March 27, 2000

Mr. Ted C. Feigenbaum
Executive Vice President and
Chief Nuclear Officer
North Atlantic Energy Service Corporation
c/o Mr. James M. Peschel
P.O. Box 300
Seabrook, NH 03874

SUBJECT: SEABROOK STATION, UNIT 1 - SITE-SPECIFIC WORKSHEETS FOR USE IN THE NUCLEAR REGULATORY COMMISSION'S SIGNIFICANCE DETERMINATION PROCESS (TAC NO. MA6544)

Dear Mr. Feigenbaum:

The purpose of this letter is to provide you with one of the key implementation tools to be used by the Nuclear Regulatory Commission (NRC) in the revised reactor oversight process, which is currently expected to be implemented at Seabrook Station, Unit 1 in April 2000. Included in the enclosed Risk-Informed Inspection Notebooks are the Significance Determination Process (SDP) worksheets that inspectors will be using to risk-characterize inspection findings. The SDP is discussed in more detail below.

On January 8, 1999, the NRC staff described to the Commission plans and recommendations to improve the reactor oversight process in SECY-99-007, "Recommendations for Reactor Oversight Process Improvements." SECY-99-007 is available on the NRC's web site at www.nrc.gov/NRC/COMMISSION/SECYS/index.html. The new process, developed with stakeholder involvement, is designed around a risk-informed framework, which is intended to focus both the NRC's and licensee's attention and resources on those issues of more risk significance.

The performance assessment portion of the new process involves the use of both licensee-submitted performance indicator data and inspection findings that have been appropriately categorized based on their risk significance. In order to properly categorize an inspection finding, the NRC has developed the SDP. This process was described to the Commission in SECY-99-007A, "Recommendations for Reactor Oversight Process Improvements (Follow-up to SECY-99-007)," dated March 22, 1999, also available at the same NRC web site noted above.

The SDP for power operations involves evaluating an inspection finding's impact on the plant's capability to limit the frequency of initiating events; ensure the availability, reliability, and capability of mitigating systems; and ensure the integrity of the fuel cladding, reactor coolant system, and containment barriers. As described in SECY-99-007A, the SDP involves the use of three tables: Table 1 is the estimated likelihood for initiating event occurrence during the degraded period, Table 2 describes how the significance is determined based on remaining mitigation system capabilities, and Table 3 provides the bases for the failure probabilities associated with the remaining mitigation equipment and strategies.

As a result of the recently concluded Pilot Plant review effort, the NRC has determined that site-specific risk data is needed in order to provide a repeatable determination of the significance of an issue. Therefore, the NRC has contracted with Brookhaven National Lab (BNL) to develop site-specific worksheets to be used in the SDP review. These enclosed worksheets were developed based on your Individual Plant Examination (IPE) submittals that were requested by Generic Letter 88-20. The NRC plans to use this site-specific information in evaluating the significance of issues identified at your facility when the revised reactor oversight process is implemented industry-wide. It is recognized that the IPE utilized during this effort may not contain current information. Therefore, the NRC or its contractor will conduct a site visit to discuss with your staff any changes that may be appropriate. Specific dates for the site visit have not been determined, but will be communicated to you in the near future. All site visits should be accomplished by June 2000. The NRC is not requesting a written response or comments on the enclosed worksheets developed by BNL.

We will coordinate our efforts through your licensing or risk organizations as appropriate. If you have any questions, please contact me at 301-415-3016

Sincerely,

/RA/

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

Docket No. 50-443

Enclosure: As Stated

cc w/encl: See next page

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RISK-INFORMED INSPECTION NOTEBOOK FOR

SEABROOK STATION

PWR, WESTINGHOUSE, FOUR-LOOP PLANT WITH LARGE DRY CONTAINMENT

Prepared by

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Department of Advanced Technology

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Prepared for

U. S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
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NOTICE

This notebook was developed for the NRC's inspection teams to support risk-informed inspections. The activities involved in these inspections are discussed in "Reactor Oversight Process Improvement," SECY-99-007A, March 1999. The user of this notebook is assumed to be an inspector with an extensive understanding of plant-specific design features and operation. Therefore, the notebook is not a stand-alone document, and may not be suitable for use by non-specialists. This notebook will be periodically updated with new or replacement pages incorporating additional information on this plant. Technical errors in, and recommended updates to, this document should be brought to the attention of the following person:

Mr. Jose G. Ibarra
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ABSTRACT

This notebook contains summary information to support the Significance Determination Process (SDP) in risk-informed inspections for the Seabrook Station.

SDP worksheets support the significance determination process in risk-informed inspections and are intended to be used by the NRC's inspectors in identifying the significance of their findings, i.e., in screening risk-significant findings, consistent with Phase-2 screening in SECY-99-007A. To support the SDP, additional information is given in an Initiators and System Dependency table, and as simplified event-trees, called SDP event-trees, developed in preparing the SDP worksheets.

The information contained herein is based on the licensee's IPE submittal. The information is revised based on IPE updates or other licensee or review comments providing updated information and/or additional details.

CONTENTS

FIGURES

TABLES

Page

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 based on the specifics of the inspection findings. To aid in this process, this notebook provides the following information:

1. Initiator and System Dependency Table
2. Significance Determination Process (SDP) Worksheets
3. SDP Event Trees

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

To evaluate the impact of the inspection's finding on the core-damage scenarios, the SDP worksheets are developed and provided. They contain two parts. The first part identifies the functions, the systems, or combinations thereof that can perform mitigating functions, the number of trains in each system, and the number of trains required (success criteria) for each class of initiators. The second part of the SDP worksheet contains the core-damage accident sequences associated with each initiator class; these sequences are based on SDP event trees. In the parenthesis next to each of the sequence 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. The classes of initiators that are considered in this notebook are 1) Transients, 2) Small Loss of Coolant Accident (LOCA), 3) Stuck-open Power Operated Relief Valve (PORV), 4) Medium LOCA, 5) Large LOCA, 6) Loss of Offsite Power (LOOP), 7) Steam Generator Tube Rupture (SGTR), and 8) Anticipated Transients Without Scram (ATWS). Main Steam Line Break (MSLB) events are included separately if they are treated as such in the licensee's Individual Plant Examination (IPE) submittal.

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.

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

1. Event trees and sequences were developed such that the worksheet contains all the major accident sequences identified by the plant-specific IPEs. In cases where a plant-specific feature introduced a sequence that is not fully captured by our existing set of initiators and event trees, then a separate worksheet is included.

2. The event trees and sequences for each plant took into account the IPE 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 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 IPEs also may define several classes of transients, depending on the initiator's impact on the systems. Such differentiations generally are not considered in the SDP worksheets unless they could not be accounted for by the Initiator and System Dependency table.

5. Major operator actions during accident scenarios are assigned as high stress operator action or an operator action using simple, standard criteria among a class of plants. This approach resulted in the designation of some actions as high-stress operator actions, even though the PRA may have assumed a (routine) operator action; hence, they have been assigned an error probability less than 5E-2 in the IPE. In such cases, a note is given at the end of the worksheet.

The three sections that follow include the initiators and dependency table, SDP worksheets, and the SDP event-trees for the Seabrook Station.

1.1 INITIATORS AND SYSTEM DEPENDENCY

Table 1 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 1 Initiators and System Dependency for Seabrook Station

Affected Systems[1]	Major Components	Support Systems	Initiating Event
AC Power System	Offsite power:[2] Switchyard	Non-Class 1E DC	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
	Vital 4.16 kV AC Power:[2] Two load groups, each with a Class 1E bus	Offsite power, Vital 125 VDC, Switchgear ventilation, Emergency power sequencer[3]	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
	120 VAC vital instrument power	Vital 4.16 kV AC Power, Vital 125 VDC	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
	Two diesel generators (one per load group)	Vital 125 VDC, SW, Diesel generator building ventilation, Fuel oil transfer pump	LOOP
Containment Building Spray (CBS) System	Two trains, each with a 100% capacity pump	Vital 4.16 kV AC Power, Vital 125 VDC, SSPS, ESFAS, PCC, EAH	LLOCA
DC Power System	Vital 125 VDC: two essential buses (11A and 11B), battery chargers and batteries. Batteries' rating is 6 hours.	Vital 4.16 kV AC Power (without AC, battery capacity is 6 hrs.)	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
	Non-Class 1E DC: Two batteries and battery chargers	Not found in IPE	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA

Table 1 (Continued)

Affected Systems[1]	Major Components	Support Systems	Initiating Event
Emergency Air Handling (EAH)	Containment Enclosure Cooling System: 2 trains, each with supply and return fans and a cooler unit	Vital 4.16 kV AC Power, PCC, IA	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
Emergency Core Cooling System[4]	SI system: Two SI pumps	Vital 4.16 kV AC Power, Vital 125 VDC, SSPS, ESFAS, PCC, EAH	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA, LOOP, SGTR, MSLBOC
	Four accumulators[5]		LLOCA
	CVCS: Two CVCS centrifugal charging pumps[6]	Vital 4.16 kV AC Power, Vital 125 VDC, SSPS, ESFAS, PCC, EAH	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
	RHR: Two RHR pumps	Vital 4.16 kV AC Power, Vital 125 VDC, SSPS, ESFAS, PCC, EAH	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, MSLBOC
Emergency Feedwater (EFW) System	One MDP	Vital 4.16 kV AC Power, Vital 125 VDC, SSPS, ESFAS, AMSAC	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA, LOOP, SGTR, ATWS, MSLBOC
	One TDP	Vital 125 VDC, IA, MS, SSPS, ESFAS, AMSAC	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA, LOOP, SGTR, ATWS, MSLBOC
	One start-up feed pump (SUFP)	Vital 4.16 kV AC Power, Vital 125 VDC	Transients with Loss of Main Feedwater

Table 1 (Continued)

Affected Systems[1]	Major Components	Support Systems	Initiating Event
Engineered Safety Features Actuation System (ESFAS)	Two trains of relays	120 VAC vital instrument power, SSPS	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
Instrument Air (IA)	3 100% capacity compressors	Vital 4.16 kV AC Power, Vital 125 VDC, SCC	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
Main Steam (MS)	4 Atmospheric Relief Valves (ARVs)	120 VAC vital instrument power, Vital 125 VDC, IA	SLOCA, SORV, MLOCA, MSLBOC
	4 Main Steam Isolation Valves (MSIVs)	Vital 125 VDC, SSPS, ESFAS	MSLBOC
	12 steam dump valves (SDVs) to condenser	120 VAC vital instrument power, Condenser vacuum, Circulating water, IA	SLOCA, SORV, MLOCA, MSLBOC
Primary Component Cooling Water (PCC)	Two trains, each with two full-capacity pumps	Vital 4.16 kV AC Power, Vital 125 VDC, SCC, SW, PAH Ventilation	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
Reactor Coolant Pressure Relief System (RCPRS)	Two PORVs and associated block valves	PORVs: Vital 125 VDC Block valves: Vital 4.16 kV	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, LOOP, ATWS, MSLBOC
	Three safety valves	None	ATWS
Reactor Coolant Pumps (RCP)	Seals	1 / 3 Charging pumps to seal injection or 1 / 4 PCC pumps to thermal barrier heat exchanger	LOOP, RCP seal LOCA

Table 1 (Continued)

Affected Systems[1]	Major Components	Support Systems	Initiating Event
Service Water System (SWS)	Two trains, each with two pumps	Vital 4.16 kV AC Power, Service Water pumphouse switchgear ventilation, cooling tower ventilation, SCC[7]	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA
Solid State Protection System (SSPS)	Redundant detector channels	120 VAC vital instrument power	Transients with Main Feedwater Available (Reactor Trip), Transients with Loss of Main Feedwater, SLOCA, SORV, MLOCA , LLOCA, LOOP, SGTR, ATWS, MSLBOC, RCP seal LOCA

Notes:

(1) The following systems were not found in Appendix E of IPE, “System Analyses Summary”: AMSAC, Circulating Water, Condenser, Emergency power sequencer, PAH Ventilation, Reactor Coolant Pumps (success criteria for RCP seal LOCA), and Secondary Component Cooling (SCC) Water.

(2) The support systems of this system are not included in IPE’s Table 3.2-2, System Dependencies. Hence, the list of support systems in Table 1 of this document may not be complete.

(3) Unavailability of the emergency power sequencer is equivalent to power failure at the 4.16 kV Class 1E level since it prevents automatic starting of the equipment supplied from the bus (IPE, page E-28).

(4) The shutoff heads of the pumps of the Emergency Core Cooling System were not found in Appendix E of IPE.

(5) Accumulators usually do not require support systems for their operation.

(6) The CVCS usually has a positive displacement pump, but this pumps was not included in section E.12 of the IPE, “Emergency Core Cooling System”.

(7) Secondary component cooling (SCC) isolation failure (for SI signal and LOSP, or TA signal) is assumed to fail SW (IPE, page 95, note 5).

(8) Plant total CDF = 1.1 E-4/yr. (external events contribute with 45.4% to this value, IPE, page 200).

Table 1 (Continued)

1.2 SDP WORKSHEETS

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

1. Transients with Main Feedwater Available (Reactor Trip)
2. Transients with Loss of Main Feedwater
3. Small LOCA
4. Stuck-open PORV
5. Medium LOCA
6. Large LOCA
7. LOOP
8. Steam Generator Tube Rupture (SGTR)
9. Anticipated Transients Without Scram (ATWS)
10. Main Steam Line Break Outside Containment (MSLBOC)

Table 2.1 SDP Worksheet for Seabrook Station —— Transients with Main Feedwater Available (Reactor Trip)

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>: [1]
Secondary Heat Removal (MFW)	
Secondary Heat Removal (EFW)	1 / 1 MDEFW trains (1 train) or 1 / 1 TDEFW train (1 ASD train)[2]
Early Inv., High Pressure Injection (EIHP)	1 / 2 charging pumps or 1 / 2 SI pumps (1 multi-train system)[3]
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs and block valves open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)

<u>**Circle Affected Functions**</u>	<u>**Recovery of Failed Train**</u>	<u>***Remaining Mitigation Capability Rating for Each Affected Sequence***</u>	<u>**Sequence Color**</u>
1 TRAN - EFW - HPR (3)			
2 TRAN - EFW - FB (4)			
3 TRAN - EFW - EIHP (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) A description of the main feedwater system was not found in Appendix E of the IPE.

(2) The value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

(3) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

Table 2.2 SDP Worksheet for Seabrook Station —— Transients with Loss of Main Feedwater

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

Safety Functions Needed:	*Full* Creditable Mitigation Capability for Each Safety Function:
Secondary Heat Removal (EFW)	1 / 2 MDEFW trains (1 multi-train system) or 1 / 1 TDEFW train (1 ASD train)(1)
Early Inventory Pressure Injection (EIHP)	1 / 2 charging pumps or 1 / 2 SI pumps (1 multi-train system)(2)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs and block valves open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)

Circle Affected Functions	Recovery of Failed Train	*Remaining Mitigation Capability Rating for Each Affected Sequence*	Sequence Color
1 TPCS - EFW - HPR (3)			
2 TPCS - EFW - FB (4)			
3 TPCS - EFW - EIHP (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 value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

(2) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

Table 2.3 SDP Worksheet for Seabrook Station —— Small LOCA

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

Safety Functions Needed:	***Full* Creditable Mitigation Capability for Each Safety Function:**
Secondary Heat Removal (EFW)	1 / 1 MDEFW trains (1 train) or 1 / 1 TDEFW train (1 ASD train)(1)
Early Inventory, High Pressure Injection (EIHP)	1 / 2 charging pumps or 1 / 2 SI pumps (1 multi-train system)(2)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs and block valves open for Feed/Bleed (operator action)
RCS Cooldown/ Depressurization (RCSDEP)	Operator depressurizes RCS using either the steam dump or atmospheric dump valves (operator action)
Low Pressure Injection (LPI)	1 / 2 RHR pumps (1 multi-train system)
RHR Cooldown (RHR)	1 / 2 RHR pumps (1 multi-train system)
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 SLOCA - RHR - HPR (3)			
2 SLOCA - EIHP - HPR (5)			
3 SLOCA - EIHP - LPI (6)			
4 SLOCA - EIHP - RCSDEP (7)			

5 SLOCA - EFW - HPR (9)			
6 SLOCA - EFW - FB (10)			
7 SLOCA - EFW - EIHP (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 value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

(2) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

Table 2.4 SDP Worksheet for Seabrook Station —— Stuck Open PORV (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:**
Isolation of Small LOCA (BLK)	The closure of the block valve associated with stuck open PORV (recovery action)
Secondary Heat Removal (EFW)	1 / 1 MDEFW trains (1 train) or 1 / 1 TDEFW train (1 ASD train)(1)
Early Inventory, High Pressure Injection (EIHP)	1 / 2 charging pumps or 1 / 2 SI pumps (1 multi-train system)(2)
Primary Heat Removal, Feed/Bleed (FB)	1 / 1 PORV and block valve open for Feed/Bleed (operator action)
RCS Cooldown / Depressurization (RCSDEP)	Operator depressurizes RCS using either the steam dump or atmospheric dump valves (operator action)
Low Pressure Injection (LPI)	1 / 2 RHR pumps (1 multi-train system)
RHR Cooldown (RHR)	1 / 2 RHR pumps (1 multi-train system)
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 SORV - BLK - RHR - HPR (3)			
2 SORV - BLK - EIHP - HPR (5)			
3 SORV - BLK - EIHP - LPI (6)			
4 SORV - BLK - EIHP - RCSDEP (7)			

5 SORV - BLK - EFW - HPR (9)			
6 SORV - BLK - EFW - FB (10)			
7 SORV - BLK - EFW - EIHP (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.			

<u>Notes</u>:

(1) The value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

(2) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

Table 2.5 SDP Worksheet for Seabrook Station —— Medium LOCA

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

Safety Functions Needed:	***Full* Creditable Mitigation Capability for Each Safety Function**:
Early Inventory, High Pressure Injection (EIHP)	2 / 4 charging and SI pumps (1 multi-train system)(1)
Secondary Heat Removal (EFW)	1 / 1 MDEFW trains (1 train) or 1 / 1 TDEFW train (1 ASD train)(2)
RCS Cooldown / Depressurization (RCSDEP)	Operator depressurizes RCS using either the steam dump or atmospheric dump valves (operator action)
Low Pressure Injection (LPI)	1 / 2 RHR pumps (1 multi-train system)
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 MLOCA - HPR (2, 4)			
2 MLOCA - EIHP - LPI (5)			
3 MLOCA - EIHP - RCSDEP (6)			
4 MLOCA - EIHP - EFW (7)			

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) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

(2) The value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

Table 2.6 SDP Worksheet for Seabrook Station —— Large LOCA

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

Safety Functions Needed:	***Full* Creditable Mitigation Capability for Each Safety Function**:
Early Inventory, Accumulators (EIAC)	3 / 3 accumulators (1 multi-train system)
Early Inventory, LP Injection (EILP)	1 / 2 RHR pump trains (1 multi-train system)
Containment Pressure / Temp Control (CNT)	1 / 2 CBS trains (1 multi-train system)
Low Pressure Recirculation (LPR)	1 / 2 RHR trains with operator switchover from injection to recirculation (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 LLOCA - LPR (2)			
2 LLOCA - CNT (3)			
3 LLOCA - EILP (4)			
4 LLOCA - EIAC (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.

Table 2.7 SDP Worksheet for Seabrook Station —— 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</u>* <u>Creditable Mitigation Capability for Each Safety Function</u>:**
Emergency AC Power (EAC)	1 / 2 Emergency Diesel Generators (1 train)(1)
Turbine-driven EFW pump (TDEFW)	1 / 1 TDP pump of EFW (1 train)(2)
Secondary Heat Removal (EFW)	1 / 2 MDEFW trains (1 multi-train system) or 1 / 1 TDEFW train (1 ASD train)(2)
Recovery of AC Power in < 2 hrs (REC2)	SBO procedures implemented (operator action under high stress)
Recovery of AC Power in < 5 hrs (REC5)	SBO procedures implemented (operator action)(3)
Early Inventory, High Pressure Injection (EIHP)	1 / 2 charging pumps or 1 / 2 SI pumps (1 multi-train system)(4)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs and block valves open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)

<u>Circle Affected Functions</u>	**<u>Recovery of Failed Train</u>**	***<u>Remaining Mitigation Capability Rating for Each Affected Sequence</u>***	**<u>Sequence Color</u>**
1 LOOP - EFW - HPR (3)			
2 LOOP - EFW - FB (4)			
3 LOOP - EFW - EIHP (5)			
4 LOOP - EAC - HPR (7, 11) (AC recovered)			

5 LOOP - EAC - EIHP (8, 13) (AC recovered)			
6 LOOP - EAC - REC5 (9)			
7 LOOP - EAC - TDEFW - FB (12) (AC recovered)			
8 LOOP - EAC - TDEFW - REC2 (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) Split fraction DGAB, Total loss of two diesel generators, is 7.5E-3.

(2) The value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

(3) In an SBO situation, an RCP seal LOCA may occur, with subsequent core damage at about 5 hours.

(4) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

Table 2.8 SDP Worksheet for Seabrook Station —— SGTR

Estimated Frequency (Table 1 Row) __________	Exposure Time __________	Table 1 Result (circle): A B C D E F G H	
Safety Functions Needed:	***Full* Creditable Mitigation Capability for Each Safety Function:**		
Secondary Heat Removal (EFW)	1 / 1 MDEFW trains (1 train) or 1 / 1 TDEFW train (1 ASD train)(1)		
Early Inventory, High Pressure Injection (EIHP)	1 / 2 charging pumps or 1 / 2 SI pumps (1 multi-train system)(2)		
Pressure Equalization (EQ)	Operator isolates the ruptured SG and depressurizes RCS using EFW and SGs(3) to less than setpoint of relief valves of SG (operator action under high stress)(4)		
Rapid Depressurization (RAPDEP)	Operator depressurizes RCS given failure of EIHP (operator action under high stress)(5)		
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)		
Low Pressure Injection (LPI)	1 / 2 RHR pumps (1 multi-train system)		
RHR Cooldown (RHR)	1 / 2 RHR pumps (1 multi-train system)		

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 SGTR - RHR (2, 5, 10)			
2 SGTR - EQ (3, 8, 12)			
3 SGTR - EIHP - LPI (6)			
4 SGTR - EIHP - RAPDEP (7)			

5 SGTR - EFW - HPR (11)			
6 SGTR - EFW - EIHP (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.			

<u>Notes</u>:

(1) The value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

(2) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

(3) If secondary cooling (EFW) is not available, feed and bleed cooling must be initiated for RCS depressurization (IPE, page 34).

(4) Operator depressurizes RCS is represented in the IPE (page 130) by two human actions: 1) “Operators depressurize the RCS using pressurizer spray, EFW, and S/Gs” (event O41, human error probability (HEP) = 5.0E-2), and 2) “Depressurize and cooldown by feed and bleed given EFW failure” (event O42, HEP = 7.0E-2).

(5) Operator depressurizes RCS given failure of EIHP is represented in the IPE (page 130) by “Operators depressurize the RCS given failure of high pressure injection” (event O52, HEP = 9.0E-2).

Table 2.9 SDP Worksheet for Seabrook Station —— ATWS

Estimated Frequency (Table 1 Row) __________	Exposure Time __________	Table 1 Result (circle): A B C D E F G H	
Safety Functions Needed:[(1)]	**Full Creditable Mitigation Capability for Each Safety Function:**		
Turbine trip (TTP)	AMSAC trips the turbine (1 train)[(2)]		
Primary Relief (SRV)	3 / 3 safety valves with 2 / 2 PORVs open (1 train)		
Secondary Heat Removal (EFW)	1 / 1 MDEFW trains (1 train) or 1 / 1 TDEFW train (1 ASD train)[(3)]		
Emergency Boration (EMEBOR)	Operator conducts emergency boration using 1 / 2 centrifugal charging pumps (operator action)		

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 ATWS - EMEBOR (2)			
2 ATWS - EFW (3)			
3 ATWS - SRV (4)			
4 ATWS - TTP (5)			

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

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

Notes:

(1) This worksheet assumes that main feedwater is not available.

(2) A description of the AMSAC was not found in the IPE.

(3) The value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

Table 2.10 SDP Worksheet for Seabrook Station —— MSLB Outside Containment (MSLBOC)

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:**
MSIV closure (MSIV)	3 / 4 MSIV close (1 train)
Secondary Heat Removal (EFW)	1 / 1 MDEFW trains (1 train) or 1 / 1 TDEFW train (1 ASD train)(1)
Operator controls EFW (OPEFW)	Operator controls EFW to prevent overcooling (operator action under high stress)(2)
Early Inventory, High Pressure Injection (EIHP)	2 / 4 charging and SI pumps (1 multi-train system)(3)
Operator controls HPI (OPHPI)	Operator controls HPI flow to prevent overpressurization (operator action)
RCS Cooldown / Depressurization (RCSDEP)	Operator depressurizes RCS using either the steam dump or atmospheric dump valves (operator action)
Low Pressure Injection (LPI)	1 / 2 RHR pumps (1 multi-train system)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs and block valves open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 charging pumps or 1 / 2 SI pumps) with 1 / 2 RHR pumps and with operator action for switchover (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 MSLBOC - EIHP - LPI (3, 11)			
2 MSLBOC - EIHP - RCSDEP (4, 12)			
3 MSLBOC - EFW - HPR (6)			
4 MSLBOC - EFW - FB (7)			

5 MSLBOC - EFW - EIHP (8)			
6 MSLBOC - MSIV - OPEFW - OPHPI (14)			
7 MSLBOC - MSIV - OPEFW - EIHP (15)			
8 MSLBOC - MSIV - EFW (16)			
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.			

Notes:

(1) The value assessed by the IPE (page E-97) for the failure of the TDP of EFW is 4.8E-2. For the SDP calculation, a value of 1E-1 can be used.

(2) The human error probability (HEP) assessed in the IPE (page 130) for controls EFW to prevent overcooling is 6.2E-2 (event OM1).

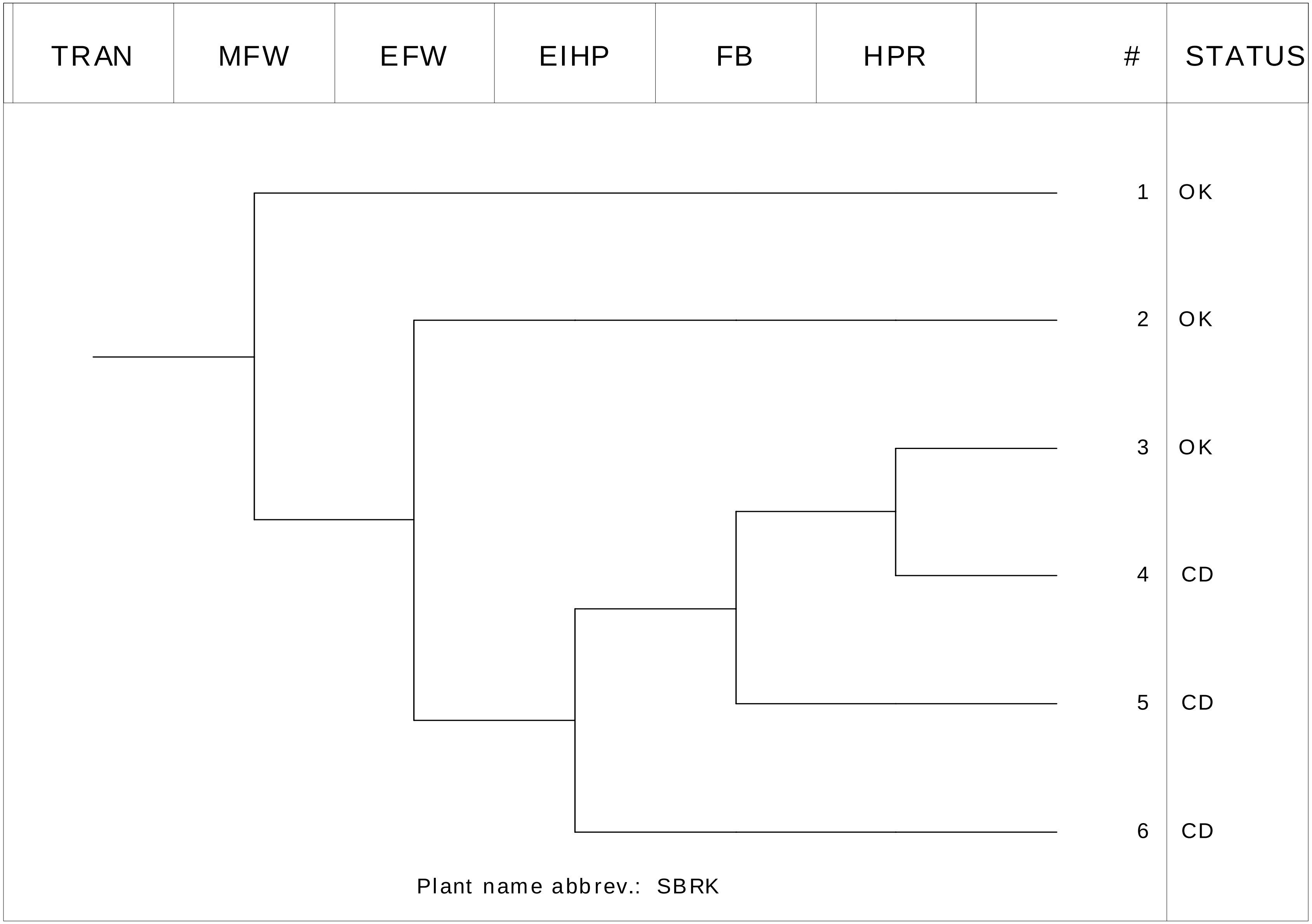
(3) Since the charging pumps and the SI pumps depend on the same support systems, the mitigating capability is 1 multi-train system.

1.3 SDP EVENT TREES

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

The following event trees are included:

1. Transients with Main Feedwater Available (Reactor Trip)
2. Transients with Loss of Main Feedwater
3. Small LOCA
4. Medium LOCA
5. Large LOCA
6. LOOP
7. Steam Generator Tube Rupture (SGTR)
8. Anticipated Transients Without Scram (ATWS)
9. MSLB Outside Containment (MSLBOC)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MFW
EFW
EIHP
FB
HPR
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3 OK
4 CD
5 CD
6 CD
Plant name abbrev.: SBRK


TPCS
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EIHP
FB
HPR
#
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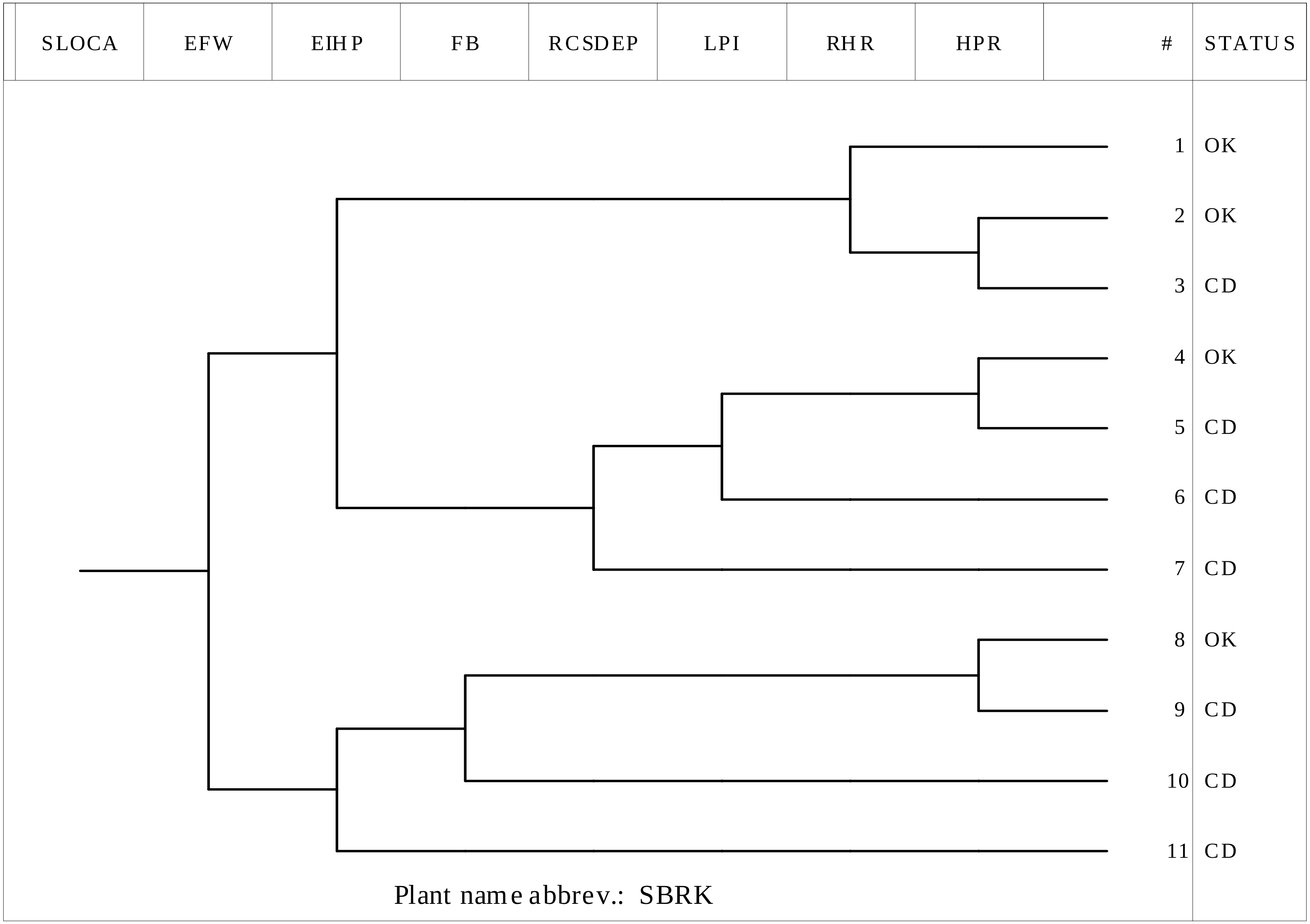
3 CD
4 CD
5 CD
Plant name abbrev.: SBRK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RHR
HPR
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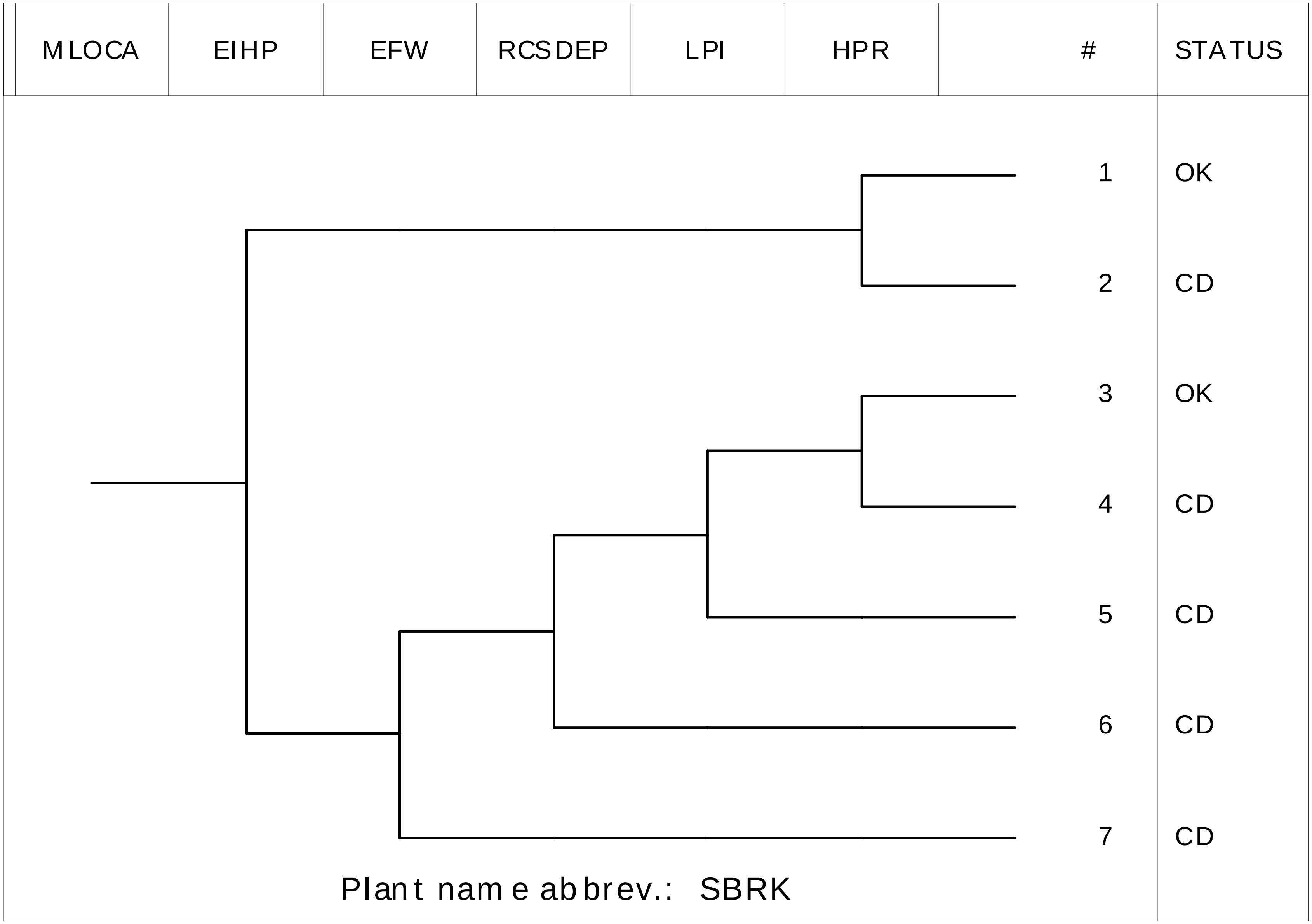
7 CD
8 OK
9 CD
10 CD
11 CD
Plant name abbrev.: SBRK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RCSDEP
LPI
HPR
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CD
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CD
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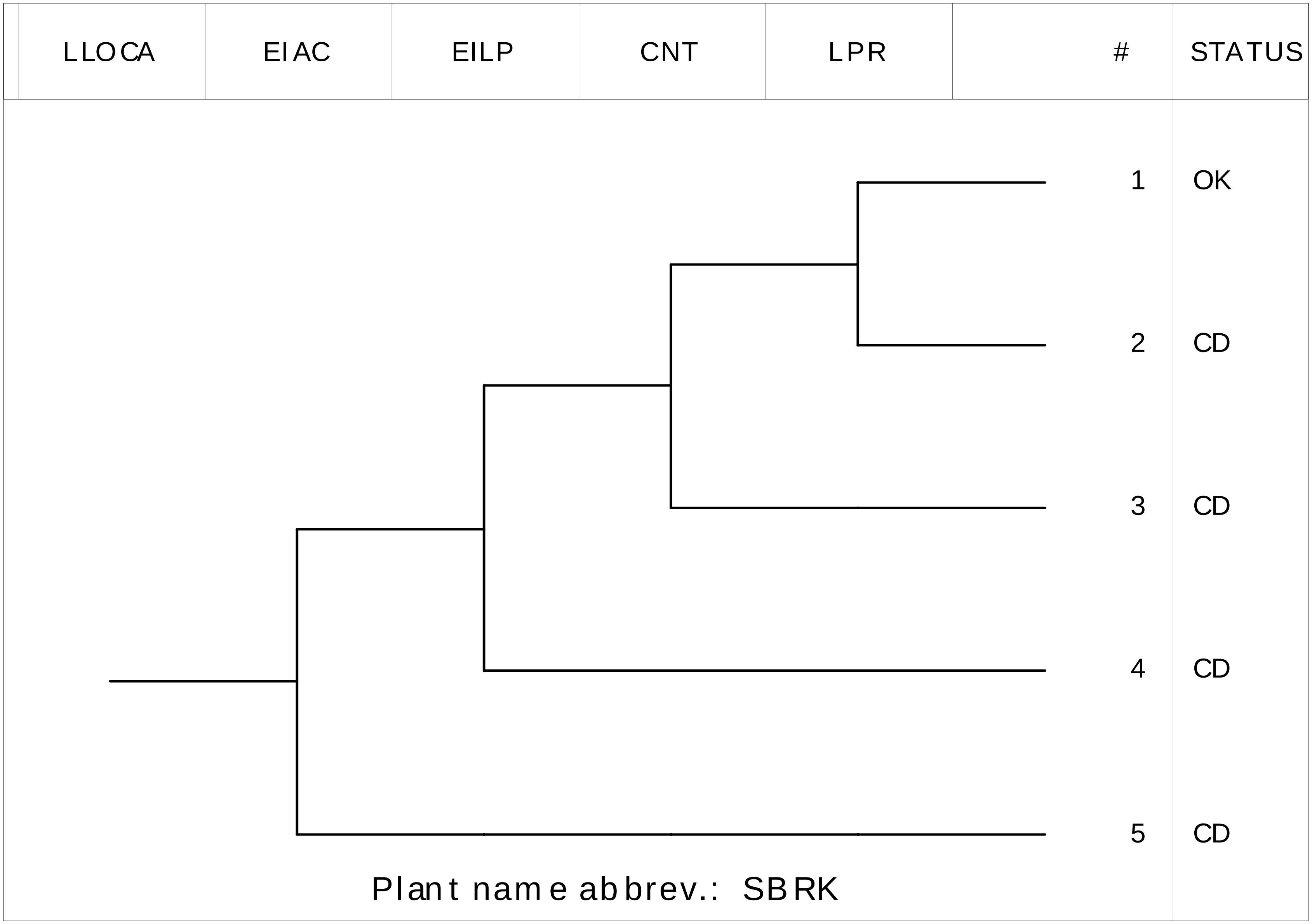
7
CD
Plant name abbrev.: SBRK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EILP
CNT
LPR
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STATUS
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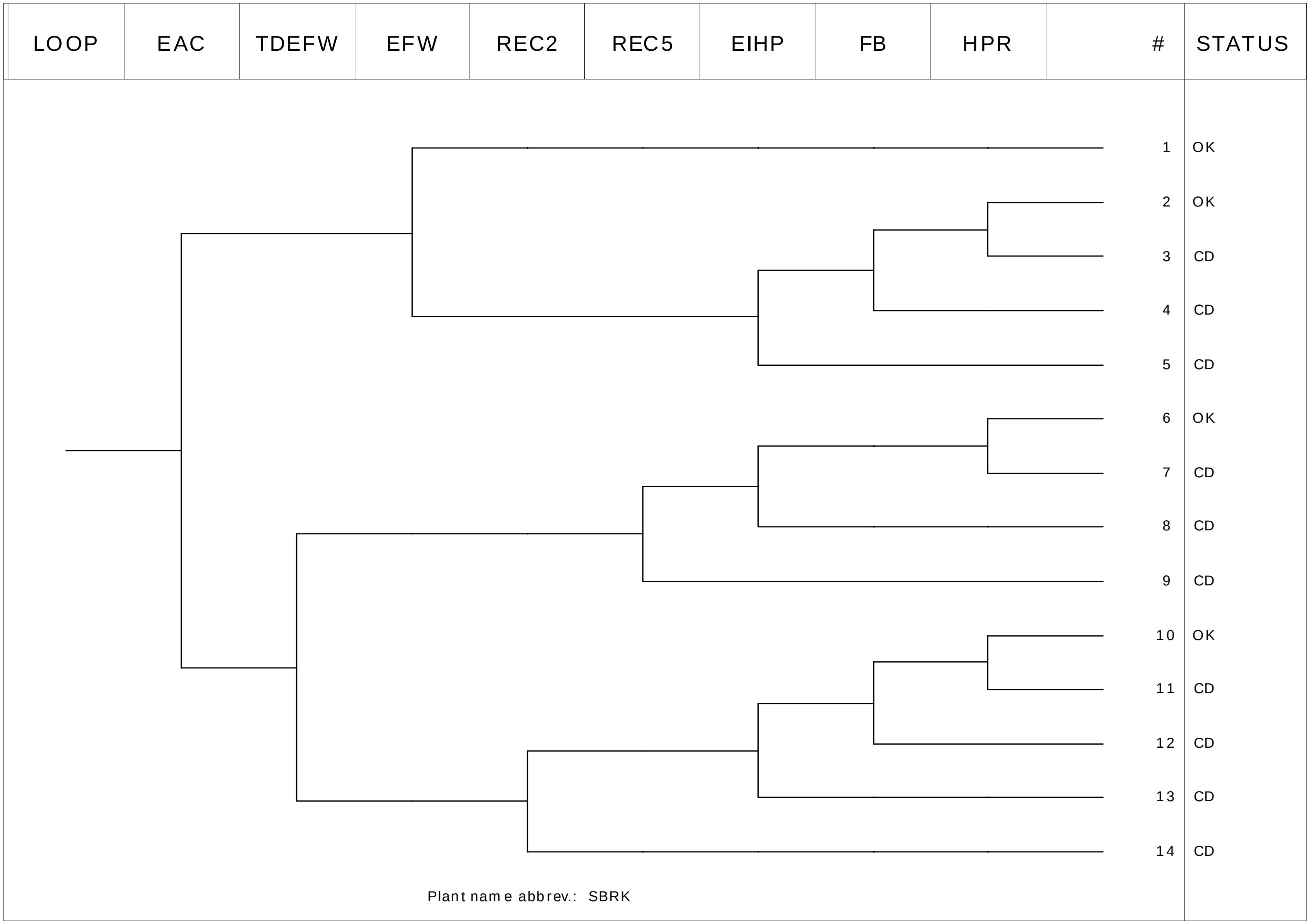
CD
5
CD
Plant name abbrev.: SBRK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EAC
TDEFW
EFW
REC2
REC5
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FB
HPR
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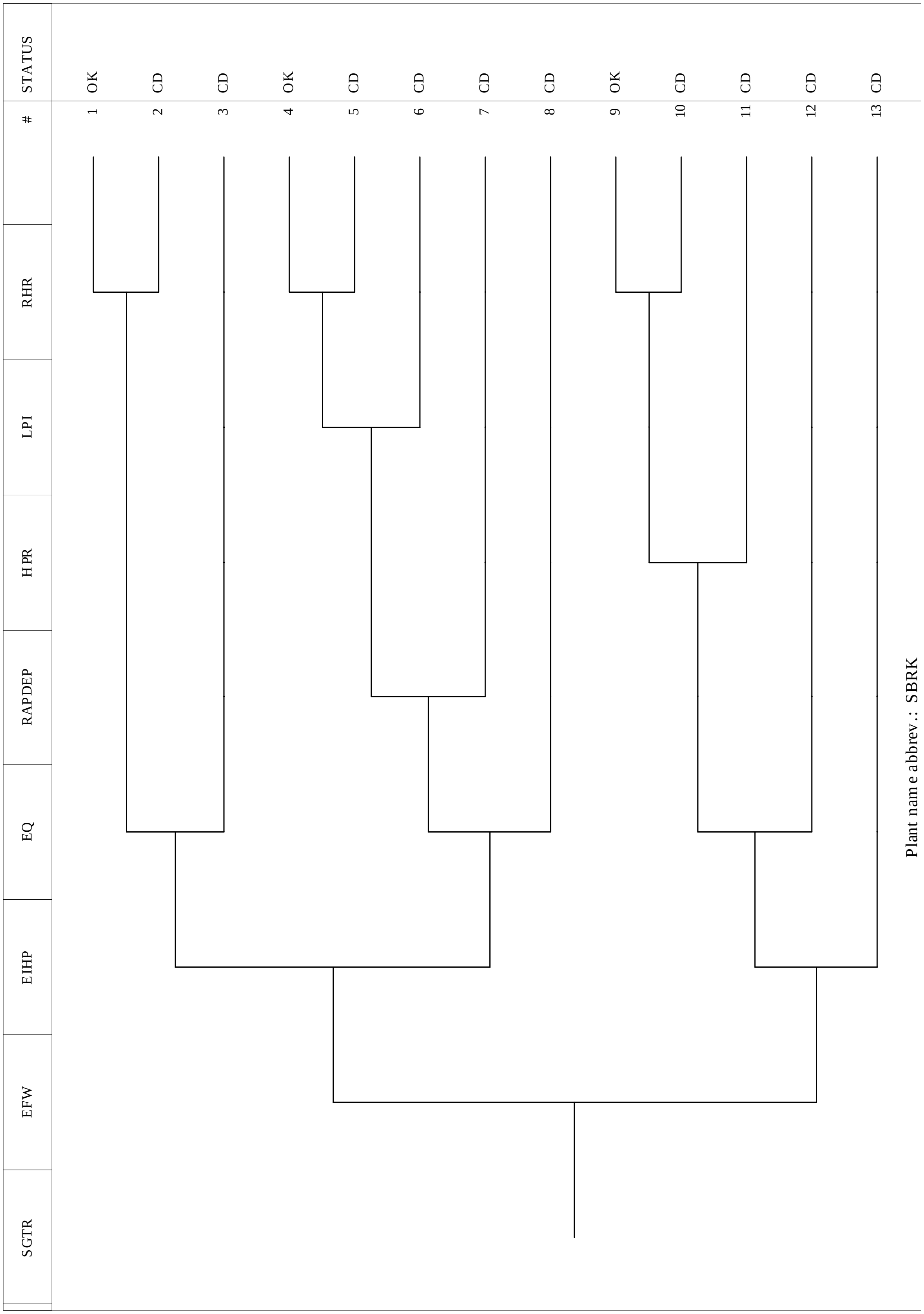
14 CD
Plant name abbrev.: SBRK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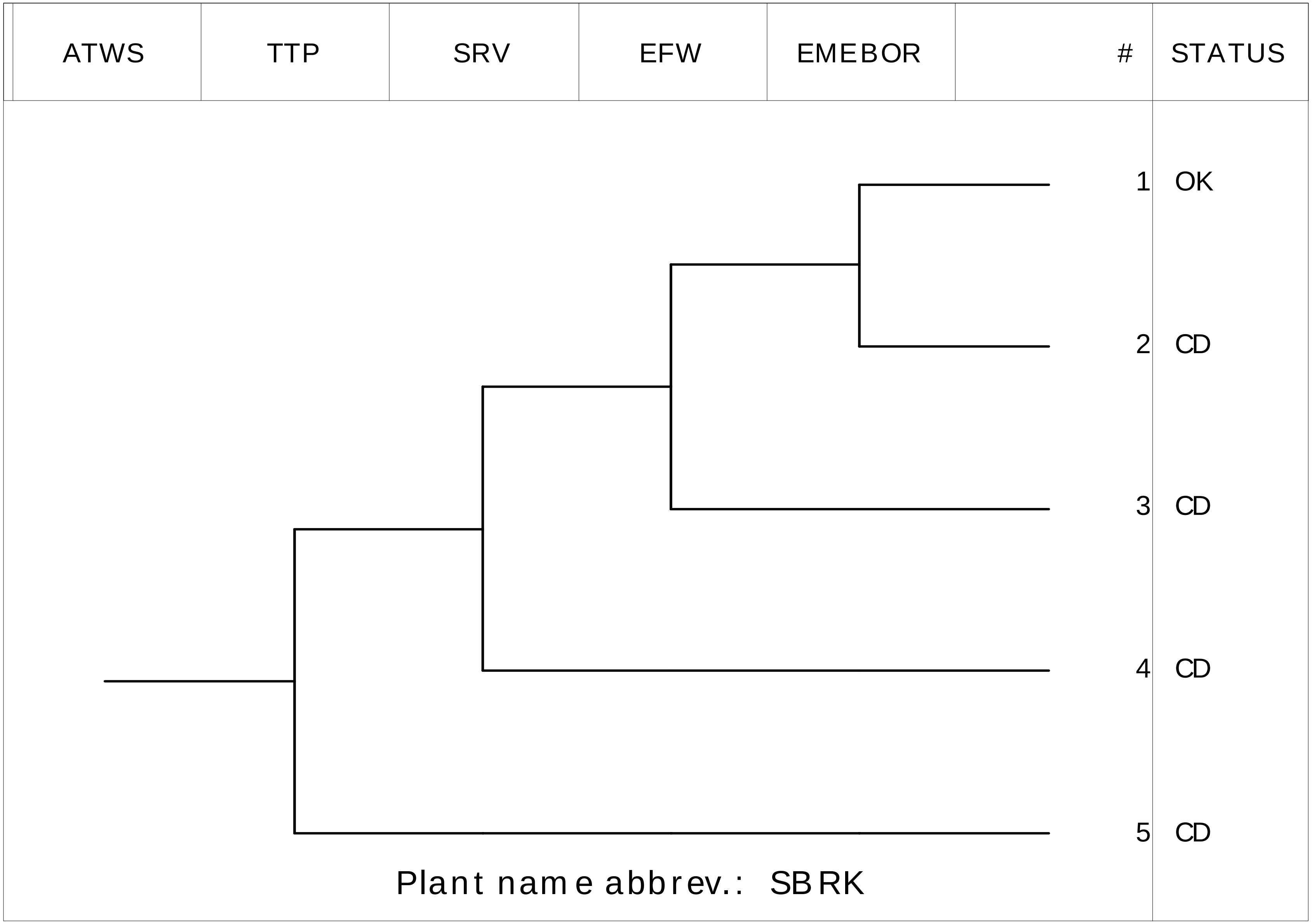
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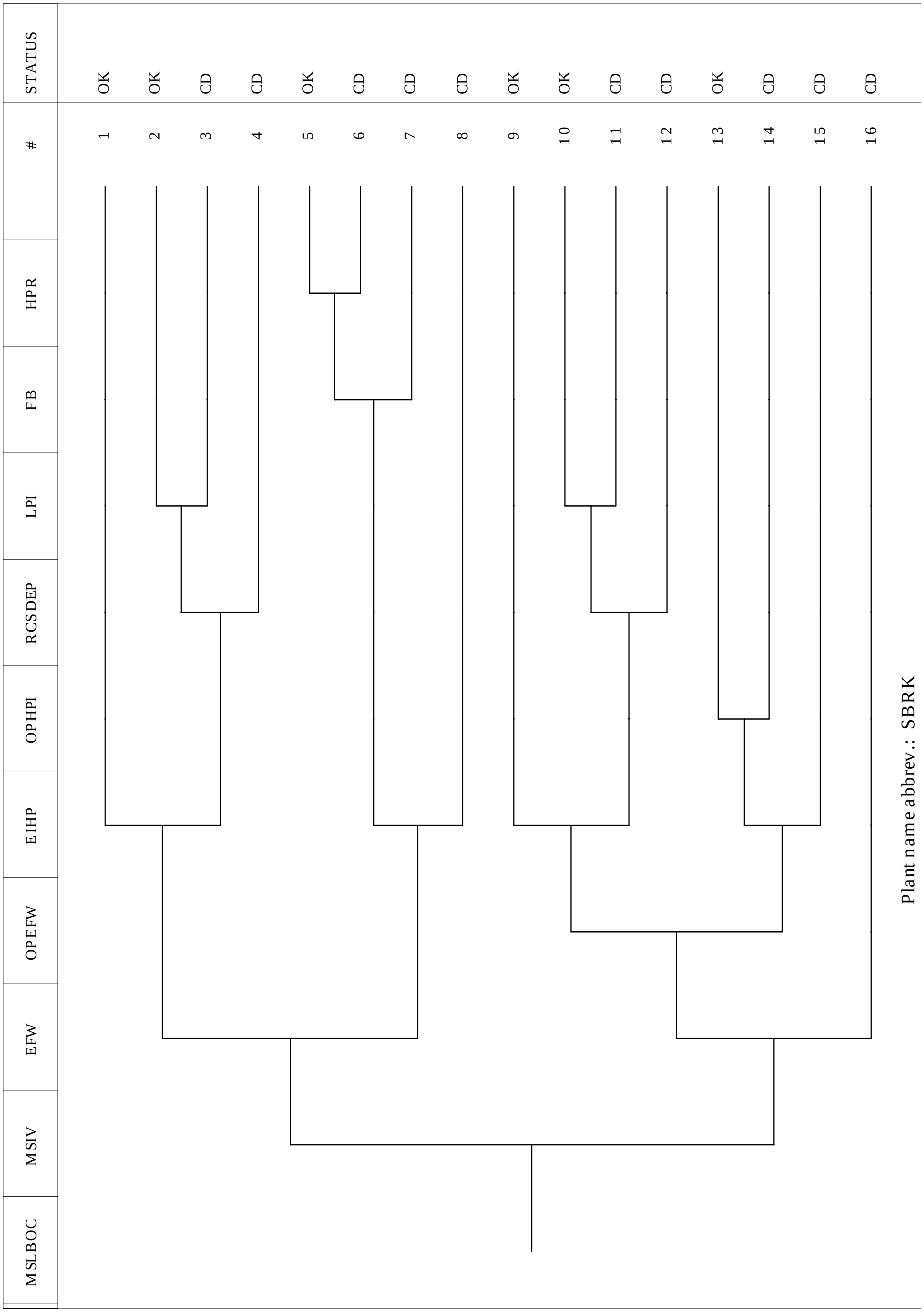
Plant name abbrev.: SBRK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15
16
HPR
FB
LPI
RCSDEP
OPHPI
EIHP
OPEFW
EFW
MSIV
MSLBOC
Plant name abbrev.: SBRK

2. RESOLUTION AND DISPOSITION OF COMMENTS

This section documents the comments received on the material included in this report and their resolution. This section is blank until comments are received and are addressed.

REFERENCES

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

2. New Hampshire Yankee, "Seabrook Station Individual Plant Examination Report," March 1991.

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