

**Industry Comments on  
Draft Order Technical Language on  
Spent Fuel Pool Instrumentation  
[Near-Term Task Force Recommendation 7.1]**

**Objective**

The NRC and industry agree that spent fuel pool (SFP) instrumentation enhancements are appropriate based on lessons-learned from the March 11, 2011, accident at Fukushima Daiichi. We further agree that the purpose of the SFP instrumentation is to provide the necessary information regarding the spent fuel pool to:

- Provide for an orderly decision making process during a beyond design basis event (BDBE) that will not delay decision making for the SFP nor distract decision makers and, thus, allow plant personnel to concentrate on the most safety-significant matters with respect to the entire plant site;
- Allow decision makers to reorder their priorities as relative safety significance changes;
- Allow decision makers to notify the emergency planning organization of a degrading condition in the SFP that may potentially affect the health and safety of the public.

The NRC and industry agree that spent fuel pool level is the key parameter for monitoring in the aftermath of a beyond design basis event.

**Industry Recommendation**

- Two channels of level instruments: either two installed, or one installed and one portable.
  - The level measured provides a sufficient range so as to indicate when water addition is needed under all plant configurations.
  - Portions of a portable channel may have some pre-installed components
- Non-safety-related, but with enhanced quality requirements (similar to augmented quality) that can ensure reliability similar to station blackout, Anticipated Transients Without Scram, and fire protection.
- Installed channel seismically mounted consistent with the existing plant seismic envelope.
- Qualifications of both channels consistent with expected conditions of operation (*e.g.*, the temperature, humidity and radiation environment associated with the spent fuel pool evaporation/boiling.)
- Power supplies: An installed channel would be powered by a non-safety-related bus with either a back-up battery installed or a portable power source to provide momentary power when needed. A portable channel would be powered by a portable power supply.

## Detailed Comments

Industry understands that the NRC is preparing an order to implement Near-Term Task Force Recommendation 7.1, Spent Fuel Pool Instrumentation. The following comments are based on the information presented by NRC staff at the January 19, 2012, public meeting as well as the associated discussions. The information has been excerpted from the NRC staff slide deck; modifications and commentary are provided, as appropriate:

### SFP Instrument Summary

<b>NRC Information (edited)</b>	
<ul style="list-style-type: none"> <li>• All operating reactors shall have a reliable indication of the water level in associated spent fuel storage pools capable of identifying the following pool water level conditions:               <ul style="list-style-type: none"> <li>○ <b>pool normal level;</b></li> <li>○ level that is minimally adequate to support operation of the normal fuel pool cooling system;</li> <li>○ level that is inadequate to provide substantial radiation shielding for a person standing on the spent fuel pool operating deck, and</li> <li>○ level that is <del>less than 1 foot above</del> <b>at the top of installed spent stored fuel racks.</b> <del>and</del></li> <li>○ <del>level that indicates below the top of spent fuel such that zirconium fire conditions could be considered imminent.</del></li> </ul> </li> </ul>	

#### Comments:

- Level is the key parameter for decision-making regarding the safety significance of the effects of a BDBE on the SFP.
  - The starting temperature of the pool (by design = < 150° F), the predetermined heat up rate of the pool without forced cooling (plants are procedurally required to know time to 200° F) and the pool level are the key data that decision maker will need to help prioritize actions.
  - As long as the pool water level is above the top of the fuel, adequate cooling to protect the cladding fission product barrier is assured.
  - Level is, therefore, the parameter that should be instrumented.
- Only a few key levels points (normal, ~10 feet above the spent fuel for radiation shielding, and top of the installed spent fuel racks) would provide clear and simple decision points.
  - As discussed in Regulatory Guide 1.13 (SFP Design Basis), ~10 ft. above the spent fuel is the level at which there will be radiological impacts to activities around the SFP. Therefore, from a decision making perspective, ~10 ft. would be a level at which the decision makers should have already initiated water injection into the pool or are taking prompt action to do so to prevent unnecessary radiation exposure to the staff involved in injection setup and initiation.
  - SFP level at the top of the installed spent fuel racks is the point at which further uncovering could eventually result in damage to the fuel cladding with a resulting radionuclide release to the environment. The exact level at which cladding damage may occur depends on many site and fuel-specific factors. Therefore, the conservative level point for protective decisions is at the top of the fuel. Additionally, this is the location at which portable instrumentation, if used, can be reliably, and if necessary, remotely installed.
    - This decision point already exists as an Emergency Action Level (EAL). Industry guidance for determining EALs (*Methodology for Development of Emergency Action Levels*, NEI 99-01, Rev 5 (2008)) defines level AA2 as "Damage to

irradiated fuel or loss of water level that has resulted or will result in the uncovering of irradiated fuel outside the reactor vessel.” EAL AA2 is applicable in all operating modes and calls for an Alert.

- Measuring water level below the top of spent fuel rack may unnecessarily complicate SFP level instrumentation and eliminate options that are otherwise technically feasible (float, radar, etc.).
- Depending on pool water inventory loss mechanism, the rate of level decrease may accelerate once the top of the fuel is uncovered.
- Intermediate pool levels (between normal and ~10 ft. above the top of the spent fuel) are useful in estimating the time that is available before water level restoration must begin, so such information is helpful to plant personnel.

### SFP Instrument Summary (continued)

#### NRC Information (edited)

- The level indication shall be
  - in an accessible location and
  - ~~continuously operable~~ **functional** under a range of conditions, including environmental conditions and high radiation fields associated with the spent fuel pool water at saturation conditions.
- ~~Operators~~ **Trained personnel** shall be able to determine spent fuel pool level from an accessible location
  - on an intermittent basis
  - without reliance on the permanent plant alternating current or direct current electric power distribution system.
- Accessible locations are
  - the control room
  - the alternate shutdown panel, ~~and~~ **or**
  - ~~portions of safety-related structures where the wet bulb temperature remains below 104°F (40°C) and radiation dose rates remain below 5 rem per hour (50 mSv/hr)~~ **or any other plant area that is accessible** under conditions associated with station blackout, ~~reactor core damage,~~ and spent fuel pool water at saturation conditions for a sustained period.

#### Comments:

- A portable instrument channel may be completely portable and installed post-event.
  - The goal of SFP level instrumentation during BDBEs is to provide decision makers with the SFP level so that they can prioritize their response to a loss of SFP forced cooling and/or a loss of SFP level in the context of other safety significant conditions that may exist as a result of the BDBE.
  - There are advantages associated with a completely portable channel. If some or all of the second instrumentation channel were to be permanently installed in the SFP, then the second channel may be subject to the same external events as the primary installed channel. The design of the second channel (portable vs. partially portable vs. installed) should allow appropriate consideration of plant-specific considerations.
  - The portable approach requires access to the SFP, and that access may be hindered by debris, radiation levels, and/or steam vapor due to pool boiling.
    - In an ideal situation none of the access hindrances would exist at the initiation of the BDBE that prevent deployment of a fully portable level instrument channel.

- If the ideal situation did not exist, several options are available to determine SFP level so that, if necessary, water can be added to the SFP. For example:
    - As long as radiation levels permit access, personnel would be able to approach pool and visually determine water level. If debris covered pool, one option would be a fiber optic instrument that could be “snaked” through the debris allowing visual confirmation of level.
    - If radiation prevented access or the debris field were so extensive as to block access to spent fuel deck, second option would be the use of a camera (hardened to radiation) on a crawler (as used by industry In-Service Inspection programs ) to determine SFP level.
    - Since pool design requirements result in pre-event SFP temperature of less than 150° F, there is a low probability that steam vapor from the pool would prevent an assessment of SFP level with a camera during the first few hours after a BDBE.
    - Lastly, an approximate SFP level can be determined using area radiation level near the SFP or at the normal access point to the SFP area. If radiation levels are normal then it can be assumed the SFP is nearly full. A significant increase in radiation levels would indicate levels are approaching ~10 ft. above used fuel and prompt actions should be taken to add water to the SFP.
- The term “...continuously operable...” should be replaced with the term “...functional...” to avoid confusion.
  - The term “continuously operable” would mean the SFP instrumentation would have to operate in an uninterrupted manner regardless of plant conditions. This is clearly not what is intended by other terms (such as “intermittent”) used elsewhere in the draft technical language. It is also inconsistent with the industry proposal provision calling for the use of “momentary power” once the non-safety-related bus powering the installed level channel is de-energized.
  - The word “operable” is a term used in NRC Inspection Manual Chapter 9900 and has a meaning relative to Technical Specification requirements. It would be best to avoid any confusion and possible misinterpretation in the future by using the general word “functional.”
- Requiring licensed operators to read the pool level instruments and deploy a portable level channel is too restrictive on plant staff during a BDBE and would distract the operators from more significant safety matters.
  - “Trained personnel” could mean any person at the plant site who is trained in the necessary functions to read pool level and relay information to the decision makers and deploy the portable level channel. These individuals could include instrumentation and control technicians, radiation protection technicians, maintenance technicians, or even security personnel who would be available during a BDBE for other duties.
- Each plant will determine the “accessible” location(s) that would support pool level determination during a BDBE. The industry guidance developed to implement this order (see below) will expand on this requirement.

## Instrument & Arrangement

### NRC Information (edited)

Instruments: The instrumentation shall consist of a permanent, fixed primary **level instrumentation channel** and a backup **level instrumentation channel**. The backup **level instrumentation channel** may be fixed or portable.

Arrangement: The **installed** spent fuel pool level instruments shall be arranged in a manner that provides reasonable protection **of the instruments**. ~~against the dynamic effects of equipment damage in the spent fuel pool area.~~ This protection shall be provided by locating the primary and fixed portions of the backup instrumentation, **if applicable**, using design criteria that consider instrument separation. ~~and inherent missile protection provided by the existing spent fuel pool structure.~~

#### Comments:

- Greater specificity on the definition of the level instruments will avoid future confusion.
  - The addition of the terms "...level instrumentation channel.." is used so all parts of the instrumentation channel needed for the SFP level to be read are covered. For example, one could construe the word "instrument" to mean only the sensor.
- The arrangement requirements would only apply to the installed level channel. This is consistent with the requirements discussed above that make the case for full portability of the backup instrumentation channel.
  - The terms "...against the dynamic effects of equipment damage in the spent fuel pool area..." and "...inherent missile protection provided by the existing spent fuel pool structure..." are undefined, confusing, and subject to misinterpretation in the future. The industry guidance developed to implement this Order (see below) will discuss this requirement.
- The addition of the phrase "...if applicable..." is consistent with a fully portable backup level channel.

## Mounting & Qualification

### NRC Information (edited)

Mounting: ~~Equipment~~ **Installed instrumentation** within the spent fuel pool shall be mounted as seismic Class IE equipment; **the instrumentation itself is not required to meet the seismic Class IE requirement.**

Qualification: The instrumentation and signal transmission equipment **in the spent fuel pool or pool area** 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). ~~This process shall consider the operating history of selected equipment in the specified environment.~~ **The qualification for the instrumentation channels are solely as described within this Order and any NRC-endorsed industry guidance to implement this Order.**

#### Comments:

- Adding the phrase "Installed instrumentation..." is a clarification consistent with a fully portable backup level channel.
- The language "...the instrumentation itself is not required to meet the seismic Class IE requirement..." adds clarity to the requirement.

- By adding the phrase "...in the spent fuel pool or pool area..." it is made clear that only the portions of the level instrumentation channels that will be subject to the conditions described have to be reliable under those conditions.
- The sentence "This process shall consider the operating history of selected equipment in the specified environment." is unnecessary, because it describes a manner in which a licensee may establish instrumentation qualification, which is established further above. The industry guidance developed to implement this Order (see below) will discuss this requirement.
- The sentence "The qualification for the instrumentation channels are solely as described within this Order and any NRC-endorsed industry guidance to implement this Order." is intended to eliminate possible future misunderstandings about the applicability of any other qualification requirements to the SFP level instrumentation channels. For example, Regulatory Guide 1.97 (Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants) does not apply to the SFP level instrumentation.

### Independence & Power Supplies

<b>NRC Information (edited)</b>
Independence: The primary instrument shall be independent of the backup instrument.
Power supplies: Permanently installed instrumentation channels shall each be powered by a separate power supply. Provisions shall be made to permit connecting each installed channel to multiple power sources (including that of other installed channels, if applicable). 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 or rechargeable batteries.

**Comments:**

- The sentence "Provisions shall be made to permit connecting each installed channel to multiple power sources (including that of other installed channels, if applicable)." Adds flexibility to powering the level channels during a BDBE when situations cannot always be predicted.
- The phrase "...or rechargeable..." provides additional flexibility.

### Range & Calibration

<b>NRC Information (edited)</b>
Range: The instrument shall have a minimum range from the pool level minimally adequate to support operation of the normal fuel pool cooling system to a level <del>below</del> at the top of the installed <del>stored</del> spent fuel racks. <del>assemblies</del> .
Calibration: The instrument shall maintain the <del>specified</del> designed accuracy following a power interruption or change in power source without recalibration.

**Comments:**

- The range of the instruments should be the same as the levels intended to measure (see above).
  - Measuring water level below the top of the spent fuel racks may unnecessarily complicate SFP level instrumentation (see above).

- The word “specified” has no meaning in the requirement, since there was no information provided as to how the value was determined or who determined it. The word “designed” means that value provided by the manufacturer of the instrument, which is known and can be used for calibration.

### Testing & Display

NRC Information (edited)
<p>Testing: The instrument design shall provide for routine testing and calibration. <del>The licensee shall test the instrument at a minimum frequency of once each refueling cycle and within one week of reactor shutdown for refueling.</del> <b>The licensee shall test the instrument at a frequency necessary to support the required accuracy.</b></p> <p>Display: <del>Operators</del> <b>Trained personnel</b> shall be able to monitor the spent fuel pool water level from <b>an</b> <del>the control room, alternate shutdown panel, or other appropriate and</del> accessible location. The display shall provide on-demand or continuous indication of spent fuel pool water level.</p>

#### Comments:

- The instrumentation testing requirement should be performance-based.
- The issue of using trained personnel and not only licensed operators is discussed above.
- “Accessible location” is defined above.

### Schedule

NRC Information (edited)
<ul style="list-style-type: none"> <li>• <b>20 day</b> response <ul style="list-style-type: none"> <li>○ Inability/unnecessary to comply</li> <li>○ Request a hearing</li> </ul> </li> <li>• <del>90</del> <b>180 days</b> for <b>licensees to provide plans and a</b> schedule for compliance</li> <li>• <del>275 day</del> response</li> <li>• <del>2 year</del> <b>Compliance within two fuel cycles or three years, whichever is longer. The compliance time period begins following NRC endorsement of implementation guidance. However, if planning for the outage that follows NRC endorsement of implementation guidance is substantially complete, then the compliance time begins upon completion of outage that follows NRC endorsement of implementation guidance.</b></li> </ul>

#### Comments:

- Generally, plant modifications require at least two fuel cycles to complete. This permits planning, engineering, design, procurement, procedure or guidance preparation, training, and “as-built” walkdowns during the first outage followed by installation, testing, and pre-operational walkdowns during the second outage.
- In this instance, modifications to SFP instrumentation are part of the greater effort to implement the post-Fukushima Near-Term Task Force Tier 1 recommendations (as defined in SECY-11-0137), which are being implemented by a complicated set of Orders and 10 CFR 50.54(f) letters. The drain of licensee resources by these efforts along with the need to keep operating plants safe and secure will make it even more difficult to complete these tasks in accordance with this recommended schedule.

## 50.59 Evaluation

### NRC Information (edited)

~~All Licensees shall, within two hundred seventy five (275) days of the date of this Order, review the functional requirements described in below to determine whether or not existing spent fuel pool instrumentation satisfies the requirements. If existing spent fuel pool level instrumentation does not conform to the requirements listed below, the licensee shall evaluate the necessary changes to the facility to bring the instrumentation into conformance with the requirements of Section 2 in accordance with Title 10 of the Code of Federal Regulations (10 CFR), Section 50.59, "Changes, tests, or experiments." Consistent with the requirements of 10 CFR 50.59, submit to the Commission a report containing a summary of the change and, if required, a request to amend the facility operating license.~~

#### Comments:

- A requirement to provide a 10 CFR 50.59 evaluation on a specified schedule is unnecessary and not material to enhancing SFP instrumentation in accordance with the expected order.
- Providing the NRC with a plan and schedule for compliance with the order is recommended above, which should provide the information the NRC needs.
- Depending how the order is written, a license amendment may not be required.
- Since a 50.59 evaluation is part of the plant modification process, requiring one early will impede an orderly SFP instrumentation modification. A 50.59 evaluation cannot be finalized until the design details are well known.

#### Guidance

- No later than May 30, 2012, the industry, through the Nuclear Energy Institute, will submit for NRC review a document providing implementing guidance for the SFP instrumentation order.
- Following a review by NRC staff, which may include public interactions between the NRC staff and the industry, and possible alterations to the implementing guidance, it is expected that the NRC will, by letter, endorse the implementing guidance.
- The target date for NRC endorsement is June 30, 2012.