

FAQ Number 18-0017 FAQ Revision 0ba1
FAQ Title Conditional Trip Probability for Modeling Operator Discretion

Plant: Harris Date: June 27, 2018
Contact: Harold Stiles Phone: (919) 546-4570
Email: Harold.Stiles@Duke-Energy.com

Distribution: *(NEI Internal Use)*

FPRA TF 805 TF FPWG RATF RIRWG BWROG PWROG

Purpose of FAQ:

For fires where no equipment-related plant trip (i.e., no automatic, manual, or LCO forced trip) is judged to occur, this FAQ proposes a more realistic method for modeling the Conditional Trip Probabilities (CTPs) due to operator discretion instead of making an "all or nothing" assumption.

NOTE: The proposed method can be applied at a Fire Compartment level as well as at a scenario level, where the associated Fire Compartment may contain equipment/cables related to a plant trip but the particular ignition source being evaluated does not impact those equipment/cables.

Is this Interpretation of guidance? Yes / No

Proposed new guidance not in NEI 04-02? Yes / No

Details:

Task 2 of NUREG/CR-6850 (Section 2.5.3) requires the identification of an appropriate initiating event based upon the equipment impacted by a fire in a Fire Compartment. In particular, an appropriate initiator should be identified if the fire affects:

- equipment whose failure would cause an automatic trip;
- equipment whose failure would likely cause a manual trip, as specified in fire procedures or plans, or other instructions; or
- equipment whose failure will invoke an LCO that would necessitate a shutdown within a certain time period (typically, considered to be 8 hours).

NOTE: This FAQ does not address the guidance for modeling plant trips where fire affected equipment satisfies any of the three criteria above.

NUREG/CR-6850 also states that a Fire Compartment need not have an initiating event assigned to it when a review of associated equipment (that could be affected by a fire) concludes that a plant trip (i.e., an automatic, administratively required manual, or LCO forced trip) could not occur. The guidance conservatively permits the analyst to assign a "reactor trip" if in doubt as to whether any of the criteria are met.

Commented [HJ1]: An evaluation of fire damage determines whether a trip occurs. A trip is not judged to occur when equipment damage drives the plant response. This FAQ, if pursued, should focus on judgments only when all cables are traced and those traced cables when damaged in the fire scenario do not lead to a trip. Absent proof from (a complete understanding of cable tracing) that a trip doesn't occur, the standard procedure of assigning a trip to the scenario with a probability = 1 is appropriate.

Commented [HJ2]: What is intended here? It sounds like this is an analytical determination based on fire damage (which is favored by the staff), not a judgment made by operators. This seems in conflict with your statement above and this conflict is the source of many of the staff comments below.

Commented [HJ3]: This sentence is confusing. An appropriate initiator should be identified in all cases.

Commented [HJ4]: Again, the scope of this FAQ as written here seems to be to address the trip probability only when a full understanding of cable routing precludes the occurrence of a trip. This again seems contrary to the Purpose.

FAQ Number 18-0017 FAQ Revision 0ba1
FAQ Title Conditional Trip Probability for Modeling Operator Discretion

However, NUREG/CR-6850 provides no guidance for the treatment of a possible plant trip due to operator discretion. Even when the fire impacts no equipment that satisfies any of the three criteria, the possibility of a plant trip due to operator discretion can be neither absolutely assured (probability = 1.0) nor absolutely precluded (probability = 0.0). Therefore, the use of CTPs for modeling operator discretion provides greater realism than an "all or nothing" assumption.

Detail contentious points if licensee and NRC have not reached consensus on the facts and circumstances:

None

Potentially relevant existing FAQ numbers:

None

Response Section:

Operating experience indicates that most fires do not result in a plant trip. Only 1 in 7 of the fire events, on which the fire ignition frequencies are based, actually culminated in a plant trip. Therefore, it would be unrealistic to assume a plant trip for every fire contributing to the fire ignition frequency.

Both NFPA 805 pilot plants used CTPs. Although the pilot plants established different rules for the use of CTPs, with the single-unit plant applying CTPs globally and the multi-unit plant applying CTPs on an as-needed basis, there were strong similarities in the final results. The use of CTPs was specifically addressed in at least one peer review. In particular, the Peer Review Team issued a Finding to require a stated basis for the selection of the particular value used for each Fire Compartment. The NFPA 805 Safety Evaluation (ML101750604) later documented that the Finding was appropriately resolved, and that Supporting Requirement was found to be MET during the NRC Audit.

As CTPs were subsequently used for other plants in the fleet, the process became more structured, with greater reliance on operator input and better documentation of the basis. The subsequent use of CTPs was described in the responses to PRA RAI 1C (ML13205A016) and PRA RAI 21 (ML15079A025) but was not specifically addressed in the respective SEs.

Proposed resolution of FAQ and the basis for the proposal:

The proposed resolution incorporates operator input to improve the quality of the decisions about modeling a possible plant trip. In addition to providing a better understanding of the typical operator response to fire, operator input can be relevant to these decisions in several ways. Operators know what equipment is located in which Fire Compartments, as well as the likely plant response to equipment failures. They

Commented [HJ5]: How was this number of trips established? The NRC does not refute that many fire events do not produce a trip, but would like to understand the completeness of the review which established that only 1 in 7 potentially challenging or undetermined fire events (per the frequency determination) were accompanied by a trip.

Commented [HJ6]: An automatic plant trip does not occur for every fire. However, the omission of a plant trip in a PRA requires adequate evidence.

Commented [HJ7]: None of the sources in either this or the previous paragraph identify or discuss a technical basis.

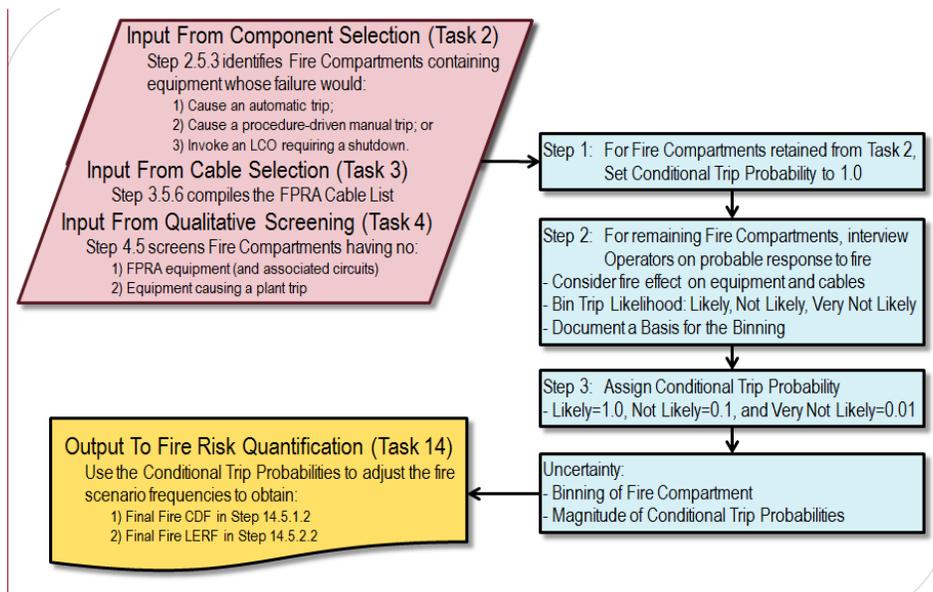
FAQ Number 18-0017 **FAQ Revision** 0ba1
FAQ Title Conditional Trip Probability for Modeling Operator Discretion

can confirm the analyst's interpretations of the requirements in the operating, fire, and emergency procedures, as well as Technical Specifications. Their knowledge of the power distribution systems provides valuable insights into the likely routing of important cables. Their experiences on the fire brigade include briefings on plant fires, detection/suppression capabilities, and particular fire vulnerabilities/protection. This operator input can both lessen the "doubt" about whether a plant trip would occur and improve the analyst's identification of which initiator would be most appropriate for a fire in a particular Fire Compartment.

With regard to the CTP, this operator knowledge and experience is captured by deterministically binning each Fire Compartment based on the likelihood of a plant trip given a fire in that Fire Compartment. The bins are characterized as a plant trip is "Likely," or "Not Likely," or "Very Not Likely." To promote confidence in the binning, input should be obtained from a small panel of operators, with the binning preferably based on a consensus; or failing that, a majority; or failing that, the most conservative bin. The basis for the binning could affect what sensitivities are later performed but not which Fire Compartments are retained for further analysis. Even the "Very Not Likely" Fire Compartments are retained for further analysis.

Figure 1 describes the proposed process for modeling the CTP as it relates to Tasks in NUREG/CR-6850.

Figure 1: CTP Process Related to NUREG/CR-6850



Commented [HJ8]: This discussion seems to indicate that the occurrence of a trip would be "judged." Fire damage and the occurrence of a trip from that damage is too important to be judged, and, a trip should be assumed if there is doubt on whether a trip would occur due to the plant's lack of knowledge of cable routings.

Commented [HJ9]: Identification of an initiator is not a judgment, as equipment damage is the primary driver. Only a judgment for a manual trip.

Commented [HJ10]: Please see discussion #2 on use of "likely, not likely," etc. which precedes this FAQ.

Commented [HJ11]: Is the argument that a smaller expert panel will have less dissent; therefore, produce more definitive results and lead to more confidence? Small groups may contain insufficiently diverse views or biases, and not lead to confident results.

Commented [HJ12]: Why is the need for sensitivities specified here? What particular sensitivities are being referred to?

Commented [HJ13]: Please see discussion #1 which precedes this FAQ on issues related to conduct of operator interviews to capture operator knowledge and experience.

Commented [HJ14]: This solution seems to involve crediting non-proceduralized actions. Per the PRA Standard, only proceduralized (or skill-of-the-craft) actions can be credited in the PRA. The actions proposed to be credited are neither.

Commented [HJ15]: Staff comments in this FAQ apply to Figure 1 as well.

FAQ Number 18-0017 FAQ Revision 0ba1
FAQ Title Conditional Trip Probability for Modeling Operator Discretion

In Step 1, the Fire Compartments, containing equipment/cables whose fire-induced failures are judged in Section 2.5.3 of Task 2 to result in a plant trip, are assigned a CTP of 1.0. In considering whether fire-induced equipment failures result in a plant trip, the potential impact of loss of instrument air due to fire-induced failure of soldered joints should be included. However, if there are doubts as to whether the criteria are met, operator input should be solicited in Step 2 before conservatively assigning a "reactor trip" to that Fire Compartment.

In Step 2, the operators bin each Fire Compartment, that Task 4 did not qualitatively screened out, based on the likelihood of a plant trip (i.e., "Likely," or "Not Likely," or "Very Not Likely") given a fire in that Fire Compartment. The operators should use the cable selection information from Task 3 to supplement their own insights on the likely routings of important cables. Where differences in the respective damage sets indicate a significant difference in the likelihood of a plant trip, scenarios smaller than a Fire Compartment may be binned separately. The basis for selecting each bin needs to be documented and should address important equipment and cables affected, procedural or Technical Specification requirements, or other relevant considerations.

In Step 3, a CTP of 1.0, 0.1, or 0.01 is assigned as a screening value to each assigned bin of "Likely," "Not Likely," or "Very Not Likely," respectively. Both pilot plants selected the same screening values for the CTPs. The CTP of 1.0 for the "Likely" bin will still be conservative for some Fire Compartments. As a representation of average, the CTP of 0.1 for the "Not Likely" bin is slightly less than the 1 in 7 frequency for plant trips related to fire. The CTP of 0.01 ensures that Fire Compartments in the "Very Not Likely" bin can be retained for further analysis without skewing the risk assessment. The decade separation between the CTPs provides better resolution than using an "all or nothing" assumption.

The CTPs are later factored into the applicable fire scenario event frequencies when calculating CDF and LERF in Task 14. Sensitivities should be performed with alternate CTPs, where the operators failed to achieve consensus on the assigned bin.

Review of Results

Where the use of CTPs changes the estimated risk sufficient to change the risk insights, the cutsets or damage sets should be reviewed with the operators to confirm that the CTP is a good representation of plant trip likelihood. Operators may be unaware of certain assumptions made in the FPRA (e.g., assumed cable routings for equipment not actually in the Fire Compartment or assumed cable lengths for breaker coordination of an electrical enclosure in a different Fire Compartment). However, the operator discretion may be based on a greater awareness of the potential fire impacts in choosing to avoid plant conditions that make plant safety more dependent on the equipment impacted by fire.

If deemed appropriate after a review of the cutsets or damage sets, the CTP for the Fire Compartment should be changed. Alternately, it might be more appropriate to change

Commented [HJ16]: The trip is not based on a "judgment" of fire induced failures, but on an analytical determination.

Commented [HJ17]: Fire damage, not operator's views, determine whether a trip will occur. Operators' views are only appropriate if cable tracing is complete and no trip is produced by fire damage.

Commented [HJ18]: Same comment as before

Commented [HJ19]: We are not interested in the "likely" routings of cables for PRA in this FAQ. Whether to assign a trip is due to the function of the cables failed by fire, not the views of the operators.

Commented [HJ20]: No basis at all for conditional probabilities of 0.1 and 0.01. Better resolution without a basis for the conditional probabilities does not lead to improved realism.

Commented [HJ21]: The likelihood is appropriate for a methodology with operator discretion on manual trips, but not necessarily for this FAQ as written.

FAQ Number 18-0017 FAQ Revision 0ba1
FAQ Title Conditional Trip Probability for Modeling Operator Discretion

the CTP for certain scenarios to something different from that of the associated Fire Compartment. Ultimately, the review should conclude that the assigned CTP is a good representation of a plant trip for operator discretion.

Some Observations From Early Applications of CTPs

Typically, the application of CTPs changes the risk for only a few Fire Compartments, because there is usually strong alignment between where the model predicts equipment damage to result in a plant trip and where the operators expect equipment damage to result in a plant trip. However, the risk impact can be significant for those few Fire Compartments. For example, fires related to the diesel generators represent a common opportunity for improvement in realism. Usually, the cells are divisionally separated in different Fire Areas by 3-hour rated fire barriers. The operators well know the LCO for the loss of a single diesel generator, and that LCO may be 7 days or longer. Consequently, operators tend to bin plant trips for such fires as "Very Not Likely" whereas it is not uncommon for the analysts to have conservatively assumed a plant trip.

When the binning of the Fire Compartments includes the consideration of cables, the CTPs can exhibit asymmetries in otherwise functionally equivalent parts of a multi-unit plant. Where this has resulted in better alignment between the risk significance determined by the PRA and the risk significance as understood by the operators (and the Fire Protection engineers), there has been increased confidence in the Fire PRA.

If appropriate, provide proposed rewording of guidance for inclusion in the next Revision:

None, this is a change only in the FPRA treatment.
=====

Commented [HJ22]: Should a CTP be approved, then the Fire Compartment CTP would incorporate insights from damage to the entire Compartment.

Commented [HJ23]: Is this the result of an operator interview as referred to in this FAQ?