July 3, 2001

Mr. John H. Mueller
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Nine Mile Point Nuclear Station
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Lycoming, NY 13093

SUBJECT: NINE MILE POINT NUCLEAR STATION, UNIT NO. 2 - SITE-SPECIFIC WORKSHEETS FOR USE IN THE NUCLEAR REGULATORY COMMISSION'S SIGNIFICANCE DETERMINATION PROCESS (TAC NO. MA6544)

Dear Mr. Mueller:

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 on March 15, 2000. 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. We encourage your further comments where it is identified that the Worksheets give inaccurately low significance determinations. Any comments should be provided to the NRC Document Control Desk, with a copy to the Chief, Probabilistic Safety Assessment Branch, Office of 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/

Peter S. Tam, Senior Project Manager, Section 1
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-410

Enclosure: As stated

cc w/o encl: See next page

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RISK-INFORMED INSPECTION NOTEBOOK FOR

NINE MILE POINT NUCLEAR STATION

UNIT 2

BWR-5, GE, WITH MARK II CONTAINMENT

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NOTICE

This notebook was developed for the NRC's inspection teams to support risk-informed inspections. The "Reactor Oversight Process Improvement," SECY-99-007A, March 1999 discusses the activities involved in these inspections. 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. It 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 Nine Mile Point Nuclear Station, Unit 2.

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 SIGNIFICANCE DETERMINATION PROCESS (SDP)

SECY-99-007A (NRC, March 1999) describes the process for making a Phase-2 evaluation of the inspection findings. In Phase 2, the first step 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 Events Categories
2. Initiator and System Dependency Table
3. Significance Determination Process (SDP) Worksheets
4. SDP Event Trees.

Table 1, Categories of Initiating Events, is used to obtain the estimated likelihood rating for applicable initiating events for the plant for different exposures times for degraded conditions. This Table follows the format of the Table 1 contained in SECY-99-007A. Initiating events are grouped in frequency bins covering one order of magnitude. The table includes the initiating events that should be considered for the plant and for which SDP worksheets are provided. Categorization of the following initiating events is based on 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); anticipated transients without scram (ATWS); interfacing systems LOCA (ISLOCA) and LOCA outside containment (LOC). The frequency of the remaining initiating events vary significantly from plant to plant, and accordingly, they are categorized using the plant-specific frequency obtained from the licensee. These initiating events include loss of offsite power (LOOP) and special initiators caused by loss of support systems.

The Initiator 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 shown in Probabilistic Risk Assessments (PRAs). This table is used to identify the SDP worksheets to be evaluated, corresponding to inspection findings on systems and components.

To evaluate the impact of an inspection finding on the core-damage scenarios, we developed the SDP worksheets. They contain two parts. The first part identifies the functions, the systems, and the combinations thereof that can perform mitigating functions, the number of trains in each system, and the number of trains required (success criteria) for each 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 parentheses next to each of the sequences the corresponding event tree branch number(s) representing the sequence is included. Multiple branch numbers indicate that the different accident sequences identified by the event tree are merged into one through the Boolean reduction.

SDP worksheets are developed for each initiating event, including "Special Initiators," which are typically caused by complete or partial loss of support systems. A special initiator typically leads to a reactor scram and degrades some front-line or support systems (e.g., Loss of Service water in BWRs). The SDP worksheets for initiating events that directly lead to core damage are different. Of this type of initiating events, only the interfacing system LOCA (ISLOCA) and LOCA outside containment (LOC) are included. This worksheet identifies the major consequential leak paths and the number of barriers that may fail to cause the initiator to occur.

For the special initiators, we considered those plant-specific initiators whose contribution to the plant's core damage frequency (CDF) is non-negligible and/or have the potential to be a significant contributor to CDF given an inspection finding on system trains and components. We defined a set of criteria for their inclusion 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 changing its mitigation capability in the worksheet. For example, a safety function with two redundant trains, classified as a multi-train system, degrades to an one-train system, to be 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 accident sequences associated with the initiator from comparable transient sequences by two and higher orders of magnitude, must be considered.

Following the above considerations, the classes of initiators that we consider in this notebook are:

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. Inadvertent or Stuck-open Power Operated Relief Valve (IORV or SORV),
5. Medium LOCA (MLOCA),
6. Large LOCA (LLOCA),
7. Loss of Offsite Power (LOOP)
8. Anticipated Transients Without Scram (ATWS).

Section 1.3 lists the plant-specific special initiators addressed in this notebook. Examples of special initiators are as follows:

1. LOOP with failure of 1 Emergency AC (LEAC) bus or associated EDG (LEAC),
2. LOOP with stuck open SORV (LORV),

3. Loss of 1 DC Bus (LDC),
4. Loss of component cooling water (LCCW),
5. Loss of instrument air (LOIA),
6. Loss of service water (LSW).

The worksheet for the LOOP may include 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. LOOP with stuck open SORV is also covered in a separate worksheet, when applicable. In some plants, LOOP with failure of 1 EAC bus and LOOP with stuck-open SORV are large contributors to the plant's core damage frequency (CDF).

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.

We considered the following items in establishing the SDP event trees and the core-damage sequences in the SDP worksheets; Section 2.1 gives additional guidelines and assumptions.

1. Event trees and sequences were developed such that the worksheet contains all the major accident sequences identified by the plant-specific IPEs or 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 took into account the IPE/PRA models and event trees for all similar plants. Any major deviations in one plant from similar plants typically are 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 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 often are represented by a single tree. For example, some IPEs define four or more classes of LOCAs rather than the three classes considered here. The sizes of LOCAs for which high-pressure injection is not required are some times divided into two classes; the only difference between them being the need for reactor scram in the smaller break size. Some consolidation of transient event tree may also be done 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 the Categories of Initiating Events Table, Initiators and System Dependency Table, SDP Worksheets, and the SDP Event Trees for the Nine Mile Point Nuclear Station, Unit 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 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, as per SECY-99-007A.

Table 1 Categories of Initiating Events for Nine Mile Point Nuclear Station, Unit 2

Row	Approximate Frequency	Example Event Type	Estimated Likelihood Rating		
I	> 1 per 1-10 yr	Reactor Trip, Loss of Power Conversion System (Loss of condenser, Closure of MSIVs, Loss of feedwater), Loss of Instrument Air (LOIA)	**A**	**B**	**C**
II	1 per 10-10^2 yr	Loss of offsite power, Inadvertent or stuck open SRVs, Loss of RBCLC	**B**	**C**	**D**
III	1 per 10^2 - 10^3 yr	Loss of Div. I or Div. II 4160 VAC bus, Loss of DC Div. I or II	**C**	**D**	**E**
IV	1 per 10^3 - 10^4 yr	Small LOCA (RCS rupture), Medium LOCA (RCS rupture),	**D**	**E**	**F**
V	1 per 10^4 - 10^5 yr	Large LOCA (RCS rupture), ATWS	**E**	**F**	**G**
VI	less than 1 per 10^5 yr	ISLOCA, Vessel rupture	**F**	**G**	**H**
			> 30 days	**3-30 days**	**< 3 days**
			Exposure Time for Degraded Condition		

Notes:

1. The SDP worksheets for ATWS core damage sequences assume that the ATWS is not recoverable by manual actuation of the reactor trip function or by ARI (for BWRs). 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).

2. The LOIA IEF is 0.14 events per reactor-year and the contribution to total CDF (internal and external events) is 8%.

3. The Loss of the Div. I or Div. II 4160 VAC bus IEF is 6 E-3 events per reactor-year and the contribution to total CDF (internal and external events) is 6% for Div. II and 1% for Div. I.

4. The Loss of RBCLC IEF is 6.7 E-2 E-3 events per reactor-year and the contribution to total CDF (internal and external events) is4%.
5. The Loss of Div. I or II 125 VDC IEF is 2.6 E-3 events per reactor-year and the contribution to total CDF (internal and external events) is 1%. A manual scram results, but HPI and LPI are still available.

6. The plant specific IEF for LOOP used in the NMP-2 PRA is 0.11 events per reactor-year.

1.2 INITIATORS AND SYSTEM DEPENDENCY

Table 2 provides the list of the systems included in the SDP worksheets, the major components in the systems, and the support system dependencies. The system involvement in different initiating events are noted in the last column.

Table 2 Initiators and System Dependency for Nine Mile Point Nuclear Station, Unit 2

Affected System		Major Components	Support Systems	Initiating Event Scenarios
Code	Name			
PCS	Power Conversion System	9 MDP, MOV	AC, DC, TBCLC, IA, CST	TRANS, SLOCA, MLOCA, IORV/SORV, LOACI, LOACII, LODCI, LODCII
HPCS	High Pressure Core Spray	1 MDP, MOV, D/G	AC, DC, act, SW, Ventilation	All
RCIC	Reactor Core Isolation Cooling	1 TDP, MOV	DC (Div. i), 120 VAC, act, SW, Ventilation	All but LLOCA, MLOCA, & LODCI
ADS/SRVs	Automatic Depressurization System/Safety Relief Valves	18 SRVs (7 ADS valves), AOV	AC, DC, act, N_2	All but LLOCA
LPCI	Low Pressure Coolant Injection	3 MDP, MOV	AC, DC, act, SW, Ventilation, SP	All
RHR	Residual Heat Removal (SP Cooling mode)	3 MDP, MOV, 2 Heat Exchangers	AC, DC, SW, SP, Ventilation	All
LPCS	Low Pressure Core Spray	1 MDP, MOV, 1 EDG	AC, DC, act, SP	All but LOACI & LODCI
AC	AC Power (non-EDG)	Breakers, transformers	DC	All
EDG	AC power (EDGs) Div. I & II	2 Engine-Generators	DC, SW, Ventilation, FO xfer	LOOP
FO xfer	Fuel Oil Transfer	6 MDP	AC, DC, act	LOOP
DC	DC power	Batteries, Chargers	None	All
act	ECCS Actuation	Instrumentation	AC, DC	All
RRCS	Redundant Reactivity Control System	Instrumentation	AC, DC	ATWS
CRD	Control Rod Drive	2 MDP, MOV	AC, DC, RBCLC, IA	None

Table 2 (Continued)

Affected System		Major Components	Support Systems	Initiating Event Scenarios
Code	**Name**			
FP	Fire protection pumps	1 MDP, 1 Diesel-driven pump	AC, FP diesel, DC	LOOP
N_2	Nitrogen System	Liquid N_2 tanks, Accumulators, Valves	AC, IA	All
IA	Instrument Air	3 Air compressors, Valves	AC, DC, RBCLC	LOIA
Ventilation	Ventilation systems	Fan coolers, Valves	AC, DC, SW, act	All
D/W Clg	Drywell Cooling	Fan coolers, Valves	AC, RBCLC	None
SLC	Standby Liquid Control	2 MDP, MOV, Explosive Valves	AC, act	ATWS
RBCLC	Reactor Building Closed Loop Cooling	6 MDP, MOV, 3 Heat exchangers	AC, SW	LOIA
TBCLC	Turbine Building Closed Loop Cooling	3 MDP, MOV, 3 Heat exchangers	AC, SW	TRANS, SLOCA, MLOCA, IORV/SORV, LOACI, LOACII, LODCI, LODCII
VS	Vapor Suppression	Suppression Pool (SP), Vacuum breakers downcomers	None	SLOCA, MLOCA, LLOCA
SW	Service Water	6 MDP, MOV	AC, DC	All
CV	Containment Venting	AOV	AC, IA, N_2	All but LOIA & LOACII

Table 2 (Continued)

Notes:

1. Information herein was developed from the NMP-2 IPE dated July, 1992. and the NMP-2 PRA, Rev. 0 dated July 1999.

2. The baseline IPE core damage frequency (CDF) from internal events was 3.1 x 10-5 events/Rx year and the Large Early Release Frequency (LERF) was 8.0 x 10-7 events/Rx year.

3. The PRA is a combined Level I/Level II PRA that includes both internal and external events and uses the PLG methodology. The combined CDF is 5.4 x 10-5 events/Rx year and the Large Early Release Frequency (LERF) is 1.5 x 10-6 events/Rx year.

4. The ‘Initiating Event Scenarios’ column provides a guide as to which worksheets contain credit for a particular system. The ISLOCA/LOC worksheet is not referenced in this column.

5. On an SBO at NMP-2 the batteries have a six hour life with no load shedding and an eight hour life with load shedding. There are 5 turbine bypass valves and the turbine bypass valve capacity is 23% of full power.

6. NMP-2 has 7 ADS SRVs and 11 non-ADS SRVs for a total of 18 SRVs. The 7 ADS valves are the only ones with a fully seismically qualified nitrogen supply. Also, the 11 non-ADS valves are operated only with Div. I AC. The 7 ADS valves can be operated either by Div. I AC, Div. I DC, or Div. II DC.

7. There are three divisions of emergency power and three EDGs at NMP-2. Division I & II supply all emergency loads except HPCS (which is supplied by Division III).

8. NMP-2 models a stuck open SRV as a medium LOCA.

9. HPCS requires SW (for pump room cooling, EDG room cooling, and EDG jacket water cooling), but is otherwise “self-supporting” with its own dedicated 120 VAC, 125 VDC, 600 VAC, & 4.16 KV AC, supplied by the Div. III EDG.

10. Where we have indicated AC in the Support system column, this means that power can be supplied by one or both of the EDG System or the non-EDG AC power system. Typically for NMP-2 the safety-related AC equipment can be supplied by either, while the non-safety can only be supplied by non-EDG power. The EDGs are only specifically credited in the LOOP Event Tree.

11. The DC system contains: normal non-safety related (NSR) 125 VDC (3 trains), NSR 24 VDC (2 trains), SR 125 VDC - Div. I, II, & III (for HPCS). The safety related DC system has two battery chargers and one battery per division.

12. Fire Water and Service Water cross ties: The B-train of SW can cross tie to the B-train of LPCI injection. The fire water pumps can cross tie to

Table 2 (Continued)

either the A or the B train of LPCI injection.

13. Ventilation: NMP2 requires ventilation cooling for EDGs, HPCS, RCIC, RHR pump rooms. The PRA credits alternate cooling for RCIC with operator actions to bypass the high temperature trips and to open the RCIC room doors.

14. CV: the NMP2 PRA credits a hard-piped vent path from the SP via a 20" purge exhaust pathway (through AOVs 109, 111, & 101) to the standby gas treatment system (bypassing the SGTS filters) and out the main stack. There is also a drywell path for use in the Level II portion of the PRA. Local operator actions are required to open valves and install blind flanges at the SGTS filters.

15. The RBCLC System provides cooling to the RHR pumps (with SW back-up), recirculation pumps, drywell cooling, and the IA compressors. Loss of RBCLC leads to a scram due to LOIA and due to loss of drywell cooling (which causes a rapid increase of drywell temperature and pressure).

1.3 SDP WORKSHEETS

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

1. Transients (Reactor Trip) (TRANS)
2. Transients without PCS (TPCS)
3. Small LOCA (SLOCA)
4. Stuck Open Relief Valve (SORV)
5. Medium LOCA (MLOCA)
6. Large LOCA (LLOCA)
7. Loss of Offsite Power (LOOP)
8. Anticipated Transients without Scram (ATWS)
9. Loss of Instrument Air (LOIA)
10. Loss of 4160 VAC Div. I (LOACI)
11. Loss of 4160 VAC Div. II (LOACII)
12. Loss of DC Div. I (LODCI)
13. Loss of DC Div. II (LODCII)
14. ISLOCA and LOCA Outside Containment (LOC)

Table 3.1 SDP Worksheet for Nine Mile Point, Unit 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)	1/3 condensate pumps, 1/3 FW pumps, 1/4 steam lines, 1/2 steam jet air ejectors, 2/6 TBVs, 1/6 CW pump, hotwell makeup from CST (operator action = 3)
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/18 ADS valves (7 ADS & 11 SRVs for a total of 18 valves) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train); or 1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	1/3 B-train SW pumps cross-tied to the BRHR loop (operator action = 1)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TRANS - PCS - CHR - CV (4, 8, 11)			
2 TRANS - PCS - HPCS - CHR - LI (7)			
3 TRANS - PCS - HPCS - RCIC - LPI (12)			

4 TRANS - PCS - HPCS - RCIC - DEP (13)			
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. NMP-2 credits portions of the PCS for DEP, LPI, and CHR. We have modeled all of these in the PCS function here.

2. The NMP2 PRA does not take credit for injection using the CRD pumps.

3. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

4. The NMP-2 HEP for DEP in transients and SLOCA is 1.1 E-3.

5. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

6. Late inventory makeup (LI) is not modeled separately in NMP-2, but we have taken the typical LI systems modeled by NMP-2 as LPI and have credited them for LI and LPI here. This is the B-train SW pumps cross-tied to the B RHR loop. The HEP for this action in the PRA is 4 E-2.

Table 3.2 SDP Worksheet for Nine Mile Point, Unit 2 — Transients without PCS (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:**
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/18 ADS valves (7 ADS & 11 SRVs for a total of 18 valves) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train); or 1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TPCS - CHR - CV (3, 7, 10)			
2 TPCS - HPCS - CHR - LI (6)			
3 TPCS - HPCS - RCIC - LPI (11)			
4 TPCS - HPCS - RCIC - DEP (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.

Notes:

1. This event tree and worksheet is for Transient (without PCS). It includes MSIV closure, Loss of FW, and loss of main condenser. It is assumed that no aspects of the PCS are available for safety functions during the transients evaluated in this event tree and worksheet.

2. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

3. The NMP-2 HEP for DEP in transients and SLOCA is 1.1 E-3.

4. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

5. Late inventory makeup (LI) is not modeled separately in NMP-2, but we have taken the typical LI systems modeled by NMP-2 as LPI and have credited them for LI and LPI here. This is the B-train SW pumps cross-tied to the B RHR loop. The HEP for this action in the PRA is 4 E-2.

Table 3.3 SDP Worksheet for Nine Mile Point, Unit 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:
Power Conversion System (PCS)	1/3 condensate pumps, 1/3 FW pumps, 1/4 steam lines, 1/2 steam jet air ejectors, 2/6 TBVs, 1/6 CW pump, hotwell makeup from CST (operator action = 2)
Early Containment Control (EC)	Passive operation of SP - 1/2 vacuum breakers in 4/4 vacuum relief lines remain closed (1 multi-train system); or operator action to align containment spray or to vent containment (CV), within 45 min. (operator action = 2)
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/18 ADS valves (7 ADS & 11 SRVs for a total of 18 valves) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train); or 1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)

Circle Affected Functions	Recovery of Failed Train	Remaining Mitigation Capability Rating for Each Affected Sequence	Sequence Color
1 SLOCA - PCS - CHR - CV (4, 8, 11)			
2 SLOCA - PCS - HPCS - CHR - LI (7)			
3 SLOCA - PCS - HPCS - RCIC - LPI (12)			

4 SLOCA - PCS - HPCS - RCIC - DEP (13)			
5 SLOCA - EC (14)			
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 definition for an SLOCA in the NMP-2 PRA is that RCIC is sufficient to keep the core covered.

2. The HEP for use of condensate and FW pumps on an SLOCA in the PRA is 8 E-3.

3. The HEP in the PRA for initiation of containment sprays in the event of vacuum breaker failure to ensure EC on an SLOCA is 4 E-2.

4. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

5. The NMP-2 HEP for DEP in transients and SLOCA is 1.1 E-3.

6. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

7. Late inventory makeup (LI) is not modeled separately in NMP-2, but we have taken the typical LI systems modeled by NMP-2 as LPI and have credited them for LI and LPI here. This is the B-train SW pumps cross-tied to the B RHR loop. The HEP for this action in the DAEC PRA is 4 E-2.

Table 3.4 SDP Worksheet for Nine Mile Point, Unit 2 — Inadvertent/Stuck Open Relief Valve (IORV/SORV)

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:**
High Pressure Injection (HPI)	HPCS (1 single train) or 1/3 PCS trains (operator action = 2)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/18 ADS valves (7 ADS & 11 SRVs for a total of 18 valves) manually opened (operator action = 2) or RCIC operation (1 ASD train)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	Not credited in IORV/SORV

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 IORV/SORV - CHR - CV (3, 8)			
2 IORV/SORV - HPI - CHR (5)			
3 IORV/SORV - HPI - RCIC - LPI (9)			
4 IORV/SORV - HPI - RCIC- DEP (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.

Notes:

1. The HEP in the PRA for initiation of containment sprays in the event of vacuum breaker failure to ensure EC on an SLOCA is 4 E-2.

2. NMP-2 credits the use of PCS for HPI in IORV/SORV. In order to use this without the condenser, the licensee credits gravity feed from the CST which requires IA for valves and RBCLC for cooling of the IA compressor.

3. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

4. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

5. Late inventory makeup (LI) is not modeled separately in NMP-2 for IORV/SORV. As a result, the RCIC success path requires CHR. If CHR fails, CV cannot be used, since neither RCIC nor LI will be available to provide injection.

Table 3.5 SDP Worksheet for Nine Mile Point, Unit 2 — Medium LOCA (MLOCA)

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 Containment Control (EC)	Passive operation of SP - 1/2 vacuum breakers in 4/4 vacuum breaker lines remain closed (1 multi-train system); or operator action to align containment spray or to vent containment (CV), within 20 min. (operator action = 2)
High Pressure Injection (HPI)	HPCS (1 single train)
Depressurization (DEP)	2/18 ADS valves (7 ADS & 11 SRVs for a total of 18 valves) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train); or 1/3 trains of PCS (operator action = 2)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	Not credited in MLOCA

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 MLOCA - CHR - CV (3, 6)			
2 MLOCA - HPI - LPI (7)			
3 MLOCA - HPI - DEP (8)			
4 MLOCA - EC (9)			

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 HEP in the PRA for initiation of containment sprays in the event of vacuum breaker failure to ensure EC on an SLOCA is 4 E-2.

2. The HEP for DEP in the PRA for an MLOCA is 3 E-3.

3. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

4. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

5. Late inventory makeup (LI) is not modeled separately in NMP-2 for MLOCA.

Table 3.6 SDP Worksheet for Nine Mile Point, Unit 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:**
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train) or HPCS (1 single train)
Early Containment Control (EC)	Passive operation of SP - 1/2 vacuum breakers in 4/4 vacuum relief lines remain closed (1 multi-train system)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	Not credited for LLOCA

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LLOCA - CHR - CV (3)			
2 LLOCA - LPI (4)			
3 LLOCA - EC (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 NMP-2 PRA models both an LLOCA and an excessive LOCA (XLOCA), which is a LOCA beyond the capacity of all ECCs to keep the core covered. The LLOCA for NMP-2 also includes consideration of two or more SORVs.

2. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

3. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

4. Late inventory makeup (LI) is not modeled separately in NMP-2 for LLOCA.

Table 3.7 SDP Worksheet for Nine Mile Point, Unit 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**

<u>Safety Functions Needed</u>:	<u>Full Creditable Mitigation Capability for Each Safety Function</u>:
Div 1 & 2 Emergency Power (EAC1/2)	1/2 EDGs (1 multi-train system)
Recovery of LOOP in 30 mins (RLOOP30M)	operator action = 1
Div 3 Emergency Power (EAC3)	HPCS EDG (Div 3) cross tie to Div 1 or 2 (operator action = 1)
Load Shed	Shed all non-essential DC loads and bypass RCIC isolation (operator action = 2)
Recovery of LOOP in 8 hours (RLOOP8H)	operator action = 2
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/7 ADS valves (7 ADS valves only) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Injection (LI)	Injection with diesel fire pump, or 1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 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 LOOP - CHR - CV (1, 2, 6, 9, 15)			
2 LOOP - HPCS - CHR - LI (1, 2)			
3 LOOP - HPCS - RCIC - LPI (1, 2)			

4 LOOP - HPCS - RCIC - DEP (1, 2)			
5 LOOP - EAC1/2 - RLOOP30 - CHR - LI (5, 14)			
6 LOOP - EAC1/2 - RLOOP30 - RCIC - LPI (10)			
7 LOOP - EAC1/2 - RLOOP30 - RCIC - DEP (11)			
8 LOOP - EAC1/2 - RLOOP30 - EAC3 - RCIC (16)			
9 LOOP - EAC1/2 - EAC3 - RLOOP8H (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.

<u>Notes</u>:

1. Note there are two transfers in this Event tree to the Transient without PCS (TPCS) ET.

2. LOOP is the dominant initiator in the NMP-2 PRA at 38%. The most dominant individual sequence is an SBO sequence (LOOP - EAC1/2 - RLOOP30 - EAC3 - HPI).

3. On an SBO at NMP-2 the batteries have a six hour life with no load shedding and an eight hour life with load shedding. If load shed fails RLOOP8H in the worksheet and the ET should change to RLOOP6H. Successful load shed, as modeled in the PRA, implies that operators shed all non-essential DC loads within the first two hours of the loss of power and bypass the RCIC isolation. Each of these two actions has an HEP of 3 E-3 in the PRA.

4. In the PRA, the licensee models RLOOP2H and changes in RCIC failure probability after 2 hours. These are not addressed in this worksheet. The licensee also credits use of the diesel fire pump in the event of RCIC initial operation and then failure in the 2 to 8 hour time frame. This time dependency and credit is not addressed here.

5. On a LOOP with failure of both Div. I & II EDGs, the NMP-2 PRA credits cross tie of the HPCS Div. III EDG to either Div. I or II in order to supply AC power to one SW pump, one low pressure injection pump, and one battery charger. In this arrangement, the Div. III DG does not have sufficient capacity to also run the HPCS pump. The HEP for this action is 0.1. (Note, during normal, non-blackout use of HPCS, SW cooling of the Div. III DG must come from Div. I or II.)

6. RLOOP as used here means recovery of either offsite power or an EDG. The HEPs in the PRA for RLOOP are as follows: 30 minutes - 0.28, 2 hours - 0.12, and 8 hours - 0.03.

7. The HEP for DEP during a LOOP in the NMP-2 PRA is 1 E-3.

8. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

9. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

10. Late inventory makeup (LI) is not modeled separately in NMP-2, but we have split off the typical LI systems modeled by NMP-2 as LPI and have credited them for LI here. Also, use of the diesel fire pump (with an HEP varying from 0.2 to 0.5) for LI requires the reactor to be DEP. This is not separately credited here.

Table 3.8 SDP Worksheet for Nine Mile Point, Unit 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:**
Overpressure Protection (OVERP)	16/18 SRVs (1 multi-train system)
Recirculation Pump Trip/FW runback (RPT/FW)	RRCS functions to provide automatic trip of recirculation pumps and auto runback of feedwater (1 multi-train system)
Reactivity Control (SLC)	Auto initiation of 2/2 SLC pumps (1 train)
Inhibit ADS & Level Control (INH/LC)	Operator inhibits ADS and controls RV level at the top of the active fuel (TAF) (operator action = 2)
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	3/7 ADS valves manually opened (operator action = 1)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train); or 1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)
Overfill (OVERFL)	Operator prevents overfill by LPI (operator action = 2)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	Containment venting through 20" line from SP (operator action = 2)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 ATWS - CHR - CV (3, 8)			
2 ATWS - OVERFL (4, 9)			
3 ATWS - DEP (5, 11)			

4 ATWS - HPCS - LPI (10)			
5 ATWS - SLC (12)			
6 ATWS - INH/LC (13)			
7 ATWS - RPT/FW (14)			
8 ATWS - OVERP (15)			

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. In this worksheet we have combined the ATWS initiator with failure of Alternate Rod Insertion (ARI) and Manual Rod Insertion (MRI). Also, this worksheet conservatively assumes that a loss of PCS transient initiated the ATWS. Therefore, due to these generic NRC assumptions, no credit should be given to the PCS in evaluating findings on this worksheet. The licensee does however take credit for use of PCS for HPI and CHR in the IPE.

2. At NMP-2 the RRCS provides the following functions: ARI, RPT, FW runback, and automatic SLC.

3. The SLC system is automatic and no credit is given in the PRA for manual SLC.
4. The licensee does take credit for RCIC injecting at high pressure in conjunction with SLC. However, this is not credited here, since the licensee's ATWS model assumes that DEP is always required for success. Thus, as shown in the ET, a success path includes HPCS, DEP and CHR. Another success path (with failure of HPI) includes DEP, LPI and CHR. If credit were given for RCIC, one still needs DEP, LPI and CHR.

5. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps.

6. The HEP for DEP during an ATWS in the NMP-2 PRA is 0.16.

7. The HEP for INH during an ATWS in the NMP-2 PRA is 5.6 E-3.

8. The HEP for OVERFL during an ATWS in the NMP-2 PRA is 4.6 E-2.

9. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

Table 3.9 SDP Worksheet for Nine Mile Point, Unit 2 — Loss of Instrument Air (LOIA)

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:**
High Pressure Injection (HPI)	HPCS (1 single train) or RCIC (1 ASD train)
Depressurization (DEP)	2/18 ADS valves (7 ADS & 11 SRVs for a total of 18 valves) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/3 RHR pumps in 1/3 trains in LPCI mode (1 multi-train system); or 1/1 LPCS pump (1 train)
Containment Heat Removal (CHR)	1/2 RHR pumps and 1/2 HXs in 1/2 trains in the SPC or containment spray mode plus 1/6 SW pumps (1 multi-train system)
Containment Venting (CV)	No credit for LOIA
Late Inventory, Makeup (LI)	No credit for LOIA

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LOIA - CHR (2, 4)			
2 LOIA - HPI - LPI (5)			
3 LOIA - HPI - DEP (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. A Loss of Instrument Air (LOIA) causes:
   Loss of air to CRD scram valves resulting in a scram.
   Loss of air to FW valves resulting in a LOFW.
   A turbine trip and loss of condenser vacuum.
   Loss of air to MSIVs causing them to close.
   All of this results in a TPCS transient. Thus, this event tree and worksheet for LOIA is similar to Transient (without PCS). However, LOIA also causes a loss of air to CV valves making CV inoperable and LI not applicable.

2. The LOIA IEF is 0.14 events per reactor-year and the contribution to total CDF (internal and external events) is 8%.

3. The NMP-2 HEP for DEP in transients is 1.1 E-3.

4. The Loss of RBCLC IEF is 6.7 E-2 E-3 events per reactor-year and the contribution to total CDF (internal and external events) is 4%. A Loss of RBCLC results in a LOIA and the IEF for Loss of RBCLC is notably less than LOIA. Thus, the Loss of RBCLC transient is similar to the LOIA transient, but is not provided with a separate worksheet or event tree.

Table 3.10 SDP Worksheet for Nine Mile Point, Unit 2 — Loss of 4160 VAC Div. I (LOACI)

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)	1/3 condensate pumps, 1/3 FW pumps, 1/4 steam lines, 1/2 steam jet air ejectors, 2/6 TBVs, 1/6 CW pump, hotwell makeup from CST (operator action = 3)
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/7 ADS valves (7 ADS valves only) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/2 RHR pumps in 1/2 trains in LPCI mode (1 multi-train system); or 1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)
Containment Heat Removal (CHR)	1/1 RHR pumps and 1/1 HXs in 1/1 trains in the SPC or containment spray mode plus 1/3 SW pumps (1train)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	1/3 B-train SW pumps cross-tied to the B RHR loop (operator action = 1)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LOACI - PCS - CHR - CV (4, 8, 11)			
2 LOACI - PCS - HPCS - CHR - LI (7)			
3 LOACI - PCS - HPCS - RCIC - LPI (12)			
4 LOACI - PCS - HPCS - RCIC - DEP (13)			

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. On a loss of Division I of the 4160 VAC system, NMP-2 notes that there will not be an automatic reactor or turbine trip, but that a manual shutdown would be performed. The following important equipment is lost: RHR pump A, 3/6 SW pumps (A, C, & E), the LPCS pump, & the 11 non-ADS SRVs.

2. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

3. The NMP-2 HEP for DEP in transients and SLOCA is 1.1 E-3.

4. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

5. Late inventory makeup (LI) is not modeled separately in NMP-2, but we have taken the typical LI systems modeled by NMP-2 as LPI and have credited them for LI and LPI here. This is the B-train SW pumps cross-tied to the B RHR loop. The HEP for this action in the PRA is 4 E-2.

Table 3.11 SDP Worksheet for Nine Mile Point, Unit 2 — Loss of 4160 VAC Div. II (LOACII)

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)	1/3 condensate pumps, 1/3 FW pumps, 1/4 steam lines, 1/2 steam jet air ejectors, 2/6 TBVs, 1/6 CW pump, hotwell makeup from CST (operator action = 3)
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/7 ADS valves (7 ADS valves only) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/1 RHR pumps in 1/1 trains in LPCI mode (1 train): or 1/1 LPCS pump (1 train)
Containment Heat Removal (CHR)	1/1 RHR pumps and 1/1 HXs in 1/1 trains in the SPC or containment spray mode plus 1/3 SW pumps (1 train)
Containment Venting (CV)	Lost for LOACII
Late Inventory, Makeup (LI)	Not used without CV

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LOACII - PCS - CHR (3, 5, 7)			
2 LOACII - PCS - HPCS - RCIC - LPI (8)			
3 LOACII - PCS - HPCS - RCIC - DEP (9)			

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. On a loss of Division I of the 4160 VAC system, NMP-2 notes that there will not be an automatic reactor or turbine trip, but that a manual shutdown would be performed. The following important equipment is lost: 2/3 RHR pumps (B & C), 3/6 SW pumps (B, D, & F), and the containment vent valves.

2. The NMP-2 HEP for DEP in transients and SLOCA is 1.1 E-3.

Table 3.12 SDP Worksheet for Nine Mile Point, Unit 2 — Loss of DC Division I (LODCI)

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)	1/3 condensate pumps, 1/3 FW pumps, 1/4 steam lines, 1/2 steam jet air ejectors, 2/6 TBVs, 1/6 CW pump, hotwell makeup from CST (operator action = 3)
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Depressurization (DEP)	2/7 ADS valves manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/2 RHR pumps in 1/2 trains in LPCI mode (1 multi-train system); or 1/3 B-train SW pumps cross-tied to the BRHR loop (operator action = 1)
Containment Heat Removal (CHR)	1/1 RHR pumps and 1/1 HXs in 1/1 trains in the SPC or containment spray mode plus 1/3 SW pumps (1 train)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LODCI - PCS - CHR - CV (4, 7)			
2 LODCI - PCS - HPCS - LPI (8)			
3 LODCI - PCS - HPCS - DEP (9)			

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. NMP-2 has three divisions or trains of safety related DC power, designated Division I (green), Division II (yellow), and Division III (purple). They are associated with the same three divisions of onsite emergency AC power. Loss of any one division of DC will not cause a loss of PCS or a reactor scram. Loss of Division I DC causes a loss of protection and control for the associated 4160 and 600 VAC buses and a loss of : Train A UPS, RCIC, Division I EDG controls, and the 11 non-ADS SRVs. The major pumps lost in Division I are: RHR-A, LPCS, SW -A, SW-C, & SW-E. If the pumps are running, they will continue to run; however, if they are not already running, they cannot be started. Thus, credit has not been given for these affected pumps.

2. NMP-2 credits portions of the PCS for DEP, LPI, and CHR. We have modeled all of these in the PCS function here.

3. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

4. The NMP-2 HEP for DEP in transients and SLOCA is 1.1 E-3.

5. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

6. LI is not needed here per note 3. The B-train SW pumps, cross-tied to the B RHR loop, are credited in LPI. The HEP for this action in the PRA is 4 E-2.

Table 3.13 SDP Worksheet for Nine Mile Point, Unit 2 — Loss of DC Division II (LODCII)

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)	1/3 condensate pumps, 1/3 FW pumps, 1/4 steam lines, 1/2 steam jet air ejectors, 2/6 TBVs, 1/6 CW pump, hotwell makeup from CST (operator action = 3)
High Pressure Core Spray (HPCS)	HPCS System (1 train)
Reactor Core Isolation Cooling (RCIC)	RCIC System (1 ASD train)
Depressurization (DEP)	2/18 ADS valves (7 ADS & 11 SRVs for a total of 18 valves) manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/1 RHR pumps in 1/1 trains in LPCI mode (1 train); or 1/1 LPCS pump (1 train)
Containment Heat Removal (CHR)	1/1 RHR pumps and 1/1 HXs in 1/1 trains in the SPC or containment spray mode plus 1/3 SW pumps (1 train)
Containment Venting (CV)	Containment venting through hard-piped 20" line from SP (operator action = 2)
Late Inventory, Makeup (LI)	Equipment lost due to LODCII

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LODCII - PCS - CHR - CV (4, 9)			
2 LODCII - PCS - HPCS - CHR (6)			
3 LODCII - PCS - HPCS - RCIC - LPI (10)			
4 LODCII - PCS - HPCS - RCIC - DEP (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. NMP-2 has three divisions or trains of safety related DC power, designated Division I (green), Division II (yellow), and Division III (purple). They are associated with the same three divisions of onsite emergency AC power. Loss of any one division of DC will not cause a loss of PCS or a reactor scram. Loss of Division II DC causes a loss of protection and control for the associated 4160 and 600 VAC buses and a loss of : Train B UPS, and the Division II EDG controls. The major pumps lost in Division II are: RHR-B, RHR-C, SW -B, SW-D, & SW-F. If the pumps are running, they will continue to run; however, if they are not already running, they cannot be started. Thus, credit has not been given for these affected pumps. All of the B-train SW pumps are lost and therefore there is no credit for the cross-tie to the B RHR loop.

2. NMP-2 credits portions of the PCS for DEP, LPI, and CHR. We have modeled all of these in the PCS function here.

3. The NMP-2 PRA states that, if CHR fails, then credit is given to CV as a heat removal path. Further, the ECCS pumps are designed to operate under saturated water conditions. Thus, the ECCS pumps can continue to run even after CV has been actuated through the hard piped SP vent path and after the SP has reached saturated conditions. We have verified with the licensee that this feature and credit applies to the HPCS, LPCS, & LPCI pumps (but not the RCIC pump).

4. The NMP-2 HEP for DEP in transients and SLOCA is 1.1 E-3.

5. The NMP-2 HEP for CV varies from 6 E-3 to 1.4 E-2.

Table 3.14 SDP Worksheet for Nine Mile Point, Unit 2 — Interfacing System LOCA (ISLOCA) and LOCA Outside Containment (LOC)

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

Initiation Pathways:	**Mitigation Capability: Ensure Component Operability for Each Pathway**
ISLOCA PATHWAYS:	
LPCI Injection Lines	Three LPCI injection lines each with 1 testable check valve (2RHS*AOV 16 A, B, & C) and 1 NC MOV (2RHS*MOV 24 A, B, & C)
Low Pressure Core Spray Injection Lines	One line with 1 testable check valve (2CSL*AOV101) and 1 NC MOV (2CSL*MOV104)
RHR shutdown cooling discharge line	Two shutdown cooling discharge lines each with 1 testable check valve (2RHS*AOV 39 A, & B) and 1 NC MOV (2RHS*MOV 40 A & B)
LOC PATHWAYS:	
RCIC steam Line	One 10 " line with two NO MOVs (one inside and one outside containment), but the system is high pressure design up to turbine.
RWCU System Lines	Suction: 8" line with 3 MOVs inside and 1 MOV outside containment Discharge: 8" line connecting to FW line upstream of 2 FW check valves
Feedwater Lines	Two 24" lines each with two check valves and a NO MOV
Main Steam Lines	Four 26" steam lines with 2 air-operated, fail-closed, MSIVs per line

Circle Affected Component in Pathways	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Pathway**	**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.

<u>Notes</u>:

1. The initiation pathways and the applicable components in the pathways are based on licensee inputs supplemented by generic insights based on NRC studies on ISLOCA

2. This worksheet contains pathways for both ISLOCA and LOC. Licensees typically analyze these events separately.

3. ISLOCA lines quantified in the PRA are presented in the top half of the above table. Other important ISLOCA type of lines that were considered but were screened out, include: the shutdown cooling suction path, the steam condensing suction path, and the RHR B head spray path (through the RCIC head spray).

4. The NMP-2 PRA screened out LOC due to high energy line break (HELB) outside containment in Section 5.3..3.2.1 - HELB. Lines considered are listed above in the bottom half of the table as LOC Pathways.

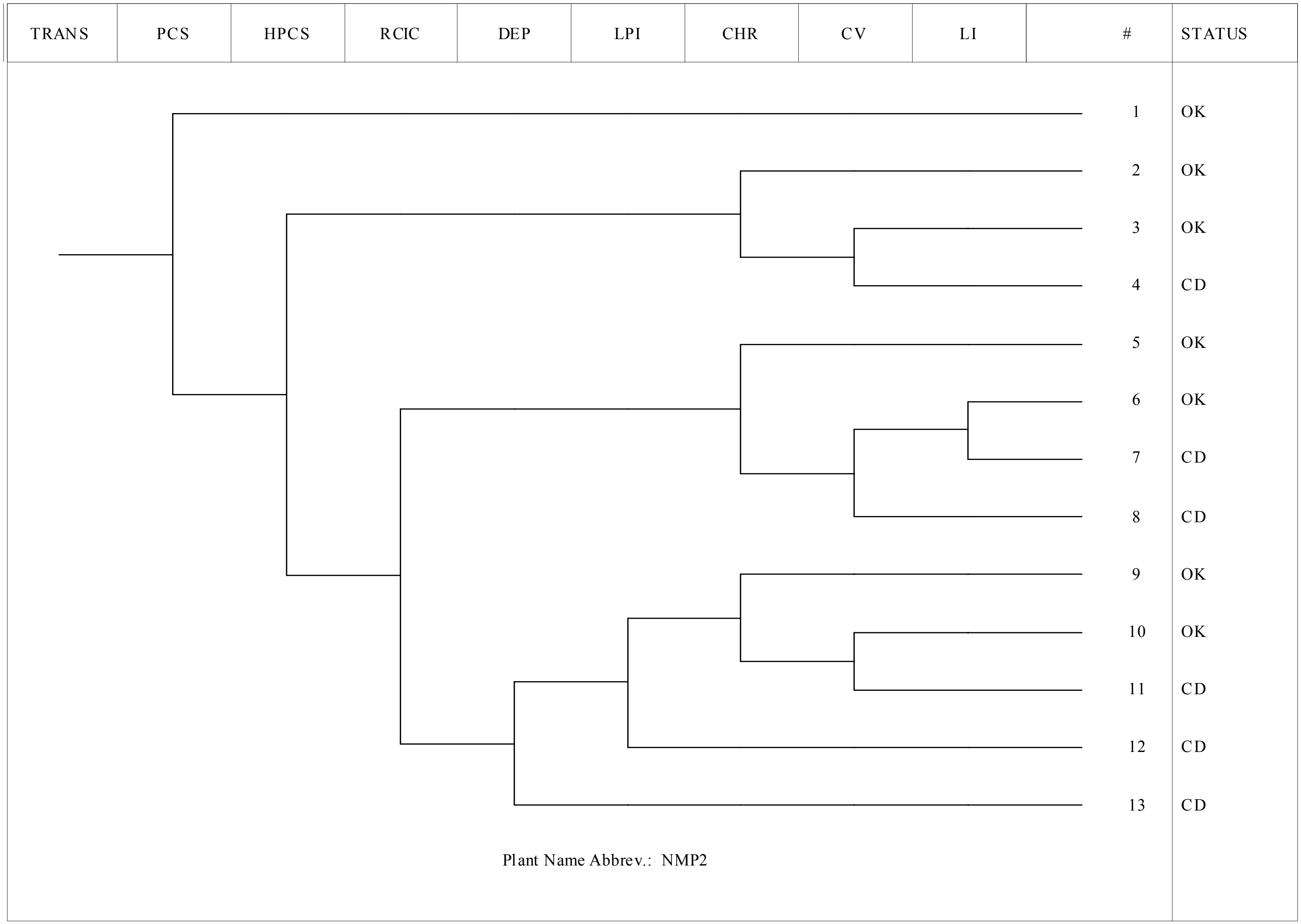
5. This worksheet is different from the other worksheets, in that ISLOCA is typically an unmitigated initiating event in most PRAs. Therefore the right side of the worksheet contains valves, whose failure may lead to an ISLOCA or LOC rather than mitigating systems to address an event in progress. As 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. 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. Inadvertent or Stuck Open Relief Valve (IORV/SORV)
5. Medium LOCA (MLOCA)
6. Large LOCA (LLOCA)
7. Loss of Offsite Power (LOOP)
8. Anticipated Transients without Scram (ATWS)
9. Loss of Instrument Air (LOIA)
10. Loss of 4160 VAC Div. I (LOACI)
11. Loss of 4160 VAC Div. II (LOACII)
12. Loss of DC Div. I (LODCI)
13. Loss of DC Div. II (LODCII)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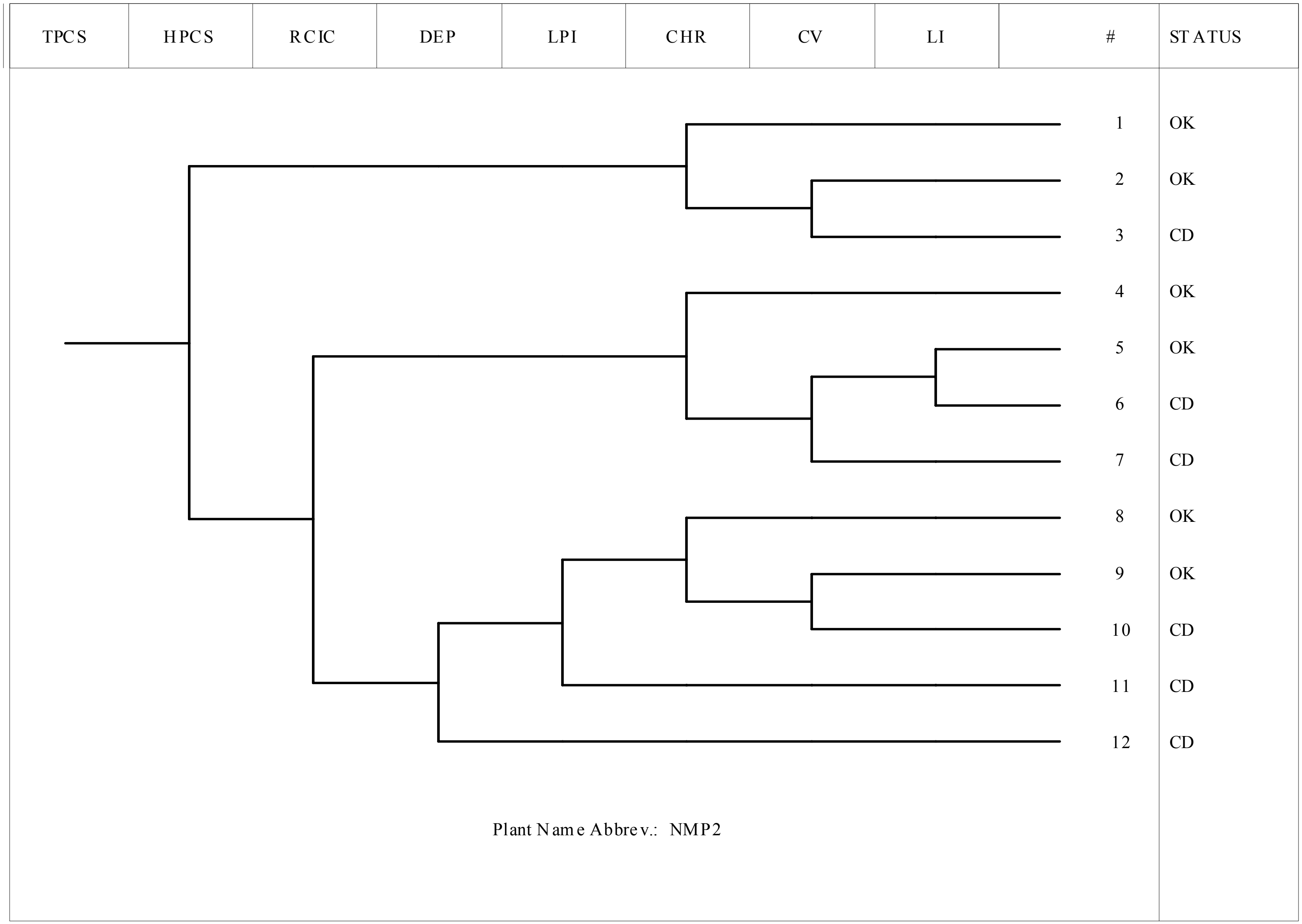
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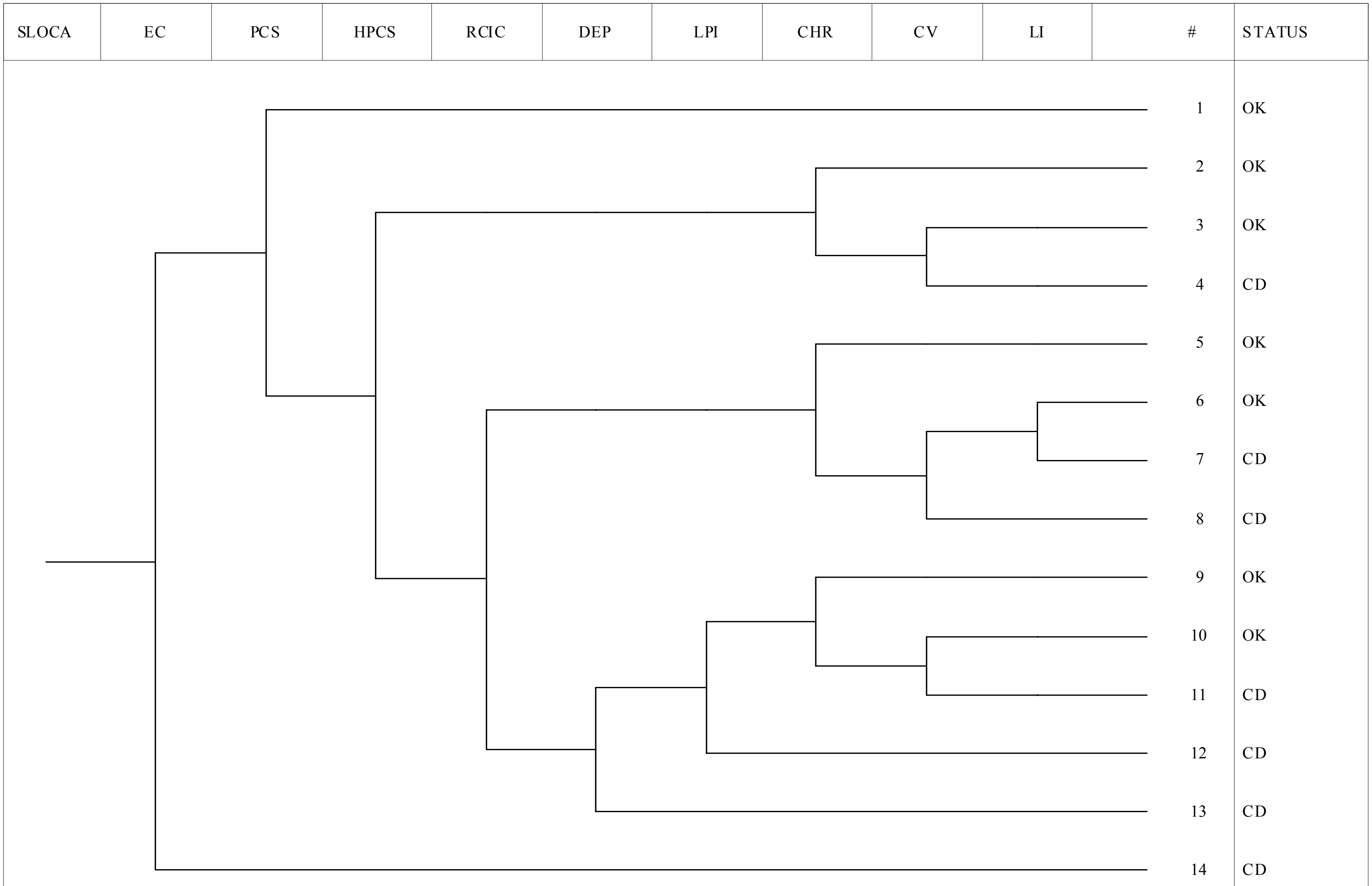

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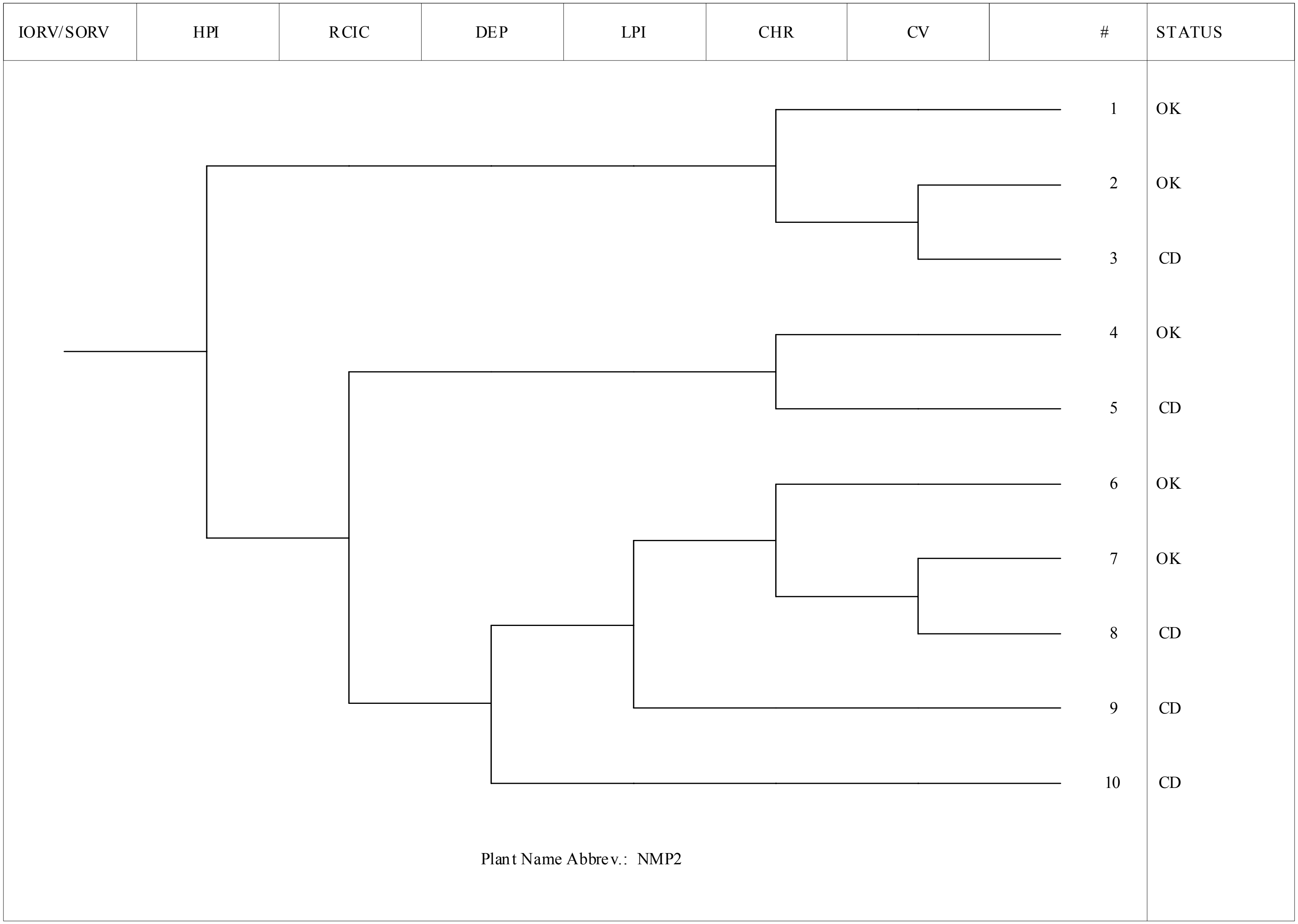
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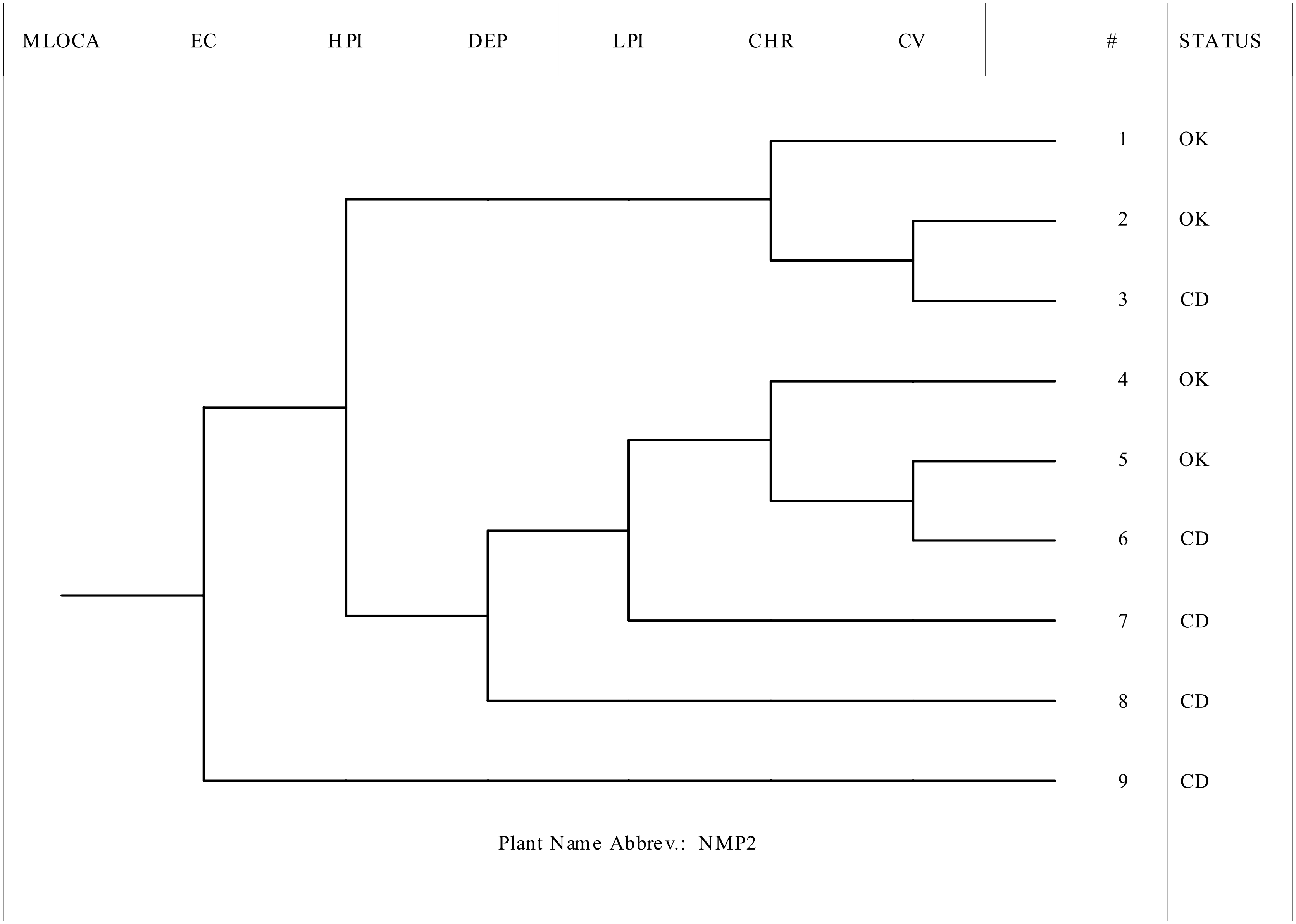
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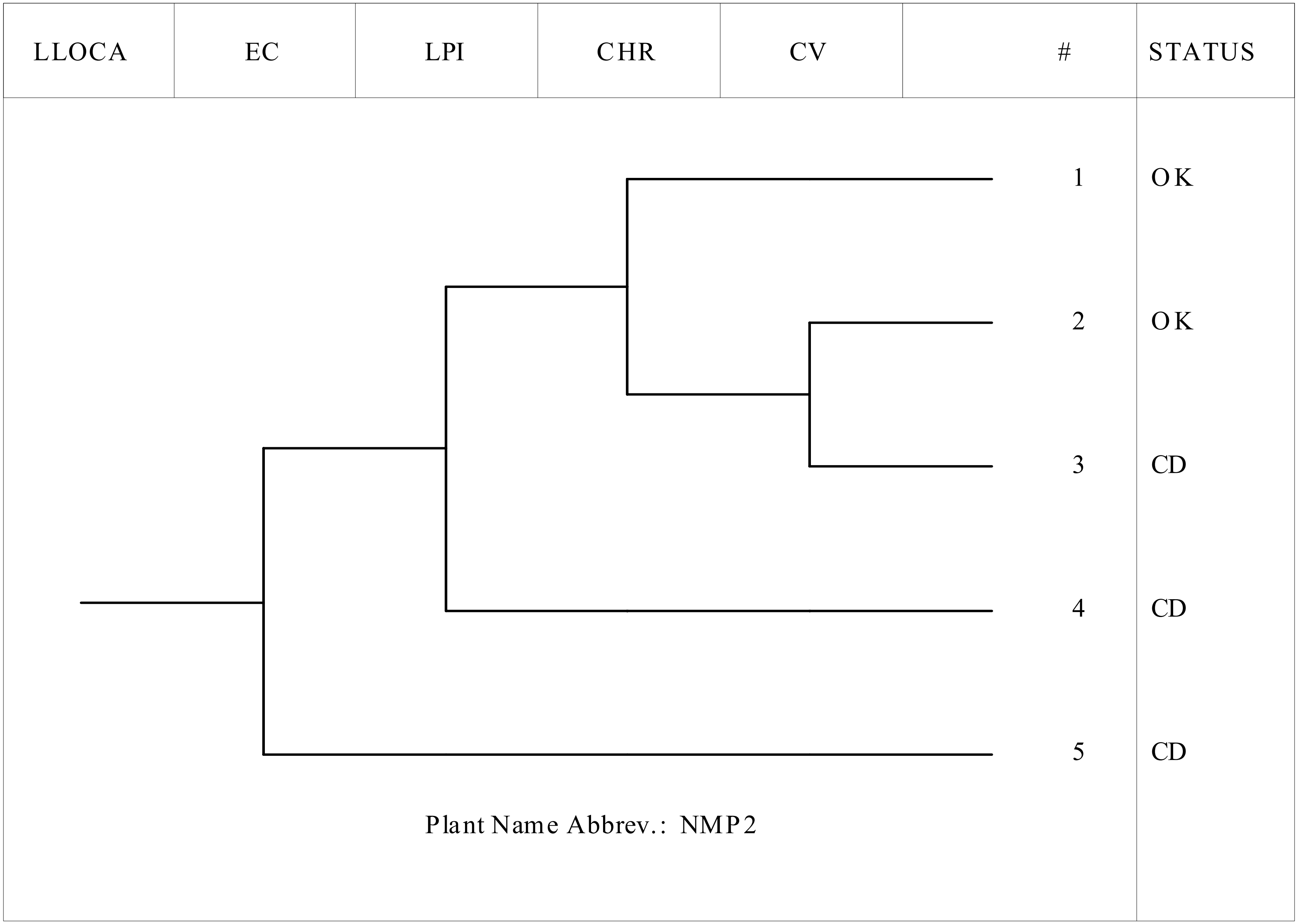
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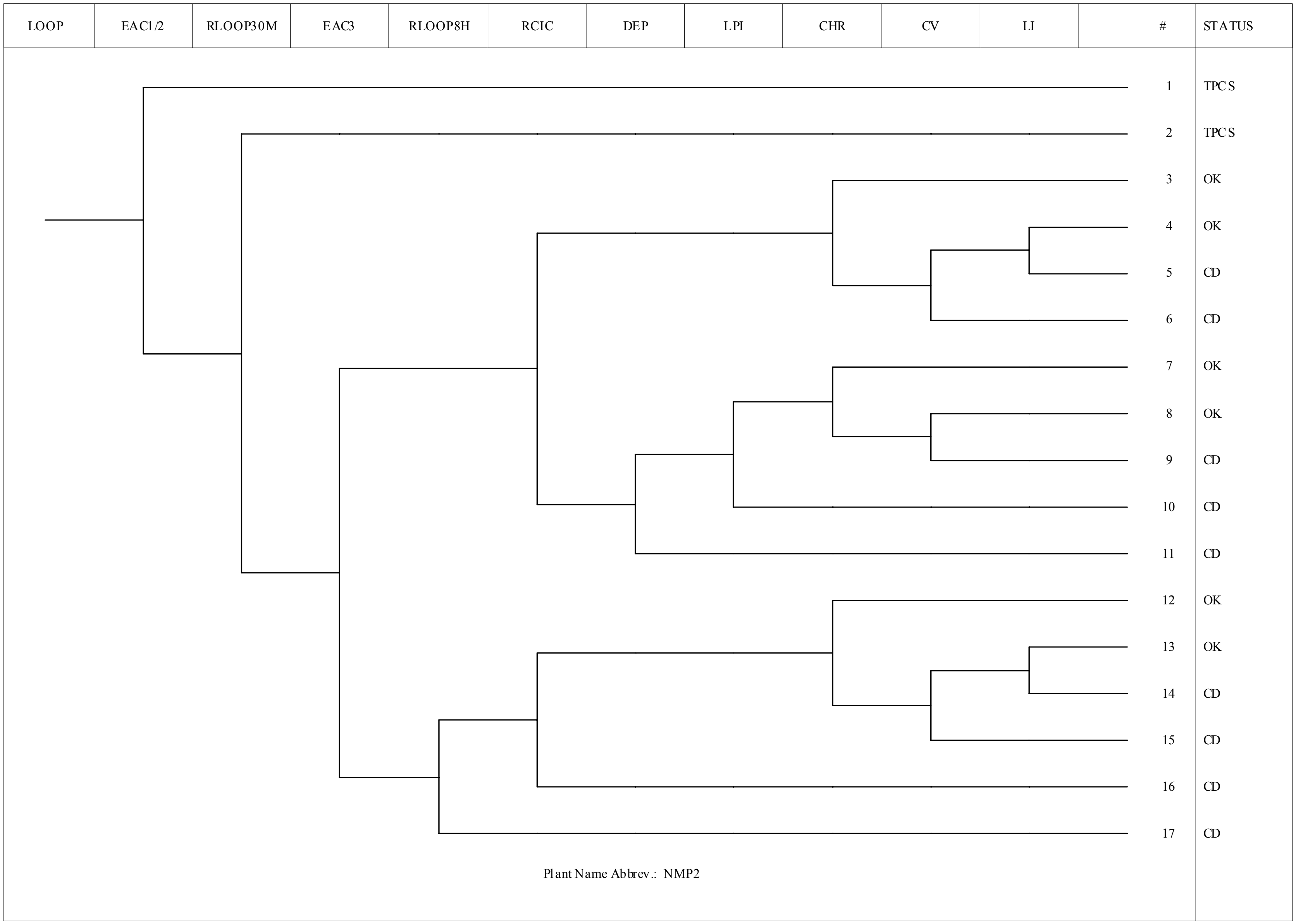
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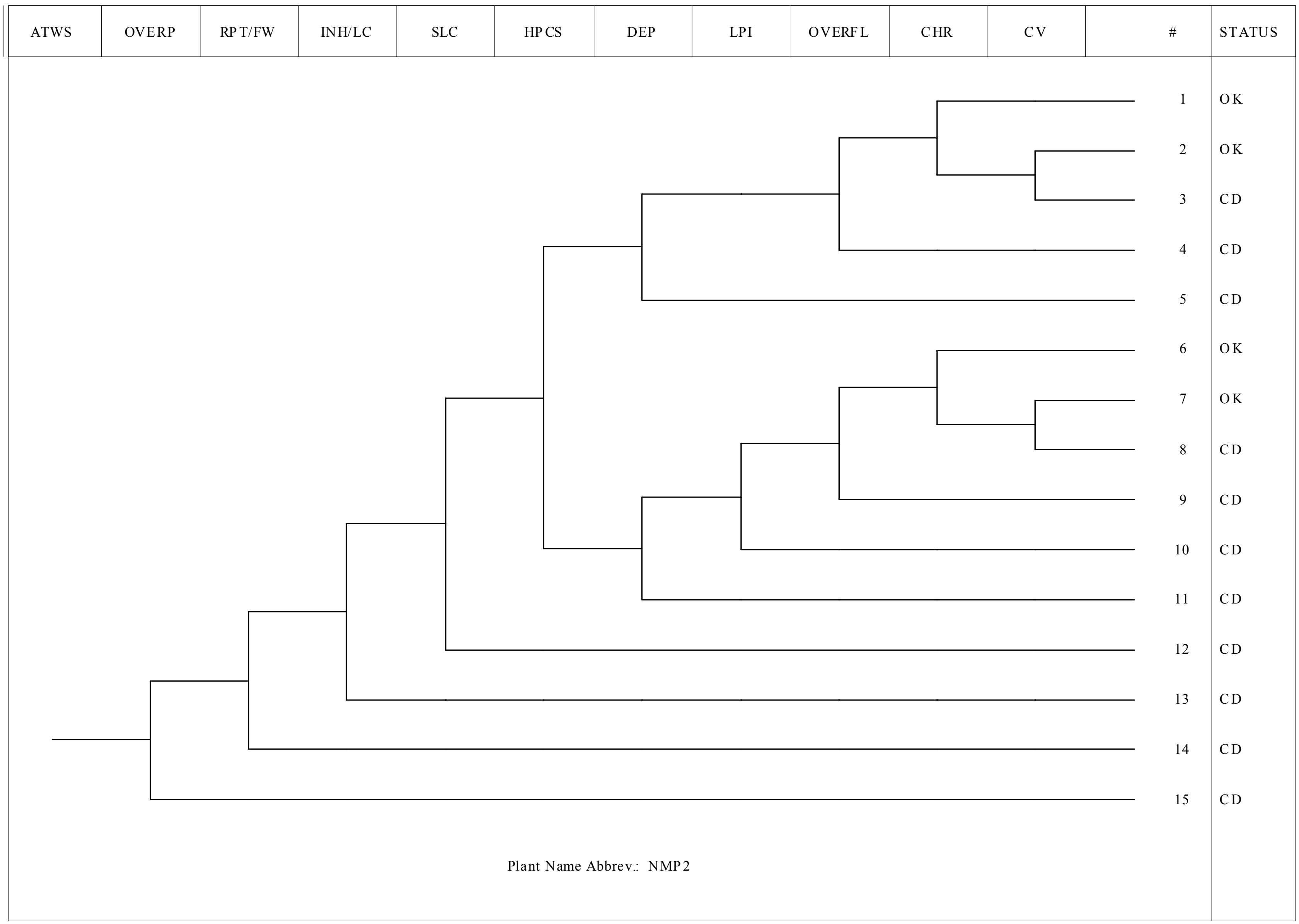
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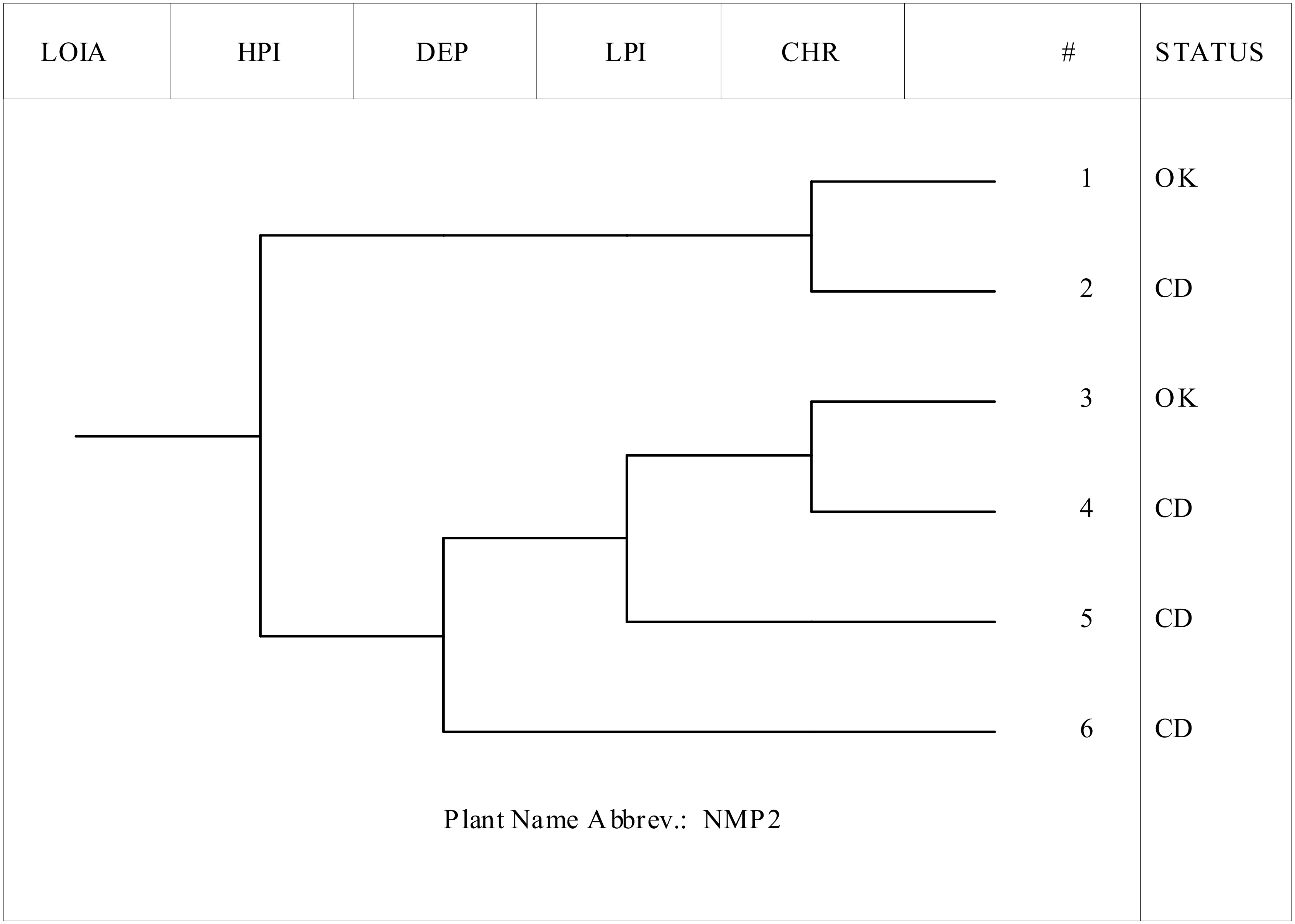
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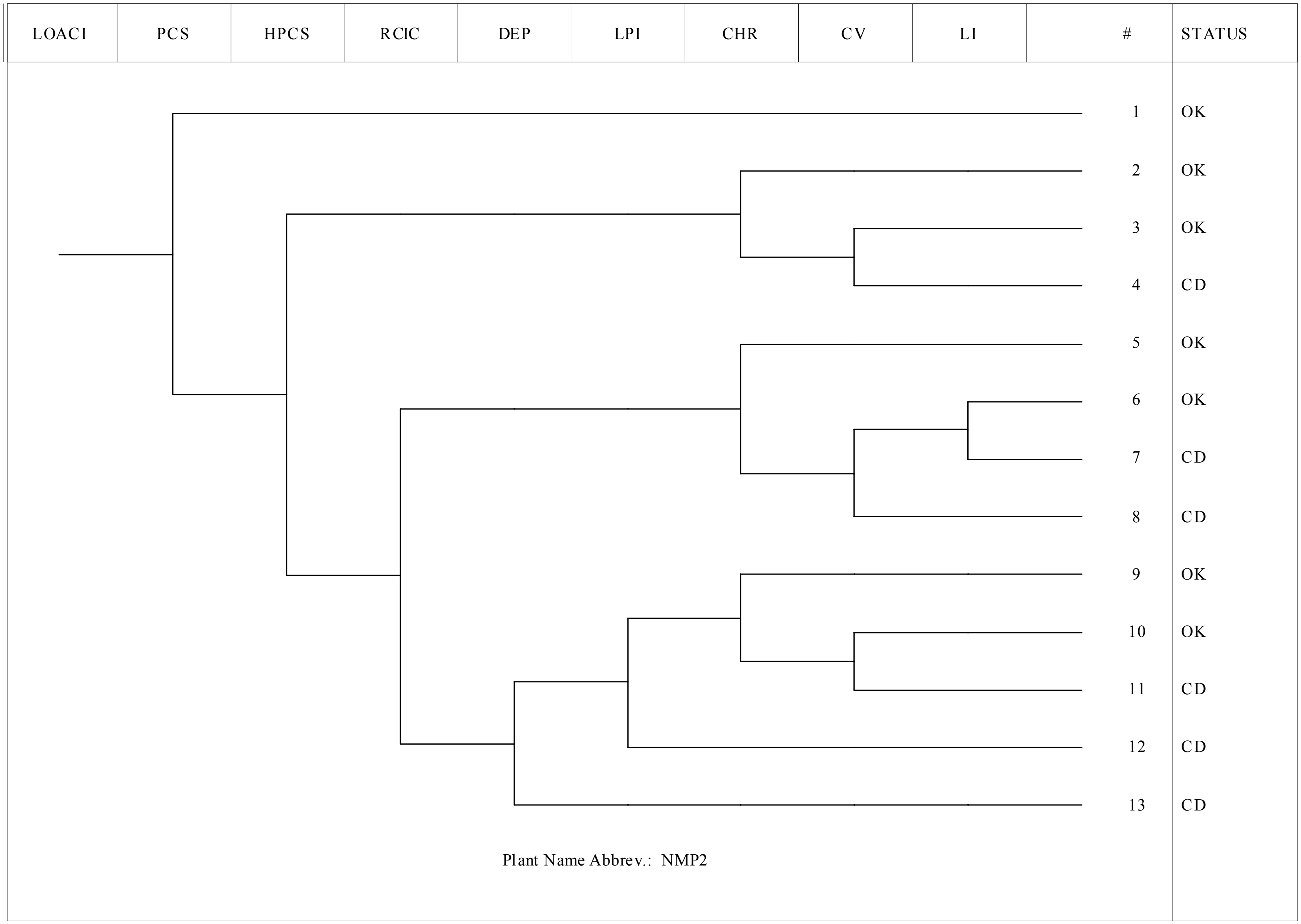
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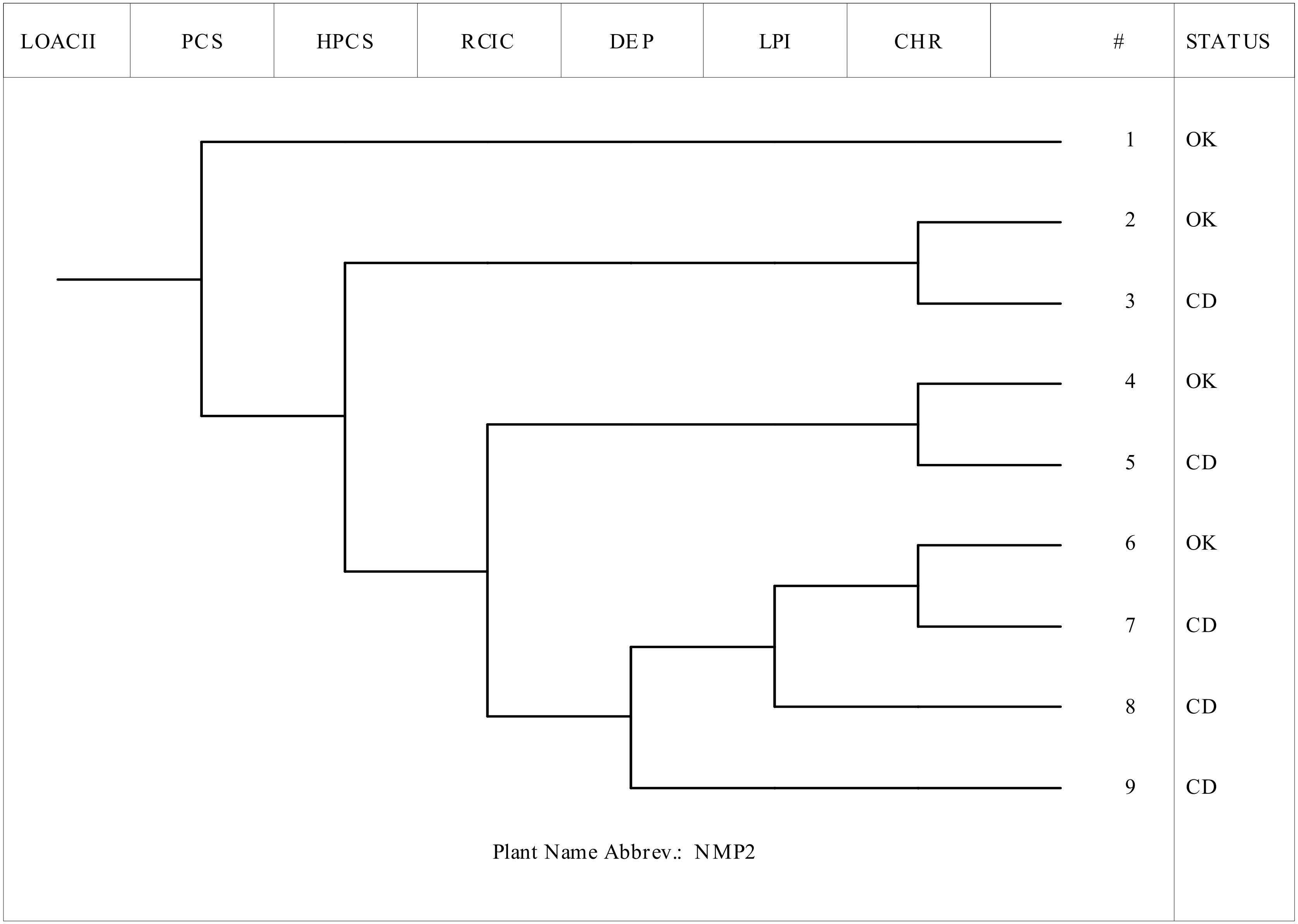
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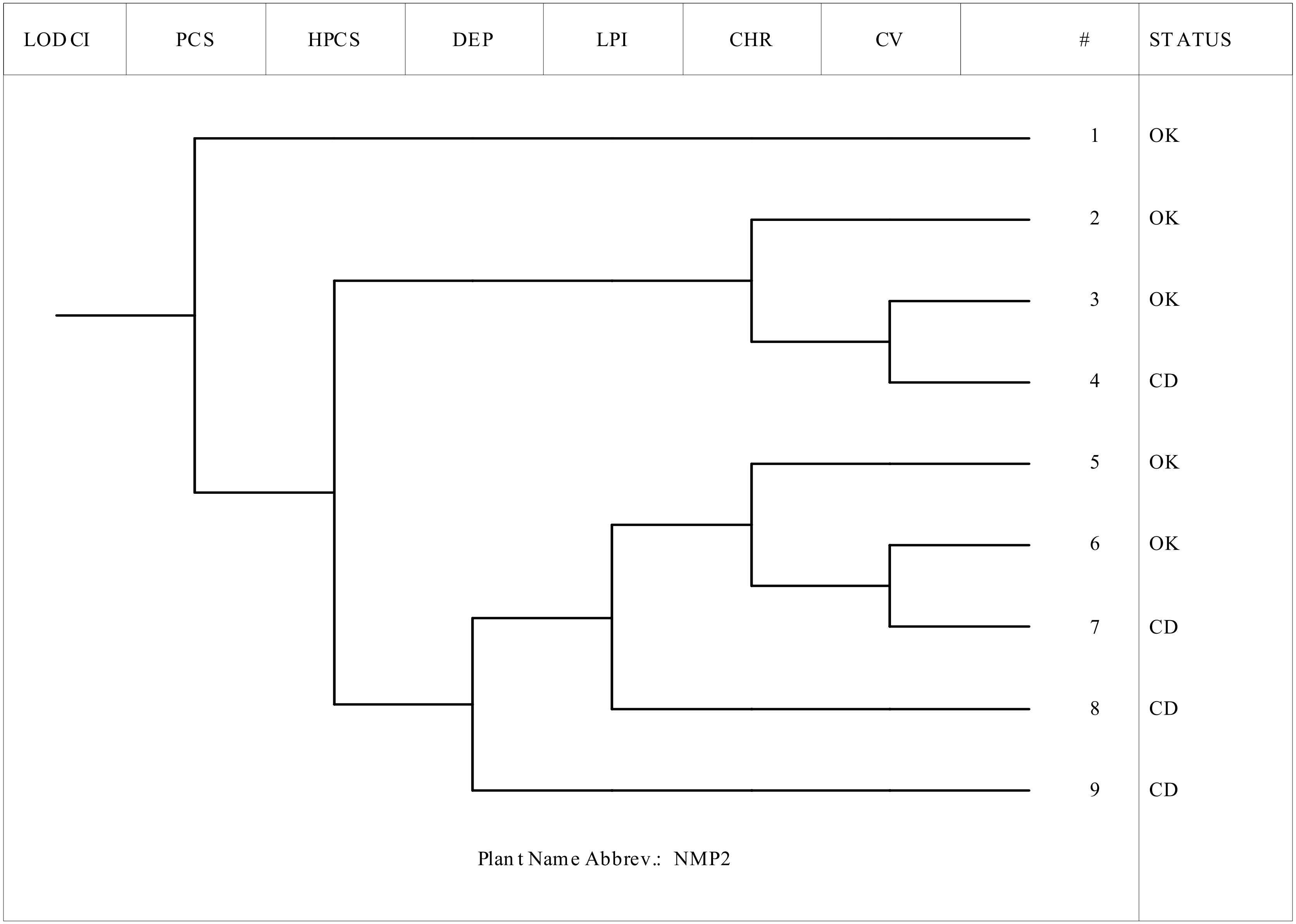
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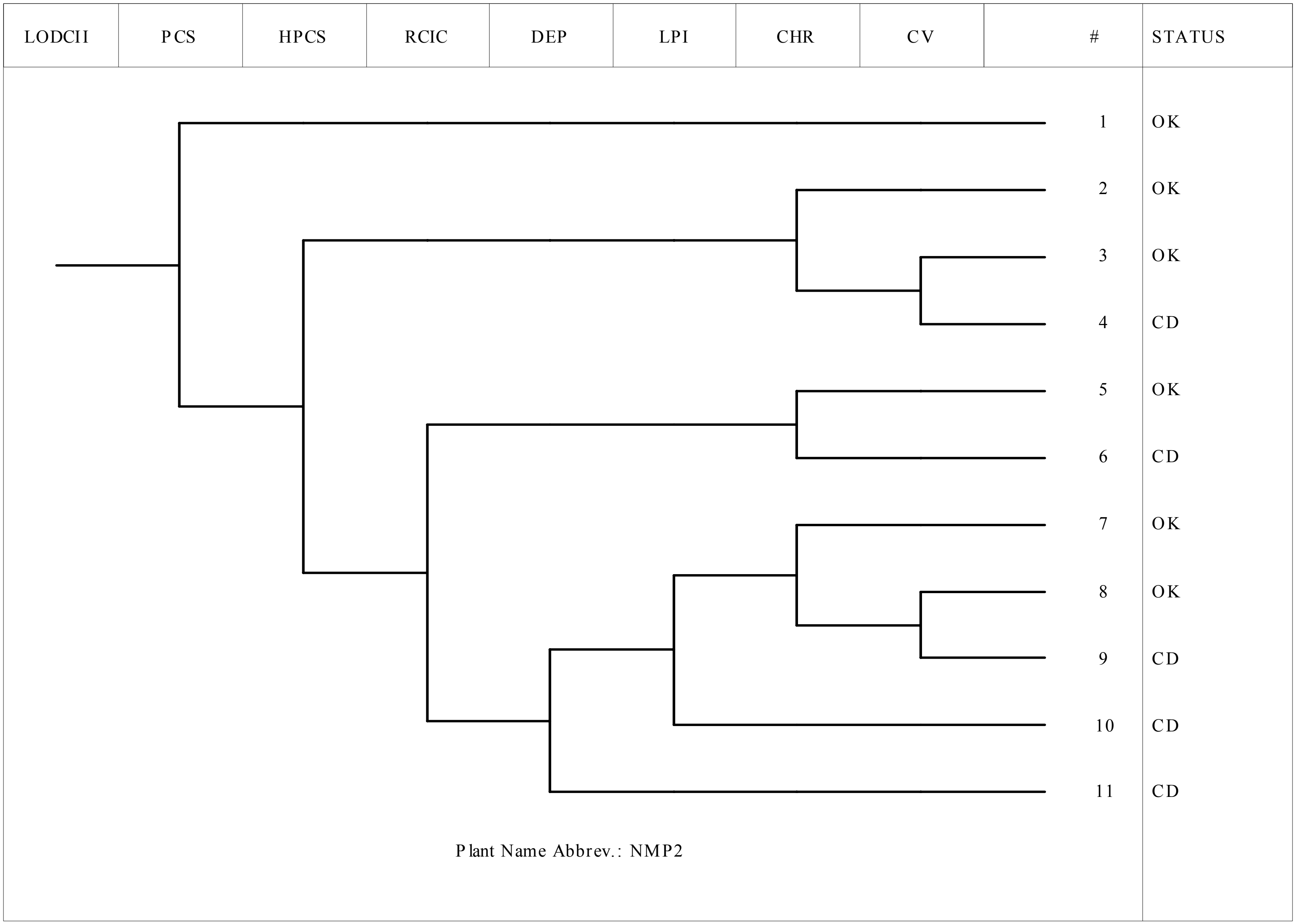
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9 CD
10 CD
11 CD
Plant Name Abbrev.: NMP2

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 BWR 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 BWRs 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 (BWRs)

Initiating Event Likelihood Rating Table

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 SRVs (IORV), anticipated transients without scram (ATWS), interfacing system LOCA (ISLOCA), and LOCA outside containment (LOC) are assigned into rows based on consideration of industry-average frequency. Plant-specific frequencies can be different, but are not considered. Plant-specific frequencies for LOOP and special initiators are used to assign these initiating events.

2. Inclusion of special initiators:

The special initiators included in the worksheets are those applicable for the plant. A separate worksheet is included for each of the applicable special initiators. The applicable special initiators are primarily based on the plant-specific IPEs. In other words, the special initiator included are those modeled in the IPEs unless it is shown to be a negligible contributor. In some cases, in considering plants of similar design, a particular special initiator may be added for a plant even if it is not included in the IPE if such an initiator is included in other plants of similar design and is considered applicable for the plant. Except for the interfacing system LOCA (ISLOCA) and LOCA outside containment (LOC), 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 focus is on the initiating event and the risk implication of the inspection finding can be directly assessed. For ISLOCA and LOC, a separate worksheet is included noting the pathways that can lead to these events.

3. Inadvertent or stuck open relief valve as an IE in BWRs:

Many IPEs/PRAs model this event as a separate initiating event. Also, the failure of the SRVs to re-close after opening can be modeled within the transient tree. In the SDP worksheet, these events are modeled in a separate worksheet (and, are not included in the transient worksheets) considering both inadvertent opening and failure to re-close. We typically consider a single valve is stuck or inadvertently open. The frequency of this initiator is generically estimated for all BWR plants. This IE may behave similar to a small or medium LOCA depending on the valve size, and the mitigation capability is addressed accordingly.

4. LOCA outside containment (LOC):

A LOCA outside of containment (LOC) can be caused by a break in a few types of lines such as Main Steam or Feedwater. LOC is treated differently among the IPEs. Separate ETs are usually not developed in the IPEs for LOCs. Thus, credit is usually not taken for mitigating actions. LOC sequences typically have a core damage frequency in the E-8 range. As such, LOCs are included together with ISLOCAs in a separate summary type SDP worksheet. Plant specific notes are included to explain how the particular IPE has addressed LOCs.

Initiating Event and System Dependency Table

1. Inclusion of systems under the support system column:

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

2. 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 ET headings/functions to that included in the Table was not considered necessary.

SDP Worksheets and Event Trees

1. 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 typically those covered under the Technical Specifications (TS) and the Maintenance Rule (MR). No evaluation was performed to assure that the components included in the worksheets are covered under TS or MR. However, if a component was included in the worksheet, and the licensee requested its removal, it may not have been removed if it is considered that the components is included in either TS or MR.

2. 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 to maintain consistency across the SDP worksheets of similar plant designs.

3. Crediting system trains with high unavailability

Some system component/trains may have unavailability higher than 1E-2, but they are treated in a manner similar to other trains with lower unavailability in the range of 1E-2. In this screening approach, this 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 1, i.e., an unavailability in the range of !E-1.

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

Passive components, namely isolation condensers in some BWRs, are credited similar to active components. The reliability of these components are not expected to differ (from that of active components) by more than an order of magnitude. Pipe failures have been excluded in this process except as part of initiating events where appropriate frequency is used. Accordingly, a separate designation for passive components was not considered necessary.

5. Defining credits for 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.

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

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

7. Dependency among multiple operator actions:

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

8. Crediting late injection (LI) following failure of containment heat removal (CHR), i.e., suppression pool cooling:

Following successful high or low pressure injection, suppression pool cooling is modeled. Upon failure of suppression pool cooling, containment venting (CV) is considered followed by late injection. Late injection is credited if containment venting is successful. Further, LI is required following CV success. The suction sources for the LI systems credited are different from the suppression pool. HPCI, LPCI, and CS are not credited in late injection. No credit is given for LI following failure of CV. The survival probability is low and such details are not considered in the screening approach here.

9. Combining late injection (LI) with low pressure injection (LPI) or containment venting (CV):

In some modeling approaches, LI is combined with LPI or CV. In the SDP worksheet approach here, these functions are separate. As discussed above, LPI and LI use different suction sources, and CV and LI may be two different categories of operator actions. In these respects, for some plants, SDP event trees may be different than the plant-specific trees.

10. Crediting condensate trains as part of multiple functions: power conversion system (PCS), low pressure injection (LPI), and late injection (LI):

Typically, condensate trains can be used as an LPI and LI source in addition to its use as part of the power conversion system. However, crediting the same train in multiple functions can result in underestimation of the risk impact of an inspection finding in the SDP screening approach since it does not account for these types of dependencies in defining the accident sequences. To simplify the process and to avoid underestimation, condensate train is not credited in LPI, but may be credited in LI.

11. Modeling vapor suppression success in different LOCA worksheets:

Vacuum breakers typically must remain closed following a LOCA to avoid containment failure and core damage. Some plants justify that vapor suppression is not needed for SLOCA. These sequences typically have low frequency and are not among the important contributors. However, an inspection finding on these vacuum breakers may make these sequences a dominant contributor. Accordingly, success of vapor suppression is included in the SDP worksheets. It is included for all three LOCA worksheets (LLOCA, MLOCA, and SLOCA); for plants presenting justification that they are not needed in a SLOCA appropriate modifications are made.

12. ATWS with successful PCS as a stable plant state:

Some plants model a stable plant state when PCS is successful following an ATWS. Following our comparison of similarly designed plants, such credits are not given.

13. Modeling different EDG configurations, SBO diesel, and cross-ties:

Different capabilities for on-site emergency AC power exist at different plant sites. To treat them consistently across plants, they are typically combined into a single emergency AC (EAC) function. The dedicated EDGs are credited following the standard convention used in the worksheets for equipment (1 dedicated EDG is 1 train; 2 or more dedicated EDGs is 1 multi-train system). The use of the swing EDG or the SBO EDG requires operator action. 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:

1. Describe the success criteria and the mitigation capability of dedicated EDGs.

2. 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.

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

4. 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.

14. 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.

15. Mitigation capability for containment heat removal:

The mitigation capability for containment heat removal (CHR) function is considered dominated by the hardware failure of the RHR pumps. The applicable operator action is categorized as an operator action with a credit 4, i.e., operator action=4. For this situation, the function is defined as 1 multi-train system since the operator action involved is considered routine and reliable, and is assigned a credit of 4. No other operator action in the worksheets is generically assigned this high credit.

16. Crediting CRD pumps as an alternate high pressure injection source:

In many plants, CRD pumps can be used as a high pressure injection source following successful operation of HPCI or RCIC for a period of time, approximately 1 to 2 hours. In some plants, CRD system is enhanced where it can be directly used and does not need the successful operation of other HPI sources. In the worksheets, if the CRD pumps require prior successful operation of HPCI or RCIC as a success criteria, then CRD is not credited as a separate high pressure injection source. If the CRD can be used and does not require successful operation of HPCI or RCIC, then it is credited as a separate success path within the HPI function.

2.2 RESOLUTION OF PLANT-SPECIFIC COMMENTS

This section documents the comments received on the material included in this report and their resolution.

Table 1.1 and 1.2

Added information on plant specific special initiators.

Added information to major components column.

Modified support systems for a few systems.

Adjusted the initiating events scenarios column based on licensee comments and changes made to worksheets.

Improved discussions of Dc, cross ties, ventilation, and containment venting.

Worksheets and Event Trees

Added the Turbine Bypass Valves (TBVs) to the Power Conversion System (PCS).

Adjusted the treatment of the PCS with consideration for generic NRC positions on credit for PCS in BWRs.

Modified the CV & LI treatment per generic NRC positions and licensee comments.

Updated credit for operator based on PRA HEPs and generic NRC credits.

Modified the CV systems.

Made minor editorial changes throughout.

Updated notes on all worksheets.

Modified LOOP worksheet and event tree. Deleted reference to RLOOP18 and RLOP18. Updated considering licensee's drawn LOOP ET and NRC standard BWR LOOP processes. Added HPCS EDG cross tie.

Added worksheets for IORV/SORV, ISLOCA and LOIA.

Did not provide credit for HPI and LPI systems in LI as per generic disposition above.

Updated treatment of suppression pool bypass in the EC function.

Some non-standard items credited by NMP-2 are only noted on the worksheets and are not credited by NRC on the worksheets. These may be credited by more detailed analyses in a Phase 3 analysis where justified.

REFERENCES

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

2. Niagara Mohawk Power Corp., "Nine Mile Point Nuclear Station, Unit 2 – Individual Plant Examination Report," dated July, 1992.

3. Niagara Mohawk Power Corp., "Nine Mile Point Nuclear Station, Unit 2 – Probabilistic Risk Assessment, July 1999, Rev. 0

4. Niagara Mohawk Power Corp., "Nine Mile Point Nuclear Station, Unit 2 – Safety and Availability Assessment, SAS-99

5. Memo, Peter Wilson to Jose Ibarra, 6/13/2000, ES00-0045, SDP Site Visit to Nine Mile Point Unit 2 - containing licensee comments on draft notebook.

6. Excerpts from NMP-2 USAR, Rev. 13, October, 2000

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