

Overview of Methods for Assessing CCF Issues Under NEI 16-XX

July 11 2016 • NRC CCF Workshop • Washington DC



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NEI 16-XX

- Purpose: Achieve alignment between the NRC and industry on the technical methods and acceptance criteria for assessing the following three issues related to the topic of CCF of multiple controlled SSCs caused by an I&C failure:
 1. CCF Susceptibility Analysis: What defensive measures can be used in the I&C to influence the likelihood of a CCF of multiple controlled SSCs, and in turn, determine its likelihood and effects?
 2. CCF Bounding Analysis: If a CCF is not unlikely, is the end result bounded by a previous analysis? What methods and acceptance criteria can be used?
 3. CCF Coping Analysis: If the CCF is not unlikely and the end result is not bounded, then what methods and acceptance criteria can be used to determine the acceptability of the CCF?
- Applicability: Affected systems, structures and components described in the FSAR for an operating plant, or described in the DCD for a new plant.

CCF Susceptibility Analysis (1/4)

- By systematically assessing all CCF sources and the available effective defensive measures, a CCF can be prevented or limited with reasonable assurance (achieving 100% assurance is not possible, nor is it necessary).
 - “Prevented” means the aggregate of preventive measures is sufficient such that no further analysis is required, except in PRA. A preventive measure reduces the likelihood of a CCF of multiple controlled SSCs for each I&C failure source to no more likely than other sources of CCF that are not considered in the deterministic plant safety analysis.
 - “Limited” means the aggregate of limiting measures is sufficient such that Bounding/Coping Analysis can consider less onerous resulting malfunctions. A limiting measure reduces the extent of the malfunction, forces a preferred malfunction, or a combination of both.

CCF Susceptibility Analysis (2/4)

- **Level 0:** CCF Not Unlikely
 - When no preventive measure applied. As likely as AOOs considered in the plant's deterministic safety analysis (typically caused by single failures in the I&C).
 - Considered within an operating plant's design basis, and considered within the design basis for new plant licensing.
 - Limiting measures may be applied.
 - CCF end result is assessed using conservative bounding or coping analysis methods.

CCF Susceptibility Analysis (3/4)

- **Level 1**: CCF significantly less likely (beyond design basis) than Level 0, but not considered unlikely
 - Level 1 is achievable when a preventive measure for a design defect is not applied, as long as the I&C has a structured development process and independence between controllers
 - Likelihood sufficiently low to be considered beyond design basis, but not unlikely, and therefore within the licensing basis.
 - Limiting measures may be applied.
 - Achieving Level 1 for safety systems has historically required more conservative defensive measures than for non-safety systems; this precedence is applied and thus provides a graded approach.
 - Unprevented or limited CCFs can use conservative or best estimate analysis methods (consistent with SECY/SRM 93-087 and BTP 7-19)

CCF Susceptibility Analysis (4/4)

- Level 2: CCF Unlikely
 - Likelihood equivalent or less than other CCFs that are not considered in deterministic safety analysis (e.g., CCF due to multiple random hardware failures)
 - Achieving Level 2 for safety systems has historically required more conservative defensive measures than for non-safety systems; this precedence is applied and thus provides a graded approach.
 - If level 2 is achieved for all I&C failure sources, then no further consideration of CCF because it is as unlikely as other CCFs that are not considered in deterministic safety analysis. It is still appropriate and recommended to consider CCF in the PRA.

CCF Bounding Analysis (1/2)

- An assessment* of the CCF result to determine all of the following:
 - If the same type of malfunction is already included in the deterministic plant safety analysis (e.g., excess feedwater event).
 - If the same mitigation strategy is employed (e.g., auto vs. manual) in the deterministic plant safety analysis, such that a change to the analysis is not needed.
 - If the end result margin to safety limits described in the plant safety analysis is maintained.

**In many cases, nothing more than an inspection of an existing deterministic safety analysis*

CCF Bounding Analysis (2/2)

- Level 0 CCFs
 - Conservative design basis analysis methods and existing AOO acceptance criteria. Bounding is based only on previously analyzed AOOs, and must maintain the existing margin to protect critical safety limits.
- Level 1 CCFs
 - Conservative design basis methods, or less conservative beyond design basis methods (also referred to as “best estimate methods”)
 - AOO or PA acceptance criteria. Bounding is based on previously analyzed AOOs or PAs, and must maintain the existing margin to protect critical safety function limits (e.g., DNBR, containment pressure, etc.).

CCF Coping Analysis

- When the Bounding Analysis concludes the malfunction end result is not bounded (i.e., a new analysis is needed)
- Level 0 CCFs
 - Conservative design basis analysis methods and existing AOO acceptance criteria.
- Level 1 CCFs
 - Conservative design basis methods, or less conservative beyond design basis methods (also referred to as “best estimate methods”)
 - AOO or PA acceptance criteria, or beyond design basis acceptance criteria:
 - coolable core geometry
 - containment integrity
 - releases do not exceed 10CFR100 limit

Coincidence of CCF and Plant Events

- For Bounding Analysis and Coping Analysis:
 - CCF leading to malfunctions that are event initiators (e.g., malfunctions due to a control system CCF) are analyzed with no other coincident event (e.g., no other AOO or PA) and no other CCF (e.g., no unrelated CCF in a safety system)
 - CCF leading to malfunctions in event mitigators (e.g., malfunctions due to a safety system CCF) are analyzed coincident with all AOOs (note: LOOP is an AOO) and PAs, but with no additional CCF (e.g., no LOOP with coincident PA; this is consistent with new plant reviews).

Next Steps

- Finalize the industry technical guidance (NEI 16-0XX) for NRC review
- Plan and conduct additional joint industry/NRC workshops for the purpose of building consensus on CCF susceptibility, bounding and coping analysis methods
- Adjust NEI 16-0XX as needed

Questions?

