June 18, 2001

Mr. Michael A. Balduzzi
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SUBJECT: VERMONT YANKEE NUCLEAR POWER STATION - SITE-SPECIFIC WORKSHEETS FOR USE IN THE NUCLEAR REGULATORY COMMISSION'S SIGNIFICANCE DETERMINATION PROCESS (TAC NO. MA6544)

Dear Mr. Balduzzi:

Enclosed please find the Risk-Informed Inspection Notebook that 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 publicly 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 that were forwarded to you last spring. Subsequently, a site visit was conducted by the NRC to verify and update plant equipment configuration data and to collect site-specific risk information from your staff. The enclosed document reflects the results of this visit.

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

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

Sincerely,

/RA/

Robert M. Pulsifer, Project Manager, Section 2
Project Directorate I
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-271

Enclosure: Risk-Informed Inspection Notebook

cc w/encl: See next page

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RISK-INFORMED INSPECTION NOTEBOOK FOR

VERMONT YANKEE NUCLEAR POWER STATION

BWR-4, GE, WITH MARK I CONTAINMENT

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ENCLOSURE

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 Vermont Yankee Nuclear Power Plant.

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

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

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1. INFORMATION SUPPORTING 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 Vermont Yankee Nuclear Power Plant.

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 Vermont Yankee Nuclear Power Plant

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 offsite power	A	B	C
II	1 per 10-10^2 yr	Inadvertent or stuck open SRVs	B	C	D
III	1 per 10^2 - 10^3 yr		C	D	E
IV	1 per 10^3 - 10^4 yr	Small LOCA (RCS rupture), Medium LOCA (RCS rupture), Loss of Service Water (LOSW)	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 initiating event frequency for Loss of Service Water (LOSW) at VY is 7 E-4 events per reactor-year.

3. VY does model the loss of a single safety related 125 VDC bus (both DC-1 and DC-2) and the loss of a single safety related 4.16 KV AC bus (both bus 3 and bus 4). However, they state that the loss of any one of these will not cause an automatic scram and should not cause a loss of PCS.

The initiating event frequency for each is 1.5 E-3 events per reactor-year. The IPE does not provide an accident sequence frequency for these events or a load list or an explanation of loads lost for any of these bus loss events. Thus these events do not appear risk significant enough to provide separate worksheets for in this notebook.

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 involvements in different initiating events are noted in the last column.

Table 2 Initiators and System Dependency Table for Vermont Yankee Nuclear Power Plant

Affected System		Major Components	Support Systems	Initiating Event Scenarios
Code	Name			
PCS	Power Conversion System	4 MSIVs, 10 TBVs, 6 MDPs, MOV, AOV, condenser	AC, DC, TBCCW, SW, Inst. Air	TRANS, SLOCA, MLOCA, IORV/SORV, LLOCA, LOOP
HPCI	High Pressure Coolant Injection	1 TDP, MOV	DC	All but LLOCA & ATWS
RCIC	Reactor Core Isolation Cooling	1 TDP, MOV	DC	TRANS, TPCS, SLOCA, LOOP, LOSW
SRVs/ADS	Safety Relief Valves	4 SRVs, 2 RVs, AOV	DC, N_2 (cryogenic N_2, containment air compressors, or N_2 bottles)	All but LLOCA
LPCI	Low Pressure Coolant Injection	4 MDPs, MOV	AC, DC	All
RHR	Residual Heat Removal	4 MDPs, MOV, 2 HXs	AC, DC, RHRSW, RBCCW, SW	All
CS	Core Spray	2 MDPs, MOV	AC, DC	All
AC	AC Power (non-EDG)	Buses, breakers, transformers	AC, DC, offsite power	All
EDGs	AC Power (EDGs)	2 Engine generators	DC, SW, FO transfer	LOOP
FO transfer	EDG fuel oil transfer	MDP	AC	LOOP
SBO DG	Station Blackout Diesel /John Deere Diesel Generator	1 Engine generator	None	LOOP
DC	DC power, 125 V and 24 V	2 Batteries, 3 battery chargers, buses	None (short term - 4 hours) Chargers and AC (long term)	All

Table 2 (Continued)

Affected System		Major Components	Support Systems	Initiating Event Scenarios
Code	Name			
RHRSW	RHR Service Water	4 MDPs, MOV	AC, DC, SW	All
CRD	Control Rod Drive Hydraulic System	2 MDPs, AOV	AC, DC, RBCCW	All but LLOCA & ATWS
act	Actuation system	instrumentation	AC, DC	All but LOSW
Air	Station Air and Instrument Air	4 Air compressors, Valves	AC	TRANS, SLOCA, MLOCA, IORV/SORV, LLOCA, LOOP
N_2	Nitrogen Systems	TCVs, cryogenic tank, HP cylinders, containment air compressor (CAC)	AC, RBCCW, Inst. air	All but LLOCA
SLC	Standby Liquid Control	2 MDPs, MOV, 2 Explosive valves	AC	ATWS
RPT	Recirc pump trip	circuit breakers	act, DC, AC	ATWS
RBCCW	Reactor Building Closed Cooling Water	2 MDPs, 2 HXs	AC, DC, SW	All but LOSW
TBCCW	Turbine Building Closed Cooling Water	2 MDPs, AOV, 2 HXs	AC, SW	TRANS, SLOCA, MLOCA, IORV/SORV, LLOCA, LOOP
SW	Station Service Water	4 MDPs, MOV	AC, DC	LOSW
CT	Cooling tower	water basin, fan	AC, DC (see note 15)	All
CV	Containment Vent	Rupture disc, MOV	AC	All
cond xfer	Condensate Transfer	2MDPs, CST	AC, LPCI or CS MOV	All but LLOCA & ATWS

Table 2 (Continued)

Affected System		Major Components	Support Systems	Initiating Event Scenarios
Code	**Name**			
Firewater System	Firewater Injection Pump	1 MDP, 1 Diesel-driven pump	AC for MDP, SBO DG	LOOP

Notes:

1. Information herein was developed from the Vermont Yankee (VY) IPE dated December, 1993. This IPE uses ETs with systems as top events and system level fault trees. It also uses a Riskman support system analysis with split fractions. Information from the VY PRA dated December, 1998, supplied by the licensee was also used in developing this Notebook.

2. The baseline IPE core damage frequency (CDF) from internal events was 4.3 X 10^{-6} events/Rx year. The PRA baseline core damage frequency (CDF) from internal events was 4.9 X 10^{-6} events/Rx year, plus 9 X 10^{-6} events/Rx year from internal floods, and 3 X 10^{-5} events/Rx year from fires.

3. 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.

4. 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 VY, 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. In the last column of the Table for AC power (non-EDG), we have included all IEs (even LOOP) because LOOP has recovery events (RLOOP) that include offsite AC power.

5. The PCS has 10 turbine bypass valves (TBVs) with a total bypass capacity of 105%.

6. DC Power: The battery duration on an SBO for VY is 4 hours.

7. 1/2 RBCCW pumps is needed to cool the RHR pumps for SDC and SPC modes but not for the LPCI mode. However, as of 4/2000 this was under evaluation by the licensee and vendor to remove this dependency. RHRSW cools the RHR HXs. The SW system is needed to supply adequate suction to the RHRSW pumps, while in normal alignment. When in the Alternate Cooling Mode (ACM), the RHRSW pumps take suction directly from the deep basin at the west cooling tower and the SW pumps are not needed.

8. The HPCI & RCIC rooms both use the Reactor Building HVAC fans (once through air cooling with outside air and no cooling water) for room cooling. The steam tunnel has RRUs 17A and 17B for area cooling and are themselves cooled by SW. However, the IPE analysis shows that

Table 2 (Continued)

both HPCI and RCIC can operate for 8 to 12 hours continuously without room cooling or steam tunnel cooling. For the 24 hour mission time of the IPE, neither HPCI nor RCIC need to operate for more than half of the 24 hour time period. Thus, the licensee has concluded that, from a PRA standpoint there is no room or area cooling dependency. HPCI & RCIC would need AC power to open the normally-open inboard CIV, if closed.

9. Similar to the HPCI system, the PRA states that LPCI/RHR and CS can operate for their PRA mission time without need for the ECCS corner room cooling.

10. For the N_2 systems, RBCCW & IA only support the containment air compressor (CAC).

11. SLC needs the RWCU isolation MOV to close to prevent removal of boron.

12. Containment Vent: Since the IPE submittal, VY has removed a manual valve and added an MOV. The single MOV (TVS-86) is now a normally closed valve. Manual operator action is necessary to open the MOV to enable/control the vent. The baseline (updated) IPE assumes that TVS-86 can also be opened locally for Transient, LOOP and ATWS events (see also notes on these worksheets). Therefore, no support systems are needed to enable/control venting for these scenarios. For LOCA events and for Level 2 venting, the IPE conservatively assumes that TVS-86 must be opened remotely from the control room. Therefore, AC power support system is needed to enable/control venting for LOCA and Level 2 scenarios.

13. The John Deere Diesel Generator (JDD) should be considered with the diesel-driven fire pump as a success path for alternate injection for LOOP scenarios when recovery of offsite power fails. The JDD can be aligned to Bus 8/9 to power the station battery chargers (and extend battery life) and to power MOVs needed to align the diesel fire pump to the RHR/LPCI system, if these MOVs cannot be locally operated.

14. The Vernon Tie line is independent from normal offsite power and has sufficient capacity to operate an entire ECCS divisional train (supplies either 4 KV Bus 4 (Division S2) or 4 KV Bus 3 (Division S1)). Alignment of the Vernon Tie requires an operator action from within the control room (IPE HEP is in the range of E-03). DC power (from DC-1AS) is assumed to be required to operate the 3V4 breaker.

15. The Alternate Cooling Mode (ACM) is credited by VY as a backup to normal RHR suppression pool cooling mode with SW cooling for most sequences. It is particularly important for Loss of SW sequences . The ACM is discussed in Sections 3.1.4.2 and 3.2.33 of the IPE. The baseline IPE assumes that 12 hours are available to align the ACM to the RHR heat exchangers. ACM uses cell 1 of the west cooling tower (CTF 2-1) and associated deep basin, RHRSW pumps and RHR heat exchangers. ACM requires operator action for local manual alignment of manual valves. The ACM can supply suction water to the RHR SW pumps and cooling to the RHR HXs, the EDGs, the RHR corner rooms, the RHR pumps, and the CRD pumps. The HEP is in the range of E-2. All motive equipment (pumps/MOVs) in the ACM is powered from an emergency AC bus.

1.3 SDP WORKSHEETS

This section presents the SDP worksheets to be used in the Phase 2 evaluation of the inspection findings for the Vermont Yankee Nuclear Power Station. 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. Medium LOCA (MLOCA)
5. Inadvertent/Stuck Open Relief Valve (IORV)
6. Large LOCA (LLOCA)
7. Loss of Offsite Power (LOOP)
8. Anticipated Transients without Scram (ATWS)
9. Loss of Service Water (LOSW)
10. Interfacing System and LOCA Outside Containment (ISLOCA/LOC)

Table 3.1 SDP Worksheet for Vermont Yankee — 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)	1/4 steam lines, condenser, TBVs, 1/2 steam jet air ejector, 1/3 circ. water pump, 1/3 condensate pumps, 1/3 feedwater pumps (operator action = 3)
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	2/4 ADS valves manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps; or ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (1 multi-train system)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	1/2 CRD pumps; or 1/2 condensate transfer pumps (operator action = 2)

Circle Affected Functions	Recovery of Failed Train	Remaining Mitigation Capability Rating for Each Affected Sequence	Sequence Color
1 TRANS - PCS - CHR - LI (4, 8)			
2 TRANS - PCS - CHR - CV (5, 9)			
3 TRANS - PCS - HPI - LPI (10)			
4 TRANS - PCS - HPI - 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. The HEP in the VY PRA for DEP is 2E-4 for Transients. For the special case of DEP failure due to loss of N_2 to ADS, then VY credits LI to prevent core damage. This special case is not shown on the ET or the worksheet in this notebook.

2. Similar to most BWRS, for Containment Heat Removal VY uses the RHR pumps and RHR HXs, cooled by the RHRSW pumps and SW pumps. This requires human actions, however the HEPs are quite low. Therefore we have classified this activity as a multi-train system.

3. See Table 2, note 15 for discussion of the Alternate Cooling Mode (ACM) method of CHR.

4. CV at VY preferentially uses a hard-piped torus vent path consisting of a rupture disk and a normally closed MOV (TVS-86). There is also a non-hard-piped vent from the drywell. The MOV can be opened locally by an operator or remotely from the control room by an operator. VY does call for later throttling of CV line after the rupture disk blows, in order to control the loss from containment while performing LI. The VY-PSA HEP for opening the vent isolation valve and controlling containment pressure is 3.0 E-3. Throttling of the vent isolation valve is considered necessary to preserve LPCI or CS suction, if these systems are initially providing RPV injection and will continue for the long term (LI). Vent throttling is assumed not required if the injection systems are taking suction independent of the suppression pool such as with feedwater/condensate, condensate transfer, CRD, or HPI. While VY does take credit for this operator action to allow continued use of LPCI and CS, it is non-standard for other BWRs and is not credited here for TRANS and LOOP. It is credited for ATWS because no other LI systems are available and it is in the portion of the ET where LPI is already successful. This also affects the event trees in that LI is needed for success (if credit is not given to the LPI systems) when CV is utilized. The more detailed operator action may be considered in the Phase 3 analysis if properly justified.

5. VY credits all of the LPI and HPI systems additionally for LI. This is non-standard for other BWRs and if done here may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

Table 3.2 SDP Worksheet for Vermont Yankee — 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 Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	2/4 ADS valves manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps; or ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (1 multi-train system)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	1/2 CRD pumps; or 1/2 condensate transfer pumps (operator action = 2)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 TPCS - CHR - LI (3, 7)			
2 TPCS - CHR - CV (4, 8)			
3 TPCS - HPI - LPI (9)			
4 TPCS - HPI - 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. CV at VY preferentially uses a hard-piped torus vent path consisting of a rupture disk and a normally closed MOV (TVS-86). There is also a non-hard-piped vent from the drywell. The MOV can be opened locally by an operator or remotely from the control room by an operator. VY does call for later throttling of CV line after the rupture disk blows, in order to control the loss from containment while performing LI. The VY-PSA HEP for opening the vent isolation valve and controlling containment pressure is 3.0 E-3. Throttling of the vent isolation valve is considered necessary to preserve LPCI or CS suction, if these systems are initially providing RPV injection and will continue for the long term (LI). Vent throttling is assumed not required if the injection systems are taking suction independent of the suppression pool such as with feedwater/condensate, condensate transfer, CRD, or HPI. While VY does take credit for this operator action to allow continued use of LPCI and CS, it is non-standard for other BWRs and is not credited here. This also affects the event tree in that LI is needed for success if CV is utilized. The more detailed operator action may be considered in the Phase 3 analysis if properly justified.

2. Similar to most BWRS, for Containment Heat Removal VY uses the RHR pumps and RHR HXs, cooled by the RHRSW pumps and SW pumps. This requires human actions, however the HEPs are quite low. Therefore we have classified this activity as a multi-train system.

3. The HEP in the VY PRA for DEP is 2E-4 for Transients.

4. VY credits all of the LPI and HPI systems additionally for LI. This is non-standard for other BWRs and if done here may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

Table 3.3 SDP Worksheet for Vermont Yankee — Small LOCA (SLOCA)

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

Safety Functions Needed:	**Full Creditable Mitigation Capability for Each Safety Function:**
Early Containment Control (EC)	Passive operation of SP with 10/10 vacuum breakers closed (1 train system) or 2/4 ADS valves (operator action = 2)
Power Conversion System (PCS)	1/4 steam lines, condenser, TBVs, 1/2 steam jet air ejector, 1/3 circ. water pump, 1/3 condensate pumps, 1/3 feedwater pumps (operator action = 3)
High Press Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	2/4 ADS valves manually opened (operator action = 2)
Low Press Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps; or ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (1 multi-train system)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	1/2 CRD pumps; or 1/2 condensate transfer pumps (operator action = 2)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 SLOCA - PCS - CHR - LI (4, 8)			
2 SLOCA - PCS- CHR - CV (5, 9)			
3 SLOCA - PCS - HPI - LPI (10)			

4 SLOCA - PCS - HPI - DEP (11)			
5 SLOCA - EC (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. VY credits operator action to depressurize the primary via the ADS valves in the event of vapor suppression system failure and thus avoid overpressurization of the drywell. For the vapor suppression and depressurization use of the ADS valves in an SLOCA the HEPs are 4E-3 and 2E-4 respectively.

2. VY credits all of the LPI and HPI systems additionally for LI. This is non-standard for other BWRs and if done here may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

Table 3.4 SDP Worksheet for Vermont Yankee — 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:**
High Pressure Injection (HPI)	HPCI (1 ASD train)
Early Containment Control (EC)	Passive operation of SP with 10/10 vacuum breakers closed (1 train system) or 2/4 ADS valves (operator action = 1)
Depressurization (DEP)	2/4 ADS valves auto or manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps; or ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (1 multi-train system); or 1/3 trains of PCS (operator action = 1)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	1/3 Condensate pumps (operator action = 2)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 MLOCA - CHR- LI (3, 8)			
2 MLOCA - CHR - CV (4, 9)			
3 MLOCA - LPI (5, 10)			
4 MLOCA - HPI - DEP (11)			

5 MLOCA - EC (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. For the vapor suppression use of ADS valves in an MLOCA the HEP is in the E-1 range. Per VY drywell spray may also be a viable alternative for EC.

2. VY credits FW for HPI in the MLOCA. Also VY credits PCS for CHR in the MLOCA. These are non-standard for other BWRs and if done here with full credit may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

3. For the depressurization use of ADS valves in an MLOCA the HEP is in the E-3 range.

4. VY credits all of the LPI and HPI systems additionally for LI. This is non-standard for other BWRs and if done here may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

Table 3.5 SDP Worksheet for Vermont Yankee — 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)	HPCI (1 ASD train) or 1/3 trains of Feedwater/condensate/hotwell makeup (operator action = 2)
Depressurization (DEP)	1/3 ADS valves auto or manually opened, in addition to the IORV/SORV(operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps; or ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (1 multi-train system)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	1/2 CRD pumps; or 1/2 condensate transfer pumps; or 1/3 Condensate pumps (operator action = 2)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 IORV - CHR- LI (3, 8)			
2 IORV - CHR - CV (4, 9)			
3 IORV - LPI (5, 10)			
4 IORV - HPI - 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. Per the VY IPE, the transient ET is used only for evaluating the frequency of a SORV. The MLOCA ET is then used to analyze the SORV event. Thus, the MLOCA ET and worksheet have been adapted for the IORV/SORV.

2. For the depressurization use of ADS valves in an MLOCA the HEP is in the E-3 range. Therefore we presume that it will be similar for the IORV event. Since 2/4 ADS valves were needed for an MLOCA, and since one of the four ADS valves is assumed to be the IORV/SORV, we need one of the remaining three ADS valves for DEP.

3. VY credits all of the LPI and HPI systems additionally for LI. This is non-standard for other BWRs and if done here may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

4. VY also credits PCS for the CHR function. We have not credited that here due to a generic NRC position that an SORV typically results from transients caused by a loss of the turbine, TBVs, or MSIVs. Credit has been given for a (feedwater, condensate, and hotwell makeup) train for the HPI function and for condensate pumps in the LI function.

Table 3.6 SDP Worksheet for Vermont Yankee — Large LOCA (LLOCA)

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

Safety Functions Needed:	**Full Creditable Mitigation Capability for Each Safety Function:**
Early Containment Control (EC)	Passive operation of SP with 10/10 vacuum breakers closed (1 train system)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps; or ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (1 multi-train system)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	No credit for LI on LLOCA

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LLOCA -CHR - LI (3)			
2 LLOCA - CHR - CV (4)			
3 LLOCA - LPI (5)			
4 LLOCA - EC (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.

Note:

1. VY credits all of the LPI systems (LPCI & CS) additionally for LI in the LLOCA. This credit is based on operator action to throttle CV with an HEP of 3 E-3. This is non-standard for other BWRs and if done here may give those systems excessive credit in this screening methodology. However per the IPE, VY does not take credit for other alternate late injection sources that have suction from other than the suppression pool, e.g. fire water or Service Water. As a result, there is no credit for given LI on LLOCA, but LI is maintained in the structure for the ET and worksheet (to facilitate later credit that may be given for LI).

Table 3.7 SDP Worksheet for Vermont Yankee — Loss of Offsite Power (LOOP)

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

Safety Functions Needed:	**Full Creditable Mitigation Capability for Each Safety Function:**
DC Batteries (B)	1/2 DC batteries (2 diverse trains)
Emergency Power (EAC)	1/2 EDGs (1 multi-train system) or Vernon tie line (operator action = 2)
Recovery of LOOP in 45 min (RLOOP45M)	Recovery of AC power within 45 minutes (operator action = 1)
Recovery of LOOP in 4 hrs (RLOOP4H)	Recovery of AC power within 4 hours (operator action = 1)
High Pressure Injection (HPI)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	2/4 ADS valves manually opened (operator action = 2)
Fire Water Pump (FWP)	1/1 Fire Water pump plus 1/1 John Deere Diesel Generator (SBO diesel generator) (operator action = 1)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps; or ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (1 multi-train system)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	1/2 CRD pumps; or 1/2 condensate transfer pumps; or 1/3 condensate pumps (operator action = 2); or Fire Water Pump (operator action = 1)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LOOP - CHR - LI (1, 4)			
2 LOOP - CHR - CV (1, 5)			
3 LOOP - HPI- LPI (1)			

4 LOOP - HPI - DEP (1)			
5 LOOP - EAC - RLOOP4H - CV (7)			
6 LOOP - EAC - RLOOP4H - FWP (8)			
7 LOOP - EAC - RLOOP4H - DEP (9)			
8 LOOP - EAC - HPI (10)			
9 LOOP - B (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. In the VY IPE the LOOP initiating event frequency is 0.1 events per reactor-year.

2. VY has added a core damage sequence for LOOP plus failure of all batteries (B), however they note the following. For short term functioning (up to 4 hours) the batteries do not require any support systems, have no notable dependencies between trains, and the failure probability of both battery trains is about 1 E-8. Therefore VY has recommended that the two trains of the batteries be considered as two diverse trains.

3. The Vernon Tie line is independent from normal offsite power and has sufficient capacity to operate an entire ECCS divisional train (supplies either 4 KV Bus 4 (Division S2) or 4 KV Bus 3 (Division S1)). Alignment of the Vernon Tie requires an operator action from within the control room to close breaker 3V4 (IPE HEP is in the range of E-03 but credited as 2 herein). DC power (from DC-1AS) is required to operate the 3V4 breaker.

4. The RLOOP actions include only the recovery of offsite power and not failed EDGs. We have included in this worksheet recovery of offsite power at only one time, 4 hours (RLOOP4H), per the VY IPE. The VY IPE does not use a shorter RLOOP value, such as RLOOP1H, as do most other BWRs. As a result, VY (and our LOOP event tree) has a sequence LOOP - EAC - HPI rather than LOOP - EAC - RLOOP1H - HPI. The licensee has stated that they did not need to model this shorter RLOOP value in the IPE due to the credit taken in EAC for the very reliable Vernon tie line.

5. The RLOOP4H time is based on the VY battery duration of 4 hours, at which time batteries will fail, causing in turn a loss of HPCI and RCIC. The non-recovery probability of RLOOP4H in the VY IPE is 0.088.

6. The licensee suggested that the ET question HPI after a failure of RLOOP4H, however this was not included since HPI will fail on loss of batteries at 4 hours.

7. The HEP for depressurization (DEP) using ADS in transients, in the IPE and the PRA, is in the E-3 or lower range.

8. In Vermont Yankee (VY) on a station blackout, the IPE and the PRA assume that operator action is needed at 4 hours because at 4 hours HPCI and RCIC will fail due to battery depletion. However, if HPCI & RCIC fail at 4 hrs, credit is still given for DEP and then alternate injection by the fire water pump (FWP).

9. VY credits the use of fire water for alternate injection only if: (1) HPCI or RCIC succeed in the first 4 hours, in order to allow time for operators to line up the firewater injection; and (2) the reactor is successfully depressurized (DEP). The John Deere Diesel Generator (JDD) is used for Station Blackout (SBO) situations and should be considered with the diesel-driven FWP. The JDD can be aligned to Bus 8/9 to power the station battery chargers (and extend battery life) and to power MOVs needed to align the diesel fire pump to the RHR/LPCI system, if these MOVs cannot be locally operated.

10. The use of PCS for CHR or condensate / condensate transfer for LI requires recovery of offsite power. The CRD pumps are credited in LI for LOOP and are powered from the emergency buses.

11. VY credits all of the LPI and HPI systems additionally for LI. This is non-standard for BWR 4 plants and if done here may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

12. CV at VY preferentially uses a hard-piped torus vent path consisting of a rupture disk and a normally closed MOV (TVS-86). There is also a non-hard-piped vent from the drywell. The MOV can be opened locally by an operator or remotely from the control room by an operator. VY

does call for later throttling of CV line after the rupture disk blows, in order to control the loss from containment while performing LI. The VY-PSA HEP for opening the vent isolation valve and controlling containment pressure is 3.0 E-3. Throttling of the vent isolation valve is considered necessary to preserve LPCI or CS suction, if these systems are initially providing RPV injection and will continue for the long term (LI). Vent throttling is assumed not required if the injection systems are taking suction independent of the suppression pool such as with feedwater/condensate, condensate transfer, CRD, or HPI. While VY does take credit for this operator action to allow continued use of LPCI and CS, it is non-standard for other BWRs and is not credited here for TRANS and LOOP. It is credited for ATWS because no other LI systems are available and it is in the portion of the ET where LPI is already successful. This also affects the event trees in that LI is needed for success (if credit is not given to the LPI systems) when CV is utilized. The more detailed operator action may be considered in the Phase 3 analysis if properly justified.

Table 3.8 SDP Worksheet for Vermont Yankee — 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)	Need 50% reactor power relief capacity: 4/6 of SRVs/RVs (1 multi-train system)
Recirculation Pump Trip (RPT)	Manual or automatic trip of recirculation pumps plus trip of feedwater pumps (1 multi-train system)
Inhibit ADS (INH)	Operator inhibits ADS (operator action = 2)
Reactivity Control (SLC)	Operators manually inject with 1/2 SLC pumps (operator action = 2)
Rx Level Control (LC)	Control reactor water level in EOP control bands throughout the ATWS scenario, before and after DEP and SLC (operator action = 1)
High Pressure Injection (HPI)	Not credited
Depressurization (DEP)	2/4 ADS valves manually opened (operator action = 2)
Low Press Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps and 2/4 SW pumps (1 multi-train system)
Containment Venting (CV)	Operator throttles CV through hard-piped torus vent path (operator action = 1)
Late Inventory, Makeup (LI)	No credit for LI at VY in ATWS

Circle Affected Functions	**Recovery or Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 ATWS - OVERP (10)			
2 ATWS - RPT (9)			
3 ATWS - INH (8)			

4 ATWS - SLC (7)			
5 ATWS - LC (6)			
6 ATWS - DEP (5)			
7 ATWS - LPI (4)			
8 ATWS - CHR - CV (3)			

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

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

Notes:

1. In this worksheet we have combined the ATWS initiator with failure of Alternate Rod Insertion (ARI) and Manual Rod Insertion (MRI). Thus the ATWS assumes that electrical and mechanical scrams and ARI have all failed.

2. For conservatism this worksheet assumes ATWS follows an MSIV closure. Thus no credit is given for PCS. However, VY has a TB capacity of 105% and a condenser capacity of 110%, which assist in the mitigation of other ATWS events.

3. The VY IPE assumes that both RPT and trip of the motor-driven feedwater pumps is required to limit reactivity on an ATWS after an MSIV closure.
4. Different from other BWRs, VY does not credit HPI for an ATWS event.

5. VY uses an HEP of less than E-2 for depressurization (DEP) during ATWS.

6. LC in the VY IPE includes several related operator actions: (1) terminate and prevent all injection before DEP, (2) lower reactor water level (RWL) to the TAF and maintain level in the EOP control band until enough SLC is injected to shutdown the reactor, and (3) restore RWL after SLC injection to assure boron mixing. It is presumed that these LC actions also include the typical BWR action of preventing overfill by te LPI systems when they actuate. In the ATWS scenarios, LC is given HEPs in the E-3 to E-2 range.

7. CV at VY preferentially uses a hard-piped torus vent path consisting of a rupture disk and a normally closed MOV (TVS-86). There is also a non-hard-piped vent from the drywell. The MOV can be opened locally by an operator or remotely from the control room by an operator. VY does call for later throttling of CV line after the rupture disk blows, in order to control the loss from containment while performing LI. The VY-PSA HEP for opening the vent isolation valve and controlling containment pressure is 3.0 E-3. Throttling of the vent isolation valve is considered necessary to preserve LPCI or CS suction, if these systems are initially providing RPV injection and will continue for the long term (LI). Due to the vent throttling, the credit for the operator action is reduced to 1 from the generic NRC value of 2. Vent throttling is assumed not required if the injection systems are taking suction independent of the suppression pool such as with feedwater/condensate, condensate transfer, CRD, or HPI. While VY does take credit for this operator action to allow continued use of LPCI and CS, it is non-standard for other BWRs and is not credited here for TRANS and LOOP. It is credited for ATWS because no other LI systems are available and it is in the portion of the ET where LPI is already successful. This also affects the event trees in that LI is needed for success (if credit is not given to the LPI systems) when CV is utilized. The more detailed operator action may be considered in the Phase 3 analysis if properly justified.

Table 3.9 SDP Worksheet for Vermont Yankee — Loss of Service Water (LOSW)

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)	HPCI (1 ASD train) or RCIC (1 ASD train)
Depressurization (DEP)	2/4 ADS valves manually opened (operator action = 2)
Low Pressure Injection (LPI)	1/4 RHR pumps in 1/2 trains in LPCI Mode (1 multi-train system) or 1/2 CS pumps in 1/2 trains (1 multi-train system)
Containment Heat Removal (CHR)	ACM with 1/4 RHR pumps and 1/2 RHR HXs in 1/2 trains plus 1/4 RHRSW pumps, and cooling tower (operator action = 1)
Containment Venting (CV)	CV through hard-piped torus vent path (operator action = 2)
Late Inventory, Makeup (LI)	1/2 CRD pumps cooled by ACM; or 1/2 condensate transfer pumps (operator action = 2)

Circle Affected Functions	**Recovery of Failed Train**	**Remaining Mitigation Capability Rating for Each Affected Sequence**	**Sequence Color**
1 LOSW - CHR - LI (3, 7)			
2 LOSW - CHR - CV (4, 8)			
3 LOSW - HPI - LPI (9)			
4 LOSW - HPI - 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. LOSW results in a turbine trip and loss of PCS. This worksheet should be used with the event tree for TPCS, since it causes a loss of the PCS and behaves similarly. The initiating event frequency for Loss of Service Water (LOSW) at VY is 7 E-4 events per reactor-year.

2. SW loads at VY include: Diesel Generators, RBCCW, TBCCW, and corner room RRUs. Loss of SW will cause a loss of the PCS and a loss of SW cooling to the RHRSW System and the RHR heat exchangers.

3. The HEP in the VY PRA for DEP is 2E-4 for Transients, including LOSW.

4. For normal Containment Heat Removal VY uses the RHR pumps and RHR HXs, cooled by the RHRSW pumps and SW pumps. With the LOSW, this method of CHR is not available, therefore VY credits the ACM using the cooling towers in place of SW. VY also credits the ACM with providing cooling to the RHR corner room coolers, RHR pump cooling, and CRD pump cooling. This, however, requires numerous operator valve manipulations and thus the credit has been reduced to 1.

5. CV at VY preferentially uses a hard-piped torus vent path consisting of a rupture disk and a normally closed MOV (TVS-86). There is also a non-hard-piped vent from the drywell. The MOV can be opened locally by an operator or remotely from the control room by an operator. VY does call for later throttling of CV line after the rupture disk blows, in order to control the loss from containment while performing LI. The VY-PSA HEP for opening the vent isolation valve and controlling containment pressure is 3.0 E-3. Throttling of the vent isolation valve is considered necessary to preserve LPCI or CS suction, if these systems are initially providing RPV injection and will continue for the long term (LI). Vent throttling is assumed not required if the injection systems are taking suction independent of the suppression pool such as with feedwater/condensate, condensate transfer, CRD, or HPI. While VY does take credit for this operator action to allow continued use of LPCI and CS, it is non-standard for other BWRs and is not credited here. This also affects the event tree in that LI is needed for success if CV is utilized. The more detailed operator action may be considered in the Phase 3 analysis if properly justified.

6. VY credits all of the LPI and HPI systems additionally for LI. This is non-standard for other BWRs and if done here may give those systems excessive credit in this screening methodology. These may be considered in the Phase 3 analysis.

Table 3.10 SDP Worksheet for Vermont Yankee — 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 A & B	Two 24" lines with swing check valves V-46 A/B and normally closed (NC) MOV-27 A/B
CS Injection Lines A & B	Two 10" lines with swing check valves V-13 A/B and NC MOV-12 A/B
RHR SDC Line	One 20" line with NC MOV-17 and MOV-18
LOC PATHWAYS	
HPCI Line	Two MOVs (MOV-15 & -16), but the system is high pressure design up to turbine.
RCIC Line	Two MOVs (MOV-15 & -16), but the system is high pressure design up to turbine.
RWCU to Main Condenser and Waste Collector Tank	discharge line: MOV-18 plus two 'B' FWL check valves and two RWCU check valves V-62 and V-64 suction line: two RWCU MOVs
Feedwater Lines (FWLs)	Three check valves in each of two FWLs, V28 A/B, V96 A/B, and V27 A/B
Main Steam Lines (MSLs)	Two MSIVs per each of four MSLs.

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 defined are primarily based information from the VY PRA as supplied by the licensee. This was supplemented by information from NUREG/CR-5928, ISLOCA Research Program, Final Report, July 1993.

2. This worksheet contains pathways for both ISLOCA and LOC. Licensees typically analyze these events separately. The VY IPE results show that both of ISLOCA and LOC together equal 1% of total internal events CDF.

3. This worksheet is different from the other worksheets, in that ISLOCA is typically an unmitigated initiating event in most PRAs. Therefore the SDP notebook for this worksheet is such that 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 1.2, Initiators and System Dependency Table. We note, however, that VY has prepared ETs for both ISLOCA and LOC in the IPE and the PRA. Results are given in note 4.

4. The ISLOCA pathways for VY are LPCI injection lines A & B, the CS injection lines A & B, and the RHR shutdown cooling (SDC) line. The total IE frequency for these three pathways is 2.3 E-7 events per reactor-year. The VY PRA credits mitigating actions and systems typical for other LOCAs for the ISLOCAs scenarios. The resulting ISLOCA accident sequence frequency is 5.2 E-8 events per reactor-year.

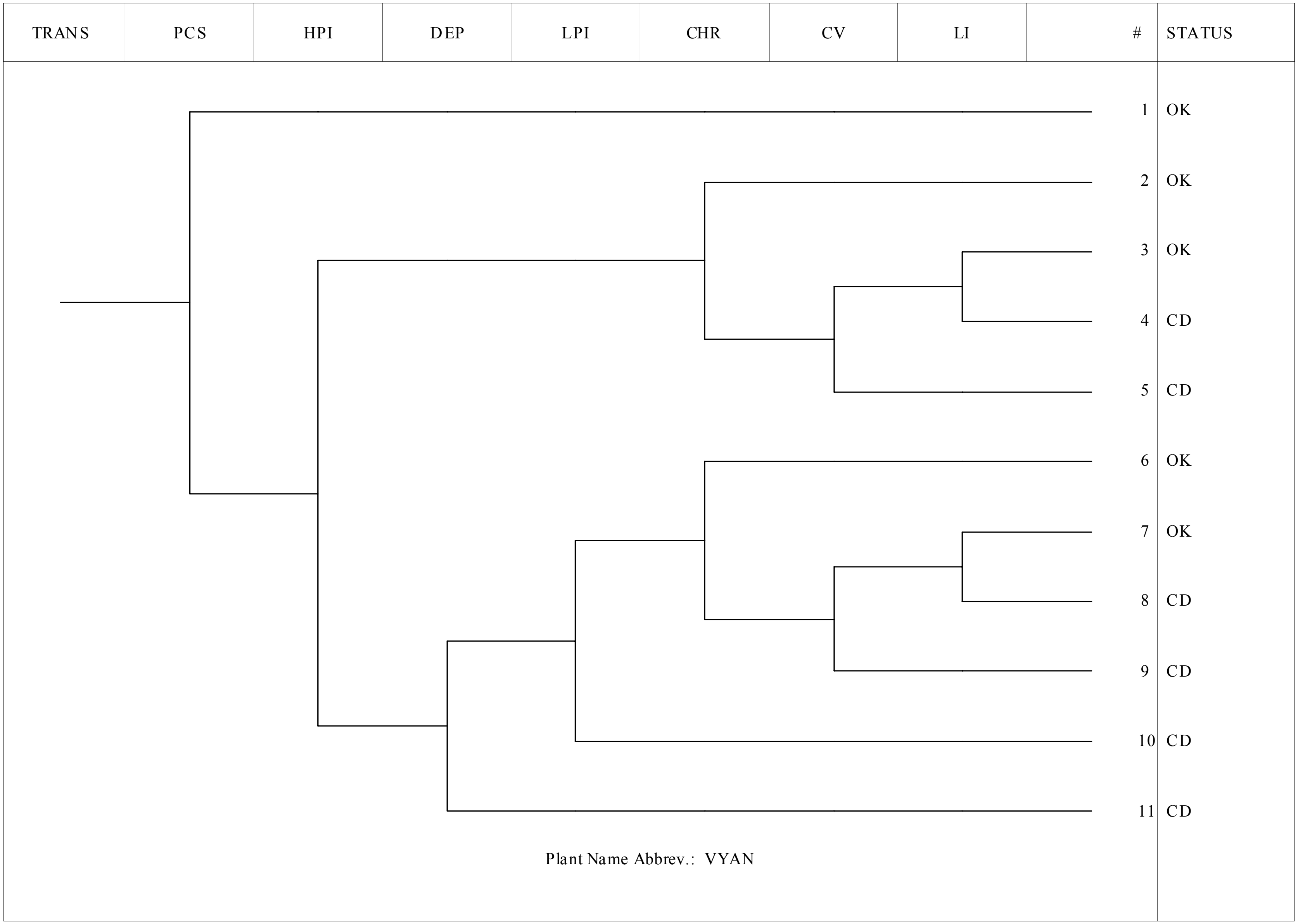
5. VY separately models LOCA outside containment (LOC) from ISLOCAs. The lines analyzed for LOC are: steam breaks for the main steam lines, HPCI line, and RCIC line; water breaks for feedwater lines and RWCU lines. The IE frequency for LOC is 1.5 E-6 events per reactor-year.

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. Medium LOCA (MLOCA)
5. Inadvertent/Stuck Open Relief Valve (IORV/SORV)
6. Large LOCA (LLOCA)
7. Loss of Offsite Power (LOOP)
8. Anticipated Transients without Scram (ATWS)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HPI
DEP
LPI
CHR
CV
LI
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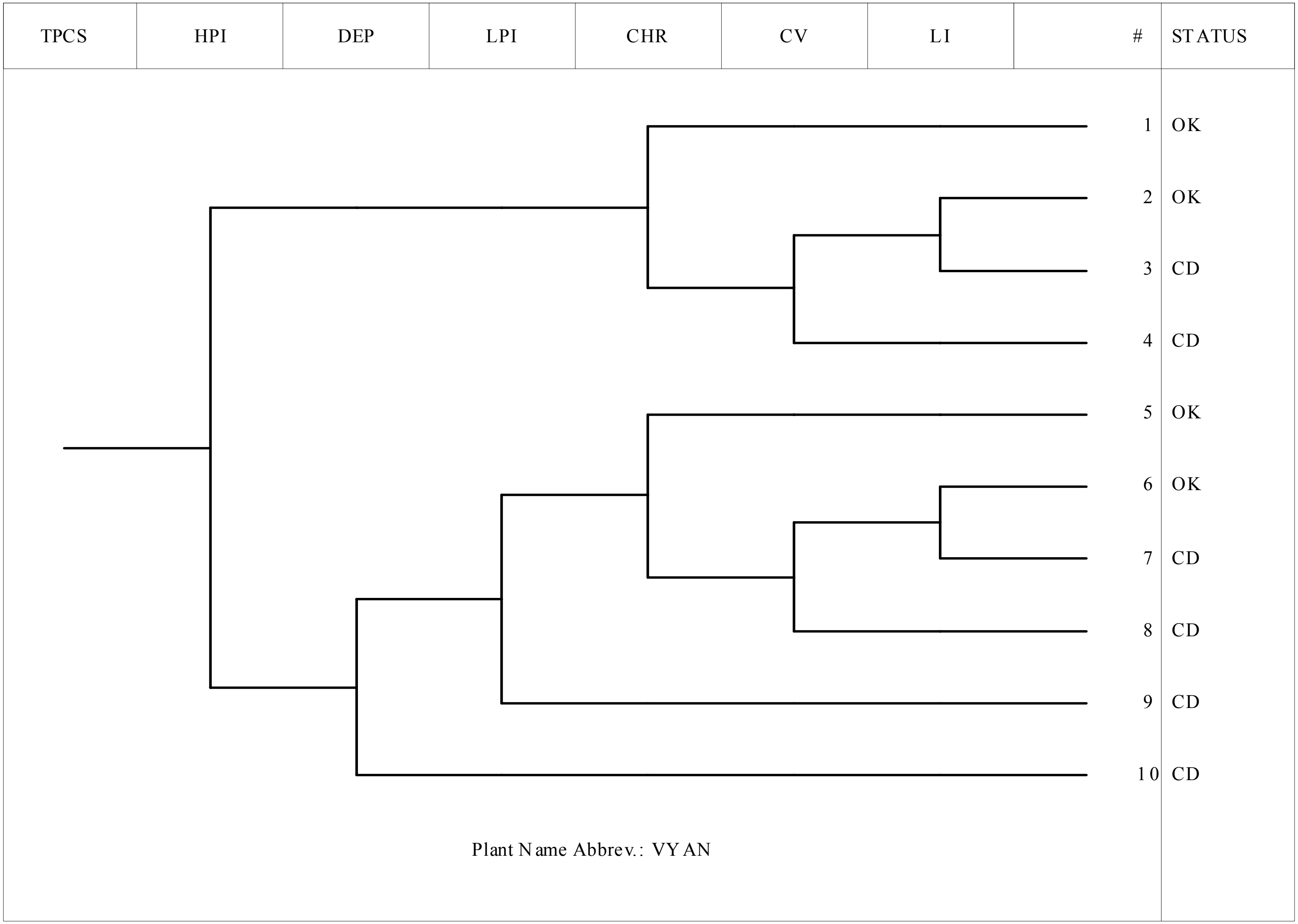
8 CD
9 CD
10 CD
11 CD
Plant Name Abbrev.: VYAN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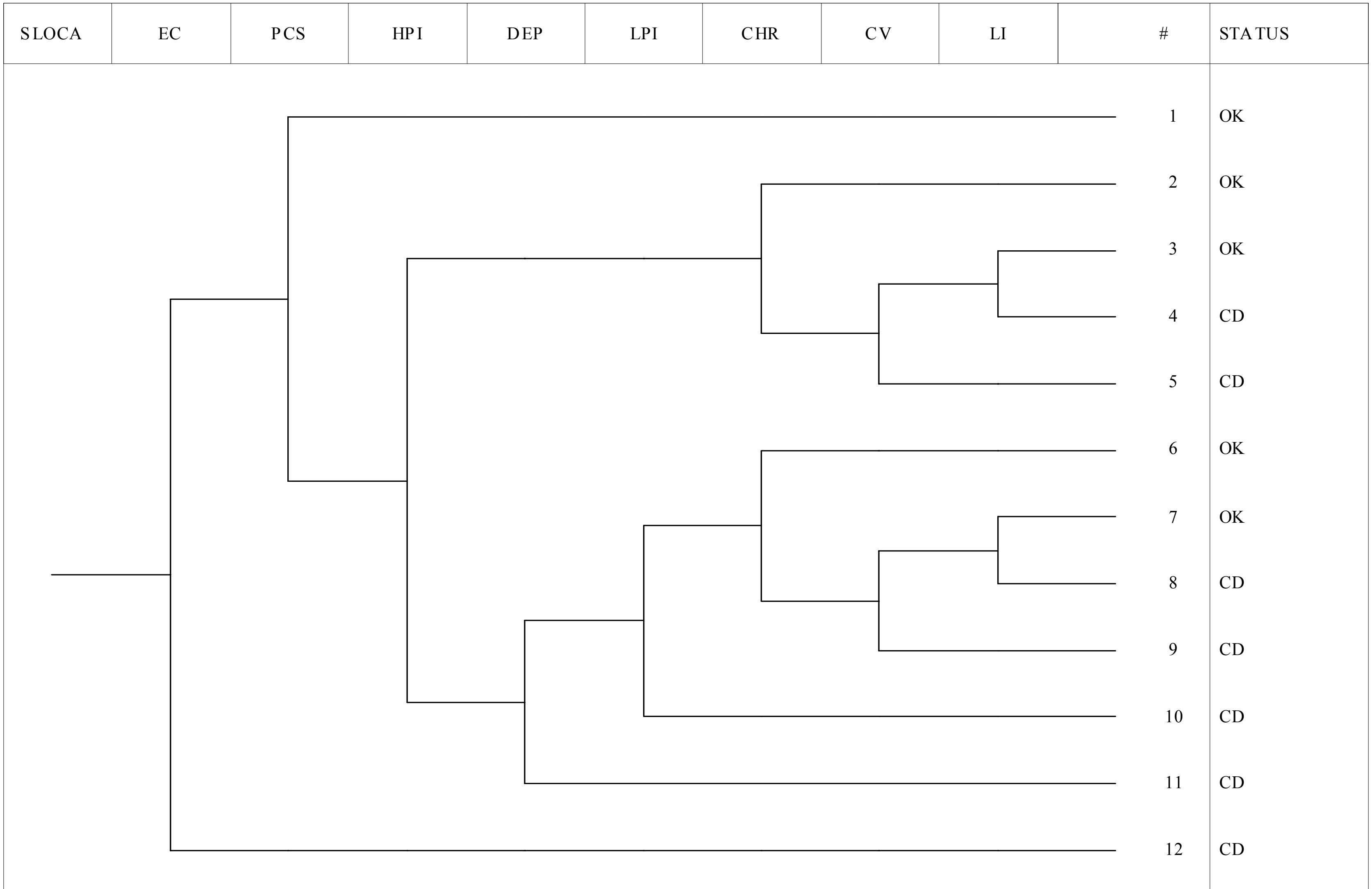

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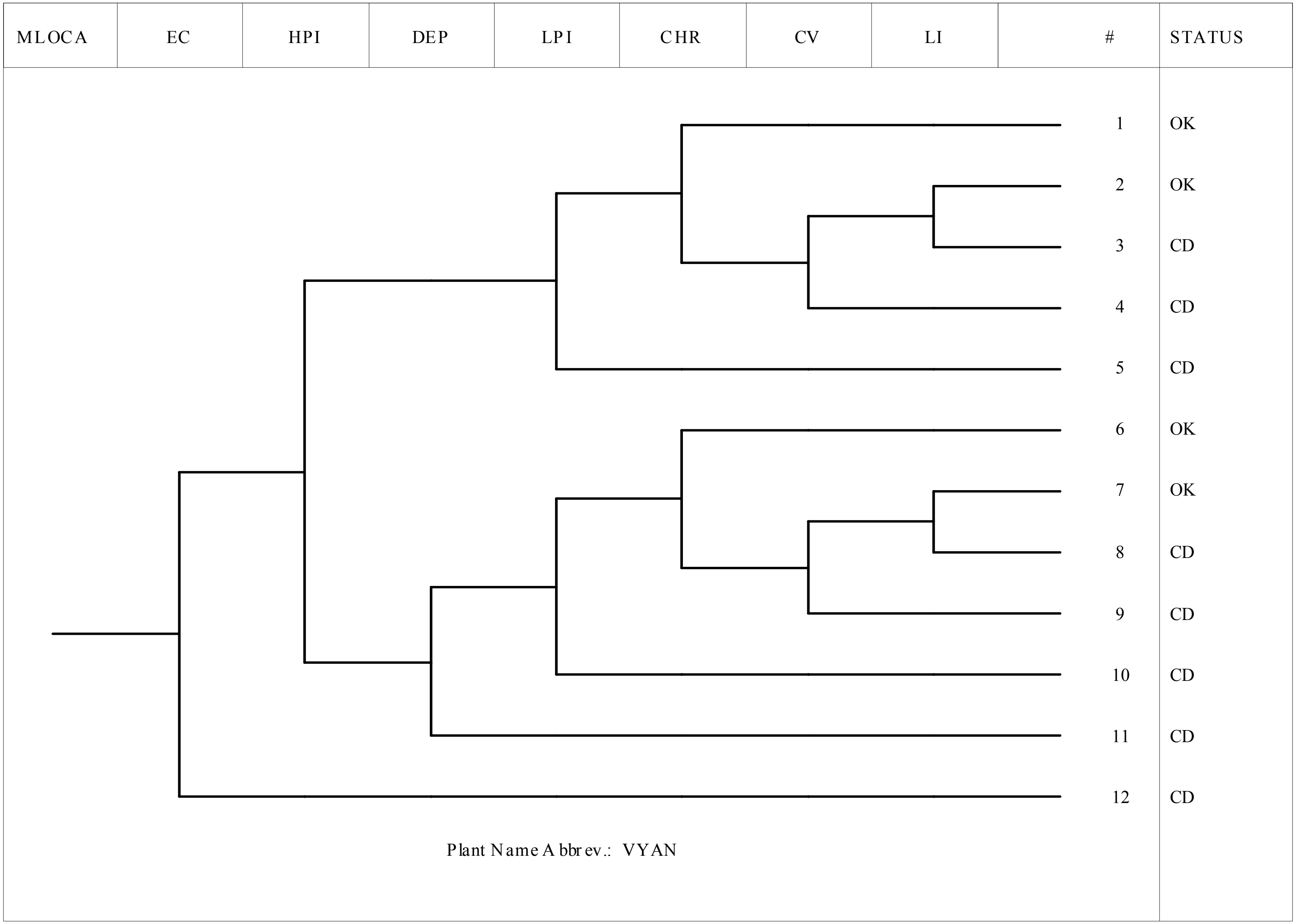
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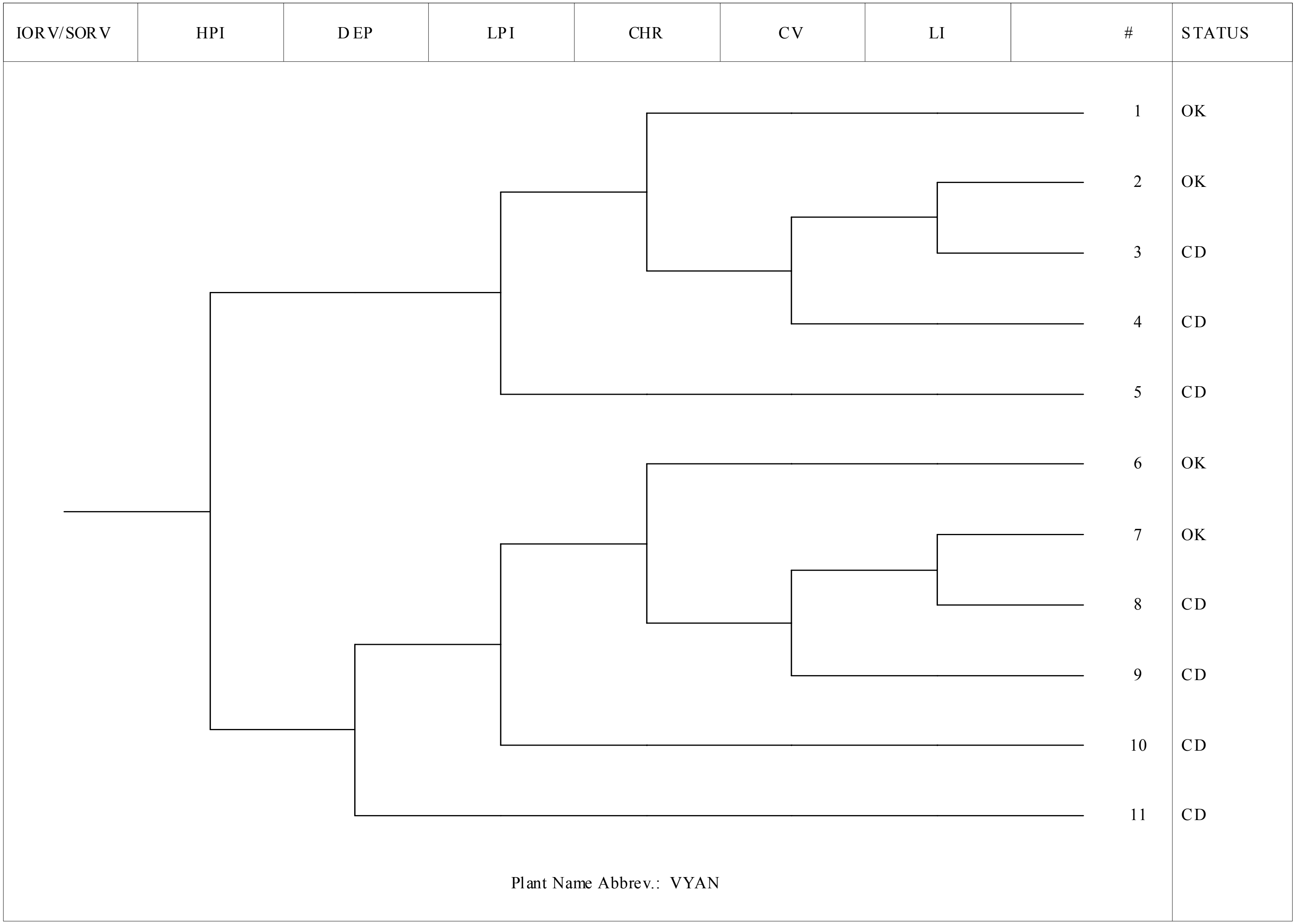
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CHR
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LI
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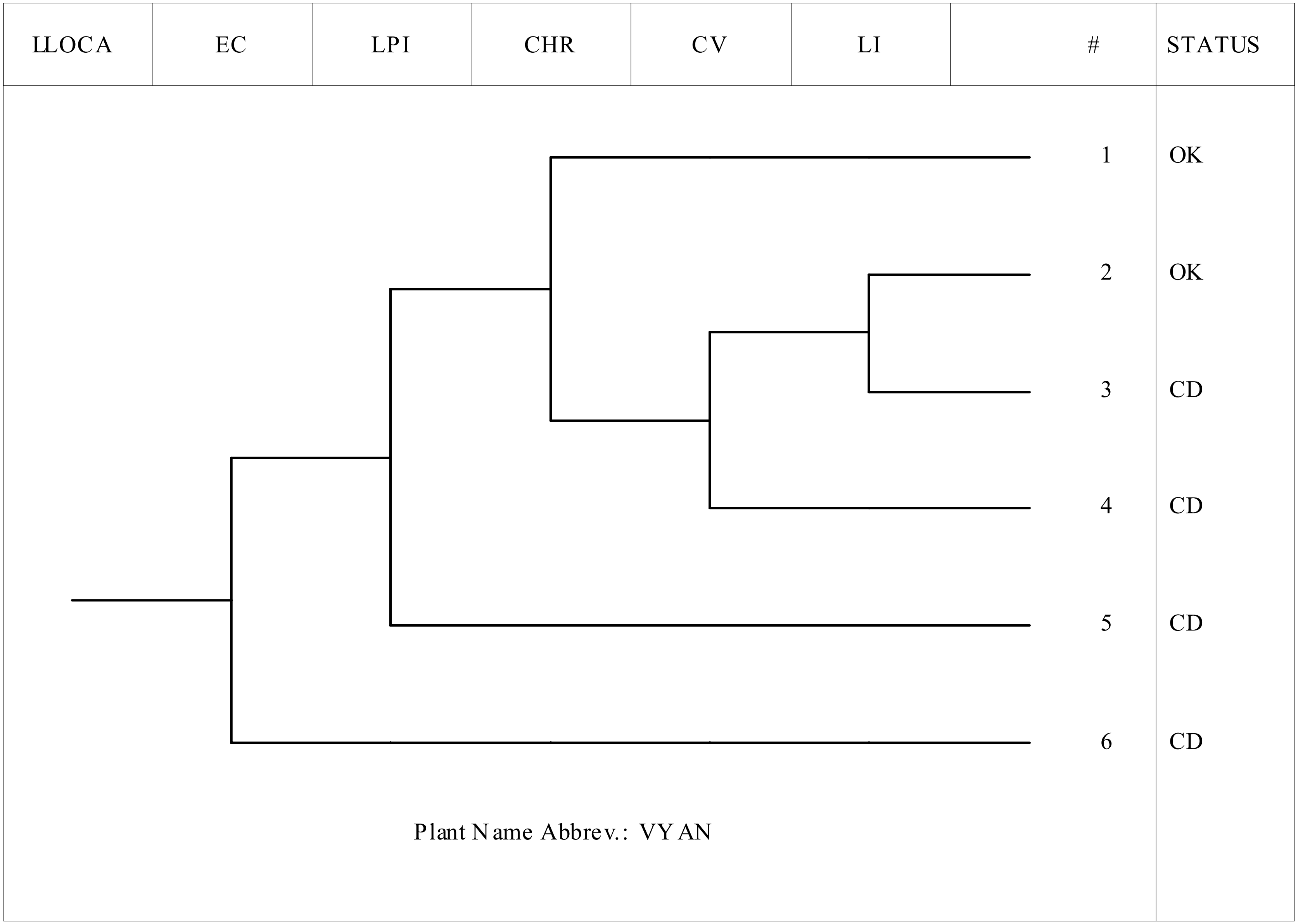
Plant Name Abbrev.: VYAN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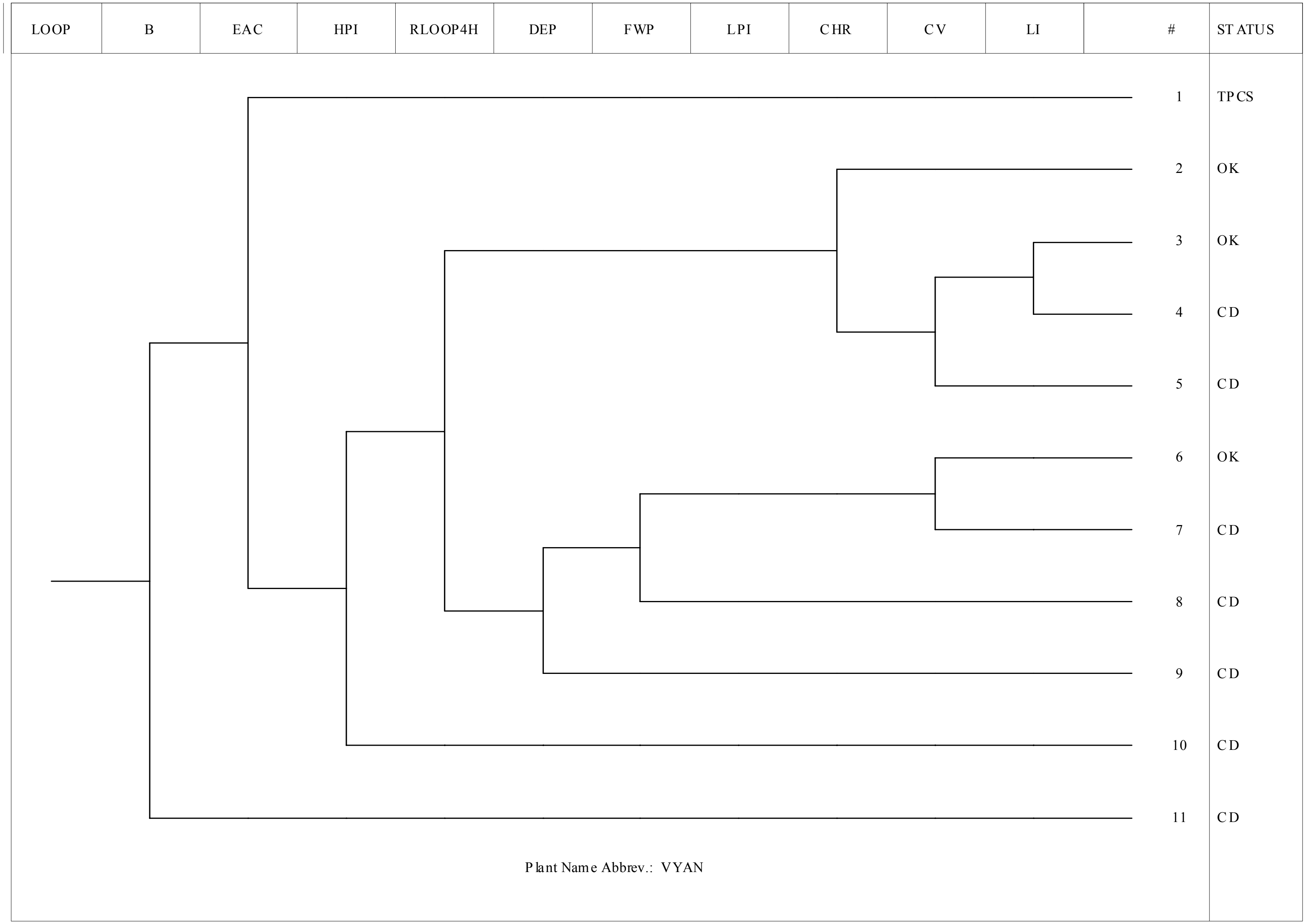
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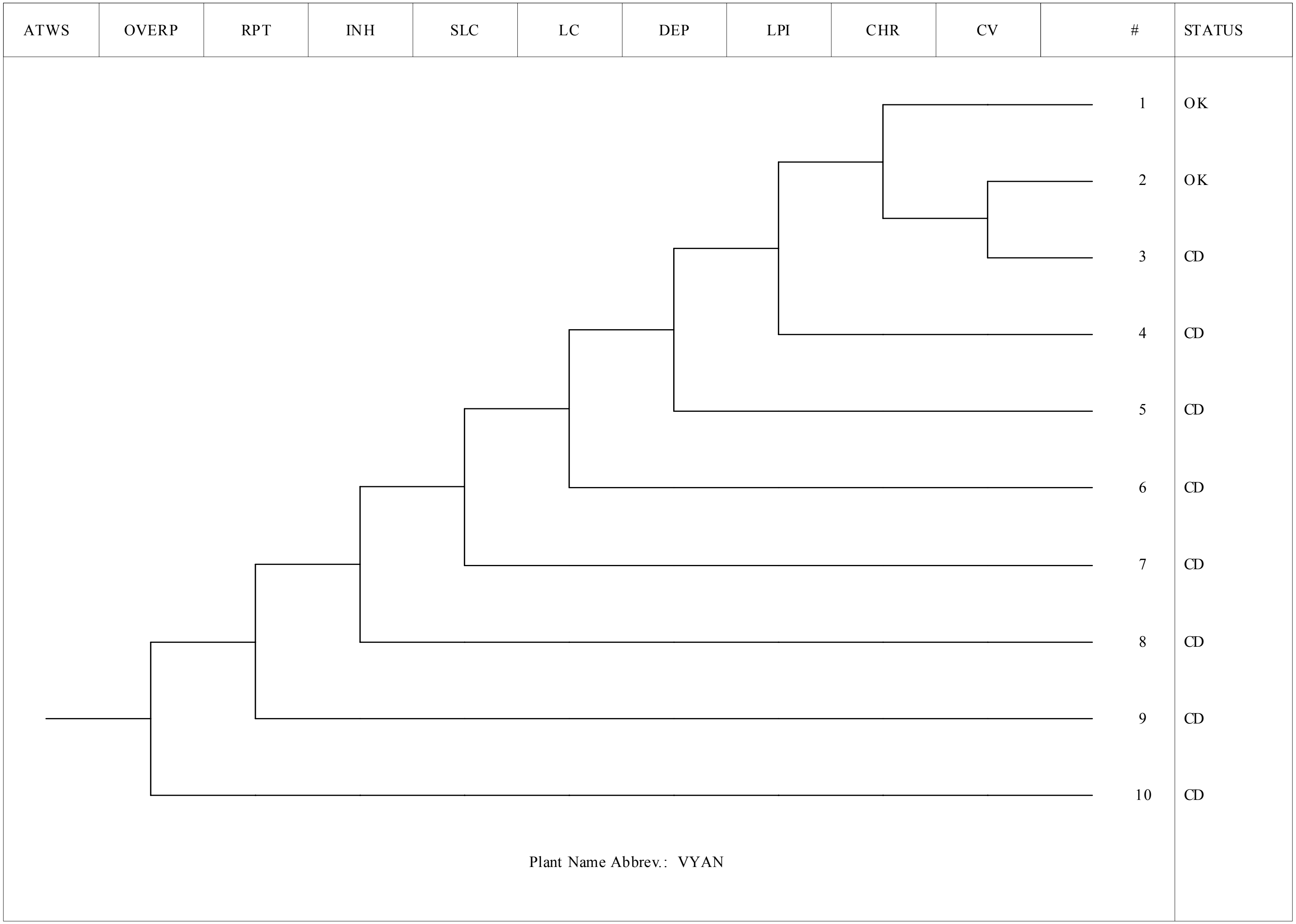
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10 CD
Plant Name Abbrev.: VYAN

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.

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2.2 RESOLUTION OF PLANT-SPECIFIC COMMENTS

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

Table 1.2

Added updated information based on the VY PRA dated December, 1998.

Added information to major components column.

Modified support systems for a few systems.

Added lines for the Station Blackout (SBO) diesel, namely the John Deere Diesel, and for Recirculation Pump Trip (RPT) circuitry.

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

Modified information of condensate transfer and Firewater Injection Pump.

Added summary information from VY PRA , December, 1998 to Table notes.

Added notes Nitrogen, TBVs, SLC and the RWCU isolation MOV, RBCCW support for LPCI, AC power for HPCI & RCIC containment isolation valves, containment venting, the John Deere Diesel, the Vernon tie line, and the Alternate Cooling Mode (ACM).

Worksheets

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

Modified the CV systems.

Made minor editorial changes throughout.

Added credit for the Alternate Cooling Mode (ACM) to LI.

Updated notes on all worksheets.

Deleted PCS from SLOCA worksheet.

Revised the LOOP worksheet and ET to transfer to TPCS, to add the Vernon tie, to change the order of safety functions to match the ET, to add a safety function of Fire Water Injection, to add CV, and to add ACM to the CHR function. Also developed new sequences based on the revised ET.

Deleted credit for LI and HPI on ATWS.

Added worksheets for ISLOCA, IORV/SORV, & LOSW.

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

Some non-standard items credited by VY 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. (e.g., throttling of CV in order to ensure that the suppression pool is vented but can still supply suction for injection systems, or use of HPI and LPI systems for LI).

Added worksheet for Loss of Service Water (LOSW) as a special initiator. VY comments note that Loss of individual AC and DC buses were considered as other possible special initiators, but that the loss of any single bus will not immediately cause a reactor trip or other transient. No sequences or separate ETs for these events were identified in the IPE. The IPE (PLG style) contains support system trees that address the impact of loss of various support systems (e.g., electrical buses) on front line systems.

REFERENCES

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

2. Vermont Yankee Nuclear Power Corporation, "Individual Plant Examination of Vermont Yankee, dated December, 1993.

3. Vermont Yankee PRA dated December, 1998, excerpts

4. Vermont Yankee Preliminary Review of Draft NRC SDP Tables (VY Specific), dated April 17, 2000.