July 12, 2000
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RISK ASSESSMENT FOR ANO UNIT 2 FIRE DOOR 269

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A significance determination process Phase II risk assessment was performed for the ANO Unit 2 Fire Door 269 being left in an untested (double doors not latched) configuration.

The senior resident inspector identified an inoperable fire door between the redundant ANO Unit 2 4kV switchgear rooms (2A3 & 2A4 vital busses). The fire barrier consists of a double door, one door is intended to be stationary (latched at top and bottom into the floor) and the other door is used for ingress/egress). A slight push on the stationary door opened them both. Redundant safe shutdown cables/switchgear are less than 10 feet apart.

This condition had existed for about 4 days.

All the SDP Phase 2 analyses assume that all equipment required for a transient is lost and that the TDEFW is recoverable.

I. Background

Fire Door 269 which provides a 3-hour fire barrier between the Unit 2 vital switch gear rooms 2A3 (North) and 2A4 (South) was found closed but the upper and lower latches were not secured. This condition allowed the double doors to swing from the area 2A4 into 2A3. The pressure across the doors that was required to cause the doors to open was very little (i.e small delta P or fire house spray could cause the doors to open. The doors were assumed to be "operable" from the north 2A3 into the south (2A4) area because of the door design.

II: Safety Impact

Fire Door 269 opens from the South switchgear room into the North switchgear room. It is assumed that the door was operable in the reverse direction (i.e. assumes that the 3-hour fire barrier would serve to isolate a fire in the North switch gear room. The fire hazards analysis states that a fire duration in the south switchgear room is moderate.

A fire in the south switchgear room that affects all electrical equipment associated with engineered safeguards features switchgear 2A4, 480 volt load center 2b6, and 480v MCC 2B64. The fire is assumed to propagate through the inoperable fire barrier, door 269, resulting in afire in the North switchgear room. A fire in the North switchgear room is assumed to0 affect all electrical equipment associated with the ESF switchgear 2A3, 480v load center 2B5 and 480v 2B54.

There were operable fire detection in both rooms but there is no automatic fire suppression. There is one CO2 extinguisher in each room and one hose reel located outside of each room. This condition appears to have existed for 4.5-days. The fire door provides a 3-hour barrier between Fire Zone 2101-AA and 2100-Z. Redundant safe shutdown equipment is located less than 10-feet apart.

III. IPEEE Results/Considerations (1993 Update)

X/1

The IPEEE states that a fire induced initiating event was modeled as a simple reactor trip. But, also accounts for fire induced failures. For example, a fire in the North switchgear room would result in critical components being lost that would prevent the main feedwater system from performing (transient initiator) from performing its function. This emphasizes emergency feedwater and bleed and feed.

The prefire plan for these fire zones states that loss of EFW suction and discharge valves due to cable damage may interrupt water supply to the steam generators and EFW pumps,. Credit is taken for manual operation of the valves. Also, loss of operability of the atmospheric dump valves may result from cable damage. Credit is taken for their manual operation. The turbine driven EFW pump (without room cooling) is assumed to be recoverable as a high stress operator action.

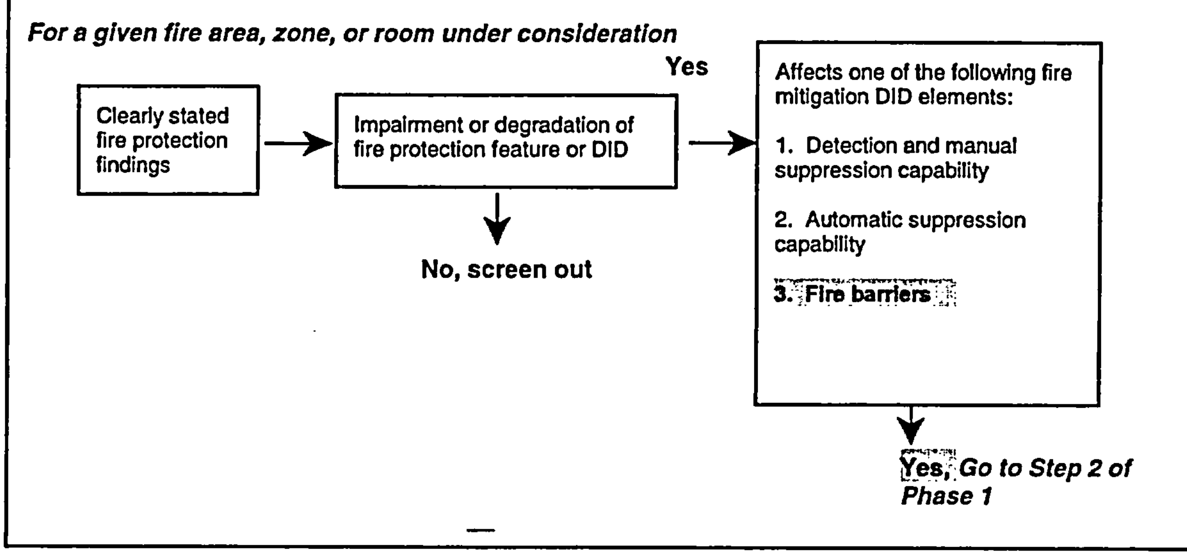
The fire initiating event frequency for the South Switchgear Room 2A3 is 1.09 E-3.l The generic value provided in **Table 5.4 Generic Ignition Frequencies Plant Buildings or Rooms is 1E-2/ry**

IV. Significance Determination Process/Qualitative Analysis

Fire Protection Risk Significance Screening Methodology—Phase 1

Step 1: Screening of Fire Protection Findings

Figure 4-1: Screening Process Phase 1 (Step 1)



Step 2: Safety Importance Determination

When findings affect one or more of the fire protection DID elements in a given fire area, zone, or room of concern, it is necessary to perform an additional screening. In order to implement this screening step and determine if the findings are potentially risk significant, the post-fire SSD capability for the fire area, zone, or room of concern and the fire protection schemes used to maintain one SSD success path free of fire damage will have to be determined. For those findings that do not screen out[1], a Phase 2 evaluation will be performed.

[1] Findings that do screen out should not be disregarded, they should be referred to the licensee and placed in the licensee corrective action program.

The SSD determination can be made by reviewing the plant's Fire Safe Shutdown Analysis (FSSA). Using the FSSA information, the method and equipment being used to achieve and maintain post-fire SSD for each fire area, zone, or room of concern can be determined. In addition, the FSSA will identify fire protection schemes used to protect the analyzed SSD success path. Depending on the degree of physical and electrical separation provided for the various SSD success paths, different fire protection schemes are used to ensure that one SSD success path is free of fire damage. Figures 4-2 through 4-5 below, presents additional screening guidance for determining if the fire protection DID findings are potentially significant. If a question is not asked about a DID principle along a specific screening path, the assumption is that the DID elements not being questioned are capable of performing their intended function (normal operating state) and their designs meet the minimum criteria established by the code-of-record. Therefore, if a degradation in a DID element exists in the fire area, room, or zone, the path containing the query about the condition of that DID element(s) must be explicitly followed in the flow chart, or the analyst will underestimate the risk associated with that finding(s).

SSD system with redundancy is located in the area, zone, or room of concern. The remaining recovery capability is none. No additional recovery capability exists for performing the essential SSD functions external to the area, zone, or room of concern.

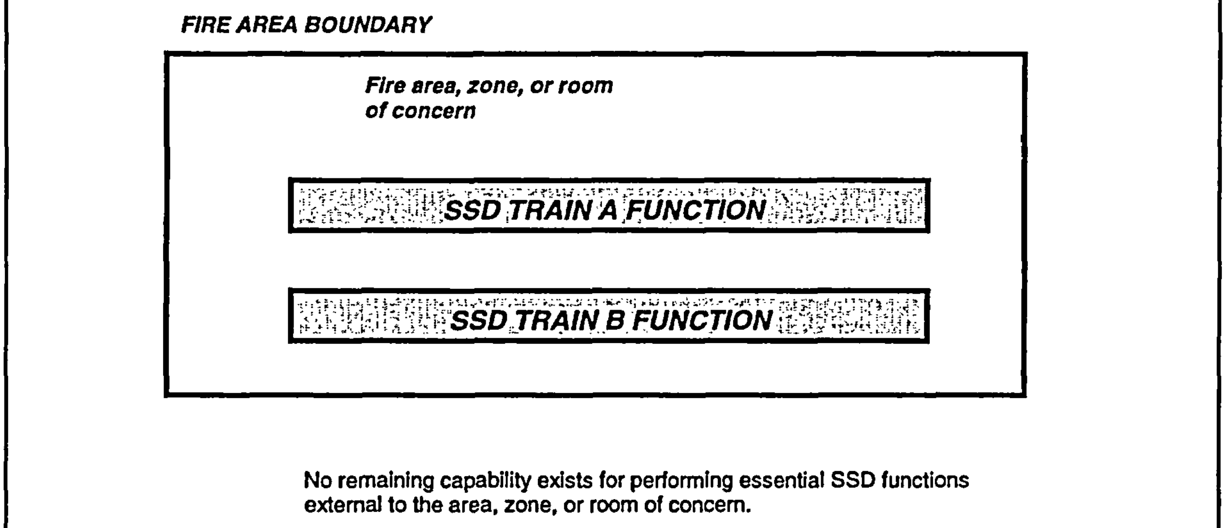
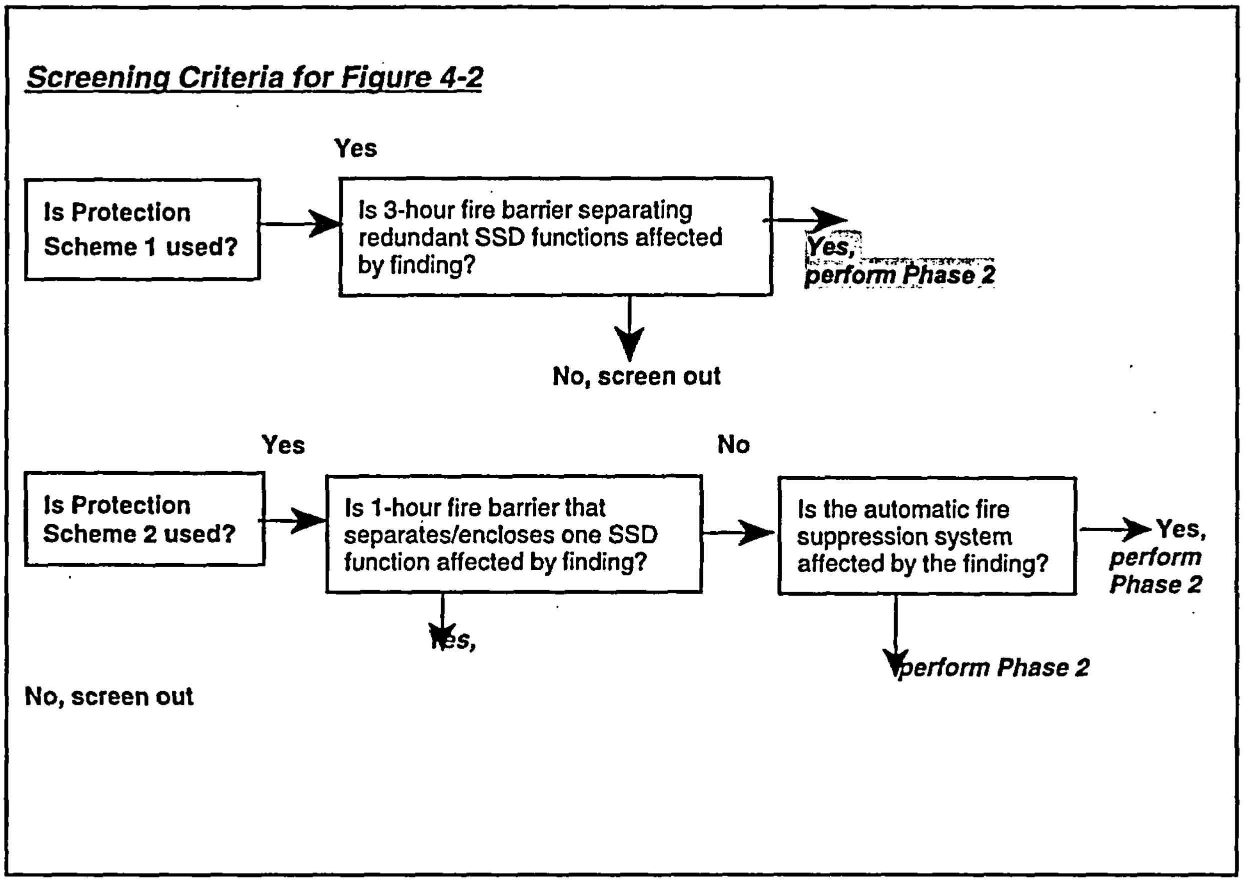


Figure 4-2

Scheme 1 Provide a 3-hour fire barrier separation that either encloses one SSD train or provides wall-to-wall and floor-to-floor separation between the redundant trains; or



F.5 Fire Protection Risk Significance Screening Methodology—Phase 2

Step 1: Grouping of Fire Protection and Post-fire Safe Shutdown Findings

The specific fire protection inspection findings affecting the fire protection mitigation DID features are grouped according to each specific fire area, zone, or room which they impact. Then an area-specific fire damage scenario is defined and its effects are postulated. Step 2 provides guidance for defining fire scenarios. Step 1 and Step 2 should be performed during an inspection in an integrated manner (i.e., observations of a fire protection degradation and the related fire hazards in the area of concern).

Step 2; Define the Fire Scenario

In order to properly support the FPRSSM risk estimates, the inspector or the reviewer will need to develop a postulated fire damage scenario that describes the fire and its potential for propagation (see Inspection Procedure (IP) 64700, Fire Protection Supplemental Inspection (FPSI), for further guidance) within the fire area, zone, or room under consideration. Under this postulated scenario, the inspector or reviewer must make deterministic/qualitative judgments regarding the effectiveness of various degraded fire protection mitigation features or systems and their ability to protect a post-fire safe shutdown path and maintain it free from fire damage. Postulated fires involving fuel sources in an area under consideration are deemed important if they are capable of developing a plume and/or a hot gas layer that has the potential to directly affect components of equipment that are important to safety.

Step 3: Qualitative Evaluation of Findings

Once the various inspection DID findings and a meaningful fire scenario have been established for the fire area, zone or room of concern, the individual findings must be evaluated with respect to their ability to satisfy the performance objective established by the applicable DID element. Upon determining which DID elements have been affected by the specific fire protection finding, a qualitative evaluation of each finding and its effects on accomplishing the DID objective is performed. It should be noted that many inspection findings can contribute to a degradation in a DID element. For example, poor training, poor fire brigade/operational drill performance, improperly installed detection, and inadequate hose coverage of a fire area can all contribute to the degradation rating assigned to manual suppression. Therefore, in order to perform this step, the existing plant conditions as noted by the inspection

finding are evaluated against the deterministic/qualitative evaluation guidance and degradations categorization criteria established in IP 64700, Fire Protection Supplemental Inspection.

The output from this deterministic/qualitative evaluation, results in a degradation rating (DR) being assigned to each DID element.

Step 4: Integrated Assessment of DID Findings (Excluding SSD) and Fire Ignition Frequency

Once Step 3 has been completed, the respective DID findings for a given fire area, zone, or room of concern are assessed collectively by summing, using the following formula, the fire Ignition Frequency (IF) and the DR for each of the fire protection DID elements. This value is called the Fire Mitigation Frequency (FMF) and inputs into the Significance Determination Process (SDP) (NUREG/CR-5499) to determine the change in risk.

FMF = IF + FB + MS + AS + CC (when appropriate)

where IF = Fire Ignition Frequency
FB = Fire Barrier (used for DRT only; see Step 9)
MS = Manual Suppression/Detection
AS = Automatic Suppression/Detection
CC = Dependencies/Common Cause Contribution

IF based on IPEEE initiating event frequency — 1.09E-3/ry log value -2.96
generic initiating event frequency — 1.0E-2/ry log value -2.0

Manual Fire Suppression

The credit given for manual fire suppression (fire brigade) should be discussed during the panel meeting. The SRI identified that the fire brigade drill was not all encompassing and did not challenge the fire brigade members (Drill was conducted in accordance with the scenario and controllers directions)

To get an appreciation for manual suppression capability, I observed a fire drill involving a fire in one of the bus rooms.

The scenario chosen involved only a single 4kV breaker cubicle and was suppressed with only CO2. Is a fire drill that is limited to a fire in a single breaker cubicle a reasonable scenario?

The fire brigade drill did s not require that the hose be extended on grounds of heat stress concerns. The brigade leader just had to tell the controller what he intended to do.

When I asked the controller about this he told me that he wanted to avoid actually extending hose because of heat stress concerns for the brigade members in the turbine building, where the hose reel and staging area was located. Anyway, he said, the brigade members get plenty of hose training at their fire training facility.

Step 5: Assignment of Quantitative Values

From Step 3, "Qualitative Evaluation of the Findings," a DR is assigned to each DID element. Once the DRs for a DID element have been determined, they are quantified by assigning a value from Table 5.1.

Table 5.1 Quantification of Degradation Ratings (DR) of the Individual DID Elements[2]

Level of Degradation	*3-Hour Fire Barrier*	*1-Hour Fire Barrier*	*20-feet Separation*	*Automatic Fire Suppression Effectiveness*	*Manual Fire Fighting Effectiveness (Fire Brigade)*	
					Outside Control Room	Inside Control Room
High	[redacted]	0	0	0	-0.25	-0.75
Moderate	-1.25	-0.5	N/A	-0.75	-0.5	-1

[2] Each of these values in Tables 5.1, 5.2, and 5.3 is approximately an exponent of 10.

Normal Operating State	-2 (door(s), or multiple dampers, or damper & door)) -2.5 (damper or multiple pen seals or both) -3	-1	-2	-1.25		-1.5

Rigorous[3] compensatory measures for the DID elements are credited. The credit given for an rigorous compensatory measure to a DID element is the credit provided for a moderate degradation of the DID element.

The bases for the failure probabilities in Table 5.1 follow. The normal operating state probability for the 3 hour barrier is found in several NRC and industry documents (e.g. EPRI Fire PRA Implementation Guide, NUREG/CR-4550).

Manual suppression capability is credited even when it is highly degraded, unlike other DID elements. This credit is based upon the potential for early detection and suppression of fires by personnel using hand-held fire extinguishers. Quantitatively, the credit provided for the control room comes from the control room severity factor which is partially based on detection and suppression by personnel inhabiting the control room. Less credit is given for a high degradation of non-control room areas since those are not normally manned continuously.

Dependencies exist between certain DID elements. Those dependencies and their values are expressed in **Table 5.2** below.

No common cause dependencies were considered because the area lacks automatic fire suppression

Step 6: Determination of Fire Ignition frequency

The next step is to determine the fire ignition frequency for the fire area, zone, or room of concern. If a fire ignition frequency can be obtained for the specific fire area, zone, or room of concern from the plant-specific IPEEE, it should be used. However, if the IPEEE does not provide it, then it may be selected from **Table 5.4**[4].

Table 5.4 Generic Ignition Frequencies Plant Buildings or Rooms

Building or Room	***Ignition Frequency (IF) / Yr***	***Log of Ignition Frequency***
Control Room	7E-3	-2.2
Cable Spreading Room	4E-3	-2.4
Diesel Generator Room	3E-2	-1.5
Switchgear Room	1E-2	-2.0
Battery Room	3E-3 to 1E-2	-2.5 to -2.0
Reactor Building[5]	2E-2	-1.7

Generic ignition frequencies for specific buildings or rooms are provided in Table 4.4a (taken from AEOD data base, NRC's "Special Study: Fire Events—Feedback of U.S. Operating Experience—Final Report," June 19, 1997).

Auxiliary Building[7]	4E-2	-1.4
Turbine Building	6E-2	-1.2
Containment	9E-3	-2.1

FMF = IF + FB + MS + AS + CC (when appropriate)

FMF based on IPEEE initiating event frequency
FMF = -2.96 + 0 + -1 + N/A+ NA
FMF = -3.96

FMF based on generic value
FMF = 2.0 + 0 + -1 + N/A + N/A
FMF = -3.0

Table 5.6 Association of FMF to Table 5.7 (SDP Table 1) Approximate Frequencies for Calculation of Delta CDF

Fire Mitigation Frequency (FMF)	Table 5.7 Approximate Frequencies (per year)
FMF > -2	1 per 10 to 10^2
-2 ≥ FMF > -3	1 per 10^2 to 10^3
[redacted]	[redacted]
-4 ≥ FMF > -5	1 per 10^4 to 10^5
-5 ≥ FMF > -6	1 per 10^5 to 10^6
FMF ≤ -6	Less than 10^6

The approximate frequency is adjusted in **Table 5.7** by the length of time that the degradation existed. In practice, as part of the initial assessment, the inspector should assume that the degradations are simultaneous, and that all occur for the length of time associated with the longest degradation. This is a conservative approach, and if desired, can be refined. (The refinement of this approach is to consider whether the DID degradations overlap in time, and perform the analysis accordingly.) To adjust the time of the degradation, a letter is selected on the basis of the degradation time from **Table 5.7**. The degradation of 3–30 days decreases the frequency by 10, and the degradation of less than 3 days decreases the frequency by 100.

Table 5.7 Estimated Likelihood Rating for Initiating Event Occurrence During Degraded Period

Approx. Freq.	Estimated Likelihood Rating		
>1 per 1 - 10 yr	A	B	C
1 per 10 - 10^2 yr	B	C	D
1 per 10^2 - 10^3 yr	C	D	E
1 per 10^3 - 10^4 yr	D	E	F
1 per 10^4 - 10^5 yr	E	F	G
1 per 10^5 - 10^6 yr	F	G	H
<1 per 10^6 yr	G	H	H
Source: SDP Table 1, NUREG/CR-5499	> 30 days	30-3days	<3 days
	Exposure Time for Degraded Condition		

Step 7: Integration of Adjusted FMF with SSD

The FMF, which has been adjusted by the length of degradation, represents the integration of IF with the DR associated with each of the fire protection DID elements. In this step, the FMF is integrated with the SSD capability that is free from fire damage.

The SSD capability is developed by using the Reactor Safety Full Power Level 1 plant-specific event trees (worksheets) which identify the internal event initiating events and the respective sequences which lead to core damage. By understanding the systems that could be potentially affected by a fire in the area of concern, a fire induced initiating event determination (e.g. reactor trip, LOOP, or small break LOCA) can be made, and the appropriate internal events event tree worksheet selected for the fire area analysis. After this determination, the number of plant systems or recovery actions available to prevent core damage are mapped onto the sequences for the appropriate event trees.

Table 2.1 SDP Worksheet for Arkansas Nuclear One, Unit 2 —— Transients

Estimated Frequency (Table 1 Row) ________ Exposure Time 4.5 Days Table 1 Result (circle): A B C D E F G H

Safety Functions Needed:	***Full* Creditable Mitigation Capability for Each Safety Function:**
Power Conversion System (PCS)	1 / 2 Feedwater trains with 1 / 4 condensate trains (Operator action)
Secondary Heat Removal (EFW)	1 / 2 MDEFW trains (1 train) or 1 TDEFW train (1 ASD train)
High Pressure Injection (EIHP)	1 / 3 HPI Pumps from RWT (1 multi-train system)
Primary Heat Removal, Feed/Bleed (FB)	1/4 LTOP or ECCS vent path to open for Feed/Bleed and initiate HPI cooling (Operator action)
Long Term Cooling (SDC)(1)	½ LPI pump and the associated Heat Exhanger. In SDC mode (Operator action)

Circle Affected Functions	Recovery of Failed Train	*Remaining Mitigation Capability Rating for Each Affected Sequence*	Sequence Color
1 TRANS - PCS - EFW - FB (6)	1 for TDEFW	0 + 0 + 0	White
2 TRANS - PCS - EFW -EIHP (5)	1 for TDEFW	0 + 0 + 0	White
3 TRANS - PCS - EFW - SDC (4)	1 for TDEFW	0 + 0 + 0	White

Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event:

The prefire plan for these fire zones states that loss of EFW suction and discharge valves due to cable damage may interrupt water supply to the steam generators and EFW pumps,. Credit is taken for manual operation of the valves. Also, loss of operability of the atmospheric dump valves may result from cable damage. Credit is taken for their manual operation. The turbine driven EFW pump (without room cooling) is assumed to be recoverable as a high stress operator action.

If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and ready for use.

Step 8: Modifications Necessary To Add Impact of Spurious Actuations

Spurious actuations are accounted for by impacting the relevant sequences identified on the Reactor Safety Full Power internal events worksheets. For each train which experiences fire damage only in the form of spurious actuations, the train is considered failed in the sequence. A factor of -1 is then added to the cutset that is impacted by spurious actuations. (This is equivalent to saying that multiple spurious actuations occur with a probability of 0.1).

A more complicated solution exists for addressing the more difficult case where a train fails due to direct fire damage, and consequently has its recovery complicated by spurious actuations. In this case, the different sequences associated with the non-recovery without spurious actuations, and nonrecovery with spurious actuations must be calculated. For example, assume that a sequence consists of failure of two trains A and B. Assume each of those trains is damaged by fire. Also assume train B is subject to failure due to spurious actuations also. The first sequence associated with this example is failure of A and B with failure to recover each train, excluding the impact of spurious actuations. This sequence is the normal sequence which one would get without spurious actuations. The second sequence involves the impact of spurious actuations. The logic that follows in the development of this sequence is that recovery of train B occurs; however, immediately afterwards, train B experiences a spurious actuation which fails the train. Then the operators attempt to recover train B from the spurious actuation. As a result, the sequence is failure to recover train A without spurious actuations, success in recovering train B without spurious actuations, failure of train B due to spurious actuations, failure to recover train B from spurious actuations.

Step 9: General Rules for Applying FPRSSM

Since a fire barrier failure is represented by a probability, the ΔCDF for a fire area is a combination of two contributions: a contribution from barrier failure, and one from the barrier success. Table 5.1 can be used to calculate both of these terms. For purposes of discussion, the term referring to the case in which the barrier between the two fire areas fails will be called the double room term (DRT) and the case in which the barrier between the two fire areas succeeds in preventing fire damage beyond the area of fire origin will be called the single room term (SRT). The SRT is defined as the combination of the FMF and safe shutdown (SSD) capability free of fire damage due to success of the barrier, and the DRT is the FMF and SSD capability free of fire damage due to failure of the barrier. The SRT and DRT are shown by the figures 8.1 and 8.2 below. (Note that although the SRT and DRT concept is demonstrated in Figures 8.1 and 8.2 for a 3 hour barrier, it also applies to 1 hour barriers.)

Figure 8.1

Double Room Term (DRT) Fire Barrier Fails to Prevent Fire/Smoke Propagation

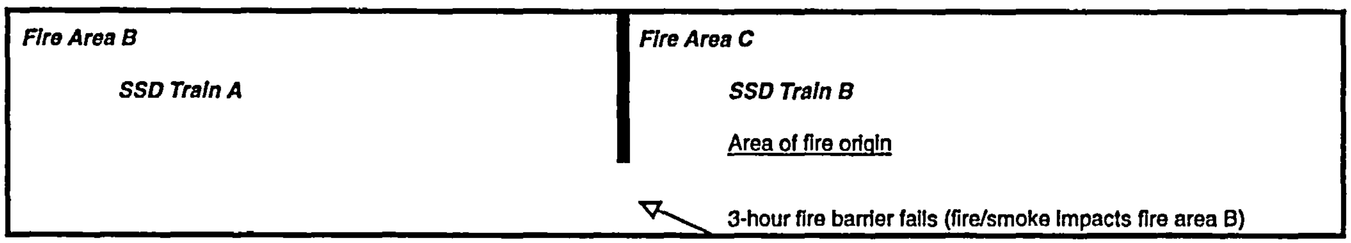


Figure 8.2

For the SRT, all equipment, cables, and actions in the area of fire origin (fire area C) are assumed to fail. As a result, safe shutdown for the SRT (i.e. SSD(SRT)) is the combination of mitigating equipment, associated cables, and actions which remain free of fire damage given that fire damage is limited to fire area C. For the DRT, all equipment, cables, and actions in the area of fire origin, and in the area protected by the barrier, i.e. (Fire areas B and C), are assumed to fail. As a result, safe shutdown for the DRT (i.e. SSD(DRT)) is the combination of mitigating equipment, cables, and actions free of fire damage after all equipment, cables, and actions in both fire areas B and C are lost.

The SSD impact can be different depending on whether the SRT or DRT is calculated. The equipment which mitigates core damage for the DRT is a subset of (or can be equal to) the mitigation equipment for the SRT. The logic is a follows: All the equipment in B and C fail for the DRT, and only that equipment in C fails for the SRT. Thus, more equipment is available to mitigate core damage for a fire which is confined to the area of fire origin (SRT) than one that fails the barrier and damages equipment on the other side of the barrier (DRT).

Other than SSD, the only other part of the CDF determination which will have different values between the SRT and DRT is the credit for the fire barrier. In the DRT, the fire barrier credit comes from Table 5.1. For instance, a medium degradation of a 3 hour barrier utilizes -1.25 as the probability of the barrier in failing to prevent fire propagation into the neighboring fire area (DRT). Yet, for the SRT no credit is given for a barrier since no barrier protects safe shutdown equipment in the room of fire origin. Therefore, for the SRT , the FB is eliminated from the FMF equation.

Both the SRT and DRT are not needed in all cases. The following rules provide guidance on when to use these terms in calculating the ΔCDF for a fire area, and are primarily for the analyst's convenience (since the SRT and DRT may be calculated and summed to get the change in CDF whenever a barrier has either a medium degradation or is in normal operating condition).

(Rule 1) If the fire barrier has a high degradation, just use the DRT to calculate ΔCDF.

(Rule 2) For a 1 hour barrier in either a medium degradation or in its normal operating state, use DRT only as long as SSD(DRT) ≥ 10 times SSD(SRT). Otherwise use SRT + DRT.

(Rule 3) If the 3 hour fire barrier has a medium degradation, use the SRT only if SSD(DRT) ≤ 10 times SSD(SRT). Otherwise, use DRT only.

(Rule 4) If the 3 hour fire barrier is in its normal operating state and has no door, no damper, and does not have multiple pen seals, use only the SRT as long as SSD(DRT) ≤ 1000 times SSD(SRT). Otherwise use DRT only.

If the 3 hour fire barrier is in its normal operating state and has at least a door, or a damper, or multiple pen seals, use only SRT if SSD(DRT) ≤ 100 times SSD(SRT). Otherwise, use DRT only.

(Therefore, it is expected that a 3 hour fire barrier in its normal operating state will often only require evaluation of the SRT. However, as more safe shutdown related equipment is protected by the 3 hour fire barrier, the fire barrier (and therefore the DRT) will become more important.)

As a result, it is recognized that the DRT is solely needed for a high degradation of a fire barrier. Also, the DRT is likely to dominate in most cases where any degradation exists in a 1 hour fire barrier. However, the SRT is likely to dominate whenever a 3 hour barrier exists in its normal operating state. In other words, as the barrier effectiveness decreases (e.g. from the normal operating state for a 3 hour barrier to either the moderate barrier degradation or normal operating state of 1 hour barrier), the DRT takes on more and more significance until it exclusively represents the high degradation of either barrier.

The other component of the above rules is the safe shutdown related equipment protected by the barrier. Equipment with higher reliability are more important to mitigating core damage than equipment with low reliability. Therefore, a barrier is more important if it is protecting a set of equipment with high reliability. As a result, a combination of the barrier failure probability and the failure probability of the set of equipment protected by the barrier are factored into the rules, via the comparison of SSD(SRT) and SSD(DRT) for a given barrier having a particular failure probability.

For example, since the ratio of SSD(DRT) and SSD(SRT) depicts the reliability of that equipment protected by the fire barrier, the relationship SSD(DRT) ≥ 100 times SSD(SRT) requires a set of higher reliability equipment be protected by the fire barrier than SSD(DRT) ≥ 10 times SSD(SRT). In other words, the larger SSD(DRT) is relative to SSD(SRT), then the higher the reliability of the equipment protected by the barrier. The importance of this equipment for a given barrier with its failure probability determines whether the SRT, DRT, or both are needed to calculate ΔCDF.

The SSD(SRT) and SSD(DRT) should be calculated for all sequences corresponding to the appropriate initiator(s) from the internal events SDP worksheet for the fire area to perform the above comparison which determines if both SRT and DRT are needed. Once it is established which terms (either DRT, or SRT, or both) are needed to calculate ΔCDF (by the SSD comparison) for the fire area, those terms (i.e. DRT, or SRT, or both) which consist of both the FMF and SSD (<u>for all sequences in the event tree</u>) are calculated to represent the change in CDF for the fire area.

Note that if the finding in the fire area is ***solely*** against the fire barrier, the inspector will need to validate that the equipment protected by that degraded barrier is an important contributor to core damage. A criteria which may be used to determine the importance of a degraded fire barrier is SSD(DRT) $\geq$ 10 times SSD(SRT). As indicated earlier, the importance of the barrier is dependent on the reliability of the set of equipment it protects, i.e. the higher the reliability of the equipment being protected by the barrier, the more important the barrier. For example, this criteria (SSD(DRT) $\geq$ 10 times SSD (SRT)) means that either the redundant train, diverse train, or recovery action in the dominant sequence is protected by the fire barrier. If this criteria is met, the degraded barrier is important. If this criteria is not met, a more refined analysis must be done to validate the importance of the degraded barrier.

FINAL NOTE ON DRT AND SRT

Remember that only the DRT is needed for high degradatión of a barrier. As the barrier effectiveness gets better, the opportunity for the SRT to be important grows, until at the 3 hour barrier in its normal operating state, the SRT often dominates. For the case where a medium degradation or normal operating state exists for a barrier, the analyst can simply add the SRT and DRT to get the change in CDF without doing the comparison between SSD(SRT) and SSD(DRT).

Figure 5.1 Fire Protection Risk Significance Screening Methodology (FPRSSM)
Determination Process of Potential Risk Significance of Fire Protection Inspection Findings

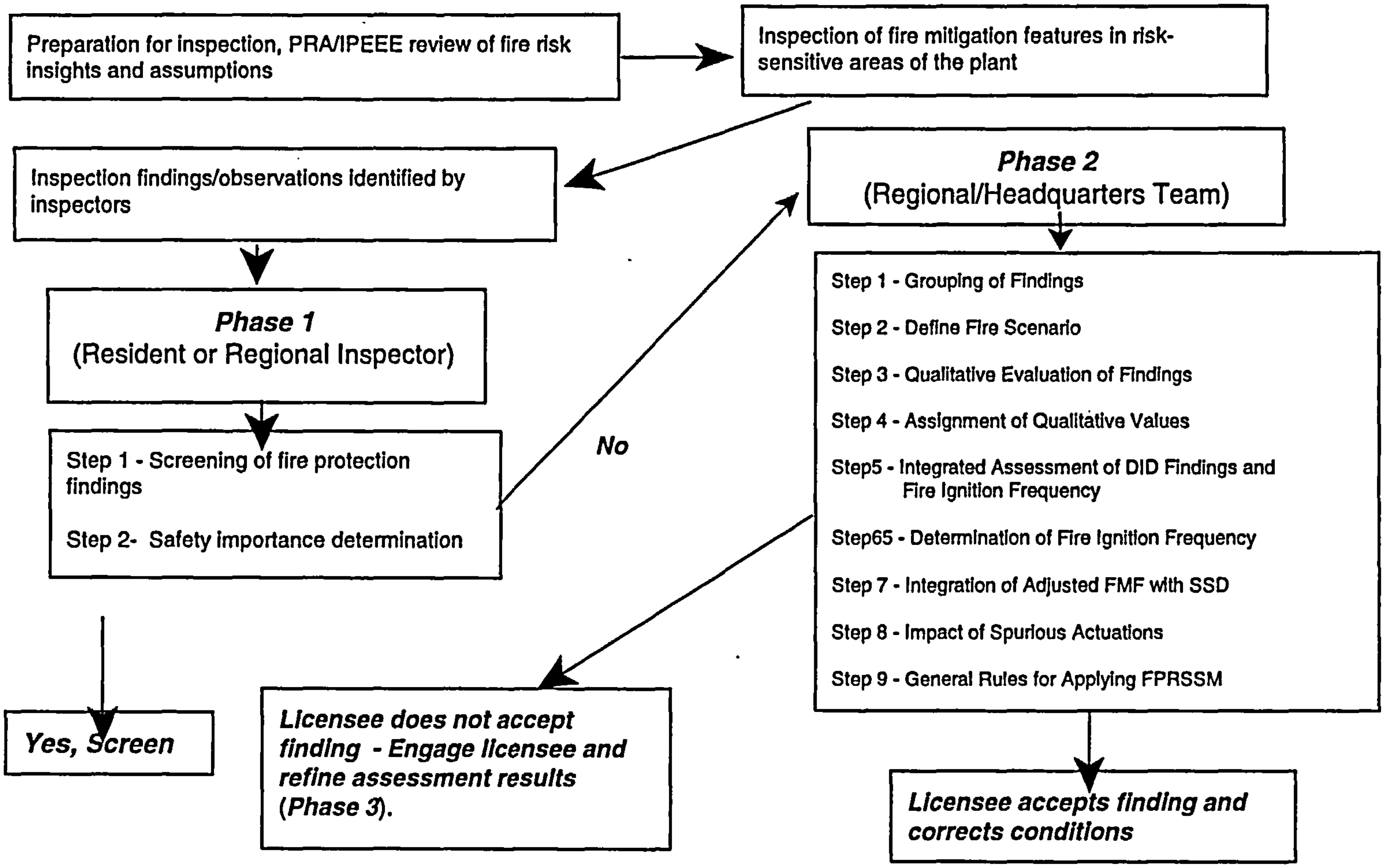


Table 3 - Remaining Capability Rating Values

Type of Remaining Capability	Remaining Capability Rating
Operator Action Under High Stress Definition: Operator action assumed to have about a 1E-1 probability of failing when credited as "remaining mitigation capability".	1
Recovery of Failed Train Definition: Operator action to recover failed equipment that is capable of being recovered after an initiating event occurs that requires the equipment (e.g., equipment was unavailable due to a switch misalignment). Action may take place either in the control room or outside the control room and is assumed to have about a 1E-1 probability of failing when credited as "remaining mitigation capability".	1
1 Automatic Steam-Driven (ASD) Train Definition: A collection of associated equipment that includes a single turbine-driven component to provide 100% of a specified safety function. The probability of such a train being unavailable due to failure, test, or maintenance is assumed to be about 1E-1 when credited as "remaining mitigation capability".	1
Operator Action Definition: Operator action that can occur with sufficient time to have about a 1E-2 probability of failing when credited as "remaining mitigation capability".	2
1 Train (diverse as compared to other trains) Definition: A collection of associated equipment (e.g., pumps, valves, breakers, etc.) that together can provide 100% of a specified safety function and for which the probability of being unavailable due to failure, test, or maintenance is assumed to be about 1E-2 when credited as "remaining mitigation capability". Two or more trains are diverse if they are not considered to be susceptible to common cause failure modes.	2
1 Multi-Train System Definition: A system comprised of two or more trains (as defined above) that are considered susceptible to common cause failure modes. Such a system is assumed to have about a 1E-3 probability of being unavailable, regardless of how many trains comprise the system, when credited as "remaining mitigation capability".	3
2 (diverse) Trains [adding example] (2 diverse trains are assumed to have a combined 1E-4 probability of being unavailable)	4 (= 2 + 2)
1 Train + Recovery of Failed Train [adding example] (1 train plus recovery of failed train is assumed to have a combined 1E-3 probability of being unavailable or failed)	3 (=2 + 1)

Table 3 - Remaining Capability Rating Values

Table 5.8 - Risk Significance Estimation Matrix

Initiating Event Likelihood	Remaining Mitigation Capability Rating (with Examples)						
	-6	-5	-4	-3	-2	-1	0
	3 diverse trains OR 2 multi-train systems OR 1 train + 1 multi-train system + recovery of failed train	1 train + 1 multi-train system OR 2 diverse trains + recovery of failed train	2 diverse trains OR 1 multi-train system + recovery of failed train	1 train + recovery of failed train OR 1 multi-train system OR Operator action + recovery of failed train	1 train OR Operator action OR Operator action under high stress + recovery of failed train	Recovery of failed train OR Operator action under high stress	none
A	Green	White	Yellow	Red	Red	Red	Red
B	Green	Green	White	Yellow	Red	Red	Red
C	Green	Green	Green	White	Yellow	Red	Red
D	Green	Green	Green	Green	White	Yellow	Red
E	Green	Green	Green	Green	Green	White (3)	Yellow
F	Green	Green	Green	Green	Green	Green	White
G	Green	Green	Green	Green	Green	Green	Green
H	Green	Green	Green	Green	Green	Green	Green

V. Conclusions

The results of the review were three whites next to a yellow. By the accounting rule for Phase 2 reviews this would result in a yellow finding. However, the SDP for the period 3-30 days assumes 30-days in the **Table 5.8 - Risk Significance Estimation Matrix**. Based on the period being essentially a factor 10 difference (4 days vs 30 days) the results would best be reflected as a "white" issue. Consideration of the fire barrier being moderately degraded would result in the issue being "Green" based on a credit of -1.25 being added to the fire mitigation frequency. Using the generic initiating event frequency for the switchgear room a value of 3 greens next to a white is obtained.

VI. Recommendations

The issue appears to be other than "green" by this Phase 2 assessment. The topic of fire barrier degradation should be discussed during the Significance Determination Process and Enforcement Review Panel. The determination as to whether the barrier was significantly or moderately degraded establishes the difference between a "Green" and "White" finding using the mitigating systems assumptions previously discussed.

The credit given for manual fire suppression (fire brigade) should also be discussed during the panel meeting. The SRI identified that the fire brigade drill was not all encompassing and did not challenge the fire brigade members (Drill was conducted in accordance with the scenario and controllers directions).

VII. References

Manual Chapter 0609
Significance Determination Process worksheets for ANO Unit 2
Individual Plant Evaluation External Events
CR 2-2000-225
Fire Hazards Analysis excerpts
Pre fire plan

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A. Howell (ATH)
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