Attachment 1

APPLICATION OF FIRE PROTECTION RISK-SIGNIFICANT
SCREENING METHODOLOGY TO HYPOTHETICAL CASES

Case 1: Cable Spreading Room

A single CSR exists in a plant. The CSR is located adjacent to a fire area that contains the remote shutdown panel (RSP). A 3-hour barrier separates the two fire areas. The CSR has an automatic carbon dioxide suppression system. For the purposes of simplicity in this example, each of the electrical cabinets in the CSR is assumed to have the potential to produce a fire which could damage all cables in the room, challenge the 3-hour barrier, and expose the RSP to the fire effects. (It is essential for the inspector to recognize this is an assumption. As a result, the inspector must develop his own scenario when assessing the significance of cable spreading room fires.) The ignition frequency for the CSR due to these electrical cabinets found in the IPEEE is 5E-3/yr. The impact of transient fires needs not to be considered in this room since the postulated damage and frequency of fire dominates any contribution which would arise from the consideration of transient fires.

The only safe shutdown methodology for the CSR fire is the RSP. Note that no Reactor Safety Internal Events SDP Worksheet exists for this example, since shutting down via remote shutdown operations is peculiar to fire risk analysis. This worksheet was developed and follows Example 2, and demonstrates the one sequence, i.e. LOOP-RSP, for this particular CSR fire.

Example 1A

The 3-hour fire barrier wall has a high degradation. The automatic carbon dioxide suppression system has also a moderate degradation. The fire brigade is in its nominal operating state (NOS). Each of these degradations has lasted longer than 30 days.

Since the fire barrier has a high degradation, only the DRT is used for SSD according to the rules. Since the DRT is used, the appropriate value for the fire barrier is chosen from Table 5.1.

The fire mitigation frequency (FMF) = IF + FB + AS + MS + CC

where IF = ignition frequency
FB = fire barrier
AS = automatic suppression/detection
MS = manual suppression/detection
CC = dependencies/ common cause Contribution

Thus FMF = -2.3 + 0 - 0.75 - 1 = -4.05 since CC is not appropriate for this example.

From Table 5.6 note that an FMF of -4.05 converts to an approximate frequency of 1E-4/yr to 1E-5/yr.

From **Table 5.5** (SDP Table 1) locate the Approximate Frequency = 1E-4/yr to 1E-5/yr. Since the degradation is greater than 30 days, select E from the table.

Now SSD(DRT) must be determined. Since all equipment, cables, and human actions on both sides of the barrier are damaged for the DRT, no credit is given for the RSP. Since the RSP is the only means to mitigate a challenging fire in the cable spreading room, SSD(DRT) is none (0) in Table 5.8. As a result, the color representing the change in CDF is Yellow.

Example 1B

Suppose the 3-hour fire barrier wall has been improved to a moderate degradation. All other degradations remain the same. According to the rules, both SSD(DRT) and SSD(SRT) must be calculated to determine if more than the SRT must be used to determine ΔCDF.

As before SSD(DRT) = 1E-0 = 1.

Now to calculate SSD(SRT). For the SRT, fire does not propagate beyond the area of fire origin. Therefore, the RSP which is on the other side of the fire barrier, is not damaged by fire. The value assigned for the random failure probability of the RSP is 0.1 or 1E-1. Therefore, SSD(SRT) = 0.1 or 1E-1.

Since SSD(DRT) = 10 * SSD(SRT) only the SRT is necessary.

The SRT for example 1B is done as follows:

FMF = IF + AS + MS (with FB term eliminated).

FMF = -2.3 - 0.75 - 1 = - 4.05

Using Tables 5.6 and 5.7 produces an E.

Utilizing Table 5.8 with SSD(SRT) = -1 yields a white for the CDF.

Notes for Examples 1A and 1B

It is recognized that the approximation used to determine if only the SRT needed in Example 1B underpredicts the CDF since the true impact on risk is the sum of the SRT + DRT. However, to counter that under prediction of risk, the CDF due to the inspection findings is used as the ΔCDF in the Phase 2 which is conservative. As a result, these two factors counter one another.

As an aside, IF, AS, and MS always remain the same for the DRT and SRT. In fact, the only difference between the FMF for the DRT and SRT is the credit provided for FB. For the SRT, FB does not enter into the equation for FMF since no credit is given for a barrier protecting safe shutdown equipment in the area of fire origin. For the DRT, credit for the FB is taken out of the Table 5.1. And of course, SSD(DRT) usually differs from the SSD(SRT) since more equipment is available to mitigate core damage if the fire is constrained to the area of fire origin (than if it fails the barrier between the two fire areas).

Example 1C

Suppose the 3-hour fire barrier wall (with a door) is repaired so that it is in its normal operating state. The automatic suppression continues to have a medium degradation.

Since the 3-hour fire barrier wall is in its normal operating state, the relationship between SSD(DRT) and SSD(SRT) from examples 1B and 1C needs to be used. As you will remember, the SSD(DRT) is none or 0(in log space) as before. The SSD(SRT) is 0.1 or 1E-1 or -1(in log space) as before. So it is clear that SSD is dependent on the configuration, i.e. what is in the room of fire origin, and what is on the other side of the barrier. In the case of the 3 hour barrier in its normal operating state, we see the SSD(DRT) is not greater than 100 times the SSD(SRT), therefore, use the SRT in this case.

As a result, we use the SRT as in Example 1B: Therefore the FMF for the SRT is again: FMF = IF + AS + MS = -2.3 - 0.75 - 1 = -4.05

From **Table 5.5** (SDP Table 1) locate Approximate Frequency = E-4 to 1E-5. Since all degradations lasted longer than 30 days, select E from **Table 5.5**.

Given that the SSD(SRT) is -1, Table 2 produces a White condition.

Note For Comparing Examples 1B and 1C:

The ΔCDF for examples 1B and 1 C are the same within the resolution of the Phase 2 model. This is because both examples for 1B and 1C use only the SRT (according to the rules) which ignores the improvement of the fire barrier. If this Example 1B result (which ignores the improvement of the barrier) concerns the analyst, this concern may be rectified (i.e. see the decrease in risk denoted by improving the barrier) by noting that the ΔCDF is actually the sum of the SRT and DRT, and do that calculation. Note that if safe shutdown equipment with a higher reliability were in the place of the RSP, then the DRT would have been used for example 1B (since barrier would have played a more important role by protecting more reliable equipment), and the fire barrier improvement would have shown up in the calculation done for the Phase 2.

Summary of Case 1: Cable Spreading Room

Example 1A: 3 hour Fire Barrier = High; Autosuppression = Moderate; Fire Brigade = NOS (normal operating state)

- Color = Yellow (via DRT)

Example 1B: 3 hour Fire Barrier = Moderate; Autosuppression = Moderate; Fire Brigade = NOS

- Color = White (via SRT)

Example 1C: 3 hour Fire Barrier = Low; Autosuppression = Moderate; Fire Brigade = NOS

- Color = White (via SRT)

As a result, any finding against a cable spreading room which is adjacent to the RSP where only one CSR exists per unit will be risk significant under Phase 2 application. This occurs, in most cases, even if this risk baseline of -5.55(log space) or 3E-6/yr for the CSR/RSP configuration is subtracted from the CDF (with a DID degradation) to get the ΔCDF. As a reminder, Phase 2 considers the ΔCDF to be the CDF due to inspection findings alone. The baseline is not subtracted off in the Phase 2 methodology. The point here is even if the baseline were subtracted off, most findings against this CSR/RSP configuration would still be white since the ΔCDF threshold for a white is 1E-6/yr.

Case 2: Auxiliary Feedwater Room

An AFW fire area contains a turbine auxiliary feedwater (TDAFW) pump and MDAFW train A. The only other AFW pump, the motor driven auxiliary feedwater (MDAFW) train B pump, is located in a different fire area. The inspector has judged that a credible fire which starts in the MDAFW A pump will not propagate damage to the TDAFW pump due to the distance between pumps. However, since the unprotected cables for MDAFW train A run over the TDAFW pump, a fire in the TDAFW pump can damage the MDAFW train A cables. The MDAFW B cables penetrating from another room run over the TDAFW pump also, but not over the MDAFW A pump. The MDAFW B pump cabling is protected by a 1-hour fire barrier. The AFW room is protected by an area-wide automatic sprinkler system. The cables for the MFW pumps have not been traced. The ignition frequency for the TDAFW pump is 3E-3/yr, according to the IPEEE.

Example 2A

Assume the degradation in DID for the fire area are as follows: Moderate degradation for the 1 hour barrier; Moderate degradation of the sprinkler system.
For the scenario developed, the impact of transient combustibles is negligible since the frequency of the TDAFW pump dominates the frequency of transient fires, and the TDAFW pump can produce a fire which challenges the 1 hour barrier.

The scenario evaluated in this and the following examples is the case where the TDAFW pump initiates a fire, damages the MDAFW train A cables, and challenges the 1-hour barrier protecting the MDAFW train B cables.

In this case, the initiator that the fire produces is a plant transient condition. A plant transient is assumed since the postulated challenging fire (which can occur in the fire area due to the regional fire protection assessment) is assumed to produce at least a manual scram. As a result, the transient worksheet is used to calculate SSD capability for the AFW fire area. (Also remember that the SORV worksheet is used also to assess the impact of a potentially stuck open PORV due to the reactor trip. These worksheets follow the examples) Three sequences exist on the transient SDP worksheet. To evaluate the sequences, the analyst must know whether he can credit the systems in each sequence. The first rule is that no credit can be given for a train if the cables associated with that train have not demonstrated to be free of fire damage given the particular scenario. For this example, assume that MFW cables have not been traced; however cabling locations for all other systems identified in the sequences are known.

Since we have a moderate degradation in the 1 hour barrier, it is expected that at least the DRT will be needed. However, to determine that is the only term needed we will need to compare SSD(DRT) and SSD(SRT). Note that for the SRT, all equipment in the AFW fire area except that protected by the barrier, is assumed to fail. For the DRT, all equipment in the AFW fire area included that protected by the barrier is assumed to fail.

First we will look at the transient sequences. Since feed/bleed, high pressure injection, and high pressure recirculation are not mentioned as being damaged in the fire scenario, it is assumed that they will be free of fire damage. Thus we will only assume their random failure probabilities in the SDP transient worksheet.

To evaluate the DRT, the equipment that fails is the equipment in the area of fire origin not protected by the barrier i.e. TDAFW and MDAFW A, plus the equipment protected by the barrier i.e. MDAFW B. And of course since the MFW system cables have not been traced, no credit can be taken for that system. Therefore for the DRT, sequence 1 produces a SSD due to bleed only. Sequence 2 provides SSD due to all of high pressure injection. Sequence 3 provides SSD due to high pressure recirculation only. Therefore for sequence 1 SSD = -2 due to operator action; sequence 2 produces SSD = -3 due to multi-train system; sequence 3 produces SSD = -2 due to HPR being an operator action.

If we evaluate the SORV tree, several sequences have at most SSD(DRT) = -4 since the probability of a PORV being challenged and sticking open is -2 and the probability of the block valve failing is -2. Therefore the transient tree dominates. (In fact, if the reader looks at the SORV sequences which follow, they are even lower than -4 due to the other equipment credited to mitigate core damage.)

To evaluate the SRT, the equipment that fails is only that equipment in AFW fire area damaged according to the fire scenario that is not protected by the 1 hour fire barrier. Thus if we look at those three transient sequences again, we realize that sequence 1 has a SSD = -4 (1 train of AFW and bleed). Sequence 2 has SSD = -5 due to the train of AFW and multi-train system. Sequence 3 has SSD = -4 due to the train of AFW and HPR.
Note that the SORV tree produces even smaller values for the SSD(SRT).

Therefore, let us only compare the DRT and SRT for the transient worksheet (since transient worksheet in the case of SRT and DRT dominates the SORV worksheet). Remember that the DRT consisted of three values of SSD. They were -2, -3, and -2. For the SRT the SSDs were for those sequences -4, -5 and -4. Remembering that these values are exponents of ten, the analyst can see that the DRT is 100 times larger than the SRT. (Note this is because of the additional train of AFW available for the SRT, and that AFW is in every sequence) Thus we have validated that the DRT is all that is necessary, even though in making that evaluation we did most of the work to calculate the CDF from both DRT and SRT.

Now to calculate the FMF for the DRT, we do the following: IF = -2.5 (log of 3E-3), MS = -1 (normal operating state), AS = -0.75 (moderate degradation of sprinkler), FB = -0.5 (moderate degradation of a 1 hour barrier), no CC term. Therefore FMF for the DRT = -4.75. Go to table 5.6 and note this FMF refers to 1E-4 to 1E-5, then to table 5.7 and choose E since the degradations have lasted more than 30 days. Now for sequence number 1, note that SSD = -2 and E intersect in table 5.8 at Green. For sequence number 2, note SSD = -3 and E intersect at Green. For sequence number 3, SSD = -2 and E intersect in table 5.8 at Green. Only two of these Greens is beside a White, therefore there is no potential for Greens to sum to be a White. (Remember that three Greens each to the left of a white may sum to be a white).

<u>Example 2B</u>

The 1-hour barrier has a high degradation. The automatic sprinkler suppression system has a high degradation. The fire brigade is in its normal operating state. Each of these degradations has lasted longer than 30 days.

Only the DRT is needed since the barrier has a high degradation.

The SSD done for the DRT in example 2A (in both transient and SORV worksheets) holds here since the same equipment exists in the AFW fire area, included that protected by the 1 fire hour barrier. (In fact, if the SRT was needed here, it would have been the same as done in example 2A also. But the SRT is not appropriate for the case with a high degradation of a barrier) Therefore, we only need to calculate the FMF.

IF = -2.5, MS = -1, AS = 0, FB = 0. Therefore FMF = -2.5 + -1 + 0 + 0 = -3.5

For each case, from **Table 5.4**, FMF = -4 corresponds to 1E-3 to 1E-4 approximate frequency. Therefore select D from table 5.5.

For sequence 1 of the transient worksheet SSD = -2 as before. Sequence 2 has SSD = -3. Sequence 3 has SSD = -2. Therefore from table 5.8, sequence 1 produces a white, sequence 2 produces a green, and sequence 3 produces a white.

<u>Example 2C - Spurious Actuations</u>

Take example 2A and assume that in addition to the other findings in the AFW room, that an inspector discovered that the licensee had not protected against the possibility of a spurious actuation in the AFW room. We will assume this cabling is subject to fire damage due to the

TDAFW pump fire, and we will assume that this cabling was not protected by the 1 hour fire barrier. Assume this spurious actuation could cause the PORV to open and make it unable to be closed.

In this case instead of using the random failure probability for the PORV being challenged and sticking open (random failure probability for PORV being challenged is 0.1; random failure probability for PORV sticking open is 0.1; therefore random failure probability for both happening is 0.01), the PORV is considered failed in the SORV sequences. Credit is still given for the block valves according to the SDP worksheet. For each sequence where the PORV is considered, the sequence after its evaluation is adjusted by -1.

Therefore, let us do the DRT. First of all, sequence 1. The SORV event is considered failed. The high pressure injection is not impacted by the fire. Therefore since the high pressure injection is a multi-train system, -3 credit is given for it. -2 is given for the block valve, and since the sequence is impacted by spurious actuations, another -1 is added to the sequence. Therefore sequence 1 is represented by SSD = -3 -2 -1 = -6.

For sequence 2, the SORV is assumed failed. Credit is given for the block valve (-2) and bleed (-2) and spurious actuations (-1). Therefore sequence 2 is represented by SSD = -5. (Note that bleed here is represented by the manual actions necessary to maintain pressurizer level with the high pressure pumps. After all, the PORV is stuck open due to the initiator.) For sequence 3, the SORV event is assumed failed again. HPR is considered an operator action which is equal to -2. The block valve is -2. Since the PORV is affected by the spurious actuation, add -1 to the sequence. Therefore, SSD for sequence 3 is -5.

Therefore for the DRT for the SORV we have SSD = -6, -5 and -5 for the three sequences. In example 2A we saw that SSD for the transient sequences were -2, -3, and -2. Since these are exponents of 10, it is clear that the transient sequence still dominates the DRT for the AFW fire area.

For the SRT for the transient worksheets, in example 2A, we had SSD = -4, -5, -4 for the three sequences. For the SRT with the SORV, sequence number 1 is -6 since we still have all high pressure injection, the block valve, and the -1 assigned for spurious actuation of the PORV. Sequence number 2 is SORV failed, auxiliary feedwater = -2, block valve = -2, and bleed = -2, and spurious actuation = -1. Therefore sequence number 2 is represented by -7. Sequence number 3 is SORV failed, block valve = -2, high pressure recirculation = -2, adjustment for spurious actuations = -1. So the SSD(SRT) for the SORV is -6 , -7, -5.

So the SSD(SRT) for the SORV is still less than that SSD(SRT) of the transient.
Since the SSD(SRT) of the transient still dominates the SSD(SRT) of the SORV, and since SSD(DRT) of the transient still dominates SSD(DRT) of the SORV, it is only necessary to use the transient to determine if the DRT is all that is needed. In fact since the DRT is still approximately 100 times the SRT, only the DRT is needed. Therefore, we use the DRT of the transient to do the calculation. Therefore, the PORV which spuriously actuates has no impact in this situation since the SORV contribution was always smaller than the transient contribution. (Actually, prior to determining the DRT is all that is needed, the analyst could have determined that the spurious actuation had no impact in this example. After all, the SORV is still dominated by the transient worksheet in both the SRT and DRT cases. This is noted prior to the comparison of SRT versus DRT.)

<u>Summary of Case 2: Auxiliary Feedwater Room</u>

Example 2A: 1 hour Fire Barrier = Moderate; Autosuppression = Moderate; Fire Brigade = NOS (normal operating state)

- Color = Green (via DRT)

Example 1B: 1 hour Fire Barrier = High; Autosuppression = High; Fire Brigade = NOS

- Color = White (via DRT)

Example 1C: 1 hour Fire Barrier = Moderate; Autosuppression = Moderate; Fire Brigade = NOS

- Color = Green since spurious actuations had no risk significant impact on safe shutdown capability

Note that the significance of these findings in Case 2 is much lower than in Case 1 despite the DID degradations being comparable. However, since Case 2 has much more safe shutdown capability than Case 1, the DID findings in Case 2 are not as significant.

ADDITIONAL SEQUENCES

Sample LOOP sequences are provided for completeness since it is expected that the attached sheets are the ones most commonly used. However, note that sequences for transient, LOOP, and SORV will be plant specific, so these generic sequences are not applicable to any specific plant. It is expected that additional plant specific sequences for other initiators will be developed by the Reactor Systems SDP team. If these initiators can be fire induced, then it may be more appropriate to use one of these additional initiators in place of those identified here. The authors cannot comment specifically on this issue since these additional initiators are in development.

FINAL NOTE ON DRT AND SRT

Remember that only the DRT is needed for high degradation 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). However, to use the model, the analyst will need to know how to calculate both the SRT and DRT.

DETAIL ON ADDITION OF SORV TO TRANSIENT OR LOOP SEQUENCES

The authors recognize that addition of SORV sequences to the transient or LOOP sequences must be done such that those SORV sequences are not over counted. Over counting of SORV sequences will occur when those SORV sequences which are added to the transient or LOOP sequences are non-minimal. (Non-minimal is a PRA term which essentially says that the sequence is already contained in another sequence.) For example, on the transient sequences, the failure of AFW-PCS-FB constitutes a core damage sequence. Therefore, to count SORV-BLK-AFW-PCS-FB as a different core damage sequence is not permitted since the failure of AFW-PCS-FB is in both sequences. However practically speaking, since the transient or LOOP sequence will dominate the non-minimal SORV sequence as long as the SORV and block valve do not both fail due to direct (as opposed to spurious actuation) fire damage, the quantification of non-minimal SORV sequences under those conditions will have no significant impact on CDF. Example 2 demonstrates that the quantification of the non-minimal sequence is insignificant for the conditions where no simultaneous direct fire damage occurs to SORV and the block valve.

DRT FOR CABLE SPREADING ROOM (EXAMPLES 1A, 1B, 1C)

Estimated Frequency (Table 1 Row)

Exposure time ___________ Table 1 result (circle): A B C D E F G H

Safety Functions Needed:	*Full* Creditable Mitigation Capability for each Safety Function:
Remote Shutdown Operations (RSO)	Manual actions are consistent with Note 1, shutdown can be performed by available equipment (Random failure of RSO= -1)

Circle affected functions	Remaining Mitigation Capability	Sequence Color
1 LOOP/TRANS - RSO	NONE (0)	

Identify any human actions for the RSO which may occur within areas that are affected by fire or smoke:

Note 1: 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

FIRE WHICH REQUIRES REMOTE SHUTDOWN OPERATIONS (RSO) LOOP/TRANS

SRT FOR CABLE SPREADING ROOM (EXAMPLES 1B, 1C)

Estimated Frequency (Table 1 Row)

Exposure time ___________ Table 1 result (circle): A B C D E F G H

Safety Functions Needed:	*Full* Creditable Mitigation Capability for each Safety Function:
Remote Shutdown Operations (RSO)	Manual actions are consistent with Note 1, shutdown can be performed by available equipment (Random failure of RSO= -1)

Circle affected functions	Remaining Mitigation Capability	Sequence Color
1 LOOP/TRANS - RSO	RSO (-1)	

Identify any human actions for the RSO which may occur within areas that are affected by fire or smoke:

Note 1: 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

DRT FOR AFW ROOM (EXAMPLES 2A, 2B, 2C) Estimated Frequency (Table 1 Row) __________ Exposure Time _______ 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 and 1/3 condensate pump (Operator action)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 ASD Train)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs open for Feed/Bleed (operator action)
High Pressure Injection for FB (EIHP)	1 / 4 Charging or SI trains (multi-train system)
High Pressure Recirculation (HPR)	1 / 4 Charging or SI trains taking suction from 1 / 2 LPSI trains with successful switchover to sump (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining* Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TRANS - AFW - PCS - FB		**FB (-2)**	
2 TRANS - AFW - PCS -EIHP		EIHP (-3)	
3 TRANS - AFW - PCS - HPR		HPR (-2)	

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

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.

SRT FOR AFW ROOM (EX. 2A, 2C) Estimated Frequency (Table 1 Row) __________ Exposure Time __________ 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 and 1/3 condensate pump (Operator action)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 ASD Train)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs open for Feed/Bleed (operator action)
High Pressure Injection for FB (EIHP)	1 / 4 Charging or SI trains (multi-train system)
High Pressure Recirculation (HPR)	1 / 4 Charging or SI trains taking suction from 1 / 2 LPSI trains with successful switchover to sump (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining* Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TRANS - AFW - PCS - FB		**AFW (-2) FB (-2) = -4**	
2 TRANS - AFW - PCS -EIHP		AFW (-2) EIHP (-3) = -5	
3 TRANS - AFW - PCS - HPR		AFW (-2) HPR (-2) = -4	

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

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.

DRT FOR AFW ROOM (EX. 2A, 2B) Estimated Frequency (Table 1 Row) __________ Exposure Time __________ Table 1 Result (circle): A B C D E F G H

Safety Functions Needed:	*Full* Creditable Mitigation Capability for each Safety Function:
Closure of Block Valve (BLK)	To close the block valve if the PORV stuck open or failed to reclose in response to an initiator (operator action)
Early Inventory, HP Injection (EIHP)	1 / 4 Charging or SI trains (multi-train system)
Power Conversion System (PCS)	1/3 condensate pump (operator action)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 diverse train)
Primary Heat Removal, Feed/Bleed (FB)	1 / 2 PORVs open for Feed/Bleed (operator action)(1)
High Pressure Recirculation (HPR)	1 / 4 Charging or SI trains taking suction from 1 / 2 LPSI trains with successful switchover to sump (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining* Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 SORV - BLK - EIHP		**N/A since no components from this sequence failed in fire scenario.**	
2 SORV - BLK - AFW - PCS - FB		SORV (-2) BLK (-2) FP (-2) = -6	
3 SORV - BLK - HPR		N/A since no components from this sequence failed in fire scenario	

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

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. FB refers to the manual actions necessary to control HPI.

SRT FOR AFW ROOM (EX. 2A) (circle): A B C D E F G H	Estimated Frequency (Table 1 Row) __________	Exposure Time __________	Table 1 Result

Safety Functions Needed:	*Full* Creditable Mitigation Capability for each Safety Function:
Closure of Block Valve (BLK)	To close the block valve if the PORV stuck open or failed to reclose in response to an initiator (operator action)
Early Inventory, HP Injection (EIHP)	1 / 4 Charging or SI trains (multi-train system)
Power Conversion System (PCS)	1/3 condensate pump (operator action)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 diverse train)
Primary Heat Removal, Feed/Bleed (FB)	1 / 2 PORVs open for Feed/Bleed (operator action)(1)
High Pressure Recirculation (HPR)	1 / 4 Charging or SI trains taking suction from 1 / 2 LPSI trains with successful switchover to sump (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining* Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 SORV - BLK - EIHP		**N/A since no components from this sequence failed in fire scenario**	
2 SORV - BLK - AFW - PCS - FB		SORV (-2) BLK (-2) AFW (-2) FB (-2) = -8	
3 SORV - BLK - HPR		N/A since no components from this sequence failed in fire scenario	

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

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.

DRT WITH SPURIOUS ACTUATION (EX. 2C) Estimated Frequency (Table 1 Row) ___________ Exposure Time ________ Table 1 Result (circle): A B C D E F G H

Safety Functions Needed:	*Full* Creditable Mitigation Capability for each Safety Function:
Closure of Block Valve (BLK)	To close the block valve if the PORV stuck open or failed to reclose in response to an initiator (operator action)
Early Inventory, HP Injection (EIHP)	1 / 4 Charging or SI trains (multi-train system)
Power Conversion System (PCS)	1/3 condensate pump (operator action)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 diverse train)
Primary Heat Removal, Feed/Bleed (FB)	1 / 2 PORVs open for Feed/Bleed (operator action)(1)
High Pressure Recirculation (HPR)	1 / 4 Charging or SI trains taking suction from 1 / 2 LPSI trains with successful switchover to sump (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining* Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 SORV - BLK - EIHP		**BLK (-2) EIHP (-3) SPURIOUS (-1) = -6**	
2 SORV - BLK - AFW - PCS - FB		BLK (-2) FB (-2) SPURIOUS (-1) = -5	
3 SORV - BLK - HPR		BLK (-2) HPR (-2) SPURIOUS (-1) = -5	

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

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.

SRT WITH SPURIOUS ACTUATION (EX. 2C) Estimated Frequency (Table 1 Row) __________ Exposure Time ______ Table 1 Result (circle): A B C D E F G H

<u>Safety Functions Needed</u>:	*<u>Full</u>* <u>Creditable Mitigation Capability for each Safety Function</u>:
Closure of Block Valve (BLK)	To close the block valve if the PORV stuck open or failed to reclose in response to an initiator (operator action)
Early Inventory, HP Injection (EIHP)	1 / 4 Charging or SI trains (multi-train system)
Power Conversion System (PCS)	1/3 condensate pump (operator action)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 diverse train)
Primary Heat Removal, Feed/Bleed (FB)	1 / 2 PORVs open for Feed/Bleed (operator action)(1)
High Pressure Recirculation (HPR)	1 / 4 Charging or SI trains taking suction from 1 / 2 LPSI trains with successful switchover to sump (operator action)

<u>Circle Affected Functions</u>	**<u>Recovery of Failed Train</u>**	***<u>Remaining</u>*** **<u>Mitigation Capability Rating for Each Affected Sequence</u>**	**<u>Sequence Color</u>**
1 SORV - BLK - EIHP		**BLK (-2) EIHP (-3) SPURIOUS (-1) = -6**	
2 SORV - BLK - AFW - PCS - FB		BLK (-2) AFW (-2) FB (-2) SPURIOUS (-1) = -7	
3 SORV - BLK - HPR		BLK (-2) HPR (-2) SPURIOUS (-1) = -5	

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

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.

SAMPLE WORKSHEET Estimated Frequency (Table 1 Row) __________ Exposure Time __________ Table 1 Result (circle): A B C D E F G H

<u>Safety Functions Needed</u>:	<u>*Full* Creditable Mitigation Capability for each Safety Function:</u>
Emergency AC Power (EAC)	2 / 3 Emergency Diesel Generators (3 EDGs = 1 multi-train system, 2 EDG = 1 diverse train) or 1 Gas Turbine Generator (1 diverse train)
Recovery of AC power in < 6 hrs (REC6)	Recovery of or source of AC including Turbine Generator (Operator action)
Recovery of AC Power in < 2 hrs (REC2)	Recover a source of AC to allow primary injection (Operator action under high stress)
Failure of PORV to Re-close after it opened (SORV)	2/2 PORVs Re-close after opening (1 train system)
Closure of Block Valve (BLK)	To close the block valve if the PORV stuck open (operator action)
Early Inventory, HP Injection (EIHP)	1 / 4 Charging or SI trains (1 multi-train system)
Secondary Heat Removal (AFW)	1 TDAFW train (1 train) or 1 / 2 MDAFW trains (1 multi-train system)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	1 / 4 Charging or SI trains taking suction from 1 / 2 LPSI trains (with successful recirculation (operator action)

<u>Circle Affected Functions</u>	**<u>Recovery of Failed Train</u>**	**<u>*Remaining* Mitigation Capability Rating for Each Affected Sequence</u>**	**<u>Sequence Color</u>**
1 LOOP - EAC - REC6			
2 LOOP - EAC - REC2 - TDAFW			
3 LOOP - EAC - EIHP (RCP seal LOCA, AC recovered in 6 hours)			
4 LOOP - EAC - REC2 - HPR (RCP seal LOCA, AC recovered in 6 hrs)			
5 LOOP - AFW - FB (AC initially available or become available <2 hrs)			
6 LOOP - AFW - EIHP (AC initially available or become available <2 hrs)			
7 LOOP - AFW - HPR (AC initially available or become available <2 hrs)			

8 LOOP - SORV - BLK - EIHP[(1)] (Emergency AC available)			
9 LOOP - SORV - BLK - HPR[(1)] (Emergency AC available)			

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

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.

END