Fire PRA Uncertainty Sources

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Fire Risk Equation: Four-Factor Formula

- CDF = $\sum$ ($\lambda_f \cdot SF \cdot P_{ns} \cdot CCDP$) *
  – λ_f = scenario fire frequency (ignition of [potentially] challenging fire)
  – SF = severity factor (includes propagation, zone of influence)
  – P_{ns} = probability of non-suppression (automatic and/or manual, including fire brigade)
  – CCDP = conditional core damage probability (interface from internal events, with allowance for additional mitigation credited from Safe Shutdown provisions, and "common-cause" fire effects that can "fail" multiple components)

*(summed over all contributing scenarios)

Fire Frequency - λ_f

- Important source of uncertainty
- Parametric uncertainty covered by current methods
  - Routinely quantified in generic tables
  - Easily propagated through analysis
- Related SRs are in Technical Element (TE) IGN and the following High Level (HLR) and Supporting Requirements (SRs) in particular:
  - HLR-IGN-A, SRs: IGN-A5, IGN-A10 (analysis)
  - HLR-IGN-B, SRs: IGN-B4, IGN-B5 (documentation)

λ_f: TE IGN (HLR-IGN-A)

<table>
<tr><th>High Level or Supporting Requirement</th><th>What are the Sources of Model Uncertainty?</th><th colspan="3">Discussion of HLR (or SR) and Issue:
How is the model uncertainty manifested in the PRA?
How does the model uncertainty affect the PRA results?</th><th>Model Uncertainty Significance (High/Medium/Low)</th></tr>
<tr><td>HLR-IGN-A</td><td>See below.</td><td colspan="3">The Fire PRA shall develop fire ignition frequencies for every physical analysis unit that has not been qualitatively screened.

Note that this HLR does not mention “uncertainty,” but it is included here since some of its SRs mention it.</td><td>See below.</td></tr>
<tr><td>SR-IGN-A5 (All three CCs)</td><td>Fire frequency uncertainty should be essentially parametric in nature.</td><td colspan="3">CALCULATE generic fire ignition frequencies or plant-specific fire frequency updates on a reactor-year basis (generic fire frequencies are typically reported on this same basis), i.e., the analysis accounts for the fraction of the year that the plant is in at-power operational state. INCLUDE in the fire frequency calculation the plant availability, such that the frequencies are weighted by the fraction of time the plant is at-power.</td><td>Medium. Although essentially parametric, there can be variable degrees of completeness uncertainty due to vagaries in reporting fire events.</td></tr>
<tr><td rowspan="2">SR-IGN-A10 (CC-I, II, III)</td><td rowspan="2">Such uncertainties typically are parametric only. Note (6) also addresses only parametric uncertainties. However, because ignition frequencies for components are currently conserved on a plant wide basis, fire frequencies for plants with fewer components have the same frequency as plants with more.</td><td>PROVIDE a characterization (e.g., qualitative discussion) of the uncertainty intervals for significant fire ignition frequencies.</td><td>PROVIDE a mean value of, and a statistical representation of, the uncertainty intervals for significant fire ignition frequencies.</td><td>PROVIDE a mean value of and a statistical representation of the uncertainty intervals for all fire ignition frequencies.</td><td rowspan="2">Medium. This is very plant specific. Significant variations in numbers of like components may exist across plant types according to the last recorded plant-wide equipment count, documented in the Fire PRA Implementation Guide (EPRI TR-105928, p. C-5).</td></tr>
<tr><td colspan="3">[Note (6): Use of the mean values and uncertainty intervals provided in NUREG/CR-6850, EPRI 1011989 for ignition frequencies combined with a review of plant-specific experience and implementation of any updates required per IGN-A4 is one acceptable method for meeting the Capability Category II and III requirements.]</td></tr>
</table>

λ_f: TE IGN (HLR-IGN-B)

High Level or Supporting Requirement	What are the Sources of Model Uncertainty?	Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?	Model Uncertainty Significance (High/Medium/Low)
HLR-IGN-B	**See below.**	**The Fire PRA shall document the fire frequency estimation in a manner that facilitates Fire PRA applications, upgrades, and peer review.** **Note that this HLR does not mention "uncertainty," but it is included here since one of its SRs mentions it.**	**See below.**
SR-IGN-B4 (All three CCs)	For (c) and (d), both are plant-specific and should have little, if any, uncertainty.	DOCUMENT the plant-specific frequency updating process. INCLUDE in the documentation: *(a)* the selected plant-specific event; *(b)* the basis for the selection and or exclusion of event; *(c)* the analysis supporting the plant-specific reactor-years; *and (d)* the Bayesian process for updating generic frequencies.	Low
SR-IGN-B5 (All three CCs)	Such uncertainties typically are parametric only.	DOCUMENT the assumptions and sources of **uncertainty** associated with the ignition frequency analysis.	Medium. As discussed for SR-IGN-A5, completeness uncertainty is typically an issue.

Conditional Core Damage Probability – CCDP

- Quantified using plant response model (event/fault tree models) – TE PRM (HLR-PRM-B)
- Uncertainty can be easily quantified to same level as internal events (since we start with internal events model)
- Importance to fire is equivalent to importance to internal events
- Some factors are unique to fire or re-quantified for fire scenarios:
  - Circuit failure modes likelihood estimates: see TE CF, HLR-CF-A, SR-CF-A2
  - Post-fire HEP values: see TE HRA, HLR-HRA-C, SR-HRA-C1

CCDP: TEs PRM and CF (HLRs PRM-B and CF-A)

High Level or Supporting Requirement	What are the Sources of Model Uncertainty?	Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?	Model Uncertainty Significance (High/Medium/Low)
HLR-PRM-B	**Basically, this is a punt of the fire PRA model, which is based on the internal events model, back to uncertainty in the internal events PRA model, with some special additions as discussed in the HLR. Such fire-specific uncertainties are usually addressed by other Elements, so these can be ignored here. Only the punt back to the internal events needs to be considered under this HLR.**	**The Fire PRA plant response model shall include fire-induced initiating events, both fire-induced and random failures of equipment, fire-specific as well as non–fire-related human failures associated with safe shutdown, accident progression events (e.g., containment failure modes), and the supporting probability data (including <u>uncertainty</u>) based on the SRs provided under this HLR that parallel, as appropriate, Part 2 of this Standard, for Internal Events PRA.** **Interestingly, none of the SRs that accompany this HLR includes "uncertainty."**	**Commensurate with that of internal events PRA model.**
HLR-CF-A	**See below.**	**The Fire PRA shall determine the applicable conditional probability of the cable and circuit failure mode(s) that would cause equipment functional failure and/or undesired spurious operation based on the credited function of the equipment in the Fire PRA.** **Note that this HLR does not mention "uncertainty," but it is included here since one of its SRs mentions it.**	**See below.**
SR-CF-A2 (All three CCs)	While the probability of a particular type of fire-induced circuit failure (e.g., "hot short") will have a quantifiable parametric uncertainty, there may also be uncertainty in the type of failure itself (e.g., short to ground vs. "hot short"), which translates more into a model uncertainty.	CHARACTERIZE the **<u>uncertainty</u>** associated with the applied conditional failure probability assigned for fire-induced circuit failures per SR-CF-A1. [Note (2): Refer to SR DA-D3 in Part 2 for requirements for characterizing uncertainty.]	Medium

CCDP: TE HRA (HLR-HRA-C)

High Level or Supporting Requirement	What are the Sources of Model Uncertainty?	Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?			Model Uncertainty Significance (High/Medium/Low)
HLR-HRA-C	**See below.**	**The Fire PRA shall quantify HEPs associated with the incorrect responses accounting for the plant-specific and scenario-specific influences on human performance, particularly including the effects of fires.**			**See below.**
SR-HRA-C1 (CC-I, II, III)	Basically, this is a punt of the fire HRA model, which is usually based on the internal events model, back to uncertainty in the internal events HRA model, with modifications of internal events HFEs/HEPs for fire effects as well as addition of fire-specific HFEs/HEPs.	For each selected fire scenario, QUANTIFY the HEPs for all HFEs, accident sequences that survive initial quantification *and* ACCOUNT FOR relevant fire-related effects using conservative estimates (e.g., screening values), in accordance with the SRs for HLR-HR-G in Part 2 set forth under CC-I, with the following clarification:	For each selected fire scenario, QUANTIFY the HEPs for all HFEs and ACCOUNT FOR relevant fire-related effects using detailed analyses for significant HFEs and conservative estimates (e.g., screening values) for non0significant HFEs,, in accordance with the SRs for HLR-HR-G in Part 2 set forth under CC-II, with the following clarification:	For each selected fire scenario, QUANTIFY the HEPs for all HFEs and ACCOUNT FOR relevant fire-related effects using detailed analyses, in accordance with the SRs for HLR-HR-G in Part 2 set forth under at least CC-III, with the following clarification:	At least commensurate with that of internal events HRA model (may be greater due to fire effects).
		(a) Attention is to be given to how the fire situation alters any previous assessments in non-fire analyses as to the influencing factors and the timing considerations covered in SRs HR-G3, HR-G4 and HR-G5 in Part 2 *and* (b) DEVELOP a defined basis to support the claim of non-applicability of any of the requirements under HLR-HR-G in Part 2.			
		[NOTE (1): The Fire PRA context introduces new aspects to those performance shaping factors (PSFs) already identified in the Part 2 requirements (e.g., the effects of the environmental conditions would need to consider relevant fire environments), or might introduce new PSFs (e.g., the fact that one operator is generally assigned as member of the fire brigade or the added burden associated with post-fire operator actions). The intent of SR HRA-C1 is to ensure treatment of such factors.]			

Non-Suppression Probability - P_{ns}

- P_{ns} reflects a race between fire growth and fire suppression
  - If: (t_{damage}) < ($t_{suppression}$), loss of target set is assumed to occur
- Both elements, ($t_{damage,}$ $t_{suppression}$), contribute to uncertainty:
  - Fire phenomenological modeling calculations provide time to damage
  - Suppression reliability curves give probability of suppression as function of time
  - Given a time to damage, P_{ns} is taken from suppression curve

Non-Suppression Probability - P_{ns} (cont.)

- Once again, difficult to quantify fire phenomenological modeling uncertainties
  - Somewhat similar to thermal-hydraulic calculations for internal events
- Suppression reliability curves are based on analysis of data from actual events
  - Parametric uncertainty on suppression rate factor is easily quantified
  - NUREG/CR-6850, EPRI TR-1011989 did include probabilistic values for suppression rates
  - FAQ-08-0050 updated suppression rate factors, but did not include probabilistic values – these can easily be reproduced
- At minimum, current methods can easily incorporate P_{ns} uncertainty based on uncertainty in suppression curves

Severity Factor - SF

- Uncertainty for severity factor is more challenging
- SFs are typically derived from one of two sources:
  - Analysis of event data – severity factor reflects fraction of fire events use in fire frequency that exhibited some specific adverse behavior
    - (e.g., fire spread beyond source…)
  - Application of fire phenomenological modeling tools – e.g., SF reflects fraction of fires large enough to cause damage to at least one damage target or to ignite any secondary fuel package

Severity Factor – SF (cont.)

- Severity factors can substantially impact CDF results
- Under current practice, we use point estimates that don't include uncertainty
- Uncertainty may be high
- For event-analysis-based SF: formal uncertainty analysis will be difficult, but sensitivity studies can be easily performed
- Where based on fire phenomenological modeling, uncertainty is difficult to quantify for a given application because factors that drive these fire modeling results are each uncertain but uncertainty is not well characterized
- Overall – best approach on SF may be sensitivity analysis rather than formal uncertainty characterization and propagation

P_{ns} and SF – Fire Phenomenology

- Both of these, especially SF, interface directly with fire phenomenological modeling, which may be the biggest fire PRA uncertainty challenge
- Uncertainty here is difficult to quantify
  - Many input values and each is uncertain
  - Dominant inputs will vary by application and by the tool used
  - Difficult to separate bias from uncertainty
  - Similarities to thermal-hydraulic calculations for internal events

Fire Phenomenological Modeling Uncertainty in Fire PRA

- The more substantive fire phenomenological modeling takes place in the area of fire growth/damage:
  - Fire spread beyond initiating source
  - Thermal response of damage targets – time to damage
- Wide range of phenomenological modeling tools
  - Simple closed-form handbook correlations (e.g., FDTs)
  - Empirical models (e.g., HEAF and cable tray spread models)
  - Fire compartment zone models (e.g., CFAST, MAGIC)
  - Computational fluid dynamic (e.g., FDS)
  - Specific application models (e.g., THIEF for time to cable damage)

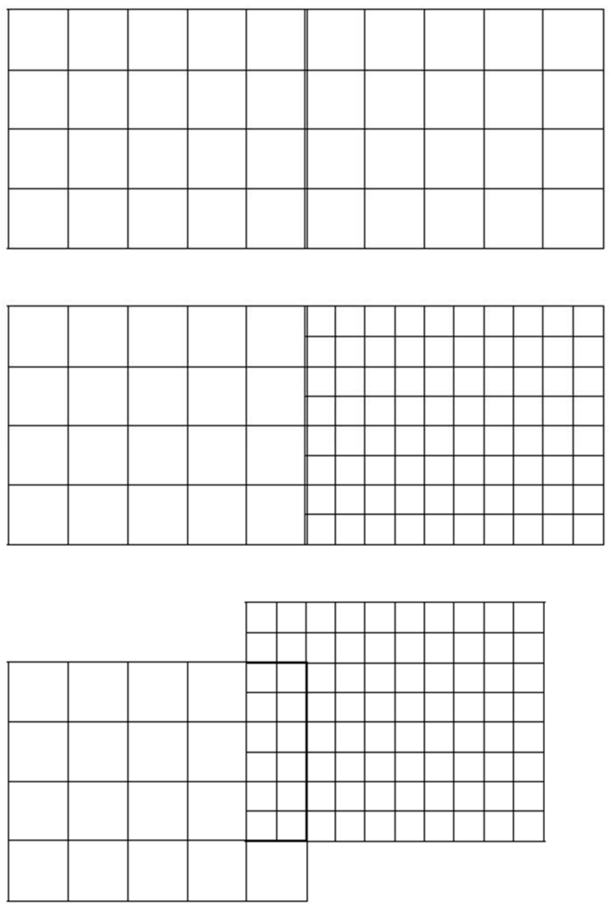
Uncertainty in Phenomenological Modeling

- Input values (e.g., HRR, thermal conductivity) have primarily parametric uncertainties
  - Addressable by varying assumed values
  - Empirical vs. statistical
- Analyst/User Options – “modeling”/completeness uncertainties
  - Model selection: empirical vs. zonal vs. CFD
  - Level of detail, e.g., complex geometry and phenomena, visual representation
  - Availability and form of information

Uncertainty in Phenomenological Modeling (cont.)

- Analyst/User Options (cont.)
  - The analyst/user is “free” to:
    - Specify compartment/room dimensions, with “rounding”
    - Select certain parameters (with associated parametric variability)
    - Modify assumptions or make deliberate adjustments to “manipulate” the model
    - Collect and interpret data and results, e.g., virtual thermocouples, detectors, “slice” files, images
    - Choose hardware capacity, e.g., CPU, RAM, random number generators

Uncertainty in Phenomenological Modeling (cont.)



This is the ideal kind of mesh to mesh alignment.

This is allowed so long as there are an integral number of fine cells abutting each coarse cell.

This is allowed, but of questionable value.

Analyst/User Options (cont.)

- The analyst/user is “free” to select grid resolution – fine vs. coarse, composite, even overlapping (example from Fire Dynamics Simulator)

Fire Growth/Damage

- Range of tools used in fire growth/damage analysis complicates the uncertainty question
  - Each phenomenological modeling form implies different types and levels of uncertainty
  - Some tools carry substantive bias
  - Many input parameters carry uncertainty but importance varies substantially
- Typical analysis provides no real assessment of uncertainties (or bias) associated with fire phenomenological modeling tools being applied

Fire Growth/Damage (cont.)

- Heat Release Rate (HRR) is arguably the single most important factor in growth/damage analysis
- HRR has high aleatory (inherent) uncertainty
- Fires are chaotic, not orderly, events
- Key characteristics/parameters:
  - Peak intensity: Current methods provide peak intensity distributions for various sources characterizing aleatory uncertainty
  - Growth rate/time (time from ignition to peak): Typically based on best-estimate values with no uncertainty treatment
  - Burn-out decay time/behavior: Not typically treated since active fire suppression limits fire duration anyway

Fire Growth/Damage (cont.)

- Much potential for bias in fire scenario analysis
  - Real fires involve complex behaviors and the spread of fire damage over time
  - PRA fire scenarios are often treated as static events and using simplified approaches lumps target set approaches
- Typical treatment can lead to conservative bias, e.g.,
  - Damage targets are cables in various trays above the fire source
  - Analysis assumes all targets fail when first (lowest) tray fails
- Relatively small time differences (minutes) can mean large risk differences
- Problem can be addressed by building multiple target sets to reflect different damage times for different trays, but that adds to analysis complexity and documentation challenges

Fire Growth/Damage (cont.)

- Bias can also result from failure to apply all available tools to get more realistic estimates of time to damage, e.g., the simplified THIEF cable damage model or reliance on screening in lieu of more detailed fire analysis
- Key TE for Fire Phenomenological Modeling is FSS, with HLRs FSS-D, FSS-E and FSS-H
  – SRs include FSS-E3 (parametric) and FSS-E4 (cable routing); FSS-H5 and FSS-H9 (documentation)

P_{ns} and SF – TE FSS (HLRs FSS-D & -E)

High Level or Supporting Requirement	What are the Sources of Model Uncertainty?	Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?	Model Uncertainty Significance (High/Medium/Low)
HLR-FSS-D	Adjustments to manual suppression credit cannot be made to the fire brigade separately from the first responder. For example, a general model uncertainty issue is adjusting manual suppression for fire brigade response time. Currently, the entire manual suppression curve is adjusted.	The Fire PRA shall quantify the likelihood of risk-relevant consequences for each combination of an ignition source and damage target sets selected [that] ... represent the fire scenarios for each unscreened physical analysis unit upon which estimation of the risk contribution (CDF and LERF) of the physical analysis unit will be based. The many SRs in HLR-FSS-D, while not explicitly citing "uncertainty," incorporate statistical models, one of which is the manual suppression in Fire PRA. Manual suppression is credited across the plant and, as such, has a plant-wide effect. Manual suppression integrates credit from the first responder and the fire brigade team.	Manual suppression can be applied to every fire scenario, but its model uncertainty is unknown and potentially important. Long durations, which contribute to large non-suppression probabilities, can arise from responses by extinguishers alone. This runs counter to an easy assignment of importance with respect to model uncertainty. The fire database effort underway will provide the ability to better evaluate this issue.
HLR-FSS-E	See below.	The parameter estimates used in fire modeling shall be based on relevant generic industry and plant-specific information. Where feasible, generic and plant-specific evidence shall be integrated using acceptable methods to obtain plant-specific parameter estimates. Each parameter estimate shall be accompanied by a characterization of the uncertainty.	See below.

P_{ns} and SF – TE FSS (HLR FSS-E [cont.])

High Level or Supporting Requirement	What are the Sources of Model Uncertainty?	Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?			Model Uncertainty Significance (High/Medium/Low)
SR-FSS-E3 (CC-I, II, III)	Such uncertainties typically are parametric only. However, assessing the model uncertainty could be important. For example, the effects of ventilation in cabinets on HRR can be important.	PROVIDE a characterization (e.g., qualitative discussion) of the **uncertainty** intervals for the parameters used for modeling the significant fire scenarios.	PROVIDE a mean value of and statistical representation of, the **uncertainty** intervals for the parameters used for modeling the significant fire scenarios.	PROVIDE a mean value of and statistical representation of, the **uncertainty** intervals for the parameters used for modeling the fire scenarios	Varies (likely Medium), depending upon the extent to which different models involve different parameters. If all models employ the same parameters, then this reduces to Low, since only parametric, not modeling, uncertainty prevails.
SR-FSS-E4 (All three CCs)	While not all cables can be traced, typically those important to the fire PRA are traced to the extent practicable. Those that cannot be traced are handled by assuming that, in any locale where they MAY be present, they are assumed always to be affected by fire in that locale (usually assumed failed or, if applicable, "hot shorted").	PROVIDE a characterization of the **uncertainties** associated with cases where cable routing has been assumed based on SRs CS-A10 and/or CS-A11. [Note (1): **Uncertainties** associated with cases where cable routing was assumed may be associated with the exact location of the cables with respect to the ignition sources, and fire-resistance characteristics and fire protection (e.g., fire-resistant covers) of the cables.]			Medium

P_{ns} and SF – TE FSS (HLR FSS-H)

High Level or Supporting Requirement	**What are the Sources of Model Uncertainty?**	**Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?**			**Model Uncertainty Significance (High/Medium/Low)**
HLR-FSS-H	**See below.**	**The Fire PRA shall document the results of the fire scenario and fire modeling analyses including supporting information for scenario selection, underlying assumptions, scenario descriptions, and the conclusions of the quantitative analysis, in a manner that facilitates Fire PRA applications, upgrades, and peer review.** **Note that this HLR does not mention "uncertainty," but it is included here since some of its SRs mention it.**			**See below.**
SR-FSS-H5 (CC-I, II, III)	Both intra- and inter-model uncertainty exist. Intra-model uncertainty addresses the variability that can be obtained if different models of the same type (e.g., zone or CFD) are compared. Inter-model uncertainty addresses use of different types (levels) of model, usually associated with greater and lesser degrees of refinement (e.g., more detailed modeling possible via a CFD model such as FDS vs. a zonal model such as CFAST).	DOCUMENT fire modeling output results for each analyzed fire scenario in a manner that facilitates Fire PRA applications, upgrades, and peer review.	DOCUMENT fire modeling output results for each analyzed fire scenario, including - the results of parameter **uncertainty** evaluations (as performed) in a manner that facilitates Fire PRA applications, upgrades, and peer review.	DOCUMENT fire modeling output results for each analyzed fire scenario, including the results of parameter **uncertainty** evaluations (as performed) in a manner that facilitates Fire PRA applications, upgrades, and peer review *and* DISCUSS insights related to the impact of uncertainties for key input parameters in the context of the resulting fire risk estimates.	High. While this SR addresses documentation, it is a convenient roll-up of all uncertainties assocaited
SR-FSS-H9 (All three CCs)	Documentation only.	DOCUMENT key sources of **uncertainty** for the FSS technical element.			N/A

Rolling up the Fire Risk Equation

- CDF = $\sum$ ($\lambda_f \cdot SF \cdot P_{ns} \cdot CCDP$)
  - Ultimately, all factors must be quantified and their uncertainties compounded
    - May be "straightforward" for parameter uncertainties, but more elusive for model uncertainties
      - Sensitivity analysis may be the most viable alternative
- TEs FQ and UNC, with HLRs FQ-A, FQ-F and UNC-A, address the overall quantification
  - HLRs FQ-A and FQ-F: SRs FQ-A3 and FQ-F1
  - HLR-UNC-A: SRs UNC-A1 and UNC-A2

$CDF = \sum(\lambda_f \cdot SF \cdot P_{ns} \cdot CCDP)$: TE FQ (HLRs FQ-A and FQ-F)

High Level or Supporting Requirement	What are the Sources of Model Uncertainty?	Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?	Model Uncertainty Significance (High/Medium/Low)
HLR-FQ-A	**See below.**	**Quantification of the Fire PRA shall quantify the fire-induced CDF.** **Although none of the four SRs in HLR-FQ-A explicitly cite "uncertainty," the fact that all are related to quantification of fire-induced CDF implicitly incorporates uncertainty aspects.**	**See below.**
SR-FQ-A3 (All three CCs)	Multiple	For each fire scenario selected per the FSS requirements that will be quantified as a contributor to fire-induced plant CDF and/or LERF, QUANTIFY the Fire PRA plant response model reflecting the scenario-specific quantification factors (i.e., circuit failure likelihoods per the CF requirements, HEP values for HFEs quantified per the HRA requirements, and the fire-induced equipment and cable failures for each fire scenario selected for quantification).	High, as the quantification includes all other aspects of the Fire PRA model.
HLR-FQ-F	**See below.**	**Documentation of the CDF and LERF analyses shall be consistent with the applicable SRs.** **Note that this HLR does not mention "uncertainty," but it is included here since one of its SRs mentions it.**	**See below.**
SR-FQ-F1 (All three CCs)	Documentation only.	DOCUMENT the CDF and LERF analyses in accordance with HLR-QU-F and HLR-LE-G and their SRs in Part 2 with the following clarifications: *(a)* SRs QU-F2 and QU-F3 of Part 2 are to be met including identification of which fire scenarios and which physical analysis units (consistent with the level of resolution of the Fire PRA such as fire area or fire compartment) are significant contributors *(b)* SR QU-F4 of Part 2 is to be met consistently with 4-2.13 *(c)* SRs LE-G2 (**uncertainty** discussion) and LE-G4 of Part 2 are to be met consistently with 4-2.13 *and* DEVELOP a defined basis to support the claim of non-applicability of any of the requirements under these sections in Part 2.	N/A

$CDF = \sum(\lambda_f \cdot SF \cdot P_{ns} \cdot CCDP)$: TE UNC (HLR-UNC-A)

High Level or Supporting Requirement	What are the Sources of Model Uncertainty?	Discussion of HLR (or SR) and Issue: How is the model uncertainty manifested in the PRA? How does the model uncertainty affect the PRA results?	Model Uncertainty Significance (High/Medium/Low)
HLR-UNC-A	**See below.**	**The Fire PRA shall identify sources of CDF and LERF uncertainties and related assumptions and modeling approximations. These uncertainties shall be characterized such that their potential impacts on the results are understood.**	**See below.**
SR-UNC-A1 (All three CCs)	This is a "catch-all" SR to ensure that uncertainty analysis, including that for modeling uncertainty, is addressed wherever appropriate.	PERFORM the **uncertainty** analysis in accordance with HLR-QU-E and its SRs in Part 2 as well [as SRs LE-F2 and LE-F3 under HLR-LE-F in Part 2 *and* DEVELOP a defined basis to support the claim of non-applicability of any of the requirements under these sections in Part 2. Note (1) It is intended that the **uncertainty** analysis cover that which has been included in the quantification as affecting the quantified fire-induced CDF and LERF for the fire scenarios quantified per FQ-A3. Hence, it is not intended that **uncertainty** analysis cover that which has been screened out by virtue of meeting the technical elements of this Standard (i.e., that screened out per 4-2.4 or 4-2.8 or any other justified screening performed).]	High
SR-UNC-A2 (All three CCs)	Mainly documentation to ensure that uncertainty as referenced in other HLRs and SRs is addressed. Note that SR-PRM-A4 does not mention uncertainty, so its reference here may be an error in the Standard.	INCLUDE the treatment of **uncertainties**, including their documentation, as called out in SRs PRM-A4, FQ-F1, IGN-A10, IGN-B5, FSS-E3, FSS-E4, FSS-H5, FSS-H9, and CF-A2 and that required by performing Part 2 referenced requirements throughout this Standard.	N/A