Enclosure 2

Handouts discussed during the May 14, 2014 ROP WG Public Meeting

NEI 99-02 White Paper
"Initial Transient"

Two of the questions in NEI 99-02 used to determine if a BWR reactor trip was an Unplanned Scram with Complications include the undefined term "initial transient"; "Was pressure control unable to be established following initial transient?" and "Following initial transient did stabilization of reactor pressure/level and drywell pressure meet the entry conditions for EOPs?" The failure to define the term has resulted in confusion, with some licensees interpreting "initial transient" to be equivalent to "scram response".

The following definition is proposed to be added to NEI 99-02:

> *Initial Transient* is intended to envelope ~~-~~the immediate and~~,~~ expected changes to BWR ~~reactor~~ parameters as a result of a scram~~, such~~(e.g.,~~ as~~ pressure,~~ and~~ level, etc.) ~~which normally accompany BWR scrams~~ because of~~due to~~ the collapsing of voids in the core and the routine response of the main feedwater and turbine control systems. For example, at some BWRs the reflected pressure wave resulting from the rapid closure of turbine valves during a turbine trip may result in a pressure spike in the reactor vessel that causes one or more safety-relief valves (SRVs) to briefly lift. The intent is to allow a licensee to exclude the momentary operation of SRVs when answering "Was pressure control unable to be established?" The sustained or repeated operation of SRVs in response to turbine control bypass valve failures or Main Steam Isolation Valve (Group I) isolations are not~~NOT~~ a part of routine BWR scram responses and are therefore not~~NOT~~ considered to occur within the *initial transient*. Similarly, a reactor level decrease to Level 3 following a reactor trip due to the expected collapsing of voids in the core can be excluded when answering the question "Following *initial transient*, did stabilization of reactor pressure/level and drywell pressure meet the entry conditions for EOPs?" as long as the feedwater control system and at least one feedwater pump were operating as designed. ~~"~~*Initial transient*~~"~~ is different from ~~"~~*scram response*~~"~~.~~, which bounds the time during which the performance indicator is active.~~ The *initial transient* is a subset of the overall scram response time.

1.0 Purpose

To assess the appropriateness of screening insensitive trains or segments from unavailability monitoring similar to the approach used for valves and circuit breakers as stated in NEI 99-02 Section F 2.3.5.

2.0 Issue Description

Although the systems selected for MSPI monitoring are relatively risk-significant at most plants, the Birnbaum measures (Bs) for specific system *trains* may be small at some plants. As stated in NUREG 1816, this is attributable, in part, to the system selection process — an indicator defined for systems that are important at many plants, but not at all plants, may be *insensitive* at some plants. This problem was recognized by the developers of MSPI and resulted in the addition of two compensating mechanisms:

1. Performance-based backstops
2. Screening of low-significant valves and circuit breakers

NUREG 1816 included a discussion of screening other low-significant components. It stated that a case could have been made to exclude some pumps based strictly on risk but concluded that screening pumps would be inconsistent with the intent of the MSPI as pumps are the core of system reliability. No discussion was found on the potential screening of train/segment unavailability. This may be due to it also being considered a core element of the MSPI program.

In summary, due to the simplification used in system selection, the collection of some MSPI data may have limited value due to their low significance. The contrary is also true, in that the selection of MSPI scope systems does not ensure that all risk significant trains and segments have been identified at all plants. This has resulted in the exclusion of MSPI monitoring of some risk significant systems.

Screening the low valued data from scope may be appropriate to minimize industry burden but does not enhance public confidence and may even erode confidence due to the reduction in monitoring scope.

3.0 Solution Options

Several options were identified in the development of this paper to address the low risk-significant unavailability issue. These are generally listed in the order of complexity starting with the least complex and proceeding to options that have greater comprehensiveness and complexity. These options are:

1. Screen low significant trains and segments
2. Develop an unavailability performance backstop
3. Screen all low-significant trains, segments and components
4. Supplement MSPI system scope with a limited risk-informed process
5. Risk-inform system/train/segment selection

Each option is discussed below.

1. Screen Low Significant Trains and Segments

This is the Industry recommendation that proposes to exclude any train or segment that has a Birnbaum of < 1E-07 from the requirement to monitor for unavailability. The proposal does not affect reliability monitoring and therefore will likely maintain at least one component for each train (e.g., the associated pump) thus maintaining the train/segment within the scope of the MSPI program. However, similar to the augment included in NUREG 1816, the monitoring of unavailability is a core element of the MSPI program. The elimination of low significant valves and breakers cited by the industry as the model for this screening exception was limited to specific component types and maintained the monitoring of reliability by excluding components such as pumps and diesel generators from the screening scope. The application of this screening approach to unavailability would result in the elimination of unavailability monitoring from the affected train/segment. This approach may be seen as being inconsistent with original philosophy used in the MSPI development.

2. Develop an Unavailability Performance Backstop

This option applies a similar approach to low-risk unavailability as was applied to low-risk reliability. It assumes that maintaining the core element of unavailability is important and enhances it by developing performance-based thresholds. This approach would require the development of the unavailability performance thresholds but would result in complete conformance with the original MSPI framework. A limitation of this approach is that performance-based thresholds have seldom been triggered.

3. Screen Low-significant Trains, Segments and Components

This option explores the concept of screening all low-significant components. It assumes that if fundamental elements are not required to be maintained, then development of screening criteria for all elements should be considered. This approach would result in some low-risk systems at some plants being removed from the MSPI scope. This option would also eliminate the need for performance-based backstops as all low risk-significant components would be screened. It has the effect of partially risk informing the system selection process by removing low risk trains/segments. However, it does not result in the addition of any risk-significant systems, trains, or segments.

4. Supplement MSPI System Scope with a Limited Risk-informed Process

This option proposes a limited risk informing of the MSPI scope with the objective of maintaining a near neutral industry burden while enhancing the effectiveness of the MSPI program. Although the removal of low risk-significant trains, segments and components would need to be carefully balanced against the addition of trains, segments and components, a first cut approach could be:

1. The removal all low risk-significant trains, segments and components (Option 3) from MSPI scope, and
2. The addition of risk-significant non-safety on-site AC (e.g., SBO diesels, GTGs), and risk-significant non-safety trains/pumps that support steam generator or RCS injection.

This approach may result in the removal from monitoring of some systems, trains or segments (e.g., RHR, cooling water) at some plants. It will also result in the addition of trains, segments and components at some plants. As proposed, it will not result in the addition of any new systems, as all new trains and segments will be associated with the current MSPI systems. It will result in the addition of new component types (e.g., gas turbine generators).

Thresholds for inclusion and exclusion would need to be established. The Industry recommendation for exclusion that uses a Birnbaum value of < 1E-07 for exclusion may be appropriate and an inclusion threshold such as > 1E-06 would need to be established.

A phased implementation could be used where unavailability monitoring for the new trains is initially implemented without reliability monitoring. Reliability monitoring could be added later as data and CDE changes become available.

5. Risk-inform System/Train/Segment Selection

Using a risk-informed process to select system, train and segment that are within the scope of MSPI for each plant is the most comprehensive and risk-informed approach. This option will result in a customized system set for each plant based on a plant-specific risk analysis. It is anticipated that many of the current MSPI systems would be maintained but additional systems unique to each site may be added.

4.0 MSPI System Selection Background

Although the MSPI program is risk informed, the selection of performance indicators was the result of a thoughtful and informed process that took advantage of previously available indicators. The selection of the current indicators, although important to measuring key attributes in each cornerstone, was not performed using a risk-informed process.

This is can be demonstrated through the review of the following documents:

SECY 99-007, “Recommendations for Reactor Oversight Process Improvements,” dated 1/8/1999, states

> “Where possible, the task group sought to identify performance indicators as a means of measuring the performance of key attributes in each of the cornerstone areas. In selecting performance indicators, the task group tried to select indicators that:
>
> (1) were capable of being objectively measured;
>
> (2) allowed for the establishment of a risk-informed threshold to guide NRC and licensee actions;

> (3) provided a reasonable sample of performance in the area being measured;
>
> (4) represented a valid and verifiable indication of performance in the area being measure;
>
> (5) would encourage appropriate licensee and NRC actions; and
>
> (6) would provide sufficient time for the NRC and licensees to correct performance deficiencies before the deficiencies posed an undue risk to public health and safety.
>
> Where such a performance indicator could not be identified, the group proposed a “complementary” inspection activity. Where a performance indicator was identified but was not sufficiently comprehensive to cover all performance areas to be measured, the group proposed “supplementary” inspection activities. The task group also identified areas where “verification” type inspections should be performed to verify the accuracy and completeness of the reported performance indicator data.”

SECY-99-007A, Recommendation for Reactor Oversight Process Improvements (Follow-up to SECY-99-007), dated 3/22/1999, states:

> “The NRC staff developed a set of 20 indicators to measure important attributes of the seven areas listed in questions 1 above. The PIs, together with findings from associated baseline inspections in attributes not fully measured or not measured at all by the indicators, should provide a broad sample of data on which to assess licensee performance in those important attributes. One reason these specific indicators were proposed is because they are readily available and can be implemented in a short period of time. Other indicators will be developed and included in the oversight process as their ability to measure licensee performance is determined.”

NUREG 1753, “Risk-Based Performance Indicators: Results of Phase 1 Development,” dated April 2002, included a discussion as to whether any additional performance indicators were needed in the ROP. The report states that industry representatives questioned whether NRC needed to have a broader coverage of risk measured in the ROP indicators, especially if it did not result in a corresponding reduction in the inspection program. Section 6.1 of the report states:

> “Subsequent to the closing of the comment period for this report, the agency and industry (through the continuing ROP interactions) have identified several aspects of unreliability and unavailability indicators from the RBPI development that will be piloted in 2002 for potential implementation in the ROP. These involve unreliability and unavailability indicators associated with the six SSUPIs under the mitigating system cornerstone of the current ROP.”

NEI 99-02 Rev 7 states that “the purpose of the Mitigating System Performance Index is to monitor the performance of selected systems based on their ability to perform risk-significant functions as defined herein.”

5.0 Insensitive Indicators Background

NUREG 1816, "Independent Verification of the Mitigating Systems Performance Index (MSPI) Results for the Pilot Plants," identified a number of significant issues that arose regarding the fundamental MSPI methodology during the pilot program. Two issues germane to the issue of screening low significant unavailability are 1) "insensitive" indicators, whereby a very large number of similar component failures within a system would be necessary to reach the WHITE threshold and 2) the prescriptive rules for inclusion of components within the pilot program, some plants may need to monitor an inordinately large number of low risk-significance valves.

NUREG 1816 Appendix E, "Technical Basis for the Backstop to Address Insensitive Indicators," explores the solution for the monitoring of insensitive systems included in the MSPI program. It states:

> "Although the systems selected for monitoring are relatively risk-significant at most plants, the Birnbaum measures (Bs) for specific system *trains* may be relatively small numbers at some plants. This is attributable, in part, to the system selection process — an indicator defined for systems that are important at many plants, but not at all plants, may be *insensitive* at some plants. A low value of train B can also easily arise in highly redundant systems; failure of *individual* trains in a highly redundant system may not yield a high conditional CDF, even if failure of the entire system would do so. In such a case, the number of failures needed to produce a change in the MSPI greater than $1x10^{-6}$ is large. This makes it possible for many failures to occur in a system having apparent regulatory significance, with the performance index still falling short of the WHITE performance band threshold."

The appendix states that from both technical and outside stakeholders' points of view that an indicator scheme appears deficient if large numbers of failures do not warrant a "WHITE" response. Moreover, it states that absent a comprehensive model relating licensee performance to different kinds of indications, it is difficult to conclude on purely technical grounds that such performance excursions are risk-insignificant (e.g., potential for cross-cutting issues), even if they arise in low-B trains. The resulting solution was the additional of a performance-based backstop.

NUREG 1816 Appendix G, "Technical Basis for Excluding Active Valves Based on Birnbaum Importance" provides a technical basis on the exclusion of valves within a monitored system. It states:

> "Another important consideration is whether or not some minimum number of valves should remain in-scope regardless of their risk importance. *Any valves that meet the cutoff criterion of $1x10^{-6}$/yr on Birnbaum (including common cause) do not impact URI in any way.* However, there could be undesirable consequences of monitoring too few valves in MSPI. For one, the more valves that are monitored, the larger the pool of similar valves and the higher the number of demands. If a larger population is considered, the URI is less sensitive to small numbers of failures of valves, and less likely to result in a false WHITE for a small (statistically not unlikely) number of failures. Secondly, valves not monitored in the MSPI could be subject to the inspection process. Thirdly, as the plant PRA model changes owing to changes in plant design or equipment

> performance, it is likely that importance measures also change. A valve with a Birnbaum just under the $1x10^{-6}$/yr cutoff probably should be included because of its potential to meet the criterion at some future point. It therefore seems reasonable to ensure a minimum number of valves within fluid systems are monitored by the MSPI, regardless of their risk significance.

The report states that the next logical question would be to ask whether such a cutoff could be applied to components other than valves. If an analysis was performed for pumps in a way similar to valves, a case could have been made to exclude some pumps based strictly on risk. However, the report states that since the pumps are at the core of the system reliability, it would be inconsistent with the intent of the MSPI to exclude pumps from monitoring."

6.0 Recommendation

Although more complex then Options 1 – 3, Option 4 seems to strike a balance between increase MSPI monitoring and industry's data collection burden. As one of the objectives of this option is to apply a limited risk-informed process in order to achieve a scope addition commensurate with the scope reduction, it represents the only option which achieves a balance of the five options included in this paper.

Option 1 does not provide any MSPI enhancement and may result in some erosion of public confidence. For Option 2, although applying performance-based backstops to low risk-significant train and segment unavailability is consistent with the original MSPI framework, the current performance-based back stops are rarely used and therefore would likely be only marginally effective. Option 3 is a broader application of Option 1 resulting in a greater reduction in scope.

Option 5 requires significant development and implementation effort. Its implementation would also be a significant change from the current MSPI framework. A comprehensive cost / benefit analysis would be required prior to its implementation.