General Criteria for Binning Scenarios for Assigning Screening HEPs

(This is the "meat" of what will replace the yellow highlighted paragraphs in section 2.2 of the FAQ)

This section provides discussion and guidance of how to justify the use of a 0.1 screening HEP for the failure to successfully shut down after a loss of habitability in the MCR, as well as guidance for the determination of when to apply values other than 0.1 for screening.

The specified criteria that would be used to determine whether 0.1 could be used for any given scenario (or bin of scenarios), and also when values other than 0.1 should be considered, are generic so that they can be applied to any situation. Based on the discussions in the last conference call, some enhancements have been made, in particular adding an explicit assessment of the concept of "complexity" as a named PSF. This contrasts with the previous paper, which saw complexity as being implied by the combination of the status of the other PSFs.

In this approach, complexity is first assessed as an "entry condition" into the rest of evaluation. We suggest that the basis for assessing complexity be as defined in the flooding ISG. This is something that has already been agreed to between industry and NRC, would be easy to implement, and (as can be seen from the text below) is applicable to a fire situation.

Assessment of Complexity of the Required Action

Complexity refers to the nature of the situation that must be diagnosed, the decision to be made, or the action to be performed. High levels of complexity, particularly in the absence of training and practice, reduce the feasibility of manual actions. Sources of complexity that may affect the timeliness and effectiveness of cognition (i.e., detection, diagnosis, and decision-making) may include:

- diagnostic ambiguity from conflicting or difficult-to-interpret cues and indications
- unfamiliar circumstances that require mental effort and, perhaps consultation, to interpret
- ambiguity in the appropriate prioritization of competing goals
- the need to consider multiple variables simultaneously while implementing a proceduralized action

Sources of complexity that may affect the timeliness and effectiveness of action execution may include:

- the need for personnel to perform many unfamiliar steps in rapid succession;
- the need to perform multiple actions concurrently; and
- whether special sequencing or coordination is required for the action to be successful (especially if it involves multiple persons in different locations)

Actions that require concurrent diagnosis and execution or sensitive and careful manipulations are also likely to be complex.

Input from personnel should be obtained regarding their perceptions of whether the scenario is complex or simple. If rarely-used configurations will be necessary, the licensee should consider the possibilities of

new single failures, interfacing loss-of-coolant accidents, inadvertent system interactions, and unrecognized drainage pathways for the reactor vessel or important storage tanks. In addition, to evaluate complexity, the following questions should be considered:

- Are there many alarms or indications to which the crew or operator must identify, evaluate, and respond?
- Will communication between several individuals at different locations be necessary?
- Will plant symptoms be difficult to ascertain because of instrumentation failures and spurious indications?
- Will component failures have multiple or propagated effects on systems, equipment, or other components?
- Will the action sequence include concurrent tasks that require specific timing to be successful?
- Will the situation include many distractions, crowds of people, or other factors that could divert attention from the required tasks?

Based on the considerations described above, the PSF for complexity should be evaluated for cognition and execution using the following categorization schemes:

Cognition

- Nominal—Detection, diagnosis, and decisionmaking associated with the action are simple, straightforward, and unambiguous or the crew or individual is highly familiar with and skilled in addressing the situation.
- Degraded—The available information is conflicting or difficult to interpret. Resolution of any ambiguity or response planning requires obtaining validating or convergent information, consideration of competing goals, multiple variables or consultation. Sources of distraction are present. Conditions require counter-intuitive responses or responses that conflict with highly trained responses to similar circumstances.

Execution

- Nominal—Execution of the action is simple and straightforward. Coordination requirements are minimal or highly practiced. Steps in the action sequence are performed at a single location, involve the concurrent management of one or very few variables, and feedback on the effectiveness of the action is easily available and accurate.
- Degraded—Execution of the action is difficult. Execution requires rapid performance of multiple, complicated steps, the performance of steps by the same individual at multiple locations, coordination of steps between two or more individuals at multiple locations, or very sensitive and careful manipulations. Several variables may be involved in the action or there is ambiguity in how to perform the action.

Note that the definitions are not to be applied blindly. For example, one should not say “oh, actions are performed at multiple locations so execution complexity is degraded.” The definitions are only summaries of considerations of nominal and degraded states. The analyst is required to fully assess the

conditions and answer the questions shown, consider how they balance out, consider mitigating circumstances including the extent of training and the quality of the communications systems, and any complications such as the need for SCBA equipment. Based on this, the analyst makes their case for whether the complexity is nominal or degraded.

The complexity designation is made for each of the five tasks on the evaluation criteria matrix (Table 1) and then applied along with the other PSFs to determine the applicability of using 0.1 or the need/ability to use a different screening value. Note that for the loss of habitability case the diagnosis of decision to abandon (Task 1) is by definition nominal because the conditions are obvious and forcing.

Because of the nature of HRA, the application of this guidance will be somewhat subjective. Controlling this subjectivity is best done by the use of examples. Therefore, specific examples of the application of this guidance for determining the level of complexity are provided in Attachment A.

Application of the Assessment Matrix

Once the base level of complexity is determined, the assessment is completed using the PSF matrix (Table 1). The starting point would be to check the PSF guidance in the six columns (one for each task) under the heading "Conditions Supporting Use of 0.1 Screening Value" to see if those conditions apply. If one or more do not (or do not fully) apply, or if the meaning of the condition is potentially unclear, then a check is made against the other three columns to confirm the 0.1 condition is met or to determine what complicating or mitigating conditions may apply.

The six tasks are defined as follows:

Task 1: Decide to Abandon. The decision that the conditions exist such that the plant cannot be safely shut down from the MCR and it is necessary to abandon. For loss of habitability, this decision is a given.

Task 2: Isolate MCR Circuits. These actions are those required to isolate MCR control circuits so that control can be accomplished outside the control room without concern that fire-induced failures will result in spurious operations for the circuits with this isolation capability.

Task 3: Establish RSD Control and Instrumentation. These actions are those required to transfer the control and instrumentation functions to the RSD locations.[1] These include actions taken in the MCR prior to leaving, taken on the way to the RSD locations to allow enabling their functions, and at the RSD locations to enable them (e.g., place controls in Local).

Task 4: Restore/ Ensure Decay Heat Removal. These actions are those performed at the RSD locations to align, actuate, and control the systems required for decay heat removal.

Task 5: Restore/ Ensure Injection. These actions are those performed at the RSD locations to align, actuate, and control the systems required for RCS injection.

[1] The use of the word "locations" is intentional, to indicate that such locations may include individual pieces of equipment in addition to dedicated RSD Panels.

Task 6: Recover from Spurious Operations. These actions are those performed at the RSD locations to eliminate the effects of any spurious operations that may have occurred. This differs from Task 2 in that it refers to addressing spurious operations that were not prevented by designed-in MCR control circuit isolation capability.

There are two key points to keep in mind when performing the assessment.

- Not every plant will require consideration of all six tasks. The tasks as defined should cover all eventualities, but some tasks may not be relevant to the plant being evaluated. Further information is provided in the last row of the table.
- In cases where complicating or mitigating conditions apply, the analyst must consider whether the combination of such considerations is sufficient to require the use of a value other than 0.1. That is, just because one PSF does not meet the 0.1 criterion does not mean that 0.1 cannot be used – the combination of PSF conditions for the specific plant must be considered as a whole and a conclusion reached and justified. The exception to this is where any "go/no-go" condition exists, in which case the use of 1.0 is required. Further PSF specific guidance is provided in the comments column and in the notes.

Because of the nature of HRA, the application of this guidance will be somewhat subjective. Controlling this subjectivity is best done by the use of examples. Therefore, specific examples of the application of this guidance for determining the appropriate screening HEP to use are provided in Attachment B.

Table 1
Loss of Habitability Screening Criteria

Performance Influence Factor	Conditions Supporting Use of 0.1 Screening Value						"Go/No-Go" Conditions (If Any of These Conditions Exists, 1.0 HEP is Used)	Considerations That Suggest Use of Screening HEP > 0.1 [Note 1]	Considerations That Support Use of Screening HEP < 0.1 [Note 2]	Comments
	Task 1 Decide to Abandon	Task 2 Isolate MCR Circuits	Task 3 Establish RSD Control & Instrumen-tation	Task 4 Restore/ Ensure Decay Heat Removal	Task 5 Restore/ Ensure Injection	Task 6 Recover from Spurious Operations				
Complexity	Nominal	Nominal	Nominal	Nominal	Nominal	Nominal	See training and communications.	Degraded	Nominal	Complexity holds a somewhat higher weight than most of the other PSFs. While it does not fully override other considerations, nominal complexity is required in order to use 0.1 or lower unless System Time Window versus time required is favorable.
Procedure	Available and complete	Available and complete	Available and complete	Available and complete	Available and complete	Available and complete	Procedure not available or completion will not result in success.	Procedure is potentially confusing, unclear, or overly subject to interpretation.	Procedure very straightforward, easy to implement, minimal or no steps not directly required for Tasks 1-5.	Procedure is the MCR Abandonment procedure.
Training	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	No training	Subsumed by Complexity.	Subsumed by Complexity.	If Job Performance Measures used, then this clearly documents training and timing. Because training is inherently considered in the complexity assessment previously described, it is only considered on this table with respect to the "go/no-go" condition.
Cues/ Indications	Yes, smoke	Yes (Note 4)	Yes (Note 4)	Yes (Note 4)	Yes (Note 4)	Yes (Note 4)	Cues are in error for given fire scenario.	Cues are provided, but are not clear.	Cues clear and well trained.	
Staffing	Adequate	Adequate	Adequate	Adequate	Adequate	Adequate	Insufficient staff to perform all required actions.	Expect staff limitations to result in a longer time required to complete each task.	Extra staff available for checking.	Some plants take from MCR staff for Fire Brigade; and some plants have additional staff (beyond the minimum complement).
Tools/Parts	N/A	Available (if needed)	Available (if needed)	Available (if needed)	Available (if needed)	Available (if needed)	Not available	Need or location unclear. Difficult to obtain.	No special tools or parts required for any execution activities.	
Accessibility	N/A (Note 3)	Accessible	Accessible	Accessible	Accessible	Accessible	Not accessible	Limited accessibility (e.g., tight quarters, long access path)	Highly accessible, no impairments, short direct access paths.	
Communications	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	Subsumed by Complexity	Not available or highly questionable reliability.	Subsumed by Complexity	Subsumed by Complexity	Because communication is inherently considered in the complexity assessment previously described, it is only considered on this table with respect to the "go/no-go" condition.
Lighting	Emergency	Emergency	Emergency	Emergency	Emergency	Emergency	None in one or more areas where actions take place.	Portable in one or more locations where actions take place	Normal in all areas where actions take place.	If on emergency lighting, will actions occur after depletion of light power supply.
Timing	5 timing elements for each task	5 timing elements for each task	5 timing elements for each task	5 timing elements for each task	5 timing elements for each task	5 timing elements for each task	See below	See below	See below	Key considerations include: 1. Are any SSCs beyond those leading to a reactor trip? 2. Is there a SI actuation signal? 3. Is there a loss of offsite power? 4. Is there a station blackout?

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	Task 1 Decide to Abandon	Task 2 Isolate MCR Circuits	Task 3 Establish RSD Control & Instrumen-tation	Task 4 Restore/ Ensure Decay Heat Removal	Task 5 Restore/ Ensure Injection	Task 6 Recover from Spurious Operations				
1) System Time Window	n/a	Time Margin (System Time Window – Time Required) is 20 to 30 minutes					Time Required is equal to or greater than System Time Window.	Time Margin (System Time Window - Time Required) is 5 to 15 minutes.	Time Margin (System Time Window – Time Required) is at least 35 minutes.	Time margin holds a somewhat higher weight than most of the other PSFs. While it does not fully override other considerations, extra time margin can compensate for a number of other degraded PSFs, and reduced time margin can cancel out the benefits of a number of favorable PSFs. System Time Window is derived From T/H calculations. Time Required is determined by the integrated total of the four time factors presented below for each task (Note 5). For the purpose of the screening assessment, the determination of System Time Window and Time Required more finely than an approximation of the closest five minute internal is not warranted.
2) Time of the decision to abandon	See comments column	See comments column	See comments column	See comments column	See comments column	See comments column	n/a	n/a	n/a	Decision occurs at the time LOH conditions (per 6850) are reached, based on fire modeling. However, since actions in the MCR are not credited for abandonment, assuming abandonment occurs at t=0 is conservative (maximum decay heat, all actions occur outside MCR). Therefore, this factor is essentially irrelevant to the loss of habitability case. It is retained for completeness and for use in the loss of control case, addressed in FAQ-0008.
3) Time of Cue	n/a	Note 5	Note 5	Note 5	Note 5	Note 5	See System Time Window	See System Time Window	See System Time Window	Part of Time Required, represents the time to reach the associated procedure step (the cue for that task).
4) Diagnosis Time	n/a	Note 5	Note 5	Note 5	Note 5	Note 5	See System Time Window	See System Time Window	See System Time Window	Part of Time Required, representing the evaluation of input data for that task (e.g., check PZR pressure stable, or verify CCW in service), considering hold points and coordination with other procedure steps. In the case of loss of habitability, the diagnosis of when to abandon is effectively negligible. However, for the other tasks it likely applies.
5) Time to Execute	n/a	Note 5	Note 5	Note 5	Note 5	Note 5	See System Time Window	See System Time Window	See System Time Window	Part of Time Required, includes transit time plus time to obtain tools and/or PPE.
Additional Notes Regarding the Tasks	Critical task but the HEP is negligible for LOH.	The purpose of this task is to prevent spurious operations. May or may not be a critical task depending on fire location (effect on control circuits).	Critical task. Task includes all actions to transition command and control from the MCR. Plants with RSP have 1 step in this task, and plants with several remote panels have more steps.	Critical Task	May or may not be a critical task depending on the plant. Injection may not be required for some plants or scenarios.	May or may not be a critical task. Depends on whether spurious operations occur, and whether recovering them is essential to RSD strategy.	Only when the tasks are not feasible.	Only when the tasks can only be accomplished without any margin.		"Tasks" taken as functional tasks. For the simplified case we will assume and evaluate the equivalent of 4 HFEs representing 1 for each task.

Notes:

1. The existence of only one of these conditions does not by itself constitute a basis for using a value greater than 0.1.
2. The existence of only one or a few of these conditions does not by itself constitute a basis for a value less than 0.1. There must be a “preponderance of evidence” to support this.
3. While initially accessible, the accumulation of smoke leads to inaccessibility resulting in MCR evacuation.
4. Given the decision is made to abandon, a MCR Abandonment procedure step is the cue for this task.
5. The determination of the total time required as an integration of all of the time elements is not a simple sum of the individual values. Tasks overlap in their performance, cues for each task are not necessarily mutually exclusive, and diagnoses of the need/process for performing each task are likely dependent. Therefore, the assessment of the total time required needs to take all the indicated factors into consideration, but they need to be assessed holistically to approximate the total time required to complete all applicable (to the scenario/bin) tasks successfully. As noted in the comment column for System Time Window, the total time required should be approximated to the closest five minute interval.