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Enclosure 1 contains the subject partial ESBWR Probabilistic Risk Assessment (PRA) document (Revision 1).

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
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D068

Enclosure:

1. MFN 06-289 – NEDO-33201, Revision 1, "ESBWR Probabilistic Risk Assessment:"
    - Section 11 – Uncertainty and Sensitivity Analysis

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ENCLOSURE 1

MFN 06-289

NEDO-33201, Revision 1, "ESBWR Probabilistic Risk Assessment"

- **Section 11 – Uncertainty and Sensitivity Analysis**

11 UNCERTAINTY AND SENSITIVITY ANALYSIS

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11 UNCERTAINTY AND SENSITIVITY ANALYSIS

11.1 INTRODUCTION

The purpose of this section is to summarize and document the activities carried out in the quantification with respect to the uncertainty and sensitivity analysis of the quantification results as part of the ESBWR PRA[1].

The first part of this section presents the aleatory uncertainty analysis that was performed on the internal events, full power PRA. A description of the analysis method, the data used, and the results are provided in Section 11.2.

The next part describes various sensitivity analyses that were performed to address decisions and assumptions that are embedded in the PRA model. Sensitivity analyses are provided for the chosen mission time of the PRA and the truncation level used in the PRA. Because squib valve reliability is very important in the ESBWR, a sensitivity analysis on the reliability of squib valves is presented. In addition, a sensitivity concerning the contribution of human actions is presented.

Finally, this section presents a summary of the focused PRA that was used to determine which non-safety systems should be part of the RTNSS programs. Chapter 20 provides a full discussion of RTNSS for ESBWR.

[1] In revision 0, this section contained a discussion of importance factors. Starting with revision 1, the importance factors are discussed in Chapter 18.

11.2 UNCERTAINTY ANALYSIS

The uncertainty calculations are performed using the Level 1 internal events, full power core damage cutsets that are described in Chapter 7. The purpose of this calculation is to show that the point estimate CDF calculated elsewhere in this document is an appropriate representation of plant risk given the uncertainties in the input data values.

The uncertainty calculation was performed using the Latin Hypercube sampling method. This method ensures that the upper and lower tails of the distributions are adequately covered in the sampling. The data uncertainty distribution parameters are presented in Chapter 5, Data Analysis. The distributions for all of the data are assumed to be lognormal.

The initial run of the uncertainty calculation provided a mean value that was much higher than the point estimate. This was investigated to determine the cause of this apparent anomaly. In many low level cutsets (below $2x10^{-12}$), there were terms that contained combination of basic events whose values were assigned inappropriately. These cutsets were associated with the spurious opening of multiple (3) BiMAC squib valves. The database contained an erroneously high valve for each valve because a 2-year test interval was assumed. This uncertainty analysis used corrected cutsets that take this into account.

The ESBWR CDF that was evaluated here retained cutsets that had only one spurious BiMAC squib valve open, but did not apply any recovery factor for isolation or credit for shutting down the reactor to prevent other events, i.e. LOCA. The cutsets that contained multiple spurious squib valves were eliminated from the results. This resulted in a point estimate CDF of $2.62x10^{-8}$ for the cutsets evaluated with the uncertainty code.

The parameters associated with the resulting CDF distribution are obtained using the uncertainty module from CAFTA. The Latin Hypercube sampling method was chosen for the quantification of the uncertainty parameters. The values below were obtained using 30,000 simulations.

Mean	2.64E-08
5%	3.34E-09
50%	1.50E-08
95%	8.28E-08

The graphics associated to the uncertainty calculation are shown in Figures 11-1 and 11-2 for the density function and cumulative distribution function, respectively.

This shows that the CDF distribution is still well away from any risk goal thresholds and that numerical uncertainty is not a significant risk driver for ESBWR.

11.3 SENSITIVITY ANALYSES

In order to address the importance of various assumptions in the PRA, a set of sensitivity analyses were performed. This section contains the results of those analyses.

The first assumption addressed is the mission time of the PRA. Like the PRA analyses for the operating plants, the ESBWR uses a 24-hour mission time to evaluate risk. This mission time is consistent with the linked fault tree methodology, which is a time-independent approximation of a fundamentally time-dependent analysis. This section provides a sensitivity analysis that extends the mission time of the PRA beyond 24 hours to 72 hours. It covers both the Level 1 and Level 2 PRA.

The next sensitivity is associated with the credit given for operation of non-safety systems to mitigate risk. It was used to validate the systems that are to be controlled in the Regulatory Treatment of Non-Safety Systems (RTNSS) program. This sensitivity also covers both the Level 1 and Level 2 PRA in a quantitative way.

The third sensitivity covers the selection of the truncation level for the PRA. Typical practice is for the truncation level to be set 5 orders of magnitude below the point estimate of the CDF. This sensitivity assesses if any of the objectives of the PRA would change due to a lower truncation value.

The fourth sensitivity addresses credit for human actions in the ESBWR PRA. It re-quantifies the Level 1 PRA without credit for any post initiator operator actions. Once again, the sensitivity assesses if any of the objectives of the PRA would change if no credit were given for post initiator operator actions.

The final set of sensitivity analyses address the data values used for important passive components. Passive components have not typically been treated in PRA analyses, so therefore the available data for those components is sparse. The only passive components that have a significant contribution in ESBWR are the squib valves in the ECCS system. This sensitivity looks at the PRA goals while varying the estimated failure rate of these valves.

11.3.1 Mission Time of the PRA

The ESBWR Level 1 Internal Events PRA does not include Class II accident sequences in the calculation of CDF. Class II accidents are those where the containment fails while the core is successfully cooled, and the core damage occurs later as a result of the effect that containment failure has on core cooling systems. Section 3.2.4 shows that, for the ESBWR, any core damage that occurs during a Class II sequence occurs later than 72 hours from the initiating event. The mission time of the ESBWR PRA is 24 hours.

The purpose of this sensitivity analysis is to determine the contribution to CDF of Class II accident sequences using an extended mission time of 72 hours.

For this purpose, the Class II accident sequences shown in the even trees of Appendix A.3 are further analyzed in this section. This analysis is performed using additional event trees, which are called Class II Core Cooling Vulnerability (CCV) event trees. Only Class II sequences resulting in a frequency above the truncation limit of 1.0×10^{-13} were further analyzed using the CCV event trees.

11.3.1.1 Class II CCV Event Tree Description

The CCV event trees are presented in Appendix A.11. These event trees take as initiating events the Class II end states of the Level 1 internal events event trees. At this point in each sequence, the containment has failed, but core cooling is still available. The mission time for core cooling is assumed to be 72 hours from the initiating event. Accident sequences resulting from the CCV event trees are grouped into three categories:

- CD-II: Accident sequences that have available cooling only from the GDCS and the suppression pool (i.e. passive systems) at the end of the CCV event trees. These Class II sequences lead to core damage following the end of the 72-hour mission.
- OK: Accident sequences that have additional cooling available from active systems. For these sequences, core damage can be avoided for much longer than the 72-hour mission.
- CD-V: Accident sequences that do not have any cooling available (from passive or active systems). These sequences appear in LOCA scenarios, after loss of the steam suppression function (Node DS). In these scenarios, core damage occurs before the end of the 72-hour mission but after containment failure. These sequences can be considered containment-bypass sequences because they have similar consequences to the Class V sequences described in the base PRA study.

The CCV event trees for transients include mainly the Fuel and Auxiliary Pool Cooling System (FAPCS) and the Fire Protection System (FPS) as additional active cooling systems to be used after successful water injection from GDCS and the suppression pool.

The Loss-of-Preferred-Power CCV event trees also take credit for recovery of offsite power within 24 hours. Most cutsets resulting from the LOPP Class II sequences already contain a short-term power recovery event. Therefore, the probability of failure to recover power within 24 hours, included in the CCV event trees, is conditional of the failure to recover power short term, already included in the model. The value of this probability was calculated based on data from NUREG/CR-INEEL/EXT-04-02326, "Evaluation of Loss of Offsite Power Events at Nuclear Power Plants: 1986 -- 2003 (Draft)", October 2004. Table 4-1 of the NUREG, shows a probability of offsite power recovery failure in 0.5 hours of 0.664, while the probability of offsite power recovery failure in 24 hours is 0.065. Therefore, the conditional probability of offsite recovery failure in 24 hours, given failure to recover in 0.5 hours, is 0.065/0.664 = 0.0979.

The only LOCA sequences resulting in a Class II CDF above the truncation limit of 1.0×10^{-13} are on the failure branch of the DS event-tree node, i.e., following failure of the Steam Suppression System. The CCV event trees shown in figures A.11-5 through A.11-9 represent the continuation of these sequences. Using the same success criteria for active systems as on the success path of the DS node, systems like Control Rod Drive (CRD), Feedwater (FDW), FAPCS and FPS were modeled before Node VG4. The only difference between these CCV sequences, and those modeled on the success branch of Node DS in Chapter 3 consists in the fact that containment will fail before core damage due to failure of the vacuum breakers, i.e., the steam suppression function.

MAAP analyses performed for the steam LOCA scenarios with immediate failure of the Steam Suppression System show that the water level in the vessel can be maintained above the top of active fuel for more than 72 hours with two out of the three GDCS pools, and one equalizing line from the suppression pool available. CCV event-tree node VG4 models this success criterion. For the liquid LOCA scenarios, the core uncovers between 60 and 72 hours for scenarios in which the vacuum breaker fails concurrent with the LOCA and the VG4 node is successful. The failure mode assumed here is the passive function of the vacuum breaker; it is more reasonable to consider an active failure following the first cycling of the vacuum breaker, which occurs much later in the scenario, if at all. In either case, the long time to core uncovery makes it appropriate to treat these the same as the steam LOCA scenarios.

Following success of the passive core cooling systems (success branch of VG4), active systems like Shutdown Cooling (SDC) or FAPCS in suppression pool cooling mode can be used to ensure core cooling far beyond the stated 72-hour mission.

11.3.1.2 Results of the 72-Hour-Mission-Time Sensitivity

Table 11-1 presents the results of the 72-hours-mission-time sensitivity analysis. The table includes all Class II sequences that result in a frequency above the truncation of 1.0×10^{-13} before being taken through the CCV event trees. Table 11-1 presents the results of the Class II sequence quantification both before, and after the CCV event trees.

All CD-V accident sequences have frequencies below a truncation limit, therefore, are considered negligible and results are not reported.

After the CCV event trees, the CDF resulting from accident Class II sequences was reduced to 4.26×10^{-11}, or 0.15% of total CDF. Given the 72-hour length of the mission time, this contribution to CDF could be reduced even further, through detailed recovery analysis at the cutset level. However, this was not considered necessary due to the already insignificant contribution of the Accident Class II sequences to total CDF.

The results of this sensitivity analysis justify not including Class II accident sequences in the calculation of the Level 1 Internal Events CDF, due to their insignificant contribution.

11.3.2 Importance of Non-Safety Systems

The objective of this PRA sensitivity is to evaluate the plant's capability to respond to an accident using only safety-related systems, and systems assigned to the Regulatory Treatment of Non-Safety Systems (RTNSS) program. The only systems assigned to the RTNSS program is the portion of the Fire Protection system used to refill the IC and PCCS pools and the BiMAC.

11.3.2.1 Core Damage Frequency Goal

Appendix B.11 presents the event trees used for quantifying the Level 1, internal events model, assuming only safety-related and RTNSS systems are available. These event trees were obtained from the internal-events event trees by eliminating all nodes modeling non-safety systems, except for Node WT modeling the long-term PCC pools inventory. The nodes were eliminated by deleting the success branch; therefore, elimination of these nodes removed any credit for the systems they used to model.

The following non-safety system headings were eliminated from this quantification:

- Power Conversion System
- CRD
- Feedwater and Condensate
- LPCI Mode of FAPCS
- SPC Mode of FAPCS
- SDC Mode of RWCU
- Fire Water Injection
- Containment Vent

A 24-hour mission time was used for this calculation. The CDF resulting from this quantification is 6.68×10^{-6} per year. The quantification for this sensitivity was run at 10^{-11}.

The top 50 cutsets from this sensitivity, representing 99.8% of CDF are presented in Table 11-5. The dominant initiating events are:

- Loss of Feedwater 42%
- Inadvertent Open Relief Valve 31%
- Loss of Preferred Power 21%
- Medium Liquid LOCA 3%
- Small Liquid LOCA 2%

The remaining initiating events each contribute less than 1% of the total.

The dominant failure modes are the common cause failure of GDCS and equalizing line injection valves and the common cause failure of DPVs. These make up 83% and 11%, respectively, of CDF. This is expected because in the top sequences, the ICS is not available due to depressurization of the plant, and the GDCS system is the only safety related injection mode.

11.3.2.2 Large Release Frequency Goal

The method of quantifying the containment event trees described in Chapter 8 was applied to the focused PRA. It is summarized below for the focused PRA calculation.

The systems used in the CSET have a slight dependence on some of the systems used in the Level 1 PRA.

There is a potential for power dependence for the vacuum breakers (node VB) and for the long term containment cooling (node W2). Therefore, the Level 1 results are separated into loss of preferred power (LOPP) sequences vs non-LOPP sequences. This was done by splitting the cutset files based on the initiating event.

The containment response is different based on the accident class. Therefore, the Level 1 results are separated by class. In all, 6 separate cases (subclasses) are generated.

1. Class I LOPP (IL)
2. Class I no-LOPP (IN)

3. Class III LOPP (IIIL)
4. Class III no-LOPP (IIIN)
5. Class IV (IV)
6. Class V (V)

Class IV did not contain any LOPP initiated cutsets. The cutsets for Class IV do not contain any failures that would preclude plant depressurization. Therefore, just as in the Chapter 8 base case, it is assumed that the Class IV sequences behave similar to Class I sequences. Also Class V goes directly to a release, so no CET processing is needed. There are no Class II sequences in the 24-hour PRA.

In Chapter 8, the LDW water level bins were determined on a sequence basis. In this chapter, they were determined on a cutset basis. The cutset binning based on the initiating event provides an acceptable method because the initiating event is the primary determining factor for this parameter. All cutsets with the following initiating events were assigned to a high water bin:

- Feedwater Line Breaks
- Medium Liquid LOCAs
- Small Liquid LOCAs

All other cutsets were assigned to a low water bin. Some of the small LOCAs could reasonably be considered to result in a medium water level, however it is conservative to assign them to the high water level bin.

The frequencies of the bins generated for this analysis are:

IN-HWL	3.44×10^{-7}
IN-LWL	4.93×10^{-6}
IL-LWL	1.39×10^{-6}
IIIN-HWL	4.79×10^{-9}
IIIN-LWL	1.00×10^{-8}
IIIL-LWL	6.3×10^{-11}
IV	1.11×10^{-10}
V	1.16×10^{-10}

Each of the CPET and CSET pairs for the subclasses are solved by assigning an initiator value based on the sum of the Level 1 sequences that make up the subclass, followed by nodal probabilities for the various branches. The probabilities assigned to the branches are based on criteria and models that are described later in this section. The event trees are then quantified by multiplying the node probabilities (or the complement on the success branches) for each sequence.

The following CPET/CSET nodes are independent of the Level 1 sequences:

- BI_FN Debris is Successfully Cooled

- BI_SP GDCS Deluge Supply to BiMAC Successful
- CIS Containment Isolation System
- DCH Containment Intact / Insignificant DCH
- EVE_DAM Pedestal Intact
- VT Vent Operation

These nodes are assigned the same value in all subclasses. The nodes themselves are described in either Chapter 8 or Chapter 21. The probabilities used for the CPET / CSET nodes are summarized in Table 11-3.

The event trees in different subclasses may have different probabilities assigned to the other nodes because of dependences with the Level 1 sequences. These nodes are:

- LD_LVL Water Level Prior to RPV Failure
- VB Vapor Suppression Function
- W1 Containment Heat Removal (Short Term: <24 Hours)
- W2 Containment Heat Removal (Long Term: <24 Hours)

Conditional probabilities for the node LD_LVL were calculated by identifying the sequences that contribute to the particular water level bin. The node probability is assigned according to the fraction of the total subclass frequency that results in the given water level condition. Conditional probabilities for the failure branches of CSET nodes VB, W1, and W2 were calculated by developing fault trees for these nodes, converting the subclass cutsets into fault trees, linking these fault trees using simple event trees, and quantifying these event trees using the cutset methodology. Conditional probabilities were then calculated based on the sequence quantification results of the simple event trees.

The system fault trees were generated by extracting the appropriate gates from the master model files of the Level 1 Internal Events Focused PRA. This way, all support systems are accounted for, consistently with the Level 1 model. The top gates of the systems modeled are:

VB = GT10-0001-_1

W1 = GT15TOP

W2 = GT15-0033-_1

Where:

GT10-0001-_1: Isolation of Vacuum Breaker Leaks Fails

GT15TOP: 3/6 PCCS Fail

GT15-0033-_1: Loss of Pool Water (72 hours)

These fault trees are shown in Chapter 4.

Accident sequences that result in containment failure in the in the CPETs are containment bypass sequences. Therefore, dependency of the CSET nodes on these sequences does not need to be considered, and they were not included in the CDF subclasses for Level 2 CSETs. All of the

LDW high water level cutsets are in this category. Table 11-3 contains the calculated conditional probabilities.

In the base PRA, an insignificant fraction of the Class III scenarios had high water in the lower drywell. In the focused PRA, however, some cutsets resulting in high water level in the lower drywell have a significant contribution. These cutsets were conservatively treated as containment failure scenarios. They are depicted in the CPET for Class III without LOPP using the LD_LVL node. This is shown in Figure 11-3.

The end states for each of the CETs were evaluated and are shown on Table 11-4. The total LRF for the focused PRA is 4.2×10^{-7}, which represents 6.3% of the focused PRA CDF of 6.68×10^{-6} per year.

Most of this, ~5% of CDF, is associated with steam explosions caused by high water level in the LDW at the time of vessel failure. This compares to the base PRA value of ~1% of CDF. The main reason for this is that in LOCAs, the ICS does not perform any useful function. Therefore, the active systems are the primary backup for GDCS. In transients, the active systems plus ICS are available in addition to GDCS. The relatively small increase in contribution, however, does not warrant designating any of the active systems RTNSS.

The other ~1% of CDF that results in LRF is associated with the uncertainty of the BiMAC functionality. This is the same as in the base PRA.

Practically no containment systems contribute to LRF, therefore, no additional systems need to be considered for RTNSS based on the Focused Level 2 analysis.

11.3.3 Truncation Value

The ESBWR Internal Events PRA is quantified with a truncation value of 1.0×10^{-13}. This value is five orders of magnitude below CDF, and is sufficient to capture most of the risk. The 24-hour model was requantified using a truncation level of 1.0×10^{-14} to validate the selected truncation value. The result is presented in Table 11-2.

This quantification brings in an additional 79,000 cutsets, yet only increases the mean CDF by 8%. The dominating initiating events in the additional cutsets are Loss of Preferred Power (83%) and Loss of Feedwater (14%). The rest each contribute less than 2% each. These dominant initiators reflect the ESBWR overall risk profile. Therefore no new insight is brought in by this.

The basic event importance ranking was also reviewed for the lower truncation value. There are no new events that contribute a significant fraction to CDF than in the base case. There are a few common cause events that have a moderately high RAW value (between 10 and 100) that are added during this sensitivity. These are all in combination with other common cause failures in the cutsets and have a very low FV importance. Because of this, these should be reviewed by the expert panel in the D-RAP phase 2.

The additional sequences that were introduced by this sensitivity do not affect the calculation of LRF.

11.3.4 Human Reliability

The ESBWR Internal Events PRA model includes minimal credit for operator actions. This sensitivity is provided to demonstrate the contribution of the modeled human action to CDF.

The sensitivity is performed by setting all post-initiator human actions to TRUE, or always failed. The Level 1, internal events model is re-quantified to obtain the result. The result is presented in Table 11-2. The top 200 cutsets, representing 63% of CDF, are presented in Table 11-6.

The dominating initiating events in the additional cutsets are Loss of Preferred Power (57%) and Loss of Feedwater (38%). The rest each contribute less than 1.5% each. These dominant initiators reflect the ESBWR overall risk profile. Therefore no new insight is brought in by this.

The basic event importance ranking was also reviewed for the case without operator actions. There are four additional components that are identified as having a significant contribution (FV >= 0.005) in this sensitivity. These are in the service air system and in the electrical system, and should be reviewed by the expert panel in phase 2 of the D-RAP. There are a few common cause events that have a moderately high RAW value (between 10 and 100) that are added during this sensitivity. These are all in combination with other common cause failures in the cutsets and have a very low FV importance. Because of this, these should be reviewed by the expert panel in the D-RAP phase 2.

It is not useful to perform LRF based sensitivities for operator actions. First, because the total CDF estimated in this sensitivity is less than 10^{-6} per year, it is not possible to raise the LRF value above the goal. Second, there are no important operator actions credited in the LRF evaluation[2]. For example, removing containment vent from the LRF calculation would not affect the results because both the success of vent and the failure of containment due to overpressure are treated as large releases.

11.3.5 Squib Valve Reliability

The ESBWR PRA includes data for squib valve failures based on generic data. An increased failure rate was used for the squib valves located in harsh environments. The ESBWR passive systems relay heavily on squib valves; therefore, this sensitivity was performed to provide assurance that this component selection is appropriate.

Two sensitivity cases were analyzed, one with squib-valve failure rates increased by a factor of 5, and another one with the failure rates increased by a factor of 10. Common cause failure probabilities of squib valves were also increased by the same factors. The results are presented in Table 11-2.

The results of this sensitivity are expected. More than 80% of the CDF in ESBWR involves cutsets with squib valve failures. This would indicate that the CDF would vary linearly with the probability of squib valve failure. This sensitivity bears that out.

The base value used in the model for squib valve failure is fairly high in the first place. There is no reason to believe that these valves would fail at a higher rate than a currently available MOV.

[2] Isolation of the backup vacuum breaker was conservatively modeled as a purely manual action. In fact, the design of the vacuum breaker described in DCD Chapter 6 indicates that this isolation is an automatic feature. This automatic isolation makes the manual backup action much less important.

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Table 11-1

Results of the 72-Hour Mission Time Sensitivity Analysis

Initiating Event	Quantification Results without CCV Treatment				Quantification Results after CCV Treatment			
	Acc. Sequence	CDF [/yr]	% of Class	% of Total	Acc. Sequence	CDF [/yr]	% of Class	% of Total
T-GEN	T-GEN022	4.22E-13	0.02%	0.00%	T-CCV02	3.13E-11	73.46%	0.11%
	T-GEN025	1.97E-13	0.01%	0.00%				
T-FDW	T-FDW039	3.27E-11	1.30%	0.10%				
	T-FDW042	8.72E-13	0.03%	0.00%				
T-IORV	T-IORV023	4.86E-12	0.19%	0.02%				
	T-IORV010	3.01E-13	0.01%	0.00%	T-IORV010	3.01E-13	0.71%	0.00%
T-SW	T-SW005	4.58E-12	0.18%	0.01%	T-SW005	4.58E-12	10.75%	0.02%
	T-SW007	1.20E-12	0.05%	0.00%	T-SW007	1.20E-12	2.81%	0.00%
	T-SW014	6.38E-12	0.25%	0.02%	T-SWCCV02	4.04E-13	0.95%	0.00%
	T-SW016	2.68E-12	0.11%	0.01%				
T-LOPP	T-LOPP008	2.20E-13	0.01%	0.00%	T-LOPPACCV02	ε		
	T-LOPP011	1.03E-13	0.00%	0.00%				
	T-LOPP021	3.92E-12	0.16%	0.01%	T-LOPPBCCV03	4.82E-12	11.33%	0.02%
	T-LOPP024	1.83E-12	0.07%	0.01%				
	T-LOPP036	1.51E-11	0.60%	0.05%				
	T-LOPP039	1.13E-09	45.00%	3.56%				
	T-LOPP042	1.94E-10	7.74%	0.61%				
LL-S	LL-S-015	9.99E-10	39.79%	3.15%	LL-S-CCV05	ε		
LL-S-FDWA	LL-S-FDWA014	1.11E-11	0.44%	0.04%	LL-S-FDWACCV04	ε		
LL-S-FDWB	LL-S-FDWB014	1.11E-11	0.44%	0.04%	LL-S-FDWBCCV04	ε		
ML-L	ML-L-016	7.53E-11	3.00%	0.24%	ML-L-CCV05	ε		
ML-L-RWCU	ML-L-RWCU015	1.47E-11	0.58%	0.05%	ML-L-RWCUCCV04	ε		
Class II Totals:		**2.51E-09**	100.00%	**7.91%**		**4.26E-11**	100.00%	**0.15%**
Total CDF, without Class II:		**2.92E-08**				**2.92E-08**		
Total CDF, including Class II:		**3.17E-08**				**2.93E-08**		

Note: "ε" indicates that the accident sequence quantification did not produce any cutsets above the truncation limit of 1.0E-13

Table 11-2

Sensitivity Analysis Results Compilation

Case	CDF [/yr]
Base	2.92×10^{-8}
Non-Safety Systems Unavailable – 24-Hour Mission Time	6.68×10^{-6}
Truncation 1.0×10^{-14}	3.15×10^{-8}
No Operator Credit	1.49×10^{-7}
Squib Valve Failure Rate x 5	1.40×10^{-7}
Squib Valve Failure Rate x 10	2.81×10^{-7}

Table 11-3

Focused Level 2 Node Probabilities

	IL	IN	IIIL	IIIN	IVN
LD_L1	1.0	9.35E-01	1.0	6.77E-01	1.0
LD_L2		0.00E+00		0.00E+00	
LD_L3		6.52E-02		3.23E-01	
EVE_DAM		1.00E-03		1.00E-03	
DCH_DAM			1.00E-03	1.00E-03	
BI_SP	1.00E-03	1.00E-03	1.00E-03	1.00E-03	1.00E-03
BI_FN	1.00E-02	1.00E-02	1.00E-02	1.00E-02	1.00E-02
CIS	3.50E-05	3.50E-05	3.50E-05	3.50E-05	3.50E-05
VB	5.36E-06	5.38E-06	3.00E-04	1.30E-05	5.36E-06
W1	1.82E-04	1.82E-04	1.82E-04	1.82E-04	1.82E-04
W2	8.64E-07	1.10E-06	5.38E-03	4.22E-05	8.24E-07
VT	1.0	1.0	1.0	1.0	1.0

Table 11-4

Focused Level 2 End State Frequencies

	IL	IN	IIIL	IIIN	IVN	V	Totals
CCIW	1.39E-08	4.93E-08	6E-13	1.00E-10	1.1E-12		6.33E-08
CCID	1.39E-09	4.93E-09	ε	1.00E-11	1E-13		6.33E-09
EVE	0	0			0		0
EVE(CCIW*)	0	3.44E-07		4.79E-09	0		3.49E-07
DCH			ε	1.00E-11			1.01E-11
TSL	1.38E-06	4.88E-06	6.22E-11	9.92E-09	1.10E-10		6.26E-06
FR	0	0	0	0	0		0
OPW2	1.2E-12	5.4E-12	3E-13	4E-13	ε		7.30E-12
OPW1	2.51E-10	8.86E-10	ε	1.8E-12	ε		1.14E-09
OPVB	7.4E-12	2.63E-11	ε	1E-13	ε		3.38E-11
BYP	4.82E-11	1.71E-10	ε	3E-13	ε		2.19E-10
BOC						1.16E-10	1.16E-10

Table 11-5

Top 50 Cutsets for RTNSS Sensitivity Analysis

Probability	%	Class	Initiator	Basic Events	
1.39E-06	20.80%	CDI	%T-FDW	E50-SQV-CF-GDCS7OPEN	
1.39E-06	41.50%	CDI	%T-FDW	E50-SQV-CF-OPENALL	
6.90E-07	51.80%	CDIII	%T-IORV	B21-SQV-CF-DPVOPEN	
6.90E-07	62.20%	CDI	%T-IORV	E50-SQV-CF-GDCS7OPEN	
6.90E-07	72.50%	CDI	%T-IORV	E50-SQV-CF-OPENALL	
6.90E-07	82.80%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	
6.90E-07	93.10%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	
6.41E-08	94.10%	CDI	%SL-L-RWCU	E50-STR-CF-SPPLUG	
4.28E-08	94.70%	CDI	%SL-L	E50-STR-CF-SPPLUG	
3.33E-08	95.20%	CDI	%ML-L	E50-SQV-CO-F009A	E50-SYS-FF-MLLOCA
3.33E-08	95.70%	CDI	%ML-L	E50-SQV-CO-F009D	E50-SYS-FF-MLLOCA
3.33E-08	96.20%	CDI	%ML-L	E50-SQV-CO-F009E	E50-SYS-FF-MLLOCA
3.33E-08	96.70%	CDI	%ML-L	E50-SQV-CO-F009H	E50-SYS-FF-MLLOCA
3.33E-08	97.20%	CDI	%ML-L	E50-SQV-CO-F009I	E50-SYS-FF-MLLOCA
3.33E-08	97.70%	CDI	%ML-L	E50-SQV-CO-F009L	E50-SYS-FF-MLLOCA
1.11E-08	97.90%	CDI	%T-FDW	B21-LT_-CF-N001ABCD	
9.66E-09	98.00%	CDIII	%T-IORV	C51-ACT-CF-APRMSTUCK	
9.41E-09	98.20%	CDI	%ML-L	E50-STR-CF-SPPLUG	
9.06E-09	98.30%	CDIII	%SL-S	B21-SQV-CF-DPVOPEN	
9.06E-09	98.40%	CDI	%SL-S	E50-SQV-CF-GDCS7OPEN	
9.06E-09	98.60%	CDI	%SL-S	E50-SQV-CF-OPENALL	
6.66E-09	98.70%	CDI	%T-FDW	E50-OR_-CF-PLUGALL	
6.48E-09	98.80%	CDI	%T-FDW	E50-OR_-CF-7PLUG	
5.52E-09	98.90%	CDI	%T-IORV	B21-LT_-CF-N001ABCD	
5.52E-09	98.90%	CDI	%T-LOPP	B21-LT_-CF-N001ABCD	
5.13E-09	99.00%	CDI	%SL-L-RWCU	E50-SQV-CF-EQALLOPEN	
4.99E-09	99.10%	CDI	%LL-S	E50-SQV-CF-GDCS7OPEN	
4.99E-09	99.20%	CDI	%LL-S	E50-SQV-CF-OPENALL	
3.42E-09	99.20%	CDI	%SL-L	E50-SQV-CF-EQALLOPEN	
3.31E-09	99.30%	CDI	%T-IORV	E50-OR_-CF-PLUGALL	
3.31E-09	99.30%	CDI	%T-LOPP	E50-OR_-CF-PLUGALL	
3.22E-09	99.40%	CDI	%T-IORV	E50-OR_-CF-7PLUG	
3.22E-09	99.40%	CDI	%T-LOPP	E50-OR_-CF-7PLUG	
2.56E-09	99.50%	CDIII	%SL-L-RWCU	B21-SQV-CF-DPVOPEN	
2.56E-09	99.50%	CDI	%SL-L-RWCU	E50-SQV-CF-4OPEN	
2.56E-09	99.50%	CDI	%SL-L-RWCU	E50-SQV-CF-GDCS7OPEN	
2.05E-09	99.60%	CDI	%SL-L-RWCU	C74-DTM-CF-ALL	
1.83E-09	99.60%	CDI	%ML-L-RWCU	E50-STR-CF-SPPLUG	
1.71E-09	99.60%	CDIII	%SL-L	B21-SQV-CF-DPVOPEN	
1.71E-09	99.60%	CDI	%SL-L	E50-SQV-CF-4OPEN	

Table 11-5

Top 50 Cutsets for RTNSS Sensitivity Analysis

Probability	%	Class	Initiator	Basic Events	
1.71E-09	99.70%	CDI	%SL-L	E50-SQV-CF-GDCS7OPEN	
1.37E-09	99.70%	CDI	%SL-L	C74-DTM-CF-ALL	
7.60E-10	99.70%	CDI	%T-GEN	B21-SYS-FF-1/9OPEN	C71-SYS-FF-SCRAM
7.53E-10	99.70%	CDI	%ML-L	E50-SQV-CF-EQALLOPEN	
5.34E-10	99.70%	CDI	%SL-L-RWCU	C74-VLU-CF-ALL	
5.20E-10	99.70%	CDI	%T-FDW	E50-SQV-CF-4OPEN	E50-STR-CF-SPPLUG
4.60E-10	99.70%	CDI	%T-IORV	C71-SYS-FF-SCRAM	
3.76E-10	99.70%	CDIII	%ML-L	B21-SQV-CF-DPVOPEN	
3.76E-10	99.70%	CDI	%ML-L	E50-SQV-CF-4OPEN	
3.76E-10	99.80%	CDI	%ML-L	E50-SQV-CF-GDCS7OPEN	

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
3.20E-09	2.20%	CDI	%T-FDW	C12-XHE-MH-F013A	C12-XHE-MH-F013B	E50-SQV-CF-GDCS7OPEN	
3.20E-09	4.30%	CDI	%T-FDW	C12-XHE-MH-F013A	C12-XHE-MH-F013B	E50-SQV-CF-OPENALL	
3.20E-09	6.50%	CDI	%T-FDW	C12-XHE-MH-F013A	C12-XHE-MH-F015B	E50-SQV-CF-GDCS7OPEN	
3.20E-09	8.60%	CDI	%T-FDW	C12-XHE-MH-F013A	C12-XHE-MH-F015B	E50-SQV-CF-OPENALL	
3.20E-09	10.80%	CDI	%T-FDW	C12-XHE-MH-F013B	C12-XHE-MH-F015A	E50-SQV-CF-GDCS7OPEN	
3.20E-09	12.90%	CDI	%T-FDW	C12-XHE-MH-F013B	C12-XHE-MH-F015A	E50-SQV-CF-OPENALL	
3.20E-09	15.10%	CDI	%T-FDW	C12-XHE-MH-F015A	C12-XHE-MH-F015B	E50-SQV-CF-GDCS7OPEN	
3.20E-09	17.20%	CDI	%T-FDW	C12-XHE-MH-F015A	C12-XHE-MH-F015B	E50-SQV-CF-OPENALL	
2.22E-09	18.70%	CDI	%T-FDW	B21-UV_-CC-F102B	E50-SQV-CF-GDCS7OPEN		
2.22E-09	20.20%	CDI	%T-FDW	B21-UV_-CC-F102B	E50-SQV-CF-OPENALL		
2.22E-09	21.70%	CDI	%T-FDW	B21-UV_-CC-F103B	E50-SQV-CF-GDCS7OPEN		
2.22E-09	23.20%	CDI	%T-FDW	B21-UV_-CC-F103B	E50-SQV-CF-OPENALL		
2.22E-09	24.70%	CDI	%T-FDW	C12-UV_-CC-F022	E50-SQV-CF-GDCS7OPEN		
2.22E-09	26.20%	CDI	%T-FDW	C12-UV_-CC-F022	E50-SQV-CF-OPENALL		
1.59E-09	27.20%	CDI	%T-LOPP	C12-XHE-MH-F013A	C12-XHE-MH-F013B	E50-SQV-CF-GDCS7OPEN	
1.59E-09	28.30%	CDI	%T-LOPP	C12-XHE-MH-F013A	C12-XHE-MH-F013B	E50-SQV-CF-OPENALL	
1.59E-09	29.40%	CDI	%T-LOPP	C12-XHE-MH-F013A	C12-XHE-MH-F015B	E50-SQV-CF-GDCS7OPEN	
1.59E-09	30.40%	CDI	%T-LOPP	C12-XHE-MH-F013A	C12-XHE-MH-F015B	E50-SQV-CF-OPENALL	
1.59E-09	31.50%	CDI	%T-LOPP	C12-XHE-MH-F013B	C12-XHE-MH-F015A	E50-SQV-CF-GDCS7OPEN	
1.59E-09	32.60%	CDI	%T-LOPP	C12-XHE-MH-F013B	C12-XHE-MH-F015A	E50-SQV-CF-OPENALL	
1.59E-09	33.60%	CDI	%T-LOPP	C12-XHE-MH-F015A	C12-XHE-MH-F015B	E50-SQV-CF-GDCS7OPEN	
1.59E-09	34.70%	CDI	%T-LOPP	C12-XHE-MH-F015A	C12-XHE-MH-F015B	E50-SQV-CF-OPENALL	
1.10E-09	35.50%	CDI	%T-LOPP	B21-UV_-CC-F102B	E50-SQV-CF-GDCS7OPEN		
1.10E-09	36.20%	CDI	%T-LOPP	B21-UV_-CC-F102B	E50-SQV-CF-OPENALL		
1.10E-09	36.90%	CDI	%T-LOPP	B21-UV_-CC-F103B	E50-SQV-CF-GDCS7OPEN		
1.10E-09	37.70%	CDI	%T-LOPP	B21-UV_-CC-F103B	E50-SQV-CF-OPENALL		
1.10E-09	38.40%	CDI	%T-LOPP	C12-UV_-CC-F022	E50-SQV-CF-GDCS7OPEN		

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
1.10E-09	39.20%	CDI	%T-LOPP	C12-UV_-CC-F022	E50-SQV-CF-OPENALL		
4.23E-10	39.50%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTA1	
4.23E-10	39.70%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTA2	
4.23E-10	40.00%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTB1	
4.23E-10	40.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTB2	
4.23E-10	40.60%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTA1	
4.23E-10	40.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTA2	
4.23E-10	41.20%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTB1	
4.23E-10	41.40%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-TM-R16BTB2	
3.61E-10	41.70%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-CS-ALLDG	
3.61E-10	41.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-CS-ALLDG	
3.38E-10	42.20%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R22-RE_-FD-10A11	
3.38E-10	42.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R22-RE_-FD-10A21	
3.38E-10	42.60%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R22-RE_-FD-10A11	
3.38E-10	42.80%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R22-RE_-FD-10A21	
3.31E-10	43.10%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R21-DG_-FS-DGB
3.31E-10	43.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R21-DG_-FS-DGA
3.31E-10	43.50%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R21-DG_-FS-DGB
3.31E-10	43.70%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R21-DG_-FS-DGA
2.84E-10	43.90%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-FS-DGA
2.84E-10	44.10%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-FS-DGB
2.84E-10	44.30%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-FS-DGA
2.84E-10	44.50%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-FS-DGB
2.84E-10	44.70%	CDI	%T-LOPP	C12-XHE-MH-F003B	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA
2.84E-10	44.90%	CDI	%T-LOPP	C12-XHE-MH-F003B	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA
2.84E-10	45.10%	CDI	%T-LOPP	C12-XHE-MH-F018A	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB
2.84E-10	45.30%	CDI	%T-LOPP	C12-XHE-MH-F018A	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB
2.84E-10	45.50%	CDI	%T-LOPP	C12-XHE-MH-F018B	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
2.84E-10	45.60%	CDI	%T-LOPP	C12-XHE-MH-F018B	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA
2.84E-10	45.80%	CDI	%T-LOPP	C12-XHE-MH-F021A	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB
2.84E-10	46.00%	CDI	%T-LOPP	C12-XHE-MH-F021A	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB
2.84E-10	46.20%	CDI	%T-LOPP	C12-XHE-MH-F021B	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA
2.84E-10	46.40%	CDI	%T-LOPP	C12-XHE-MH-F021B	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA
2.66E-10	46.60%	CDI	%T-FDW	C12-MOV-CC-F014A	C12-XHE-MH-F013B	E50-SQV-CF-GDCS7OPEN	
2.66E-10	46.80%	CDI	%T-FDW	C12-MOV-CC-F014A	C12-XHE-MH-F013B	E50-SQV-CF-OPENALL	
2.66E-10	46.90%	CDI	%T-FDW	C12-MOV-CC-F014A	C12-XHE-MH-F015B	E50-SQV-CF-GDCS7OPEN	
2.66E-10	47.10%	CDI	%T-FDW	C12-MOV-CC-F014A	C12-XHE-MH-F015B	E50-SQV-CF-OPENALL	
2.66E-10	47.30%	CDI	%T-FDW	C12-MOV-CC-F014B	C12-XHE-MH-F013A	E50-SQV-CF-GDCS7OPEN	
2.66E-10	47.50%	CDI	%T-FDW	C12-MOV-CC-F014B	C12-XHE-MH-F013A	E50-SQV-CF-OPENALL	
2.66E-10	47.70%	CDI	%T-FDW	C12-MOV-CC-F014B	C12-XHE-MH-F015A	E50-SQV-CF-GDCS7OPEN	
2.66E-10	47.80%	CDI	%T-FDW	C12-MOV-CC-F014B	C12-XHE-MH-F015A	E50-SQV-CF-OPENALL	
2.54E-10	48.00%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-EMS-FC-DIVADID	R11-SYS-FF-NOREC	
2.54E-10	48.20%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-EMS-FC-DIVBDID	R11-SYS-FF-NOREC	
2.54E-10	48.40%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-EMS-FC-DIVADID	R11-SYS-FF-NOREC	
2.54E-10	48.50%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-EMS-FC-DIVBDID	R11-SYS-FF-NOREC	
2.44E-10	48.70%	CDI	%T-LOPP	C12-XHE-MH-F003B	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	48.90%	CDI	%T-LOPP	C12-XHE-MH-F003B	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	49.00%	CDI	%T-LOPP	C12-XHE-MH-F018A	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	49.20%	CDI	%T-LOPP	C12-XHE-MH-F018A	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	49.30%	CDI	%T-LOPP	C12-XHE-MH-F018B	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	49.50%	CDI	%T-LOPP	C12-XHE-MH-F018B	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	49.70%	CDI	%T-LOPP	C12-XHE-MH-F021A	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	49.80%	CDI	%T-LOPP	C12-XHE-MH-F021A	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	50.00%	CDI	%T-LOPP	C12-XHE-MH-F021B	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.44E-10	50.20%	CDI	%T-LOPP	C12-XHE-MH-F021B	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC
2.11E-10	50.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTA1	

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
2.11E-10	50.50%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTA2	
2.11E-10	50.60%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTB1	
2.11E-10	50.70%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTB2	
2.11E-10	50.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTA1	
2.11E-10	51.00%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTA2	
2.11E-10	51.20%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTB1	
2.11E-10	51.30%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R16-BT_-LP-R16BTB2	
2.03E-10	51.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R13-INV-FC-R13A1	
2.03E-10	51.60%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R13-INV-FC-R13A2	
2.03E-10	51.70%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R13-INV-FC-R13B1	
2.03E-10	51.90%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R13-INV-FC-R13B2	
2.03E-10	52.00%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R13-INV-FC-R13A1	
2.03E-10	52.10%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R13-INV-FC-R13A2	
2.03E-10	52.30%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R13-INV-FC-R13B1	
2.03E-10	52.40%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R13-INV-FC-R13B2	
2.00E-10	52.50%	CDI	%T-FDW	C12-XHE-MH-F003B	C12-XHE-MH-F018A	E50-SQV-CF-GDCS7OPEN	
2.00E-10	52.70%	CDI	%T-FDW	C12-XHE-MH-F003B	C12-XHE-MH-F018A	E50-SQV-CF-OPENALL	
2.00E-10	52.80%	CDI	%T-FDW	C12-XHE-MH-F003B	C12-XHE-MH-F021A	E50-SQV-CF-GDCS7OPEN	
2.00E-10	52.90%	CDI	%T-FDW	C12-XHE-MH-F003B	C12-XHE-MH-F021A	E50-SQV-CF-OPENALL	
2.00E-10	53.10%	CDI	%T-FDW	C12-XHE-MH-F018A	C12-XHE-MH-F018B	E50-SQV-CF-GDCS7OPEN	
2.00E-10	53.20%	CDI	%T-FDW	C12-XHE-MH-F018A	C12-XHE-MH-F018B	E50-SQV-CF-OPENALL	
2.00E-10	53.30%	CDI	%T-FDW	C12-XHE-MH-F018A	C12-XHE-MH-F021B	E50-SQV-CF-GDCS7OPEN	
2.00E-10	53.50%	CDI	%T-FDW	C12-XHE-MH-F018A	C12-XHE-MH-F021B	E50-SQV-CF-OPENALL	
2.00E-10	53.60%	CDI	%T-FDW	C12-XHE-MH-F018B	C12-XHE-MH-F021A	E50-SQV-CF-GDCS7OPEN	
2.00E-10	53.70%	CDI	%T-FDW	C12-XHE-MH-F018B	C12-XHE-MH-F021A	E50-SQV-CF-OPENALL	
2.00E-10	53.90%	CDI	%T-FDW	C12-XHE-MH-F021A	C12-XHE-MH-F021B	E50-SQV-CF-GDCS7OPEN	
2.00E-10	54.00%	CDI	%T-FDW	C12-XHE-MH-F021A	C12-XHE-MH-F021B	E50-SQV-CF-OPENALL	
1.88E-10	54.10%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-MCB-CC-XFRMAA2	R11-SYS-FF-NOREC	R21-DG_-FR-DGB

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
1.88E-10	54.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-MCB-CC-XFRMBB2	R11-SYS-FF-NOREC	R21-DG_-FR-DGA
1.88E-10	54.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD1
1.88E-10	54.50%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD2
1.88E-10	54.60%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD3
1.88E-10	54.80%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD4
1.88E-10	54.90%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD5
1.88E-10	55.00%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD1
1.88E-10	55.20%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD2
1.88E-10	55.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD3
1.88E-10	55.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD4
1.88E-10	55.50%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD5
1.88E-10	55.70%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-MCB-CC-XFRMAA2	R11-SYS-FF-NOREC	R21-DG_-FR-DGB
1.88E-10	55.80%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-MCB-CC-XFRMBB2	R11-SYS-FF-NOREC	R21-DG_-FR-DGA
1.88E-10	55.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD1
1.88E-10	56.00%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD2
1.88E-10	56.20%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD3
1.88E-10	56.30%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD4
1.88E-10	56.40%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R22-MCB-CC-2LOAD5
1.88E-10	56.50%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD1
1.88E-10	56.70%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD2
1.88E-10	56.80%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD3
1.88E-10	56.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD4
1.88E-10	57.10%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R22-MCB-CC-1LOAD5
1.62E-10	57.20%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-MCB-CC-XFRMAA2	R11-SYS-FF-NOREC
1.62E-10	57.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-MCB-CC-XFRMBB2	R11-SYS-FF-NOREC
1.62E-10	57.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD1
1.62E-10	57.50%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD2
1.62E-10	57.60%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD3

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
1.62E-10	57.70%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD4
1.62E-10	57.80%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD5
1.62E-10	57.90%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD1
1.62E-10	58.00%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD2
1.62E-10	58.10%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD3
1.62E-10	58.20%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD4
1.62E-10	58.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD5
1.62E-10	58.50%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-MCB-CC-XFRMAA2	R11-SYS-FF-NOREC
1.62E-10	58.60%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-MCB-CC-XFRMBB2	R11-SYS-FF-NOREC
1.62E-10	58.70%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD1
1.62E-10	58.80%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD2
1.62E-10	58.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD3
1.62E-10	59.00%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD4
1.62E-10	59.10%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-1LOAD5
1.62E-10	59.20%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD1
1.62E-10	59.30%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD2
1.62E-10	59.40%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD3
1.62E-10	59.60%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD4
1.62E-10	59.70%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R22-MCB-CC-2LOAD5
1.42E-10	59.80%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R21-DG_-TM-DGB
1.42E-10	59.90%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R21-DG_-TM-DGA
1.42E-10	59.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGA	R21-DG_-TM-DGB
1.42E-10	60.00%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	R11-SYS-FF-NOREC	R21-DG_-FR-DGB	R21-DG_-TM-DGA
1.32E-10	60.10%	CDI	%T-LOPP	C12-MOV-CC-F014A	C12-XHE-MH-F013B	E50-SQV-CF-GDCS7OPEN	
1.32E-10	60.20%	CDI	%T-LOPP	C12-MOV-CC-F014A	C12-XHE-MH-F013B	E50-SQV-CF-OPENALL	
1.32E-10	60.30%	CDI	%T-LOPP	C12-MOV-CC-F014A	C12-XHE-MH-F015B	E50-SQV-CF-GDCS7OPEN	
1.32E-10	60.40%	CDI	%T-LOPP	C12-MOV-CC-F014A	C12-XHE-MH-F015B	E50-SQV-CF-OPENALL	
1.32E-10	60.50%	CDI	%T-LOPP	C12-MOV-CC-F014B	C12-XHE-MH-F013A	E50-SQV-CF-GDCS7OPEN	

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
1.32E-10	60.60%	CDI	%T-LOPP	C12-MOV-CC-F014B	C12-XHE-MH-F013A	E50-SQV-CF-OPENALL	
1.32E-10	60.70%	CDI	%T-LOPP	C12-MOV-CC-F014B	C12-XHE-MH-F015A	E50-SQV-CF-GDCS7OPEN	
1.32E-10	60.80%	CDI	%T-LOPP	C12-MOV-CC-F014B	C12-XHE-MH-F015A	E50-SQV-CF-OPENALL	
1.27E-10	60.80%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-10A11	R11-SYS-FF-NOREC	
1.27E-10	60.90%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-10A21	R11-SYS-FF-NOREC	
1.27E-10	61.00%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-ESF1ADID	R11-SYS-FF-NOREC	
1.27E-10	61.10%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-ESF1BDID	R11-SYS-FF-NOREC	
1.27E-10	61.20%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-ESF2ADID	R11-SYS-FF-NOREC	
1.27E-10	61.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-ESF2BDID	R11-SYS-FF-NOREC	
1.27E-10	61.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-R101	R11-SYS-FF-NOREC	
1.27E-10	61.40%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	H23-RMU-FC-R102	R11-SYS-FF-NOREC	
1.27E-10	61.50%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-10A11	R11-SYS-FF-NOREC	
1.27E-10	61.60%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-10A21	R11-SYS-FF-NOREC	
1.27E-10	61.70%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-ESF1ADID	R11-SYS-FF-NOREC	
1.27E-10	61.80%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-ESF1BDID	R11-SYS-FF-NOREC	
1.27E-10	61.90%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-ESF2ADID	R11-SYS-FF-NOREC	
1.27E-10	62.00%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-ESF2BDID	R11-SYS-FF-NOREC	
1.27E-10	62.00%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-R101	R11-SYS-FF-NOREC	
1.27E-10	62.10%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	H23-RMU-FC-R102	R11-SYS-FF-NOREC	
1.22E-10	62.20%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-TM-DGA
1.22E-10	62.30%	CDI	%T-LOPP	E50-SQV-CF-GDCS7OPEN	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-TM-DGB
1.22E-10	62.40%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-TM-DGA
1.22E-10	62.50%	CDI	%T-LOPP	E50-SQV-CF-OPENALL	P30-XHE-MH-F015	R11-SYS-FF-NOREC	R21-DG_-TM-DGB
9.94E-11	62.50%	CDI	%T-LOPP	C12-XHE-MH-F003B	C12-XHE-MH-F018A	E50-SQV-CF-GDCS7OPEN	
9.94E-11	62.60%	CDI	%T-LOPP	C12-XHE-MH-F003B	C12-XHE-MH-F018A	E50-SQV-CF-OPENALL	
9.94E-11	62.70%	CDI	%T-LOPP	C12-XHE-MH-F003B	C12-XHE-MH-F021A	E50-SQV-CF-GDCS7OPEN	
9.94E-11	62.70%	CDI	%T-LOPP	C12-XHE-MH-F003B	C12-XHE-MH-F021A	E50-SQV-CF-OPENALL	
9.94E-11	62.80%	CDI	%T-LOPP	C12-XHE-MH-F018A	C12-XHE-MH-F018B	E50-SQV-CF-GDCS7OPEN	

Table 11-6

Top 200 Cutsets for Human Reliability Sensitivity

Probability	%	Class	Initiator	Basic Events			
9.94E-11	62.90%	CDI	%T-LOPP	C12-XHE-MH-F018A	C12-XHE-MH-F018B	E50-SQV-CF-OPENALL	
9.94E-11	62.90%	CDI	%T-LOPP	C12-XHE-MH-F018A	C12-XHE-MH-F021B	E50-SQV-CF-GDCS7OPEN	
9.94E-11	63.00%	CDI	%T-LOPP	C12-XHE-MH-F018A	C12-XHE-MH-F021B	E50-SQV-CF-OPENALL	
9.94E-11	63.10%	CDI	%T-LOPP	C12-XHE-MH-F018B	C12-XHE-MH-F021A	E50-SQV-CF-GDCS7OPEN	
9.94E-11	63.10%	CDI	%T-LOPP	C12-XHE-MH-F018B	C12-XHE-MH-F021A	E50-SQV-CF-OPENALL	

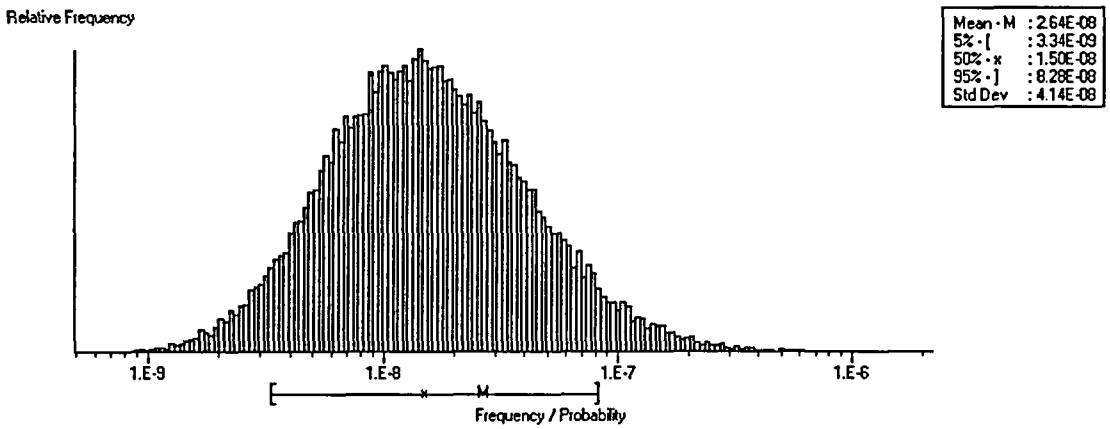

Figure 11-1. Uncertainty Distribution Level 1, Internal Events

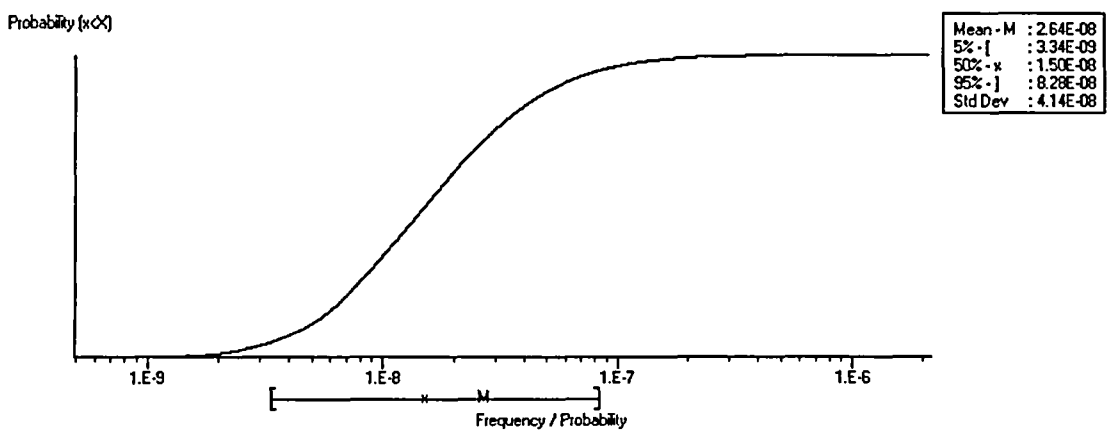

Figure 11-2. Cumulative Distribution Function Level 1, Internal Events

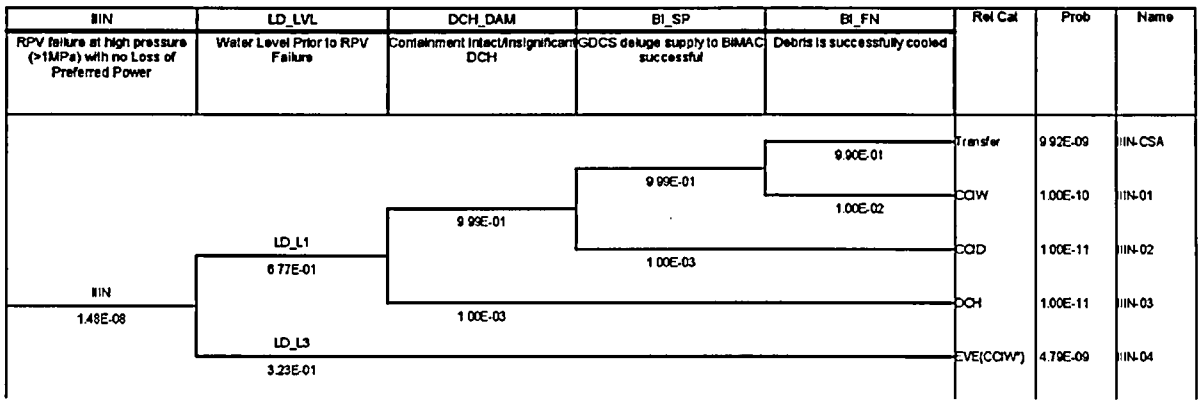

Figure 11-3. Class III without LOPP CPET for RTNSS Sensitivity

Appendix A.11
Class II Core Cooling Vulnerability (CCV) Event Trees

Figure A.11-1. Class II CCV for Transients, Except Loss of Service Water and Power
Figure A.11-2. Class II CCV for Loss of Service Water
Figure A.11-3. Class II CCV for Loss of Preferred Power (A)
Figure A.11-4. Class II CCV for Loss of Preferred Power (B)
Figure A.11-5. Class II CCV for Large LOCA
Figure A.11-6. Class II CCV for Large LOCA in Feedwater Line A
Figure A.11-7. Class II CCV for Large LOCA in Feedwater Line B
Figure A.11-8. Class II CCV for Medium Liquid LOCA
Figure A.11-9. Class II CCV for Medium Liquid LOCA in RWCU

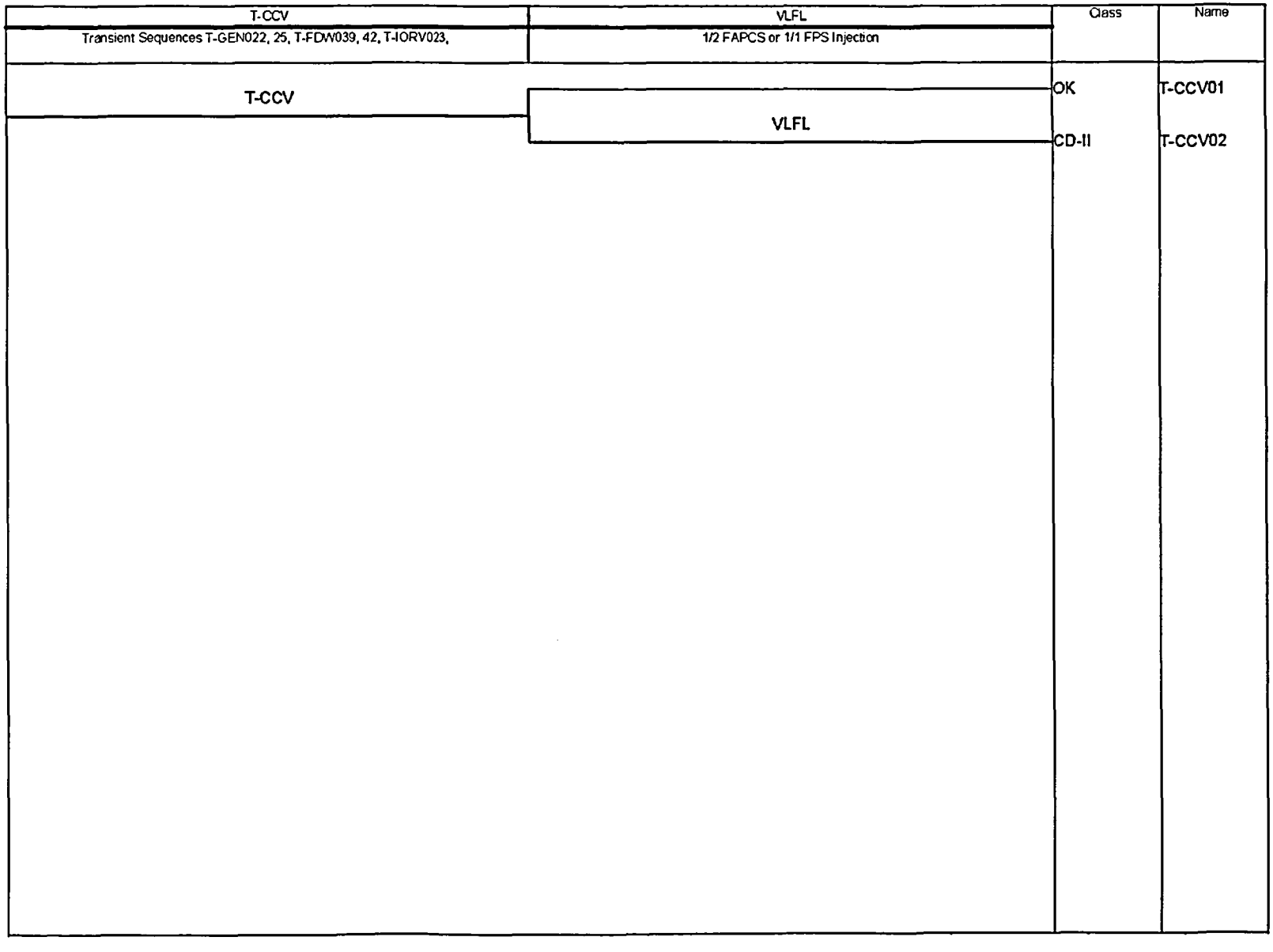

Figure A.11-1. Class II CCV for Transients, Except Loss of Service Water and Power

T-SWCCV	VFL	Class	Name
Sequences 14 and 16 of Loss of Service Water	1/1 FPS Injection		
T-SWCCV	GU43-0001-_3	OK	T-SWCCV01
		CD-II	T-SWCCV02

Figure A.11-2. Class II CCV for Loss of Service Water

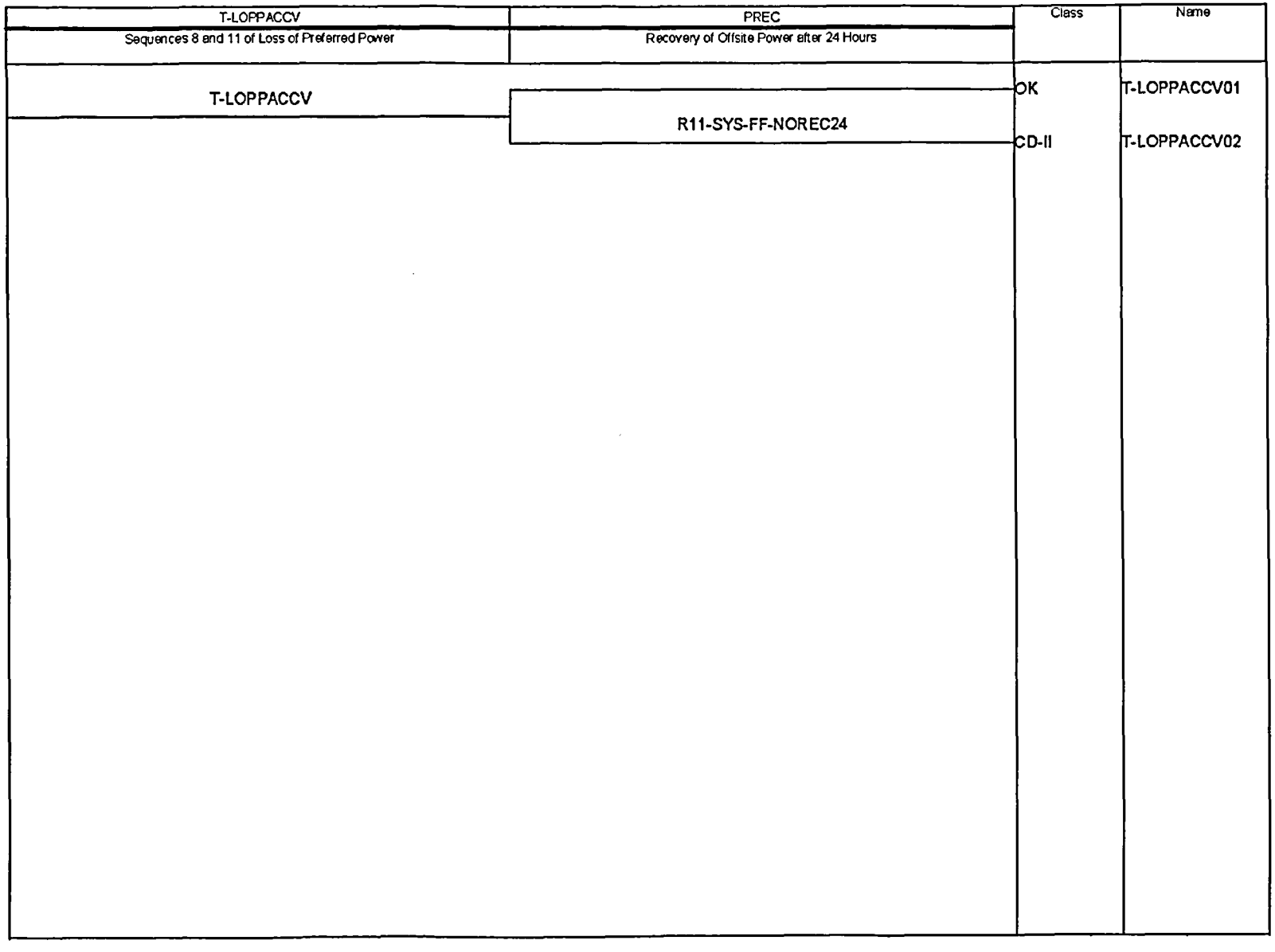

Figure A.11-3. Class II CCV for Loss of Preferred Power (A)

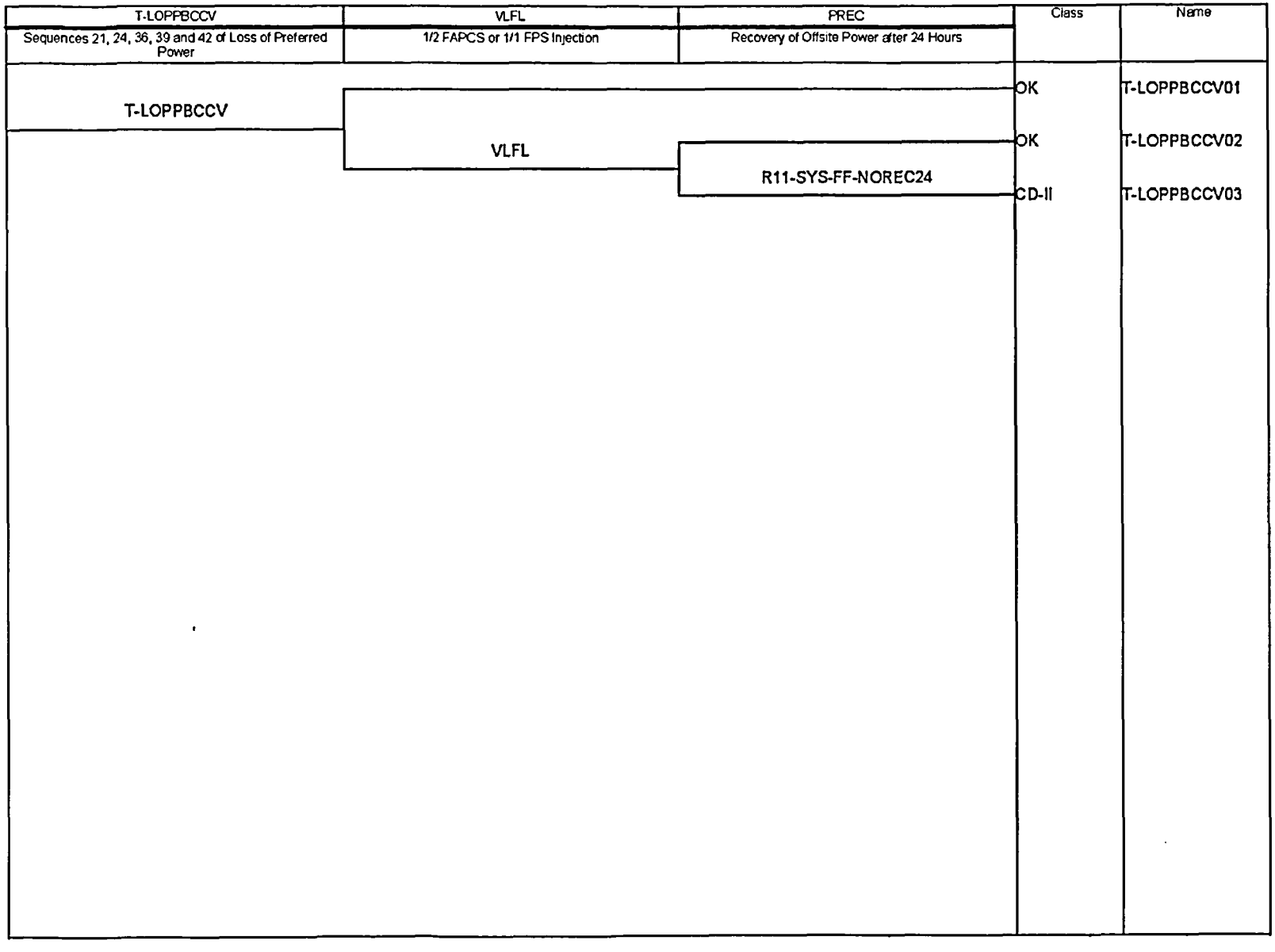

Figure A.11-4. Class II CCV for Loss of Preferred Power (B)

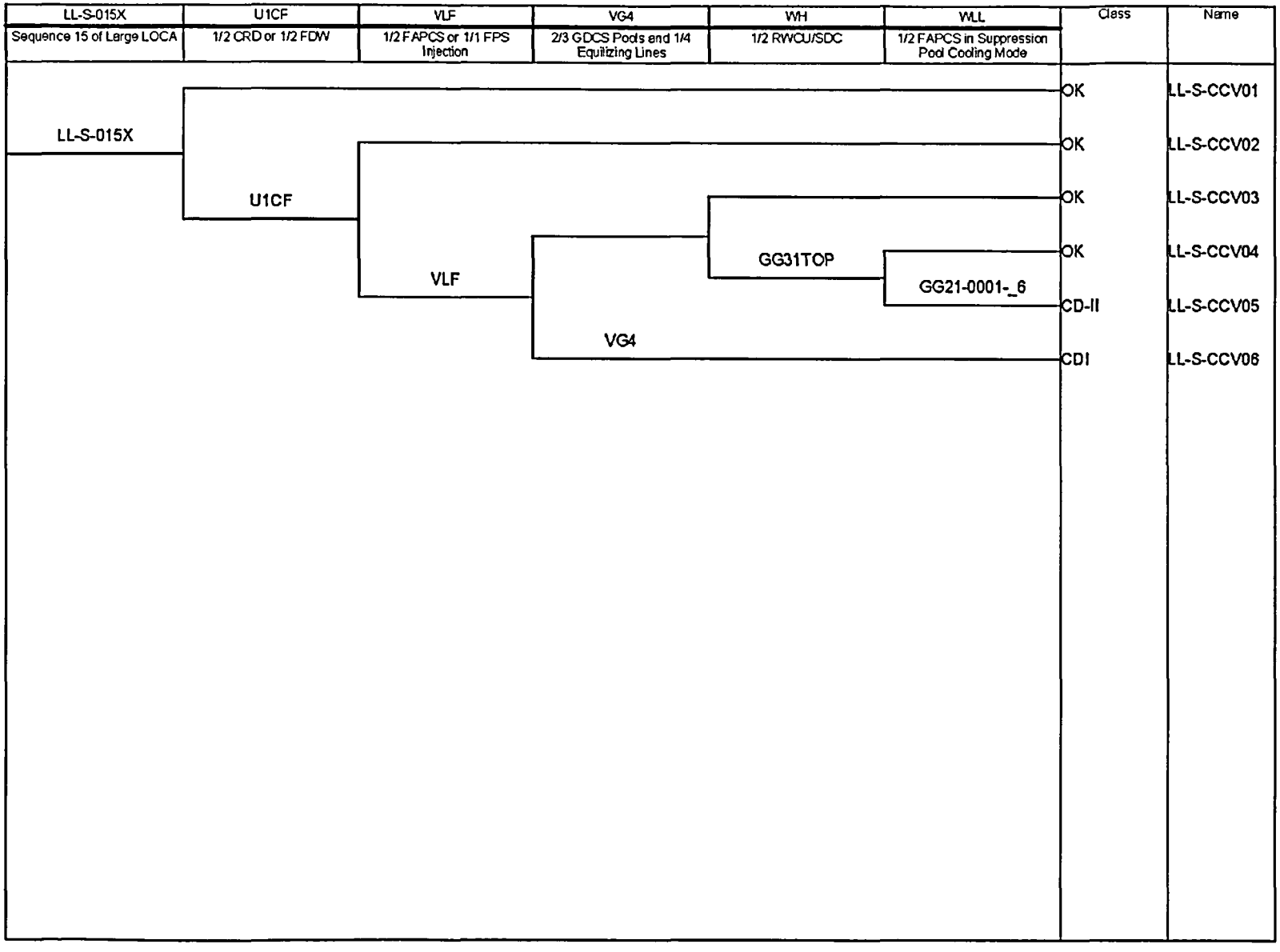

Figure A.11-5. Class II CCV for Large LOCA

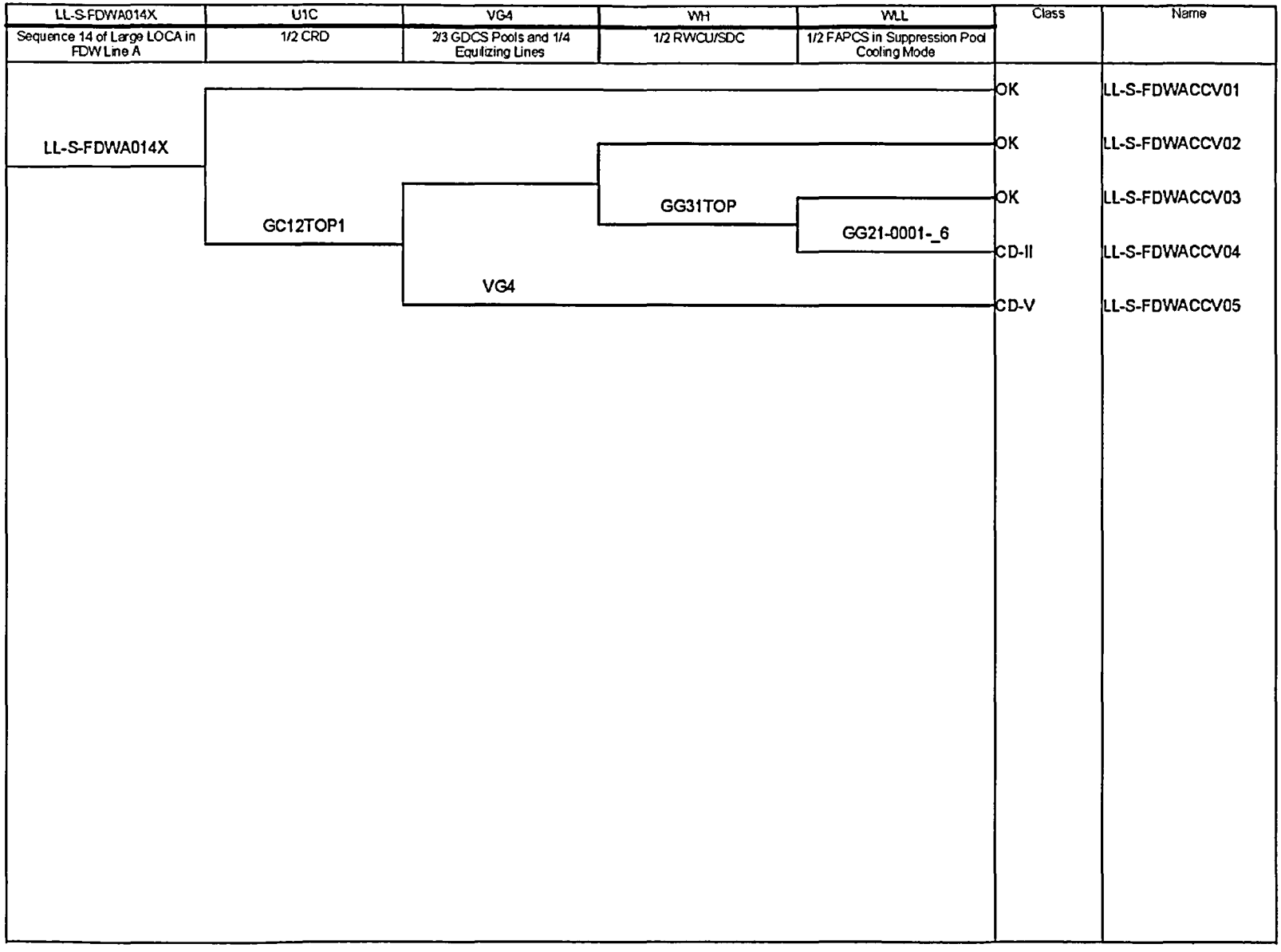

Figure A.11-6. Class II CCV for Large LOCA in Feedwater Line A

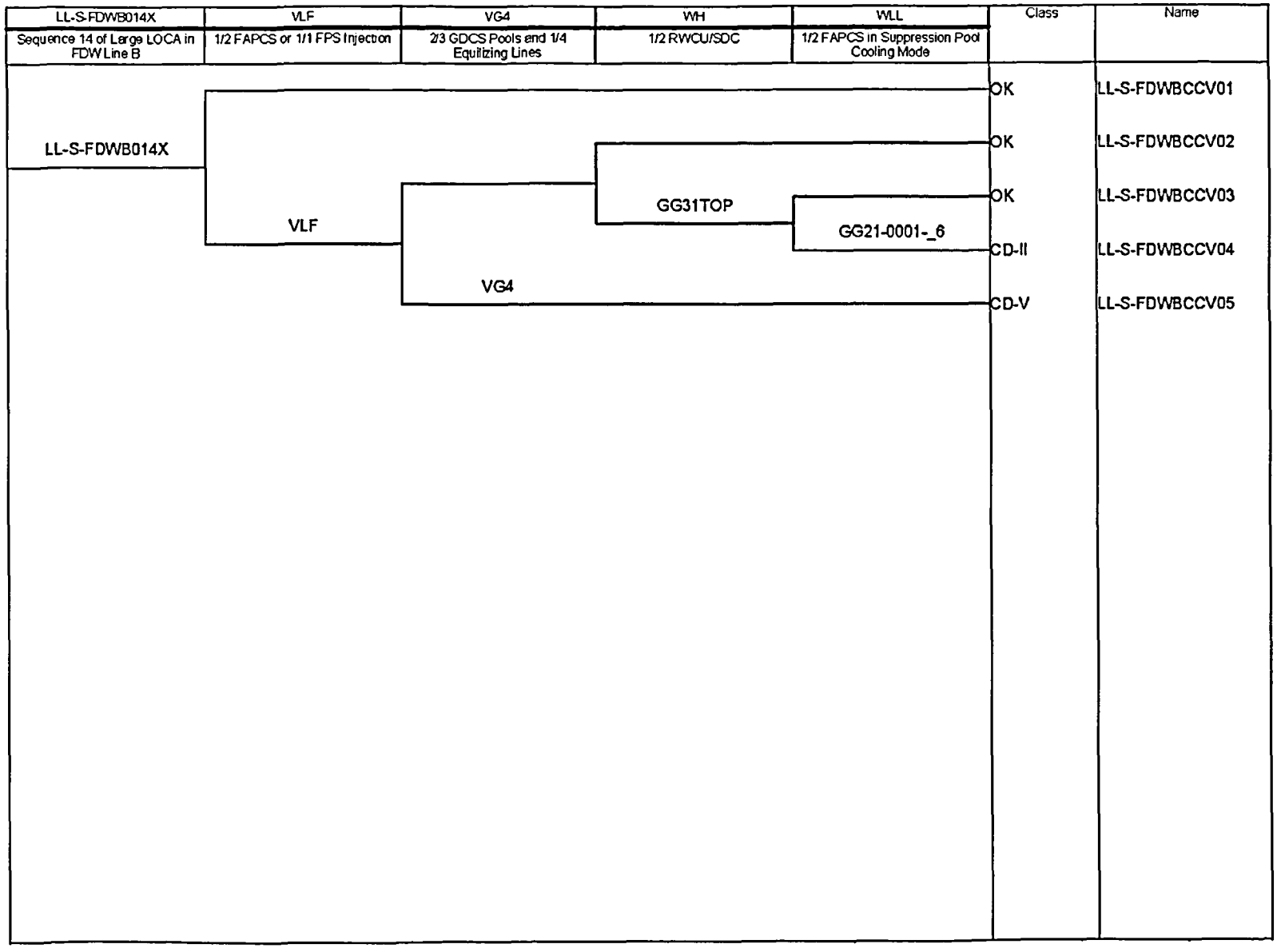

Figure A.11-7. Class II CCV for Large LOCA in Feedwater Line B

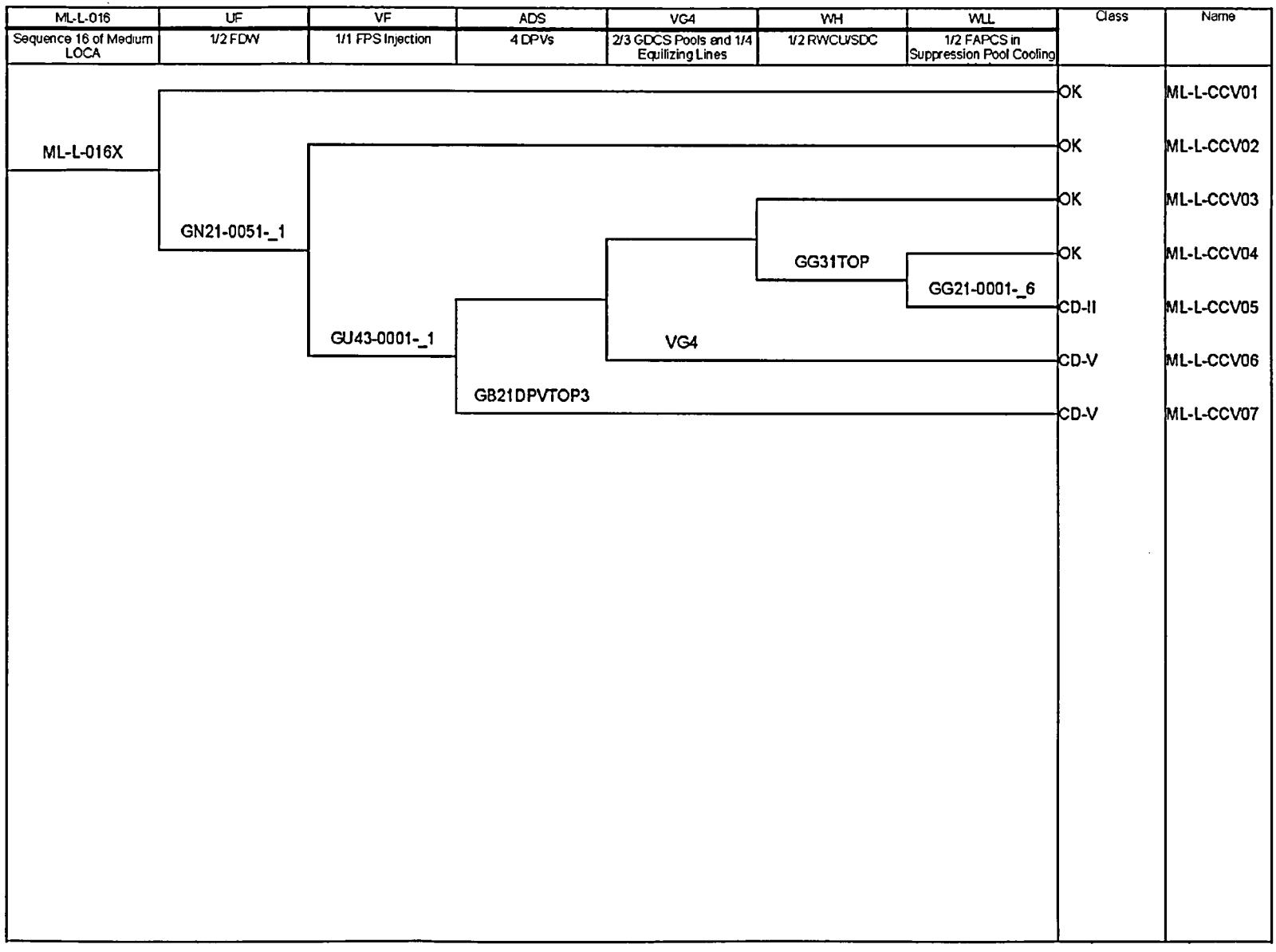

Figure A.11-8. Class II CCV for Medium Liquid LOCA

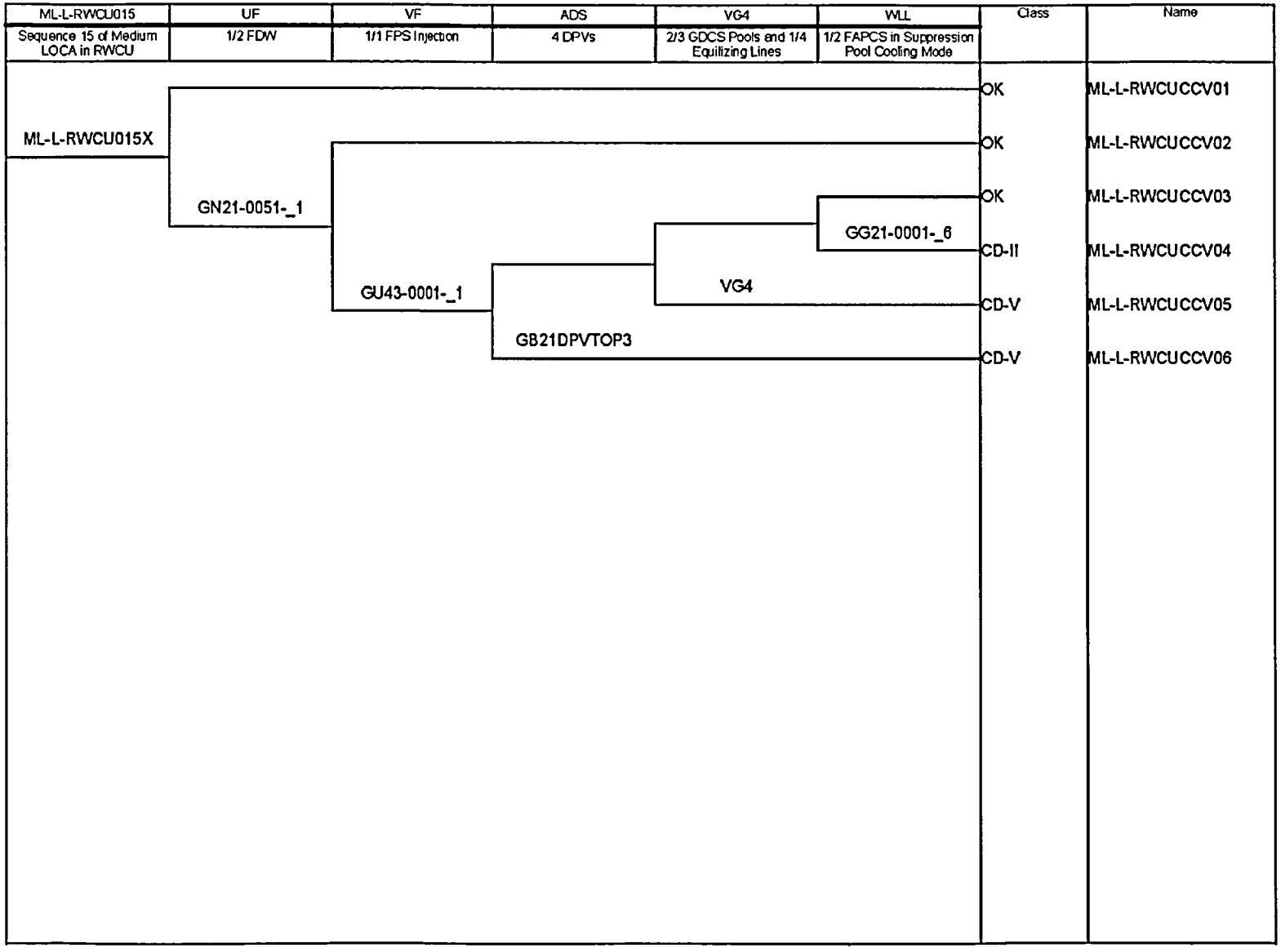

Figure A.11-9. Class II CCV for Medium Liquid LOCA in RWCU

Appendix B.11

Event Trees Used for Assessing the Impact of Non-Safety Systems

Figure B.11-1. General Transient

Figure B.11-2. Transient with PCS Unavailable

Figure B.11-2a. Transient with PCS Unavailable after BOC in IC or MS

Figure B.11-3. Loss of Feedwater Transient

Figure B.11-4. Loss of Service Water System

Figure B.11-5. Loss of Preferred Power Transient

Figure B.11-6. Inadvertent Opening of a Relief Valve

Figure B.11-7. ATWS from General Transient

Figure B.11-7a. ATWS from Loss of Preferred Power

Figure B.11-8. ATWS from Transient Loss of PCS

Figure B.11-8a. ATWS from Loss of PCS after BOC in IC or MS

Figure B.11-9. ATWS from Transient with Loss of Feedwater System

Figure B.11-10. ATWS from Transient with Loss of Service Water System

Figure B.11-11. ATWS from Inadvertent Opening of a Relief Valve

Figure B.11-11a. ATWS from Small LOCA above Reactor Core

Figure B.11-12. Large Steam Breaks (above L3) other than Feedwater Lines

Figure B.11-13. Large Steam Breaks (above L3) in FDW (A) Line

Figure B.11-14. Large Steam Breaks (above L3) in FDW (B) Line

Figure B.11-15. Small Steam Breaks (above L3)

Figure B.11-16. Medium Liquid Breaks (below L3) other than RWCU/SDC Lines

Figure B.11-17. Medium Liquid Breaks (below L3) in RWCU/SDC Lines

Figure B.11-18. Small Liquid LOCA (below L3) other than RWCU/SDC Lines

Figure B.11-19. Small Liquid LOCA (below L3) in RWCU/SDC Lines

Figure B.11-20. Reactor Vessel Rupture

Figure B.11-20a. Reactor Vessel Rupture after Loss of Preferred Power

Figure B.11-21. Steam Break Outside Containment in Main Steam Lines

Figure B.11-22. Steam Break Outside Containment in FDW A Line

Figure B.11-23. Steam Break Outside Containment in FDW B Line

Figure B.11-24. Large Steam Break Outside Containment in IC Lines

Figure B.11-25. Large Liquid Break Outside Containment in RWCU/SDC Lines

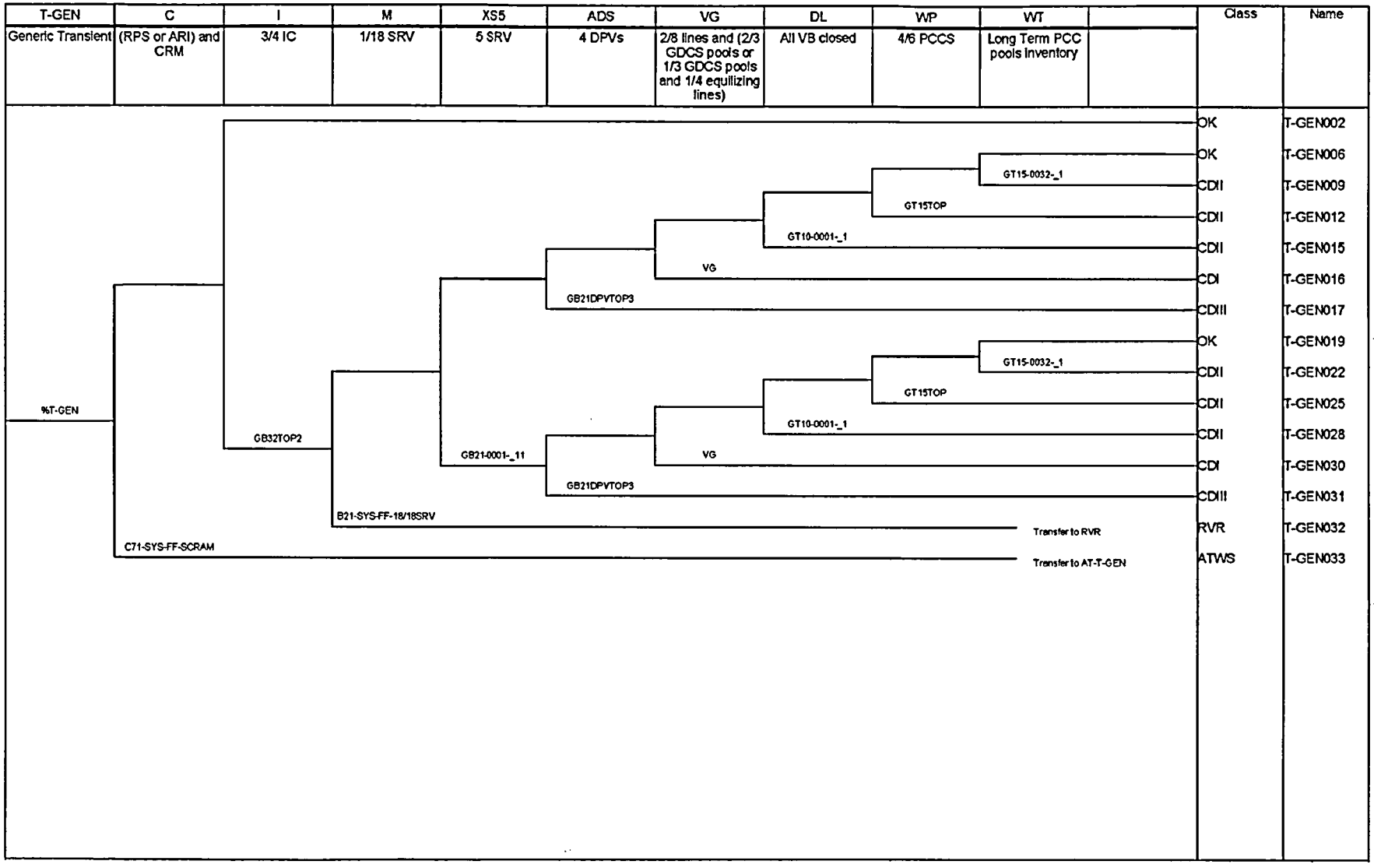

Figure B.11-1. General Transient

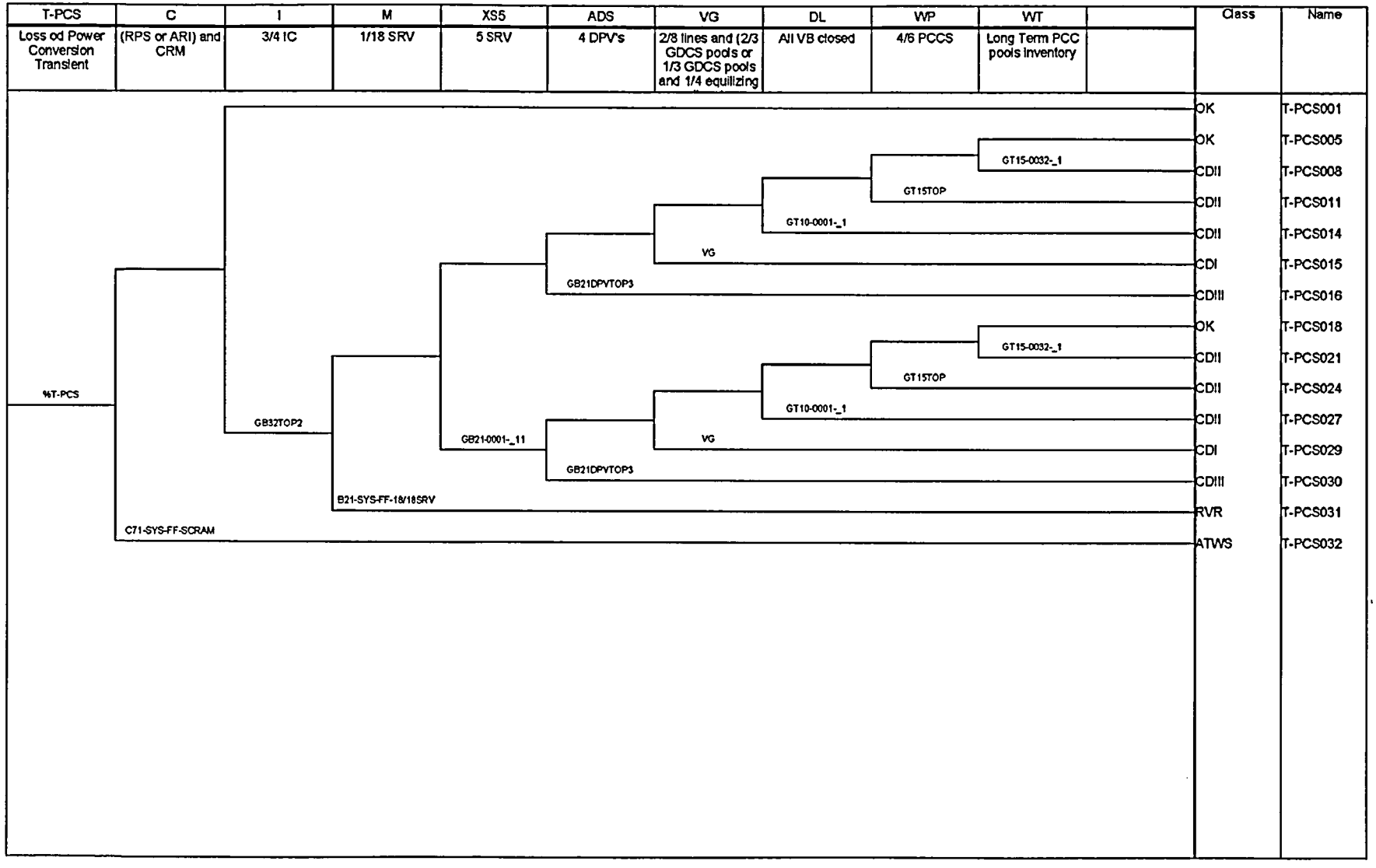

Figure B.11-2. Transient with PCS Unavailable

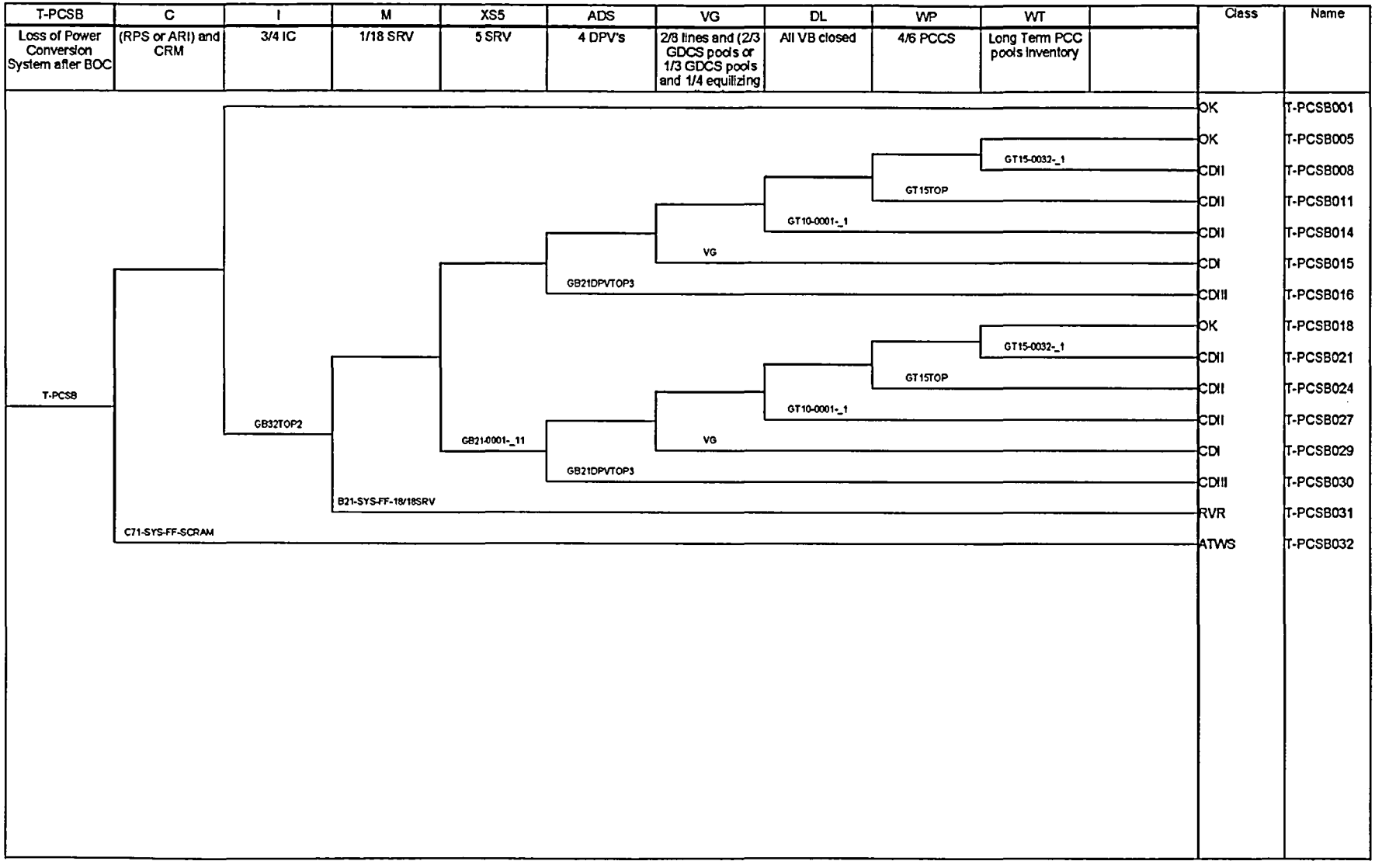

Figure B.11-2a. Transient with PCS Unavailable after BOC in IC or MS

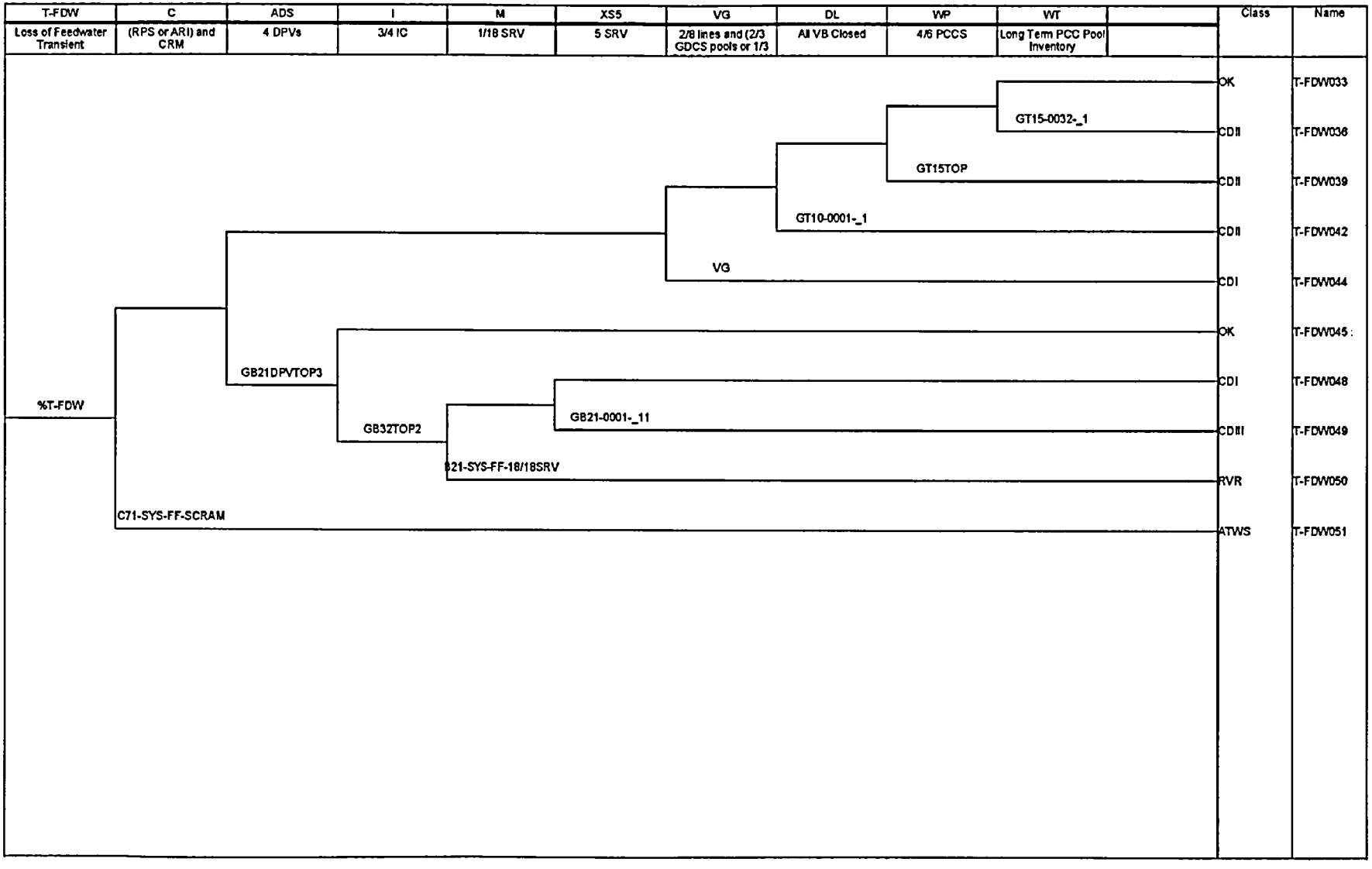

Figure B.11-3. Loss of Feedwater Transient

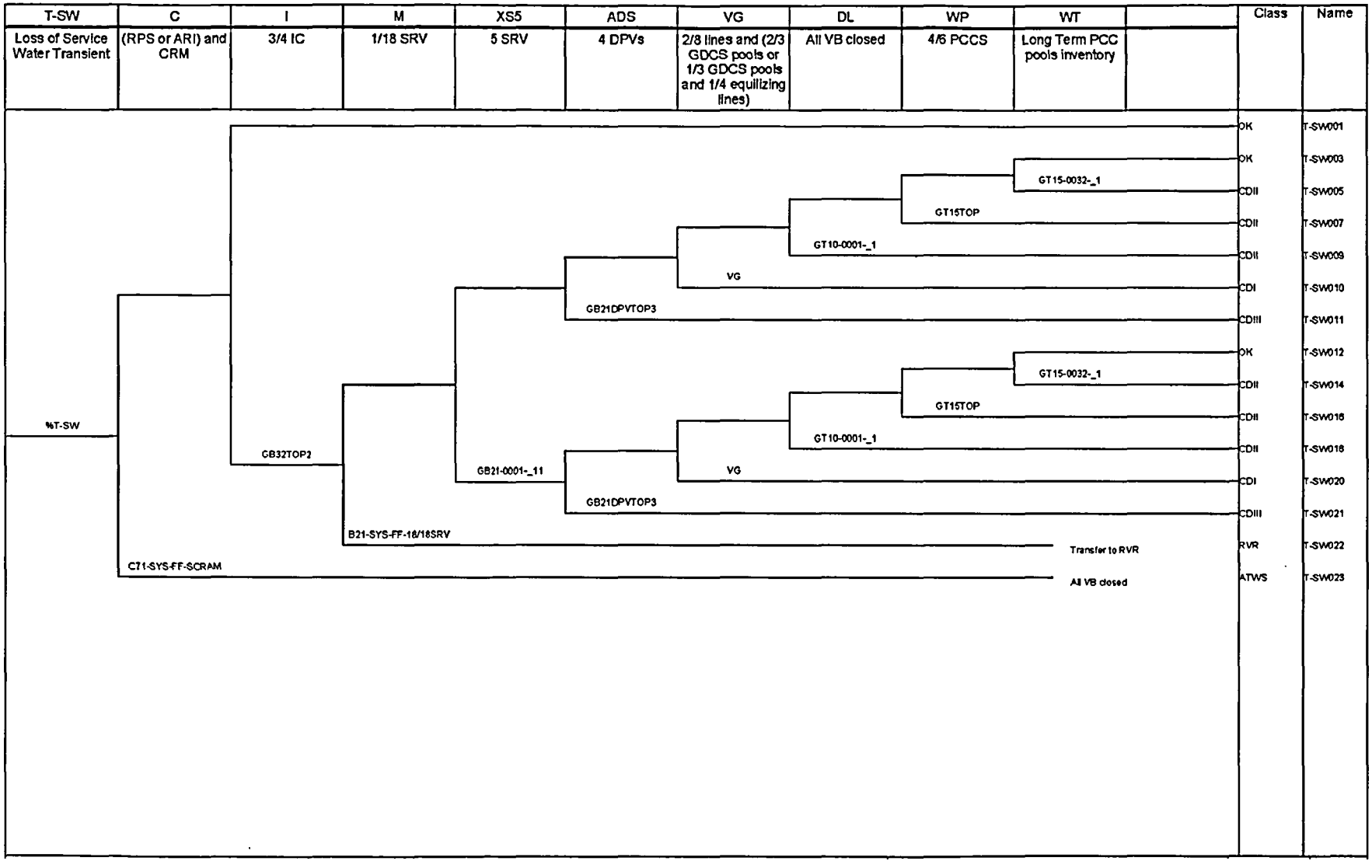

Figure B.11-4. Loss of Service Water System

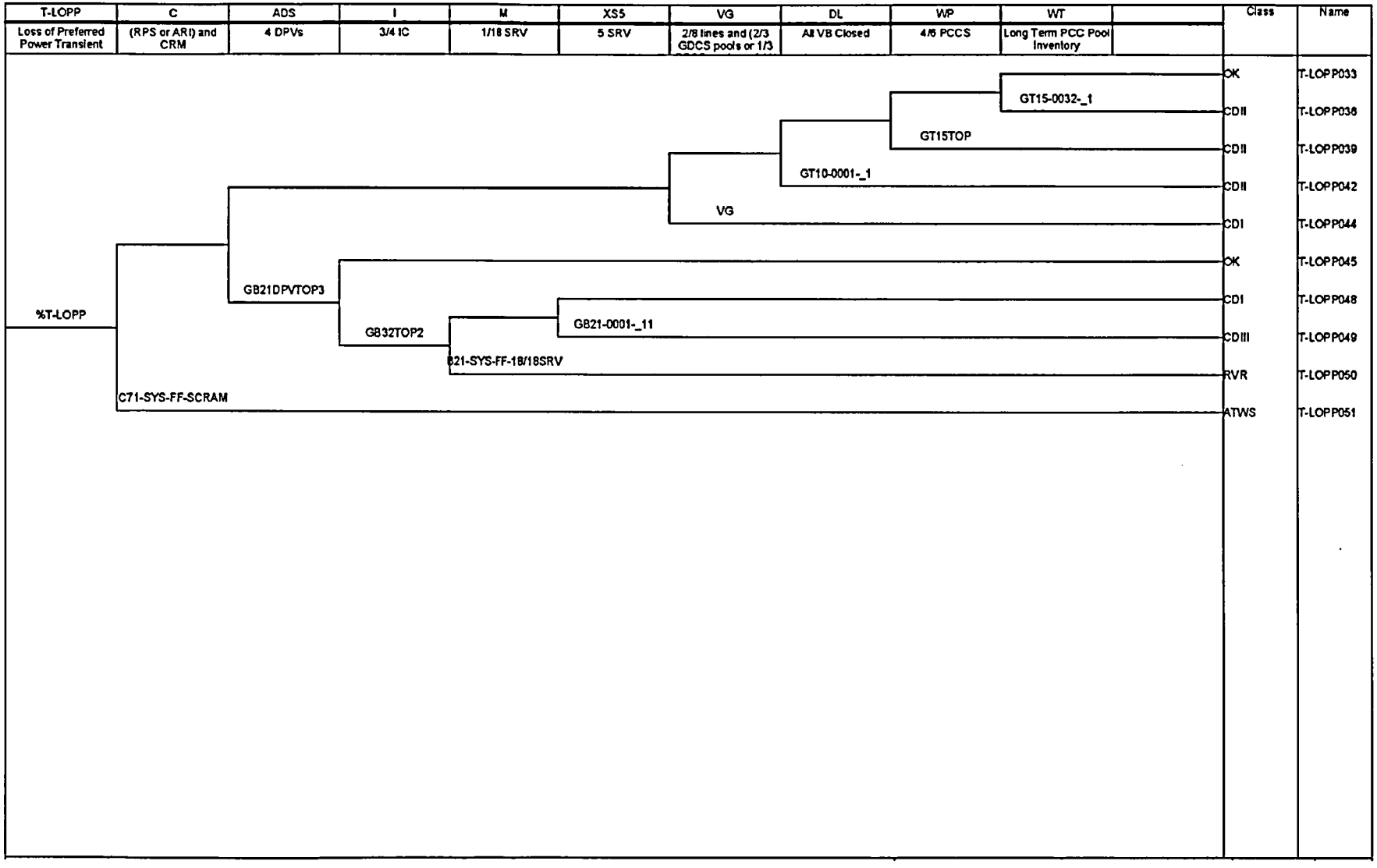

Figure B.11-5. Loss of Preferred Power Transient

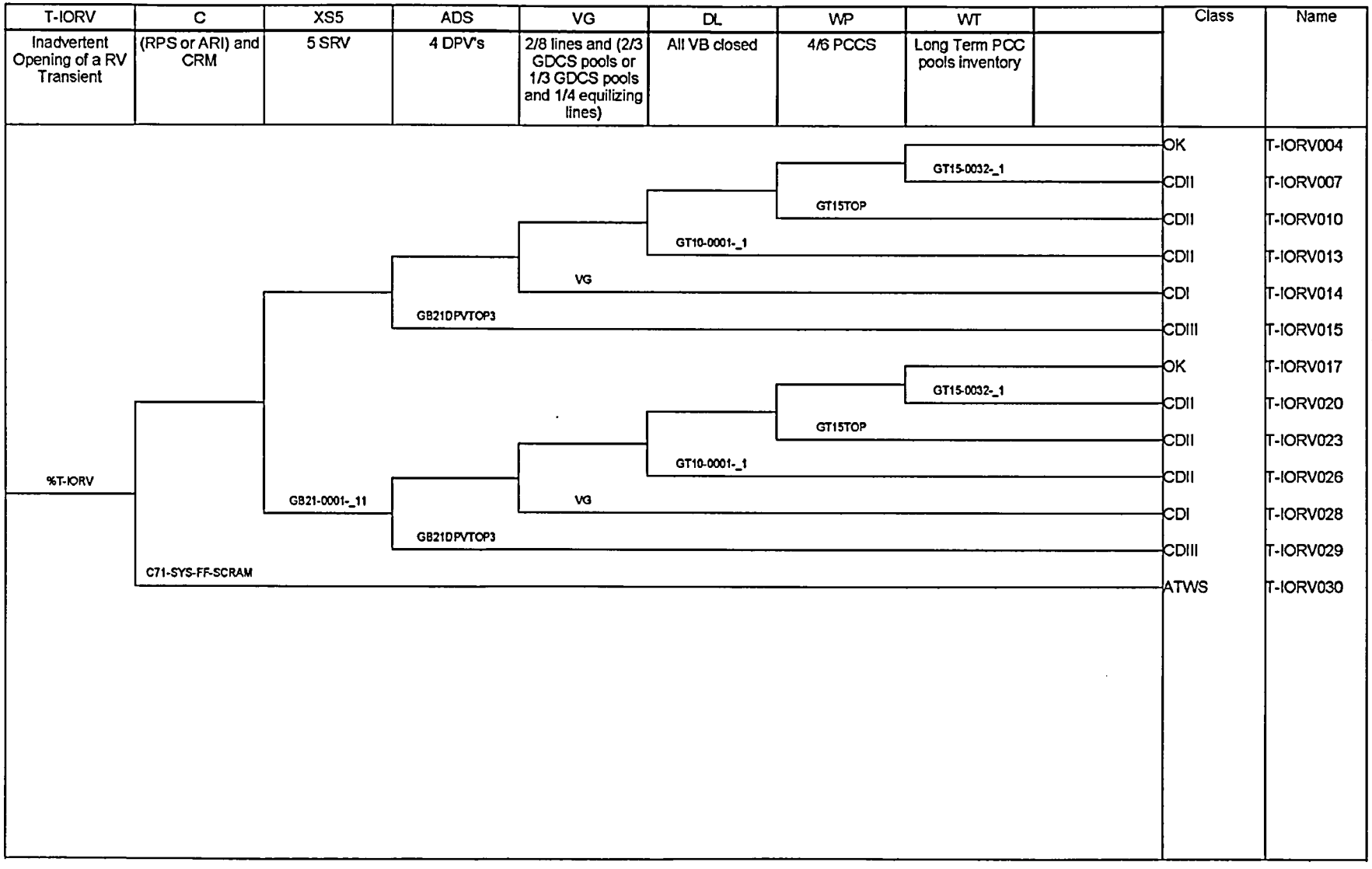

Figure B.11-6. Inadvertent Opening of a Relief Valve

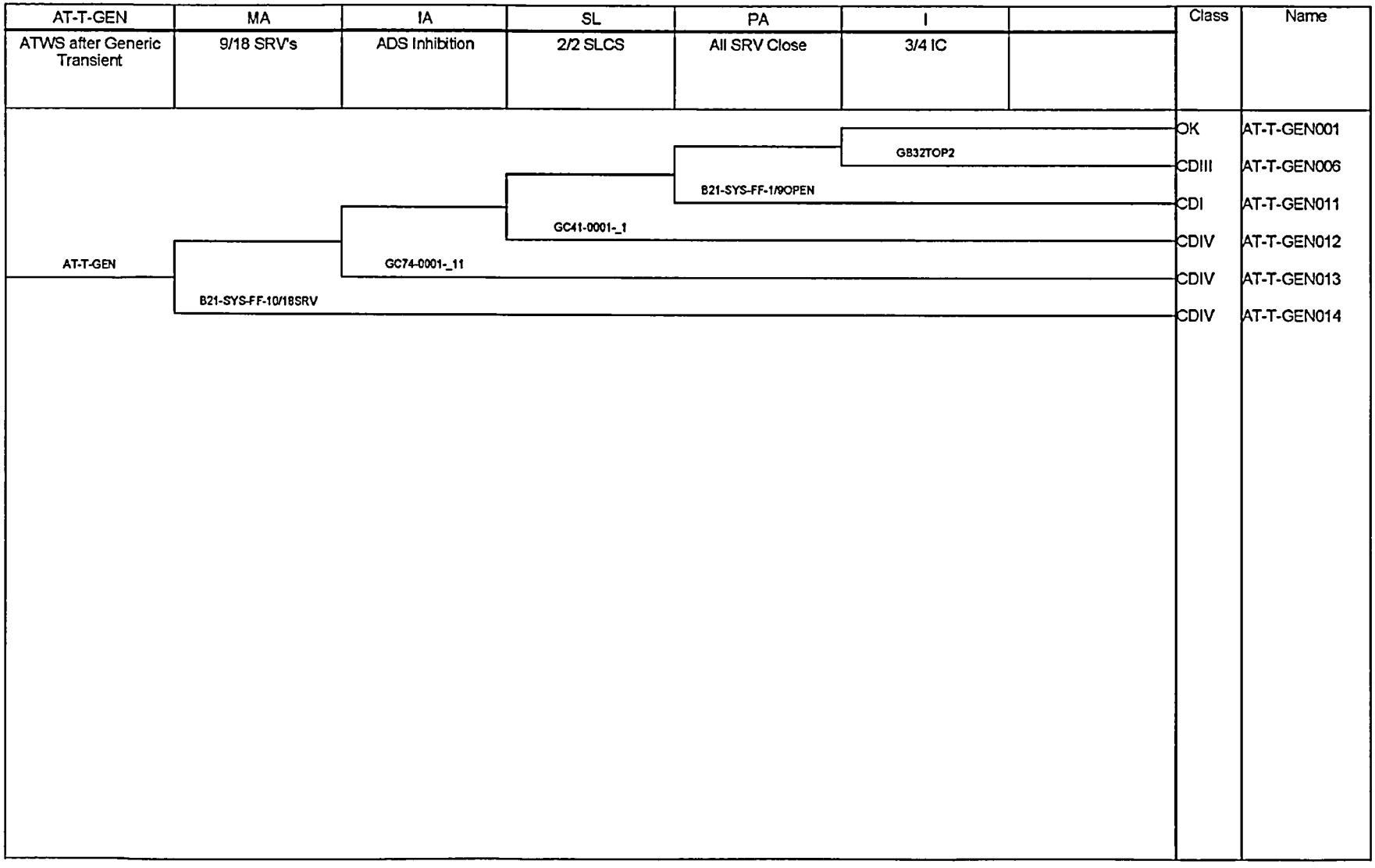

Figure B.11-7. ATWS from General Transient

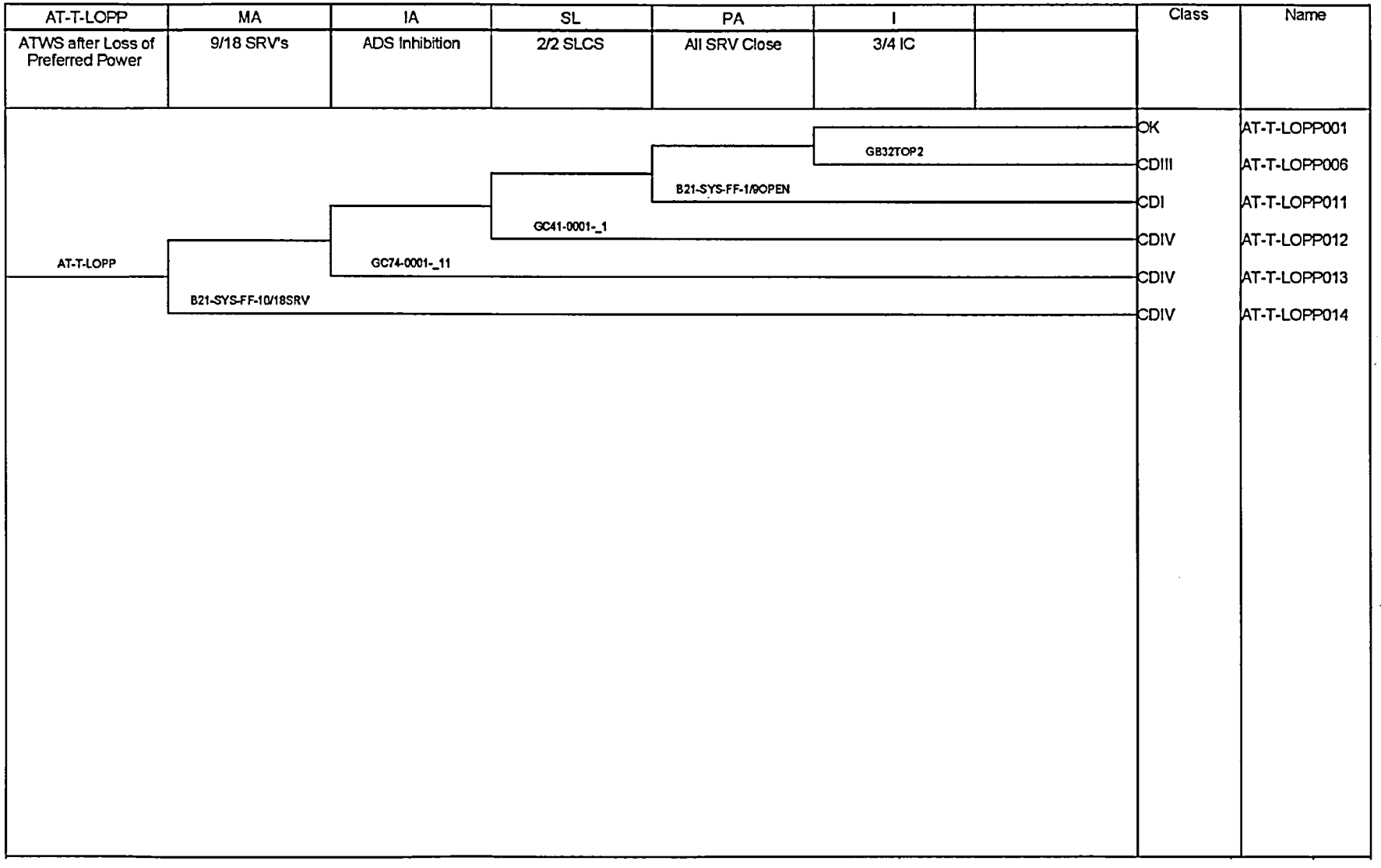

Figure B.11-7a. ATWS from Loss of Preferred Power

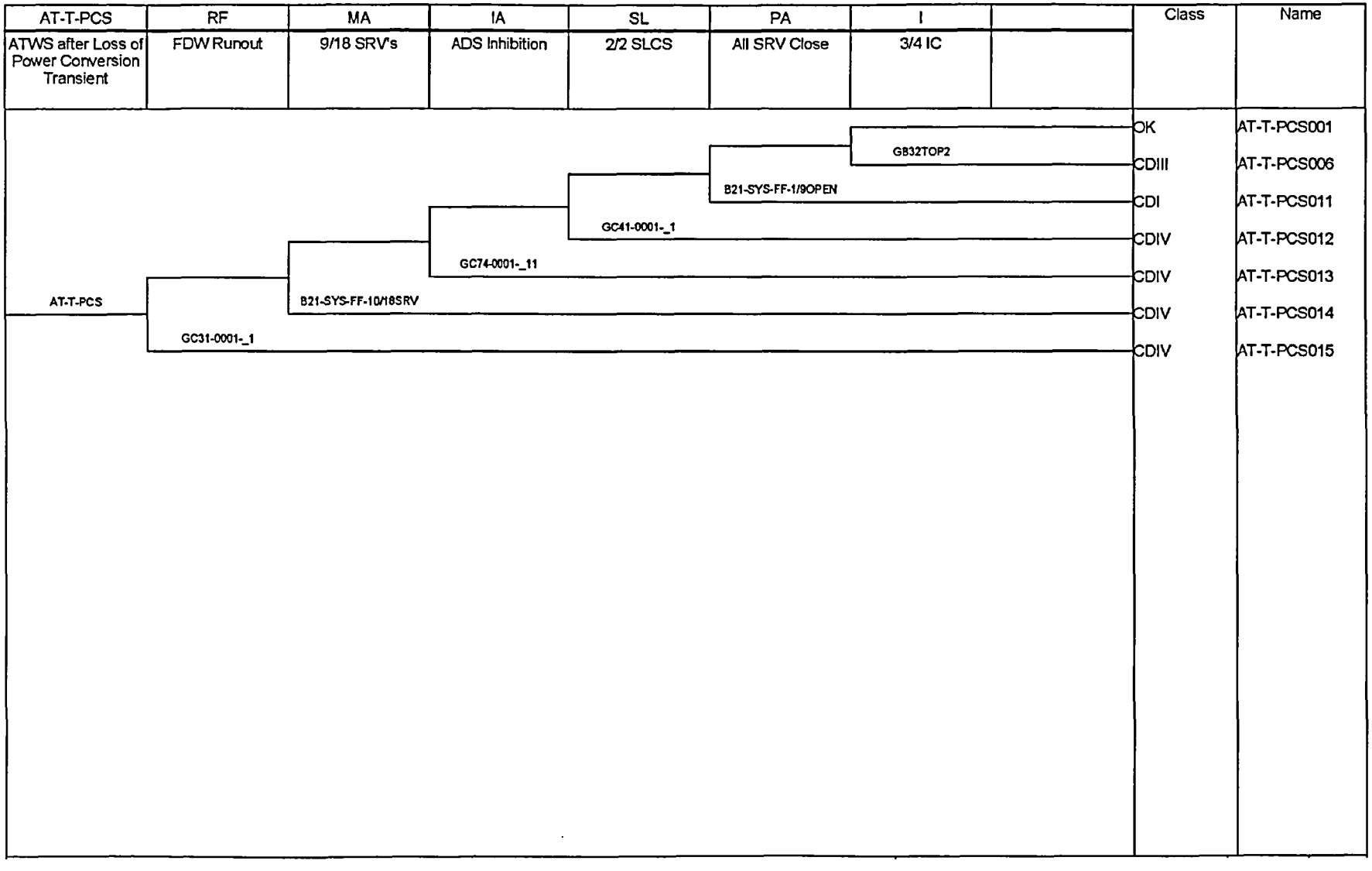

Figure B.11-8. ATWS from Transient Loss of PCS

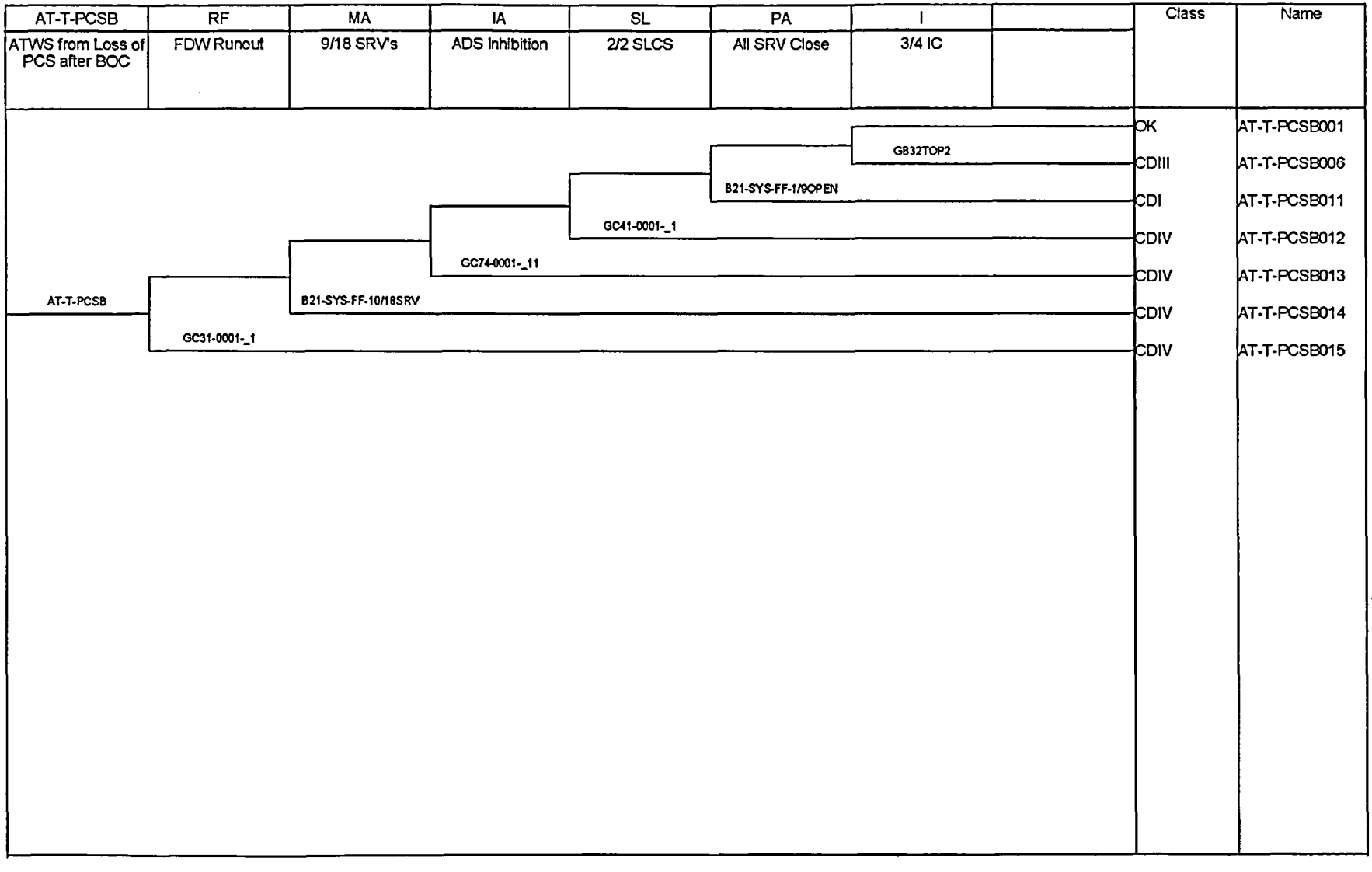

Figure B.11-8a. ATWS from Loss of PCS after BOC in IC or MS

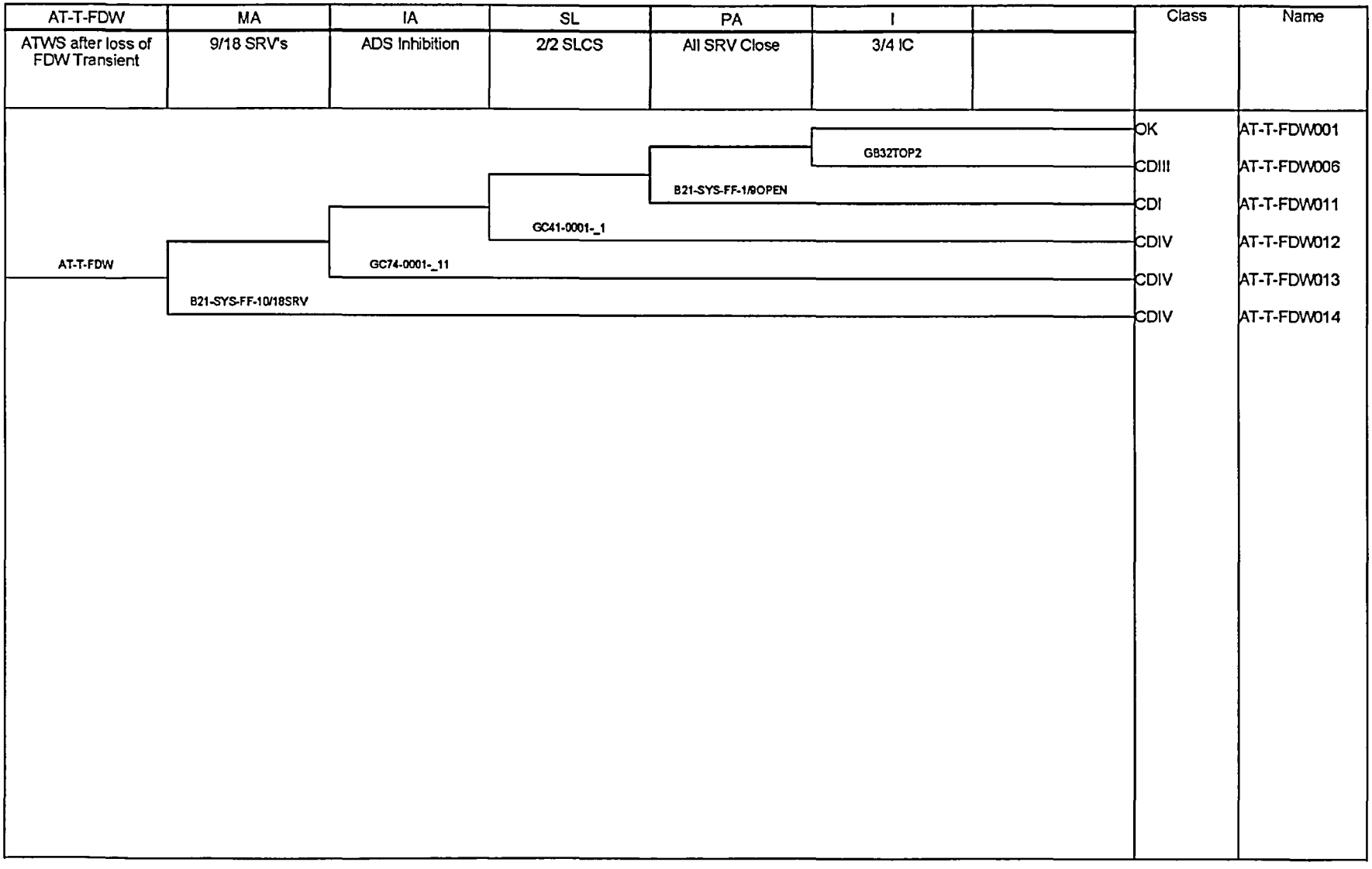

Figure B.11-9. ATWS from Transient with Loss of Feedwater System

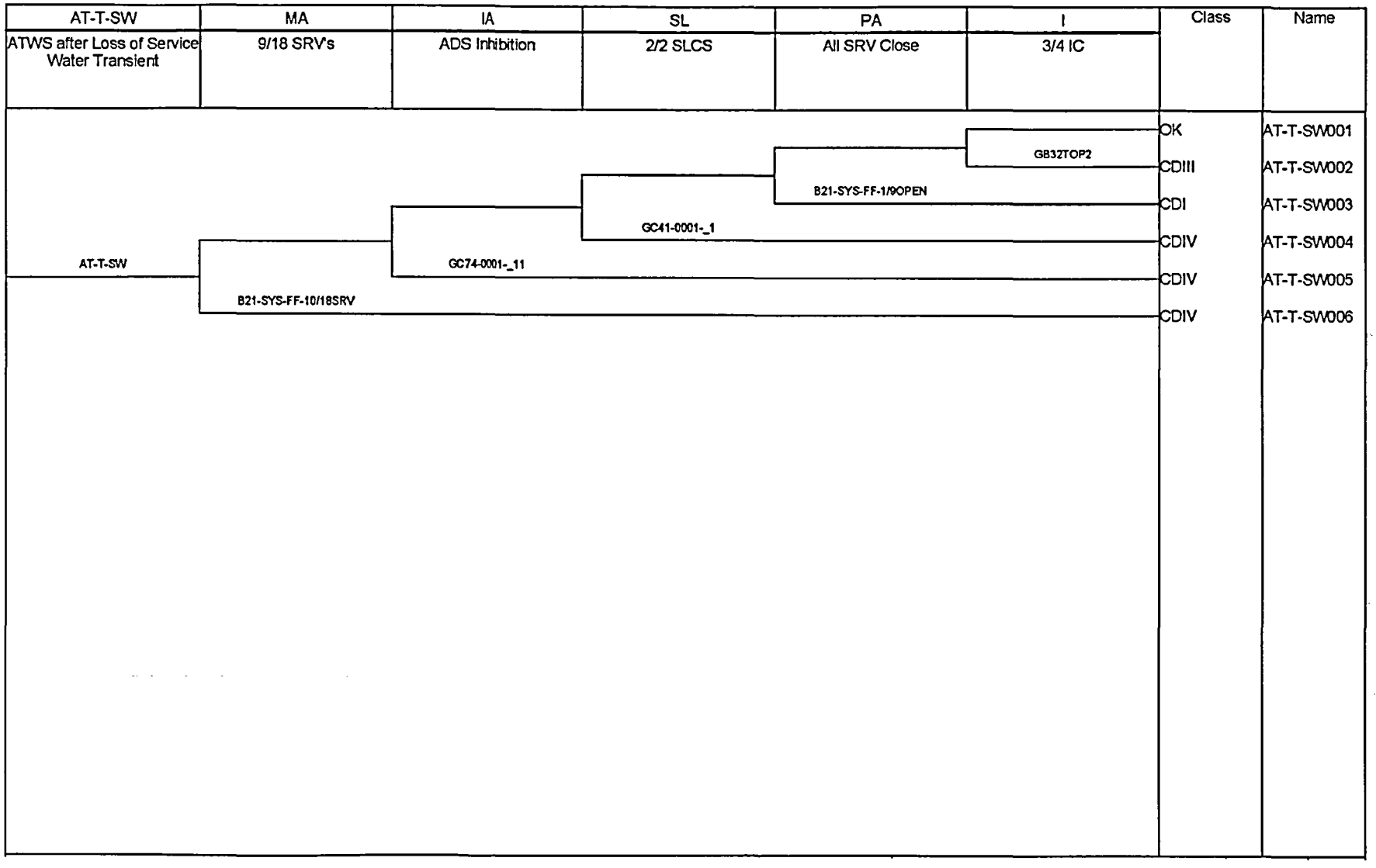

Figure B.11-10. ATWS from Transient with Loss of Service Water System

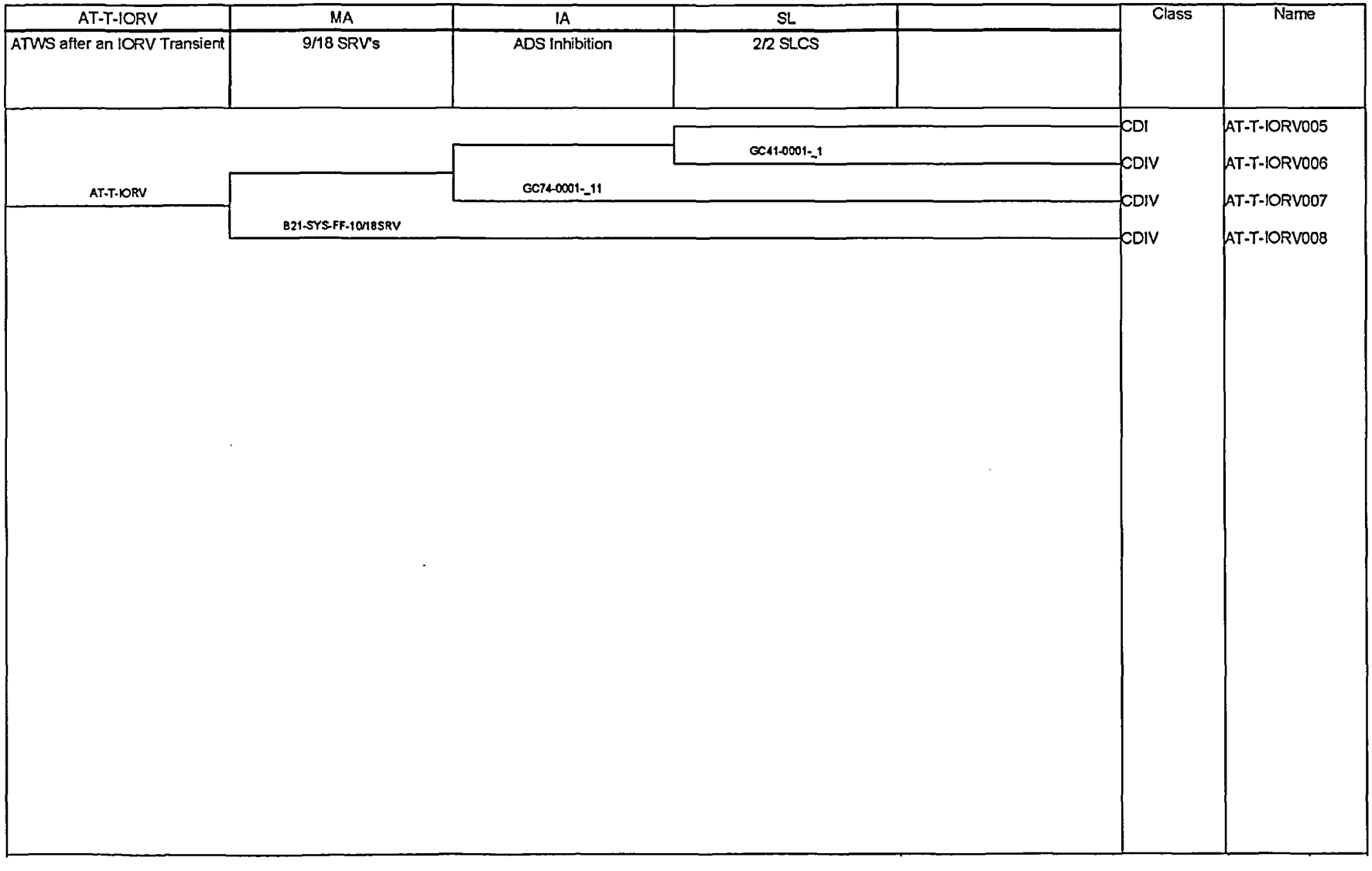

Figure B.11-11. ATWS from Inadvertent Opening of a Relief Valve

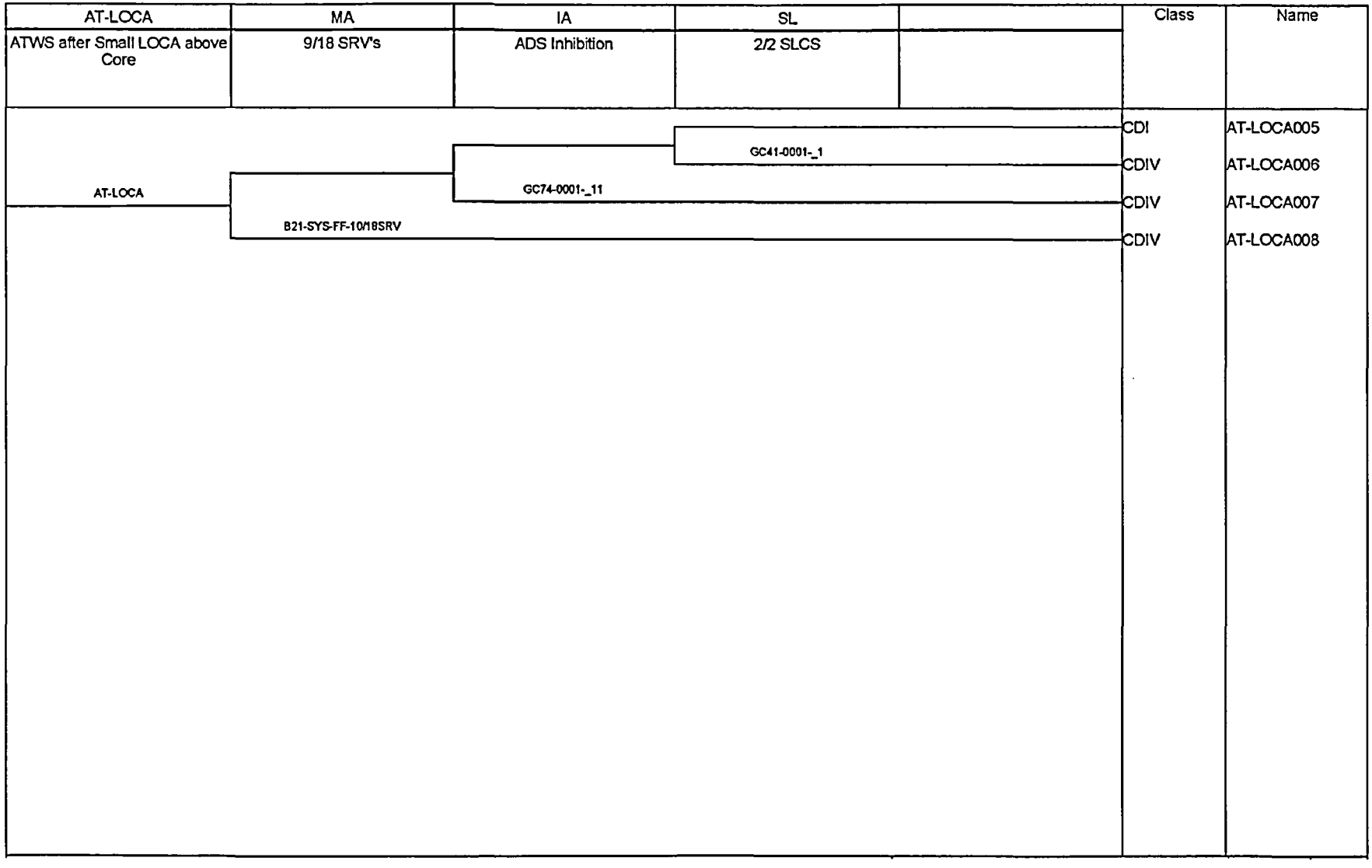

Figure B.11-11a. ATWS from Small LOCA above Reactor Core

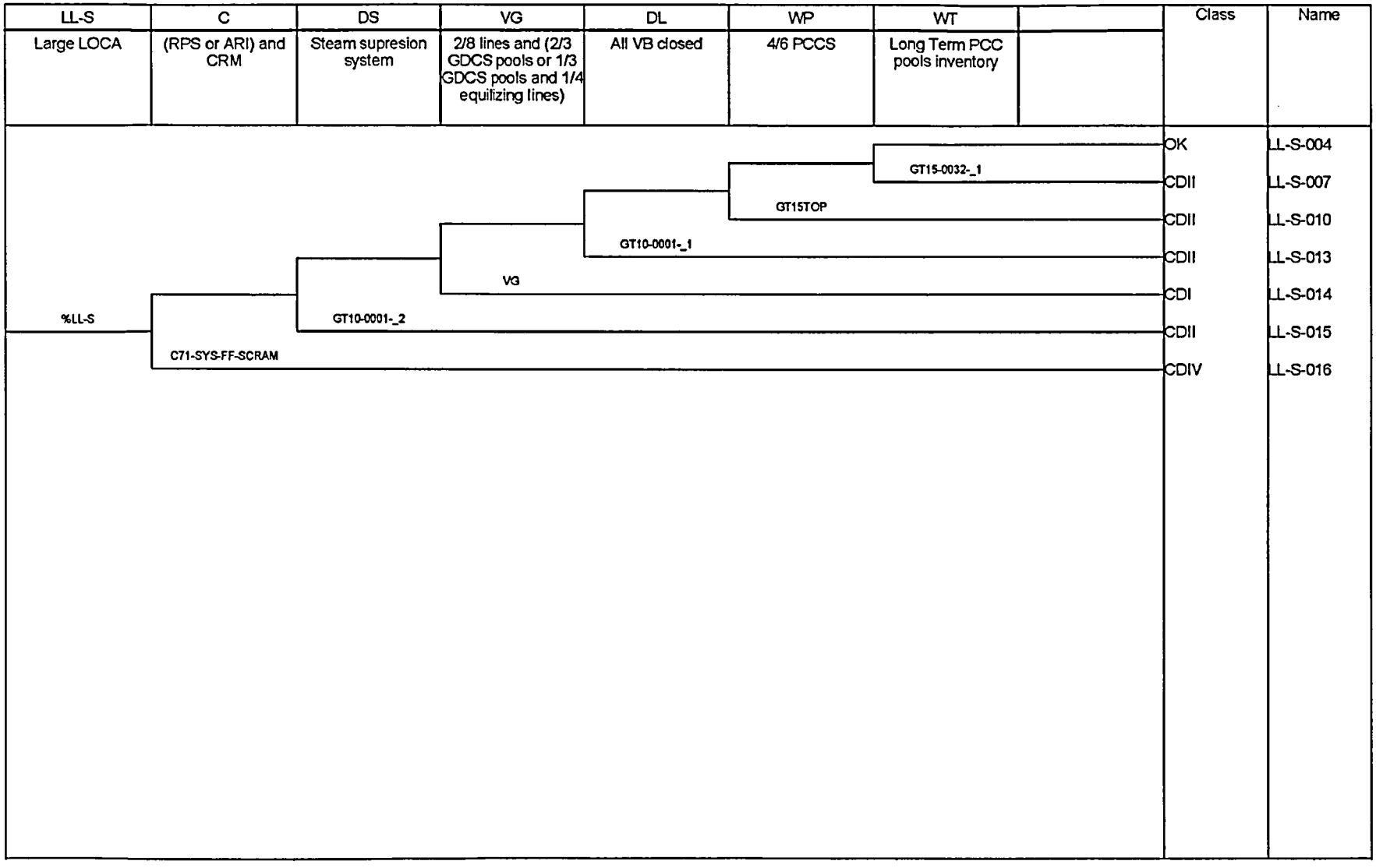

Figure B.11-12. Large Steam Breaks (above L3) other than Feedwater Lines

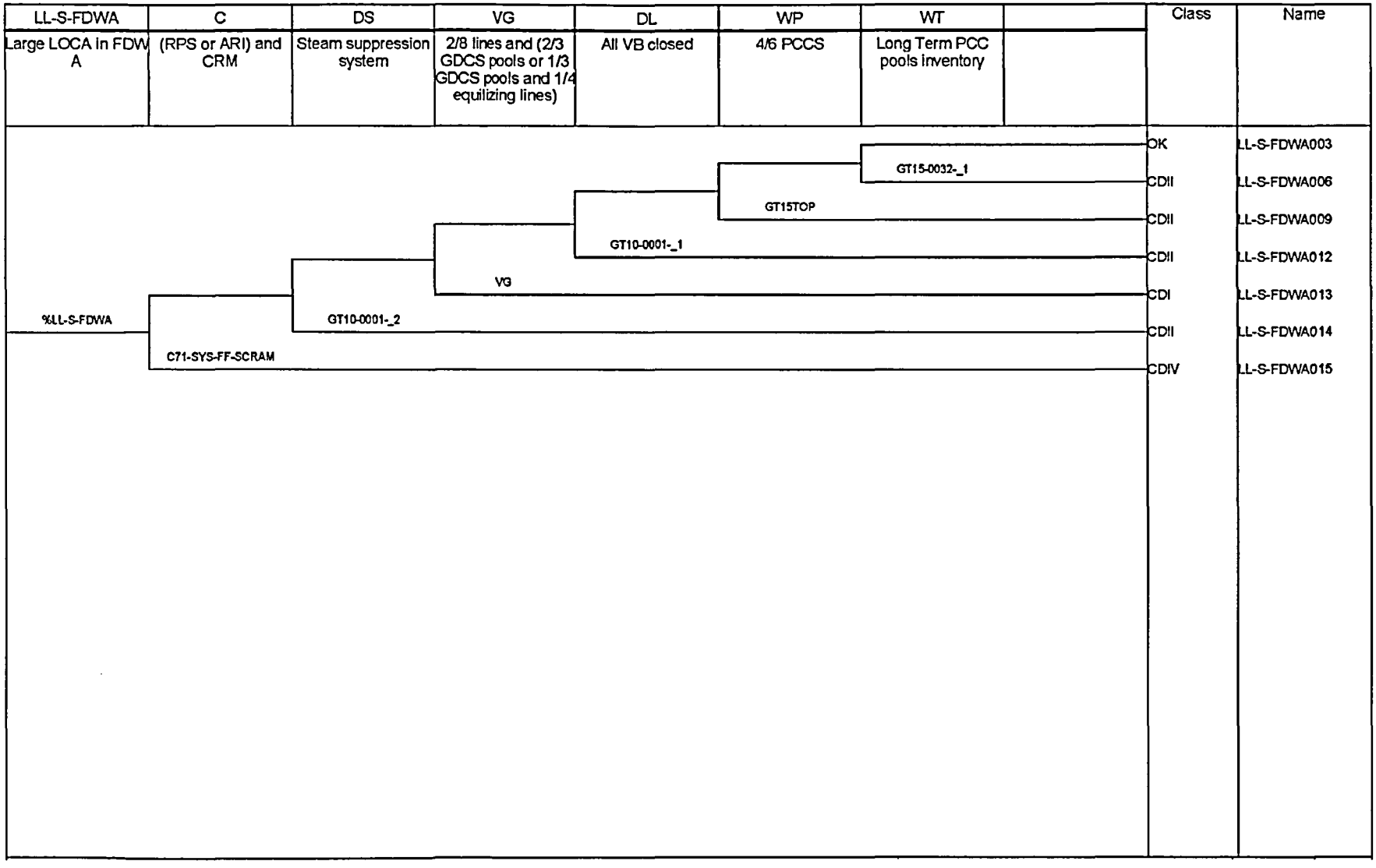

Figure B.11-13. Large Steam Breaks (above L3) in FDW (A) Line

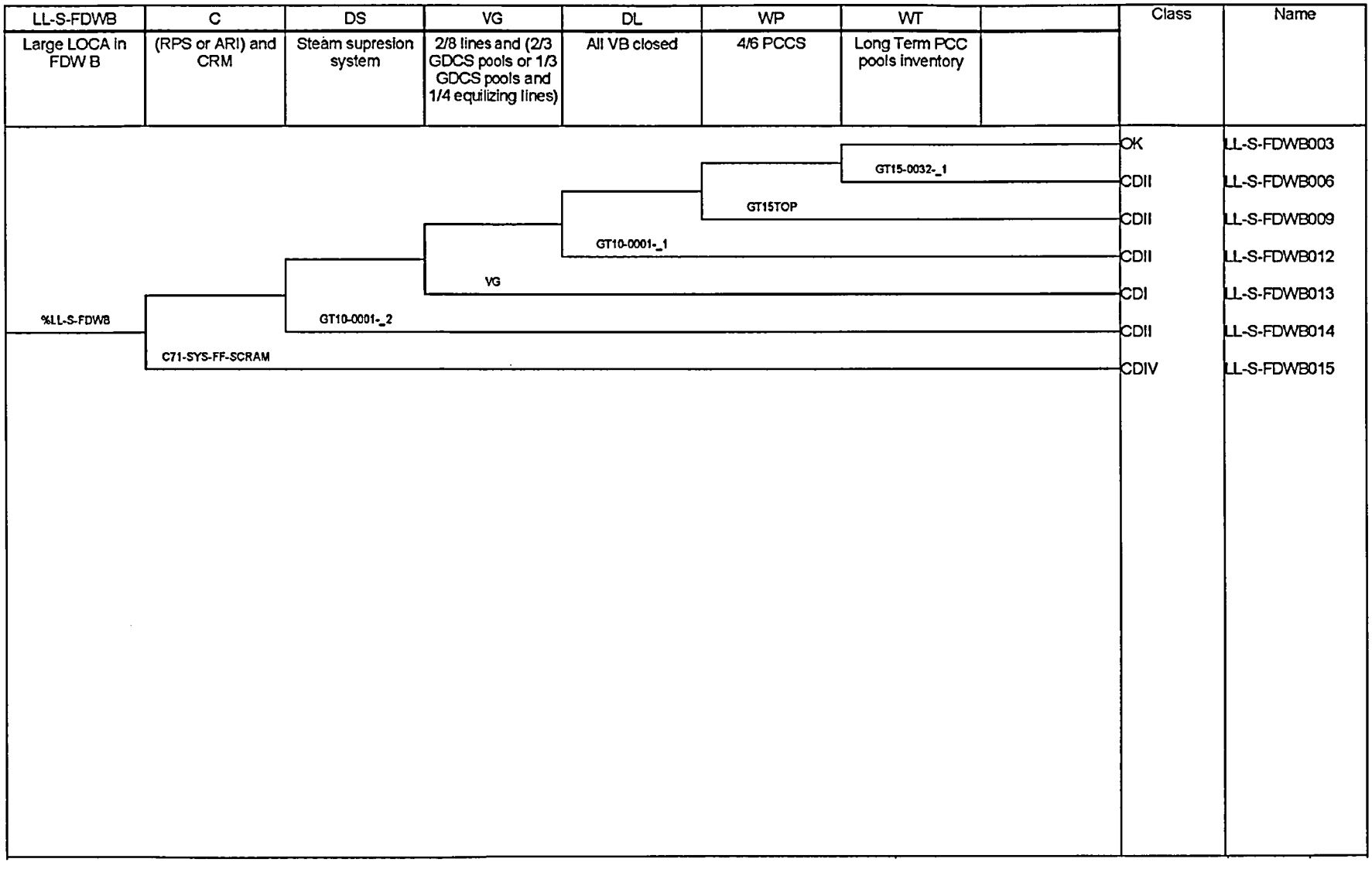

Figure B.11-14. Large Steam Breaks (above L3) in FDW (B) Line

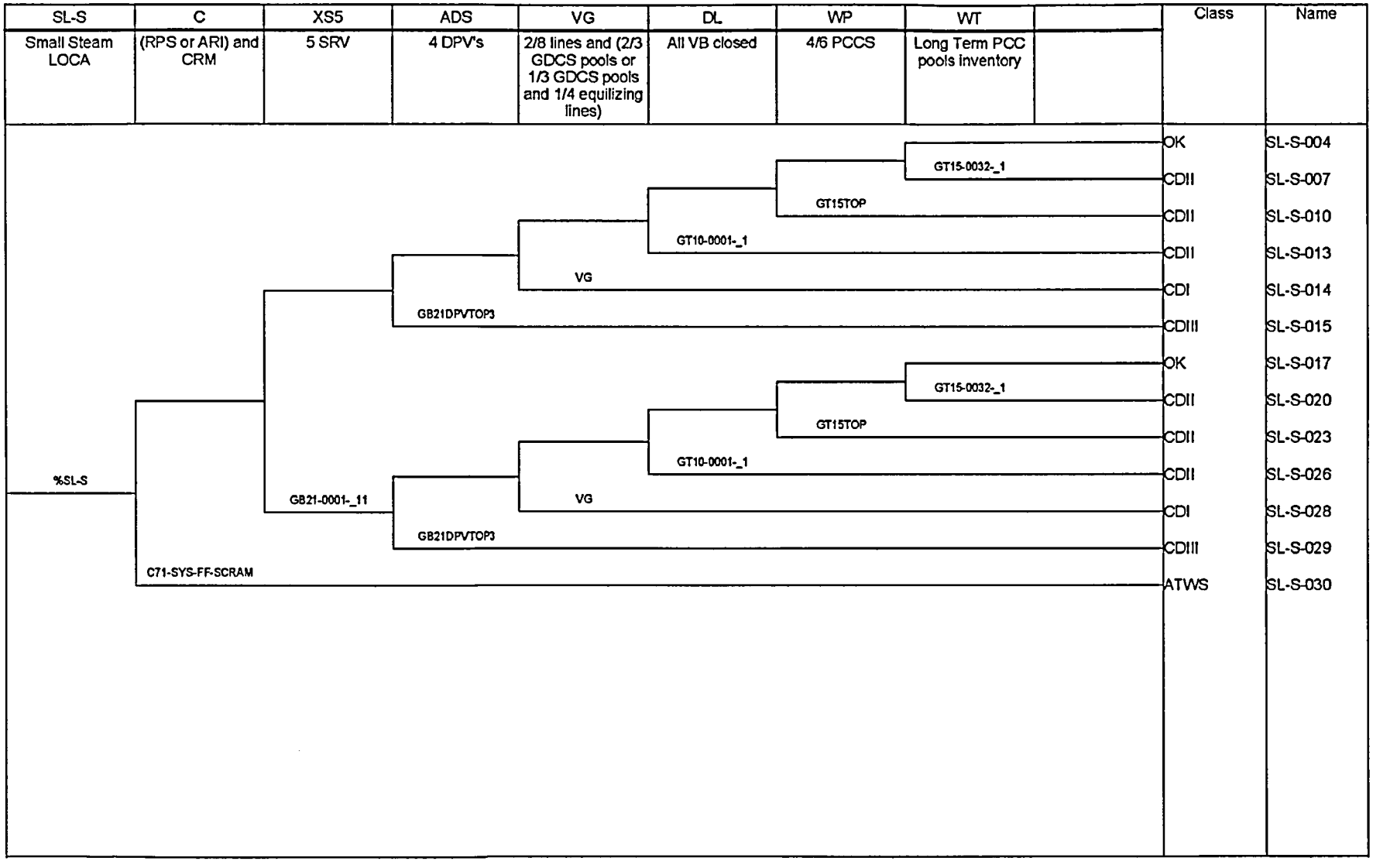

Figure B.11-15. Small Steam Breaks (above L3)

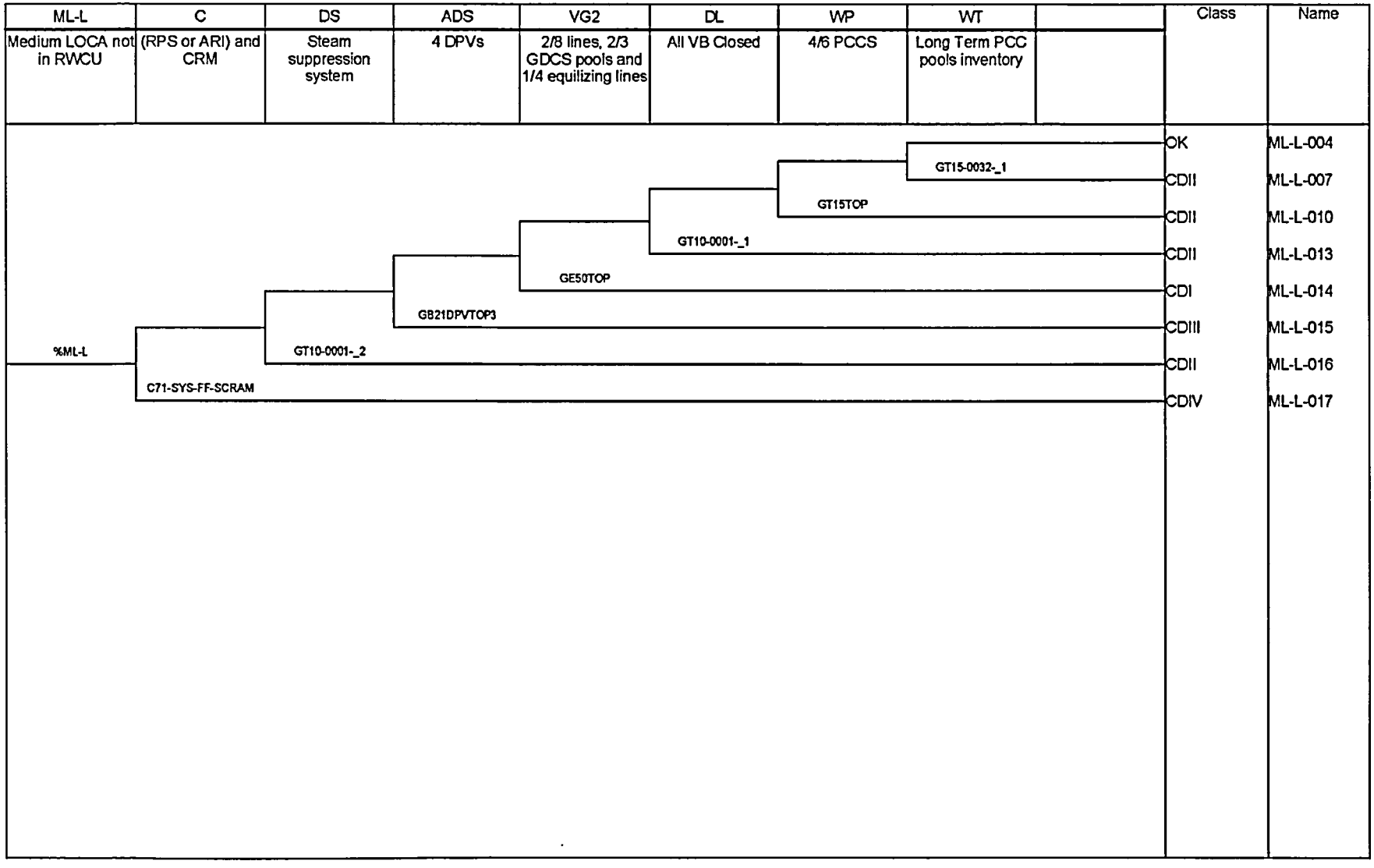

Figure B.11-16. Medium Liquid Breaks (below L3) other than RWCU/SDC Lines

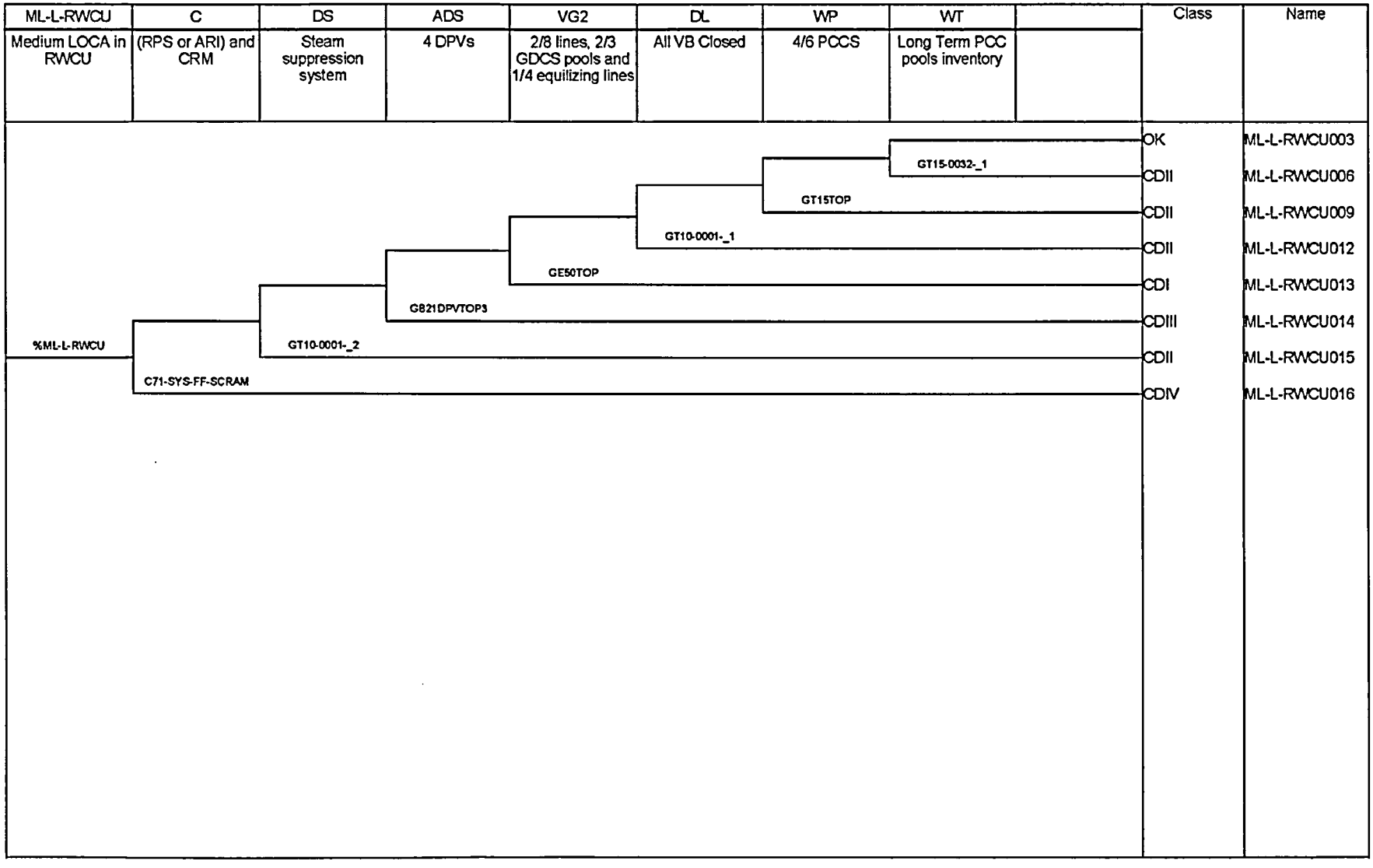

Figure B.11-17. Medium Liquid Breaks (below L3) in RWCU/SDC Lines

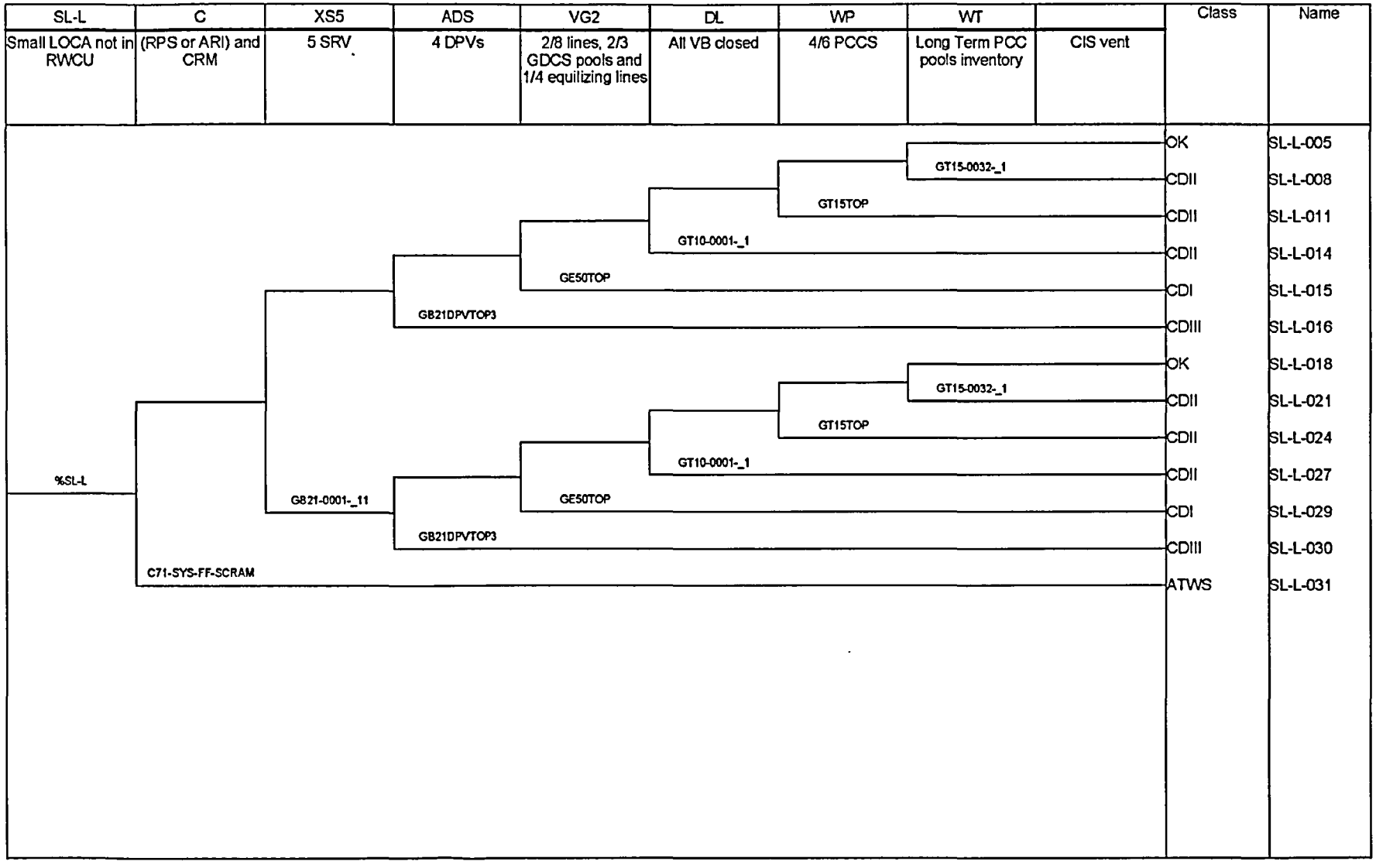

Figure B.11-18. Small Liquid LOCA (below L3) other than RWCU/SDC Lines

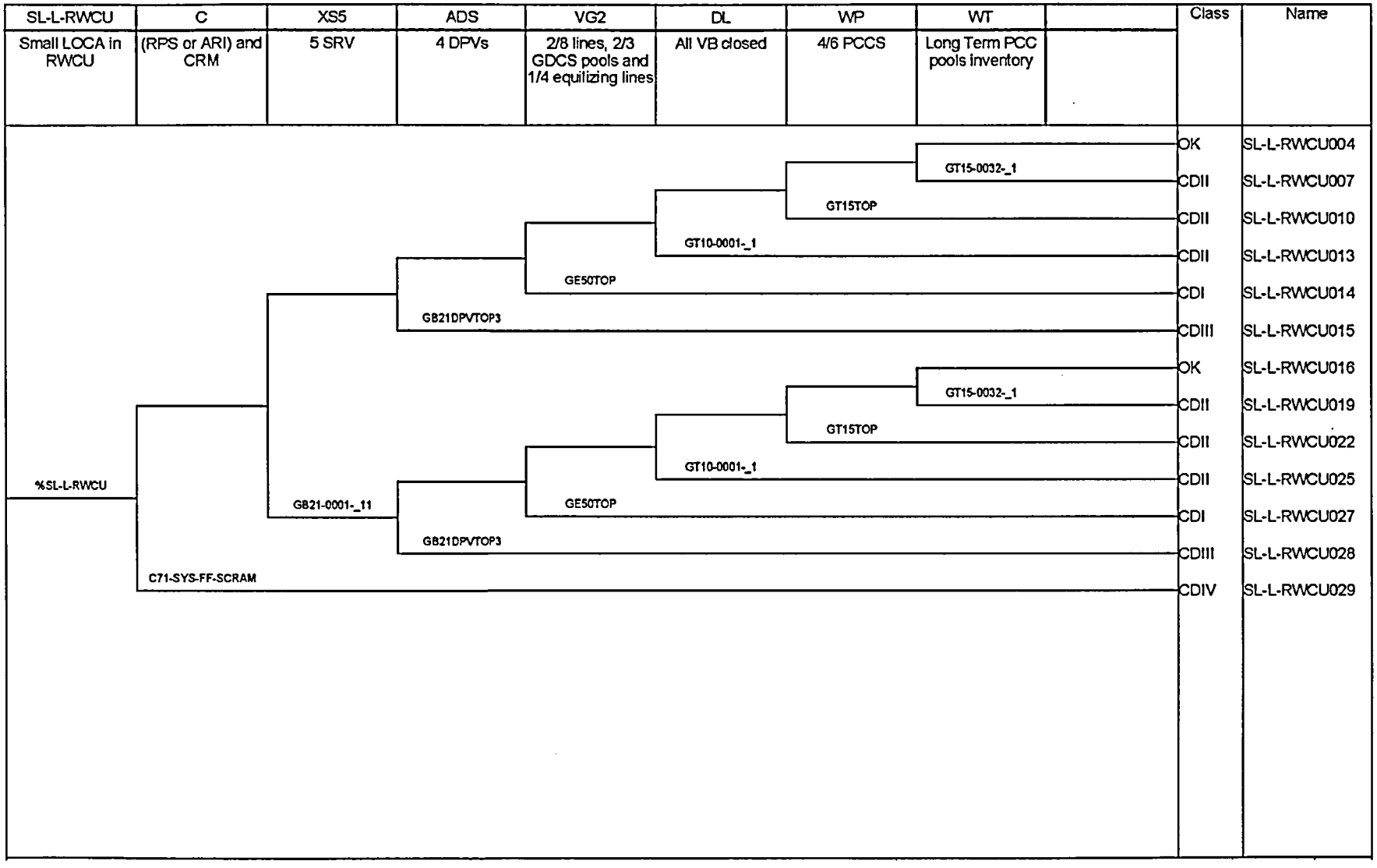

Figure B.11-19. Small Liquid LOCA (below L3) in RWCU/SDC Lines

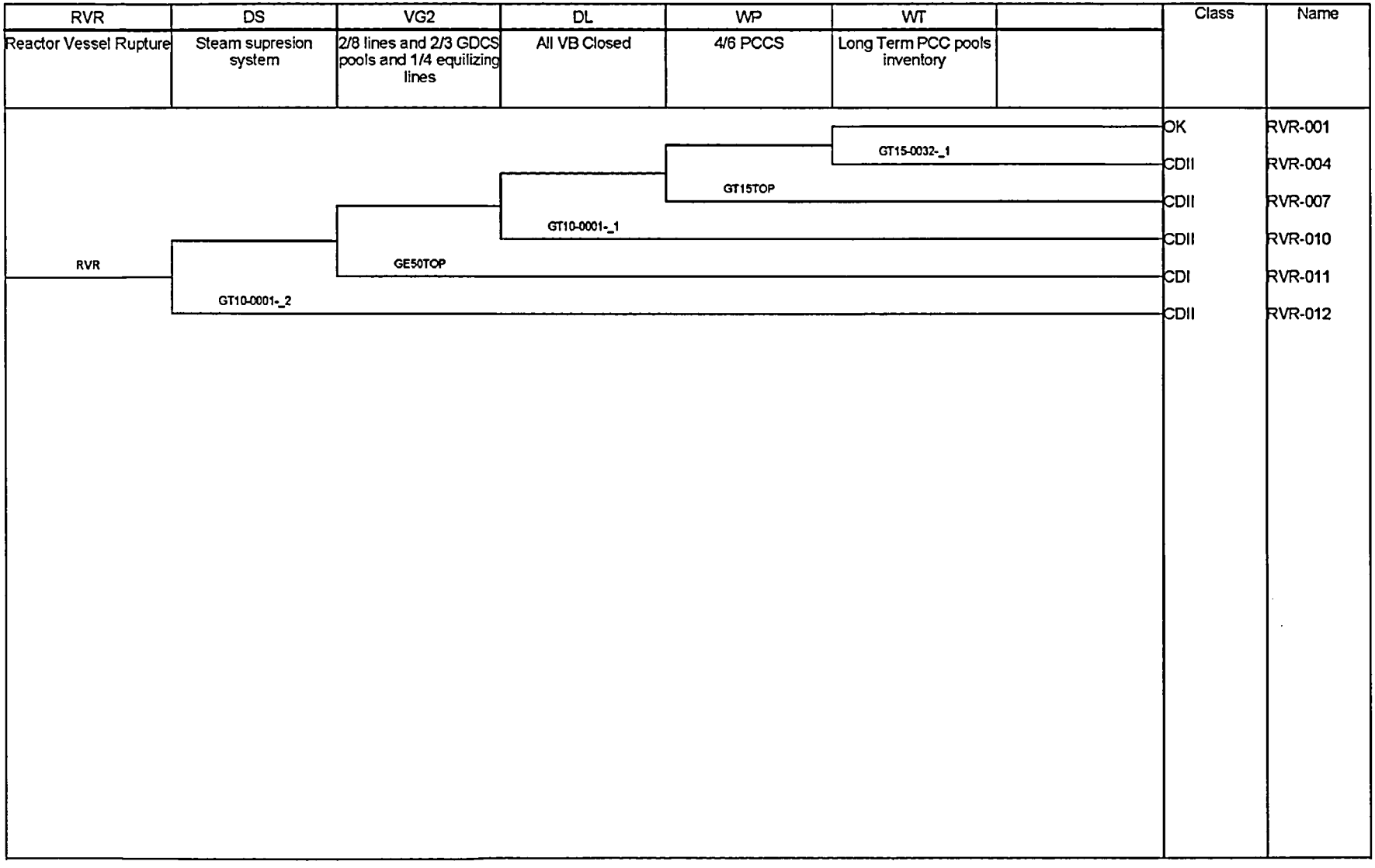

Figure B.11-20. Reactor Vessel Rupture

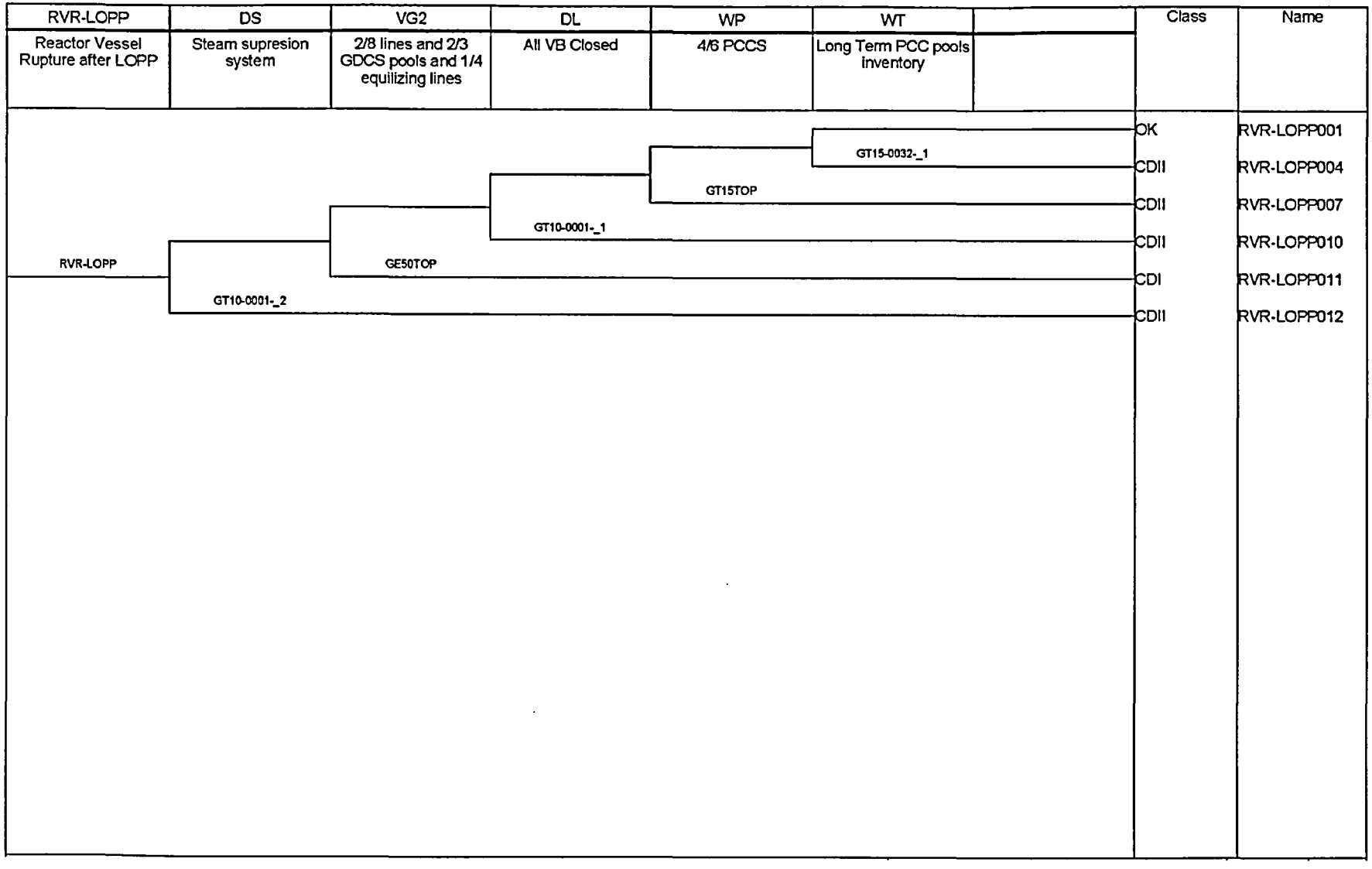

Figure B.11-20a. Reactor Vessel Rupture after Loss of Preferred Power

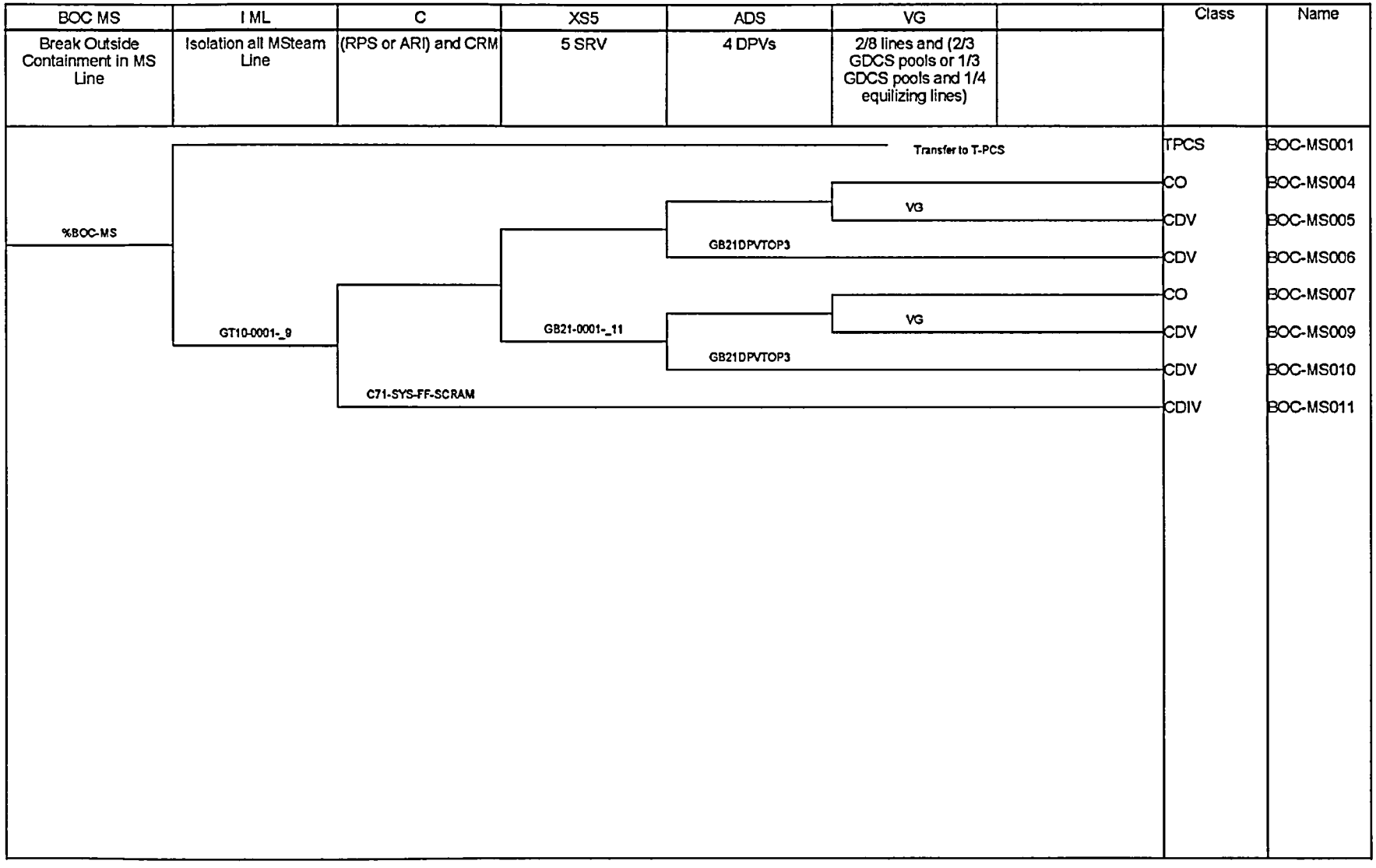

Figure B.11-21. Steam Break Outside Containment in Main Steam Lines

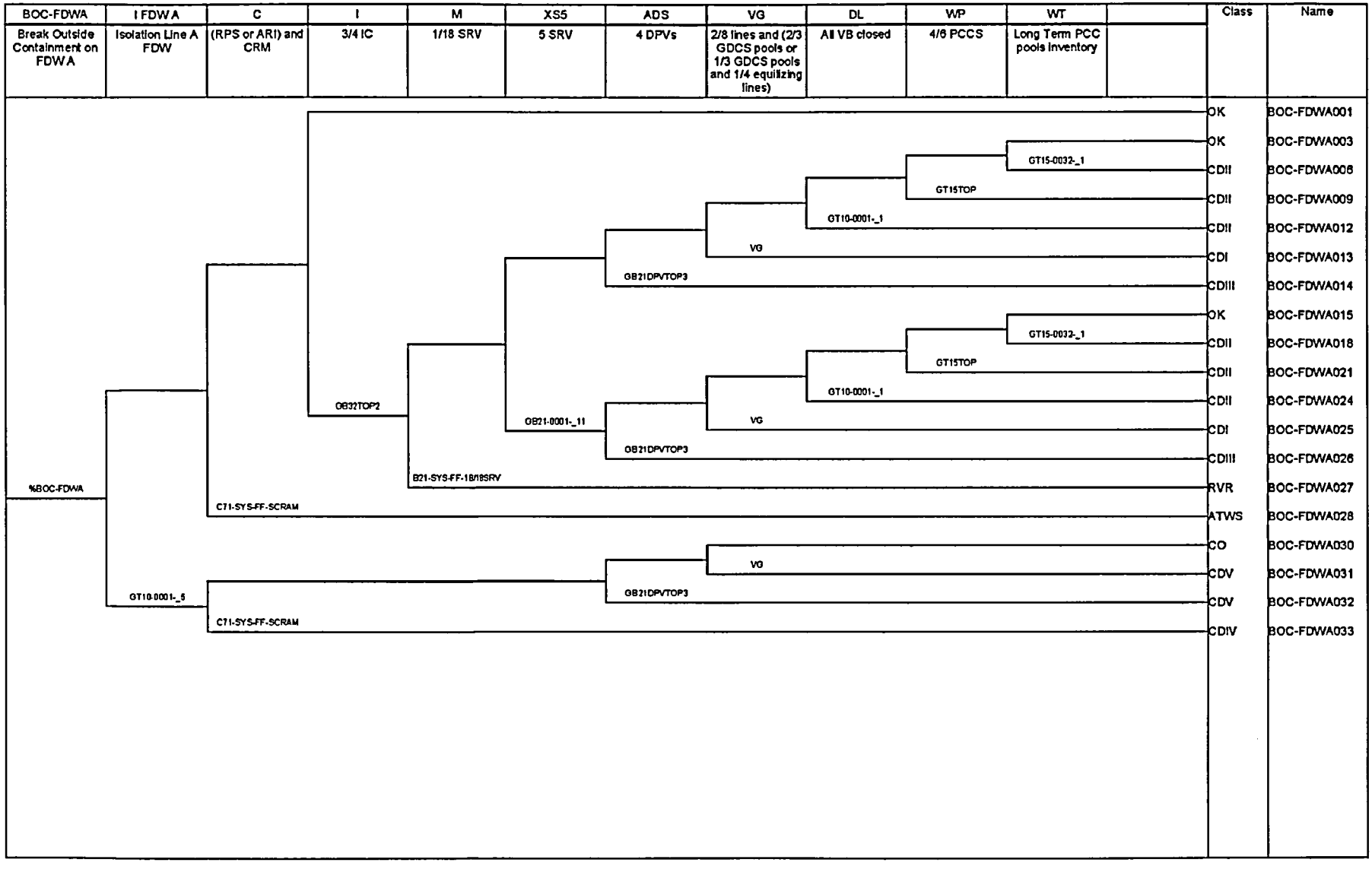

Figure B.11-22. Steam Break Outside Containment in FDW A Line

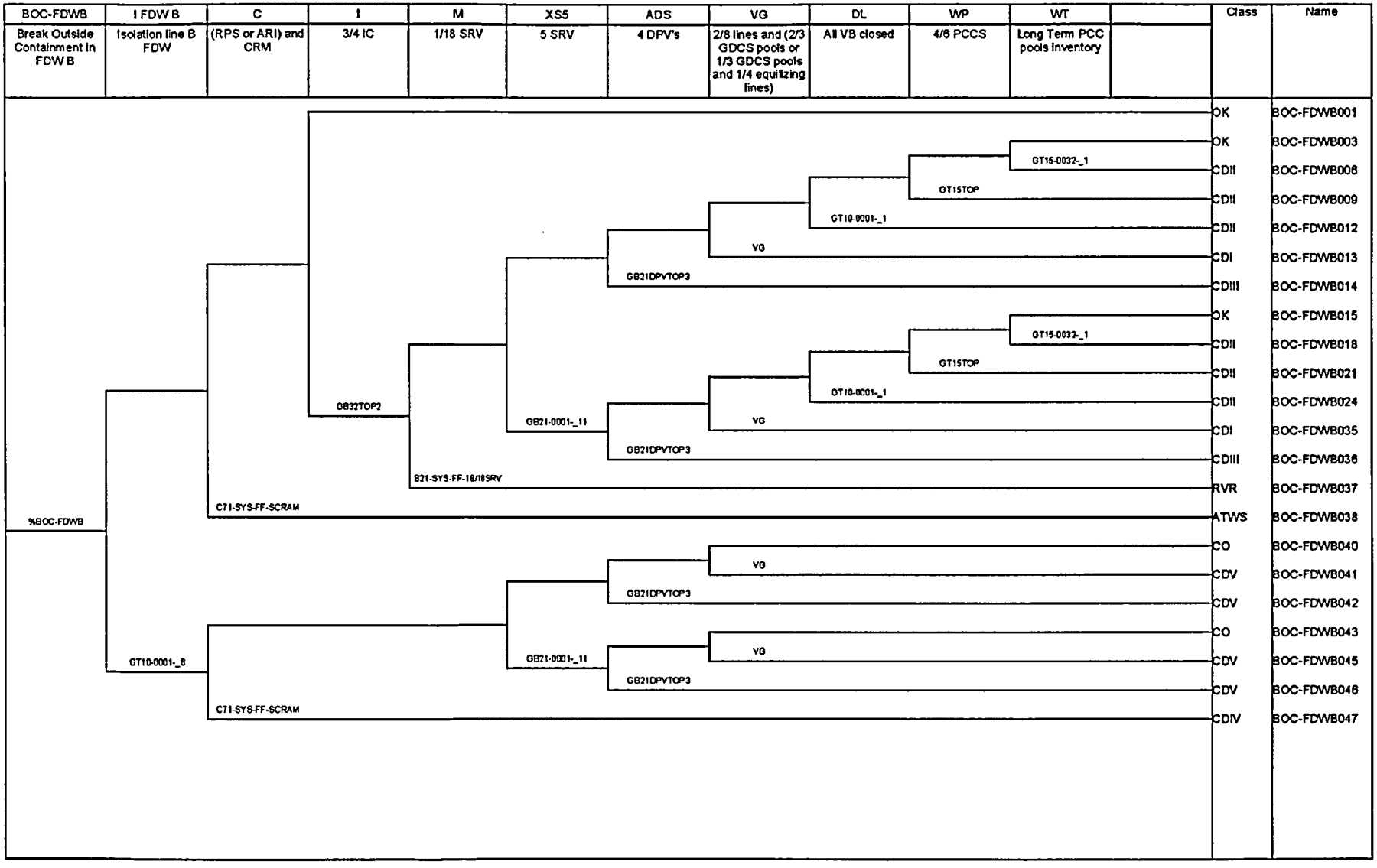

Figure B.11-23. Steam Break Outside Containment in FDW B Line

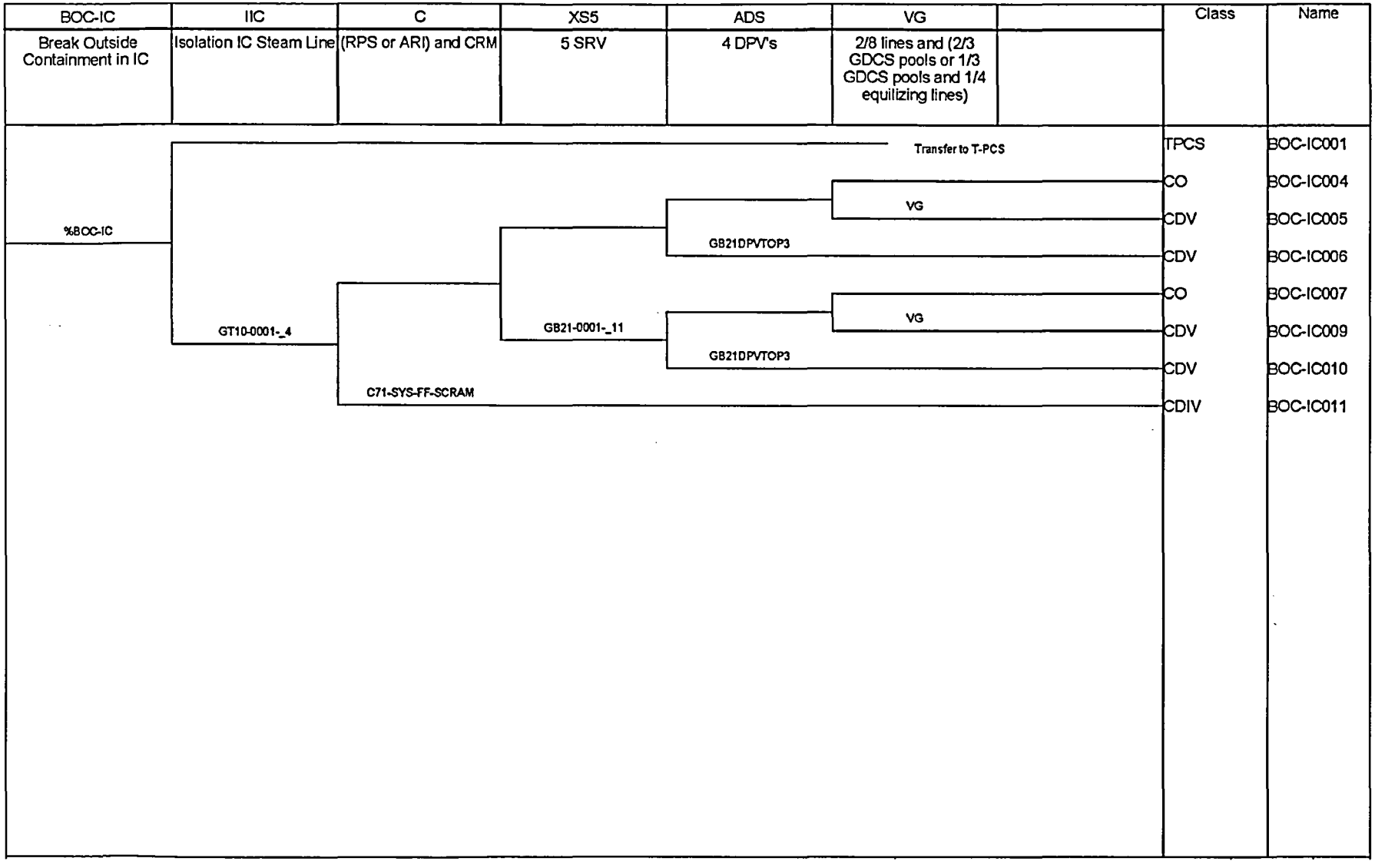

Figure B.11-24. Large Steam Break Outside Containment in IC Lines

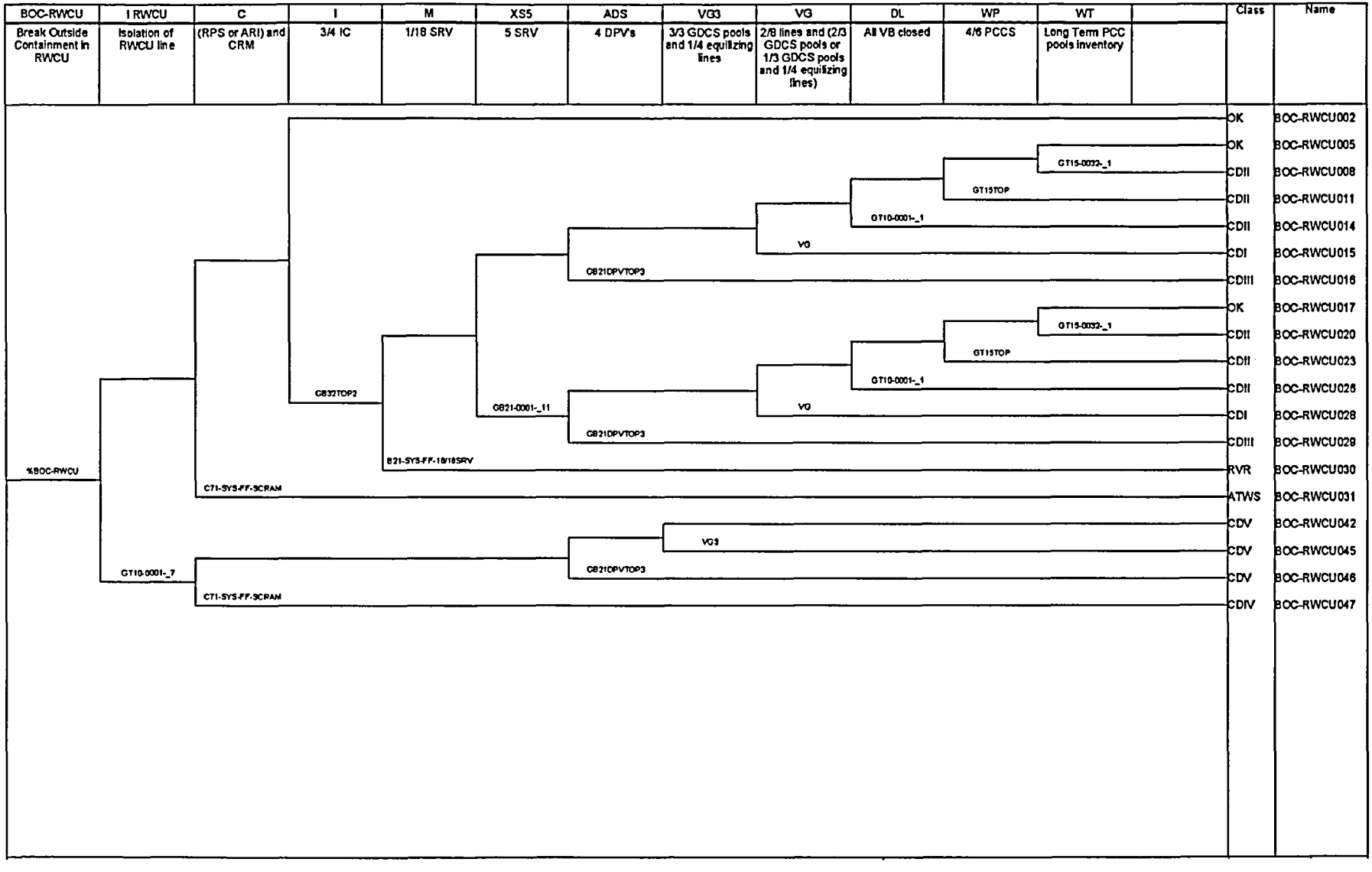

Figure B.11-25. Large Liquid Break Outside Containment in RWCU/SDC Lines