February 16, 2000

Mr. Otto L. Maynard
President and Chief Executive Officer
Wolf Creek Nuclear Operating Corporation
Post Office Box 411
Burlington, KA 66839

SUBJECT: SITE SPECIFIC WORKSHEETS FOR USE IN THE NRC'S REVISED REACTOR OVERSIGHT PROCESS FOR WOLF CREEK GENERATING STATION

Dear Mr. Maynard:

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 Wolf Creek Generating Station (WCGS) in April 2000. Included in the attached Risk-Informed Inspection Notebook 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 its plans and recommendations to improve the reactor oversight process. These recommendations were contained in SECY-99-007, "Recommendation for Reactor Oversight Process Improvements," which is available to you through the internet 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 the 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 (PI) data and inspection findings that have been appropriately categorized based on their risk significance. In order to properly categorize an inspection finding, the NRC staff has developed the SDP. This process was also described to the Commission in SECY 99-007A, "Recommendations for the Reactor Oversight Process Improvements (the follow-up paper to SECY-99-007 above)," dated March 22, 1999, also available on the above noted web site.

The SDP for power operations involves evaluating an inspection finding's impact on the plant staff's capability to do the following: 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. 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 worksheets were developed based on your individual plant examination (IPE) submittal that was requested by Generic Letter GL 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 in the future to discuss with your staff any changes that may be appropriate. We are not requesting written comments on the enclosed Inspection Notebook.

We will coordinate our efforts through your licensing or risk organizations as appropriate. If you have any questions, please contact me at (301)-415-1307, or through the internet at jnd@nrc.gov.

Sincerely,

/***RA/***

Jack Donohew, Senior Project Manager, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosure: Risk Informed Inspection Notebook
for Wolf Creek Generating Station

cc w/encl: See next page

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We will coordinate our efforts through your licensing or risk organizations as appropriate. If you have any questions, please contact me at (301)-415-1307, or through the internet at jnd@nrc.gov.

Sincerely,
/RA/
Jack Donohew, Senior Project Manager, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-482

Enclosure: Risk Informed Inspection Notebook
for Wolf Creek Generating Station

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cc:

Jay Silberg, Esq.
Shaw, Pittman, Potts & Trowbridge
2300 N Street, NW
Washington, D.C. 20037

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 1000
Arlington, Texas 76011

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P. O. Box 311
Burlington, Kansas 66839

Chief Engineer
Utilities Division
Kansas Corporation Commission
1500 SW Arrowhead Road
Topeka, Kansas 66604-4027

Office of the Governor
State of Kansas
Topeka, Kansas 66612

Attorney General
Judicial Center
301 S.W. 10th
2nd Floor
Topeka, Kansas 66612

County Clerk
Coffey County Courthouse
Burlington, Kansas 66839

Vick L. Cooper, Chief
Radiation Control Program
Kansas Department of Health
and Environment
Bureau of Air and Radiation
Forbes Field Building 283
Topeka, Kansas 66620

Vice President & Chief Operating Officer
Wolf Creek Nuclear Operating Corporation
P. O. Box 411
Burlington, Kansas 66839

Superintendent Licensing
Wolf Creek Nuclear Operating Corporation
P.O. Box 411
Burlington, Kansas 66839

U.S. Nuclear Regulatory Commission
Resident Inspectors Office
8201 NRC Road
Steedman, Missouri 65077-1032

RISK-INFORMED INSPECTION NOTEBOOK FOR

WOLF CREEK GENERATING STATION

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

Prepared by

Brookhaven National Laboratory
Department of Advanced Technology

Contributors

M. A. Azarm
J. Carbonaro
T. L. Chu
A. Fresco
J. Higgins
G. Martinez-Guridi
P. K. Samanta

NRC Technical Review Team

John Flack	**RES**
Morris Branch	**NRR**
Doug Coe	**NRR**
Gareth Parry	**NRR**
Peter Wilson	**NRR**
Jim Trapp	**Region I**
Michael Parker	**Region III**
William B. Jones	**Region IV**

Prepared for

U. S. Nuclear Regulatory Commission
Office of Nuclear Regulatory Research
Division of Risk Analysis & Applications

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
U. S. Nuclear Regulatory Commission
RES/DSARE/REAHFB
TWFN T10 E46
11545 Rockville Pike
Rockville, MD 20852

ABSTRACT

This notebook contains summary information to support the Significance Determination Process (SDP) in risk-informed inspections for the Wolf Creek Generating 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 Individual Plant Examination (IPE) submittal. The information is revised based on IPE updates, or on other licensee or review comments providing updated information and/or additional details.

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TABLES

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 Wolf Creek Generating 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 Wolf Creek Generating Station

Affected Systems	Major Components	Support Systems	Initiating Event Scenarios
Accumulators (ACS)	Four accumulators		MLOCA, LLOCA
Auxiliary Feedwater (AFW)	2 100% MDPs	4160VAC, 480VAC, 125VDC, RPS/ESFAS, ESW	Transient, SLOCA, SORV, MLOCA, LOOP, SGTR, ATWS, MSLB, Special Initiators (LOSSSW)
	1 200% TDP		
Chemical and Volume Control System (CVCS)	Two centrifugal charging pumps (CCPs) and boric acid transfer pumps	4160VAC, 480VAC, 125VDC, RPS/ESFAS, CCW (for recirculation), ESW	Transient, SLOCA, SORV, MLOCA, LOOP, SGTR, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA)
Component Cooling Water (CCW)	Two trains, each with two 100% pumps	4160VAC, 480VAC, 125VDC, RPS/ESFAS, ESW	Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA)
Condensate and Main Feedwater Systems	Main Feedwater System: two 67% turbine-driven feedwater pumps, and one motor-driven startup pump. For each steam generator: a FW flow control valve and main FW isolation valve	480VAC, 125VDC	Transient
	Condensate System: three 50% pumps		
Containment Cooling System	Four containment fan coolers	480VAC, RPS/ESFAS, ESW	MLOCA, LLOCA
Containment Spray System (CSS)	Two 100% pumps	4160VAC, 480VAC, 125VDC, RPS/ESFAS, ESW	MLOCA, LLOCA

Table 1 (Continued)

Affected Systems	Major Components	Support Systems	Initiating Event Scenarios
Electric Power System (EPS)	4160 V-AC Power System: Two load groups, each with an ESF transformer, an Emergency Diesel Generator (EDG), 4.16 KV distribution, 480 V distribution	125VDC, RPS/ESFAS, ESW	Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, ATWS, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA, LOSSSW)
	480VAC Power System: Two load groups, each with two load centers and seven motor control centers	4160VAC	Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, ATWS, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA, LOSSSW)
	120VAC System(1)	480VAC, 125VDC	Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, ATWS, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA, LOSSSW)
	125 VDC Power system: Four systems, each with one bus, one battery, one battery charger		Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, ATWS, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA, LOSSSW)
Essential Service Water System (ESW)	Essential Service Water System: two pumps	4160VAC, 480VAC, 125VDC, RPS/ESFAS	Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, ATWS, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA, LOSSSW)
	Non-essential Service Water System: three 50% pumps, and one 17% low flow pump	Not given in the IPE	
Main Steam System (MSF)	Main steam isolation valves (MSIVs), atmospheric relief valves, steam dump valves, and safety valves	125VDC, RPS/ESFAS	SLOCA, SORV, MLOCA, MSLB

Table 1 (Continued)

Affected Systems	Major Components	Support Systems	Initiating Event Scenarios
Pressurizer Relief System	Three safety valves and two PORVs with associated block valves	480VAC, 125VDC, 120VAC	Transient, SLOCA, SORV, MLOCA, LOOP, SGTR, ATWS, MSLB
Reactor Coolant System (RCS)	Seals of Reactor Coolant Pumps (RCP)	The success criteria is 1 / 2 CCW pumps to the RCP thermal barriers (1 multi-train system) or 1 / 2 CCPs for RCP seal injection (1 multi-train system)	RCP seal LOCA
Reactor Protection System (RPS)	Reactor Trip, System (RTS)	125VDC, 120VAC	Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, ATWS, MSLB, RCP seal LOCA, Special Initiators (LOSSCCWA, LOSSSW)
	Engineered Safety Features Actuation System (ESFAS)		
	ATWS Mitigation System Actuating Circuitry (AMSAC)	125VDC, 120VAC	ATWS
Residual Heat Removal (RHR) System	Two 100% pumps and two heat exchangers	4160VAC, 480VAC, 125VDC (for injection), RPS/ESFAS, CCW (for recirculation), ESW	Transient, SLOCA, SORV, MLOCA, LLOCA, LOOP, SGTR, MSLB
Safety Injection System (SI)	Two SI pumps	4160VAC, 480VAC, 125VDC, RPS/ESFAS, CCW (for recirculation), ESW	Transient, SLOCA, SORV, MLOCA, LOOP, SGTR, MSLB

Notes:

(1) The IPE does not describe this system.

Plant internal event CDF = 4.2 x 10^{-5} /yr. (including internal floods)

1.2 SDP WORKSHEETS

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

1. Transients
2. Small LOCA
3. Stuck-open PORV
4. Medium LOCA
5. Large LOCA
6. LOOP
7. Steam Generator Tube Rupture (SGTR)
8. Anticipated Transients Without Scram (ATWS)
9. Main Steam Line Break (MSLB)
10. Special Initiators

Table 2.1 SDP Worksheet for Wolf Creek Generating Station —— Transients

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

Safety Functions Needed:	***Full* Creditable Mitigation Capability for Each Safety Function:**
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 / 1 TDAFW train (1 ASD train)
Power Conversion System (PCS)	(1 / 2 TDMFW pumps or 1 / 1 MDMFW pump) with 1 / 3 condensate pumps (operator action)
High Pressure Injection for FB (EIHP)	1 / 2 CCPs or 1 / 2 SI pumps (1 multi-train system)(1)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs (and associated block valves) open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 CCPs or 1 / 2 SI pumps) with 1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)

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

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

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

Notes:

(1) Since the CCPs and SI pumps depend on the same support systems, they are assumed to be 1 multi-train system.

Table 2.2 SDP Worksheet for Wolf Creek Generating 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:**
Early Inventory, HP Injection (EIHP)	1 / 2 CCPs or 1 / 2 SI pumps (1 multi-train system)(1)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 / 1 TDAFW train (1 ASD train)
Rapid cooldown and depressurization (RAPDEP)	Operator cools down and depressurizes the RCS using steam dump to condenser or SG PORVs (operator action)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs open for Feed/Bleed (operator action)
Low Pressure Injection (LPI)	1 / 2 RHR pumps (operator action)
High Pressure Recirculation (HPR)	(1 / 2 CCPs or 1 / 2 SI pumps) with 1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)
Low Pressure Recirc (LPR)	1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 SLOCA - HPR - LPR (3)			
2 SLOCA - AFW - HPR (5)			
3 SLOCA - AFW - FB (6)			
4 SLOCA - EIHP - LPR (8)			

5 SLOCA - EIHP - LPI (9)			
6 SLOCA - EIHP - RAPDEP (10)			
7 SLOCA - EIHP - AFW (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 to be used.			

Notes:

(1) Since the CCPs and SI pumps depend on the same support systems, they are assumed to be 1 multi-train system.

Table 2.3 SDP Worksheet for Wolf Creek Generating 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)
Early Inventory, HP Injection (EIHP)	1 / 2 CCPs or 1 / 2 SI pumps (1 multi-train system)[(1)]
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 / 1 TDAFW train (1 ASD train)
Rapid cooldown and depressurization (RAPDEP)	Operator cools down and depressurizes the RCS using steam dump to condenser or SG PORVs (operator action)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs open for Feed/Bleed (operator action)
Low Pressure Injection (LPI)	1 / 2 RHR pumps (operator action)
High Pressure Recirculation (HPR)	(1 / 2 CCPs or 1 / 2 SI pumps) with 1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)
Low Pressure Recirc (LPR)	1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 SORV - BLK - HPR - LPR (3)			
2 SORV - BLK - AFW - HPR (5)			
3 SORV - BLK - AFW - FB (6)			
4 SORV - BLK - EIHP - LPR (8)			

5 SORV - BLK - EIHP - LPI (9)			
6 SORV - BLK - EIHP - RAPDEP (10)			
7 SORV - BLK - EIHP - AFW (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 to be used.			

Notes:

(1) Since the CCPs and SI pumps depend on the same support systems, they are assumed to be 1 multi-train system.

Table 2.4 SDP Worksheet for Wolf Creek Generating 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, Accumulators (EIAC)	3 / 3 Accumulators (1 train)[(1)]
Early Inventory, HP Injection (EIHP)	1 / 2 CCPs or 1 / 2 SI pumps (1 multi-train system)[(2)]
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 ASD train)
Rapid Depressurization (RAPDEP)	Operator cools down and depressurizes the RCS using steam dump to condenser or SG PORVs (operator action)
Low Pressure Injection (LPI)	1 / 2 RHR pumps (1 multi-train system)
Containment Press/Temp Control (CNT)	2 / 4 containment fan coolers or 1 / 2 CSS pumps (2 multi-train system)
High Pressure Recirc (HPR)	(1 / 2 CCPs or 1 / 2 SI pumps) with 1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)
Low Pressure Recirc (LPR)	1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)

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

5 MLOCA - EIHP - RAPDEP (8)			
6 MLOCA - EIHP - AFW (9)			
7 MLOCA - EIAC (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 to be used.			

Notes:

(1) Accumulators are passive, highly reliable components and their probability of failure may be smaller than 1E-2.

(2) Since the CCPs and SI pumps depend on the same support systems, they are assumed to be 1 multi-train system.

Table 2.5 SDP Worksheet for Wolf Creek Generating 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 (EIAC)	3 / 3 Accumulators (1 train)[(1)]
Early Inventory, LP Injection (EILP)	1 / 2 RHR pumps (1 multi-train system)
Low Pressure Recirculation (LPR)	1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)
Late Containment P/T Control (CNT)	2 / 4 containment fan coolers or 1 / 2 CSS pumps (2 multi-train system)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 LLOCA - LPR (2)			
2 LLOCA - 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 to be used.

Notes:

(1) Accumulators are passive, highly reliable components and their probability of failure may be smaller than 1E-2.

Table 2.6 SDP Worksheet for Wolf Creek Generating Station —— LOOP

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

Safety Functions Needed:	***Full* Creditable Mitigation Capability for each Safety Function:**
Emergency AC Power (EAC)	1 / 2 Emergency Diesel Generators (1 multi-train system)
Recovery of AC power in < 5 hrs (REC5)[1,2]	Recovery of AC power (operator action)
Recovery of AC Power in < 2 hrs (REC2)[2]	Recovery of AC power (operator action under high stress)
Early Inventory, HP Injection (EIHP)	2 / 2 CCPs (1 train system)[3]
Secondary Heat Removal, Turbine-driven pump of AFW (TDAFW)	1 / 1 TDAFW pump (1 train)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 / 1 TDAFW train (1 ASD train)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs (and associated block valves) open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 CCPs or 1 / 2 SI pumps) with 1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 LOOP - AFW - HPR (3)			
2 LOOP - AFW - FB (4)			
3 LOOP - AFW - 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 - TDAFW - FB (12) (AC recovered)			
8 LOOP - EAC - TDAFW - 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 to be used.			

Notes:

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

(2) For the functions “Recovery of AC Power in < 2 hrs (REC2)” and “Recovery of AC Power in < 5 hrs (REC5)”, the IPE has the events “Restore AC Power within 2 Hours” (XHR (2HR)), and “Restore AC Power within 4 Hours” (XHR (4HR)), respectively. No human error probability was found in the IPE for these events (Table 3.3-4, pages 3-146).

(3) For those sequences with unsuccessful secondary heat removal, the RCS pressure will be above the shutoff head of the SI pumps, and only the CCPs can provide makeup. For those sequences with successful secondary heat removal, the success criteria is 1 / 2 CCPs or 1 / 2 SI pumps (2 multi-train systems).

Table 2.7 SDP Worksheet for Wolf Creek Generating 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 (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 / 1 TDAFW train (1 ASD train)
Early Inventory, HP Injection (EIHP)	1 / 2 CCPs or 1 / 2 SI pumps (1 multi-train system)(1)
Isolation of the ruptured SG (ISOL)	Operator isolates the ruptured SG (operator action)
Primary/Secondary pressure Equalization (EQ)	Operator depressurizes RCS to less than setpoint of safety valves of SG (operator action under high stress)(2)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 PORVs open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 CCPs or 1 / 2 SI pumps) with 1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)
Rapid Depressurization (RAPDEP)	Operator rapidly cools down and depressurizes RCS using 1 / 2 PORVs, and aligns 1 / 2 RHR pumps (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 SGTR - EQ - RAPDEP (3, 8)			
2 SGTR - ISOL - RAPDEP (5, 10)			
3 SGTR - SHR - HPR (12)			

4 SGTR - SHR - FB (13)			
5 SGTR - SHR - ISOL (14)			
6 SGTR - SHR - EIHP (15)			
Identify any operator recovery actions that are credited to directly restore the degraded equipment or initiating event: If operator actions are required to credit placing mitigation equipment in service or for recovery actions, such credit should be given only if the following criteria are met: 1) sufficient time is available to implement these actions, 2) environmental conditions allow access where needed, 3) procedures exist, 4) training is conducted on the existing procedures under conditions similar to the scenario assumed, and 5) any equipment needed to complete these actions is available and ready to be used.			

Note:

(1) Since the CCPs and SI pumps depend on the same support systems, they are assumed to be 1 multi-train system.

(2) "Primary/Secondary pressure Equalization (EQ)" is represented in the IPE (page 3-146) by two events: 1) "Initial RCS cooldown, given SG rupture" (event OD1-COOL, human error probability (HEP) = 5.55E-3), and 2) "Initial RCS Depressurize, given SG tube rupture" (event OD1-DP, HEP = 9.55E-3).

Table 2.8 SDP Worksheet for Wolf Creek Generating 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)
Safety Relief Valves (SRV)	3 / 3 pressurizer safety valves with 2 / 2 PORVs (1 train)
Secondary Heat Removal (AFW)	2 / 2 MDAFW trains (1 train) with 1 / 1 TDAFW train (1 ASD train)[2]

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

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

Notes:

(1) The IPE considers that emergency boration is too slow to prevent RCS pressurization for limiting ATWS events (IPE, page 3-35). Hence, the IPE did not include this function in its ATWS model.

(2) The loss of main feedwater initiating event leads to the most severe RCS pressure transient, and the IPE developed the ATWS event tree (IPE page 3-35) by taking into account this condition.

Table 2.9 SDP Worksheet for Wolf Creek Generating Station —— Main Steam Line Break (MSLB)

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

Safety Functions Needed:	***Full* Creditable Mitigation Capability for each Safety Function:**
Early Inventory, HP Injection (EIHP)	1 / 2 CCPs or 1 / 2 SI pumps (1 multi-train system)(1)
MSLB Isolated (SLIS)	3 / 4 MSIVs close (1 train)
Secondary Heat Removal (AFW)	1 / 2 MDAFW trains (1 multi-train system) or 1 TDAFW train (1 ASD train)
Secondary Heat Removal, Motor-driven pumps of AFW (MDAFW)	1 / 2 MDAFW trains (1 multi-train system)
Primary Heat Removal, Feed/Bleed (FB)	2 / 2 pressurizer PORVs open for Feed/Bleed (operator action)
High Pressure Recirculation (HPR)	(1 / 2 CCPs or 1 / 2 SI pumps) with 1 / 2 RHR pumps with operator aligning CCW to RHR heat exchanger (operator action)

Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
1 MSLB - AFW - HPR (3)			
2 MSLB - AFW - FB (4)			
3 MSLB - SLIS -MDAFW - HPR (7)			
4 MSLB - SLIS - MDAFW - FB (8)			

5 MSLB - EIHP - AFW (10)			
6 MSLB - EIHP - SLIS (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 to be used.			

Notes:

(1) Since the CCPs and SIPs depend on the same support systems, they are assumed to be 1 multi-train system.

Table 2.10 SDP Worksheet for Wolf Creek Generating Station —— Special Initiators

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:**		
RCP seal cooling (OPSEAL)	Operator aligns and starts equipment to provide RCP seal cooling (operator action)		
RCP seal LOCA (COSEAL)	Conditional probability of an RCP seal LOCA (1 train)[1]		
Operating CCW train (CCWOP)	1 / 1 operating CCW train (1 train)		
Secondary Heat Removal (TDAFW)	1 / 1 TDAFW pump (recovery of failed train)[2]		
Circle Affected Functions	**Recovery of Failed Train**	***Remaining Mitigation Capability Rating for Each Affected Sequence***	**Sequence Color**
Initiator: Loss of operating CCW train (LOSSCCWA) 1 LOSSCCWA - OPSEAL - COSEAL (Dom 8)			
2 LOOP - CCWOP - OPSEAL (Dom 13)			
Initiator: Loss of all service water (LOSSSW) 3 LOSSSW - TDAFW (Dom 15)			

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

Notes:

(1) This is the conditional probability of an RCP seal LOCA, and it is not associated directly with any equipment or operator action. It is included in the sequence to obtain an approximation of the frequency evaluated by the IPE (IPE, page 3-179).

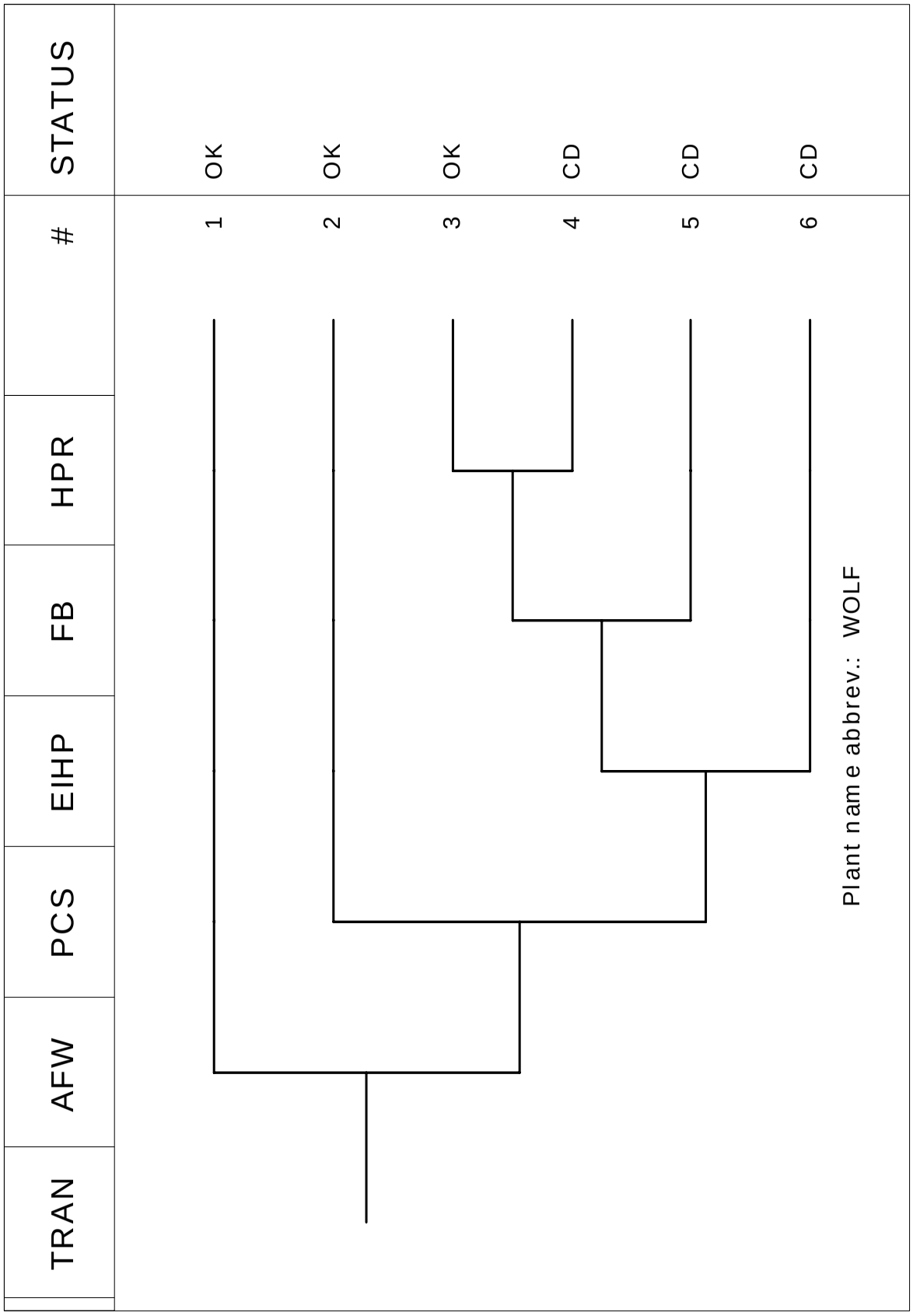
(2) "Recovery of failed train" is assigned to obtain an approximation of the frequency evaluated by the IPE (IPE, page 3-186).

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
2. Small LOCA
3. Medium LOCA
4. Large LOCA
5. LOOP
6. Steam Generator Tube Rupture (SGTR)
7. Anticipated Transients Without Scram (ATWS)
8. Main Steam Line Break (MSLB)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AFW
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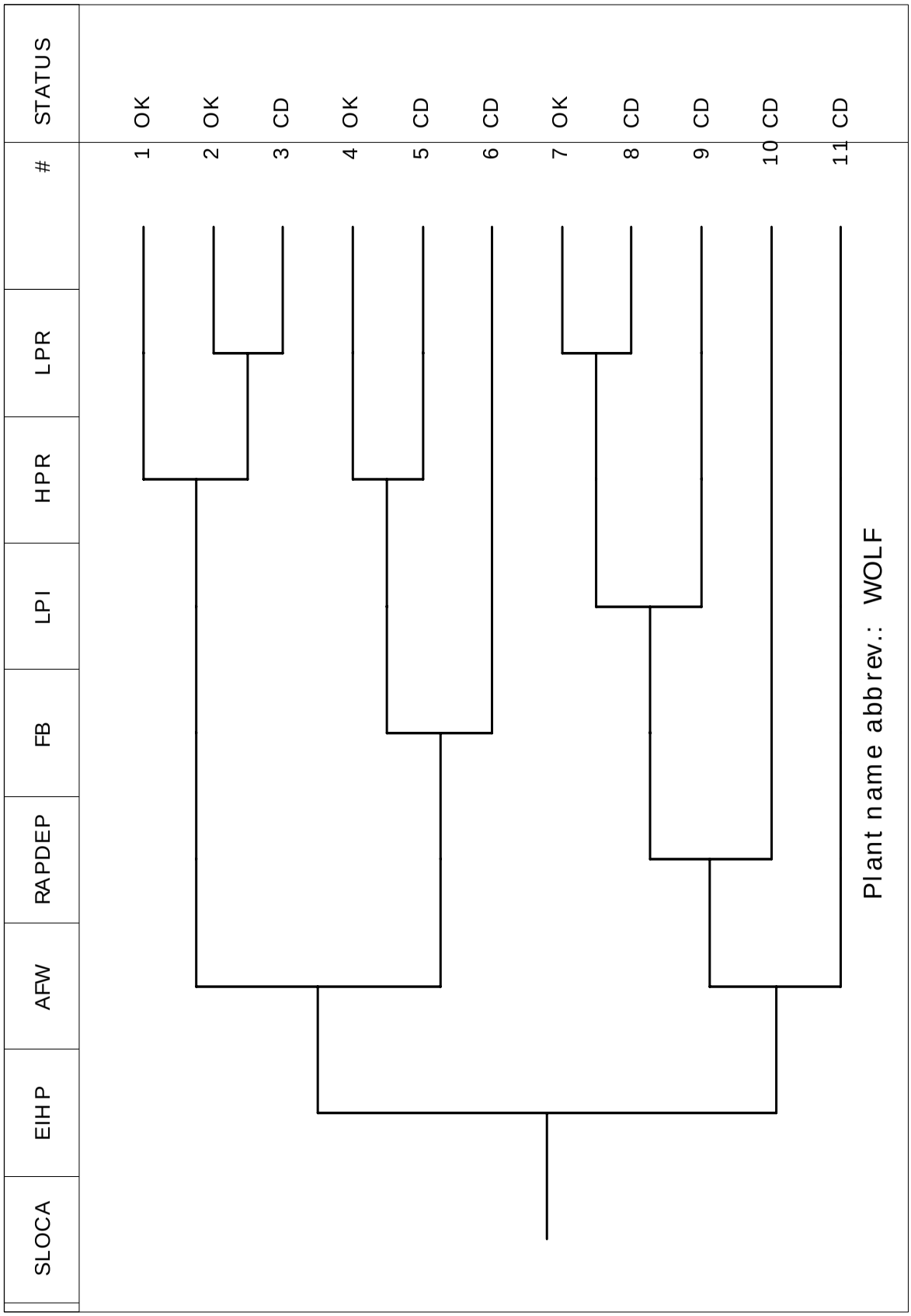
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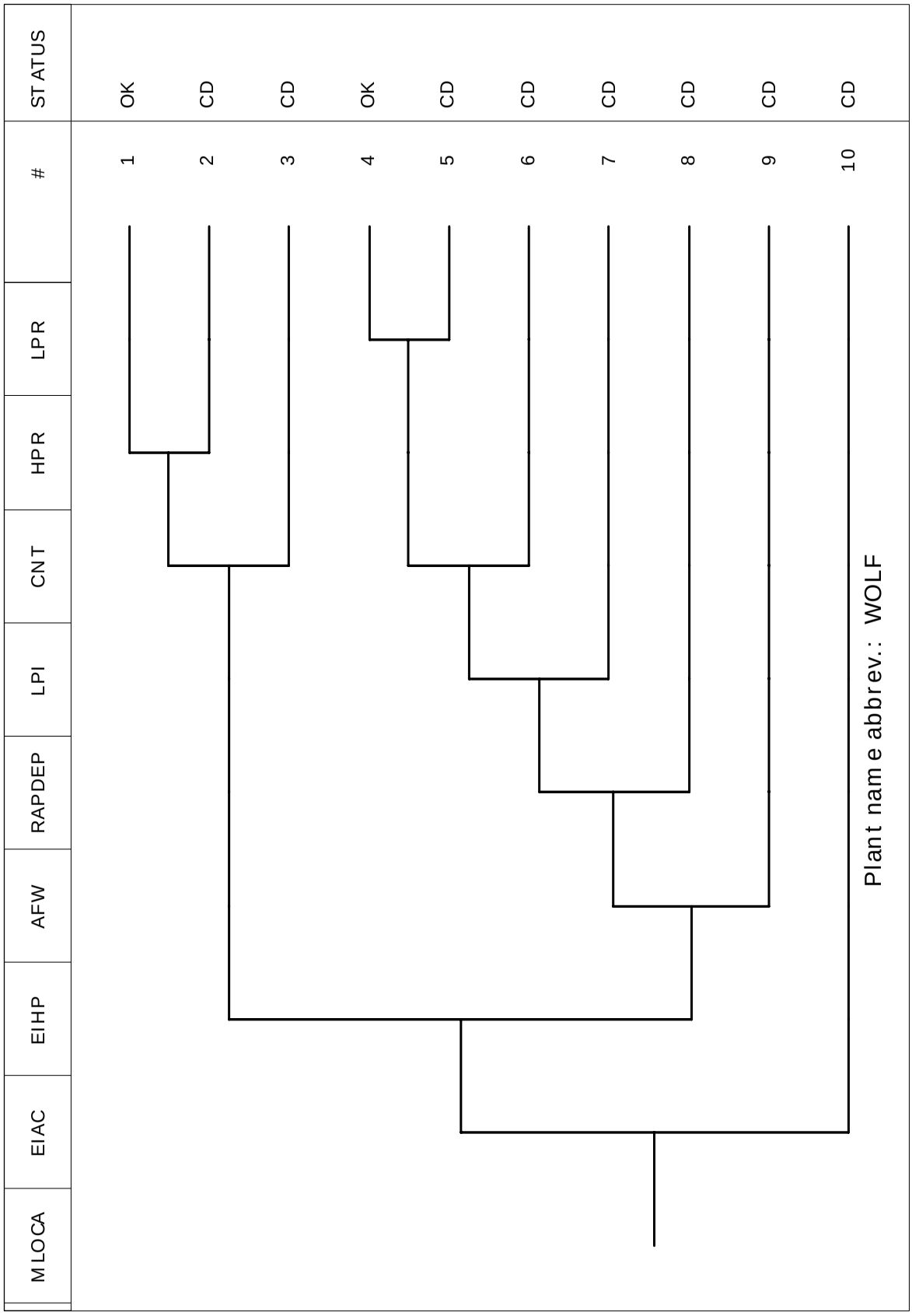
8 CD
9 CD
10 CD
11 CD
Plant name abbrev.: WOLF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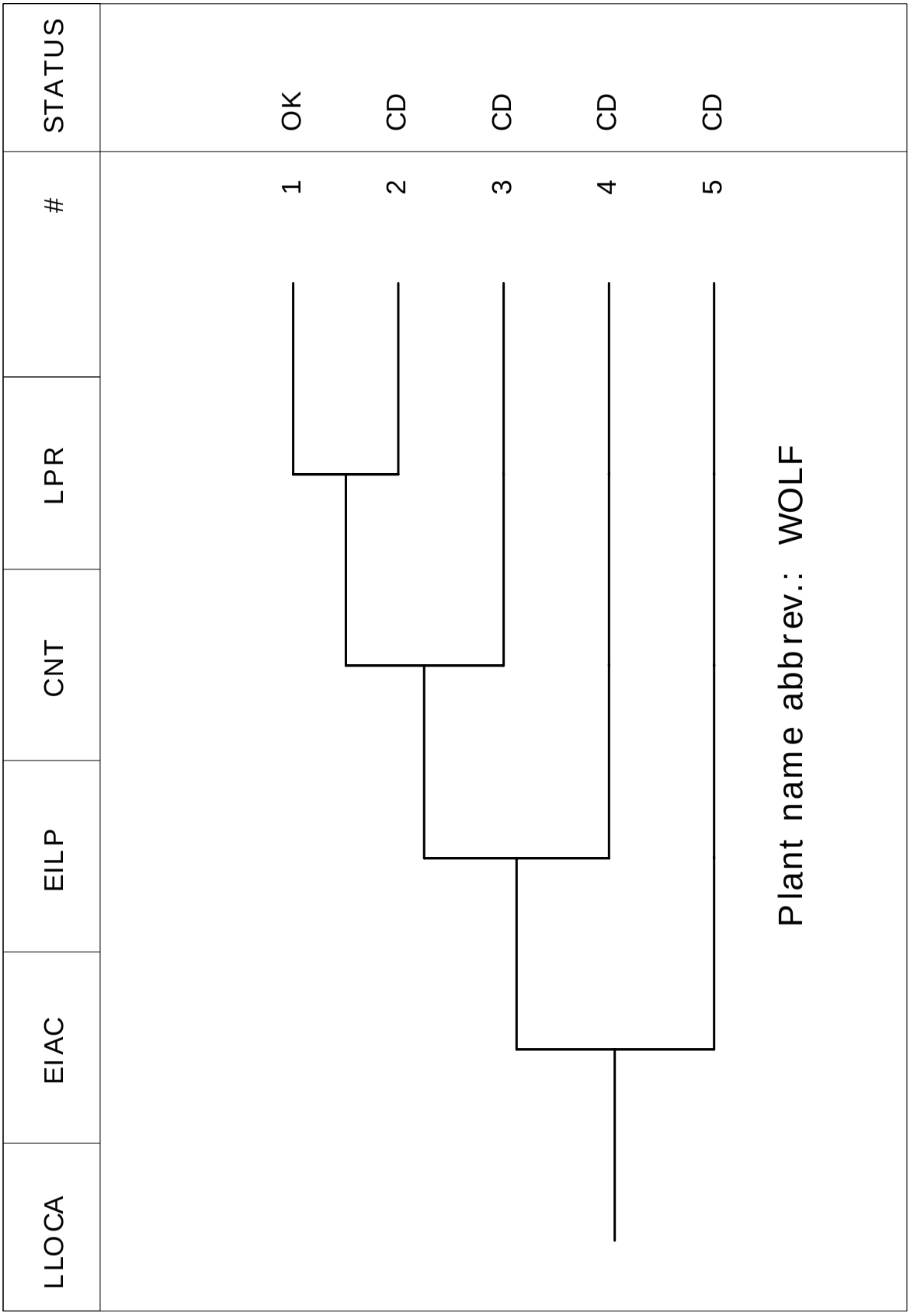
9
10
Plant name abbrev.: WOLF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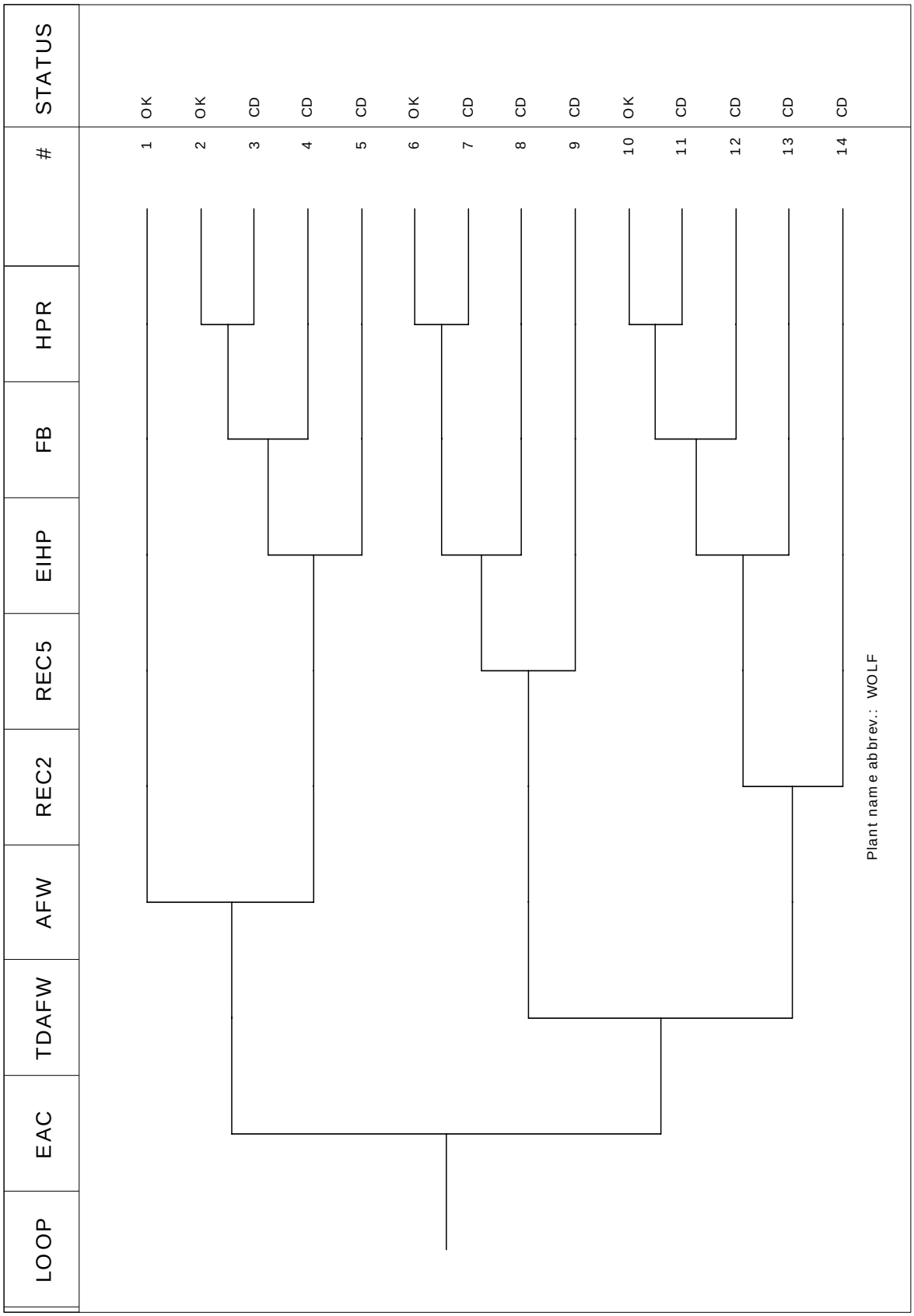
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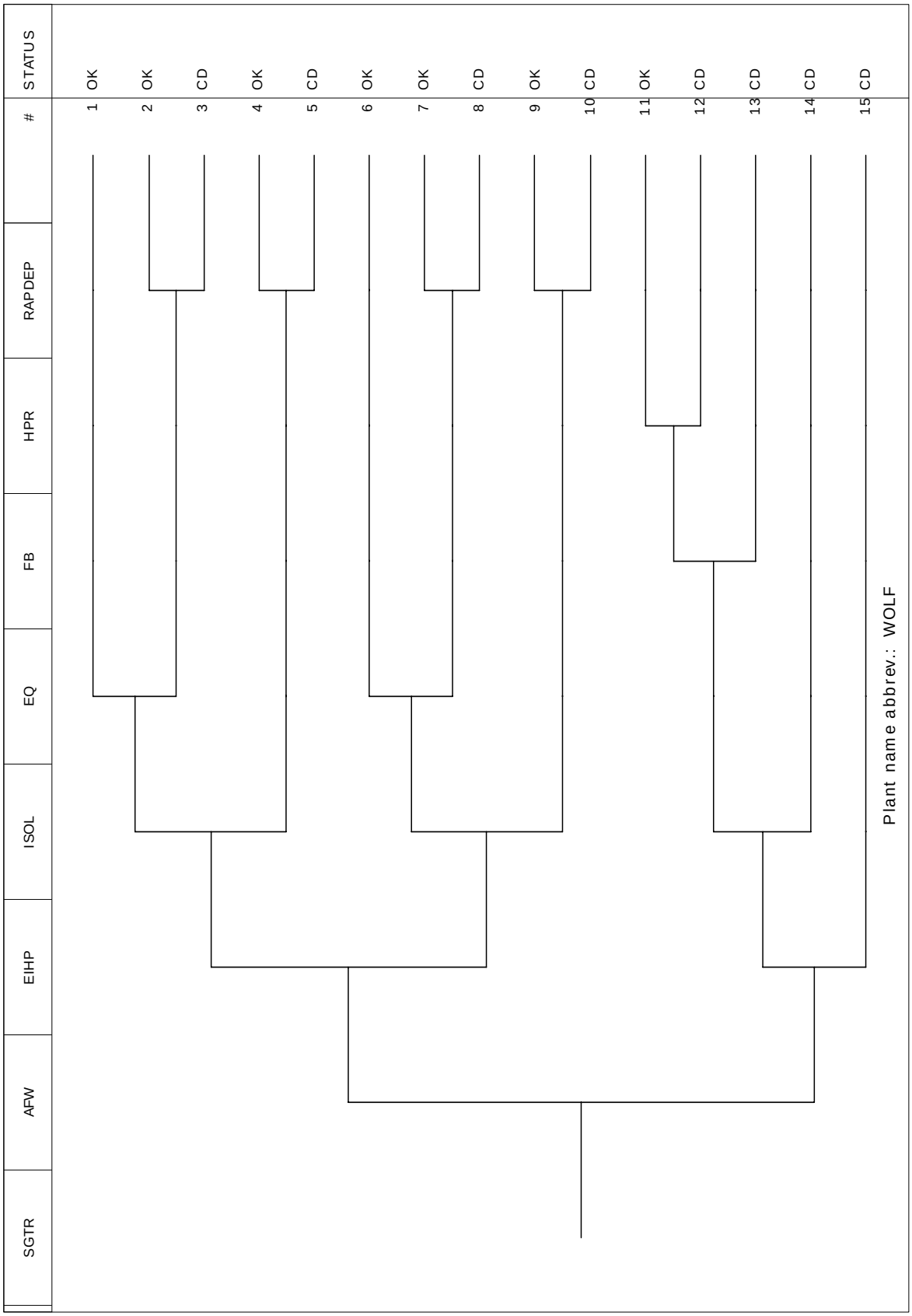
Plant name abbrev.: WOLF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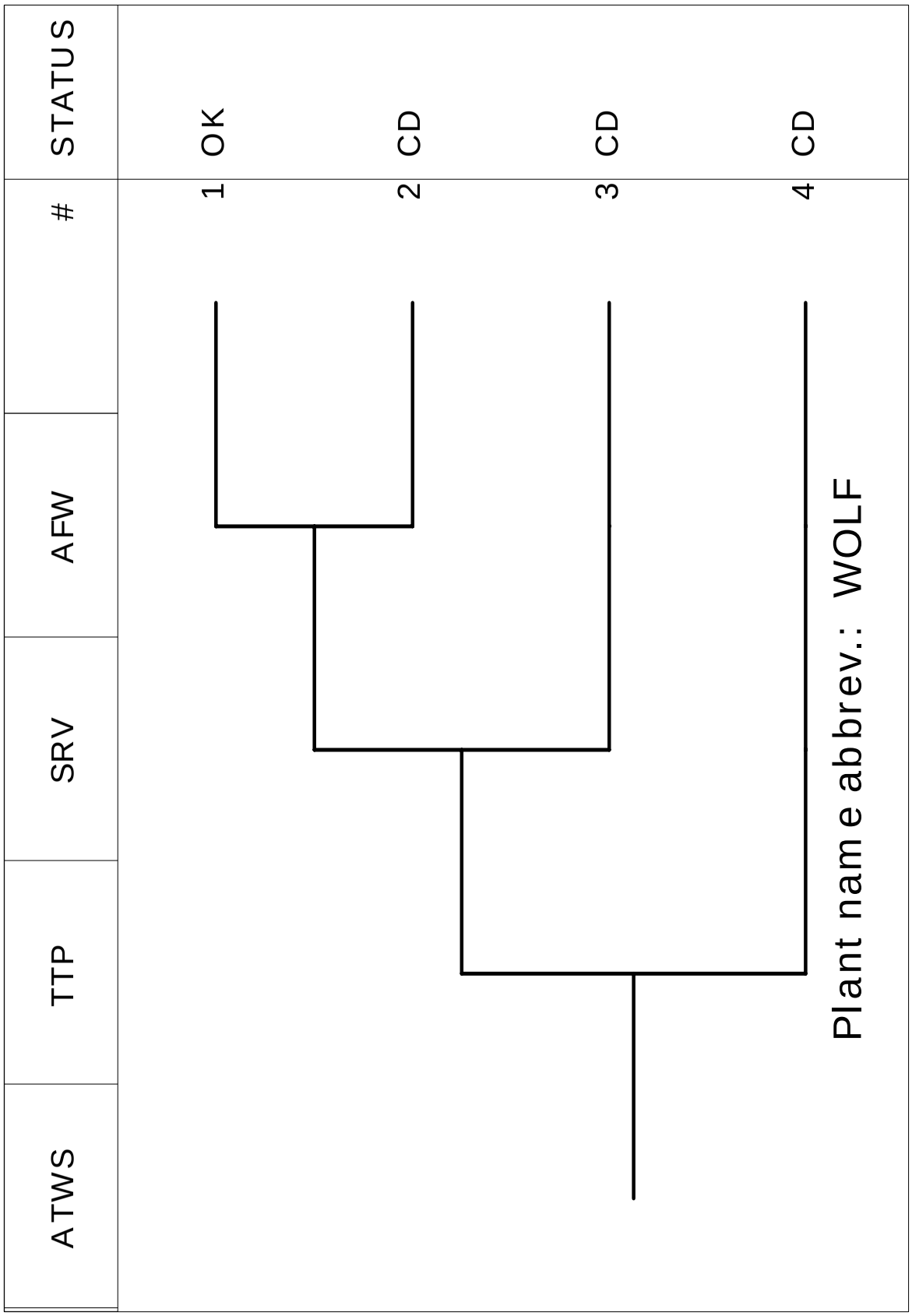
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SRV
TTP
ATWS
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4 CD
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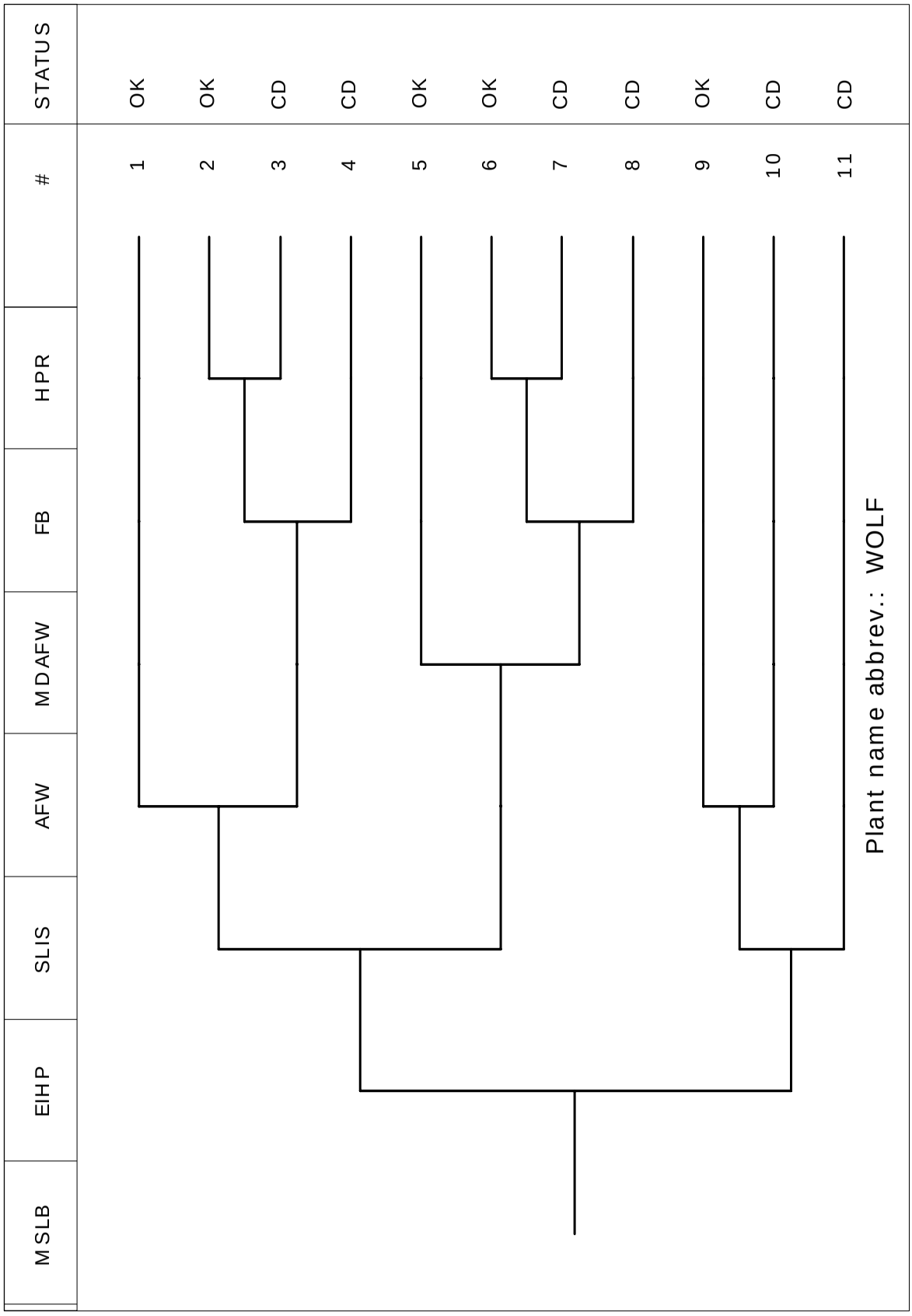
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11
Plant name abbrev.: WOLF

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. Wolf Creek Nuclear Operating Corporation, Wolf Creek Generating Station Individual Plant Examination Summary Report, September, 1992.