year** after issuance of the final ISG, submit to the Commission for review an overall integrated plan, including a description of how compliance with the requirements described in Attachment 2 or Attachment 3 will be achieved.
2. All Licensees and CP holders shall provide an initial status report **sixty (60) days** after the issuance of the final ISG, and **at six (6)-month intervals** following submittal of the overall integrated plan, as required in Condition C.1, which delineates progress made in implementing the requirements of this Order.
3. All Licensees and CP holders shall report to the Commission when full compliance with the requirements described in Attachment 2 or Attachment 3 is achieved.

Licensee or CP holder responses to Conditions B.1, B.2, C.1, C.2, and C.3, above, shall be submitted in accordance with 10 CFR 50.4 and 10 CFR 52.3, as applicable.

As applicable, the Director, Office of Nuclear Reactor Regulation or the Director, Office of New Reactors may, in writing, relax or rescind any of the above conditions upon demonstration by the Licensee or CP holder of good cause.

V.

In accordance with 10 CFR 2.202, the Licensee or CP holder must, and any other person adversely affected by this Order may, submit an answer to this Order, and may request a hearing on this Order, **within twenty (20) days** of the date of this Order. Where good cause is shown, consideration will be given to extending the time to answer or to request a hearing. A request for extension of time in which to submit an answer or request a hearing must be made in writing to the Director, Office of Nuclear Reactor Regulation or to the Director, Office of New Reactors, U.S. Nuclear Regulatory Commission, Washington, DC 20555, and include a statement of good cause for the extension. The answer may consent to this Order.

If a hearing is requested by a Licensee, CP holder, or a person whose interest is adversely affected, the Commission will issue an Order designating the time and place of any hearings. If a hearing is held, the issue to be considered at such hearing shall be whether this Order should be sustained. Pursuant to 10 CFR 2.202(c)(2)(i), the Licensee, CP holder, or any other person adversely affected by this Order, may, in addition to demanding a hearing, at the time the answer is filed or sooner, move the presiding officer to set aside the immediate effectiveness of the Order on the ground that the Order, including the need for immediate effectiveness, is not based on adequate evidence but on mere suspicion, unfounded allegations, or error.

All documents filed in NRC adjudicatory proceedings, including a request for hearing, a petition for leave to intervene, any motion or other document filed in the proceeding prior to the submission of a request for hearing or petition to intervene, and documents filed by interested governmental entities participating under 10 CFR 2.315(c), must be filed in accordance with the NRC E-Filing rule (72 FR 49139, August 28, 2007). The E-Filing process requires participants to submit and serve all adjudicatory documents over the internet, or in some cases to mail copies on electronic storage media. Participants may not submit paper copies of their filings unless they seek an exemption in accordance with the procedures described below.

To comply with the procedural requirements of E-Filing, at least 10 days prior to the filing deadline, the participant should contact the Office of the Secretary by e-mail at [hearing.docket@nrc.gov](mailto:hearing.docket@nrc.gov), or by telephone at (301) 415-1677, to request (1) a digital ID certificate, which allows the participant (or its counsel or representative) to digitally sign documents and access the E-Submittal server for any proceeding in which it is participating; and (2) advise the Secretary that the participant will be submitting a request or petition for hearing (even in instances in which the participant, or its counsel or representative, already holds an NRC-issued digital ID certificate). Based upon this information, the Secretary will establish an electronic docket for the hearing in this proceeding if the Secretary has not already established an electronic docket.

Information about applying for a digital ID certificate is available on NRC's public Web site at <http://www.nrc.gov/site-help/e-submittals/apply-certificates.html>. System requirements for accessing the E-Submittal server are detailed in NRC's "Guidance for Electronic Submission," which is available on the agency's public Web site at <http://www.nrc.gov/site-help/esubmittals.html>. Participants may attempt to use other software not listed on the web site, but should note that the NRC's E-Filing system does not support unlisted software, and the NRC Meta System Help Desk will not be able to offer assistance in using unlisted software.

If a participant is electronically submitting a document to the NRC in accordance with the E-Filing rule, the participant must file the document using the NRC's online, web-based submission form. In order to serve documents through the Electronic Information Exchange, users will be required to install a web browser plug-in from the NRC web site. Further information on the web-based submission form, including the installation of the Web browser plug-in, is available on the NRC's public web site at <http://www.nrc.gov/site-help/esubmittals.html>.

Once a participant has obtained a digital ID certificate and a docket has been created, the participant can then submit a request for hearing or petition for leave to intervene. Submissions should be in Portable Document Format (PDF) in accordance with NRC guidance available on the NRC public Web site at <http://www.nrc.gov/site-help/e-submittals.html>. A filing is considered complete at the time the documents are submitted through the NRC's E-Filing system. To be timely, an electronic filing must be submitted to the E-Filing system no later than 11:59 p.m. Eastern Time on the due date. Upon receipt of a transmission, the E-Filing system time-stamps the document and sends the submitter an e-mail notice confirming receipt of the document. The E-Filing system also distributes an e-mail notice that provides access to the document to the NRC Office of the General Counsel and any others who have advised the Office of the Secretary that they wish to participate in the proceeding, so that the filer need not serve the documents on those participants separately. Therefore, applicants and other participants (or their counsel or representative) must apply for and receive a digital ID certificate before a hearing request/petition to intervene is filed so that they can obtain access to the document via the E-Filing system.

A person filing electronically using the agency's adjudicatory E-Filing system may seek assistance by contacting the NRC Meta System Help Desk through the "Contact Us" link located on the NRC web site at <http://www.nrc.gov/site-help/e-submittals.html>, by e-mail at [MSHD.Resource@nrc.gov](mailto:MSHD.Resource@nrc.gov), or by a toll-free call at (866) 672-7640. The NRC Meta System Help Desk is available between 8 a.m. and 8 p.m., Eastern Time, Monday through Friday, excluding government holidays.

Participants who believe that they have a good cause for not submitting documents electronically must file an exemption request, in accordance with 10 CFR 2.302(g), with their initial paper filing requesting authorization to continue to submit documents in paper format. Such filings must be submitted by: (1) first class mail addressed to the Office of the Secretary of

the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, Attention: Rulemaking and Adjudications Staff; or (2) courier, express mail, or expedited delivery service to the Office of the Secretary, Sixteenth Floor, One White Flint North, 11555 Rockville Pike, Rockville, Maryland, 20852, Attention: Rulemaking and Adjudications Staff. Participants filing a document in this manner are responsible for serving the document on all other participants. Filing is considered complete by first-class mail as of the time of deposit in the mail, or by courier, express mail, or expedited delivery service upon depositing the document with the provider of the service. A presiding officer, having granted an exemption request from using E-Filing, may require a participant or party to use E-Filing if the presiding officer subsequently determines that the reason for granting the exemption from use of E-Filing no longer exists.

Documents submitted in adjudicatory proceedings will appear in NRC's electronic hearing docket, which is available to the public at [http://ehd.nrc.gov/EHD\\_Proceeding/home.asp](http://ehd.nrc.gov/EHD_Proceeding/home.asp), unless excluded pursuant to an order of the Commission, or the presiding officer. Participants are requested not to include personal privacy information, such as social security numbers, home addresses, or home phone numbers in their filings, unless an NRC regulation or other law requires submission of such information. With respect to copyrighted works, except for limited excerpts that serve the purpose of the adjudicatory filings and would constitute a Fair Use application, participants are requested not to include copyrighted materials in their submission.

If a person other than the Licensee or CP holder requests a hearing, that person shall set forth with particularity the manner in which his interest is adversely affected by this Order and shall address the criteria set forth in 10 CFR 2.309(d).

In the absence of any request for hearing, or written approval of an extension of time in which to request a hearing, the provisions specified in Section IV above shall be final twenty (20) days from the date of this Order without further order or proceedings. If an extension of time for

requesting a hearing has been approved, the provisions specified in Section IV shall be final when the extension expires if a hearing request has not been received. AN ANSWER OR A REQUEST FOR HEARING SHALL NOT STAY THE IMMEDIATE EFFECTIVENESS OF THIS ORDER.

FOR THE NUCLEAR REGULATORY COMMISSION

Eric J. Leeds, Director  
Office of Nuclear Reactor Regulation

Michael R. Johnson, Director  
Office of New Reactors

Dated this \_\_\_\_ day of March 2012

POWER REACTOR LICENSEES AND LICENSEES  
WITH ACTIVE AND/OR DEFERRED CONSTRUCTION PERMITS

Arkansas Nuclear One, Units 1 and 2  
Entergy Nuclear Operations, Inc.  
London, AR  
Docket Nos. 50-313 and 50-368  
License Nos. DPR-51 and NPF-6

Beaver Valley Power Station, Units 1 and 2  
First Energy Nuclear Operating Co.  
Shippingport, PA  
Docket Nos. 50-334 and 50-412  
License Nos. DPR-66 and NPF-73

Bellefonte Nuclear Power Station, Units 1 and 2  
Tennessee Valley Authority  
Scottsboro, AL  
Docket Nos. 50-438 and 50-439  
Construction Permit Nos. CPPR-122 and CPPR-123

Braidwood Station, Units 1 and 2  
Exelon Generation Co., LLC  
Braceville, IL  
Docket Nos. 50-456 and 50-457  
License Nos. NPF-72 and NPF-77

Browns Ferry Nuclear Plant, Units 1, 2 and 3  
Tennessee Valley Authority  
Athens, AL  
Docket Nos. 50-259, 50-260, and 50-296  
License Nos. DPR-33, DPR-52 and DPR-68

Brunswick Steam Electric Plant, Units 1 and 2  
Carolina Power & Light Co.  
Southport, NC  
Docket Nos. 50-325 and 50-324  
License Nos. DPR-71 and DPR-62

Byron Station, Units 1 and 2  
Exelon Generation Co., LLC  
Byron, IL  
Docket Nos. 50-454 and 50-455  
License Nos. NPF-37 and NPF-66

Callaway Plant  
Union Electric Co.  
Fulton, MO  
Docket No. 50-483  
License No. NPF-30

Calvert Cliffs Nuclear Power Plant, Units 1 and 2  
Calvert Cliffs Nuclear Power Plant, Inc.  
Lusby, MD  
Docket Nos. 50-317 and 50-318  
License Nos. DPR-53 and DPR-69

Catawba Nuclear Station, Units 1 and 2  
Duke Energy Carolinas, LLC  
York, SC  
Docket Nos. 50-413 and 50-414  
License Nos. NPF-35 and NPF-52

Clinton Power Station, Unit 1  
Exelon Generation Co., LLC  
Clinton, IL  
Docket No. 50-461  
License No. NPF-62

Columbia Generating Station, Unit 2  
Energy Northwest  
Richland, WA  
Docket No. 50-397  
License No. NPF-21

Comanche Peak Steam Electric Station, Units 1 and 2  
Luminant Generation Co., LLC  
Glen Rose, TX  
Docket Nos. 50-445 and 50-446  
License Nos. NPF-87 and NPF-89

Cooper Nuclear Station  
Nebraska Public Power District  
Brownville, NE  
Docket No. 50-298  
License No. DPR-46

Crystal River Nuclear Generating Plant, Unit 3  
Florida Power Corp.  
Crystal River, FL  
Docket No. 50-302  
License No. DPR-72

Davis-Besse Nuclear Power Station, Unit 1  
First Energy Nuclear Operating Co.  
Oak Harbor, OH  
Docket No. 50-346  
License No. NPF-3

Diablo Canyon Nuclear Power Plant, Units 1 and 2  
Pacific Gas & Electric Co.  
Avila Beach, CA  
Docket Nos. 50-275 and 50-323  
License Nos. DPR-80 and DPR-82

Donald C. Cook Nuclear Power Plant, Units 1 and 2  
Indiana Michigan Power Co.  
Bridgman, MI  
Docket Nos. 50-315 and 50-316  
License Nos. DPR-58 and DPR-74

Dresden Nuclear Power Station, Units 2 and 3  
Exelon Generation Co., LLC  
Morris, IL  
Docket Nos. 50-237 and 50-249  
License Nos. DPR-19 and DPR-25

Duane Arnold Energy Center  
FPL Energy Duane Arnold, LLC  
Palo, IA  
Docket No. 50-331  
License No. DPR-49

Edwin I. Hatch Nuclear Plant, Units 1 and 2  
Southern Nuclear Operating Co.  
Baxley, GA  
Docket Nos. 50-321 and Docket No. 50-366  
License Nos. DPR-57 and NPF-5

Fermi, Unit 2  
The Detroit Edison Co.  
Newport, MI  
Docket No. 50-341  
License No. NPF-43

Fort Calhoun Station, Unit 1  
Omaha Public Power District  
Fort Calhoun, NE  
Docket No. 50-285  
License No. DPR-40

Grand Gulf Nuclear Station, Unit 1  
Entergy Nuclear Operations, Inc.  
Port Gibson, MS  
Docket No. 50-416  
License No. NPF-29

H. B. Robinson Steam Electric Plant, Unit 2  
Carolina Power & Light Co.  
Hartsville, SC  
Docket No. 50-261  
License No. DPR-23

Hope Creek Generating Station, Unit 1  
PSEG Nuclear, LLC  
Hancocks Bridge, NJ  
Docket No. 50-354  
License No. NPF-57

Indian Point Nuclear Generating Station, Units 2 and 3  
Entergy Nuclear Operations, Inc.  
Buchanan, NY  
Docket Nos. 50-247 and 50-286  
License Nos. DPR-26 and DPR-64

James A. FitzPatrick Nuclear Power Plant  
Entergy Nuclear Operations, Inc.  
Scriba, NY  
Docket No. 50-333  
License No. DPR-59

Joseph M. Farley Nuclear Plant, Units 1 and 2  
Southern Nuclear Operating Co.  
Columbia, AL  
Docket Nos. 50-348 and 50-364  
License Nos. NPF-2 and NPF-8

Kewaunee Power Station  
Dominion Energy Kewaunee, Inc.  
Kewaunee, WI  
Docket No. 50-305  
License No. DPR-43

LaSalle County Station, Units 1 and 2  
Exelon Generation Co., LLC  
Marseilles, IL  
Docket Nos. 50-373 and 50-374  
License Nos. NPF-11 and NPF-18

Limerick Generating Station, Units 1 and 2  
Exelon Generation Co., LLC  
Limerick, PA  
Docket Nos. 50-352 and 50-353  
License Nos. NPF-39 and NPF-85

McGuire Nuclear Station, Units 1 and 2  
Duke Energy Carolinas, LLC  
Huntersville, NC  
Docket Nos. 50-369 and 50-370  
License Nos. NPF-9 and NPF-17

Millstone Power Station, Units 2 and 3  
Dominion Nuclear Connecticut, Inc.  
Waterford, CT  
Docket Nos. 50-336 and 50-423  
License Nos. DPR-65 and NPF-49

Monticello Nuclear Generating Plant, Unit 1  
Northern States Power Company  
Monticello, MN  
Docket No. 50-263  
License No. DPR-22

Nine Mile Point Nuclear Station, Units 1 and 2  
Nine Mile Point Nuclear Station, LLC  
Scriba, NY  
Docket Nos. 50-220 and 50-410  
License Nos. DPR-63 and NPF-69

North Anna Power Station, Units 1 and 2  
Virginia Electric & Power Co.  
Louisa, VA  
Docket Nos. 50-338 and 50-339  
License Nos. NPF-4 and NPF-7

Oconee Nuclear Station, Units 1, 2, and 3  
Duke Energy Carolinas, LLC  
Seneca, SC  
Docket Nos. 50-269, 50-270, and 50-287  
License Nos. DPR-38, DPR-47, and DPR-55

Oyster Creek Nuclear Generating Station, Unit 1  
Exelon Generation Co., LLC  
Forked River, NJ  
Docket No. 50-219  
License No. DPR-16

Palisades Nuclear Plant  
Entergy Nuclear Operations, Inc.  
Covert, MI  
Docket No. 50-255  
License No. DPR-20

Palo Verde Nuclear Generating Station, Units 1, 2, and 3  
Arizona Public Service Company  
Wintersburg, AZ  
Docket Nos. 50-528, 50-529, and 50-530  
License Nos. NPF-41, NPF-51 and NPF-74

Peach Bottom Atomic Power Station, Units 2 and 3  
Exelon Generation Co., LLC  
Delta, PA  
Docket Nos. 50-277 and 50-278  
License Nos. DPR-44 and DPR-56

Perry Nuclear Power Plant, Unit 1  
First Energy Nuclear Operating Co.  
Perry, OH  
Docket No. 50-440  
License No. NPF-58

Pilgrim Nuclear Power Station  
Entergy Nuclear Operations, Inc.  
Plymouth, MA  
Docket No. 50-293  
License No. DPR-35

Point Beach Nuclear Plant, Units 1 and 2  
FPL Energy Duane Arnold, LLC  
Two Rivers, WI  
Docket Nos. 50-266 and 50-301  
License Nos. DPR-24 and DPR-27

Prairie Island Nuclear Generating Plant, Units 1 and 2  
Northern States Power Co. Minnesota  
Welch, MN  
Docket Nos. 50-282 and 50-306  
License Nos. DPR-42 and DPR-60

Quad Cities Nuclear Power Station, Units 1 and 2  
Exelon Generation Co., LLC  
Morris, IL  
Docket Nos. 50-254 and 50-265  
License Nos. DPR-29 and DPR-30

River Bend Station, Unit 1  
Entergy Nuclear Operations, Inc.  
St. Francisville, LA  
Docket No. 50-458  
License No. NPF-47

R.E. Ginna Nuclear Power Plant  
R.E. Ginna Nuclear Power Plant, LLC  
Ontario, NY  
Docket No. 50-244  
License No. DPR-18

St. Lucie Plant, Units 1 and 2  
Florida Power & Light Co.  
Jensen Beach, FL  
Docket Nos. 50-335 and 50-389  
License Nos. DPR-67 and NPF-16

Salem Nuclear Generating Station, Units 1 and 2  
PSEG Nuclear, LLC  
Hancocks Bridge, NJ  
Docket Nos. 50-272 and 50-311  
License Nos. DPR-70 and DPR-75

San Onofre Nuclear Generating Station, Units 2 and 3  
Southern California Edison Co.  
San Clemente, CA  
Docket Nos. 50-361 and 50-362  
License Nos. NPF-10 and NPF-15

Seabrook Station, Unit 1  
FPL Energy Seabrook, LLC  
Seabrook, NH  
Docket No. 50-443  
License No. NPF-86

Sequoyah Nuclear Plant, Units 1 and 2  
Tennessee Valley Authority  
Soddy-Daisy, TN  
Docket Nos. 50-327 and 50-328  
License Nos. DPR-77 and DPR-79

Shearon Harris Nuclear Power Plant, Unit 1  
Carolina Power & Light Co.  
New Hill, NC  
Docket No. 50-400  
License No. NPF-63

South Texas Project, Units 1 and 2  
STP Nuclear Operating Co.  
Bay City, TX  
Docket Nos. 50-498 and 50-499  
License Nos. NPF-76 and NPF-80

Surry Nuclear Power Station, Units 1 and 2  
Virginia Electric & Power Co.  
Surry, VA  
Docket Nos. 50-280 and 50-281  
License Nos. DPR-32 and DPR-37

Susquehanna Steam Electric Station, Units 1 and 2  
PPL Susquehanna, LLC  
Salem Township, Luzerne Co., PA  
Docket Nos. 50-387 and 50-388  
License Nos. NPF-22 and NPF-14

Three Mile Island Nuclear Station, Unit 1  
Exelon Generation Co., LLC  
Middletown, PA  
Docket No. 50-289  
License No. DPR-50

Turkey Point Nuclear Generating, Units 3 and 4  
Florida Power & Light Co.  
Homestead, FL  
Docket Nos. 50-250 and 50-251  
License Nos. DPR-31 and DPR-41

Vermont Yankee Nuclear Power Plant, Unit 1  
Entergy Nuclear Operations, Inc.  
Vernon, VT  
Docket No. 50-271  
License No. DPR-28

Virgil C. Summer Nuclear Station, Unit 1  
South Carolina Electric & Gas Co.  
Jenkinsville, SC  
Docket No. 50-395  
License No. NPF-12

Vogtle Electric Generating Plant, Units 1, 2, 3, and 4  
Southern Nuclear Operating Co.  
Waynesboro, GA  
Docket Nos. 50-424, 50-425, 52-025, and 52-026  
License Nos. NPF-68, NPF-81, NPF-91 and NPF-92

Waterford Steam Electric Station, Unit 3  
Entergy Nuclear Operations, Inc.  
Killona, LA  
Docket No. 50-382  
License No. NPF-38

Watts Bar Nuclear Plant, Units 1 and 2  
Tennessee Valley Authority  
Spring City, TN  
Docket No. 50-390 and 50-391  
License No. NPF-90 and  
Construction Permit No. CPPR-92

Wolf Creek Generating Station, Unit 1  
Wolf Creek Nuclear Operating Corp.  
Burlington, Coffey County, KS  
Docket No. 50-482  
License No. NPF-42

REQUIREMENTS FOR RELIABLE SPENT FUEL POOL LEVEL  
INSTRUMENTATION AT OPERATING REACTOR SITES AND  
CONSTRUCTION PERMIT HOLDERS

All licensees identified in Attachment 1 to this Order shall have a reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

1. The spent fuel pool level instrumentation shall include the following design features:
  - 1.1. Instruments: The instrumentation shall consist of a permanent, fixed primary instrument channel and a backup instrument channel. The backup instrument channel may be fixed or portable. Portable instruments shall have capabilities that enhance the ability of trained personnel to monitor spent fuel pool water level under conditions that restrict direct personnel access to the pool, such as partial structural damage, high radiation levels, or heat and humidity from a boiling pool.
  - 1.2. Arrangement: The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the primary instrument channel and fixed portions of the backup instrument channel, if applicable, to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the spent fuel pool structure.
  - 1.3. Mounting: Installed instrument channel equipment within the spent fuel pool shall be mounted to retain its design configuration during and following the maximum seismic ground motion considered in the design of the spent fuel pool structure.
  - 1.4. Qualification: The primary and backup instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period. This reliability shall be established through use of an augmented quality assurance process (e.g., a process similar to that applied to the site fire protection program).
  - 1.5. Independence: The primary instrument channel shall be independent of the backup instrument channel.
  - 1.6. Power supplies: Permanently installed instrumentation channels shall each be powered by a separate power supply. Permanently installed and portable instrumentation channels shall provide for power connections from sources independent of the plant ac and dc power distribution systems, such as portable generators or replaceable batteries. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

- 1.7 Accuracy: The instrument channels shall maintain their designed accuracy following a power interruption or change in power source without recalibration.
  - 1.8 Testing: The instrument channel design shall provide for routine testing and calibration.
  - 1.9 Display: Trained personnel shall be able to monitor the spent fuel pool water level from the control room, alternate shutdown panel, or other appropriate and accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.
2. The spent fuel pool instrumentation shall be maintained available and reliable through appropriate development and implementation of the following programs:
- 2.1 Training: Personnel shall be trained in the use and the provision of alternate power to the primary and backup instrument channels.
  - 2.2 Procedures: Procedures shall be established and maintained for the testing, calibration, and use of the primary and backup spent fuel pool instrument channels.
  - 2.3 Testing and Calibration: Processes shall be established and maintained for scheduling and implementing necessary testing and calibration of the primary and backup spent fuel pool level instrument channels to maintain the instrument channels at the design accuracy.

## REQUIREMENTS FOR RELIABLE SPENT FUEL POOL LEVEL INSTRUMENTATION AT COL HOLDER REACTOR SITES

Attachment 2 to this Order for Part 50 Licensees requires reliable indication of the water level in associated spent fuel storage pools capable of supporting identification of the following pool water level conditions by trained personnel: (1) level that is adequate to support operation of the normal fuel pool cooling system, (2) level that is adequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck, and (3) level where fuel remains covered and actions to implement make-up water addition should no longer be deferred.

The design bases of Vogtle Units 3&4 address many of these attributes of spent fuel pool level instrumentation. The NRC staff reviewed these design features prior to issuance of the combined licenses for these facilities and certification of the AP1000 design referenced therein. The AP1000 certified design largely addresses the requirements in Attachment 2 by providing two safety-related spent fuel pool level instrument channels. The instruments measure level from the top of the spent fuel pool to the top of the fuel racks to address the range requirements listed above. The safety-related classification provides for the following additional design features:

- Seismic and environmental qualification of the instruments
- Independent power supplies
- Electrical isolation and physical separation between instrument channels
- Display in the control room as part of the post-accident monitoring instrumentation
- Routine calibration and testing

As such, this Order requires Vogtle Units 3&4 to address the following requirements that were not specified in the certified design.

1. The spent fuel pool level instrumentation shall include the following design features:
  - 1.1 Arrangement: The spent fuel pool level instrument channels shall be arranged in a manner that provides reasonable protection of the level indication function against missiles that may result from damage to the structure over the spent fuel pool. This protection may be provided by locating the safety-related instruments to maintain instrument channel separation within the spent fuel pool area, and to utilize inherent shielding from missiles provided by existing recesses and corners in the spent fuel pool structure.
  - 1.2 Qualification: The level instrument channels shall be reliable at temperature, humidity, and radiation levels consistent with the spent fuel pool water at saturation conditions for an extended period.
  - 1.3 Power supplies: Instrumentation channels shall provide for power connections from sources independent of the plant alternating current (ac) and direct current (dc) power distribution systems, such as portable generators or replaceable batteries. Power supply designs should provide for quick and accessible connection of sources independent of the plant ac and dc power distribution systems. Onsite generators used as an alternate power source and replaceable batteries used for instrument channel power shall have sufficient capacity to maintain the level indication function until offsite resource availability is reasonably assured.

- 1.4 Accuracy: The instrument shall maintain its designed accuracy following a power interruption or change in power source without recalibration.
  - 1.5 Display: The display shall provide on-demand or continuous indication of spent fuel pool water level.
2. The spent fuel pool instrumentation shall be maintained available and reliable through appropriate development and implementation of a training program. Personnel shall be trained in the use and the provision of alternate power to the safety-related level instrument channels.