The

OFFICIAL

Senior Reactor Analyst

Users' Manual
(abridged)

OR

How to Win Final Resolution of your Issues

AND

Influence Fire Analyst Cooperation

A/32

SRA Deliverables and Expectations

Area	Deliverable	Received	Returned	Expected Turnaround
Inspection Support	Telephone discussion of ongoing issues, SDP process, report documentation, etc.	N/A	N/A	Usually same day
Risk Insights	E-mail and discussion of high level risk potentials.	When placed in our system as designated by a return e-mail specifically stating the area of support we will be providing.	N/A	Usually less than 48 hours
Phase 2	E-mail documenting the validated Phase 2	When placed in our system with: Completely filled out Phase 1 and Phase 2	-Unrealistic Assumptions -Incomplete -Bad logic	One week
	Memorandum delineating Phase 2 in specialty areas with headquarters peer review.	When placed in our system with: Completely filled out Phase 1 with logic to Phase 2 and appropriate assumptions	-Unrealistic Assumptions -Bad logic	30 days
Phase 3	Memorandum delineating phase 3 analysis if green	When placed in our system with: Completely filled out Phase 1 and Phase 2	-Unrealistic Assumptions -Incomplete -Bad logic	3 weeks
	SERP worksheet if greater than green with peer review and SERP support.			45 days
MD 8.3 Evaluation	Verbal recommendation with supporting numbers and critical assumptions.	When placed in our system with: -Knowledgable individual has discussed the related assumptions - Applicable drawings, documents, etc. provided. - Deterministic reason based on MD 8.3 for conditions	-Deterministic reason is not supported in MD 8.3. - If support necessary is not obtained from Branch	Early assessment at 24 hours
	Memorandum documenting the analysis with inspection recommendations.			One week

Green Background: May be requested by any technical staff.
Red Background: May only be requested by an inspection branch chief.
Blue: Items required by the SRA for acceptance.
Orange: Items that may cause the analysis to be returned to the branch.

Step 1

Identify Risk-Significant Fire Areas Affected

Inspection Needed: The inspector needs to understand the scope of the issue, such that (working with the analyst), a selection of risk areas needed to be evaluated can be developed.

Example Questions:

- How many areas have the failed penetrations in their barriers?

- What rooms are provided with automatic suppression that is substandard?

- What equipment is affected by the bad procedure and what fire areas are these pieces of equipment and their attendant equipment located?

Step 2

Screen Areas Using Fire Mitigation Frequency

Inspection Required:	Request from licensee basic information about each fire area to be analyzed.
Example Questions:	- What is the Fire Ignition Frequency? - What kind of detection/suppression is available in the room? - How long has the deficiency affected the area?

Step 3

Conduct a Bounding Evaluation of the Remaining Areas

Inspection Needed:	Identify equipment, instrumentation, cables, and piping are in the remaining areas. Determine the affect that the loss of attendant equipment cause.
Example Questions:	- What power cables are affected and what equipment outside the room would be lost? - Does loss of instrumentation or piping cause failure of front-line systems outside the room?

Approach to Broad Area Fire Affects

Step 1: **Identify Risk-Significant Fire Areas Affected**

During the Individual Plant Examination for External Events - Fort Calhoun Station, the licensee used a screening criteria of 1×10^{-7} as the threshold for determining that the fire risk in a given area was negligible. The analyst determined that this screening was low enough to identify those areas important to the subject finding. The IPEEE documents 14 fire areas, with 59 fire zones that yielded a ΔCDF greater than the screening criteria.

Table 4.b

Potentially Significant Internal Fire Areas

Fire Areas:	Fire Affects	Fire Ignition Frequency (per year)	Screened?	ΔCDF
Compressor Area	AFW	1.88×10^{-4}	YES	N/A
East Switchgear Area	LOOP, AFW	8.29×10^{-3}	NO	3.45×10^{-6}
West Switchgear Area	AFW	8.29×10^{-3}	YES	N/A
Cable Spreading Room	LOOP, AFW	7.80×10^{-4}	NO	3.0×10^{-7}
Main Control Room	LOOP, AFW	9.50×10^{-3}	NO	1.2×10^{-6}
Transformer Yard Area	LOOP	9.88×10^{-3}	YES	N/A
Turbine Building	AFW	5.83×10^{-2}	YES	N/A
Internal Fire Change in Core Damage Frequency:				5.0×10^{-6}

Inspection Needed: The inspector needs to understand the scope of the issue, such that (working with the analyst), a selection of risk areas needed to be evaluated can be developed.

Example Questions:
- How many areas have the failed penetrations in their barriers?
- What rooms are provided with automatic suppression that is substandard?
- What equipment is affected by the bad procedure and what fire areas are these pieces of equipment and their attendant equipment located?

Step 2: **Screen Areas Using Bounding Analyses of Fire Mitigation Frequency**

- Compressor, West Switchgear, and Turbine Building Areas

The analyst assumed that areas that only affected auxiliary feedwater but did not result in a loss of offsite power would not have a major impact on risk. To validate this assumption, the analyst evaluated fire zone FA46F containing the diesel-driven auxiliary feedwater pump, Pump FW-54. The ignition frequency was 6.27×10^{-3} and the nonsuppression probability was 5×10^{-2}. Multiplying these, the analyst calculated a conservative fire mitigation frequency of 2.1×10^{-5}. The fire mitigation frequency for 29 days was then calculated as follows:

$$FMF = 2.1 \times 10^{-5} \div 365 * 29 = 1.67 \times 10^{-6}$$

The analyst noted that for these areas, a loss of offsite power would have to occur following or coincident with the fire, but prior to the licensee placing the plant in a safe condition. Assuming that the licensee took 3 days to shut down and cool the reactor to shutdown cooling pressures, the analyst calculated the probability that a loss of offsite power occurred during this time, IEL_{LOOP}, as follows:

$$IEL_{LOOP} = 3.31 \times 10^{-2} \div 365 * 3 = 2.72 \times 10^{-4}$$

Therefore, the likelihood that a large fire would occur and a loss of offsite power occurred while the reactor was being shutdown and cooled, $IEL_{FIRE\text{-}LOOP}$, was calculated as follows:

$$IEL_{FIRE\text{-}LOOP} = 1.67 \times 10^{-6} * 2.72 \times 10^{-4} = 4.54 \times 10^{-10}$$

This value is low enough to support the analysts assumption that areas where fires would only affect auxiliary feedwater had a negligible risk increase related to the subject performance deficiency. Therefore, the analyst screened the compressor, west switchgear, and turbine building areas from further review.

Inspection Required: Request from licensee basic information about each fire area to be analyzed.

Example Questions:
- What is the Fire Ignition Frequency?
- What kind of detection/suppression is available in the room?
- How long has the deficiency affected the area?

Step 3: **Conduct a Bounding Evaluation of the Remaining Fire Areas**

- East Switchgear Area

  In the paragraph regarding the transformer yard above, the analyst calculated a fire mitigation frequency of 4.1×10^{-4}/yr for this area. This represents the probability that a fire ignites and the Halon system is unsuccessful. This scenario is the only one deemed credible that could result in both a loss of offsite power and a loss of the motor-driven auxiliary feedwater pump. The likelihood that this event is initiated within the 29 days exposure time, $IEL_{FIRE\text{-}LOOP}$, can be calculated as follows:

  $$IEL_{FIRE\text{-}LOOP} = 4.1 \times 10^{-4}/yr \,/\, 365 * 29 = 3.25 \times 10^{-5}$$

  The area has cabling that feeds offsite power to Switchgear 1A4 in addition to the Switchgear 1A3 itself. Therefore, a large fire without suppression is assumed to cause a Station Blackout instead of a loss of offsite power, because of the failure of Diesel Generator 2.

  Given the failure of Diesel Generator B, the analyst determined that this event would go to core damage without Auxiliary Feedwater Pump FW-54. Therefore, the analyst set the conditional core damage probability for a fire in the east switchgear area, with the failure of Diesel Generator B, P_{CASE}, to the failure probability of the diesel-driven auxiliary feedwater pump upon battery depletion, calculated previously to be 1.08×10^{-1}.

  To determine the baseline risk for an unsuppressed fire in this area, that analyst quantified an unrecoverable (extreme weather) loss of offsite power with a failure of Switchgear 1A3. The resulting CCDP was 1.8×10^{-2}. The analyst determined that the actual CCDP was that quantified multiplied by the failure probability of the diesel-driven auxiliary feedwater pump upon battery depletion, calculated previously to be 1.08×10^{-1}. Therefore the final baseline CCDP, P_{BASE}, was 1.94×10^{-3}.

  The analyst then calculated the change in risk for this area as follows:

  $$\Delta CDF = (3.25 \times 10^{-5} * 1.08 \times 10^{-1}) - (3.25 \times 10^{-5} * 1.94 \times 10^{-3})$$

  $$= 3.45 \times 10^{-6}$$

Inspection Needed: Identify equipment, instrumentation, cables, and piping are in the remaining areas. Determine the affect that the loss of attendant equipment cause.

Example Questions: - What power cables are affected and what equipment outside the room would be lost?

- Does loss of instrumentation or piping cause failure of front-line systems outside the room?