12/21/04 RJB received

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Date: Thu, Dec 16, 2004 8:16 AM
Subject: Response from "Comment on NRC Documents"

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Below is the result of your feedback form. It was submitted by

Dennis Henneke (dwhenneke@duke-energy.com) on Thursday, December 16, 2004 at 08:16:09

Document_Title: Fire PRA Methodology for Nuclear Power Facilities

NUREG/CR-6850

Comments: General

The 600 + pages of Fire PRA Procedures provided have not been test run at any pilot plants. At least one additional pilot plant scheduled to use the procedures is likely not going to use the procedures in 2005, due to the loss of key personnel. It is recommended that the Technical Peer Review group for the project be asked to determine when the procedures have received sufficient trial use as to issue a final version of the procedures.

There are specific sections which are new and need to be fully piloted. This includes the circuit analysis sections (also affecting component selection), the main control board sections, the HRA sections, and the new severity factor and suppression curve combinations. You may want to recruit NFPA-805 pilot plants to test run particular sections of the procedures, such as control room fires.

Section 2.3.2

Please add discussion on consideration of the likelihood of spurious operation. If the likelihood of spurious operation is low (armored cable, cable in conduit), in may not be necessary to look at doubles or triples.

Section 2.5

What is missing here is the specific treatment of Fire-Induced Initiating Events and Event Tree sequences not included in the Internal Events PRA. There is some references around this issue (see Table 2-1, reference to PORV spurious opening, etc.), but there is insufficient discussion on the possible need to include both new initiating events, and initiating events screened in the internal events PRA. For example, spurious injection is typically screened in the internal events PRA, but may be important in areas where the PORV is damaged and the Pressurizer Safety is challenged. Spurious opening of a sump valve is an event that doesn't fit the typical internal events initiating event, nor does spurious containment spray.

Section 2.5.2.5

Manual actions can also fail safe shutdown functions. For example, for certain fires, manual actions may be performed to trip a feeder breaker, thus failing everything supplied. Manual action could also close a PORV block valve, resulting in the need to operate the safety valve. This can lead to a more likely small LOCA if the valve fails to reclose. Safety Valve lifts may not be treated in the internal events event tree structure.

Section 2.5.6

High Consequence events should be correctly defined. The definition, as provided, does not address LERF. Additionally, a spurious operation that can affect common equipment or two valves in the same

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system is not "high consequence" unless this leads to either a loss of function or LERF. Item c is closer to the point, but needs to be reworded to emphasize the LERF/containment bypass aspect.

Section 2.6

Earlier in Section 2, the procedure discussed tracking components that are assumed failed (not credited). This should be discussed in the uncertainty section. One suggested method is to carry this information forward, and treat this under the final results uncertainty.

Section 2.6

Please make the uncertainty section more concise. Also, the section on plant configuration is not discussed in other sections. As such, it is not a proven uncertainty, or one that can be analyzed within the procedure. Also, if the internal events PRA includes various configurations, then this may not be an area of large uncertainty. Recommend removing the discussion.

Section 3.4.2.2

Please add discussion on areas where the Appendix R circuits and components may not be included in the Fire PRA tracing. For example, equipment whose spurious operation may affect pressurizer level, but does not directly affect core damage or LERF risk may not be traced by the Fire PRA. Additionally, boron control required for Appendix R is typically not important in Fire PRA due to the low likelihood of ATWS (See Table 2-1). So a mismatch is OK between Appendix R and the Fire PRA, but should be reviewed.

Section 3.6.2

It is common for appendix R analysis to assume that any control cable can result in failure and/or spurious operation of a component, rather than spend the time to do a detailed circuit analysis. This carries forward unless there is an Appendix R conflict requiring detailed circuit analysis. This may also be carried through into the Fire PRA, making the Fire PRA results conservative. Please add discussion of this in the uncertainty section.

Section 4.6

As stated, the impact on a fire on shutdown may not be known and will be typically assumed. As such, the fire areas/compartments carried forward are conservative, since many may not actually result in a plant shutdown. Please add discussion on this issue.

Section 5.5.1.2

Please expand the line item/bullet on manual actions. Manual actions may change a component status (Close a PORV Block), trip a component, or trip a power supply. As such, the manual action may fail safe shutdown function, or may actually help by precluding the effect of a spurious operation. What is missing here is the discussion on how a manual action may actually hurt safe shutdown functions. Also, timing is important, since some actions are perfumed immediately upon detection of a fire, while others are performed as a result of a failure or event.

Also note that manual actions may be as a result of many things, not just spurious operation. For example, manual actions may be as a result of a degraded barrier or breaker coordination.

Section 6.5.6 Control Boards: See also 11.5.1.1.2. Please provide additional explanation on control boards and other equipment. The statements provided seem to indicate that the fire frequency is only associated with the main control board (s) while the 5 fires that occurred and are counted in the data generally occurred in other cabinets. It is agreed that if there are plant wide equipment in the control room, such as transformers, etc, these should be added to the overall control room fire frequency. However, any

electrical cabinet typically in the control room should be assigned a fire frequency based on the control room fire frequency. That is, if there are 23 cabinets typically in the control room, each is assigned one twenty-third of the total frequency.

A review of the control room fires was performed. Most fires were relays in back cabinets. Only one was clearly a control board fire. However, the reviewer does not have the latest Fire Data used by the project team since this is not publicly available. Please review the breakdown of the assigned fires for control boards with the project peer review to ensure the correct assignment of fire frequency versus method is established. The data assigned to the MCB cabinets also affects the suppression curves developed.

Table 7-2. The CDF/LERF Criteria, as listed, is not clear. It lists that (remove parentheses) the CDF < Highest fire frequency * CCDF. This is repeated in the supporting appendix, but not clarified. I am not sure what this means. Please clarify and/or provide an example.

Section 8.5.1.3 Please describe how the Fire SDP Zone of influence tables can be used for screening ZOI estimates. Many folks will probably use these first, since they are accepted and can be referenced.

Section 8.4.5 It is not clear in the procedure, but it seems to indicate that if a fire size resulting in a severity factor of 0.02 does not damage safe shutdown equipment or cables, then the ignition source can be screened. Please clarify.

Section 9.5.1.1: This task does not flow well from the Task 3 output. Since the output of task 3 is a list of components and cables, the steps to confirm the cable list (1.1) and confirm unscreened plant components are identified is redundant to task 3. There should be no confirmation steps at this point.

Section 9.5.2.2 Discussion on three phase hot shorts is a repeat of previous discussion (see 3.5.2.2).

Section 9.5.3 The "Equipment Failure Response Report" is just one of many ways to list the fire area/compartment versus the components and their potential failure mode. Would recommend not referring to a specific report name, but rather discuss what output is needed for future use, and why.

Section 10.5.4 Please do not refer to a particular report name (Circuit Failure Mode Probability Report) and refer rather to what is needed and why. In generally, plants using Fault Tree codes, such as CAFTA will document the probabilities with the CAFTA database. Some of the supporting information will be in CAFTA, and others will be included in specific analysis files. However, a particular report may not be provided.

Table 10-1:

The circuit failure probabilities provided are not correct based on incorrect understanding of the failure data and spurious operation probability. The original data and resulting expert panel report provided a spurious operation probability for any direction. In the original tests, there were two motor starters used in the circuits, one to represent the open MOV circuit and one to represent the close MOV circuit. The data was then developed based on either circuit having a spurious operation. The expert panel results were also developed using this data for either circuit being energized.

However, in PRA, we are looking at a failure in only a single direction (opened or closed, start or stopped, etc.). Therefore, the results in Table 10-1 should be divided in half to get the correct results.

Additionally, the failure probability in a given direction may be different for two components with similar cables but different circuit designs. For example, if a valve is closed and gets a close signal resulting in a circuit fuse trip or other interlock, this would be different than a valve getting a close circuit, but can re-open once the close signal is cleared – or if the close signal does not affect the valve operation. Some of the difference is n whether the spurious operation probability can drive the valve into its open or closed seat resulting in a motor failure. If this is not possible, then spurious operation in the opposite direction is possible. It is in fact possible to have a valve cycle from open to closed back to open, etc. The

methodology and the supporting probabilities should support this.

Right now, for example, an MOV without a CPT would be assigned an open spurious operation of 0.6 and a closed spurious operation of 0.6, and a fail as is of 0.4. This can not be possible. The correct assignment is a 0.3 open/closed spurious operation and a 0.4 fail as is.

Section 10.5.3.2

The computational method provided has not received the proper technical review and expert panel elicitation to support its publication as an accepted method. The Requantification Project Peer Review noted this in its comments. However, the comment was never fully addressed. Initial response was that an expert panel elicitation would be held on the method. However, this has not been performed to date.

Table 11-1

It is not explained in the text what is meant when an "Assume 1.0" is listed under HRR. If this means assume a severity factor of 1.0 for all fires, this is extremely conservative. For cable fires, this means using the methods in requantification Appendix R, and assume full engulfment of the cable tray, and a spread based on R.4.1. However, much of the data included small and localized fires. In fact, there is little evidence in the data that full engulfment of a cable tray would be expected as a result of a welding event or other similar event where an external flame source is not initially provided. For catastrophic failures (high energy arcing and transformer – Catastrophic), a 1.0 severity factors looks reasonable.

Section 12.5.1.3, Pre-initiator: Item 1 – it is difficult to understand how an operator can change separation during test, maintenance and repair. Please explain or remove. Item 2: All plants are required to maintain fire barriers. Please explain what further we need to do, or remove the item. Items 3 and 4. Similarly, testing of fire detection and suppression systems is required.

Section 12. 5.1.3, pre-initiator, item 5. This factor is already included in the assignment of transient fire frequencies. Please remove the item here. Any factors not included in the transient fire frequency development should be moved to that procedure.

Appendix C:

Hydrogen Tanks: Original Data shows only 2 Challenging Fires, while table C-3 shows 4. Please explain which events are challenging.

Pumps: Table C-3 shows 52 fires. However, original data only shows 54 total fires, many of which were not challenging. Please explain the differences.

Transformers: Please note that Table C-3 lists 23 fires with a mean value of 9.9E-03/year. However, this is transposed into Table 6-1 as categories 23A and 23B, both with mean values of 9.9E-03/year. This is a double counting of transformer fires. Please correct Table 6-1 and supporting Appendix Material. Additionally, the original data shows only 16 total fires (including challenging, and a 0.5 for unknown). Please explain the differences.

The review performed for the above comments has resulting in about a 50% discrepancy rate (6 categories randomly reviewed, 3 problems found – 1 major). Please have a technical review re-performed by the project peer review for the Fire Frequency data versus the access data. This data is a key step to all future fire PRAs, and needs to be as accurate as possible.

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