Position Paper: Shutdown / Refueling Modes

NEI 12-06 Guidance:

NEI 12-06 provides guidance that the strategies developed should assume that prior to the event the reactor has been operating at 100 percent rated thermal power for at least 100 days or has just been shut down from such a power history as required by plant procedures in advance of the impending event. NEI 12-06 also discusses that the FLEX strategies are not explicitly designed for outage conditions due to the small fraction of the operating cycle that is spent in an outage condition, generally less than 10%. To provide FLEX capability during refueling unit outage NEI 12-06 requires that the portable equipment remain available during outages and that specific makeup rates and connections will be sized to support outage conditions, i.e., connection points for RCS makeup will be sized to support core cooling.

Discussion:

NEI 12-06 provides guidance for meeting EA-12-049, Order Modifying Licenses With Regard To Requirements for Mitigation Strategies for beyond Design Basis External Events. Consistent with the Order, Licensees must be capable of implementing the strategies in all modes. As discussed in NEI 12-06, although the strategies can be deployed in all modes, including shutdown and refueling, the strategies are not fully analyzed for the large and diverse sets of individual equipment and system outage conditions which might exist during a plant outage.

The scope of activities that each utility undertakes during a normal refueling outage is large and diverse. Besides refueling, activities associated with preventive and corrective maintenance, modifications, surveillance testing, in-service inspection, and the administrative activities that support these tasks require rigorous controls for outage planning. The coordination of these activities with the objective to manage risk and maintain key safety functions is essential and goes beyond compliance with technical specifications requirements during shutdown. In addition, while the scope of activities for an unplanned or forced outage is far less than that of a refueling outage, the same awareness of vulnerabilities during shutdown conditions is required to safely conduct these outages.

NUMARC formed the Shutdown Plant Issues Working Group to coordinate industry activities relating to shutdown safety and to provide the focal point for industry interaction with the NRC on shutdown plant issues. The goal of the working group was to identify these issues and develop guidance that addresses both industry and regulatory concerns. Reference 1 was the main product of the working group's effort. Reference 1 provides guidance to utilities on assessing and enhancing their practices for planning and conducting outages. Reference 1 notes that over the long term, the guidance from Reference 1 along with historical lessons learned would be located in revisions to INPO's Guidelines for the Conduct of Outages (Reference 2).

Reference 3 (NUMARC 93-01) further discusses shutdown safety considerations with respect to maintaining key shutdown safety functions, which should be considered in developing an assessment process that meets the requirements of §50.65(a)(4) (maintenance rule). The document provides guidance to licensees on the scope of hazard groups to be considered for the

§50.65(a)(4) assessment provision during shutdown conditions. Section 11.3.6 of NUMARC 93-01 specifically considers internal events for assessment as well as weather, external flooding, and other external impacts if such conditions are imminent or have a high probability of occurring during the planned out-of-service duration. Reference 4 discusses the endorsement of Reference 3 by the NRC with regard to §50.65(a)(4).

Due to the large and diverse scope of activities and configurations for any given nuclear plant outage (planned or forced), both References 1 and 2 concluded that a systematic approach to shutdown safety risk identification and planning is the most effective way of enhancing safety during shutdown.

NEI 12-06 relies on the concepts established in Reference 1 and 2 for outage planning and control including integrated management, level of activities, defense-in-depth, contingency planning, training, and outage safety review. In particular, the contingency planning includes the following:

- CONTINGENCY PLANS should be available when entering a HIGHER RISK EVOLUTION;
- CONTINGENCY PLANS should be developed when system AVAILABILITY drops below the planned DEFENSE IN DEPTH.
- CONTINGENCY PLANS should consider the use of alternate equipment to respond to the loss of dedicated safety and monitoring equipment, and should also consider additional monitoring or controls to minimize the potential for unplanned equipment unavailability.
- Personnel who may be required to implement a CONTINGENCY PLAN should be identified and familiar with the plan.

For planned outages, and early in unplanned outages, an outage risk profile is developed. The risk assessment is updated on a daily basis and as changes are made to the outage schedule. Contingency actions are developed for high risk evolutions and time needed for such evolutions is minimized. During the outage additional resources are available on site and during the high risk evolutions individuals are assigned specific response actions (e.g., response team assigned to close the containment equipment hatch). The risk assessment accounts for, among other things, environmental conditions and the condition of the grid

Due to the small fraction of the operating cycle that is spent in an outage condition, generally less than 10%, the probability of a NEI 12-06 beyond design basis external event occurring during any specific outage configuration is very small. Additionally, due to the large and diverse scope of activities and configurations for any given nuclear plant outage (planned or forced), a systematic approach to shutdown safety risk identification and planning, such as that currently required to meet §50.65(a)(4) along with the availability of the FLEX equipment, is the most effective way of enhancing safety during shutdown.

In order to effectively manage risk and maintain safety during outages, plants maintain contingencies to address the precautions and response actions for loss of cooling. These contingencies direct actions to minimize the likelihood for a loss of cooling but also direct the

actions to be taken to respond to such an event. For example, for a pressurized water reactor the initial response would utilize installed plant equipment such as gravity draining from the Refueling Water Storage Tank into the reactor coolant system to maintain core cooling. These actions are symptom-based not event-based.

In order to further reduce shutdown risk, the shutdown risk process and procedures will be enhanced through incorporation of the FLEX equipment. Consideration will be given in the shutdown risk assessment process to:

- Maintaining FLEX equipment necessary to support shutdown risk processes and procedures readily available, and
- How FLEX equipment could be deployed or pre-deployed/pre-staged to support maintaining or restoring the key safety functions in the event of a loss of shutdown cooling.

In cases where FLEX equipment would need to be deployed in locations that would quickly[1] become inaccessible as a result of a loss of decay heat removal from an ELAP event, pre-staging of that equipment is required.

In a future update to the licensees' integrated plans the following template wording will be provided to address the content of this position paper:

"(Name of licensee) will incorporate the supplemental guidance provided in the NEI position paper entitled "Shutdown / Refueling Modes" to enhance the shutdown risk process and procedures."

References:

1. NUMARC 91-06, Guidelines for Industry Actions to Assess Shutdown Management

2. INPO 06-008, February 2011, Guidelines for the Conduct of Outages at Nuclear Power Plants

3. NUMARC 93-01 Rev 4A, Industry Guideline For Monitoring The Effectiveness Of Maintenance At Nuclear Power Plants

4. Regulatory Guide 1.160 Rev 3, Monitoring The Effectiveness Of Maintenance At Nuclear Power Plants

5. NEI 12-06 Rev 0, Diverse And Flexible Coping Strategies (Flex) Implementation Guide

[1] Quickly – the FLEX equipment deployment time exceeds the time for the deployment location to become inaccessible.