August 15, 2001

Mr. H. B. Barron
Vice President, McGuire Site
Duke Energy Corporation
12700 Hagers Ferry Road
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SUBJECT: SITE-SPECIFIC WORKSHEETS FOR USE IN THE NUCLEAR REGULATORY COMMISSION'S SIGNIFICANCE DETERMINATION PROCESS (TAC NO. MA6544)

Dear Mr. Barron:

Enclosed please find the Risk-Informed Inspection Notebook which incorporates the updated Significance Determination Process (SDP) Phase 2 Worksheets that inspectors will be using to characterize and risk-inform inspection findings. This document is one of the key implementation tools of the reactor safety SDP in the reactor oversight process and will also be publically available through the Nuclear Regulatory Commission (NRC) external website at http://www.nrc.gov/NRC/IM/index.html.

The 1999 Pilot Plant review effort clearly indicated that significant site-specific design and risk information was not captured in the Phase 2 worksheets forwarded to you last spring. Subsequently a site visit was conducted by the NRC to verify and update plant equipment configuration data and to collect site-specific risk information from your staff. The enclosed document reflects the results of this visit.

The enclosed Phase 2 Worksheets have incorporated much of the information we obtained during our site visits. The staff encourages further licensee comments where it is identified that the Worksheets give inaccurately low significance determinations. Any comments should be provided to the Document Control Desk, with a copy to the Chief, Probabilistic Safety Assessment Branch, Nuclear Reactor Regulation. We will continue to assess SDP accuracy and update the document based on continuing experience.

While the enclosed Phase 2 Worksheets have been verified by our staff to include the site specific data we will continue to assess its accuracy throughout implementation and update the document based on comments by our inspectors and your staff.

Sincerely,

/RA/

Robert E. Martin, Senior Project Manager, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket Nos. 50-369 and 50-370

Enclosure: As Stated

cc w/encl: See next page

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RISK-INFORMED INSPECTION NOTEBOOK FOR

MCGUIRE NUCLEAR STATION

UNITS 1 AND 2

PWR, WESTINGHOUSE, FOUR-LOOP PLANT WITH ICE CONDENSER CONTAINMENT

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NOTICE

This notebook was developed for the NRC's inspection teams to support risk-informed inspections. The activities involved in these inspections are discussed in "Reactor Oversight Process Improvement," SECY-99-007A, March 1999. The user of this notebook is assumed to be an inspector with an extensive understanding of plant-specific design features and operation. Therefore, the notebook is not a stand-alone document, and may not be suitable for use by non-specialists. This notebook will be periodically updated with new or replacement pages incorporating additional information on this plant. All recommendations for improvement of this document should be forwarded to the Chief, Probabilistic Safety Assessment Branch, NRR, with a copy to the Chief, Inspection Program Branch, NRR.

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ABSTRACT

This notebook contains summary information to support the Significance Determination Process (SDP) in risk-informed inspections for the MC Guire Nuclear Power Plant.

The information includes the following: Categories of Initiating Events Table, Initiators and System Dependency Table, SDP Worksheets, and SDP Event Trees. This information is used by the NRC's inspectors to identify the significance of their findings, i.e., in screening risk-significant findings, consistent with Phase 2 screening in SECY-99-007A. The Categories of Initiating Event Table is used to determine the likelihood rating for the applicable initiating events. The SDP worksheets are used to assess the remaining mitigation capability rating for the applicable initiating event likelihood ratings in identifying the significance of the inspector's findings. The Initiators and System Dependency Table and the SDP Event Trees (the simplified event trees developed in preparing the SDP worksheets) provide additional information supporting the use of SDP worksheets.

The information contained herein is based on the licensee's Individual Plant Examination (IPE) submittal, the updated Probabilistic Risk Assessment (PRA), and system information obtained from the licensee during site visits as part of the review of earlier versions of this notebook. Approaches used to maintain consistency within the SDP, specifically within similar plant types, resulted in sacrificing some plant-specific modeling approaches and details. Such generic considerations, along with changes made in response to plant-specific comments, are summarized.

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1. INFORMATION SUPPORTING THE SIGNIFICANCE DETERMINATION PROCESS (SDP)

SECY-99-007A (NRC, March 1999) describes the process for making a Phase 2 evaluation of the inspection findings. The first step in this is to identify the pertinent core damage scenarios that require further evaluation consistent with the specifics of the inspection findings. To aid in this process, this notebook provides the following information:

1. Estimated Likelihood Rating for Initiating Event Categories
2. Initiators and System Dependency Table
3. Significance Determination Process (SDP) Worksheets
4. SDP Event Trees.

Table 1, Categories of Initiating Events, is used to estimate the likelihood rating for different initiating events for a given degraded condition and the associated exposure time at the plant. This Table follows the format of Table 1 in SECY-99-007A. Initiating events are grouped in frequency bins that are one order of magnitude apart. The Table includes the initiating events that should be considered for the plant and for which SDP worksheets are provided. The following initiating events are categorized by industry-average frequency: transients (Reactor Trip) (TRANS); transients without power conversion system (TPCS); large, medium, and small loss of coolant accidents (LLOCA, MLOCA, and SLOCA); inadvertent or stuck open relief valve (IORV or SORV); main steam line break (MSLB), anticipated transients without scram (ATWS), and interfacing system LOCA (ISLOCA). The frequency of the remaining initiating events vary significantly from plant to plant, and accordingly, they are categorized by plant-specific frequency obtained from the licensee. They include loss of offsite power (LOOP) and special initiators caused by loss of support systems.

The Initiators and System Dependency Table shows the major dependencies between frontline- and support-systems, and identifies their involvement in different types of initiators. This table identifies the most risk-significant systems; it is not an exhaustive nor comprehensive compilation of the dependency matrix, as known in Probabilistic Risk Assessments (PRAs). For pressurized water reactors (PWRs), the support systems/success criteria for Reactor Coolant Pump (RCP) seals are explicitly denoted to assure that the inspection findings on them are properly accounted for. This Table is used to identify the SDP worksheets to be evaluated, corresponding to the inspection's findings on systems and components.

To evaluate the impact of the inspection's findings on the core-damage scenarios, SDP worksheets are provided. There are two sets of SDP worksheets; one for those initiators that can be mitigated by redundant trains of safety systems, and the other for those initiators that cannot be mitigated; however, their occurrence is prevented by several levels of redundant barriers.

The first set of SDP worksheets contain two parts. The first identifies the functions, the systems, or combinations thereof that have mitigating functions, the number of trains in each system, and the number of trains required (success criteria) for the initiator. It also characterizes the mitigation capability in terms of the available hardware (e.g., 1 train, 1 multi-train system) and the operator action involved. The second part of the SDP worksheet contains the core-damage accident sequences associated with each initiator; these sequences are based on SDP event trees. In the parenthesis next to each sequence, the corresponding event-tree branch number(s) representing the sequence is given. Multiple branch numbers indicate that the different accident sequences identified by the event tree have been merged into one through Boolean reduction. The SDP worksheets are developed for each of the initiating event categories, including the "Special Initiators", the exception being those which directly lead to a core damage (the inspections of these initiators are assessed differently; see SECY-99-007A). The special initiators are those that are caused by complete or partial loss of support systems. A special initiator typically leads to a reactor scram and degrades some frontline or support systems (e.g., Loss of CCW in PWRs).

In considering the special initiators, we defined a set of criteria for including them to maintain some consistency across the plants. These conditions are as follows:

1. The special initiator should degrade at least one of the mitigating safety functions thereby changing its mitigation capability in the worksheet. For example, when a safety function with two redundant trains, classified as a multi-train system, degrades to a one-train system, it is classified as 1 Train, due to the loss of one of the trains as a result of the special initiator.

2. The special initiators which degrade the mitigation capability of the systems/functions associated with the initiator from comparable transient sequences by two and higher orders of magnitude must be considered.

From the above considerations, the following classes of initiators are considered in this notebook:

1. Transients with power conversion system (PCS) available, called Transients (Reactor trip) (TRANS),
2. Transients without PCS available, called Transients w/o PCS (TPCS),
3. Small Loss of Coolant Accident (SLOCA),
4. Stuck-open Power Operated Relief Valve (SORV),
5. Medium LOCA (MLOCA),
6. Large LOCA (LLOCA),
7. Steam Generator Tube Rupture (SGTR),
8. Anticipated Transients Without Scram (ATWS), and
9. Main Steam Line Break (MSLB).

Examples of special initiators included in the notebook are as follows:

1. Loss of Offsite Power (LOOP),
2. LOOP with failure of 1 Emergency AC bus or associated EDG (LEAC),
3. Loss of 1 DC Bus (LDC),

4. Loss of component cooling water (LCCW),
5. Loss of instrument air (LIA),
6. Loss of service water (LSW).

The worksheet for the LOOP includes LOOP with emergency AC power (EAC) available and LOOP without EAC, i.e., Station Blackout (SBO). LOOP with partial availability of EAC, i.e., LOOP with loss of a bus of EAC, is covered in a separate worksheet to avoid making the LOOP worksheet too large. In some plants, LOOP with failure of 1 EAC bus is a large contributor to the plant's core damage frequency (CDF).

The second set of SDP worksheets addresses those initiators that cannot be mitigated, i.e., can directly lead to core-damage. It currently includes the Interfacing System LOCA (ISLOCA) initiator. ISLOCAs are those initiators that could result in a loss of RCS inventory outside the containment, sometimes referred to as a "V" sequence. In PWRs, this event effectively bypasses the capability to utilize the containment sump recirculation once the RWST has emptied. Also, through bypassing the containment, the radiological consequences may be significant. In PWRs, this typically includes loss of RCS inventory through high- and low-pressure interfaces, such as RHR connections, RCP thermal barrier heat-exchanger, high-pressure injection piping if the design pressure (pump head) is much lower than RCS pressure, and, potentially, through excess letdown heat exchanger. RCS inventory loss through ISLOCA could vary significantly depending on the size of the leak path; some may be recoverable with minimal impact. The SDP worksheet for ISLOCA, therefore, identifies the major consequential leak paths, and the barriers that should fail, allowing the initiator to occur.

Following the SDP worksheets, the SDP event trees corresponding to each of the worksheets are presented. The SDP event trees are simplified event trees developed to define the accident sequences identified in the SDP worksheets. For special initiators whose event tree closely corresponds to another event tree (typically, the Transient (Reactor trip) or Transients w/o PCS event tree) with one or more functions eliminated or degraded, a separate event tree may not be drawn.

The following items were considered in establishing the SDP event trees and the core-damage sequences in the SDP worksheets:

1. Event trees and sequences were developed such that the worksheet contains all the major accident sequences identified by the plant-specific IPEs/PRAs. The special initiators modeled for a plant is based on a review of the special initiators included in the plant IPE/PRA and the information provided by the licensee.

2. The event trees and sequences for each plant take into account the IPE/PRA models and event trees for all similar plants. For modeling the response to an initiating event, any major deviations in one plant from similar plants may be noted at the end of the worksheet.

3. The event trees and the sequences were designed to capture core-damage scenarios, without including containment-failure probabilities and consequences. Therefore, branches of event

trees that are developed only for the purpose of a Level II PRA analysis are not considered. The resulting sequences are merged, using Boolean logic.

4. The simplified event trees focus on classes of initiators, as defined above. In so doing, many separate event trees in the IPEs/PRAs often are represented by a single tree. For example, some IPEs/PRAs define four classes of LOCAs rather than the three classes considered here. The sizes of LOCAs for which high-pressure injection is not required are sometimes divided into two classes, the only difference between them being the need for reactor scram in the smaller break size. There may be some consolidation of transient event trees besides defining the special initiators following the criteria defined above.

5. Major actions by the operator during accident scenarios are credited using four categories of Human Error Probabilities (HEPs). They are termed operator action =1 (representing an error probability of 5E-2 to 0.5), operator action=2 (error probability of 5E-3 to 5E-2), operator action=3 (error probability of 5E-4 to 5E-3), and operator action=4 (error probability of 5E-5 to 5E-4). An human action is assigned to a category bin, based on a generic grouping of similar actions among a class of plants. This approach resulted in designation of some actions to a higher bin, even though the IPE/PRA HEP value may have been indicative of a lower category. In such cases, it is noted at the end of the worksheet. On the other hand, if the IPE/PRA HEP value suggests a higher category than that generically assumed, the HEP is assigned to a bin consistent with the IPE/PRA value in recognition of potential plant-specific design; a note is also given in these situations. Operator’s actions belonging to category 4, i.e., operator action=4, may only be noted at the bottom of worksheet because, in those cases, equipment failures may have the dominating influence in determining the significance of the findings.

The four sections that follow include Categories for Initiating Events Table, Initiators and Dependency Table, SDP worksheets, and the SDP event trees for McGuire Nuclear Station, Units 1 and 2.

1.1 INITIATING EVENT LIKELIHOOD RATINGS

Table 1 presents the applicable initiating events for this plant and their estimated likelihood ratings corresponding to the exposure time for degraded conditions. The initiating events are grouped into rows based on their frequency. As mentioned earlier, loss of offsite power (LOOP) and special initiators are assigned to rows using the plant-specific frequency obtained from individual licensees. For other initiating events, industry-average values are used.

Table 1 Categories of Initiating Events for W. E. McGuire Nuclear Station, Units 1 and 2

Row	Approximate Frequency	Example Event Type	Estimated Likelihood Rating		
I	> 1 per 1-10 yr	Reactor Trip (TRANS), Loss of Power Conversion System (TPCS), Loss of Instrument Air (TIA)	A	B	C
II	1 per 10-10^2 yr	Loss of offsite power (LOOP), Loss of 4KV Essential Bus (T1E), Loss of 125 VDC (T1ED), Loss of KC (TKC)	B	C	D
III	1 per 10^2 - 10^3 yr	Steam Generator Tube Rupture (SGTR), Stuck open PORV/SRV (SORV), Small LOCA including RCP seal failures (SLOCA), MSLB/FLB (outside containment), Loss of NSW (TRN)	C	D	E
IV	1 per 10^3 - 10^4 yr	Medium LOCA (MLOCA), LEAC	D	E	F
V	1 per 10^4 - 10^5 yr	Large LOCA (LLOCA)	E	F	G
VI	less than 1 per 10^5 yr	ATWS[1] (mechanical only), Interfacing System LOCA (ISLOCA)	F	G	H
			> 30 days	3-30 days	< 3 days
			Exposure Time for Degraded Condition		

Note:

1. The SDP worksheets for ATWS core damage sequences assume that the ATWS is not recoverable by manual actuation of the reactor trip function. Thus, the ATWS frequency to be used by these worksheets must represent the ATWS condition that can only be mitigated by the systems shown in the worksheet (e.g., boration). Any inspection finding that represents a loss of capability for manual reactor trip for a postulated ATWS scenario should be evaluated by a risk analyst to consider the probability of a successful manual trip.

1.2 INITIATORS AND SYSTEM DEPENDENCY

Table 2 lists the systems included in the SDP worksheets, the major components in the systems, and the support system dependencies. The systems' involvements in different initiating events are noted in the last column.

Table 2 Initiators and System Dependency for W. E. McGuire Nuclear Station, Units 1 and 2[1]

Affected Systems	Major Components	Support Systems	Initiating Event
Accumulators	4 Accumulators	600 VAC (Cold leg injection)	LLOCA
Essential Auxiliary Power System	AC Power Distribution & AC Instrument Power	125 VDC 1EVDA for train A, and 1EVDD for train B (4 KVAC and lower) 1DCA and 1DCB for 6.9KV HVAC two trains for each switchgear room [2]	All
EDG	2 EDGs per unit and the associated Fuel Transfer pumps	125VDC, RN, VG(DG starting air), KD (DG cooling water), LD (lube oil system), and VD (HVAC)	LOOP, LEAC
AFW (CA)	2 MDPs	4.16KVAC,125 VDC, ESFAS, RN, IA (Control Valves Open), Water supply (UST, Condenser, CA CST, and RN)	All except MLOCA and LLOCA
	1 TDP	ESFAS, 125 VDC, VI (Instrument Air for Control Valves to Open), Main Steam System, Water supply (UST, Condenser, CA CST, and RN)	
CCW (KC)	2 headers each with two pumps and one HX	4 KVAC,600 VAC, 125VDC,RN (Dependent but fail safe are VI, and ESFAS)	All
Condensate / MFW	3 50% Condensate pumps 2 50% Turbine driven FPs	6900VAC,600VAC,125VDC, IA(VI), Recirculated cooling water (KR), Condenser circulating water (RC)	TRANS, T1E

Table 2 (Continued)

Affected Systems	Major Components	Support Systems	Initiating Event
CVCS (NV)	1PDP (32 GPM) 2 CCP(150GPM@2670PSIG) 2 Boric acid transfer pumps and BAT	4160VAC, 600VAC (also for PDP), 125VDC, RN, FWST	All except LLOCA, TRN, T1ED
DC Power System	4 Divisions of panel boards and distribution centers, Buses, battery chargers and batteries	600 VAC Dist. (without AC, battery capacity is 3 hrs.)	All
ESFAS	Dual Train Control System	120 VAC, HVAC (some actuation are fail safe)	All
HVAC: Control area (VC) and aux. Bldg. HVAC including control room, and Engineering Safeguard pump room (VA)	2 Train of chilled water(YC) with cross connection, each with a compression tank, a chilled water pump, and a chiller.	RN, 4160 VAC, 600 VAC, 120 VAC	All
Instrument Air (VI)	6 Air compressors 3 operating and 3 backup per unit	600 VAC,120 VAC, Recirculated cooling water (KR)	TIA
Main Steam (SM)	Per SG: 1 Secondary PORV and the associated block valve, 5 safety relief valves. One MSIVs and 8 condenser steam dump valves with total of 40% capacity	VI and 125 VDC for MSIVs and secondary PORVs, 600 VAC for block valves	All except MLOCA, LLOCA
Pressurizer Pressure Relief (NC)	3 Safety valves and 3 PORVs with associated block valves, and 2 air operated pressurizer spray valves	125 VDC, and VI with backup N2 for PORVs VI and 125 VDC for prizer spray valves 600 VAC for Block valves	All except MLOCA, LLOCA, TRN, and T1ED

Table 2 (Continued)

Affected Systems	Major Components	Support Systems	Initiating Event
FWST	Tank, Level instrumentation for automatic swap over	600 VAC, 120 VAC	All except TRN, T1ED
RCP	Seals	1 / 2 Charging pumps (NV Trains) to seal injection or 1 / 2 KC trains (2 pumps) to thermal barrier heat exchanger of all four pumps 1/1 SSF pump for seal injection as a recovery action	LOOP, SLOCA (RCP seal LOCA)
RHR/PSI (ND)	Two trains each with a pump, and a heat exchanger (with ability to cross connect trains)	4160VAC,600 VAC, 120VAC, 125VDC, Component cooling water (KC),HVAC (i.e. RN)	All except TRN, T1ED
Nuclear Service Water (RN)	2 Pumps (100%) in two train	4160 VAC, 600VAC, 125VDC	All
HPIS (NI)	2 Pumps in two trains with shutoff at 1500 psi. In recirculation manual alignment to ND pumps	4160VAC, 600VAC, 125VDC, RN, FWST	All except LLOCA, TRN, T1ED
Standby Shutdown Facility (SSF)	One Diesel generator and two makeup pumps with associated support	6900 VAC, 600 VAC, 125 VDC	LOOP, TKC, and TRN

<u>Notes</u>:

1. Plant internal event CDF = 4.0E-5/yr, Seismic 1.4E-5, and Tornado 1.9E-5, fire and flood contributions are negligible.
2. Loss of switchgear room HVAC is shown not to be a risk concern for the internal events.

1.3 SDP WORKSHEETS

This section presents the SDP worksheets to be used in the Phase 2 evaluation of the inspection findings for the McGuire Nuclear Station. The SDP worksheets are presented for the following initiating event categories:

1. Transients (Reactor Trip) (TRANS)
2. Transients with loss of PCS (TPCS)
3. Small LOCA (SLOCA)
4. Stuck-open PORV (SORV)
5. Medium LOCA (MLOCA)
6. Large LOCA (LLOCA)
7. Loss of Offsite Power (LOOP)
8. Steam Generator Tube Rupture (SGTR)
9. Anticipated Transients without Scram (ATWS)
10. Main Steam and Feed Line Break (MSLB/FLB)
11. Loss of Nuclear SW (TRN)
12. Loss of CCW (TKC)
13. Loss of 4160 Essential Bus (T1E)
14. Loss of 125 V DC 1EVDD Bus (TIED)
15. Transients with Loss of Instrument Air (TIA)
16. Interfacing Systems LOCA (ISLOCA)

Table 3.1 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Transients (Reactor Trip) (TRANS)

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 to 2/4 SG (operator action = 1) (1)
Secondary Heat Removal (AFW)	(1/2 MDAFW trains (1 multi-train system) or 1/1 TDAFW train (1 ASD train)) to 2/4 SG
Early Inventory, High Pressure Injection (EIHP)	1/2 NV trains injecting into 3/4 Loops and 1/2 NI trains injecting to 4/4 loops (1 multi-train system) (2)
Primary Heat Removal, Feed/Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) (3)
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) (4)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TRANS - PCS - AFW - HPR (4)			
2 TRANS - PCS - AFW - EIHP (5)			
3 TRANS - PCS - AFW - FB (6)			

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 and ready for use.

Notes:

1. The HEP value in the IPE is 2.0E-1.

2. The credit for the mitigation capability is based on pump train rather than injection lines. Any finding associated with injection line should be evaluated based on the number of loops required. Operation of 2/2 NV is also sufficient for feed and bleed operation when all AFW pumps fail to start. This success criteria may be considered if the inspection finding would impact both NI pumps.

3. The human error probability (HEP) for FB in IPE is 1.0E-2.

4. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.2 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Transients with Loss of PCS (1) (TPCS)

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:**
Secondary Heat Removal (AFW)	(1/2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 ASD train)) to 2/4 SG with the associated steam relief through 1/1 SG PORV or 1/5 safety relief valve
Early Inventory, High Pressure Injection (EIHP)	1/2 NV trains injecting into 3/4 Loops and 1/2 NI trains injecting to 4/4 loops (1 multi-train system) (2)
Primary Heat Removal, Feed/Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) (3)
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) (4)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TPCS - AFW - HPR (3)			
2 TPCS - AFW - EIHP (4)			
3 TPCS - AFW - FB (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 and ready for use.

Notes:

1. The frequency of transients with loss of PCS is estimated around 0.1 per year based on IPE and 0.2 probability of recovery of PCS.

2. The credit for the mitigation capability is based on pump train rather than injection lines. Any finding associated with injection line should be evaluated based on th number of loops required. Operation of 2/2 NV is also sufficient for feed and bleed operation if all AFW pumps fail to start. This success criteria may be considered when an inspection finding may imply that both NI pumps would not be available.

3. The human error probability (HEP) for FB in IPE is 1.0E-2.

4. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.3 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Small LOCA (SLOCA)

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:**
Early Inventory, HP Injection (EIHP)	(1/2 NV trains (1 multi-train system) or 1/2 NI trains (1 multi-train system)) injecting into 2/4 cold legs
Secondary Heat Removal (AFW)	(1/2 MDAFW trains (1 multi-train system) or 1/1 TDAFW train (1 ASD train)) to 2 intact SGs
Primary Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) [(1)]
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) [(2)]

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 SLOCA - HPR (2,4)			
2 SLOCA - AFW - FB (5)			
3 SLOCA - EIHP (6)			

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 and ready for use.

Notes:

1. The human error probability (HEP) for FB in IPE is 1.0E-2.

2. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.4 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Stuck-Open PORV (SORV) (1)

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:**
Operator Closes the Block Valve (BLK)	Closure of the associated block valve; operator action = 3 but limited by hardware failure (1 Train) (2)
Early Inventory, HP Injection (EIHP)	(1/2 NV trains (1 multi-train system) or 1/2 NI trains (1 multi-train system)) injecting into 2 cold legs
Secondary Heat Removal (AFW)	(1/2 MDAFW trains (1 multi-train system) or 1/1 TDAFW train (1 ASD train)) to 2 intact SGs
Primary Bleed (F&B)	1/2 remaining PORVs open for Feed and Bleed (operator action = 2) (3)
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) (4)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 SORV - BLK - HPR (2,4)			
2 SORV - BLK - AFW - FB (5)			
3 SORV - BLK - EIHP (6)			

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 and ready for use.

Notes:

1. The stuck open PORV accounts for PORVs inadvertently opens (or major leaks) during operation or failure of PORV to re-seat after a transient, e.g, loss of feed water transients. In some scenarios when the pressurizer goes solid or those scenarios with loss of secondary heat removal and failure of one or more PORVs, there is a possibility of SRV demand and its subsequent failure to re-close. The stuck open SRV is equivalent to Medium LOCA and it is not treated here. The SLOCA event tree was used for this worksheet.

2. The HEP value for operator to close the block valve is estimated as 1.0E-3 in the IPE.

3. The human error probability (HEP) for FB in IPE is 1.0E-2. Operation of one PORV is questioned here to account for those cases where PORV might have partially stuck open.

4. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.5 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Medium LOCA (MLOCA)

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>:**
Early Inventory, HP Injection (EIHP)	(1/2 NV trains (1 multi-train system) or 1/2 NI trains (1 multi-train system)) injecting into 2/4 cold leg
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) (1)

<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 MLOCA - HPR (2)			
2 MLOCA - EIHP (3)			

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 and ready for use.

<u>Note</u>:

1. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.6 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Large LOCA (LLOCA)

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:**
Early Inventory, Accumulators (EIAC)	3/3 remaining Accumulators (1 train)
Low Pressure Injection (EILP)	1/2 LPSI (RHR) trains with suction from FWST (1 multi-train system)
Low Pressure Recirculation (LPR)	1/2 LPSI (RHR) trains with suction automatically transferred to containment sump (1 multi-train system)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LLOCA - LPR (2)			
2 LLOCA - EILP (3)			
3 LLOCA - EIAC (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 and ready for use.

Table 3.7 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Loss of Offsite Power (LOOP)

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:
Emergency AC Power (EAC)	1/2 EDG (1 multi-train system)
Turbine-driven AFW Pump (TDAFW)	1/1 TDAFW train (1 ASD train)
Safe Shutdown Facility (SSF)	One Diesel generator and the makeup pumps with associated support injecting to pump seals (operator action = 1) [2]
Secondary Heat Removal (AFW2)	1/2 MDAFW trains to 2/4 SGs (1 multi-train system)
Recovery of AC Power in < 2 hrs (REC2)	Recovery of AC source in less than 2 hours [3] (operator action = 1)
Recovery of AC Power in < 4 hrs (REC4)	Recovery of AC source in less than 4 hours [4] (operator action = 1)
Early Inventory, HP Injection (EIHP)	1/2 NV trains injecting into 3/4 Loops and 1/2 NI trains injecting to 4/4 loops (1 multi-train system)
Feed and Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) [5]
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) [6]

Circle Affected Functions	Recovery of Failed Train	Remaining Mitigation Capability Rating for Each Affected Sequence	Sequence Color
1 LOOP - TDAFW - AFW2 - HPR (4)			
2 LOOP - TDAFW - AFW2 - FB (5)			
3 LOOP - TDAFW - AFW2 - EIHP (6)			

4 LOOP - EAC - REC4 (8)			
5 LOOP - EAC - SSF - HPR (10) (AC recovered in 2 hours)			
6 LOOP - EAC - SSF - EIHP (11) (AC recovered in 2 hours)			
7 LOOP - EAC - SSF - REC2 (12)			
8 LOOP - EAC - TDAFW - HPR (14) (AC recovered in 2 hours)			
9 LOOP - EAC - TDAFW - FB (15) (AC recovered in 2 hours)			
10 LOOP - EAC - TDAFW - EIHP (16) (AC recovered in 2 hours)			
11 LOOP - EAC - TDAFW - REC2 (17)			

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 and ready for use.

Notes:

1. The IPE assumes conservatively that significant RCP seal leakage without injection and cooling could start in about 15 minutes and SG dry out in about 20 to 30 minutes. We therefore assume if the AC is recovered in less than 30 minutes, neither seal cooling nor SG dry out has occurred.

2. The IPE uses a human error probability of about 5E-2 for SSF operation. A HEP credit of 1 is therefore assigned to this event.

3. In SBO scenarios; it is assumed that it takes approximately 2 hours after the RCP seal LOCA or total loss of secondary cooling for the core damage to occur. The recovery of AC power in 2 hours is 0.38 based on EPRI curve for this plant. A credit of 1 is given in this SDP worksheet.

4. The batteries are expected to deplete in about 3 hours in SBO scenarios, and it is conservatively assumed that core damage would occur in 4 hours. The recovery of AC power in 4 hours is 0.28 based on EPRI curve for this plant. A credit of 1 is given in this SDP worksheet.

5. The human error probability (HEP) for FB in IPE is 1.0E-2.

6. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.8 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Steam Generator Tube Rupture (SGTR)

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:**
Secondary Heat Removal (AFW)	(1/2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 ASD train)) to 2/4 SG
Early Inventory, HP Injection (EIHP)	1/2 NV trains (1 multi-train system) or 1/2 NI trains (1 multi-train system) to 2/4 loops
Pressure Equalization (EQ/ISO)	[Cool down: through intact SGs, throttling of Injection flow, and Pressurizer spray] ; and [Isolation: by closure of the MSIVs and isolation of the feed to the faulted SG] (operator action = 1) (1)
Primary depress- PORVs (PDP)	1/3 PORVs open (operator action = 1) (2)
Feed-and-Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) (3)
Rapid RCS Cool Down (RCSCOOL)	Rapid cool down through intact secondary SGs using 2/3 SG PORVs or 3/3 open MSIVs (operator action = 2)
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) (4)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 SGTR - EQ/ISO - HPR (3)			
2 SGTR - EQ/ISO - PDP - RCSCOOL (5)			
3 SGTR - EQ/ISO - EIHP (5) (6)			
4 SGTR - AFW - HPR (8)			

5 SGTR - AFW - FB (9)			
6 SGTR - AFW - EIHP (10)			
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 and ready for use.			

<u>Notes</u>:

1. The function EQ/ISO is not explicitly considered in the IPE. The function EQ/ISO deals with isolation of feed water to the affected SG and bringing the primary pressure below the set point of SG PORV and preventing SG overfill. The value for operator error probability for this action is assumed to be similar to depressurization function using SGs and pressurizer spray (PDS, with the HEP value of 0.1) .

2. The human error probability (HEP) assessed in the IPE for PDP is 0.1 .

3. The HEP for FB assessed in IPE is 1.0E-2. Note that failure of PORV to re-seat and the failure of operator to close block valve is not included in the event tree since the likelihood is low and the sequences are covered under SORV.

4. The human error probability for switch over to recirculation is 3.2E-3. It is also assumed that melting of ice in the ice condenser provide sufficient inventory in the sump, therefore, make up to RWST is not questioned.

5. In this sequence there is some possibility for the operator to perform Rapid RCS cool down (RCSCOOL function in the SDP work sheet), and uses the low pressure make up and RHR system for DHR. This path is not credited in the SDP work sheet due to the demanding operator action involved and expanded modeling which is beyond this screening tool.

Table 3.9 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Anticipated Transients Without Scram (ATWS)

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:**
Emergency Boration (HPI)	1/2 NV trains and use of boric acid transfer pumps to inject into 3 or more loops (operator action = 2) [(1)]
Turbine Trip (TTP)	2/2 AMSAC channels (1 train)
Primary Relief (SRV)	1/3 PORVs and 3/3 SRVs (1 train system) [(2)]
Secondary Heat Removal (AFW)	2/2 MDAFW trains (1 train)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 ATWS - SRV (2)			
2 ATWS - AFW (3)			
3 ATWS - HPI (4)			
4 ATWS - TTP (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 and ready for use.

Notes:

1. IPE assigns an operator failure probability of 0.01.

2. The IPE and the licensee submitted work sheets do not discuss the opening of PORV and SRVs. The success criteria is based on licensee comments received via an email per NRC request. The favorable MTC (typically 95% of the time) is assumed.

Table 3.10 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Main Steam and Feed Line Break (MSLB/FLB)

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:**
Isolation of all Steam lines (MSIV4)	Closure of 4/4 MSIVs (1 train)
Isolation of 3/4 Steam line (MSIV3)	Closure of 3/3 remaining MSIVs assuming failure of MSIV4 (1 train) [(1)]
Isolation of AFW flow to the affected SG (AFWI)	Isolation of AFW flow to the SG with non-isolable steam line and to prevent over-cooling (operator action = 2)
Secondary Heat Removal (AFW/FW)	1/2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 ASD train) to 2/3 SG with the associated SG PORVs
Early Inventory, High Pressure Injection (EIHP)	1/2 NV trains injecting into 3/4 Loops and 1/2 NI trains injecting to 4/4 loops (1 multi-train system) [(2)]
Terminate the HPI as necessary (STEIHP)	The operator terminates the HPI to prevent primary to go solid and allow depressurization (operator action = 1) [(3)]
Primary Heat Removal, Feed/Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) [(4)]
High Pressure Recirculation (HPR)	1/2 NV trains or 1/2 NI trains taking suction from 1/2 LPSI (RHR) trains (operator action = 3) [(5)]

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 MSLB - MSIV4 - AFWI - SETEIHP (4)			
2 MSLB - MSIV4- AFW - HPR (6)			
3 MSLB - MSIV4 - AFW - FB (7)			
4 MSLB -MSIV4 -EIHP - AFWI (9)			

5 MSLB - MSIV4 - EIHP - AFW (10)			
6 MSLB - MSIV4 - MSIV3 (11)			

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 and ready for use.

Notes:

1. SLB inside containment will cause actuation of containment spray, and the affected SG can not be isolated. SLB outside containment FLB inside or outside containment is considered here. The blow down of one SG as long as the feed to it is terminated assume not to cause a severe over cooling transient (No PTS concern).
2. The success criteria for is for Feed and Bleed, even though some early cool down and depressurization is expected.
3. The human error probability (HEP) for termination HPI is generically assigned.
4. The human error probability (HEP) for FB in IPE is 1.0E-2.
5. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.11 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Loss of Nuclear SW (TRN) (1)

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:**
Cross Connection to the other unit (XCON)	Operator recovery of loss of RN by cross connection to other unit (operator action = 1) (2)
Safe Shutdown Facility (SSF)	One Diesel generator and the makeup pumps with associated support injecting to pump seals (operator action = 1) (3)
RCP Trip (RCPT)	Trip all RCPs (operator action = 2) (4)
Secondary Heat Removal (AFW)	1/1 TDAFW train (1 ASD train) to 2/4 SGs

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TRN - XCON - AFW (3)			
2 TRN - XCON -SSF (4)			
3 TRN - XCON - RCPT (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 and ready for use.

Notes:

1. The frequency of loss of RN is estimated to be 3E-3 per year. It results in reactor trip due to overheating of RCP motors. The TDAFW and the SSF systems will be the only available mitigating capabilities.

2. The recovery action failure probability for cross connection (first containment ventilation cooling water system (RV) and then RN) to other unit in less than 55 minutes is estimated to be 5.2E-2 per updated PSA . A credit of 1 is given in this SDP worksheet.

3. The IPE uses a human error probability of about 5E-2 for alignment of SSF which is considered here as a HEP credit of 1.

4. It is not clear if the RCPs will be tripped automatically or trip action would be manual. SDP currently is giving a credit of 2 for this top event.

Table 3.12 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Loss of CCW (TKC) [1]

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:**
Safe Shutdown Facility (SSF)	One Diesel generator and the makeup pumps with associated support injecting to pump seals (operator action = 1) [2]
RCP Trip (RCPT)	Trip all RCPs (operator action = 2) [3]
Secondary Heat Removal (AFW)	(1/2 MDAFW trains (1 multi-train system) or 1/1 TDAFW train (1 ASD train)) to 2 SG's

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TKC - AFW (2)			
2 TKC - SSF (3)			
3 TKC - RCPT (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 and ready for use.

Notes:

1. The frequency of loss of KC is estimated to be about 1E-2 per year. It results in reactor trip due to overheating of RCP motors. The AFW system unaffected, however Feed and Bleed are not credited due to loss of cooling to RHR heat exchanger which is needed for HPR. In the same manner RCP seal LOCA is assumed to lead to core damage since HPR would not be available.

2. The IPE uses a human error probability of about 5E-2 for alignment of SSF which is considered here as a HEP credit of 1.

3. It is not clear if the RCPs will be tripped automatically or trip action would be manual. SDP currently is giving a credit of 2 for this top event.

Table 3.13 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Loss of 4160 Essential Bus (T1E) (1)

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 to 2/4 SG (operator action = 1) (2)
Secondary Heat Removal (AFW)	1/1 MDAFW trains (1 train) or 1/1 TDAFW train (1 ASD train) to 2/4 SG
Early Inventory, High Pressure Injection (EIHP)	1/1 NV trains injecting into 3/4 Loops and 1/1 NI trains injecting to 4/4 loops (1 train system)
Primary Heat Removal, Feed/Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) (3)
High Pressure Recirculation (HPR)	(1/1 NV trains or 1/1 NI trains) taking suction from 1/1 LPSI (RHR) trains; operator action = 3 (4) but limited by hardware failure (1 train)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 T1E - PCS - AFW - HPR (4)			
2 T1E - PCS - AFW - EIHP (5)			
3 T1E - PCS - AFW - FB (6)			

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 and ready for use.

Notes:

General Note: This transient could cause loss of RN since the operating pump will be tripped. The initiator RN to some extent covers those scenarios.

1. This special initiator is loss of 4 KV essential bus (1ETA and 1ETB) each with a frequency of 8E-3 per year. The events are enveloped by loss of 1ETA . This special initiator will cause the loss of one train (operating train) of all system. It would also behave like transients with reduced mitigating capability. The transient event tree is used for this work sheet.

2. The HEP value in the IPE is 2.0E-1.

3. The human error probability (HEP) for FB in IPE is 1.0E-2.

4. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.14 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Loss of 125 V DC 1EVDD Bus (TIED) (1)

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:
Secondary Heat Removal (AFW)	1/2 MDAFW trains (1 multi-train system) or 1/1 TDAFW train (1 ASD train) to 3/4 SG
Early Inventory, High Pressure Injection (EIHP)(2)	1/1 NV trains injecting into 3/4 Loops and 1/1 NI trains injecting to 4/4 loops (1 train system)
Primary Heat Removal, Feed/Bleed (FB)	1/1 PORVs open for Feed and Bleed (operator action = 2)
High Pressure Recirculation (HPR)	(1/1 NV trains or 1/1 NI trains) taking suction from 1/1 LPSI (RHR) trains; operator action = 3 but limited by hardware failure (1 train)

Circle Affected Functions	Recovery of Failed Train	Remaining Mitigation Capability Rating for Each Affected Sequence	Sequence Color
1 T1ED - AFW - HPR (3)			
2 T1ED - AFW - EIHP (4)			
3 T1ED - AFW - FB (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 and ready for use.

Notes:

1. This special initiator is loss of vital I&C which is bounded by loss of bus 1EVDD with a frequency of 1.3E-2 per year per bus. This special initiator will cause the loss of Feed water (MSIV and Main Feedwater control valves will close) and loss of auto-actuation of one train (non-operating train) of all system. Loss of 1EVDD will impact two of the PORVs whereas 1EVDA would impact one PORV. Regradless, Feed and Bleed can be credited in both case since operation of one PORV would be sufficient. SRVs could open in response of primary over-pressurization but long term cooling is not viable. SRVs could fail to re-seat which in this case establishes a path for Feed and Bleed but it is not credited. The AFW pumps will be available but may require some minor manual actuation. The TPCS event tree was used for this initiator. This initiator contributes to 1.7% of CDF.

2. Even though manual control of the affected ECCS pumps could be credited, it is not done so here due to demanding operator actions involved. This manual action could be treated as a recovery action during the SDP evaluation.

Table 3.15 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Transients with Loss of Instrument Air [(1)] (TIA)

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:**
Secondary Heat Removal (AFW)	1/2 MDAFW trains or 1 TDAFW train to 2/4 SG (operator action = 2) [(2)]
Early Inventory, High Pressure Injection (EIHP)	1/2 NV trains injecting into 3/4 Loops and 1/2 NI trains injecting to 4/4 loops (1 multi-train system)
Primary Heat Removal, Feed/Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action = 2) [(3)]
High Pressure Recirculation (HPR)	(1/2 NV trains or 1/2 NI trains) taking suction from 1/2 LPSI (RHR) trains (operator action = 3) [(4)]

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TRANS - AFW - HPR (4)			
2 TRANS - AFW - EIHP (5)			
3 TRANS - AFW - FB (6)			

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 and ready for use.

Notes:

1. The frequency of loss of instrument air is estimated to be 3E-1per year. It causes loss of feed water and MSIV closure. It also makes SG-PORVs unavailable but the SG SRVs will be available for stable heat removal. Transient event tree is used for this worksheet.

2. Relieving steam through SG SRV could cause SG overfill. The operator action is for controlling flow to avoid SG overfill in this condition. A HEP credit of 2 is assigned for this action.

3. The human error probability (HEP) for FB in IPE is 1.0E-2.

4. The human error probability for switch over to recirculation is 3.2E-3.

Table 3.16 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Loop with Loss of one EDG (LEAC)(1)

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 open PORVs (SORV)	All demanded PORVs re-close (1 train)
Secondary Heat Removal (AFW)	1/1 MDAFW trains (1 train system) or 1/1 TDAFW train (1 ASD train) to 2/4 SG
Early Inventory, High Pressure Injection (EIHP)	1/1 NV trains (1 train system) to 3/4 loops
Primary Heat Removal, Feed/Bleed (FB)	1/3 PORVs open for Feed and Bleed (operator action)
High Pressure Recirculation (HPR)	(1/1 NV trains or 1/1 NI trains) taking suction from 1/1 LPSI (RHR) trains ;operator action = 3, but limited by hardware failure (1 train)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LEAC - AFW - HPR (3,10)			
2 LEAC - AFW -FB (4,11)			
3 LEAC - AFW -EIHP (5)			
4 LEAC - SORV - HPR (7)			
5 LEAC - SORV - EIHP (8, 12)			

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 and ready for use.

<u>Note:</u>

1. The LOOP frequency with loss of one EDG is assigned to ROW IV.

Table 3.17 SDP Worksheet for W. E. McGuire Nuclear Station, Units 1 and 2 — Interfacing Systems LOCA (ISLOCA)[1]

Estimated Frequency (Table 1 Row) __________	**Exposure Time** __________	**Table 1 Result (circle): A B C D E F G H**	
Safety Functions Needed:[2]	**Full Creditable Mitigation Capability for Each Safety Function:**		
Decay Heat Removal Suction Line	Isolated by two NC MOVs with power removed from the valves		
ND Cold leg Injection Lines	Isolated by two CVs		
Aux. Pressurizer Spray from ND System	Two CVs and one NC air operated Valve		
Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
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 and ready for use.			

Note:

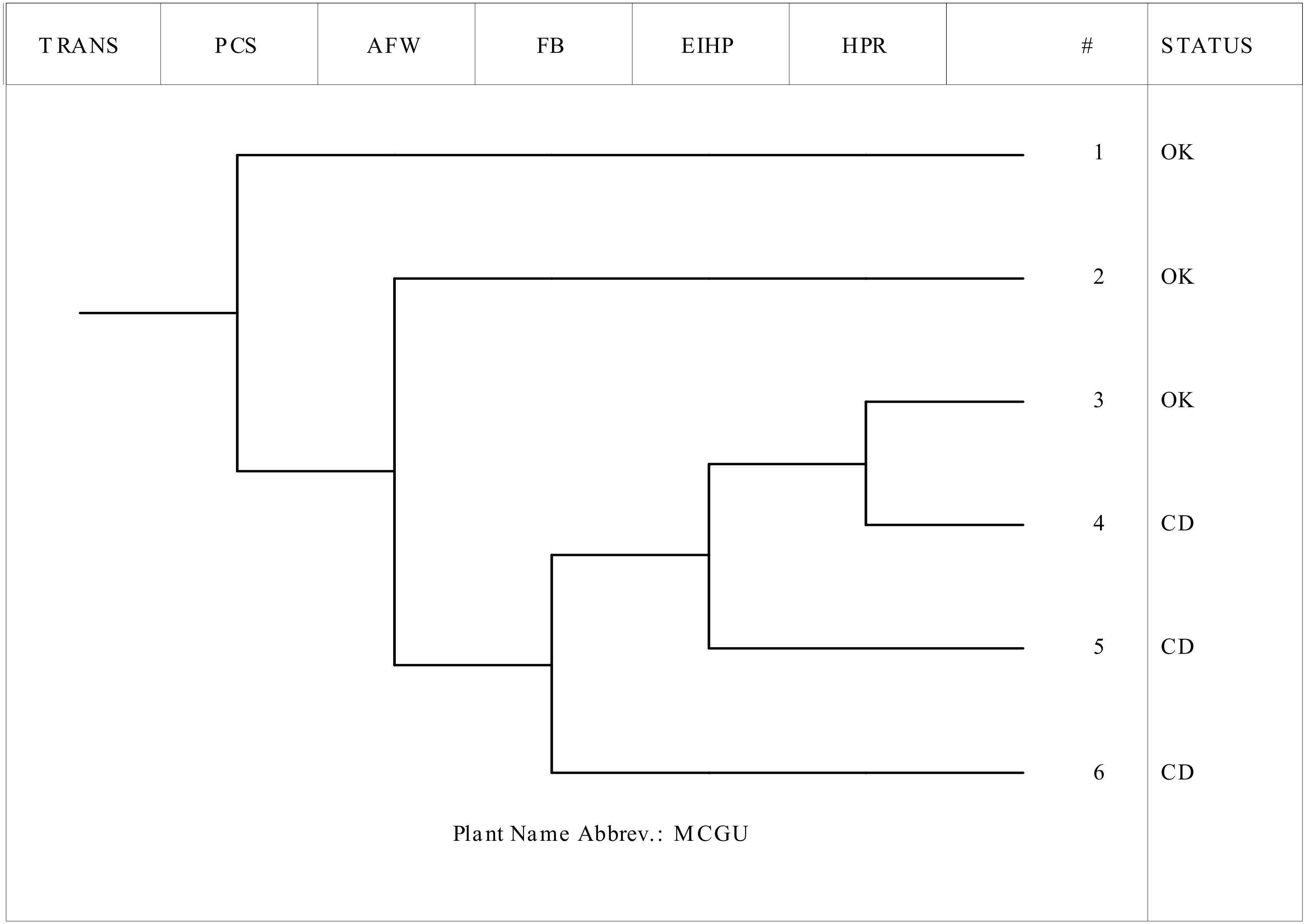
1. This worksheet is different from the other worksheets in that ISLOCA is typically an unmitigated initiating event in most PRAs. Therefore, the right side of the worksheet contains paths which may lead to an ISLOCA rather than mitigating systems to address an event in progress. As such, it is not intended to be referenced by the last column of Table 2, Initiators and System Dependency Table.

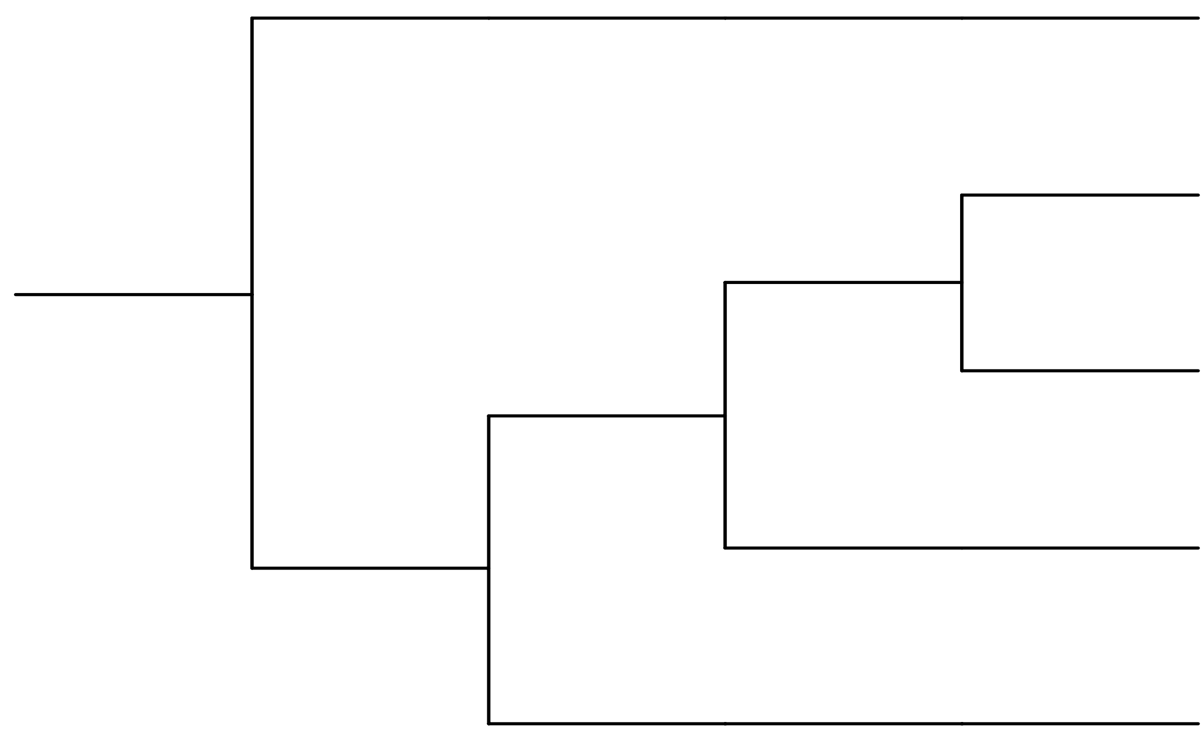
1.4 SDP EVENT TREES

This section provides the simplified event trees called SDP event trees used to define the accident sequences identified in the SDP worksheets in the previous section. An event tree for the stuck-open PORV is not included since it is similar to the small LOCA event tree. The event tree headings are defined in the corresponding SDP worksheets.

The following event trees are included:

1. Transients (Reactor Trip) (TRANS)
2. Transients without PCS (TPCS)
3. Small LOCA (SLOCA)
4. Medium LOCA (MLOCA)
5. Large LOCA (LLOCA)
6. Loss of Offsite Power (LOOP)
7. Steam Generator Tube Rupture (SGTR)
8. Anticipated Transients without Scram (ATWS)
9. Main Steam and Feed Line Break (MSLB/FLB)
10. Loss of Nuclear SW (TRN)
11. Loss of CCW (TKC)

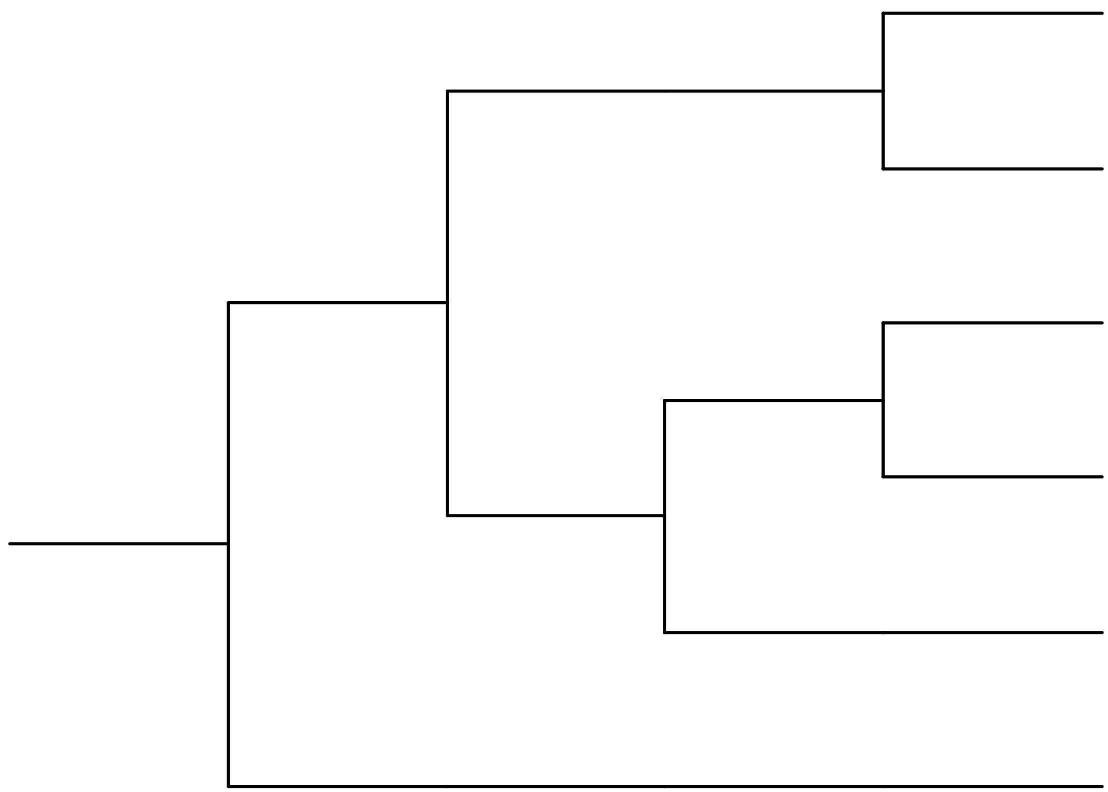

TRANS
PCS
AFW
FB
EIHP
HPR
#
STATUS
1
OK
2
OK
3
OK
4
CD
5
CD
6
CD
Plant Name Abbrev.: MCGU



TPCS	AFW	FB	EIHP	HPR		#	STATUS
						1	OK
						2	OK
						3	CD
						4	CD
						5	CD

Plant Name Abbrev.: MCGU

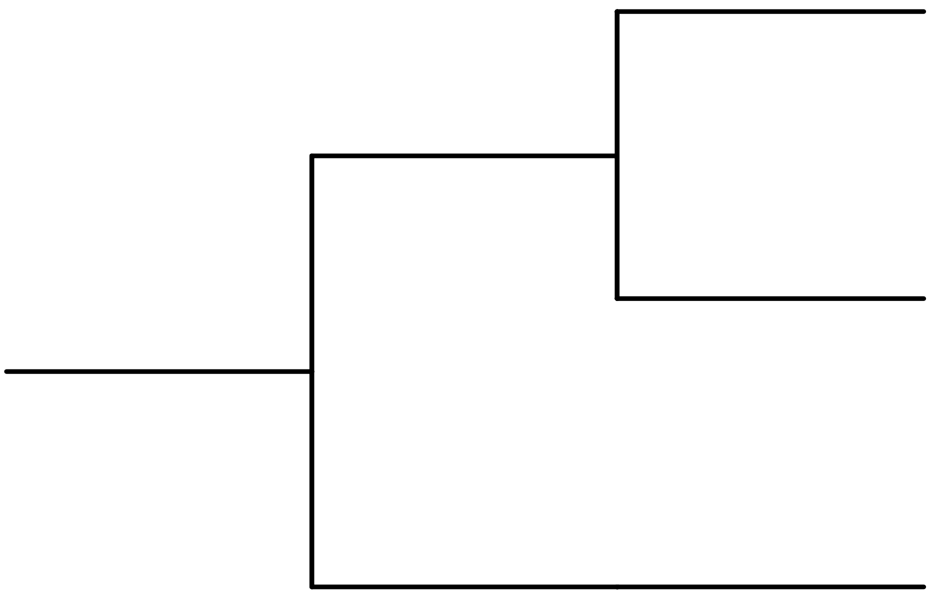
SLOCA	EIHP	AFW	FB	HPR	#	STATUS



#	STATUS
1	OK
2	CD
3	OK
4	CD
5	CD
6	CD

Plant Name Abbrev.: MCGU

MLOCA	EIHP	HPR	#	STATUS
			1	OK
			2	CD
			3	CD



Plant Name Abbrev.: MCGU

LLOCA	EIAC	EILP	LPR	#	STATUS
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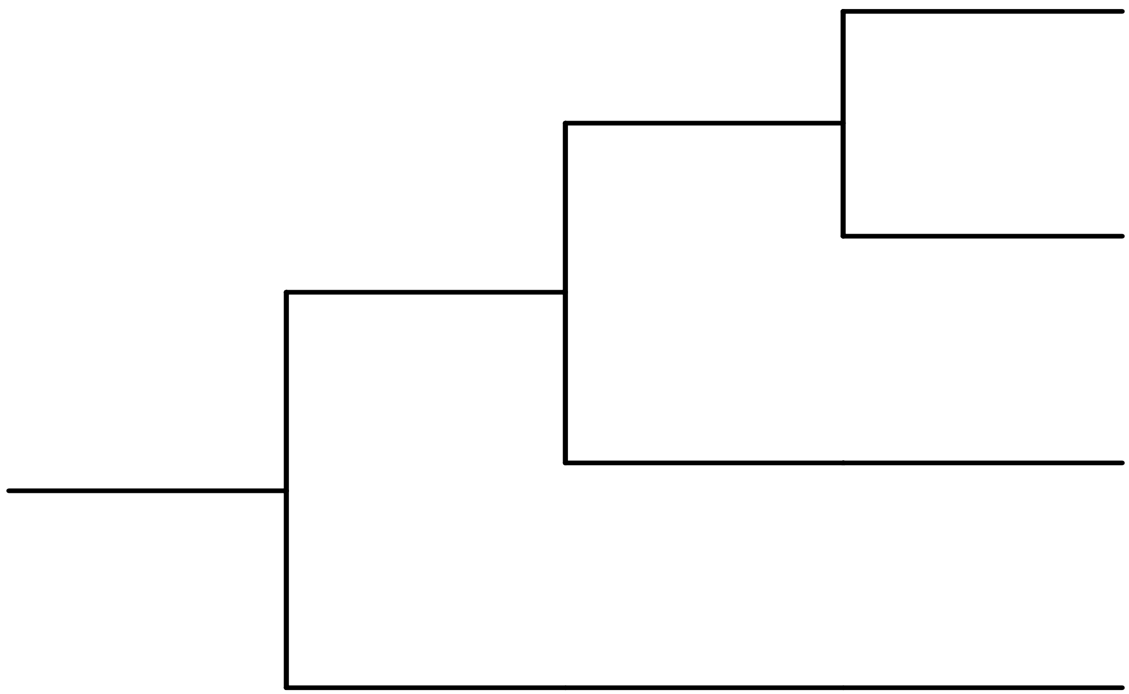
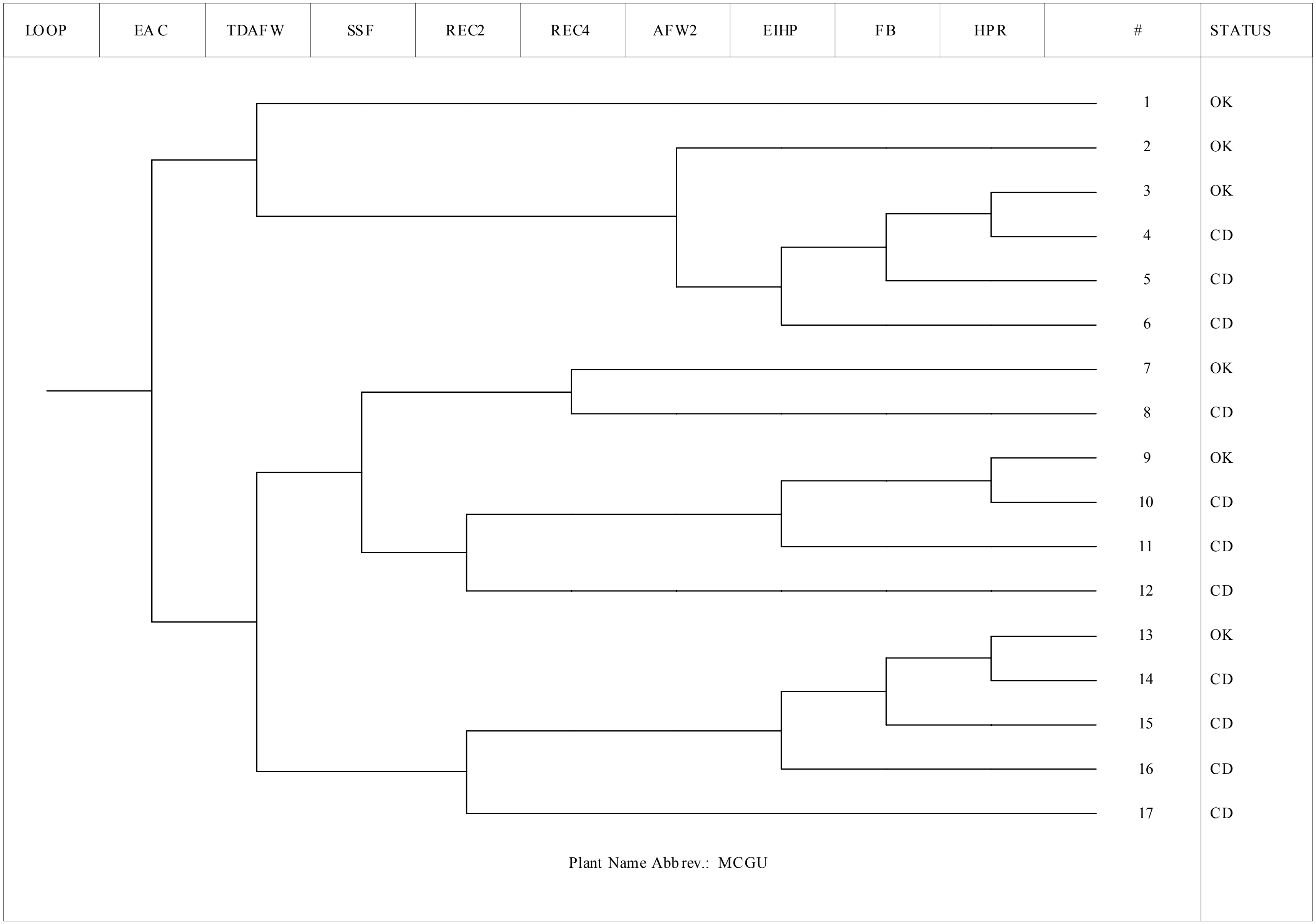
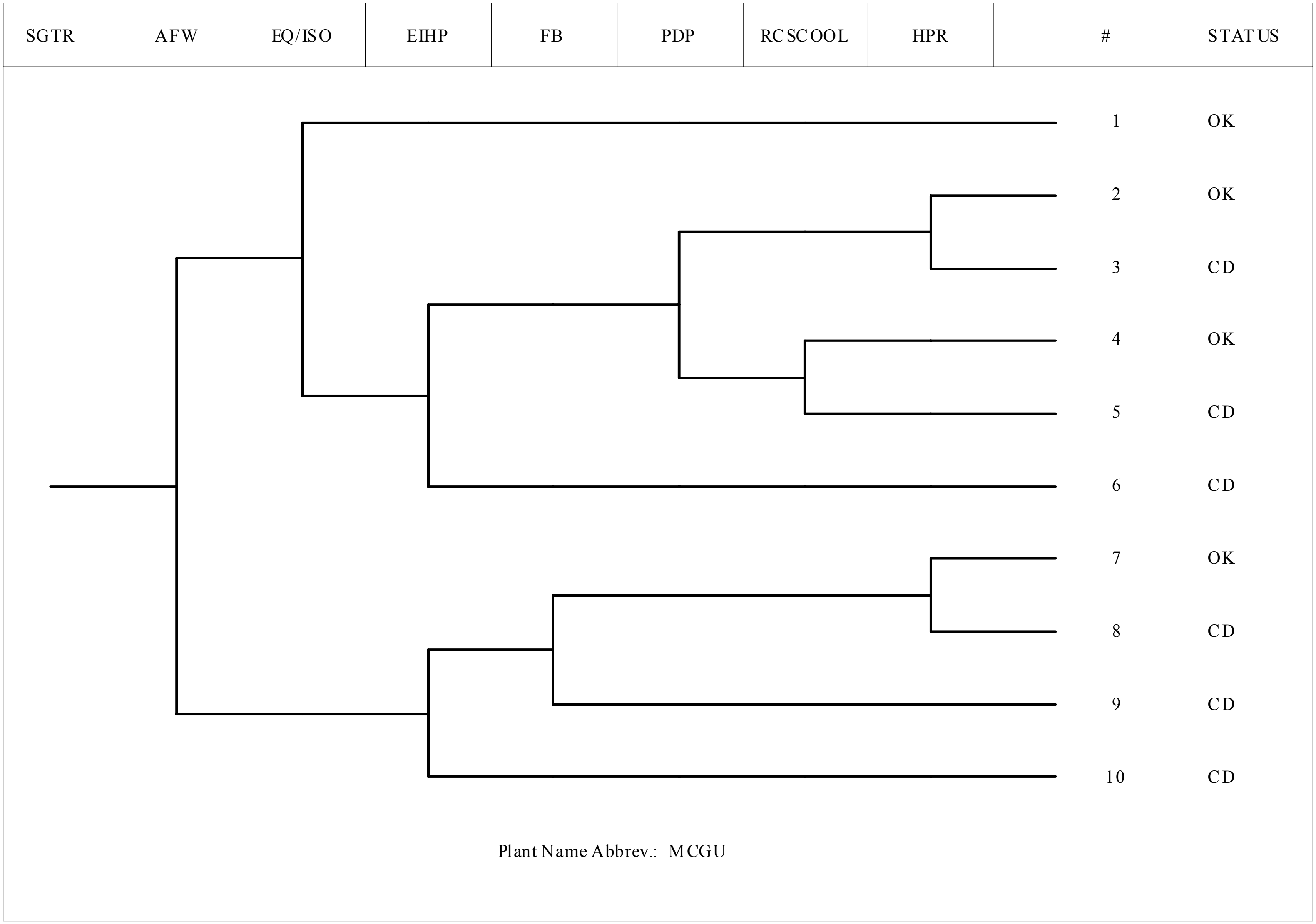
				2	CD
				3	CD
				4	CD



Plant Name Abbrev.: MCGU


LOOP
EAC
TDAFW
SSF
REC2
REC4
AFW2
EIHP
FB
HPR
#
STATUS
1 OK
2 OK
3 OK
4 CD
5 CD
6 CD
7 OK
8 CD
9 OK
10 CD
11 CD
12 CD
13 OK
14 CD
15 CD
16 CD
17 CD
Plant Name Abbrev.: MCGU


SGTR
AFW
EQ/ISO
EIHP
FB
PDP
RCSCOOL
HPR
#
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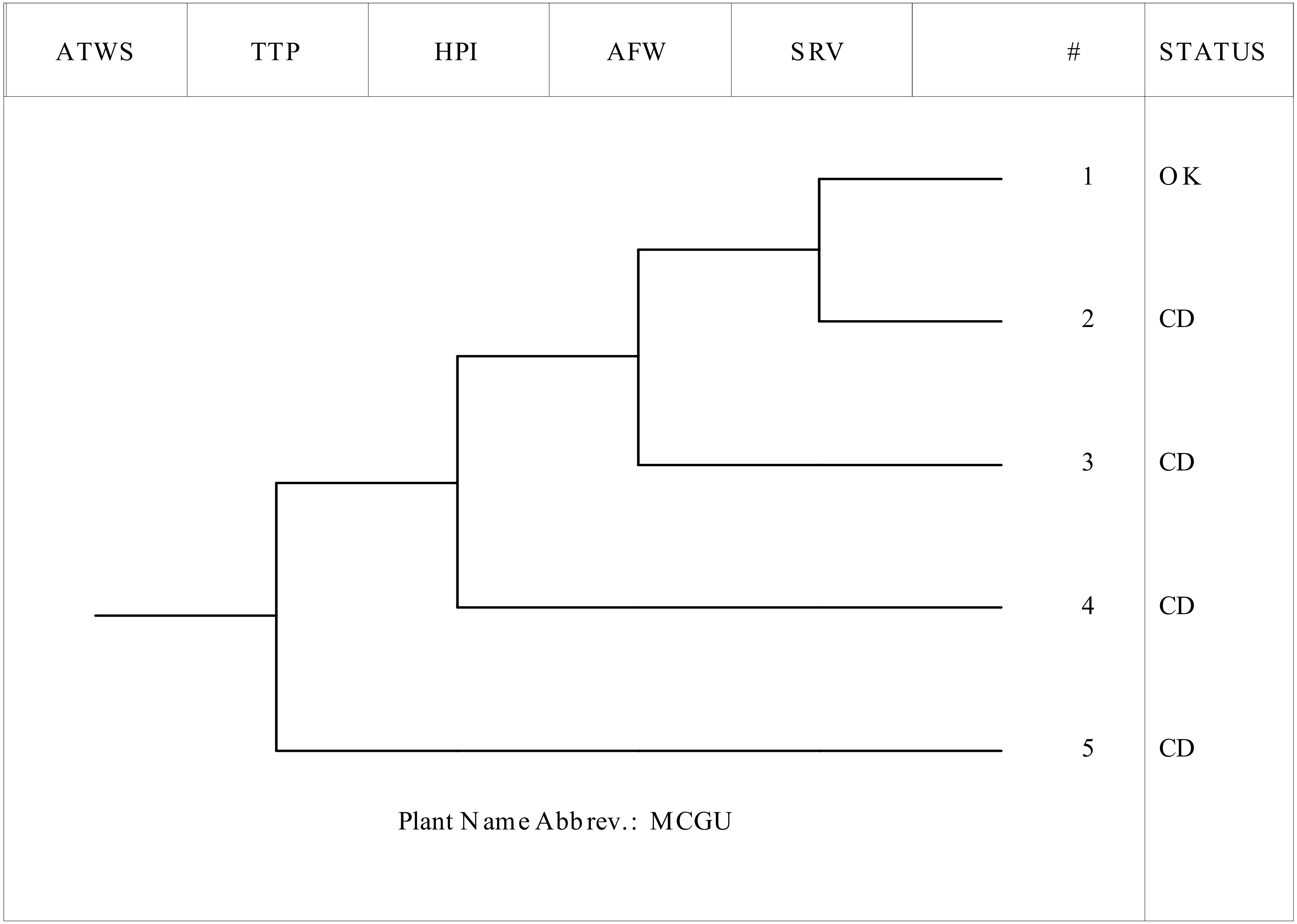
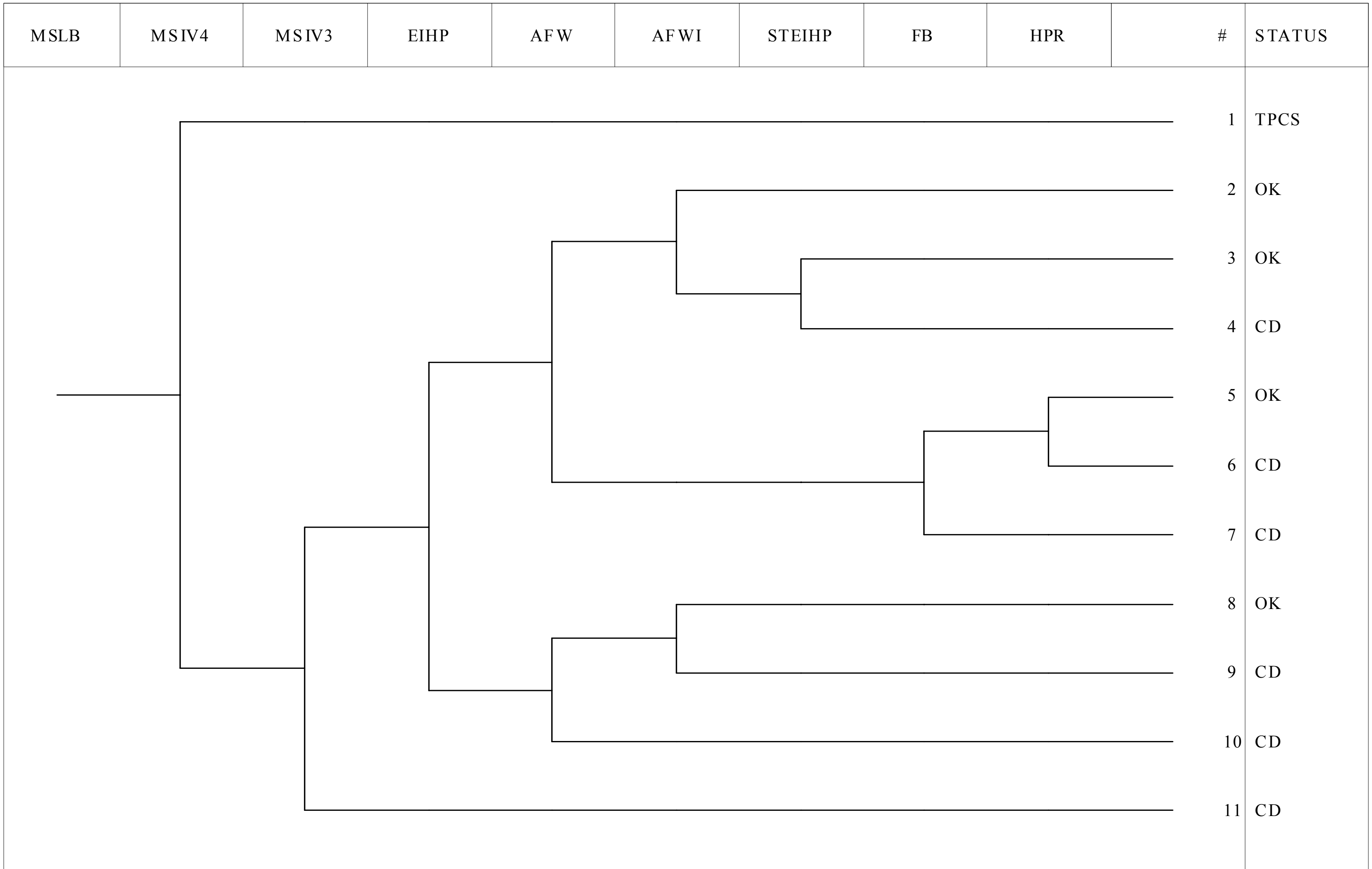
6 CD
7 OK
8 CD
9 CD
10 CD
Plant Name Abbrev.: MCGU


ATWS
TTP
HPI
AFW
SRV
#
STATUS
1
OK
2
CD
3
CD
4
CD
5
CD
Plant Name Abbrev.: MCGU



Plant Name Abbrev.: MCGU

TRN	XCON	RCPT	SSF	AFW	#	STATUS
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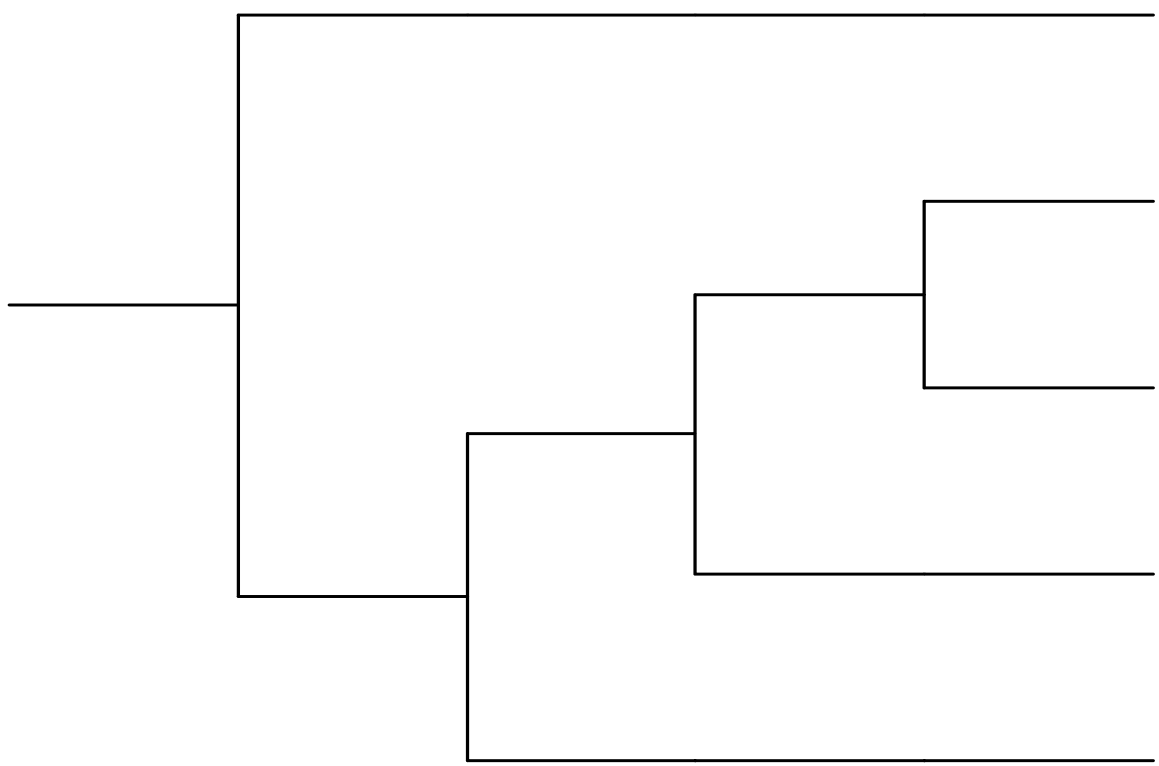
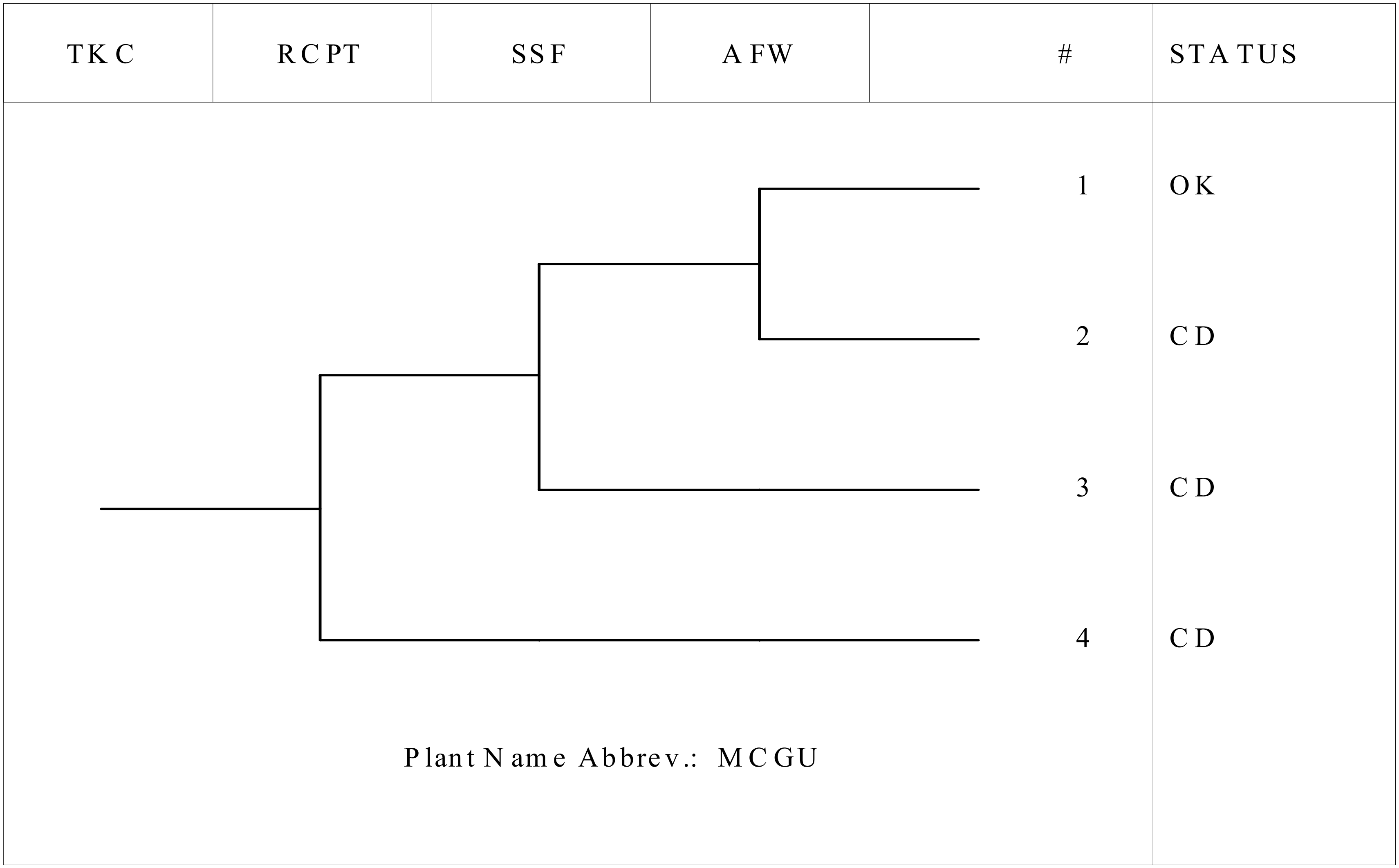
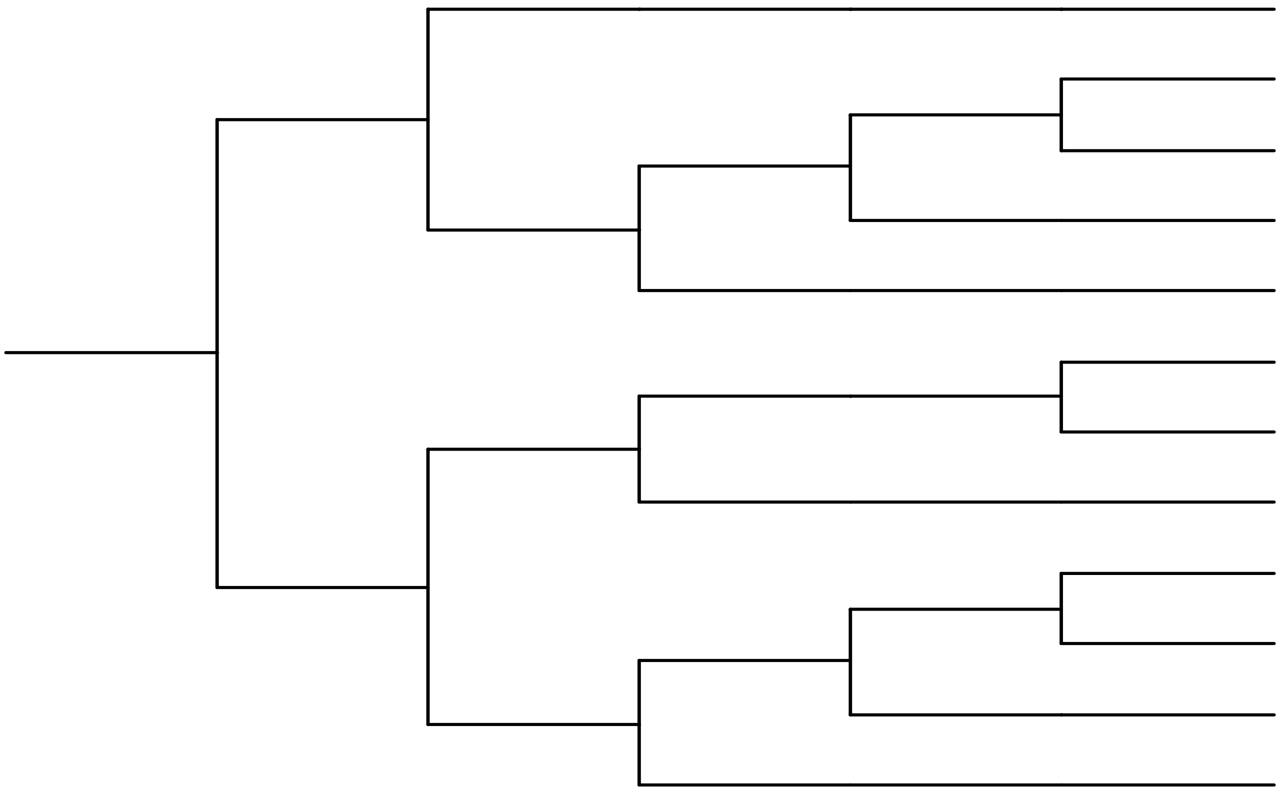
					2	OK
					3	CD
					4	CD
					5	CD



Plant Name Abbrev.: MCGU


TKC
RCPT
SSF
AFW
#
STATUS
1
OK
2
CD
3
CD
4
CD
Plant Name Abbrev.: MCGU

LEAC	SORV	AFW	EIHP	FB	HPR	#	STATUS



#	STATUS
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2	OK
3	CD
4	CD
5	CD
6	OK
7	CD
8	CD
9	OK
10	CD
11	CD
12	CD

Plant Name Abbrev.: MCGU

2. RESOLUTION AND DISPOSITION OF COMMENTS

This section is composed of two subsections. Subsection 2.1 summarizes the generic assumptions that were used for developing the SDP worksheets for the PWR plants. These guidelines were based on the plant-specific comments provided by the licensee on the draft SDP worksheets and further examination of the applicability of those comments to similar plants. These assumptions which are used as guidelines for developing the SDP worksheets help the reader better understand the worksheets' scope and limitations. The generic guidelines and assumptions for PWRs are given here. Subsection 2.2 documents the plant-specific comments received on the draft version of the material included in this notebook and their resolution.

2.1 GENERIC GUIDELINES AND ASSUMPTIONS (PWRs)

The following generic guidelines and assumptions were used in developing the SDP worksheets for PWRs. These guidelines and assumptions were derived from a review of the licensee's comments, the resolutions of those comments, and the applicability to similar plants.

1. Assignment of plant-specific IEs into frequency rows:

Transient (Reactor trip) (TRANS), transients without PCS (TPCS), small, medium, and large LOCA (SLOCA, MLOCA, LLOCA), inadvertent or stuck-open PORV/SRV (SORV), main steam and feedwater line break (MSLB), anticipated transients without scram (ATWS), and interfacing system LOCAs (ISLOCA) are assigned into rows based on a consideration of the industry-average frequency. Plant-specific frequencies are considered for loss of offsite power (LOOP) and special initiators, and are assigned to the appropriate rows in Table 1.

2. Stuck open PORV/SRV as an IE in PWRs:

This event typically is not modeled in PRAs/IPEs as an initiating event. The failure of the PORVs/SRVs to re-close after opening is typically modeled within the transient event trees subsequent to the initiators. In addition, the intermittent failure or excessive leakage through PORVs as an initiator, albeit with much lower frequency, needed to be considered. To account for such failures and to keep the transient worksheets simple in the SDP, a separate worksheet for the SORV initiator was set up to explicitly model the contribution from such failures. This SDP worksheet, and the associated event tree, is similar to that of SLOCA. The frequency of PORV to re-close depends on the status of pressurizer. If the pressurizer is solid, then the frequency would be higher than the case in which the pressurizer level is maintained. Typically, this depends on early availability of secondary heat removal. However, the frequency for the SORV initiator is generically estimated for all PWR plants in Table 1.

3. Inclusion of special initiators:

The special initiators included in the worksheets are those applicable to this plant. A separate worksheet is included for each of them. The applicable special initiators are primarily based on the plant-specific IPEs/PRAs. In other words, the special initiators included are those modeled in the IPEs/PRAs unless shown to be negligible contributors. In some cases, a particular special initiator may be added for a plant even if it is not included in the IPE/PRA, if it is included in other plants of similar design, and is considered applicable for the plant. However, no attempt is made at this time to have a consistent set of special initiators across similarly designed plants. Except for the interfacing system LOCA (ISLOCA), if the occurrence of the special initiator results in a core damage, i.e., no mitigation capability exists for the initiating event, then a separate worksheet is not developed. For such cases, the inspection's focus is on the initiating event and the risk implication of the finding can be directly assessed. For ISLOCA, a separate worksheet is included noting the pathways that can lead to it.

4. Inclusion of systems under the support system column of the Initiators and System Dependency Table:

This Table shows the support systems for the support- and frontline systems. The intent is to include only the support systems, and not the systems supporting that support system, i.e., those systems whose failure will result in failure of the system being supported. Partial dependency, e.g., a backup system, is not included. If they are, this should be so noted. Sometimes, some subsystems on which inspection findings may be noted were included as a support system, e.g., the EDG fuel oil transfer pump as a support system for EDGs.

5. Coverage of system/components and functions included in the SDP worksheets:

The Initiators and System Dependency Table includes systems and components which are included in the SDP worksheets and those which can affect the performance of these systems and components. One-to-one matching of the event tree headings/functions to that included in the Table was not considered necessary.

6. Crediting of non-safety related equipment:

SDP worksheets credit or include safety-related equipment and also, non-safety related equipment, as used, in defining the accident sequences leading to core damage. In defining the success criteria for the functions needed, the components included are those covered under the Technical Specifications (TS) and the Maintenance Rule (MR). Credits for other components may have been removed in the SDP worksheets.

7. No credit for certain plant-specific mitigation capability:

The significance determination process (SDP) screens inspection findings for Phase 3 evaluations. Some conservative assumptions are made which result in not crediting some plant-specific features. Such assumptions are usually based on comparisons with plants of similar design, and they help to maintain consistency across the SDP worksheets for similar plant designs.

8. Crediting system trains with high unavailability:

Some system component/trains may have unavailability higher than 1E-2, but they are treated similarly to other trains with lower unavailability in the range of 1E-2. In this screening, this approach is considered adequate to keep the process simple. An exception is made for steam-driven components which are designated as Automatic Steam Driven (ASD) train with a credit of 1E-1.

9. Treating passive components (of high reliability) the same as active components:

Passive components, namely accumulators, are credited similarly to active components, even though they exhibit higher reliability. Considering the potential for common-cause failures, the reliability of a passive system is not expected to differ by more than an order of magnitude from active systems. Pipe failures were excluded, except as part of initiating events where the appropriate frequency is used. Accordingly, a separate designation for passive components was not considered necessary.

10. Crediting accumulators:

SDP worksheets assume the loss of the accumulator unit associated with the failed leg in LOCA scenarios. Accordingly, in defining the mitigation capability for the accumulators, the worksheets refer to the remaining accumulators. For example, in a plant with 4 accumulators with a success criteria of 1 out of 4, for large LOCA the mitigation capability is defined as 1/3 remaining accumulators (1 multi-train system), assuming the loss of the accumulator in the failed leg. For a plant with a success criteria of 2 out of 4 accumulators, the mitigation capability is defined as 2/3 remaining accumulators (1 multi-train system).

The inspection findings are then assessed as follows (using the example of the plant with 4 accumulators and success criteria of 2 out of 4):

4 Acc. Available	Credit=3
3 Acc. Available (1 Acc. is considered unavailable, based on inspection findings)	Credit=2
< 3 Acc. Available (2 or more Acc. are considered unavailable, Based on inspection findings)	Credit=0

11. Crediting operator actions:

The operator's actions modeled in the worksheets are categorized as follows: operator action=1 representing an error probability of 5E-2 to 0.5; operator action=2 representing an error probability of 5E-3 to 5E-2; operator action=3 representing an error probability of 5E-4 to 5E-3; and operator action=4 representing an error probability of 5E-5 to 5E-4. Actions with error probability > 0.5 are not credited. Thus, operator actions are associated with credits of 1, 2, 3, or 4. Since there is large variability in similar actions among different plants, a survey of the error probability across plants of similar design was used to categorize different operator actions. From this survey, similar actions across plants of similar design are assigned the same credit. If a plant uses a lower credit or recommends a lower credit for a particular action compared to our assessment of similar action based on plant survey, then the lower credit is assigned. An operator's action with a credit of 4, i.e., operator action=4, is noted at the bottom of the worksheet; the corresponding hardware failure, e.g., 1 multi-train system, is defined in the mitigating function.

12. Difference between plant-specific values and SDP designated credits for operator actions:

As noted, operator actions are assigned to a particular category based on a review of similar actions for plants with similar design. This results in some differences between plant-specific values and credit for the action in the worksheet. The plant-specific values are usually noted at the bottom of the worksheet.

13. Dependency among multiple operator actions:

IPEs or PRAs, in general, account for dependencies among the multiple operator actions that may be applicable. In the SDP screening approach, if multiple actions are involved in one function, then the credit for the function is designated as one operator action to the extent possible, considering the dependency involved.

14. Crediting the standby high-pressure pump:

The high-pressure injection system in some plants consists of three pumps with two of them auto-aligned and the third spare pump requiring manual action. The mitigating capability then is defined as : 1/2 HPI trains or use of a spare pump (1 multi-train system). Also, a footnote is added to reflect that the use of a spare pump could be given a credit of 1 (i.e.,1E-1) as a recovery action.

15. Emergency AC Power:

The full mitigating capability for emergency AC could include dedicated Emergency Diesel Generators (EDG), Swing EDG, SBO EDG, and finally, nearby fossil-power plants. The following guidelines are used in the SDP modeling of the Emergency AC power capability:

a) Describe the success criteria and the mitigation capability of dedicated EDGs.

b) Assign a mitigating capability of “operator action=1" for a swing EDG. The SDP worksheet assumes that the swing EDG is aligned to the other unit at the time of the LOOP (in a sense a dual unit LOOP is assumed). The operator, therefore, should trip, transfer, re-start, and load the swing EDG.

c) Assign a mitigating capability of “operator action=1" for an SBO EDG similar to the swing EDG. Note, some of the PWRs do not take credit for an SBO EDG for non-fire initiators. In these cases, credit is not given.

d) Do not credit the nearby power station as a backup to EDGs. The offsite power source from such a station could also be affected by the underlying cause for the LOOP. As an example, overhead cables connecting the station to the nuclear power plant also could have been damaged due to the bad weather which caused the LOOP. This level of detail should be left for a Phase 3 analysis.

16. Treatment of HPR and LPR:

The operation of both the HPR and LPR rely on the operation of the RHR pumps and the associated heat exchangers. Therefore, failure of LPR could imply failure of both HPR and LPR.

A sequence which contains failure of both HPR and LPR as independent events will significantly underestimate the CDF contribution. To properly model this configuration within the SDP worksheets, the following procedure is used. Consider the successful depressurization and use of LPR as the preferred path. HPR is credited when depressurization has failed. In this manner, a sequence containing both HPR and LPR failures together is not generated.

17. SGTR event tree:

Event trees for SGTR vary from plant to plant depending on the size of primary-to-secondary leak, SG relief capacity, and the rate of rapid depressurization. However, there are several common functional steps that are addressed in the SDP worksheet: early isolation of the affected SG, initiation of primary cool-down and depressurization, and prevention of the SG overfill. These actions also include failure to maintain the secondary pressure below that of Main Steam safety valves which could occur either due to the failure of the relief valves to open or the operator's failure to follow the procedure. Failure to perform this task (sometimes referred to as early isolation and equalization) is assumed to cause continuous leakage of primary outside the containment. The success of this step implies the need for high-pressure makeup for a short period, followed by depressurization and cooldown for RHR entry (note, relief valves are assumed to re-close when primary pressure falls below that of the secondary). If the early makeup is not available or the operator fails to perform early isolation and equalization, rapid depressurization to RHR entry is usually assumed. This would typically require some kind of intermediate- or low-pressure makeup. Finally, depending on the size of the Refueling Water Storage Tank (RWST), sometimes it would be necessary to establish makeup to the RWST to allow sufficient time to enter the RHR mode.

18. ATWS scenarios:

The ATWS SDP worksheet assumes that these scenarios are not recoverable by operator actions, such as a manual trip. The failure of the scram system, therefore, is not recoverable, neither by the actuation of a back-up system nor through the actuation of manual scram. The initiator frequency, therefore, should only account for non-recoverable scrams, such as mechanical failure of the scram rods.

19. Recovery of losses of offsite power:

Recovery of losses of offsite power is assigned an operator-action category even though it is usually dominated by a recovery of offsite AC, independent of plant activities. Furthermore, the probability of recovery of offsite power in "X" hours (for example 4 hours) given it is not recovered earlier (for example, in the 1st hour) would be different from recovery in 4 hours with no condition. The SDP worksheet uses a simplified approach for treating recovery of AC by denoting it as an operator action=1 or 2 depending upon the HEP used in the IPE/PRA. A footnote highlighting the actual value used in the IPE/PRA is provided, when available.

20. RCP seal LOCA in a SBO:
The RCP seal LOCA in a SBO scenario is included in the LOOP worksheet. RCP seal LOCA resulting from loss of support functions is considered only if the loss of support function is a special

initiator. The dependencies of RCP seal cooling are identified in Table 2.

21. RCP Seal LOCA for Westinghouse Plants during SBO Scenarios:

The modeling of the RCP seal failures upon loss of cooling and injection as occurs during SBO scenarios has been the subject of many studies (e.g., BNL Technical report W6211-08/99 and NUREG/CR-4906P). These studies are quite complex and assign probabilities of seal failure as a function of time (duration of SBO) and the associated leak rates. The leak rates, in turn, will determine what would be the safe period for recovery of the AC source and the use of SI pumps before core uncovery and damage. On the contrary, the SDP worksheets simplify the analysis of the RCP seal LOCA during the SBO scenarios using the following two assumptions: (1) The probability of catastrophic RCP seal failure is assumed to be 1 if the SBO lasts beyond two hours, and (2) Given a catastrophic seal LOCA, the available time prior to core damage for recovery of offsite power and establishing injection is about two hours. Therefore, in almost all cases, to prevent a core damage, a source of AC should be recovered within 4 hours in SBO scenarios.

22. Tripping the RCP on loss of CCW:

Upon loss of CCW, the motor cooling will be lost. The operation of RCPs without motor cooling could result in overheating and failure of bearings. Bearing failure, in turn, could cause the shaft to vibrate and thereby result in the potential for seal failure if the RCP is not tripped. In Westinghouse plants, the operator is instructed to trip the RCPs early in the scenario (from 2 to 10 minutes after detecting the loss of cooling). Failure to perform this action is conservatively assumed to result in seal failure and, potentially in a LOCA. This failure mechanism (occurrence of seal LOCA) due to failure to trip the RCPs upon loss of cooling is not considered likely in some plants, whereas it has been modeled explicitly in other plants. To ensure consistency, the trip of the RCP pumps are modeled in the SDP worksheets, and the operator failure to do this is assumed to result in a LOCA. In many cases, the failure to trip RCP following a loss of CCW results in core damage.

23. Hot leg/Cold leg switchover:

The hot leg to cold leg switchover during ECCS recirculation is typically done to avoid boron precipitation. This is typically part of the procedure for PWRs during medium and large LOCA scenarios. Some IPEs/PRAs do not consider the failure of this action as relevant to core damage. For plants needing the hot /cold switchover, it usually can only be accomplished with SI pumps and the ECCS recirculation also uses the SI pumps.

2.2 RESOLUTION OF PLANT-SPECIFIC COMMENTS

The Licensee provided useful comments on the draft worksheets (Dated November 30,1999). The draft worksheet did not include the special initiators. The licensee review comments therefore were limited to the information contained in the original draft worksheet. To supplement the licensee comments additional information were requested via an email during the month of June 2001 prior to finalizing this notebook. The licensee comments were reviewed and incorporated into the SDP worksheet to the extent possible within the framework, scope, and limitations of the SDP worksheets. The licensee's comment and feed back have significantly contributed to the improvement of this document.

1) Licensee's comments on the Initiator and System Dependency Tables reflecting the up to date plant specific system interactions, clarification notes, and plant specific acronyms were all incorporated.

2) Licensee's comments reflecting the current understanding of success criteria were all incorporated in the SDP sheets.

3) Licensee also provided comments by annotating the draft Rev0 of the SDP notebook. These comments were also incorporated.

4) The licensee provided modified event trees and worksheet consistent with their current model. The SDP worksheets are developed consistent with these models however formatted somewhat differently to reflect generic SDP guidelines.

5) Minor deviations from the licensee's comments to ensure the specific SDP format and guidelines have been footnoted in the worksheet.

REFERENCES

1. NRC SECY-99-007A, Recommendations for Reactor Oversight Process Improvements (Follow-up to SECY-99-007), March 22, 1999.

2. Duke Power Company, "W. E. McGuire Nuclear Station, Units 1 and 2 – Individual Plant Examination Report," November, 1991.