U.S. Nuclear Regulatory Commission's Questions On the Nuclear Energy Institute's Methodology for the Resolution of the Multiple Spurious Operations Issue

NRC QUESTION #1

The methodology uses probabilistic risk assessment (PRA) insights to screen a generic list of multiple spurious operations and performs a generic analysis on this list. Subsequently, risk/PRA is used to pre-screen and/or disposition multiple spurious operations. In these activities, what measures do you propose to ensure that the PRA insights and risk/PRA analyses are of acceptable quality? What are the details of this generic analysis? To what extent does the generic analysis incorporate risk evaluations?

NEI Response to NRC Question #1

With respect to the generic list of multiple spurious operations (MSOs), PRA performed by licensees in the planned joint Owners Group survey is used only as an aid in populating the list. In the generic portion of the resolution methodology (Refer to Page 1 of attached resolution methodology flow chart), PRA is not used for screening. Similarly, the generic analysis performed on the generic list shown on Page 1 of the resolution methodology flow chart would be a deterministic analysis, not a PRA-based analysis. This deterministic analysis, however, could include a combination of generic or bounding thermal-hydraulic analyses coupled with circuit failure insights gained from the Industry and NRC fire induced circuit failure test programs, such as a bounding duration of a hot short.

As an example, if a small line such as a reactor head vent line can be shown through a thermal hydraulic analysis not to result in core uncovery until an extended period of time should the vent valves spuriously open, and if it can be determined that the vent valve circuit design is such that the valve will re-close once the hot short no longer exists, then a generic analysis could show that this condition is not a concern based on the thermal hydraulic analysis and a bounding duration for a fire induced hot short. The plant specific use of a generic analysis, such as the one described above, will require a plant specific review to assure that each licensee's plant unique design features are consistent with those assumed in the generic analysis.

Pre-screening steps are not intended to include Fire PRA. During this step, the plant will screen scenarios that are not applicable to the plant. Additionally, the plant may apply deterministic criteria and/or methods similar to those discussed above for the generic screening (i.e., thermal-hydraulic and/or fire induced circuit failure insights, such as duration of spurious operations).

During the Plant Specific Analysis, the proposed resolution methodology will use as a starting point the existing methodology in NEI 00-01, Chapter 4. Regulatory Guide 1.174 PRA quality requirements will be used to revise Chapter 4 and will be enhanced to include additional considerations aimed at assuring that the level of conservatism in the analysis is consistent with the level of rigor applied in the methodology. When using NEI 00-01 to screen out an MSO from further consideration, the screening analysis would have to be demonstrated to be conservative.

Additionally, NEI 00-01 Chapter 4 will be enhanced to ensure PRA screening or detailed analysis are documented and maintained in a quality manner, in a process consistent with

the fire safe shutdown analysis for each plant. Finally, the requirements of NEI 00-01, Section 4.4 for addressing Defense-in-Depth and Safety Margins will still apply.

The details of the resolution methodology will be provided to the NRC on a periodic basis as the process develops.

NRC QUESTION #2

The methodology relies upon screening criteria including numerical thresholds to screen risk-significant scenarios. What are the proposed screening criteria and numerical thresholds for acceptance criteria under circumstances where the analysis is (a) self-approved, or (b) NRC reviewed?

NEI Response to NRC Question #2

The screening criteria in NEI 00-01, Chapter 4 would be the starting point for the screening criteria used under the resolution methodology.

For a licensee using NEI 00-01, Chapter 4 to analyze an MSO, the numerical screening is provided in Section 4.2.2. This threshold was chosen to be consistent with RG 1.174 as follows:

> *"If the change in core damage frequency (delta-CDF) for each component combination for any fire zone is less than 1E-7 per reactor year, AND*
>
> *If the delta-CDF for each component combination is less than 1E-6 per reactor year for the plant, i.e., sum of delta-CDF for all fire zones where circuits for the component combinations (circuits for all) are routed, AND*
>
> *If the delta-CDF for each fire zone is less than 1E-6 per reactor year for the plant, i.e., the sum of delta-CDF for all combinations of circuits in the fire zone."*

Finally, the requirements of NEI 00-01, Section 4.4 for addressing Defense-in-Depth and safety margins will still apply.

The intent is to submit the revision of NEI 00-01 to the NRC for review and acceptance. Once NRC acceptance is obtained, it is expected that the resolution methodology contained in NEI 00-01 will be applied without the need for plant specific NRC submittals. As is always the case, all plant specific licensee work related to the resolution methodology can be reviewed by the NRC during future NRC inspections for compliance with the accepted methodology.

NRC QUESTION #3

The methodology utilizes fire modeling to disposition multiple spurious operations. How would a licensee ensure the acceptable quality of these fire models? How would licensees ensure fire modeling has sufficient margin to account for uncertainties?

NEI Response to NRC Question #3

The resolution methodology proposes the use of NRC accepted Fire Modeling Programs such as those described in NUREG-1824 coupled with the use of 98% heat release rates as described in NUREG/CR-6850. In addition, the resolution methodology proposes an additional enhancement by the introduction of an expert panel review and concurrence for those instances where fire modeling is used to disposition an identified MSO Impact. Finally, process improvements developed for NFPA 805 applications will be incorporated, as applicable.

NRC QUESTION #4

The methodology is unclear whether or not the cumulative effects of scenarios are considered. What will prevent a licensee from screening out significant issues by dividing them into a large number of constituent scenarios? Is there a method to ensure a licensee considers cumulative effects?

NEI Response to NRC Question #4

The resolution methodology will include provisions to address cumulative effects.

See NEI 00-01, Chapter 4. From 4.4.2:

> *If, when all evaluation phases are completed, the ΔCDF for a component or a component pair remains greater than or equal to 1E-6 per reactor year for all fire areas or the ΔCDF for a fire area remains greater than or equal to 1E-6 per reactor year for all component pairs within the fire area (summing in each case only the Screen 5 results), further analysis using detailed plant fire PRA models or actions to reduce the summed ΔCDF below 1E-6/year will be evaluated.*

NRC QUESTION #5

The methodology does not seem to consider the synergistic effects of scenarios such as interaction between circuits and manual actions. Is there a method to ensure that a licensee consider the potential of synergistic effects (e.g., a operator manual action with a high probability of failure combined with the effects of a multiple spurious operations)?

NEI Response to NRC Question #5

Consideration of synergistic effects is built into the process for the identification and evaluation of each specific MSO scenario. Mitigating the effects of a specific MSO scenario could involve numerous mitigating techniques. One of these mitigating techniques could be use of an accepted operator manual action. The feasibility of performing this manual operator action, from a timing perspective, would out of necessity require consideration of the potential timing limitations associated with the plant conditions resulting from the MSO scenario under consideration. An operator manual action satisfying the feasibility criteria under these conditions would be considered to be acceptable for use.

Additionally, NEI 00-01 Section 4.2 / 4.3 methodologies are designed to conservatively account for the numerous factors that affect fire risk.

The effect of operator manual actions on risk significance is addressed in the choice of CCDP in the Section 4.2 "Preliminary Screening" analysis. Conservative values between 0.1 and 0.01 are chosen based on the credit that can be assigned to operator actions. These conservative numbers were taken from the Fire Significance Determination Process. The effect of operator manual actions on risk significance would be similarly addressed if a Section 4.3 "Plant Specific Risk Significance Screening" approach is implemented.

The proposed resolution methodology is not intended to duplicate the guidance provided in NRC RIS 2006-10. Existing operator manual actions determined to be feasible based on a licensee's feasibility review with respect to NRC RIS 2006-10 are considered to be acceptable.

NRC QUESTION #6

The methodology relies on licensees developing reliable cable layouts. How does the methodology disposition a situation when the licensee is unable to develop a reliable cable layout database?

NEI Response to NRC Question #6

Extensive implementation of this methodology requires that the licensee have knowledge of the cable layout in its facility.

In general, reliable cable routing information is a requirement to implement this NEI methodology. There are, however, some limited exceptions where specific cable routing information may not be required. One example is provided below:

An MSO scenario may be identified for which cable routing is not already available. This could occur on the plant secondary side, which is typically outside the boundary of a typical PWR safe shutdown analysis. Cable routing may not be required, for example, if a thermal-hydraulic analysis demonstrates consequences of the MSO are acceptable. Similarly, it may also be possible to develop a bounding NEI 00-01 Chapter 4 argument to show that the risk significance of the MSO is acceptable, regardless of the fire location.

Other than the above types of examples, cable routing would be needed to support impact identification, impact resolution, including fire modeling, and the PRA scenario analysis to a level consistent with the step in the screening process. Earlier in the screening process, cable routing by fire area or zone would be sufficient. For detailed NUREG/CR-6850 scenario analysis, cable routing by specific raceway location may be needed.

NRC QUESTION #7

The methodology utilizes an expert panel to assure the completeness of the process and the integrity of the screening process. What minimum requirements will be set for an "adequate" expert panel? What process would the expert panel follow? Is there a generic expert panel review and where would it fit in the process if there is one? Is there a plant-specific expert panel review at the input of the plant specific stage to capture plant-specific scenarios? How does the expert panel review in this methodology compare to the normal NFPA 805 process for multiple spurious operation analysis expert panel review?

NEI Response to NRC Question #7

The expert panel minimum requirements will be included in the NEI 00-01 revision. The makeup of the expert panel is expected to be similar to the NFPA 805 participant makeup. The panel composition would be multi-disciplined. The technical disciplines required could include an Appendix R Engineer, a Fire Protection Engineer, an Electrical Engineer, a PRA Engineer and a representative from Operations. In addition, the expert panel may require supplemental support from other engineering disciplines (e.g., transient analysis, design engineering, system engineers, etc.) on an as-needed basis.

A generic expert panel review is not planned for this process. The NSSS Owners Groups will prepare the generic list of scenarios. The generic list of scenarios will be based on information gathered from plants' post-fire safe shutdown analysis, MSO Self-Assessments, inspection findings, and PRA output (when available). The Owners Groups' reports on this issue will be developed based on a traditional technical report review and approval without a review of the MSO survey by an expert panel.

There will be a plant specific expert panel review at the input to the plant specific stage. This review will be similar to that performed for the NFPA 805 plants. The generic list supplied by the Owners Groups will consist of either specific scenarios that must be considered or specific criteria that must be satisfied (e.g., flow diversions from a system used for inventory makeup or decay heat removal must consider the spurious operation of multiple valves). Each licensee is expected to address the list in its entirety. If specific items or criteria are to be deleted from consideration, each of these will require a review and concurrence by the expert panel.

Although the makeup of the expert panel is expected to be similar to the NFPA 805 participant makeup, the proposed functions for the expert panel will be somewhat different. The expert panel functions for the proposed resolution methodology will include additional steps beyond the NFPA 805 expert panel. The main steps include:

1) Review of screening of generic scenarios or criteria not applicable to the plant. For example, if PORV/Block scenario is on the generic list, and a plant doesn't have a PORV, then this scenario could be deleted from the generic list and not included in the plant specific list. In this case, however, the expert panel would review the basis for deleting this generic scenario from the plant specific list. There are additional process steps that will be developed for this review. For example, the expert panel would ensure that, even though the specific scenario isn't applicable, there are no similar scenarios that that may need to be included.

2) Review of Risk and/or Fire Modeling results used to disposition MSO impacts. In this case, the expert panel is similar to the Maintenance Rule expert panel, with risk information as a part of the decision process on how to categorize and treat a given component/MSO. As such, we expect to draw from the lessons learned from the Maintenance Rule and develop similar expert panel processes, training, etc. for the MSO expert panel.

Since the proposed process for identifying and dispositioning MSO scenarios is intended to be integrated into and maintained as a part of each licensee's post-fire safe shutdown analysis, the need may arise for the MSO expert panel to reconvene based on future plant changes that affect decisions made by the expert panel. Similarly, the expert panel may need to reconvene if a plant design change creates a MSO scenario requiring evaluation. By incorporating the information compiled under this effort into a plant's post-fire safe shutdown analysis, the information can be readily reviewed for any impacts as changes are made to the current plant configuration.

Details of the expert panel functions will be provided in the draft revision to NEI 00-01.

NRC QUESTION #8

The methodology does not address multiple spurious operations in Alternate Shutdown Areas (III.G.3). The staff view is that fire safety of III.G.2 areas are regulated by the separation requirements specified in Section III.G.2, and multiple spurious operations must be addressed in III.G.3 as well as III.G.2 areas. How would you modify your methodology to address III.G.3? The staff acknowledges that additional discussions must be conducted to clarify regulatory expectations on this subject.

NEI Response to NRC Question #8:

We agreed to consider the question of MSOs as they relate to alternative or dedicated shutdown under Sections III.G.3 and III.L of Appendix R. Our initial assessment is that the resolution methodology proposed for III.G.1 and III.G.2 will not be applicable to traditional plant locations relying upon alternative or dedicated shutdown capability without modifications to the methodology. Alternative or dedicated shutdown capability for complex fire areas, rooms, or zones such as Control Rooms, Cable Spreading Rooms and Relay Rooms may even require a location-specific approach.

With respect to areas outside of those mentioned above that are classified by certain licensees as alternative or dedicated shutdown areas, additional review may be necessary to understand the basis for the classification and to determine whether these types of areas can also be addressed using the proposed resolution methodology. The Industry survey described on Page 1 of the proposed resolution methodology flow chart will be revised to solicit this information. Once this information is obtained, we will either address these areas as a part of the resolution methodology or provide an explanation to the NRC as to why it may not be appropriate to include the areas as a part of the initial effort to address MSOs.

We believe that the questions related to alternative or dedicated shutdown for areas, rooms, or zones such as Control Rooms, Cable Spreading Rooms and Relay Rooms should be pursued as a follow up to the resolution methodology for fire areas governed by Sections III.G.1 and III.G.2 of Appendix R. It is expected that much will be learned about the MSO issue as we proceed with the proposed resolution methodology, and the knowledge acquired will be helpful in ultimately addressing plant locations such as Control Rooms, Cable

Spreading Rooms and Relay Rooms. Attempting to address both issues simultaneously could thwart progress on the resolution path for the initial task of addressing areas governed by Sections III.G.1 and III.G.2 of Appendix R.

With respect to the alternative or dedicated shutdown fire areas outside of those described above, it is our position that additional study is required to determine the degree to which the proposed resolution methodology can be used to address these areas. We agree to take those steps necessary to complete the additional study.