16 SHUTDOWN RISK

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16 SHUTDOWN RISK

16.1 INTRODUCTION

A detailed PRA is performed to determine the core damage frequency during shutdown. Loss of the Reactor Water Cleanup/Shutdown Cooling System, Loss of Reactor Component Cooling Water System, Loss of Plant Service Water System, and Loss of Preferred Power are all investigated. Additionally, the Core Damage Frequency (CDF) due to drain down of the RPV or Loss of Coolant Accidents (LOCAs) during shutdown is evaluated. Fault trees and event trees are used to determine the shutdown CDF for each event analyzed.

The evaluation encompasses plant operation in cold shutdown and refueling modes (Modes 5 & 6). This evaluation addresses conditions for which there is fuel in the RPV. It includes all aspects of the NSSS, the containment, and all systems that support operation of the NSSS and containment.

The scope of the Shutdown PRA is that of a Level 1 PRA. The different accident sequences are classified according to whether the core is damaged or not. All shutdown core damage sequences are assumed to lead directly to a release of radionuclides to the environment (containment is assumed to be open at the time of the initiating event).

The critical safety functions essential to the shutdown model are Decay Heat Removal and Inventory Control. Containment is open for much of the analysis, and containment integrity is not relevant to any modeled functions. Reactivity Control and Spent Fuel Pool Cooling are assumed to have no significant impact on the shutdown model. Power availability is modeled for its impact on decay heat removal. Loss of power is evaluated as an initiating event, and power dependencies for systems are included in the model.

The following subsections discuss the shutdown PRA modeling methodology, data sources, modeling assumptions, and the results of the data analyses for inclusion in the shutdown PRA model. Shutdown PRA analyses during external events are covered in individual external events Sections 12 (Fire), 13 (Flood) and 14 (High Wind).

16.2 PLANT CONFIGURATIONS IN SHUTDOWN

The differences between the shutdown PRA and the power operation PRA are due to the following:

- Plant operating mode,
- Time after shutdown,
- RPV and containment status,
- Water levels and temperatures,
- Fuel location, and
- Availability of required systems.

This analysis covers the ESBWR risk associated with a refueling outage. The systems modeled are evaluated based on anticipated activities associated with refueling operations.

To develop a suitable shutdown model, multiple bounding plant configurations are defined with similar characteristics in relation to the residual heat, the availability of systems, and the RPV water levels.

The outage plant operating mode is used to define the initial plant condition for individual accident sequence quantification.

Once the outage plant configurations have been defined, the duration of each one is estimated to determine its contribution to the overall calculation of annual core damage frequency. The duration is expressed in hours per refueling outage.

16.2.1 Definition of Plant Shutdown Configurations

The list below shows the Technical Specification definitions of the plant modes. The list is from DCD Chapter 16, Table 1.1-1.

Mode	Title	Reactor Mode Switch Position	Average RCS Temp ◦C (◦F)
1	Power Operation	Run	NA
2	Startup	Refuel or Startup	NA
3	Hot Shutdown	Shutdown	> 215.6 (420)
4	Stable Shutdown	Shutdown	≤ 215.6 (420) and > 93.3 (200)
5	Cold Shutdown	Shutdown	≤ 93.3 (200)
6	Refueling	Shutdown or Refuel	NA

When shutting down the reactor, the transition from Mode 5 to Mode 6 begins when one or more reactor vessel head closure bolts is less than fully tensioned.

The shutdown PRA considers the following outage plant configurations as representative of the possible plant configurations during shutdown.

- Mode 4 (Stable Shutdown) – bounded by full power PRA

- Mode 5 (cold shutdown)
- Mode 5 Open (cold shutdown with containment open)
- Mode 6-Unflooded (refueling)
- Mode 6-Flooded (refueling)

Figure 16.2-1 displays the duration of the different outage plant configurations considered in the ESBWR Shutdown PRA. The following paragraphs describe each of these configurations, detailing the vessel pressure and temperature conditions, as well as the assumed duration and status of RWCU/SDCS and other decay heat removal systems.

16.2.1.1 Mode 4 –Stable Shutdown

This is the cooldown phase to bring the plant to cold shutdown. The reactor mode switch is in the shutdown position. It begins after control rod insertion is completed. Operation of the reactor mode switch from one position to another bypasses Reactor Protection System trips and channels and automatically alters Neutron Monitoring System trip setpoints in accordance with the reactor conditions implied by the given position of the mode switch (Reference DCD Chapter 7).

Decay and sensible heat are removed through the Main Condenser and/or Isolation Condenser. Approximately one-half hour after control rod insertion, both RWCU/SDCS trains are operating, with the regenerative heat exchangers bypassed and pumps running at reduced speed to avoid exceeding the RCCWS design cold leg temperature. The control rod drive system is in service to provide makeup water for the reactor coolant contraction.

The duration of this mode is assumed to be 8 hours.

Containment is de-inerted but integrity is maintained during this mode.

The initial RPV conditions (pressure and temperature) for Mode 4 are the same as power operating values. A review of the Technical Specifications show that almost all credited systems in the PRA have the same Tech Spec requirements for Modes 1 through 4. The CDF contribution of this mode (as well as Modes 1, 2 & 3) is bounded by the full power PRA.

16.2.1.2 Mode 5 – Cold Shutdown

The Tech Spec defined Mode 5 begins when the Reactor Coolant Temperature drops too or below 93.3 ºC (200 ºF) while the plant is cooling/shutting down. The ESBWR shutdown PRA treats Mode 5 slightly differently. The defined conditions are the same, but the mode itself is subdivided into two sections, with and without an open containment. ‘Mode 5’ for the shutdown PRA is the portion of the Tech Spec defined mode with the upper drywell head still in place.

This mode occurs twice for each shutdown. It occurs once during cool down, and again after refueling once the reactor head and upper drywell head are replaced before startup.

The total duration of the Tech Spec defined Mode 5 is 240 hours per shutdown. Of that, there are 88 hours before refueling and 152 hours between refueling and startup (see Figure 16.2-1). For the shutdown PRA analysis, 192 hours is the assumed duration of Mode 5. The remaining 48 hours are evaluated as Mode 5 Open, which the subset of the Tech Spec defined mode.

For Mode 5, the reactor mode switch is in the shutdown position. Prior to entering Mode 5 from Mode 4, the heat removal requirements are transferred to the RWCU/SDCS. The Main Condenser and circulating water pumps are removed from service and the use of the isolation condensers is terminated. For the entire duration of Mode 5, all decay heat removal is through the RWCU/SDC system.

Both RWCU/SDCS trains run in parallel, with regenerative heat exchangers bypassed and the pump speed gradually increasing up to the maximum flow rate.

Containment is opened at some time during this mode. The Tech Spec defined mode ends once removal of the reactor head bolts begins. For the shutdown PRA analysis, this mode ends when the upper drywell bolts are removed (which opens containment to the reactor building).

RPV conditions in this mode are assumed to be a pressure of 0.75 MPa (109 psia) and a temperature of 93.3 ºC (200 ºF). Both values are the assumed high values for temperature and pressure at the transition from Mode 4 to Mode 5.

16.2.1.3 Mode 5 Open – Cold Shutdown

This mode is not a Tech spec defined Mode, and actually includes a period of time from two separate Tech Spec defined Modes. Mode 5 Open is essentially the same as Mode 5 with the exception being that there is no intact containment. The reactor vessel head is still on, but the containment is open.

This analysis assumes that the duration of this mode is approximately 48 hours per refueling outage. That allows for 24 hours to remove the drywell head and the reactor head, and 24 hours to re-attach both after refueling.

Part of the Mode 5 Open period is actually part of the Tech Spec defined Mode 6. According to the Tech Spec mode definitions, Mode 6 begins when one or more reactor vessel head closure bolts is less than fully tensioned. Mode 5 Open sequences consider pressure relief in the model. Mode 6 sequences do not since the RPV head is removed for the majority of the mode. Due to the Tech Spec definition, there is a small period of time that is technically Mode 6, but where the vessel head may still provide a pressure seal. The period of Mode 6 with the vessel head still on is included in the Mode 5 Open event trees and analysis.

16.2.1.4 Mode 6 – Refueling (Unflooded)

In this configuration the reactor head is assumed fully removed, and the reactor well is not flooded. The reactor vessel is open to the reactor building.

As soon as the reactor coolant temperature reaches 49 ºC (120 ºF), reactor head removal operations may start. Prerequisites required to remove reactor head, such as reactor well drain or drywell head removal occur during the cooldown phase.

Decay heat removal is provided by the RWCU/SDCS. At the start of this mode, both trains are expected to be running. Later, only one is required to keep the reactor coolant temperature within limits.

Though the description of this mode uses the word ‘unflooded,’ the reactor water level is maintained well above the normal level for Modes 1-5. Water level in this mode is maintained

near the flange connection for the vessel head to minimize dose in the reactor building. It is only unflooded relative to the refueling water level, which includes flooding up of the reactor well.

The duration of this mode is assumed to be approximately 59 hours, including the period before refueling and the period after refueling.

16.2.1.5 Mode 6 – Refueling (Flooded)

The plant enters this configuration after the reactor well flooding is completed.

Decay heat removal is provided by RWCU/SDCS, with only one train running much of the time in this mode. The FAPCS, operating in the reactor well cooling mode, can be used also to cool the reactor. If required, FAPCS can be operated in Reactor Well Cooling mode. In this mode, water from the reactor well is directed to the FAPCS heat exchanger to ensure adequate cooling of the upper layer of the reactor well water. It is expected that FAPCS operates in this mode 8 hours in every refueling outage.

The duration of Mode 6- Flooded is assumed to be approximately 240 hours (10 days).

In this configuration, the reactor head is removed and the reactor well is flooded.

The RPV is at atmospheric pressure and the reactor coolant temperature is maintained between 54 ºC (150 ºF) and 51 ºC (124 ºF). The reactor vessel is assumed to be open to the reactor building.

16.2.2 Mission Time

For the quantification of core damage frequency, the mission time is assumed to be 24 hours. However, the availability of inventories of water and power sufficient to ensure core cooling for longer time periods is also considered.

16.3 INITIATING EVENTS

The purpose of this subsection is to determine the initiating events that challenge the critical safety functions (e.g., heat removal, inventory control) during shutdown operations. A shutdown initiating event is defined as any event that provokes a disturbance in the stable state of the plant and that requires some kind of action to prevent damage to the core.

Section 16.3.1 discusses the shutdown critical safety functions and the shutdown initiating events that challenge these critical safety functions. Section 16.3.2 presents the analysis of the initiating events considered in the Shutdown PRA. Frequencies for initiating events are estimated in Section 16.3.3 and the recovery actions credited are discussed in Section 16.3.4.

16.3.1 Shutdown Critical Safety Functions

The primary critical safety functions accounted for in the Level 1 internal event shutdown evaluation are the following:

- Decay Heat Removal (DHR)
- Reactor Coolant System Inventory Control

No explicit treatment is necessary for the remaining critical safety functions for the following reasons:

- - Spent fuel cooling: This function will be maintained during shutdown modes just as it will during full power modes. It is assumed to have no significant impact to the shutdown model
- - Reactivity control: All control rods are fully inserted for the duration of the modeled modes. ATWS is not an issue. Reactivity control is assumed to have no significant impact on the shutdown PRA model.
- - Power availability: Modeled as it is in the full power model. 'Loss of Preferred Power' is a shutdown initiating event due to it leading to a loss of decay heat removal.
- - Containment: Containment is open for much of the shutdown model, and it not credited in the model for the time it is maintained. All core damage sequences modeled in the shutdown PRA are assumed to lead to a direct containment bypass.

16.3.1.1 Decay Heat Removal

The decay heat removal function during all shutdown modes of operation is provided by the Reactor Water Cleanup/Shutdown Cooling System (RWCU/SDCS) operating in shutdown cooling mode. In Mode 6 with the reactor well flooded, the Fuel and Auxiliary Pools Cooling System (FAPCS) may be used as an alternative.

At the beginning of every shutdown period, both RWCU/SDCS trains will be running, with pumps varying their speed in order to meet the cooldown rate objectives. Once in Mode 6, before completing reactor cavity flooding, only one train is required. Though two trains are generally running all of Mode 5, only one train is required to prevent reactor coolant boiling.

Two trains are required to lower coolant temperature from 200 ºF to the desired refueling temperature of 120 ºF.

If the reactor well is flooded (Mode 6-Flooded), the risk associated to loss of decay heat removal has been judged to be negligible because of the following:

- In addition to RWCU/SDCS, FAPCS can be aligned to cool the reactor well water, constituting a valid alternative for RWCU/SDCS, thus reducing the probability of losing the decay heat removal function.
- The large amount of water stored above the core assures core cooling during a long period of time. This time would be significantly longer than 24 hours. This long period could be used to establish an adequate path from an external water source to the reactor well. CRD pumps, FAPCS pumps, condensate pumps, or firewater pumps could provide this makeup function. The long period of time available makes it practically certain that sufficient inventory can be supplied.

Therefore, the loss of decay heat removal is not analyzed in detail for the case when the reactor well is flooded (Mode 6-Flooded).

For the other shutdown modes (Modes 5 and 6 with the reactor well unflooded), it is assumed that one RWCU/SDCS train is sufficient to remove decay heat to prevent reactor coolant boiling.

It is assumed that both RWCU/SDCS trains are running, because the time periods in which only one is running occurs when the reactor well is flooded. Consequently, failure of one of the trains is not considered an initiating event.

16.3.1.2 Reactor Coolant System Inventory Control

This critical safety function is defined as maintenance of the RCS inventory at a level sufficient to sustain decay heat removal.

LOCA and RPV draindown events can potentially challenge this critical safety function. They can occur as a result of:

- Random pipe breaks within the RCS (including breaks related to maintenance or refueling operations).
- Misalignment or leaks of systems connected to the RPV.
- Leakage during FMCRD replacement.

16.3.1.2.1 Pipe breaks

Three different cases are analyzed, depending on whether the reactor vessel head is installed or not, and depending on whether or not containment is intact or not.

The frequency of these events is expected to be lower than at full power, due to the reduced vessel pressure and temperature. For example, the Grand Gulf Shutdown Study (Reference 16-1) reports that the large LOCA frequency for shutdown events is a factor of ten lower than the frequency for the full power case. LOCA frequencies for the shutdown analysis are estimated by:

- Using the associated frequencies from the Level 1 model,

- Adjusting the value based on the duration of the Mode (time in the mode versus the yearly frequency applied to the Level 1 value), and
- Reducing the value by a factor of ten.

The difference in conditions between at power and shutdown is the primary reason for the frequency reduction. The order of magnitude reduction in LOCA frequency method is borrowed from NUREG/CR-6143, Vol. 2, Part 1 A.

Additional basis for the reduction includes:

- ISI and other pipe failure analyses show leak versus break ratio is likely 100 - 1 or greater for small pipe. Leaks in lines (Instrument & drain lines) would not be LOCA (less than 50 gpm) and would not be initiating event.
- In IS-LOCA analysis, without RPS pressure, IS-LOCA is not credible. During shutdown pressure is significantly less than during power operation.
- Shutdown LOCA frequencies at European plants are calculated using reduction factors to account for smaller pressure and temperature. (Reference 16.8)

16.3.1.2.1.1 Pipe Breaks in Mode 6

With the vessel head removed, as long as the RPV level is above Level 3 (L3), it is assumed that RWCU/SDCS provides adequate core cooling. Natural circulation of coolant inside the vessel is not challenged because L3 is above the bottom of the steam separators. As such, any break above L3 during Mode 6 does not constitute a shutdown initiating event, as RWCU/SDCS will continue to ensure normal core cooling and the core will remain covered.

However, if RPV level drops to L3, RWCU/SDCS pumps receive a runback signal, slowing down to cleanup mode flow rate. In addition, once water level in the vessel falls below the bottom of the steam separators, natural circulation is not assured and the core cooling function of RWCU/SDCS may not be adequate. As such, breaks below L3 are included in the analysis as shutdown initiating events.

Breaks below L3 are divided into the following two categories: Breaks outside containment and inside containment.

<u>Breaks Outside Containment</u>

Breaks outside containment can originate only in RWCU/SDCS piping, because this is the only system that removes reactor coolant from the containment in Mode 6; The rest of the RPV vessel piping is isolated.

The RWCU/SDCS containment penetrations have redundant and automatic power-operated containment isolation valves that close on signals from the leak detection and isolation system and the reactor protection system. An additional, diverse non-safety isolation of the RWCU/SDCS system provides protection in the event of a break outside containment.

The RWCU/SDCS return to the feedwater lines are each provided with redundant check valves in series located in the Main Steam Tunnel. A single-power operated isolation valve in each line is located upstream of the check valves and inside the Reactor Building. The FAPCS and CRDS connections are downstream of the two check valves. A postulated break in the RWCU/SDCS

piping system inside the Reactor Building, which would otherwise allow reactor coolant to flow backwards through main feedwater lines and to spill into the Reactor Building, will be isolated by either redundant RWCU/SDCS check valves or feedwater check valves even if a single failure of one check valve is assumed.

Therefore, the shutdown PRA considers RWCU/SDCS breaks outside containment to be negligible risk contributors and does not analyze them further. This is consistent with the at-power PRA which shows the CDF contribution from RWCU/SDCS breaks outside containment to be negligible.

Breaks Inside Containment

For breaks inside containment, coolant flows through the break to the lower drywell. Decay heat removal is achieved in this case by allowing reactor coolant boiling and then venting the steam to the atmosphere (i.e., the drywell head is removed in Mode 6). To maintain adequate water level in the vessel, a water supply to the vessel is required.

If a break is located below TAF, to reach a safe core cooling condition, it is necessary to flood the drywell and the vessel up to a level above the TAF.

The lower drywell is equipped with a personnel hatch and with an equipment hatch to allow access to the containment for personnel and equipment. These hatches are closed during normal operation, but they may be open during refueling. A manual recovery action to close these two hatches is required for successful drywell flooding (see recovery analysis below).

Two different cases are considered for breaks inside containment below TAF during Mode 6:

- Reactor well flooded (Mode 6-Flooded):

  If the reactor well is flooded, the water inventory stored above the core is assumed to be sufficient to flood the drywell and the vessel well above the TAF if the two lower drywell access hatches are closed at the time of the event or they are manually closed before the water level in the drywell reaches the elevation of the hatches.

- Reactor well unflooded (Mode 6-Unflooded):

  If the well is not flooded, the water inventory stored above the core is assumed to be insufficient to cover the core, and additional coolant supply is required

As discussed previously, only pipe breaks below RPV Level 3 (L3) are considered shutdown Mode 6 initiating events. Therefore, breaks in main steam lines, DPVs, and instrument lines above L3 are not considered as shutdown initiating events.

Based on the discussions above, and the line breaks identified in Table 2.3-1, the following line break categories are identified as potential shutdown LOCA initiators:

– Feedwater LOCA – As a simplifying and conservative assumption, the entire feedwater LOCA frequency is applied to feedwater Line A in the shutdown analysis. In the internal events analysis, the frequency is evenly split between the two lines (A & B). In the shutdown anlysis feedwater line A is the more limiting break. A feedwater Line A break would disable one half of RWCU/SDC, and all FAPCS and

FPS injection. A feedwater Line B break would disable the other half of RWCU/SDC and all of CRD injection.

- GDCS injection line LOCA - This event degrades the passive inventory control system.
- LOCA other than feedwater and GDCS – This is for line breaks above TAF other than GDCS injection or feedwater lines (see Table 16.3-3b and Table 2.3-1 for specific lines).
- Instrument Line LOCA below TAF – All LOCAs below TAF during shutdown require closure of lower drywell hatch. The hatch can be opened during shutdown. If a break occurs in the lower drywell and the hatch is not closed, core damage is assumed to occur (once the water level reaches the bottom of the hatch, it is assumed that the door can not be closed and the leak not isolated).
- RWCU/SDC drain line LOCA below TAF. The RWCU/SDC system has drain lines that are below the reactor core. A break in these lines is limiting because it has the potential to drain the vessel to below the fuel. Closure of the lower drywell hatch is required to mitigate this event.

16.3.1.2.1.2 Mode 5 and Mode 5 Open

The same LOCA scenarios modeled for Mode 6 are modeled for Mode 5 with and without an intact containment. Steam Line LOCAs and DPV line LOCAs are assumed to pose negligible risk. The LOCA frequencies for these are lower than GDCS and feedwater, and the resulting LOCAs don't disable any makeup function.

16.3.1.2.2 RPV Draindown events due to misalignments

The ESBWR design has significantly reduced the number of potential RPV draindown pathways due to postulated system misalignment during shutdown conditions.

In particular, as compared to Residual Heat Removal System in current BWRs, the RWCU/SDCS in the ESBWR does not have the potential for diverting RPV inventory to the suppression pool through the SP suction, return, or spray lines. RWCU/SDCS does not provide any drywell spray function, so the potential RPV draindown through drywell spray does not exist. In addition, the absence of recirculation lines in the ESBWR design further reduces the potential RPV draining paths.

The only operating system that has the potential to drain the RPV during this mode of shutdown is RWCU/SDCS. This system is connected to the RPV during shutdown and it is used to discharge excess reactor coolant to the main condenser or to the radwaste system during startup, shutdown and hot standby conditions.

An evaluation of system pipe drawings showed two potential draindown paths due to misalignment. Both lines have 20mm diameters and are assumed to be too small to be considered and initiating event.

16.3.1.2.3 FMCRD replacement

Draining the RPV during FMCRD maintenance has been evaluated, but is not considered a shutdown PRA initiating event. With the tools used for the actions, and the controls in place to monitor the evolution, the chance of a significant RPV leak due to the activity is assumed to be negligible.

The procedure for removal of the FMCRD for maintenance or replacement is similar to previous BWR product lines. The control rod is first withdrawn to the full-out position. During removal of the lower housing (spool piece) following removal of the position indicator probes and motor unit, the control rod backseats onto the control rod guide tube. This metal-to-metal contact provides the seal that prevents draining of reactor water when the FMCRD is subsequently lowered out of the CRD housing. The control rod normally remains in this backseated condition at all times with the FMCRD out; however, in the unlikely event it also has to be removed, a temporary blind flange is first installed on the end of the CRD housing to prevent draining of reactor water.

If the operator inadvertently removes the control rod after FMCRD is out without first installing the temporary blind flange, or conversely, inadvertently removes the FMCRD after first removing the control rod, an un-isolable opening in the bottom of the reactor is created, resulting in drainage of reactor water. The possibility of inadvertent reactor drain-down by this means is considered remote for the following reasons:

- Procedural controls similar to those of current BWRs provide the primary means for prevention. Current BWR operating experience demonstrates this to be an acceptable approach. There has been no instance of an inadvertent drain-down of reactor water due to simultaneous CRD and control rod removal.
- During drive removal operations, personnel are required to monitor under the RPV for water leakage out of the CRD housing. Abnormal or excessive leakage occurring after only a partial lowering of the FMCRD within its housing indicates the absence of the full metal-to-metal seal between the control rod and control rod guide tube required for full drive removal. In this event, the FMCRD can then be raised back into its installed position to stop the leakage and allow corrective action.

The COL applicant shall develop maintenance procedures with provisions to prohibit coincident removal of the control rod and CRD of the same assembly. In addition, the COL applicant shall develop contingency procedures to provide core and spent fuel cooling capability and mitigative actions during CRD replacement with fuel in the vessel.

The FMCRD design also allows for separate removal of the motor unit, position indicator probe (PIP), separation indicator probe (SIP) and spool piece for maintenance during plant outages without disturbing the upper assembly of the drive. While these FMCRD components are removed for servicing, the associated control rod is maintained in the fully inserted position by one of two mechanical locking devices that prevent rotation of the ball screw and drive shaft.

The first anti-rotation device is engaged when the motor unit consisting of the induction motor, reduction gear, brake and position signal detector is removed. It is a spring-actuated locking cam located on the bottom of the spool piece. When the motor unit is lowered away from the spool piece, the locking cam is released from its normally retracted position and engaged by spring

force with gear teeth on the bottom of the magnetic coupling outer rotor, thereby locking the shaft in place.

With the motor unit removed, the locking cam can be visually checked from below the drive to verify that it is properly engaged. When the vessel head is removed, another means of verification of proper locking is for the operator to view the top of the control rod from over the reactor vessel. If the top of the control rod is visible at its normal full in position, it provides both direct indication that the control rod remains fully inserted and additional assurance that the ball screw is restrained from reverse rotation. The drive shaft remains locked in this manner until the motor unit is reattached to the spool piece. During motor installation, a release pin on the motor unit pushes up a plunger linked to the locking cam as the motor unit is raised into contact with the spool piece. The release pin forces the locking cam away from the teeth on the bottom of the magnetic coupling outer rotor and into the normally retracted, unlocked position.

The second anti-rotation device is engaged when the spool piece is removed from the FMCRD. As described in DCD Subsection 4.6.2.1.3, this device is a spline arrangement between the ball screw lower coupling and the middle flange backseat. When removing and lowering the spool piece, the weight of the ball screw, hollow piston and control rod provides a vertical force in the downward direction that brings the two splines together. This locks the ball screw into the backseat and prevents reverse rotation. As with the first anti-rotation device, proper engagement of this device can be visually checked from below the drive. If the splines do not completely lock together, there is indication of this because the ball screw does not seat against the backseat and there is a small gap for leakage of water. If this should occur, removal of the spool piece can be discontinued and corrective action taken. If there is no leakage, it confirms that the splines are properly locked together. Also as in the case of the first anti-rotation device, visual observation of the top of the control rod from over the reactor vessel provides another means for verifying proper locking of the ball screw. The ball screw remains locked in this position until the spool piece is reattached to the FMCRD. During spool piece installation, the end of the drive shaft fits into a seat on the end of the ball screw. As the ball screw piece is raised off the middle flange backseat, the anti-rotation splines disengage and the weight of the ball screw, hollow piston and control rod is transferred to the spool piece assembly.

16.3.2 Identification of Initiating Events

The identification of the shutdown initiating events for inclusion in the ESBWR shutdown risk assessment is based on:

- Review of past shutdown PRAs,
- Review of the ESBWR full power PRA initiators, and
- Consideration of the ESBWR design and configuration during shutdown.

The potential initiator scenarios are described in Section 16.3.1. The resulting list of initiating event types during shutdown (and as a function of critical safety function) is presented in Table 16.3-1.

16.3.3 Frequency of Initiating Events

Initiating event frequencies are quantified based on a review of BWR operating experience as well as ESBWR specific evaluations.

16.3.3.1 Loss of Both Operating RWCU/SDCS Trains

The main components of the system are the pumps, heat exchangers, demineralizers, valves and piping.

RWCU/SDCS is connected to nonsafety-related standby AC power (diesel generators) allowing it to perform its reactor cooling function when the preferred power source is not available.

In addition to AC power, RWCU/SDCS requires the operation of the Reactor Component Cooling Water System (RCCWS) and the Plant Service Water System (PSWS) in order to remove decay heat.

The unavailability of the RWCU/SDCS system can occur for the following general reasons:

- Failure of both RWCU/SDCS trains.
- Isolation of the RWCU/SDCS, caused by RPV low level (Level 3 causes RWCU/SDCS pump runback and Level 2 causes loss of suction pressure), SLCS initiation, LD&IS signals, high temperature in main steam tunnel or high system flow.
- Loss of Preferred Power (LOPP).
- Loss of RCCWS or PSWS.

The Loss of RWCU/SDCS shutdown initiating event is defined by failure of both trains, either due to RWCU/SDCS component failures or by automatic closure of isolation valves. LOPP and Loss of RCCWS/PSWS are modeled as separate shutdown initiating events.

Automatic closure of RWCU/SDCS isolation valves can be initiated by the following signals:

- High RWCU/SDCS flow,
- Low reactor water level (level 2),
- High temperature in main steam tunnel, and
- Leak Detection and Isolation System signals that indicate a break in the RWCU system.

ESBWR logic design uses four divisions of power backed up by safety-related batteries. Therefore, loss of power to the logic is highly unlikely. Three divisional logic power supply failures are required to initiate the SDC isolation; as such, this RWCU/SDC failure mode is non-significant compared to loss of support systems or mechanical failures.

The initiating frequency for Loss of RWCU/SDCS is calculated from a combination of several common cause failures in the RWCU/SDC logic. The events contributing to the Loss of RWCU/SDC are listed in Table 16.3-1.

16.3.3.2 Loss of Preferred Power

Loss of Preferred Power (LOPP) may happen as a result of severe weather, grid failures or switchyard faults.

The LOPP shutdown initiator frequency is calculated using the loss of offsite power during shutdown data documented in NUREG/CR-5496. (Reference 16-2)

16.3.3.3 Loss of RCCWS/PSWS

This initiating event is the loss of the Reactor Component Cooling Water System (RCCWS) or the loss of the Plant Service Water System (PSWS) supporting the RWCU/SDCS operating in shutdown cooling mode. This initiating event poses a DHR challenge and renders the RWCU/SDCS system unavailable.

The frequency of this initiator is based on the Loss of PSWS initiating event frequency calculated for the at-power PRA.

16.3.3.4 Shutdown LOCA events

The following LOCA initiators are quantified in the shutdown PRA:

Mode5

- Break in one of the GDCS injection lines
- LOCA in FW-A
- LOCA other than FW or GDCS
- LOCA below TAF in RWCW/SDC drain lines
- LOCA below TAF in instrument lines
  - Mode 5 Open
- Break in one of the GDCS injection lines
- LOCA in FW-A
- LOCA other than FW or GDCS
- LOCA below TAF in RWCW/SDC drain lines
- LOCA below TAF in instrument lines
  - Mode 6 Unflooded
- Break in one of the GDCS injection lines
- LOCA in FW-A
- LOCA other than FW or GDCS
- LOCA below TAF in RWCW/SDC drain lines
- LOCA below TAF in instrument lines
  - Mode 6 Flooded
- LOCA below TAF in RWCW/SDC drain lines
- LOCA below TAF in instrument lines

The shutdown LOCA frequencies are based on the at-power RCS line break frequencies (refer to Chapter 2, Table 2.3-1). The at-power RCS line break frequencies are reduced by a factor of 10 for the shutdown PRA to reflect the low pressure and temperature during shutdown conditions.

16.3.4 Recovery Actions

This section documents the calculation of time-dependent, post-initiator recovery probabilities used in the ESBWR Shutdown PRA. The recovery events addressed in this section are those that terminate or mitigate the initiating event before a safety function is challenged. Unlike at full-power conditions, during shutdown modes extended time can be available to terminate the initiating event. This justifies the quantification of recovery possibilities.

Recovery events are analyzed for the following initiating events:

- Loss of both operating RWCU/SDCS trains: Operators recover at least one of the two failed trains.
- Loss of RCCWS/PSWS: Operators recover the failed equipment.
- LOCA Below TAF (Mode 6): Operators close the two lower drywell hatches if they are open.

The analysis of these events is performed using the BWR industry data from References 16-3, 16-4, 16-5 and 16-6. Industry data is included here based on operating experience in Modes 5 and 6.

The operating experience events in each category are analyzed to determine the time elapsed before the initiating event was terminated. Because of the limited data for extended durations, an additional assumed event with a recovery time of 20 hours is added to all distributions.

It is then assumed that the time to recovery is a random variable following a lognormal probability density distribution. The operating experience recover y events are listed in Table 16.3-4, and the distribution from the data is shown in figure 16.3-1.

16.3.4.1 Recovery of RWCU/SDCS

The most functionally similar system to RWCU/SDCS in current BWRs is the Residual Heat Removal system.

Events involving the loss of a running RHR pump at BWRs are identified from References 16-3, 16-4 and 16-5, and are shown in Table 16.3-4. However, due to the lack of BWR events specifying the duration, PWR events (see Reference 16-6) are also used in the recovery analysis, excluding those occurring during reduced inventory conditions. Using the methodology described above, the lognormal distribution parameters m and s are determined to be 2.73 and 2.08, respectively. The resulting recovery probability curve as a function of time for the Loss of RWCU/SDCS initiator is provided in Figure 16.3-1.

Based on the most limiting Mode 5 conditions, the time to boil following a loss of decay heat removal (loss of RWCU/SDC) would be approximately 4 hours. This time does not account for the time following boiling for level to drop to L3. This time is based on a bounding estimate of the decay heat at Mode 5 and the specific configuration of the ESBWR vessel and internals. The analysis assumed the following conditions at the moment decay heat removal was lost:

- Temperature of 93.3 °C (200 °F) – Mode 5 maximum temperature
- Atmospheric pressure at 14.7 psia – minimum Mode 5 pressure during or immediately prior to vessel head removal

- Decay heat at 3.89E-7 Watts – decay heat 5.3 hours after shutdown. Mode 5 is not likely to begin until at least 8 hours following shutdown.
- Normal water level – water level will be gradually increased during Mode 5 up to the vessel head flange. This level is likely the minimum water level for all of Mode 5.

The same calculation also estimates the time to boil for Mode 6 Unflooded conditions. This analysis estimates the time to boil for the most limiting conditions of Mode 6 is approximately 5.3 hours.

For Mode 5, the time available for operators to recover RWCU/SDC is 4 hours.

For Mode 6-Unflooded, the available time is 5.7 hours.

These two time estimates are also included on the graph in Figure 16.3-1. A vertical line on the 'time' axis at each value has been added to the plot. Both lines intercept the operating experience distribution for SDC recovery between the 0.8 and 0.9 values on the recovery axis. This establishes that recovery of RWCU/SDC for the ESBWR during shutdown is likely between 80% and 90% successful given the estimated times. Or, that the failure to recover shutdown cooling has a failure rate of 0.2 or less.

The previous revision of the ESBWR internal events shutdown PRA estimated the failure to recover RWCU/SDC probabilities to be 0.229 for Mode 5 and 0.218 for Mode 6. This revision of the shutdown model retains these failure rates for the recovery actions. The numbers are relatively close to what the updated analysis estimates. The new estimates have a slightly lower failure probability, but use of the old values remains conservative.

The non-recovery probabilities for these two cases are shown in Table 16.3-5.

16.3.4.2 Recovery of RCCWS/PSWS

The RCCWS and PSWS are used during shutdown to remove decay heat and other heat loads. The main components in the system are pumps and heat exchangers. It is assumed that the time to recover from a Loss of RCCWS/PSWS shutdown initiator follows the same probability density distribution as the time to recover the RWCU/SDCS.

The allowable time frame for recovery is taken to be the same as that for Loss of RWCU/SDCS.

For Mode 5, the available time is 1.4 hours.

For Mode 6-Unflooded, the available time is 1.5.7 hours.

The non-recovery probabilities for these two cases are shown in Table 16.3-5.

16.3.4.3 Close Lower Drywell Hatches

An equipment hatch for removal of equipment during maintenance and an air lock for entry of personnel are provided in both the lower and upper drywell. These access openings are sealed under normal plant operation but are opened when the plant is shut down for refueling. Credit is not given for closing the doors after reactor coolant overflows through the hatches. Therefore,

the time available for closing both hatches depends on the volume of the lower drywell under the bottom edge of the hatches, on the size of the break, and on the water level in the vessel or reactor well above the break.

This action is required for the LOCA below TAF initiators during shutdown. These LOCAs involve breaks in the RWCU/SDC drain lines and instrument lines.

The flow through the break is assumed constant and equal to $S\sqrt{2gh}$, where S is the break area, h is the height of water above the break, and g is the acceleration due to gravity.

Both break locations, in RWCU/SDCS drain lines and instrument lines are evaluated. The calculation assumes the reactor well is not flooded at the time of the break. Table 16.3-6 summarizes the calculation.

Detection of the event will be immediate if personnel are present in the lower drywell. If this is not the case, it is assumed that an alarm on drywell sump high level is available in the control room.

Closure of the lower drywell hatches is covered in the Availabilities Control Manual (ACM). The ability to close the hatch is covered for shutdown, and immediate action is required if hatch closure is unavailable for any reason. "ACLCO 3.6.2 - The lower drywell personnel air lock and lower drywell equipment hatch shall be AVAILABLE for closure. APPLICABILITY: MODES 5 and 6, during operations with a potential for draining the reactor vessel."

Once the event has been detected, the plant operator must correctly diagnose the situation, make the decision to close the hatches, gain access to elevation –6400 mm in the reactor building, and manually close the equipment hatch and the personnel air lock. It is assumed that during the outage, personnel will be continuously located in the area of the doors.

Probabilities of 1.0E-1 and 1.0E-2 are assigned for failing to close the DW hatches for breaks in RWCU/SDCS drain lines and instrument line breaks, respectively. The results section includes multiple sensitivity analyses with various failure probabilities for the hatch closure events.

16.4 EVENT TREES

The shutdown PRA event trees are shown in Figures 16.4-1 through 16.4-26.

The event tree construction takes into account the following aspects:

- Chronological order of system actuation
- Grouping of mitigating systems by safety functions

Descriptions of all event tree headings used are provided below.

The success criteria used in the different events are reported under the description of the event heading below in Section 16.4.1.

The accident sequence end state nomenclature is the same as in the full power PRA:

- OK: The core is successfully cooled and the containment is intact. There is no core damage in these events.
- CD I: The containment is intact when core damage occurs and the RPV is at low pressure.
- CD II: The containment fails while the core is successfully cooled, leading to subsequent core damage.
- CD III: The containment is intact when core damage occurs and the RPV is at high pressure.
- C IV; ATWS
- CD V: The containment is bypassed at the time of core damage.

All core damage sequences in the shutdown model are assumed to be category CD-V. This end state is certain in Mode 5 Open and Mode 6 due to the upper drywell head being removed. For Mode 5, this treatment is conservative.

16.4.1 Event Tree Headings

The following is a list of event tree headings used in the ESBWR Shutdown PRA and a brief description of each. Most of the headings are the same ones used in the full power PRA model. Any changes made to the logic for shutdown are described below in section 16.5.

B32-3LOOPSFAIL-Isolation Condensers (IC)

This is the same ICS heading as is used for the full power model.

Regardless of initial RPV pressure, if decay heat is not removed, the Isolation Condenser System is initiated automatically on high reactor pressure, or later on RPV water level 2.

The IC function is able to prevent RPV Level 1 from being reached if:

- The initial RPV water inventory is above Level 3
- There is little or no leakage from the RPV.

The maximum RCPB leak rate within the Technical Specification during full power operation is assumed to be insufficient to decrease the level to the point where an ADS signal occurs, even if

high pressure RPV makeup is not established during the sequence mission time. Therefore, failure of the IC function due to leaks is considered a low probability.

The success criterion of this function is the operation of both operable (2/2) ICs during the sequence mission time. The Tech Specs for Mode 5 only require 2 out of the 4 ICs be available.

MS-TOP18-At Least 1 SRV Open

This is the same heading as is used for the full power model.

If the IC function fails, the RPV pressure will increase up to the SRVs setpoint. The success criterion for this function is the automatic operation of at least 1 SRV. Failure of this function is conservatively assumed to lead to core damage.

The possibility of a stuck open relief valve is not modeled. Because no credit is given for the IC function after the opening of an SRV.

MS-TOP2-At Least 2 SRVs Open

This heading is not in the full power model, it is unique to the shutdown PRA.

If no high pressure injection system is available, it is necessary to depressurize the RPV to allow FAPCS or FPS injection to the RPV.

Success of this function requires the operator to manually open at least 2 SRVs.

The time available to the operator to manually initiate RPV depressurization is defined by the time when RPV level falls below L2 to the time when the ADS system will automatically initiate (i.e., at RPV Level 1).

UD-TOPINJ2-High Pressure Injection Systems

This is the same heading as is used for the full power model.

Water level can be maintained above RPV Level 1 by the CRD system. Under normal conditions, CRD automatically actuates when coolant drops to RPV level 2. For shutdown analysis, it is assumed operator action is required to initiate CRD injection. Successful CRD injection into the reactor vessel requires 1 CRD pump taking suction from the CST.

UD-TOPINJ-High Pressure Injections Systems

This is the same heading as is used for the full power model.

This is CRD system top when both pumps are required for success. In the above heading, only one of two pumps is needed. In cases where this heading appears, both CRD pumps are needed to meet the success criteria.

VL-TOPINJ-FAPCS-Low Pressure Injection System 1

VM-TOPINJ-FPS-Low Pressure Injection System 2

These two headings are the same ones used for the full power model.

After successful RPV depressurization, either FAPCS or FPS can fulfill the core cooling function when configured in the RPV injection mode. Both systems require manual actuation.

The time available to the operator to manually initiate either of these two systems is defined by the time when RPV pressure has been sufficiently reduced to the time when the ADS system will

automatically initiate (i.e., at RPV Level 1). Success of either function requires the operator to manually align at least 1 FAPCS or FPS train in RPV injection mode.

FAPCS requires RCCWS/PSWS for heat exchanger cooling. FPS does not require cooling.

VL-TOPINJL-FAPCS-Low Pressure Injection System 1 after ADS

VM-TOPINJL-FPS-Low Pressure Injection System 2 after ADS

These two headings are the same ones used for the full power model.

These event tree nodes model initiation of low-pressure injection following automatic RPV depressurization by the ADS system. As in the pre-ADS nodes, either 1 train of FAPCS or FPS operating in the RPV injection is needed for success. However, the time available to the operator to perform the manual alignment is different in the scenario with automatic ADS.

VI-TOPINJSD-GDCS-Gravity Driven Cooling System

This heading is also used for the full power model.

If all the active low pressure injection systems are unavailable after successful RPV depressurization, the passive GDCS system will automatically inject water into the RPV. The opening of at least 2 GDCS lines and the discharge of at least 12 GDCS pools (at least one line for each of the two pools) accomplish short term cooling. One equalizing line must be opened for long term core cooling.

One equalizing line must be opened for long term core cooling.

The success criteria for this function are the discharge of at least 2 lines and 1 2 GDCS pools and the opening of at least 1 equalizing line. If only two lines open, it must be one from each of the two pools. The opening of two lines from one pool and zero lines from the other available pool is not sufficient.

WR-TOPSDC-RWCU/SDC Restart

This heading is not in the full power model, it is unique to the shutdown PRA.

After a LOPP event, the RWCU/SDCS pumps are tripped and the decay heat removal function is temporarily unavailable. Operator action to restart the RCWU/SDCS trains on the diesel generator power is included in the fault tree logic.

The success criterion is that at least one RWCW/SDCS train successfully restarts after a LOPP event and operates during the sequence mission time.

XD-TOPDPV-ADS-At Least 4 DPVs Open Automatically

This is the same heading as is used for the full power model.

The success criterion for this function is that at least 4 DPVs automatically open.

Recovery Actions

The operator has the opportunity to recover the lost functions (RWCU, PSWS) before any safety function is challenged. See Section 16-3 above for the time available and the recovery failure probabilities. The following recovery actions are in the event trees:

R-M6-G31-RWCU/SDC recovery in Mode 6

R-PSWS-6-PSWS Recovery in Mode 6

R-M5-G31-RWCU/SDC recovery in Mode 5

R-M5-PSWS-Recovery of RCCWS/PSWS (Mode 5)

Close the lower drywell hatches

DWH-1 Close Drywell Hatch – Instrument line LOCA

DWH-2 Close Drywell Hatch – RWCU/SDC drain line LOCA

If not closed at the time of the initiating event, the operator must close the lower drywell hatches to prevent flooding of reactor building lower levels. See Subsection 16.3.4.3 for details on time available for this action and the recovery failure probability.

16.4.2 Loss of Decay Heat Removal Event Trees

Initiators leading to a loss of decay heat removal function are grouped into scenarios occurring during Mode 5 Mode 5 Open, or Mode 6 Unflooded. Given the three initiating event types leading to loss of DHR scenarios (Loss of RWCU/SDC, Loss of RCCWS/PSWS and Loss of Preferred Power), nine shutdown loss of DHR event trees are analyzed. The event trees for Mode 5 and Mode 5 Open are practically identical. The credited systems, and sequence order are the same for both modes.

16.4.2.1 Loss of DHR in Mode 5 or Mode 5 Open

Following loss of the decay heat removal function, pressure and temperature in the RPV gradually increase. Due to reduced initial pressure and temperature during shutdown conditions, the operator has the opportunity to recover the lost function before the pressure reaches the SRV setpoint.

If recovery of decay heat removal is not possible, the Isolation Condenser (IC) function will be initiated on RPV high pressure or low RPV water level (Level 2). This function provides short term as well as the long term core cooling.

If ICS fails, RPV pressure increase leads to SRV opening. Steam generated by decay heat is then discharged to the suppression pool, where it is condensed. As the level inside the RPV decreases, high pressure makeup is required to keep the core covered.

Failure of all of the SRVs to open could be postulated to lead to a vessel rupture scenario. Even if mitigation is still possible, core damage is assumed.

Control Rod Drive system (CRD) can fulfill the high-pressure makeup function. CRD is assumed to need operator actuation during shutdown.

If high pressure makeup fails, low pressure makeup is required. The opening of two SRVs enables the injection modes of either FAPCS or the Fire Protection System (FPS).

If low pressure injection systems fail after manual depressurization with 2 SRVs, the ADS will actuate and the short term and long term core cooling functions are performed with 2 of 4 lines from the Gravity Driven Cooling System (GDCS), 2 of 3 GDCS pools and the opening of at least one equalizing line. The equalizing line will permit effective RPV flooding with the suppression

pool water, as long as at least 4 DPVs have opened. If for some reason GDCS cannot inject into the depressurized reactor, either FAPCS or FPS injection mode can support the short term and long term core cooling functions.

16.4.2.1.1 Loss of Both RWCU/SDCS Trains (Mode 5 & Mode 5 Open)

For specific details about the event trees for these initiating event, refer to Figure(s) 16.4-2 and 16.4-5. The description given above corresponds to this case. The event tree headings associated with this even tree are listed here:

- R-M5-G31 - Recovery of RWCU/SDCS (Mode 5/Mode 5 Open)
- B32-3LOOPSFAIL - Isolation Condensers
- MS-TOP18 – At Least 1 SRV Open
- UD-TOPINJ2 - CRD – High Pressure Injection Systems
- MS-TOP2 – At Least 2 SRVs Open
- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- XD-TOPDPV - ADS - At Least 4 DPVs Open Automatically
- VL-TOPINJ l - FAPCSL - Low Pressure Injection System1 after ADS
- VM-TOPINJ - FPS - Low Pressure Injection System 2 after ADS
- SD-GDCS – Gravity Driven Cooling System

This tree results in 5 core damage sequences. For the specific logic associated with each, see the attached figures (16.4-2 and 16.4-5).

16.4.2.1.2 Loss of Preferred Power (Mode 5 & Mode 5 Open)

The event trees for these initiating event are shown in Figures 16.4-3 and 16.4-6. The event tree heading descriptions above for loss of DHR in Mode 5 are applicable to this case. This event tree is very similar to the Loss of RWCU/SDC event tree, though no credit is given for power recovery. Every system credited has an alternative power supply to ensure availability (FAPCS/CRD/RWCU – diesel generator, FPS has two diesel driven pumps).

- B43-3LOOPSFAIl – Isolation Condensers
- MS-TOP18 – At Least 1 SRV Open
- WR-TOPSDC – RWCU/SDC Restart after LOPP
- UD-TOPINJ2 - CRD – High Pressure Injection Systems
- MS-TOP2 – At Least 2 SRVs Open
- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- XD-TOPDPV - ADS - At Least 4 DPVs Open Automatically
- VL-TOPINJ l - FAPCSL - Low Pressure Injection System1 after ADS
- VM-TOPINJ - FPS - Low Pressure Injection System 2 after ADS

- SD-GDCS – Gravity Driven Cooling System

These trees results in 5 core damage sequences each. For the specific logic associated with each, see the attached figures (16.4-3 and 16.4-6).

16.4.2.1.3 Loss of RCCWS/PSWS (Mode 5 & Mode 5 Unflooded)

The event trees for these initiating events are shown in Figures 16.4-1 and 16.4-4. The event tree heading descriptions above apply to this tree as well, except for those systems that are unavailable because they rely on RCCWS/PSWS: CRD: and FAPCS.

- R-M5-PSWS - Recovery of RSWS/RCCWS (Mode 5/Mode 5 Open)
- B32-3LOOPSFAIL - Isolation Condensers
- MS-TOP18 – At Least 1 SRV Open
- MS-TOP2 – At Least 2 SRVs Open
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- XD-TOPDPV - ADS - At Least 4 DPVs Open Automatically
- VM-TOPINJ - FPS - Low Pressure Injection System 2 after ADS
- SD-GDCS – Gravity Driven Cooling System

These trees results in 5 core damage sequences each. For the specific logic associated with each, see the attached figures (16.4-1 and 16.4-4).

16.4.2.2 Loss of DHR in Mode 6 (Unflooded)

In this case, the RPV is open (i.e., the RPV head has been removed, Mode 6), the containment is also open, and the reactor well is assumed to be drained, so the water level is at the elevation of the vessel flange.

A considerable amount of cool water is above the core, allowing the operator significant time to recover failed equipment or systems before coolant boil-off reduces the water level in the vessel, causing safety system actuations.

However, if the decay heat function cannot be recovered, RPV coolant temperature rises, eventually reaching boiling conditions. Makeup water to the RPV is then needed to prevent core damage. Four systems are allowed for the makeup function. Three of them require manual initiation by the operator: FAPCS in injection mode and FPS in injection mode, as well as CRD (assumed to need manual action during shutdown). The one, GDCS automatically initiates on RPV Level 1.

16.4.2.2.1 Loss of Both RWCU/SDCS Trains (Mode 6)

The event tree for this initiating event is shown in Figure 16.4-8. All headings for this event tree have been described previously. The headings associated with this initiating event are:

- R-M6-G31 - RWCU/SDC recovery in Mode 6
- UD-TOPINJ2 - CRD – Control Rod Drive Pump

- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- SD-GDCS – Gravity Driven Cooling System

This trees results in only one core damage sequence. It is the result of all credited systems failing to function. For the specific logic associated the event tree, see the attached figure (16.4-8).

16.4.2.2.2 Loss of Preferred Power (Mode 6)

The event tree for this initiating event is shown in Figure 16.4-9. The descriptions above for loss of DHR in Mode 6 apply to this tree as well. RWCU/SDC is credited in this event tree. Recovery of the system does require a manual action to restart the pump on diesel generator power. The headings associated with this initiating event are: WR-TOPSDC – RWCU/SDC Restart after LOPP

- UD-TOPINJ2 - CRD – Control Rod Drive Pump
- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- SD-GDCS – Gravity Driven Cooling System

This trees results in only one core damage sequence. It is the result of all credited systems failing to function. For the specific logic associated the event tree, see the attached figure (16.4-9).

16.4.2.2.3 Loss of RCCWS/PSWS (Mode 6)

The event tree for this initiating event is shown in Figure 16.4-7. The descriptions above for loss of DHR apply to this tree as well, except that some systems are unavailable because they rely upon RCCWS/PSWS: CRD and FAPCS. FPS and GDCS remain the only makeup systems available. The headings associated with this initiating event are:

- R-PSWS-6 - PSWS Recovery in Mode 6
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- SD-GDCS – Gravity Driven Cooling System

This trees results in only one core damage sequence. It is the result of all credited systems failing to function. For the specific logic associated the event tree, see the attached figure (16.4-7).

16.4.3 Loss of Coolant Accidents

16.4.3.1 Shutdown LOCAs (Mode 5, Mode 5 Open, & Mode 6Unflooded)

Due to low pressure and temperature of shutdown conditions, all LOCAs are liquid breaks. All LOCAs in this section are analyzed for three modes (Mode 5, Mode 5 Open, and Mode 6 Unflooded). The evolution of the accident and the systems available for mitigation depend on the break location.

Four break locations are analyzed:

- Break in a GDCS injection line
- Break in feedwater line A
- Break above TAF other than GDCS or FW
- Breaks below TAF.

As soon as the break takes place, the liquid coolant flows into the lower drywell, driven by gravity and hydrostatic pressure. If insufficient coolant makeup is provided to the vessel, water level decreases from the vessel flange down to the break elevation. Only break elevations below L3 analyzed; for breaks above L3, the RWCU/SDCS continues removing the decay heat, and no safety function is directly challenged.

Once the level falls below L3, decay heat removal is lost, as the RWCU/SDCS pumps receive a runback signal, and natural circulation inside the vessel is lost when water level drops below the separators skirts.

It is assumed for breaks above TAF that providing makeup to the vessel and allowing coolant boiling is an effective method for core cooling. CRD, FAPCS, Fire Protection and GDCS are considered for water makeup.

For breaks below TAF, the drywell has to be flooded up to an elevation above TAF to reach a safe core cooling condition. The personnel and equipment access hatches to the lower drywell could be open during shutdown, a recovery action to close these doors is modeled.

16.4.3.1.1 LOCA in GDCS Line (Mode 5, Mode 5 Open, Mode 6, Unflooded)

The event trees for this initiating event, in each analyzed mode are shown in Figures 16.4-10, 16.4-15, and 16.4-20. Each event tree has the same top headings and each one has one core damage sequence (all decay heat removal/inventory makeup systems fail). The headings associated with this initiating event are:

- UD-TOPINJ - CDRCRD – Both Control Rod Drive Pumps
- *XD-TOPDPV - ADS - At Least 4 DPVs Open Automatically
- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- VI-TOPINJSD-GDCS – Gravity Driven Cooling System

For the specific logic associated these event trees, see the attached figures (16.4-10, 16.4-15, and 16.4-20).

* Node is only in Mode 5 and Mode 5 Open event trees. Depressurization is not required in Mode 6.

16.4.3.1.2 LOCA in FDW-A Line

The event trees for this initiating event, in each analyzed mode are shown in Figures 16.4-11, 16.4-16, and 16.2-21. Each event tree has the same top headings and each one has only one core damage sequence (all decay heat removal/inventory makeup systems fail). FAPCS and FPS

injection into the RPV is through feedwater Line A. With those systems unavailable, only CRD and GDCS are credited in these event trees. The headings associated with this initiating event are:

- UD-TOPINJ - CRD – Both Control Rod Drive Pumps
- VI-TOPINJSD-GDCS – Gravity Driven Cooling System

For the specific logic associated these event trees, see the attached figures (16.4-11, 16.4-16, and 16.4-21).

16.4.3.1.3 LOCA above TAF other than GDCS or FDW-A

The event trees for this initiating event are shown in Figures 16.4-12, 16.4-17, and 16.4-22. These event trees are the same as the ones listed above for GDCS line LOCAs. The available systems are the same, and the only difference is the initiating event and initiating event frequency. The headings associated with this initiating event are:

- UD-TOPINJ - CDRCRD – Both Control Rod Drive Pumps
- *XD-TOPDPV - ADS - At Least 4 DPVs Open Automatically
- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- VI-TOPINJSD-GDCS – Gravity Driven Cooling System

For the specific logic associated these event trees, see the attached figures (16.4-12, 16.4-17, and 16.4-22).

* Node is only in Mode 5 and Mode 5 Open event trees. Depressurization is not required in Mode 6.

16.4.3.1.4 LOCA below TAF in RWCU/SDC Drain Lines

The event trees for this initiating event are shown in Figures 16.4-14, 16.4-19, and 16.4-24. In all below TAF LOCA events, closure of the lower drywell hatches is required to prevent core damage. For these event trees, if the lower drywell hatch is closed, makeup to the RPV is still required to prevent core damage. The headings associated with this initiating event are:

DWH-1 - Close Drywell Hatch – RWCU/SDC drain line LOCA

- DWH-1 - Close Drywell Hatch – RWCU/SDC drain line LOCA
- UD-TOPINJ - CDRCRD – Both Control Rod Drive Pumps
- *XD-TOPDPV - ADS - At Least 4 DPVs Open Automatically
- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- VI-TOPINJSD-GDCS – Gravity Driven Cooling System

Each event tree associated with this initiator has two core damage sequences. One occurs when the drywell hatch closure fails. The other one is when the hatch is successfully closed, but no

makeup is provided. For the specific logic associated these event trees, see the attached figures (16.4-14, 16.4-19, and 16.4-24).

* Node is only in Mode 5 and Mode 5 Open event trees. Depressurization is not required in Mode 6.

If not closed at the time of the initiating event, the operator must close the lower drywell hatches to prevent flooding of reactor building lower levels. ie Section 16.3.4.3 for details on time available for this action and the recovery failure probability

16.4.3.1.5 LOCA Below TAF in Instrument Lines

The event tree for these initiating events are shown in Figures 16.4-13, 16.4-18, and 16.4-23. The description is the same as the preceding case, except that heading DWH-2 is used instead of DWH-1 to account for the longer time available to the operator to close the drywell hatches. The headings associated with this initiating event are:

- DWH-2 - Close Drywell Hatch – Instrument Line LOCA
- UD-TOPINJ - CRD – Both Control Rod Drive Pumps
- *XD-TOPDPV - ADS - At Least 4 DPVs Open Automatically
- VL-TOPINJ - FAPCS – Low Pressure Injection System 1
- VM-TOPINJ - FPS – Low Pressure Injection System 2
- SD-GDCS – Gravity Driven Cooling System

Each event tree associated with this initiator has two core damage sequences. For the specific logic associated these event trees, see the attached figures (16.4-13, 16.4-18, and 16.4-23).

* Node is only in Mode 5 and Mode 5 Open event trees. Depressurization is not required in Mode 6.

16.4.2.2 *LOCAs in Mode 6 (Flooded)*

Breaks below TAF are analyzed for LOCAs in Mode 6-Flooded. The same two below TAF break locations are analyzed:

- LOCA below TAF in RWCU.SDC Drain Lines
- LOCA below TAF in Instrument Lines.

The event trees for these two cases are provided in Figures 16.6-25 and 16.6-26, respectively. Each event tree has a single top event modeling failure to close the lower drywell hatches. The failure probabilities for this node are the same as that described previously. Failure to close the lower drywell hatch is modeled as directly leading to a core damage scenario. The scenario with successful closure of the lower drywell hatches does not result in a core damage end state (and no additional top events are questioned) because sufficient water exists above the break to flood the containment above TAF.

16.5 SYSTEM ANALYSIS

This section describes the fault trees used in the Shutdown PRA evaluation. The unavailability of a system to perform its safety function on demand is evaluated by fault tree analysis.

The necessary fault trees are identified following construction of the event trees. These fault trees represent the nodes included in the event trees.

Maximum use is made of the fault trees developed for the Full Power PRA. Potential differences between the full power and the shutdown fault tree models may result from:

- Differences in maintenance unavailabilities
- Differences in success criteria between full power and shutdown condition
- Differences in initial system configuration between full power and shutdown condition
- Differences in human actions

Maintenance events used in the full power model are not adjusted for the shutdown. This treatment is conservative. Technical Specification requirements are different for some systems during shutdown. For example, four GDCS injection lines are allowed to be out of service in Mode 5. Any maintenance is likely to be on one of the

The following paragraphs discuss the cases where modifications were made to the full power fault tree logic to reflect the shutdown conditions.

16.5.1 Reactor Water Cleanup / Shutdown Cooling System

The logic used fro RWCU in the shutdown model is the same as is used in the full power model with only slight variation. The RWCU/SDC function modeled in shutdown is the restart of at least one RWCU train after a LOPP event, including operator action to re-start the system (it is assumed to not be automatically sequenced on upon diesel generator startup). The full power model has the system in cleanup mode and has several valve position changes modeled to switch the system to the shutdown cooling mode. These position changes are not required in shutdown since the system is in SDC mode for the duration of shutdown. Several of the basic events associate with the changing of the system from cleanup mode to SDC mode have been flagged to FALSE. The system is operating in SDC mode for all of shutdown, and only needs to restart following a LOPP. The failures flagged out of the model are not credible failures during shutdown.

Maintenance is expected to be performed mostly during full power operation, when only one train is operating. Nevertheless, the same maintenance unavailability as used for the full power PRA is conservatively used in the shutdown evaluation.

16.5.2 Control Rod Drive System

It is assumed that during the entire shutdown period a single CRD pump is running (providing purge flow to FMCRD and/or the RWCU/SDC pumps) and the second pump is in standby, which is the same initial configuration as at full power.

Additionally, it is assumed that no automatic initiation of CRD injection is available and alignment in RPV injection mode requires operator action. The same action in the fault tree for the full power model is used for the shutdown analysis. The automatic actuation of the system on RPV Level 2 is removed from the shutdown analysis with the use of flag files. In the full power fault tree, there is AND gate under system actuation. One branch of the AND gate has the automatic actuation and all the logic associated with it. The other branch of the AND gate has the operator action to initiated CRD injection. For the shutdown analysis, the gate with the automatic actuation is set to TRUE, so that the system is entirely dependant on the operator action.

16.5.3 Gravity Driven Cooling System

Technical Specification requirements for the GDCS during shutdown are different than during full power operations. For shutdown modes (5 and 6) only 4 out of the 8 GDCS injection lines are required to be available, and only 2 of 3 pools are required available. For the shutdown model, it is assumed that the larger GDCS pool is unavailable. For successful GDCS at least one line from each available pool must open. To ensure cooling to 72 hours at least one equalizing line is also required to open. Logic associated with the internal events GDCS is used with some slight adjustment. The two available pools are in an OR gate so that even though only two lines are needed, it has to be a combination of two lines from the two different pools. Two lines from one pool and no lines from the other pool is failure. The logic associated with the available pools is logically OR'd with success of the equalizing lines. The four equalizing lines are under an AND gate since opening of only one line is needed to meet the success criteria.

For shutdown modeling, a new top has been created, but all of the logic in the fault tree under the top is included in the internal events GDCS fault tree.**Isolation Condenser System**

Technical Specification requirements for the ICS are different than during full power operations. The system will not function in Mode 6 with the vessel head removed and it has not been credited in any Mode 6 event trees. During Mode 5, only 2 out of the 4 IC units are required to be available The Level 1 fault tree for ICS is used for the shutdown analysis with two of the four pools TRUE (failed). Success of ICS in shutdown is proper functioning of 2/2 ICS (as opposed to 2/4 during full power).

16.5.5 Fuel and Auxiliary Pool Cooling System (FAPCS)

The Level 1 fault trees for FAPCS (both before and after ADS) are left unchanged and used in the shutdown analysis. The system is required to operate during shutdown in fuel pool cooling mode, and it is the primary shutdown cooling backup for RWCU/SDC.

The system has no automatic actuation of low pressure injection and is dependent on operator initiation for all functions credited in the shutdown analysis.

16.5.6 Fire Protection System (FPS)

The Level 1 fault trees for FPS Low Pressure Injection (both before and after ADS) are left unchanged and used in the shutdown analysis. Fire Protection requirements at the plant are not likely dependant on the reactor modes.

The system has no automatic actuation of low pressure injection, and is dependant on operator initiation for all functions credited in the shutdown analysis.

16.5.7 18/18 SRVs FAIL TO OPEN IN RELIEF MODE

This logic is modeled in the full power PRA. It represents the failure of all 18/18 SRVs to open in overpressure protection during a transient that challenges the PRV pressure. For overpressure protection, 1 of 18 SRVs must open in relief mode. The only cutset that exists for the logic (when the individual system is quantified with a truncation of 1E-16) is the common cause failure of both SRV groups. There is one group of 10 and one group of 8 SRVs. The two groups are diverse enough not to be common cause grouped together. The one cutset that shows up has a value of 2.2 E-13. For the shutdown analysis, this top event was treated as a point estimate with a failure rate of 1E-12.

16.5.8 MS-TOP2 – At Least 2 SRVs Open

This logic is also treated with a point estimate for the shutdown analysis. Manual depressurization is modeled in the Level 1 analysis. Failure of the operator action to depressurize is two orders of magnitude higher than any equipment failures. To simplify modeling, this whole heading is treated as a point estimate with a value of 5E-2 (one failure in twenty). That value is higher than the operator action screening value used in Chapter 4 section 4.01 (Depressurization System) for the manual depressurization logic

16.6 QUANTIFICATION RESULTS

The shutdown accident sequence analysis models the impacts on the following two critical safety functions during shutdown:

- Decay Heat Removal (DHR)
- Reactor Coolant System Inventory Control

Initiating event types, and associated frequencies, are identified that challenge the above critical safety functions (refer to Section 16.3). Event trees are developed specific to the shutdown configurations (refer to Section 16.4) and the system fault tree analysis is based on at-power fault tree models adjusted to match shutdown conditions (refer to Section 16.5). The model development and quantification is performed using CAFTA and FORTE. The quantification and all sensitivities were performed at a truncation limit of 1E-15/yr.

16.6.1 Baseline Shutdown PRA Results

The core damage frequency results of the ESBWR shutdown risk analysis are summarized in the following table:

- Shutdown CDF by Initiating Event and Operating Mode (Table 16.6-1)

As can be seen from these tables, the calculated shutdown CFD is 8.77E-09/yr.

The top 200 cutsets for the shutdown CDF are provided in Table 16.6-3.

The risk importance measures for the shutdown CDF are provided in Table 16.6-4.

A list of sequences that result in core damage is provided in Table 16.4-5.

The cutsets from the dominant sequences are listed in table 16.4-6.

All evaluated shutdown core damage events are assumed to result in a large release because of the potential for the containment being open during the outage. CCFP is not affected because the containment is not being used as a mitigating system during shutdown.

DCD Chapter 19, Section 19.2.1 states the following goals for a design-specific PRA:

The design-specific PRA results and insights are compared against the following goals (note: these are goals and not regulatory requirements) and address how the plant features properly balance severe accident prevention and mitigation:

- Determine how the risk associated with the design compares against the Commission's goals of less than 1E-4/yr for core damage frequency (CDF).
- Determine how the risk associated with the design compares against the Commission's goals of less than 1E-6/yr for large release frequency (LRF).

The ESBWR shutdown results are well within these documented goals:

	CDF	LRF	
ESBWR Shutdown:	9.37E-9	9.37E-9	(* assumes all events bypass containment)
Chapter 19 goals:	1.0E-4	1.0E-6	

The above result and all others presented below are presented on a yearly basis for comparison with NRC goals. To obtain a yearly shutdown risk with a once every two year refueling schedule, all initiating event frequencies were multiplied by a factor of 0.5.

The presented shutdown results should not be added to the full power results for a combined one year CDF value. There are large differences in uncertainty between the two models and simple addition of the two may provide unreasonable results.

16.6.2 Shutdown Sensitivity

The following sections show various sensitivity analyses run with the shutdown PRA.

16.6.2.1 LOCA Frequency

Due to the lower temperatures and pressures in the RPV during shutdown, a reduction factor was applied to LOCA frequencies for the shutdown PRA. The basis for the reduction is in Section 16.3.1.2.1 above. This sensitivity case shows the results with no reduction factor applied.

Baseline Results = 9.37E-9/yr

Sensitivity Results = 8.69E-8/yr

This case results in an order of magnitude increase in core damage frequency. Contribution from LOCA sequences makes up over 98% of the baseline result. The results for the entire shutdown are entirely dependant on LOCA frequencies and how they are determined essentially determines the results.
Even with no reduction factor applied to LOCA frequencies, the results are still well below the NRC stated goals for a design specific PRA.

16.6.2.2 Lower Drywell Hatch Sensitivity

Almost as important to the shutdown PRA results as LOCA frequencies is closure of the lower drywell hatch. Failure to close the hatch in the event of a lower drywell LOCA is assumed to lead to core damage. Two below TAF LOCA events are evaluated in each mode for a total of eight. The top eight cutsets are those LOCA events with drywell hatch closure failure. Those eight cutsets account for 98% of the total shutdown CDF.

Two hatch closure events are included in the model. In one case (instrument line LOCA) 360 minutes are available to close the hatch; in the other case (RWCU drain line) 90 minutes are available. Both times are based on the time available to close the hatch given a worst-case pipe break. Screening values have been used in the baseline case for the operator action to close the hatch. A failure probability of 0.01 is applied to the case with 360 minutes available for the action. A failure probability of 0.1 is applied to the case with 90 minutes available.

Three sensitivity cases have been analyzed.

Case 1 applies a higher failure rate for both hatch closure events. DWH-1 (90 minutes) and DWH-2 (360 minutes) are both given a 0.5 failure probability (50% failure rate).

Case 1 Results = 3.41E-7/yr

More than an order of magnitude increase compared to the baseline shutdown CDF. Though the DWH-2 value is a factor of ten lower than the DWH-1 number in the base case, the DWH-2 event is in four of the top six cutsets (Instrument line LOCA

frequencies are quite a bit higher than RWCU drain line ones). The increase in the DWH-2 number leads to a big increase in shutdown CDF.

Case 2 gives both values the DWH-2 screening value (0.01 – one failure in 100).

Case 2 Results = 7.56E-9/yr

A decrease compared to the base case, but not a large one. Due to the LOCA frequency associated with the instrument line LOCA (two orders of magnitude higher than RWCU drain line), the Instrument line LOCA scenarios are the ones that contribute the most.

Case 3 assumes no lower drywell entry is allowed until Mode 6. This eliminates the Mode 5 and Mode 5 Open sequences that include drywell hatch closure.

Case 2 Results = 5.53E-9/yr

Case results in CDF about half of the base case. Due to the impact the lower drywell LOCA events has on the results, any restrictions put on entering (ensuring the hatch closed) would result in a decrease in CDF.

As is the case with the LOCA frequencies, any results are going to be a direct reflection of the numbers used for the action to close the lower drywell hatch. The two events are in only eight sequences, but those are the top eight cutsets and account for 98% of the total shutdown CDF.

16.6.2.3 Operator Action Sensitivity

During shutdown, the plant relies on operators much more for accident mitigation than during at power conditions. Several systems have no automatic actuation and rely on operators to initiate (FPS, FAPCS, CRD). Human actions are the only barrier between the initiating events and core damage for LOCA events below the TAF. Also adding to the contribution of human errors during shutdown is the fact that many systems that don't require human action are in a reduced capacity during shutdown conditions (IC having only 2 out of 4 loops available).

Two operator action sensitivity cases are evaluated.

Case 1 has all recover actions set to TRUE (failed). This eliminates several systems from possible accident mitigation. CRD (during shutdown), FAPCS, FPS, and manual depressurization are all completely dependant on human action to initiate. RWCU/SDC also requires operator action following LOPP.

Case 1 Results = 2.29E-6/yr

Results show more than a two order of magnitude increase in CDF over the baseline case. The plant has features to safeguard against possible transients, but during shutdown, the arrangement of the plant requires operators to take action to put those systems into service. For many sequences in this case, the CDF value is equal to the initiating event value.

Case 2 has all recovery actions given a much lower than usual human error probability: 1.0E-3. This number is about an order of magnitude lower than most modeled human actions. It shows how CDF could be affected if credit is taken for very effective operator response to transients.

Case 2 Results = 7.78E-10/yr

Case results in decrease in CDF of approximately one order of magnitude compared to the base shutdown case. The top cutsets in this case are still dominated by human errors. Even with the reduced failure values, the human errors are still generally higher than the common cause equipment failures that show up in the top cutsets with the human errors.

The Shutdown PRA is somewhat sensitive to human errors. Many of the plants passive safety features are unavailable due to the conditions of shutdown (PCCS, ICS in Mode 6). In Mode 6, only one system that is not entirely dependant on operators is available to prevent CDF (GDCS).

16.7 INSIGHTS FROM SHUTDOWN PRA

By far, the greatest contribution to shutdown risk comes from breaks in lines connected to the vessel below TAF. In these cases, the lower drywell equipment hatch or personnel hatch is likely to be open to facilitate work in the lower drywell. Although the frequency of these events is very low, there is only one method for mitigation – manual closure of the hatch(es).

In order to minimize the risk from these scenarios, refueling outages must be conducted in a judicious manner. Whenever the hatches are open, procedures shall require personnel to be available and in close proximity to the hatches, with the purpose of providing fast closure of the containment in the event of a water leak. Other measures can be taken, including temporary installation of equipment to aid in closing the hatch or to minimize the flooding rate in the lower drywell.The next largest contributions to shutdown risk are due to losses of preferred power (LOPP) or loss of all service water (PSWS) during Mode 6 Unflooded. These scenarios are higher than other shutdown ones due to ICS being unavailable in Mode 6.

LOCA events above the TAF do not contribute much at all to the entire overall shutdown CDF. The highest sequence for any LOCA above the fuel has a value of 3E-13, which is four orders of magnitude below the highest cutset, and two orders of magnitude below the highest non-LOCA cutsets.

16.8 CONCLUSIONS

The main conclusion that can be drawn from the ESBWR shutdown risk analysis is that the ESBWR design provides a robust, passive means for preventing shutdown core damage events and the results are well below the NRC goals for CDF and LERF. The key risk insights are:

- Shutdown process should provide assurance that the equipment and personnel hatches in the lower drywell can be isolated in the event of a leak.
- Operator and staff training ensures shutdown transient identification and mitigation is stressed. Few fully automated systems are credited in the shutdown transient response. Human action is key in preventing core damage.

	CDF	LERF	
ESBWR Shutdown:	9.38.77E-9	8.779.37E-9*	(* assumes all events bypass containment)
Chapter 19/NRC goals:	1.0E-4	1.0E-6	

16.9 REFERENCES

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Table 16.3-1

Shutdown Initiating Events Challenging Critical Safety Functions

Critical Safety Function	Initiating Event
Decay Heat Removal	Loss of Both RWCU/SDCS trains
	Loss of Preferred Power
	Loss of RCCWS/PSWS
Reactor Coolant System Inventory Control (Modes 5 and 6)	GDCS LOCA
	Feedwater LOCA
	LOCA other than GDCS or feedwater
	Instrument Line LOCA below TAF
	RWCU drain line below TAF

Table 16.3-2a

ESBWR Shutdown PRA Initiating Event Types

Initiating Event	Applicable Modes
Loss of Both Operating RWCU/SDCS Trains	5,5O, 6U
Loss of Preferred Power	5, 5O, 6U
Loss of RCCWS/PSWS	5, 5O, 6U
LOCA in GDCS Line	5, 5O, 6U
LOCA in FW-A Line	5, 5O, 6U
LOCA other than GDCS/FW	5, 5O, 6U
LOCA Below TAF in RWCU/SDC Drain Lines	All
LOCA Below TAF in Instrument Lines	All
Mode Descriptions 5 – Mode 5 5O – Mode 5 Open 6U – Mode 6 Unfolded 6F- Mode 6 Flooded	

Table 16.3-2b
ESBWR Shutdown PRA Event Trees

Event Tree / Initiating Events	Mode	Figure
Loss of PSWS	5	16.4-1
Loss of RWCU/SDC	5	16.4-2
Loss of Pref Power	5	16.4-3
Loss of PSWS	5 open	16.4-4
Loss of RWCU/SDC	5 open	16.4-5
Loss of Pref Power	5 open	16.4-6
Loss of PSWS	6 Unflooded	16.4-7
Loss of RWCU/SDC	6 Unflooded	16.4-8
Loss of Pref Power	6 Unflooded	16.4-9
LOCA - RWCU/SDC below TAF	5	16.4-10
LOCA - Other than FW or GDCS	5	16.4-11
LOCA - FW Line A	5	16.4-12
LOCA - Instrument Line below TAF	5	16.4-13
LOCA - GDCS	5	16.4-14
LOCA - RWCU/SDC below TAF	5 open	16.4-15
LOCA - Other than FW or GDCS	5 open	16.4-16
LOCA - FW Line A	5 open	16.4-17
LOCA - Instrument Line below TAF	5 open	16.4-18
LOCA - GDCS	5 open	16.4-19
LOCA - RWCU/SDC below TAF	6 Unflooded	16.4-20
LOCA - Other than FW or GDCS	6 Unflooded	16.4-21
LOCA - FW Line A	6 Unflooded	16.4-22
LOCA - Instrument Line below TAF	6 Unflooded	16.4-23
LOCA - GDCS	6 Unflooded	16.4-24
LOCA - Instrument Line below TAF	6 Flooded	16.4-25
LOCA - RWCU/SDC below TAF	6 Flooded	16.4-26

Table 16.3-3a

ESBWR Shutdown PRA Initiating Event Frequencies

Initiating Events	Mode	Value	Units	Source	Value/hour	Hours in Mode	per shutdown value	Yearly value (0.5 shutdowns/year)	Values with LOCA correction
Loss of PSWS	5	9.70E-04	events/year	1	1.11E-07	192	2.13E-05	**1.06E-05**	
Loss of RWCU/SDC	5	3.15E-5	/hour	3	3.15E-5	192	6.55E-3	**3.02E-03**	
Loss of Pref Power	5	2.20E-05	/hour	2	2.20E-05	192	4.22E-03	**2.11E-03**	
Loss of PSWS	5 open	9.70E-04	events/year	1	1.11E-07	48	5.32E-06	**2.66E-06**	
Loss of RWCU/SDC	5 open	3.15E-5	/hour	3	3.15E-5	48	1.51E-3	**7.56E-04**	
Loss of Pref Power	5 open	2.20E-05	/hour	2	2.20E-05	48	1.06E-03	**5.28E-04**	
Loss of PSWS	6 unflooded	9.70E-04	events/year	1	1.11E-07	60	6.64E-06	**3.32E-06**	
Loss of RWCU/SDC	6 unflooded	3.15E-5	/hour	3	3.15E-5	60	1.89E-3	**9.45E-04**	
Loss of Pref Power	6 unflooded	2.20E-05	/hour	2	2.20E-05	60	1.32E-03	**6.60E-04**	
LOCA - RWCU/SDC below TAF	5	6.51E-06	events/year	5	7.43E-10	192	1.43E-07	7.13E-08	**7.13E-09**
LOCA - Other than FW or GDCS	5	1.68E-04	events/year	8	1.92E-08	192	3.68E-06	1.84E-06	**1.84E-07**
LOCA - FW Line A	5	1.10E-05	events/year	6	1.26E-09	192	2.41E-07	1.21E-07	**1.21E-08**
LOCA - Instrument Line below TAF	5	2.14E-04	events/year	4	2.44E-08	192	4.69E-06	2.35E-06	**2.35E-07**
LOCA - GDCS	5	1.27E-05	events/year	7	1.45E-09	192	2.78E-07	1.39E-07	**1.39E-08**
LOCA - RWCU/SDC below TAF	5 open	6.51E-06	events/year	5	7.43E-10	48	3.57E-08	1.78E-08	**1.78E-09**
LOCA - Other than FW or GDCS	5 open	1.68E-04	events/year	8	1.92E-08	48	9.21E-07	4.60E-07	**4.60E-08**
LOCA - FW Line A	5 open	1.10E-05	events/year	6	1.26E-09	48	6.03E-08	3.01E-08	**3.01E-09**
LOCA - Instrument Line below TAF	5 open	2.14E-04	events/year	4	2.44E-08	48	1.17E-06	5.86E-07	**5.86E-08**
LOCA - GDCS	5 open	1.27E-05	events/year	7	1.45E-09	48	6.96E-08	3.48E-08	**3.48E-09**
LOCA - RWCU/SDC below TAF	6 unflooded	6.51E-06	events/year	5	7.43E-10	60	4.46E-08	2.23E-08	**2.23E-09**
LOCA - Other than FW or GDCS	6 unflooded	1.68E-04	events/year	8	1.92E-08	60	1.15E-06	5.75E-07	**5.75E-08**

Table 16.3-3a

ESBWR Shutdown PRA Initiating Event Frequencies

Initiating Events	Mode	Value	Units	Source	Value/hour	Hours in Mode	per shutdown value	Yearly value (0.5 shutdowns/year)	Values with LOCA correction
LOCA - FW Line A	6 unflooded	1.10E-05	events/year	6	1.26E-09	60	7.53E-08	3.77E-08	**3.77E-09**
LOCA - Instrument Line below TAF	6 unflooded	2.14E-04	events/year	4	2.44E-08	60	1.47E-06	7.33E-07	**7.33E-08**
LOCA - GDCS	6 unflooded	1.27E-05	events/year	7	1.45E-09	60	8.70E-08	4.35E-08	**4.35E-09**
LOCA - Instrument Line below TAF	6 Flooded	2.14E-04	events/year	4	2.44E-08	240	5.86E-06	2.93E-06	**2.93E-07**
LOCA - RWCU/SDC below TAF	6 Flooded	6.51E-06	events/year	5	7.43E-10	240	1.78E-07	8.92E-08	**8.92E-09**

Note: See Table below for source details

Notes:

(1) As discussed in Section 16.2, the time in each Operating Mode is assumed to be as follows: Mode 5, 238 hrs; Mode 6-Unflooded, 59 hrs; and Mode 6-Flooded, 241 hrs.

(2) The shutdown initiating event frequencies per year are calculated using the hourly frequencies of Table 16.3-1 and multiplying by the hours in the corresponding Operating Mode. An additional 0.5 factor is applied given that shutdown is expected to occur every two years.

Table 16.3-3b

ESBWR Initiating Event Frequency Sources

	Sources
1	NEDO-33201 Rev 2, Chapter 2, Table 2.3-3 "Complete Loss of PSWS"
2	NUREG/CR-5496 (Reference 16-2) shutdown loss of offsite power frequency on a per hour basis.
3	NEDO-33201 Rev 2, Chapter 4, Section 4.08 (Sum of 6 RWCU CCF events that can cause failure to run)*
4	NEDO-33201 Rev 2, Chapter 2, Table 2.3-1 (il)
5	NEDO-33201 Rev 2, Chapter 2, Table 2.3-1 (g)
6	NEDO-33201 Rev 2, Chapter 2, Table 2.3-1 (c)
7	NEDO-33201 Rev 2, Chapter 2, Table 2.3-1 (f)
8	NEDO-33201 Rev 2, Chapter 2, Table 2.3-1 (d, e, fl, h, i2)
*	CCF events include: 3 of 3 Pumps fail to run, AOV/NOV Spurious Transfer, MOVs fail to close, and suction flow transmitters fail low

Table 16.3-4

BWR and PWR Loss of Running RHR Pump Events During Shutdown

SITE	CAUSE	REFERENCE	TIME (hours)
AG	PUMP TRIP AFTER TRANSFER OF RPS POWER SUPPLY	NSAC-157	0.02
DAVIS BESSE 1	PUMP FAILED TO START	NSAC-52	0.07
CALVERT CLIFFS 1	LPSI ACTUATION CAUSES PUMP TRIP	NSAC-52	0.25
CALVERT CLIFFS 2	LPSI ACTUATION CAUSES PUMP TRIP	NSAC-52	0.38
272/89-019	GAS BINDING (N2) DURING ACCUMULATOR DISCHARGE VALVE TESTING	AEOD/S93-05	0.70
CALVERT CLIFFS 2	CAVITATION	NSAC-52	2.00
BRUNSWICK 2	START FAILURE	NSAC-88	--
PEACH BOTTOM 3	PUMP TRIP (OVERCURRENT)	NSAC-88	--
BRUNSWICK 2	HIGH PUMP MOTOR RUNNING TEMP	NSAC-88	--
HATCH 1	HIGH RHR PUMP BEARING TEMP	NSAC-88	--
BRUNSWICK 2	LOSS OF PUMP SHAFT SEAL COOLING SYSTEM	NSAC-88	--
GRAND GULF	COOLING FAN FAILURE	NSAC-88	--
BROWNS FERRY 1	PUMP WINDING FAILURE (OVERCURRENT TRIP)	NSAC-88	--
BI	PUMP TRIP DUE TO WORN IMPELLER EYE WEAR RING	NSAC-157	--
DH	PUMP TRIP DUE TO HYDRAULIC TRANSIENT WHEN ONE PUMP STOPPED	NSAC-157	--
AI	PUMP TRIP DUE TO LOGIC POWER SUPPLY DISTURBANCE	NSAC-157	--
271/91-009	AIR BINDING OF PUMP DUE TO LOW RCS LEVEL	AEOD/S93-05	--

Table 16.3-5

Recovery Actions Failure Probabilities

Recovery Event	Mode	Time Allowable (hrs)	Failure Probability
Recovery of RWCU/SDCS	5	4	2.29E-01
	6-Unflooded	5.3	2.18E-01
Recovery of RCCWS/PSWS	5	4	2.29E-01
	6-Unflooded	5.3	2.18E-01
Close the lower drywell hatches (RWCU break)	6	1.5	1.00E-01
Close the lower drywell hatches (instr. line break)	6	6.0	1.00E-02

Table 16.3-6

Time Available to Close Lower DW Hatches

Parameter	Break in RWCU/SDCS drainlines	Break in instrument lines below TAF	Units
Lower drywell radius, R	5600		mm
Height from lower drywell to bottom of hatch	2400		mm
Volume of lower drywell below hatch, $V = \pi R^2 H$	236		m^3
Height of water above break, h	25000		mm
Break diameter, d	50	25	mm
Flow rate through break, $Q = (\pi d^2/4)\sqrt{2gh}$	157	39	m^3/hr
Time available(1), $t = V/Q$	91	362	min

Note:

(1) This is the time available to close the lower DW hatches (if open) before flood level in containment reaches the bottom elevation of the hatch opening. Closure of both the equipment hatch and personal hatch can be done form outside the lower drywell/containment.

(2) No credit is given to the two lower drywell sump pumps. Operating sump pumps would give personnel more time to close hatches.

Table 16.5-1

System Maintenance Unavailabilities During Shutdown

System	Mode 5	Mode 6	Observations
ICS	As at full power	Out of service	Maintenance expected in Mode 6, with vessel depressurized.
RWCU/SDC	As at full power	As at full power	1 or 2 trains operating. Maintenance expected to be carried out during full power on one train while the other train operates in RWCU mode.
ADS/SRV	As at full power	Out of service	Maintenance expected in Mode 6, with vessel depressurized.
Feedwater and condensate	Higher maintenance unavailability	Higher maintenance unavailability	Not credited in shutdown PRA analysis though it may be available.
CRD (injection mode)	As at full power	As at full power	Maintenance can be executed during full power on one train while the other train is in operation or on standby.
FAPCS	As at full power	As at full power	Maintenance can be executed during full power as well as during shutdown on one train while the other is operating or on standby.
FPS	As at full power	As at full power	Maintenance can be executed during full power as well as during shutdown on one train while the other is operating or on standby.
GDCS	As in full power	Higher maintenance unavailability	Maintenance during shutdown will be performed on lines and pools allowed out of service by Tech specs.
PCCS	As at full power	Out of service	Not credited in shutdown PRA analysis though it may be available for Mode 5 while containment is still intact. Maintenance expected in Mode 6, with vessel depressurized and containment open
RCCWS	As at full power	As at full power	Maintenance can be executed during full power as well as during shutdown
PSWS	As at full power	As at full power	Maintenance can be executed during full power as well as during shutdown
Service/Instrument Air	As at full power	As at full power	Maintenance can be executed during full power as well as during shutdown
HPNSS	As at full power	As at full power	Maintenance can be executed during full power as well as during shutdown
13.8 kV Power Distribution	As at full power	As at full power	It is assumed that any bus, power center or MCC can be maintained during power operation.
Diesel Generators	As at full power	As at full power	It is assumed that one DG at a time can be maintained during power operation

Table 16.5-1

System Maintenance Unavailabilities During Shutdown

System	Mode 5	Mode 6	Observations
Uninterruptible AC Power	As at full power	As at full power	It is assumed that any bus, power center or MCC can be maintained during power operation.
250V DC Power	As at full power	As at full power	It is assumed that any division can be maintained during power operation.

Table 16.6-1

Shutdown CDF by Initiating Event and by Mode of Operation

Initiating Event	CDF (Per Year)	% Of Total	Mode	CDF (Per Year)
Loss of PSWS	3.00E-12	0.00%	5	3.10E-09
Loss of RWCU/SDC	1.50E-11	0.20%		
Loss of Pref Power	1.00E-12	0.00%		
LOCA - RWCU/SDC below TAF	7.13E-10	7.60%		
LOCA - Other than FW or GDCS	3.00E-12	0.00%		
LOCA - FW Line A	1.00E-12	0.00%		
LOCA - Instrument Line below TAF	2.36E-09	25.2%		
LOCA - GDCS	ε	0.00%		
Loss of PSWS	ε	0.00%	5 Open	7.70E-10
Loss of RWCU/SDC	3.00E-12	0.00%		
Loss of Pref Power	2.00E-12	0.00%		
LOCA - RWCU/SDC below TAF	1.78E-10	1.90%		
LOCA - Other than FW or GDCS	ε	0.00%		
LOCA - FW Line A	ε	0.00%		
LOCA - Instrument Line below TAF	5.87E-10	6.30%		
LOCA - GDCS	ε	0.00%		
Loss of PSWS	1.17E-10	1.30%	6 Unflooded	1.68E-09
Loss of RWCU/SDC	8.00E-12	2.40%		
Loss of Pref Power	5.98E-10	6.40%		
LOCA - RWCU/SDC below TAF	2.23E-10	2.50%		
LOCA - Other than FW or GDCS	ε	0.00%		
LOCA - FW Line A	ε	0.00%		
LOCA - Instrument Line below TAF	7.33E-10	7.80%		
LOCA - GDCS	ε	0.00%		
LOCA - Instrument Line below TAF	2.93E-09	31.30%	6 Flooded	3.82E-09
LOCA - RWCU/SDC below TAF	8.92E-10	9.50%		
Total	**9.37E-09**			**9.37E-09**

Table 16.6-2

Shutdown CDF by Accident Class (Deleted)

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

#	Cutset Prob	Event Prob	Event	Description
1	2.93E-09	2.93E-07	%M6F_LOCA_I	INSTRUMENT LINE LOCA IN MODE 6 FLOODED
		1.00E-02	DWH-2	FAILURE TO CLOSE DRYWELL HATCH
2	2.35E-09	2.35E-07	%M5-LOCA-I	LOCA - INSTRUMENT LINE BELOW TAF MODE 5
		1.00E-02	DWH-2	FAILURE TO CLOSE DRYWELL HATCH
3	8.92E-10	8.92E-09	%M6F_LOCA_R	RWCU LOCA IN MODE 6 FLOODED
		1.00E-01	DWH-1	CLOSE LOWER DRYWELL HATCH
4	7.33E-10	7.33E-08	%M6U_LOCA-I	INSTRUMENT LINE LOCA - MODE 6 UNFLOODED
		1.00E-02	DWH-2	FAILURE TO CLOSE DRYWELL HATCH
5	7.13E-10	7.13E-09	%M5-LOCA-RW	LOCA - RWCU BELOW TAF
		1.00E-01	DWH-1	CLOSE LOWER DRYWELL HATCH
6	5.86E-10	5.86E-08	%M5O_LOCA_I	LOCA - INSTRUMENT LINE - MODE 5 OPEN
		1.00E-02	DWH-2	FAILURE TO CLOSE DRYWELL HATCH
7	2.23E-10	2.23E-09	%M6U_LOCA-RW	RWCU LOCA - MODE 6 UNFLOODED
		1.00E-01	DWH-1	CLOSE LOWER DRYWELL HATCH
8	1.78E-10	1.78E-09	%M5O_LOCA_R	LOCA - RWCU DRAINLINE MODE 5 OPEN
		1.00E-01	DWH-1	CLOSE LOWER DRYWELL HATCH
9	1.87E-11	3.32E-06	%M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		5.35E-04	E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02	G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01	R-PSWS-6	SERVICE WATER RECOVERY
10	1.07E-11	3.32E-06	%M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		1.75E-02	E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02	E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02	G21-BV_-RE-F334	MISPOSITION OF VALVE F334

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
11	1.07E-11	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
12	1.05E-11	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
13	1.05E-11	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
14	9.71E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
15	8.83E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
16	6.23E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
17	5.56E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
18	5.56E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
19	5.45E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
20	5.44E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
21	5.25E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
22	5.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
23	5.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
24	4.96E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
25	4.95E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
26	3.66E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
27	3.66E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
28	3.66E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
29	3.66E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
30	3.66E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

31	3.66E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
32	3.57E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
33	3.57E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
34	3.50E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
35	3.50E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
36	3.33E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
37	3.33E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
38	3.33E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
39	3.33E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
40	3.33E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
41	3.33E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
42	3.30E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.93E-04 P21-ACV-OO-F0016_1_2	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B
43	3.23E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
44	2.94E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
45	2.72E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
46	2.48E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

47	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
48	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
49	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
50	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
51	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
52	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
53	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
54	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
55	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
56	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
57	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
58	2.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
59	2.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
60	2.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
61	2.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
62	2.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
63	2.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
64	2.06E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
65	2.05E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
66	2.05E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
67	2.05E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
68	2.05E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
69	2.05E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
70	2.05E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
71	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
72	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
73	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
74	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
75	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
76	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
77	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

78	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
79	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
80	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
81	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
82	1.91E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
83	1.89E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.93E-04 P21-ACV-OO-F0016_1_2	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B
84	1.89E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.93E-04 P21-ACV-OO-F0016_1_2	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B
85	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
86	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
87	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
88	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
89	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
90	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
91	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
92	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
93	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
94	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
95	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
96	1.87E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
97	1.85E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.93E-04 P21-ACV-OO-F0016_1_2	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

98	1.85E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.93E-04 P21-ACV-OO-F0016_1_2	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B
99	1.85E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
100	1.85E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
101	1.84E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-03 E50-SQV-CC-F002A	SQUIB VALVE F002A FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
102	1.84E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-03 E50-SQV-CC-F002D	SQUIB VALVE F002D FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
103	1.84E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-03 E50-SQV-CC-F002E	SQUIB VALVE F002E FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
104	1.84E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-03 E50-SQV-CC-F002H	SQUIB VALVE F002H FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
105	1.81E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
106	1.81E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
107	1.75E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

108	1.71E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE	Common cause failure of software
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
109	1.71E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE_S	Common cause failure of software, for spurious
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
110	1.68E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
111	1.68E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
112	1.65E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
113	1.65E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
114	1.22E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
115	1.22E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
116	1.22E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
117	1.22E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
118	1.22E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		5.35E-04	E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.77E-02	G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02	P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02	XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
119	1.22E-12	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04	E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.77E-02	G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02	P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02	XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
120	1.21E-12	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.00E-03	C12-MOV-CC-F020A	MOTOR OPER. VALVE F020A FAILS TO OPEN
		5.35E-04	E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02	G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02	G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
121	1.21E-12	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.00E-03	C12-MOV-CC-F020B	MOTOR OPER. VALVE F020B FAILS TO OPEN
		5.35E-04	E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02	G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02	G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
122	1.12E-12	2.35E-07	%M5-LOCA-I	LOCA - INSTRUMENT LINE BELOW TAF MODE 5
		1.50E-04	B21-SQV-CC_ALL	CCF of all components in group 'B21-SQV-CC'
		3.21E-02	C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.00E-02	#NAME?	FAILURE TO CLOSE DRYWELL HATCH
123	1.12E-12	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.69E-03	C12-MP_-FS-C001B	MOTOR-DRIVEN PUMP C001B FAILS TO START

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
124	1.11E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
125	1.11E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
126	1.11E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
127	1.11E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
128	1.11E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
129	1.11E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
130	1.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.00E-03 C12-MOV-CC-F020A	MOTOR OPER. VALVE F020A FAILS TO OPEN
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
131	1.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.00E-03 C12-MOV-CC-F020B	MOTOR OPER. VALVE F020B FAILS TO OPEN
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
132	1.10E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		1.93E-04 P21-ACV-OO-F0016_1_2	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
133	1.05E-12	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		3.00E-05 E50-UV_OC-EQU_ALL	CCF of all components in group 'E50-UV_OC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
134	1.03E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
135	1.03E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
136	1.03E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
137	1.03E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
138	1.03E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

139	1.03E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
140	1.02E-12	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.69E-03 C12-MP_-FS-C001B	MOTOR-DRIVEN PUMP C001B FAILS TO START
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
141	9.78E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE	Common cause failure of software
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
142	9.78E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE	Common cause failure of software
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
143	9.78E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE_S	Common cause failure of software, for spurious
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
144	9.78E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.00E-04 C62-CCFSOFTWARE_S	Common cause failure of software, for spurious
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
145	9.60E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE	Common cause failure of software
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
146	9.60E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE_S	Common cause failure of software, for spurious
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
147	9.58E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE	Common cause failure of software
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
148	9.58E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.00E-04 C62-CCFSOFTWARE_S	Common cause failure of software, for spurious
		3.00E-04 E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
149	9.53E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03 E50-SQV-CC-F002A	SQUIB VALVE F002A FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

150	9.53E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03 E50-SQV-CC-F002D	SQUIB VALVE F002D FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
151	9.53E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03 E50-SQV-CC-F002E	SQUIB VALVE F002E FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
152	9.53E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03 E50-SQV-CC-F002H	SQUIB VALVE F002H FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
153	9.33E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
154	9.33E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
155	9.33E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
156	9.33E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
157	9.33E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
158	9.33E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
159	9.25E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.93E-04	P21-ACV-OO-F0016_1_2	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B
160	9.07E-13	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-03	C12-SYS-TM-TRAINB	TRAIN B IN MAINTENANCE
		5.35E-04	E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02	G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02	G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
161	9.06E-13	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02	C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.50E-04	E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		1.77E-02	G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02	XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
162	8.86E-13	1.84E-07	%M5-LOCA-OT	LOCA - OTHER THAN FW OR GDCS - MODE 5
		1.50E-04	B21-SQV-CC_ALL	CCF of all components in group 'B21-SQV-CC'
		3.21E-02	C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
163	8.83E-13	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02	C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		5.35E-04	E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02	G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-03	P54-XHE-FO-F026	OPERATOR FAIL TO REOPEN F026
164	8.67E-13	6.60E-04	%M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02	C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03	E50-SQV-CC-F002A	SQUIB VALVE F002A FAILS TO OPERATE
		1.75E-02	E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02	G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02	P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

165	8.67E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03 E50-SQV-CC-F002D	SQUIB VALVE F002D FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
166	8.67E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03 E50-SQV-CC-F002E	SQUIB VALVE F002E FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
167	8.67E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		3.00E-03 E50-SQV-CC-F002H	SQUIB VALVE F002H FAILS TO OPERATE
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
168	8.34E-13	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		2.38E-05 E50-SQV-CC_1_5	CCF of two components: E50-SQV-CC-F002A & E50-SQV-CC-F002E
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY
169	8.34E-13	3.32E-06 %M6U_LPSWS	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
		2.38E-05 E50-SQV-CC_4_8	CCF of two components: E50-SQV-CC-F002D & E50-SQV-CC-F002H
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		2.18E-01 R-PSWS-6	SERVICE WATER RECOVERY

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

170	8.25E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-03 C12-SYS-TM-TRAINB	TRAIN B IN MAINTENANCE
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
171	8.24E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.21E-02 C12-XHE-FO-LEVEL2	Operator fails to back-up CRD actuation
		1.50E-04 E50-SQV-CC_ALL	CCF of all components in group 'E50-SQV-CC'
		1.61E-02 P54-XHE-FO-REOPEN	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
172	7.26E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		2.40E-03 C12-MP_-FS-C001BOIL	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
173	7.09E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.84E-02 C12-BV_-RE-F013A	MISPOSITION OF VALVE F013A
		4.84E-02 C12-BV_-RE-F013B	MISPOSITION OF VALVE F013B
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
174	7.09E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.84E-02 C12-BV_-RE-F013A	MISPOSITION OF VALVE F013A
		4.84E-02 C12-BV_-RE-F015B	MISPOSITION OF VALVE F015B
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
175	7.09E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.84E-02 C12-BV_-RE-F013B	MISPOSITION OF VALVE F013B
		4.84E-02 C12-BV_-RE-F015A	MISPOSITION OF VALVE F015A
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
176	7.09E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.84E-02 C12-BV_-RE-F015A	MISPOSITION OF VALVE F015A
		4.84E-02 C12-BV_-RE-F015B	MISPOSITION OF VALVE F015B
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
177	7.09E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.84E-02 C12-BV_-RE-F064	MISPOSITION OF VALVE F064
		4.84E-02 C12-BV_-RE-F065	MISPOSITION OF LOCKED OPEN VALVE F065
		5.35E-04 E50-STR-PG_ALL	CCF of all components in group 'E50-STR-PG'
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
178	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

			NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
179	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
180	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
181	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
182	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
183	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
184	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
185	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
186	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

187	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
188	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
189	6.97E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
190	6.93E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.00E-03 C12-MOV-CC-F020A	MOTOR OPER. VALVE F020A FAILS TO OPEN
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
191	6.93E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		4.00E-03 C12-MOV-CC-F020A	MOTOR OPER. VALVE F020A FAILS TO OPEN
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
192	6.93E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.00E-03 C12-MOV-CC-F020B	MOTOR OPER. VALVE F020B FAILS TO OPEN
		1.75E-02 E50-UV_-OC-F003A	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003E	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
193	6.93E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		4.00E-03 C12-MOV-CC-F020B	MOTOR OPER. VALVE F020B FAILS TO OPEN
		1.75E-02 E50-UV_-OC-F003D	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
		1.75E-02 E50-UV_-OC-F003H	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
		4.84E-02 G21-BV_-RE-F334	MISPOSITION OF VALVE F334
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
194	6.84E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
195	6.84E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021B	MISPOSITION OF VALVE F021B
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
196	6.84E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049A	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
197	6.84E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F049B	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
198	6.84E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050A	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
199	6.84E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		3.00E-04 E50-UV_OC_ALL	CCF of all components in group 'E50-UV_OC'
		1.77E-02 G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
		1.21E-02 P21-BV_-RE-F050B	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
		1.61E-02 XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
200	6.83E-13	6.60E-04 %M6U_LOPP	LOSS OF PREF POWER - MODE 6 UNFLOODED
		1.21E-02 C12-BV_-RE-F021A	MISPOSITION OF VALVE F021A

Table 16.6-3

Internal Events Shutdown PRA Cutset Report

Cutsets with Descriptions Report
Internal Events Shutdown
Core Damage Frequency = 9.37E-09
Top 200 Cutsets

3.00E-04	E50-SQV-CC-EQU_ALL	CCF of all components in group 'E50-SQV-CC-EQU'
1.77E-02	G31-XHE-FO-SDC	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
1.61E-02	XXX-XHE-FO-LPMAKEUP	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION

Table 16.6-4

Internal Events Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Internal Event Shutdown Full Power
Core Damage Frequency = 9.37E-09

Event Name	Probability	Fus Ves	RAW	Description
DWH-2	1.00E-02	7.04E-01	70.74	FAILURE TO CLOSE DRYWELL HATCH
%M6F_LOCA_I	2.93E-07	3.13E-01	1.07E+06	INSTRUMENT LINE LOCA IN MODE 6 FLOODED
%M5-LOCA-I	2.35E-07	2.52E-01	1.07E+06	LOCA - INSTRUMENT LINE BELOW TAF MODE 5
DWH-1	1.00E-01	2.14E-01	2.93	CLOSE LOWER DRYWELL HATCH
%M6F_LOCA_R	8.92E-09	9.52E-02	1.07E+07	RWCU LOCA IN MODE 6 FLOODED
%M6U_LOCA-I	7.33E-08	7.83E-02	1.07E+06	INSTRUMENT LINE LOCA - MODE 6 UNFLOODED
%M5-LOCA-RW	7.13E-09	7.61E-02	1.07E+07	LOCA - RWCU BELOW TAF
%M6U_LOPP	6.60E-04	6.40E-02	97.72	LOSS OF PREF POWER - MODE 6 UNFLOODED
%M5O_LOCA_I	5.86E-08	6.26E-02	1.07E+06	LOCA - INSTRUMENT LINE - MODE 5 OPEN
G21-BV_-RE-F334	4.84E-02	5.98E-02	2.17	MISPOSITION OF VALVE F334
G31-XHE-FO-SDC	1.77E-02	2.77E-02	2.53	OPERATOR FAILS TO ACTUATE SDC MODE NO MSL LOCA OUSIDE CONTAINMENT NO SLCS
P54-XHE-FO-REOPEN	1.61E-02	2.51E-02	2.53	OPERATOR FAILS TO RECOGNIZE OPENING OF F009 OR F026
%M6U_LOCA-RW	2.23E-09	2.38E-02	1.07E+07	RWCU LOCA - MODE 6 UNFLOODED
XXX-XHE-FO-LPMAKEUP	1.61E-02	1.93E-02	2.18	OP. FAILS TO RECOG. NEED FOR LOW PRESS. MAKEUP AFTER DEPRESSURIZATION
%M5O_LOCA_R	1.78E-09	1.90E-02	1.07E+07	LOCA - RWCU DRAINLINE MODE 5 OPEN
E50-STR-PG_ALL	5.35E-04	1.85E-02	35.48	CCF of all components in group 'E50-STR-PG'
C12-XHE-FO-LEVEL2	3.21E-02	1.40E-02	1.42	Operator fails to back-up CRD actuation
%M6U_LPSWS	3.32E-06	1.25E-02	3.77E+03	LOSS OF SERVICE WATER - MODE 6 UNFLOODED
R-PSWS-6	2.18E-01	1.25E-02	1.04	SERVICE WATER RECOVERY
E50-UV_-OC-F003A	1.75E-02	1.23E-02	1.69	CHECK VALVE F003A FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003D	1.75E-02	1.23E-02	1.69	CHECK VALVE F003D FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003E	1.75E-02	1.23E-02	1.69	CHECK VALVE F003E FAILS TO REMAIN OPEN OR PLUG
E50-UV_-OC-F003H	1.75E-02	1.23E-02	1.69	CHECK VALVE F003H FAILS TO REMAIN OPEN OR PLUG
E50-UV_OC_ALL	3.00E-04	1.03E-02	35.15	CCF of all components in group 'E50-UV_OC'
E50-SQV-CC-EQU_ALL	3.00E-04	1.03E-02	35.15	CCF of all components in group 'E50-SQV-CC-EQU'

Table 16.6-4

Internal Events Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Internal Event Shutdown Full Power
Core Damage Frequency = 9.37E-09

E50-SQV-CC_ALL	1.50E-04	5.06E-03	34.65	CCF of all components in group 'E50-SQV-CC'
C12-BV_-RE-F021A	1.21E-02	4.96E-03	1.4	MISPOSITION OF VALVE F021A
P21-BV_-RE-F049A	1.21E-02	4.96E-03	1.4	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
P21-BV_-RE-F050A	1.21E-02	4.96E-03	1.4	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
C12-BV_-RE-F021B	1.21E-02	4.96E-03	1.4	MISPOSITION OF VALVE F021B
P21-BV_-RE-F049B	1.21E-02	4.96E-03	1.4	MISPOSITION OF RCCW INLET TO CRD HEAT EXCHANGER
P21-BV_-RE-F050B	1.21E-02	4.96E-03	1.4	MISPOSITION OF RCCW OUTLET FROM CRD HEAT EXCHANGER
R10-LOSP-EPRI	3.00E-03	3.19E-03	2.05	CONSEQENTIAL LOSS OF PREFERRED OFFSITE POWER DUE TO A TRANSIENT
P54-XHE-FO-F026	1.61E-03	2.42E-03	2.5	OPERATOR FAIL TO REOPEN F026
C12-BV_-RE-F013A	4.84E-02	2.25E-03	1.04	MISPOSITION OF VALVE F013A
C12-BV_-RE-F013B	4.84E-02	2.25E-03	1.04	MISPOSITION OF VALVE F013B
C12-BV_-RE-F015A	4.84E-02	2.25E-03	1.04	MISPOSITION OF VALVE F015A
C12-BV_-RE-F015B	4.84E-02	2.25E-03	1.04	MISPOSITION OF VALVE F015B
P21-ACV-OO-F0016_1_2	1.93E-04	2.20E-03	12.41	CCF of two components: P21-ACV-OO-F016A & P21-ACV-OO-F016B
E50-SQV-CC-F002A	3.00E-03	2.00E-03	1.66	SQUIB VALVE F002A FAILS TO OPERATE
E50-SQV-CC-F002D	3.00E-03	2.00E-03	1.66	SQUIB VALVE F002D FAILS TO OPERATE
E50-SQV-CC-F002E	3.00E-03	2.00E-03	1.66	SQUIB VALVE F002E FAILS TO OPERATE
E50-SQV-CC-F002H	3.00E-03	2.00E-03	1.66	SQUIB VALVE F002H FAILS TO OPERATE
R-M5-G31	2.29E-01	1.91E-03	1.01	RWCU/SDC RECOVERY
C12-MOV-CC-F020A	4.00E-03	1.61E-03	1.4	MOTOR OPER. VALVE F020A FAILS TO OPEN
C12-MOV-CC-F020B	4.00E-03	1.61E-03	1.4	MOTOR OPER. VALVE F020B FAILS TO OPEN
%M5-G31	3.27E-04	1.59E-03	5.81	LOSS OF RWCU/SDC MODE 5
C12-MP_-FS-C001B	3.69E-03	1.49E-03	1.4	MOTOR-DRIVEN PUMP C001B FAILS TO START
C62-CCFSOFTWARE	1.00E-04	1.23E-03	13.3	Common cause failure of software
C12-SYS-TM-TRAINB	3.00E-03	1.20E-03	1.4	TRAIN B IN MAINTENANCE
B21-SQV-CC_ALL	1.50E-04	1.16E-03	8.71	CCF of all components in group 'B21-SQV-CC'

Table 16.6-4

Internal Events Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Internal Event Shutdown Full Power
Core Damage Frequency = 9.37E-09

C62-CCFSOFTWARE_S	1.00E-04	1.13E-03	12.33	Common cause failure of software, for spurious
C12-BV_-RE-F065	4.84E-02	1.05E-03	1.02	MISPOSITION OF LOCKED OPEN VALVE F065
E50-UV_OC-EQU_ALL	3.00E-05	9.72E-04	33.28	CCF of all components in group 'E50-UV_OC-EQU'
C12-BV_-RE-F064	4.84E-02	9.72E-04	1.02	MISPOSITION OF VALVE F064
C12-MP_-FS-C001BOIL	2.40E-03	9.53E-04	1.4	MOTOR-DRIVEN AUX. OIL PUMP FOR C001B FAILS TO START
%M6U_G31	1.71E-06	8.21E-04	479.26	LOSS OF RWCU - MODE 6 UNFLOODED
R-M6-G31	2.18E-01	8.21E-04	1	FAILURE TO RECOVER RWCU/SDC
E50-SQV-CC_1_5	2.38E-05	7.65E-04	33.04	CCF of two components: E50-SQV-CC-F002A & E50-SQV-CC-F002E
E50-SQV-CC_4_8	2.38E-05	7.65E-04	33.04	CCF of two components: E50-SQV-CC-F002D & E50-SQV-CC-F002H
R21-DG_-FR-DGA	5.76E-02	7.08E-04	1.01	DIESEL GENERATOR "A" FAILS TO RUN GIVEN START
R21-DG_-FR-DGB	5.76E-02	5.65E-04	1.01	DIESEL GENERATOR "B" FAILS TO RUN GIVEN START
C12-BV_-RE-F003A	1.21E-02	5.30E-04	1.04	MISPOSITION OF VALVE FOO3A
C12-BV_-RE-F003B	1.21E-02	5.30E-04	1.04	MISPOSITION OF VALVE F003B
R21-DG_-TM-DGA	4.60E-02	4.73E-04	1.01	STANDBY DIESEL GENERATOR "A" IN MAINTENANCE
U43-XHE-FO-LPCI	1.61E-03	4.35E-04	1.27	OPERATOR FAILS TO ACTUATE U43 IN LPCI MODE
C62-UNDEVSPUR5	1.00E-03	3.92E-04	1.39	Undeveloped spurious hardware failure
C62-UNDEVSPUR7	1.00E-03	3.92E-04	1.39	Undeveloped spurious hardware failure
C63-UNDEVSPUR126	1.00E-03	3.92E-04	1.39	Undeveloped spurious hardware failure
C63-UNDEVSPUR127	1.00E-03	3.92E-04	1.39	Undeveloped spurious hardware failure
R21-DG_-TM-DGB	4.60E-02	3.64E-04	1.01	STANDBY DIESEL GENERATOR "B" IN MAINTENANCE
%M5_LPSWS	1.06E-05	3.58E-04	34.64	LOSS OF SERVICE WATER MODE 5
R-PSWS-5	2.18E-01	3.58E-04	1	FAILURE TO RECOVER SERVICE WATER
%M5O_G31	8.18E-05	3.22E-04	4.88	LOSS OF RWCU/SDC - MODE 5 OPEN
E50-SQV-CO-F009A	9.60E-06	2.98E-04	31.89	SQUIB DELUGE VALVE F009A SPUR. OPENING [#7]
E50-SQV-CO-F009D	9.60E-06	2.98E-04	31.89	SQUIB DELUGE VALVE F009D SPUR. OPENING [#7]
E50-SQV-CO-F009E	9.60E-06	2.98E-04	31.89	SQUIB DELUGE VALVE F009E SPUR. OPENING [#7]

Table 16.6-4

Internal Events Shutdown PRA Importance Measure Report

F-V and RAW Importance Measures Report
(F-V = Fussell-Vesely Importance Measure; RAW = Risk Achievement Worth Importance Measure)
Internal Event Shutdown Full Power
Core Damage Frequency = 9.37E-09

E50-SQV-CO-F009H	9.60E-06	2.98E-04	31.89	SQUIB DELUGE VALVE F009H SPUR. OPENING [#7]
E50-SQV-CO-F009J	9.60E-06	2.98E-04	31.89	SQUIB DELUGE VALVE F009J SPUR. OPENING [#7]
E50-SQV-CO-F009M	9.60E-06	2.98E-04	31.89	SQUIB DELUGE VALVE F009M SPUR. OPENING [#7]
C63-CCFSOFTWARE	1.00E-04	2.88E-04	3.86	Common cause failure of software
C63-UNDEVSPUR58	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
C63-UNDEVSPUR59	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
C63-UNDEVSPUR62	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
C63-UNDEVSPUR63	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
C63-UNDEVSPUR66	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
C63-UNDEVSPUR67	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
C63-UNDEVSPUR70	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
C63-UNDEVSPUR71	1.00E-03	2.84E-04	1.28	Undeveloped spurious hardware failure
%M5-LOCA-OT	1.84E-07	2.76E-04	1.50E+03	LOCA - OTHER THAN FW OR GDCS - MODE 5
C63-CCFSOFTWARE_S	1.00E-04	2.47E-04	3.46	Common cause failure of software, for spurious
B32-NONCONDENSE	1.00E+00	2.44E-04	1	Non condensable gasses form in ICS sufficiently to require venting
%M5O_LOPP	5.28E-04	2.33E-04	1.43	LOSS OF PREF POWER - MODE 5 OPEN
E50-UV_OC_1_2_5	7.05E-06	2.14E-04	31.29	CCF of three components: E50-UV_-OC-F003A & E50-UV_-OC-F003B & E50-UV_-OC-F003E
E50-UV_OC_1_3_5	7.05E-06	2.14E-04	31.29	CCF of three components: E50-UV_-OC-F003A & E50-UV_-OC-F003C & E50-UV_-OC-F003E
E50-UV_OC_1_4_5	7.05E-06	2.14E-04	31.29	CCF of three components: E50-UV_-OC-F003A & E50-UV_-OC-F003D & E50-UV_-OC-F003E
E50-UV_OC_1_4_8	7.05E-06	2.14E-04	31.29	CCF of three components: E50-UV_-OC-F003A & E50-UV_-OC-F003D & E50-UV_-OC-F003H
E50-UV_OC_1_5_6	7.05E-06	2.14E-04	31.29	CCF of three components: E50-UV_-OC-F003A & E50-UV_-OC-F003E & E50-UV_-OC-F003F
E50-UV_OC_1_5_7	7.05E-06	2.14E-04	31.29	CCF of three components: E50-UV_-OC-F003A & E50-UV_-OC-F003E & E50-UV_-OC-F003G

Table 16.6-5

Shutdown PRA Core Damage Sequences

Event Tree / Initiating Events	Mode	Core damage sequences
Loss of PSWS	5	M5-LPSW-6
		M5-LPSW-7
		M5-LPSW-10
		M5-LPSW-11
		M5-LPSW-12
Loss of RWCU/SDC	5	M5-LRWC-9
		M5-LRWC-10
		M5-LRWC-14
		M5-LRWC-15
		M5-LRWC-16
Loss of Pref Power	5	M5-LOP-9
		M5-LOP-10
		M5-LOP-14
		M5-LOP-15
		M5-LOP-16
Loss of PSWS	5 open	M5O-LPSW-6
		M5O-LPSW-7
		M5O-LPSW-10
		M5O-LPSW-11
		M5O-LPSW-12
Loss of RWCU/SDC	5 open	M5O-LRWC-9
		M5O-LRWC-10
		M5O-LRWC-14
		M5O-LRWC-15
		M5O-LRWC-16
Loss of Pref Power	5 open	M5O-LOP-9
		M5O-LOP-10
		M5O-LOP-14
		M5O-LOP-15
		M5O-LOP-16
Loss of PSWS	6 Unflooded	M6U-LPSW-4
Loss of RWCU/SDC	6 Unflooded	M6U-G31-6
Loss of Pref Power	6 Unflooded	M6U-LOP-6
LOCA - RWCU/SDC below TAF	5	M5-LOCA-R5
		M5-LOCA-R6
		M5-LOCA-R7
LOCA - Other than FW or GDCS	5	M5-LOCA-OT5
		M5-LOCA-OT6
LOCA - FW Line A	5	M5-LOCA-F3
LOCA - Instrument Line below TAF	5	M5-LOCA-I5
		M5-LOCA-I6
		M5-LOCA-I7
LOCA - GDCS	5	M5-LOCA-G5

Table 16.6-5

Shutdown PRA Core Damage Sequences

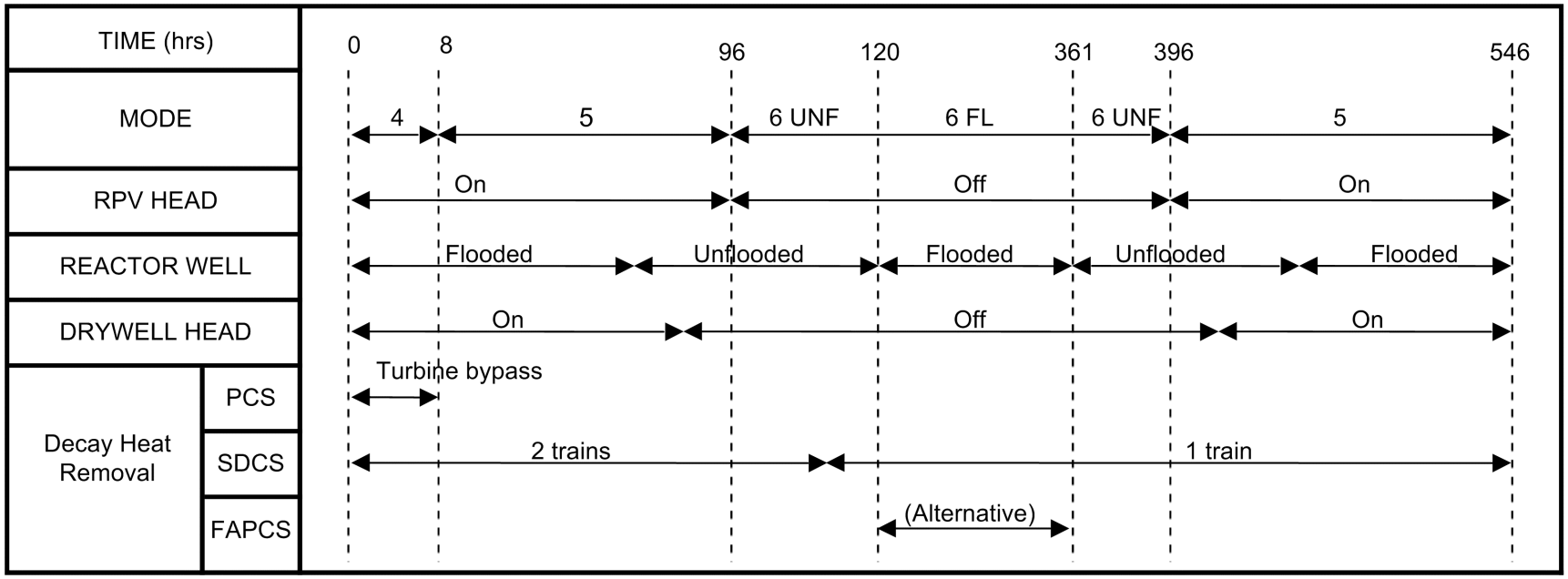
Event Tree / Initiating Events	Mode	Core damage sequences
		M5-LOCA-G6
LOCA - RWCU/SDC below TAF	5 open	M5O-LOCA-R5
		M5O-LOCA-R6
		M5O-LOCA-R7
LOCA - Other than FW or GDCS	5 open	M5O-LOCA-OT5
		M5O-LOCA-OT6
LOCA - FW Line A	5 open	M5O-LOCA-F3
LOCA - Instrument Line below TAF	5 open	M5O-LOCA-I5
		M5O-LOCA-I6
		M5O-LOCA-I7
LOCA - GDCS	5 open	M5O-LOCA-G5
		M5O-LOCA-G6
LOCA - RWCU/SDC below TAF	6 Unflooded	M6U-LOCA-R5
		M6U-LOCA-R6
LOCA - Other than FW or GDCS	6 Unflooded	M6U-LOCA-OT5
LOCA - FW Line A	6 Unflooded	M6U-LOCA-F3
LOCA - Instrument Line below TAF	6 Unflooded	M6U-LOCA-I5
		M6U-LOCA-I6
LOCA - GDCS	6 Unflooded	M6U-LOCA-G5
LOCA - Instrument Line below TAF	6 Flooded	M6F-LOCA-I2
LOCA - RWCU/SDC below TAF	6 Flooded	M6F-LOCA-R2

Table 16.6-6

Shutdown PRA Core Damage Sequences

#	Probability	% of CDF	Sequence	Cutsets	
1	2.93E-09	31.30%	M6F-LOCA-I2	%M6F_LOCA_I	DWH-2
2	2.35E-09	56.50%	M5-LOCA-I6	%M5-LOCA-I	DWH-2
3	8.92E-10	66.00%	M6F-LOCA-R2	%M6F_LOCA_R	DWH-1
4	7.33E-10	73.80%	M6U-LCOA-I6	%M6U_LOCA-I	DWH-2
5	7.13E-10	81.40%	M5-LOCA-R6	%M5-LOCA-RW	DWH-1
6	5.86E-10	87.70%	M5O-LOCA-I6	%M5O_LOCA_I	DWH-2
7	2.23E-10	90.10%	M6U-LCOA-R6	%M6U_LOCA-RW	DWH-1
8	1.78E-10	92.00%	M5O-LOCA-R6	%M5O_LOCA_R	DWH-1

Note: All the dominant cutsets in the internal events shutdown model are from LOCA events below the TAF. All these sequences have only one cutset; the initiating event combined with failure to close the lower drywell hatch.



Note: Node 5 Open is assumed to occur the last 24 hours of Mode 5 before refueling (hours 72-96), and the first 24 hours of Mode 5 following refueling (hours 396-420).

Figure 16.2-1. ESBWR Refuel Outage Plan for Shutdown PRA

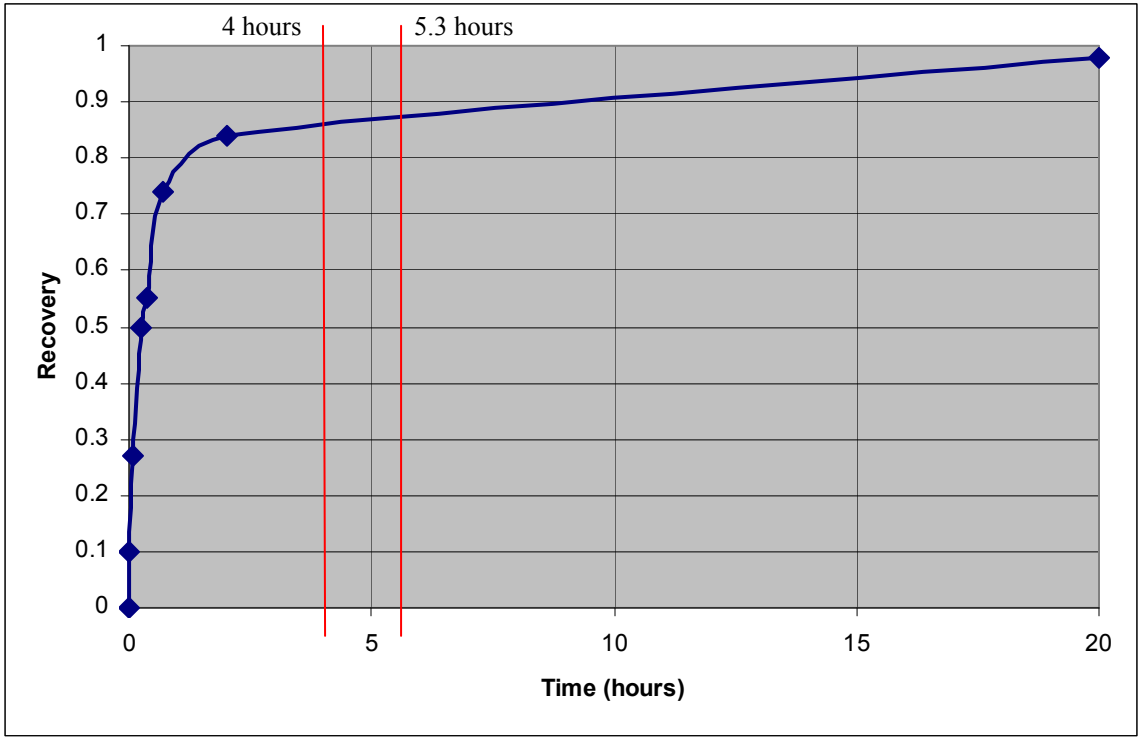


Figure 16.3-1. RWCU/SDCS Recovery Probability (Cumulative)

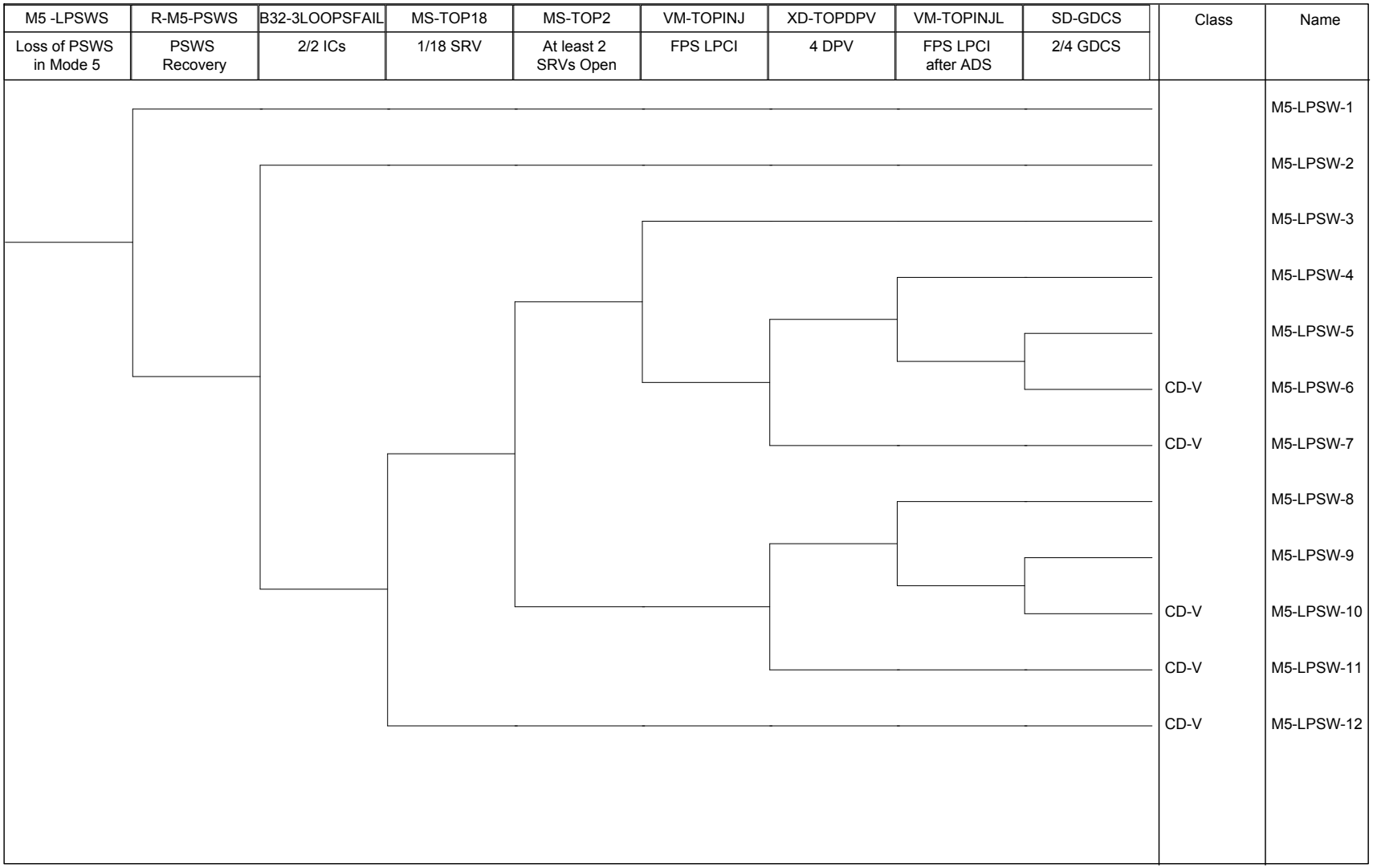


Figure 16.4-1. Loss of all Service Water PSWS/RCCWS (Mode 5)

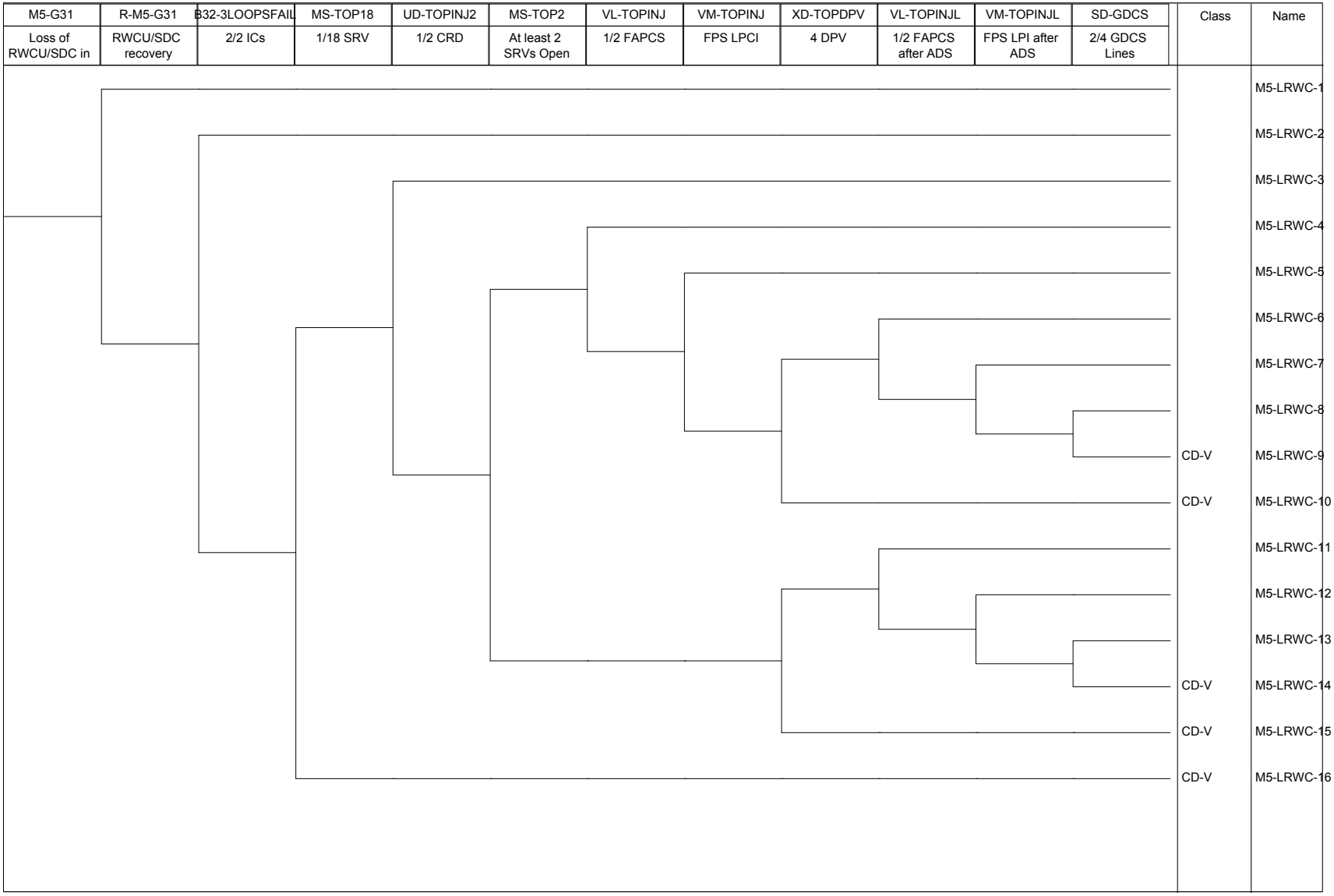


Figure 16.4-2. Loss of Both RWCU/SDCS Trains (Mode 5)

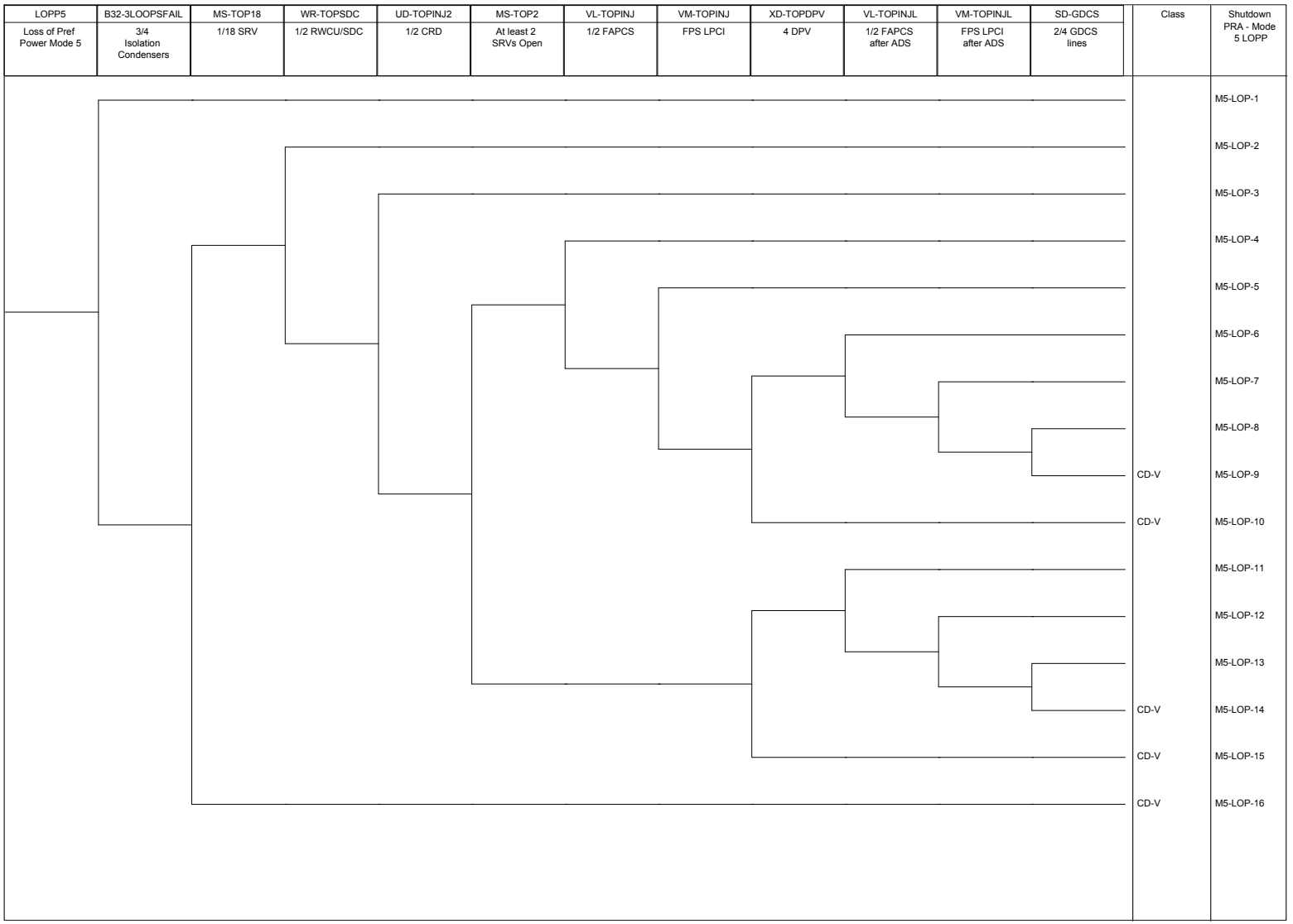


Figure 16.4-3. Loss of Preferred Power (Mode 5)

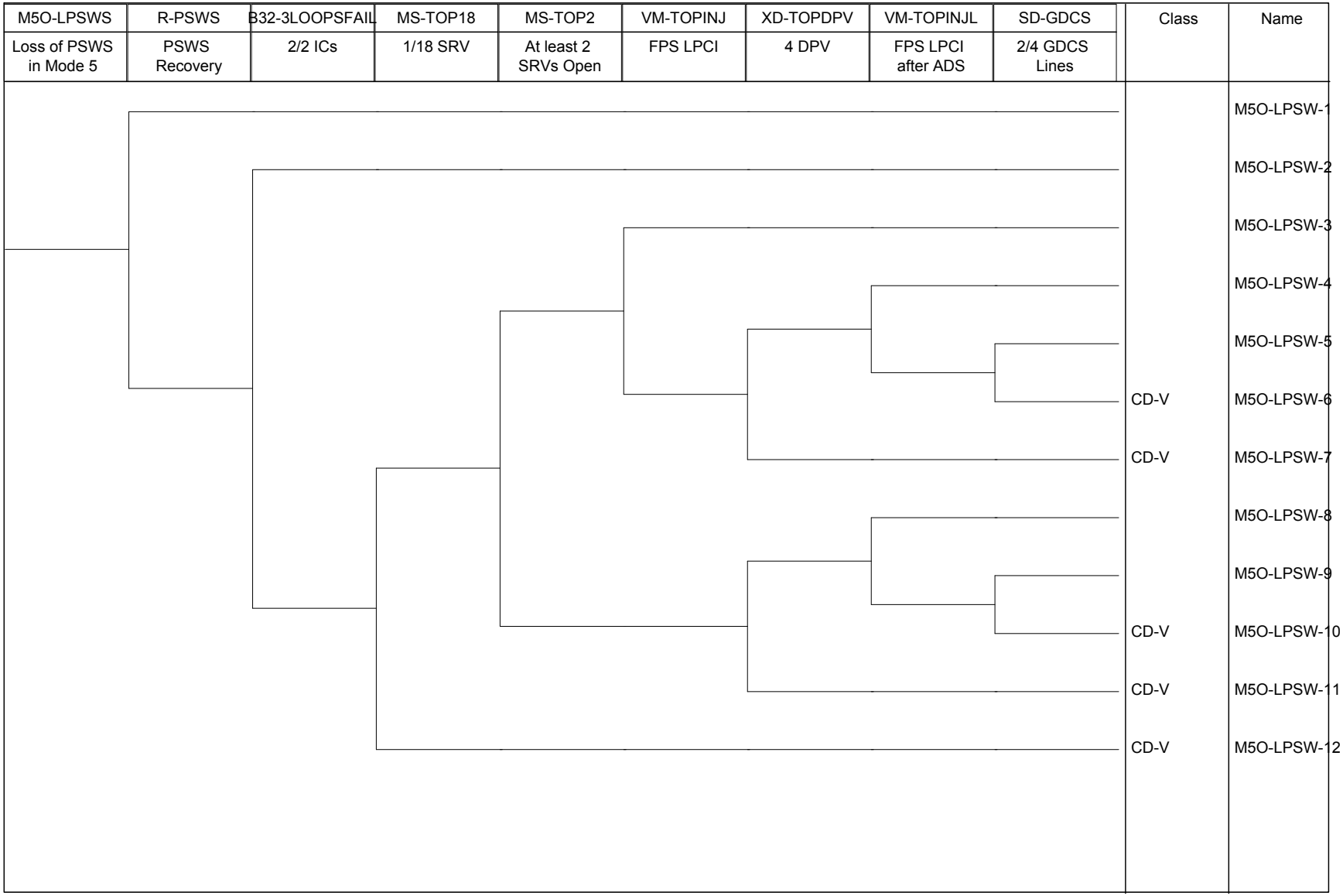


Figure 16.4-4. Loss of all Service Water PSWS/RCCWS (Mode 5 Open)

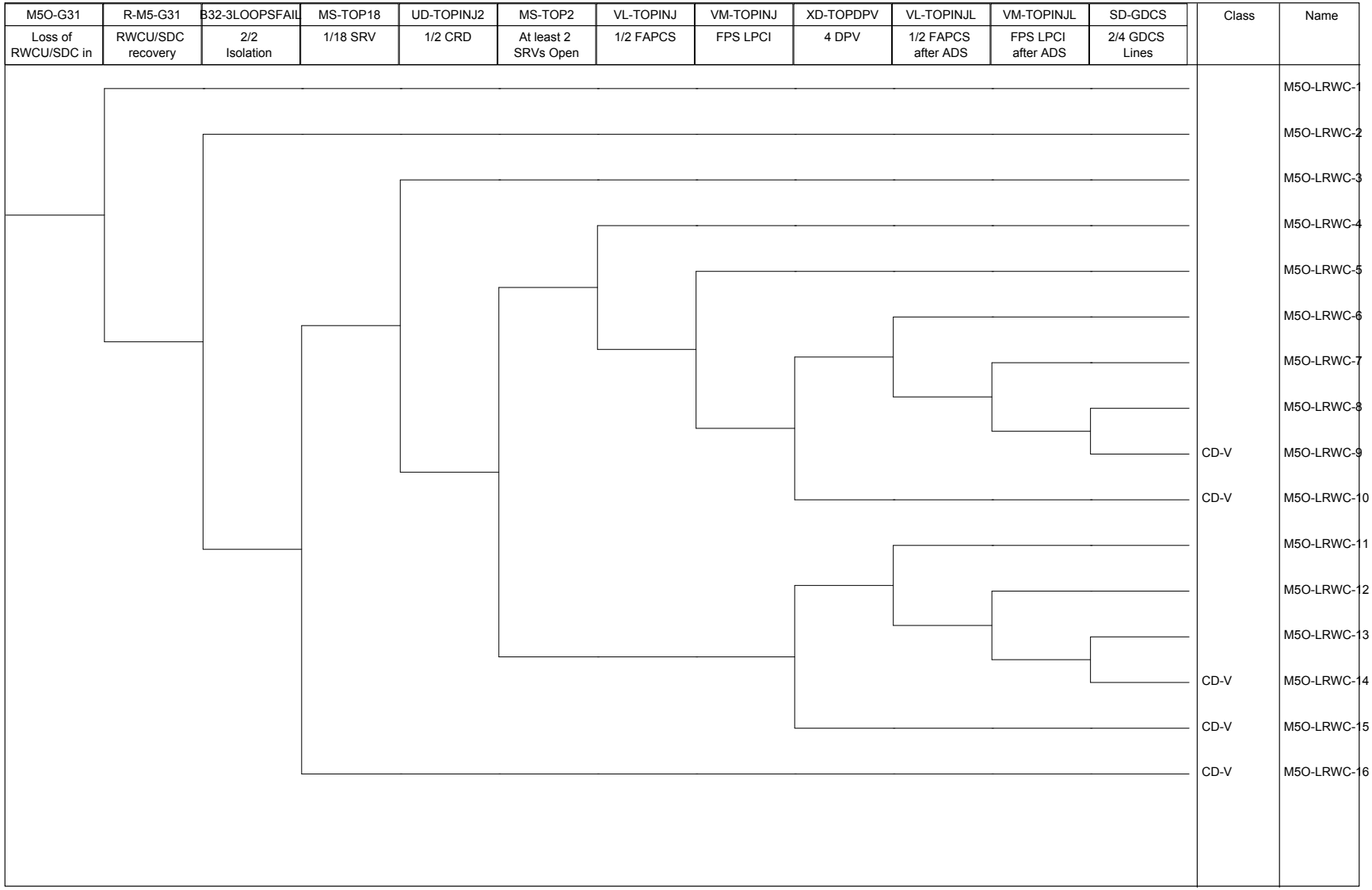


Figure 16.4-5. Loss of Both RWCU/SDCS Trains (Mode 5 Open)

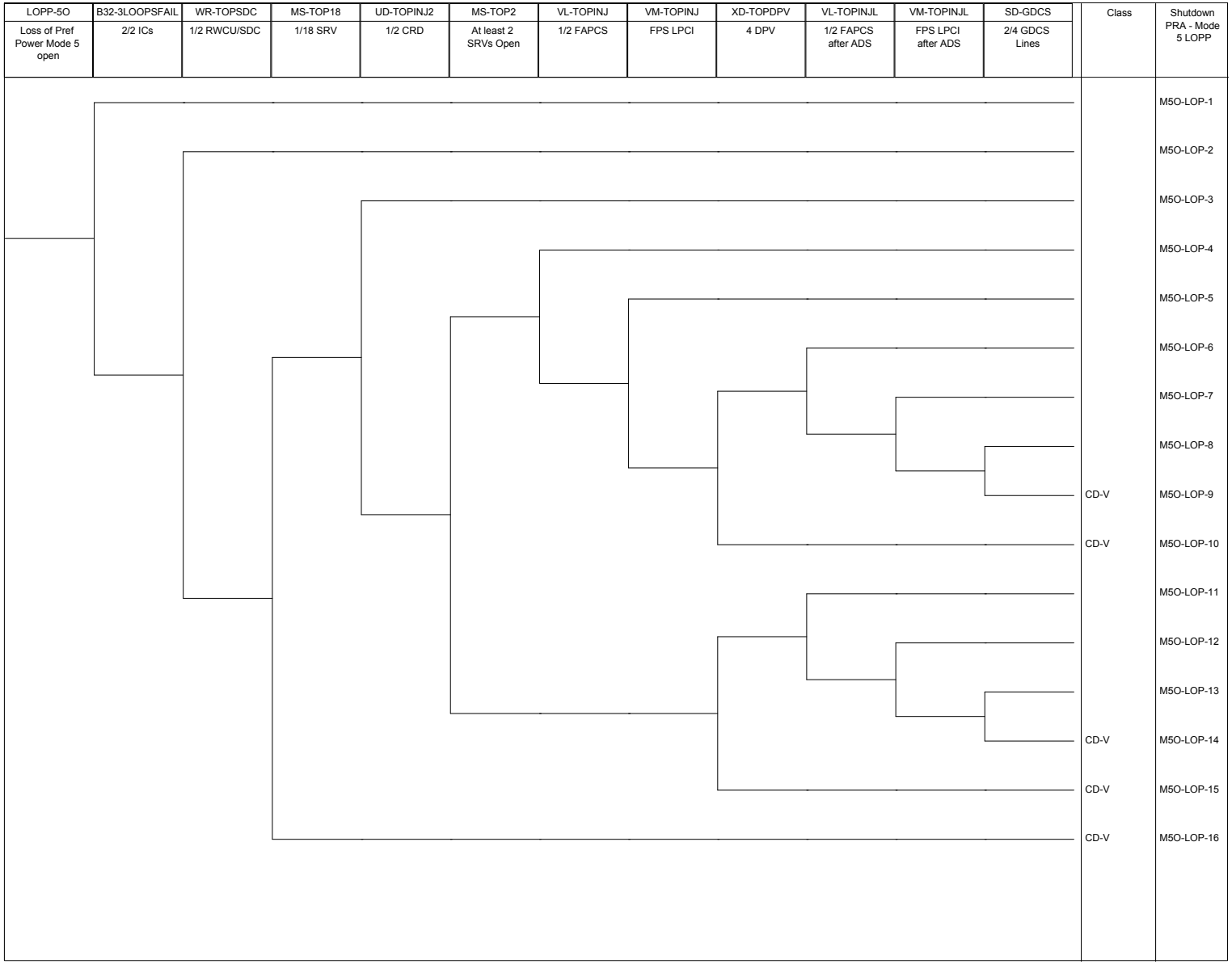


Figure 16.4-6. Loss of Preferred Power (Mode 5 Open)

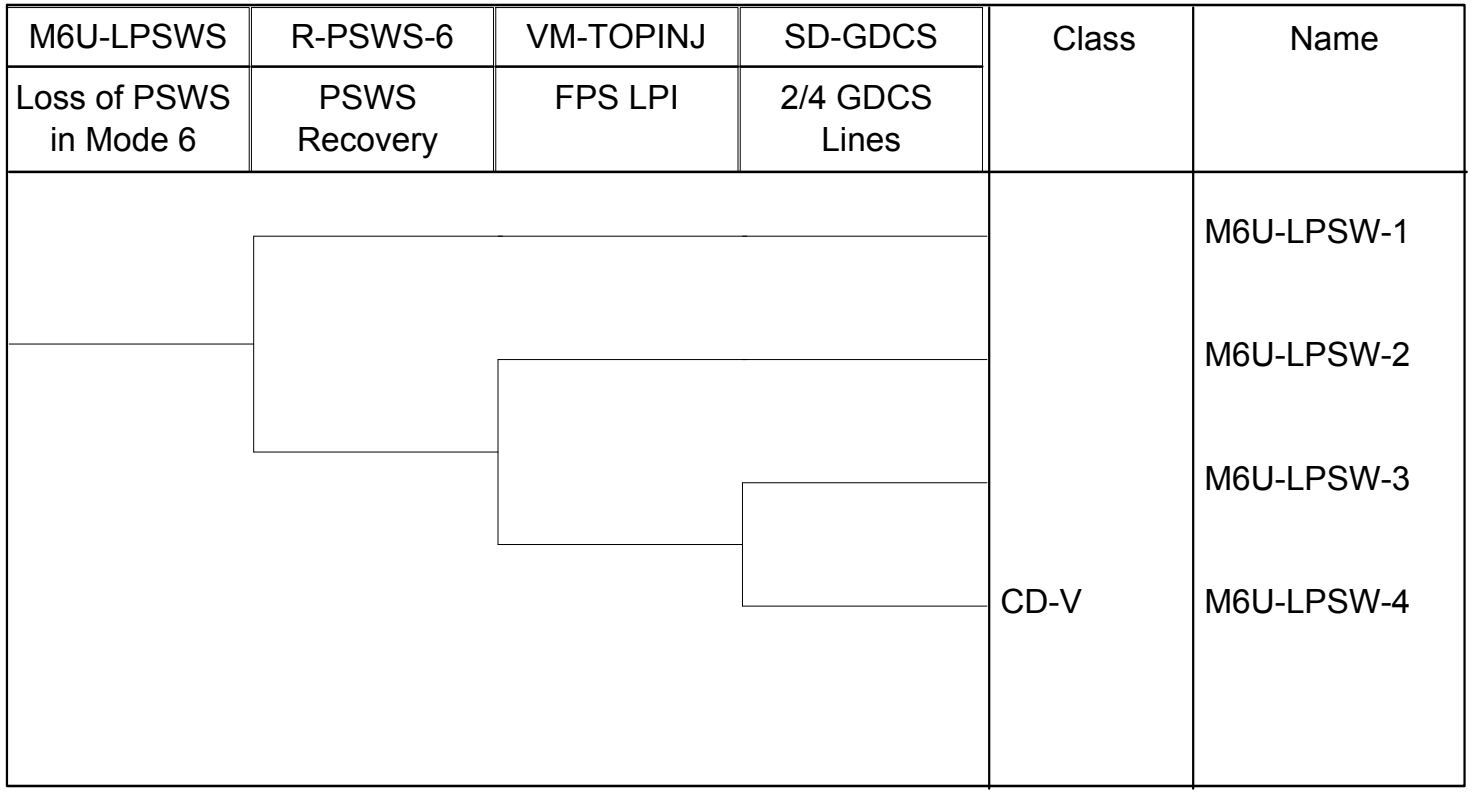


Figure 16.4-7. Loss of all Service Water PSWS/RCCWS (Mode 6 Unflooded)

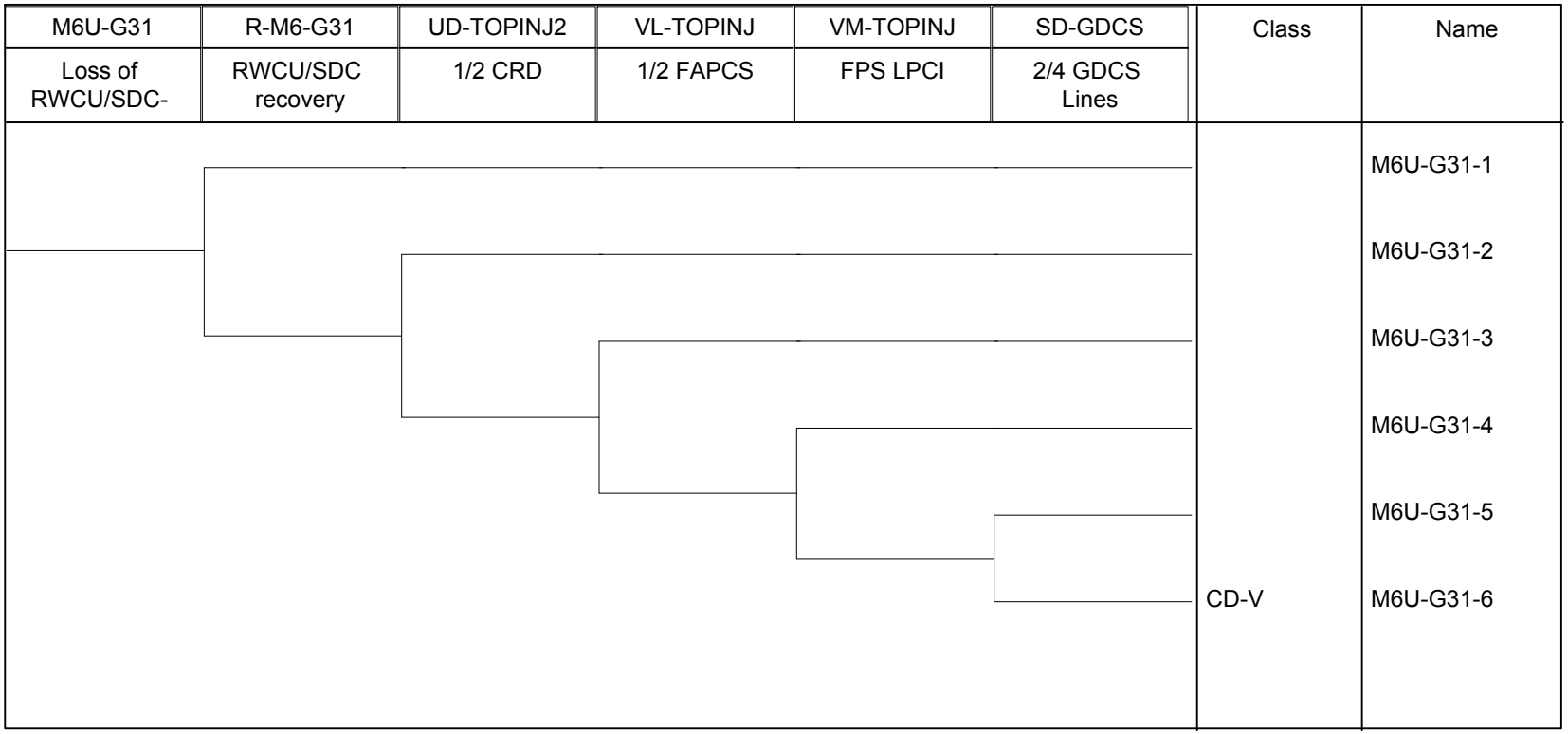


Figure 16.4-8. Loss of Both RWCU/SDCS Trains (Mode 6 Unflooded)

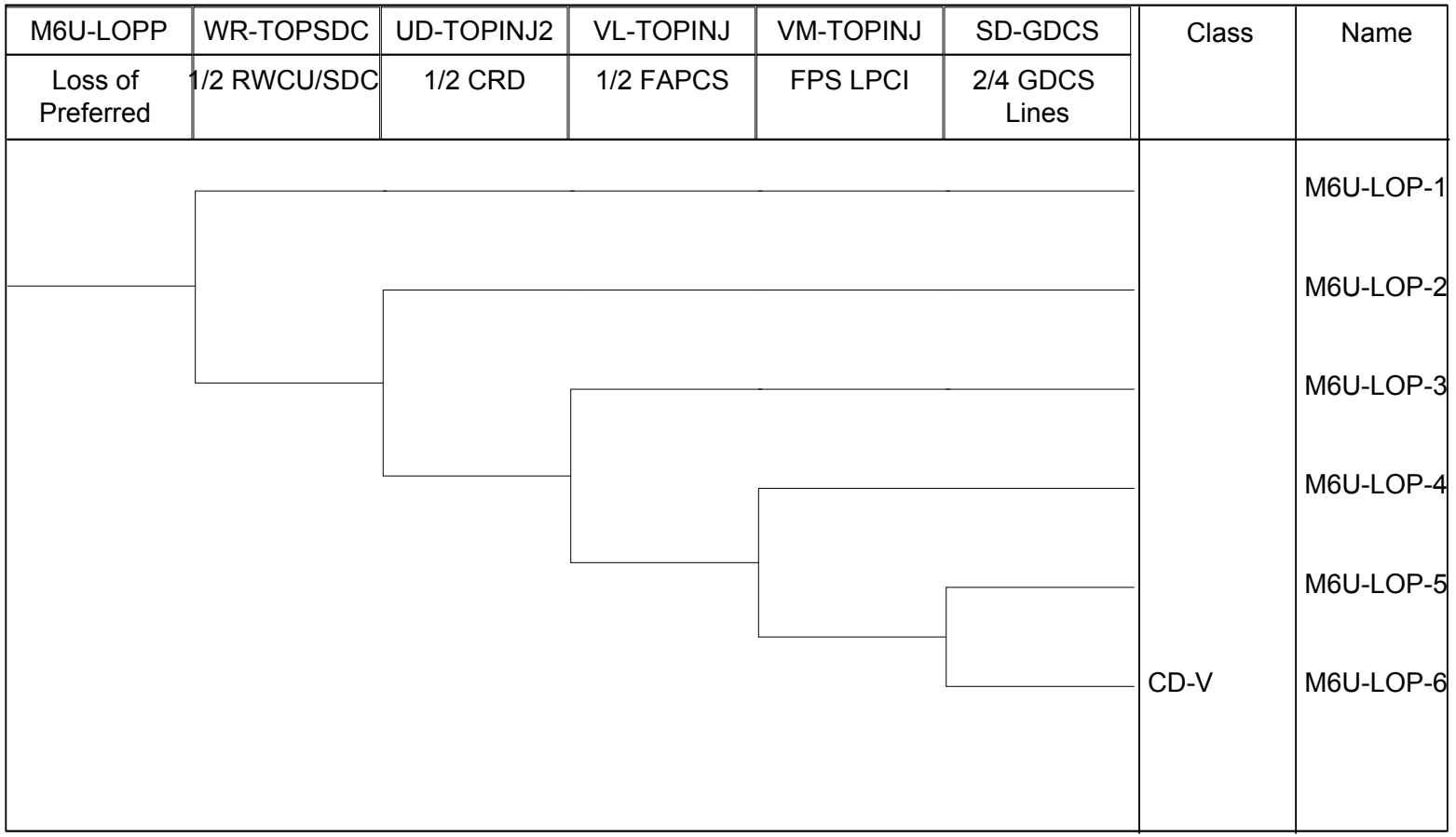


Figure 16.4-9. Loss of Preferred Power (Mode 6 Unflooded)

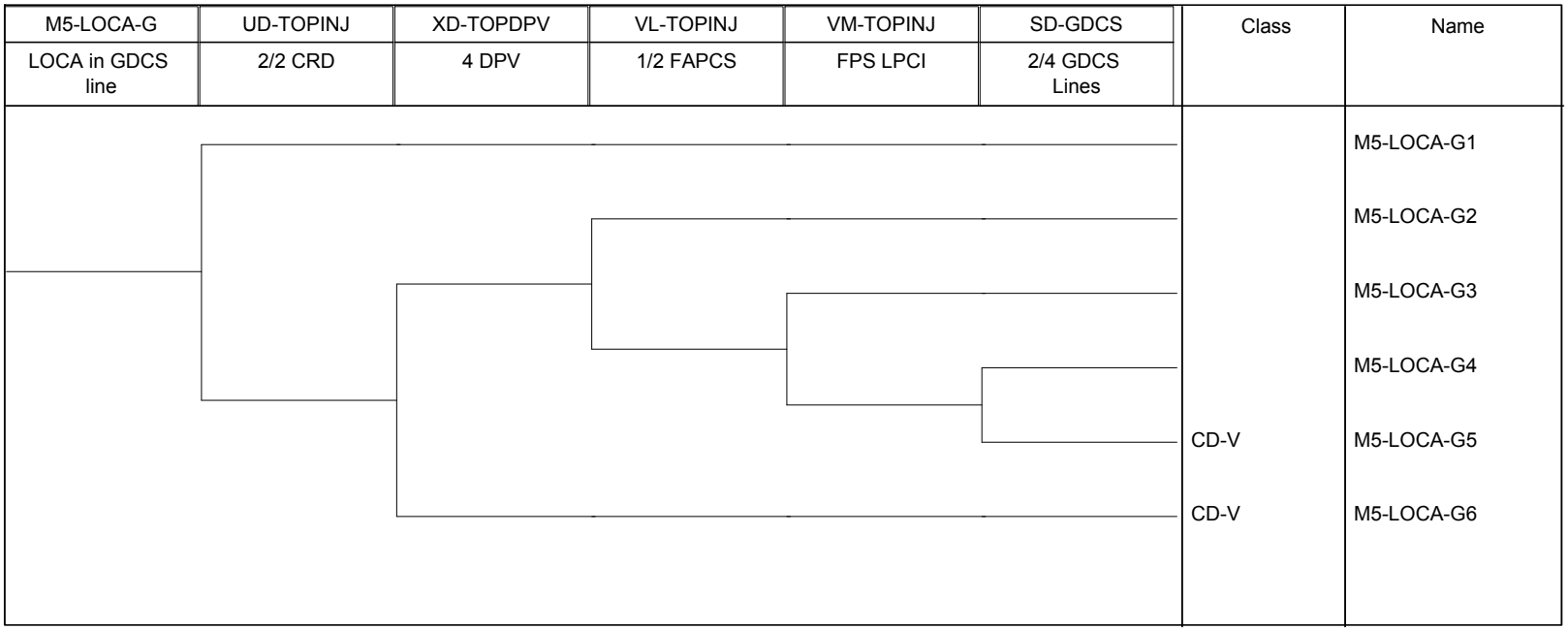


Figure 16.4-10. GDCS LOCA (Mode 5)

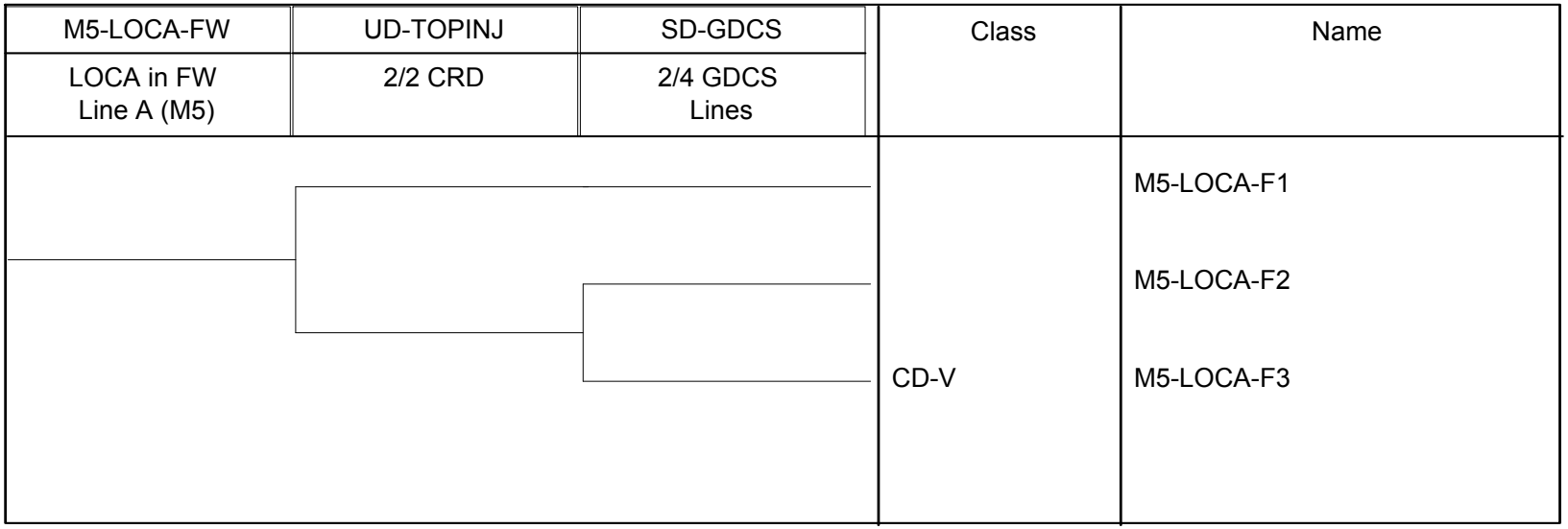


Figure 16.4-11. LOCA in Feedwater line (Mode 5)

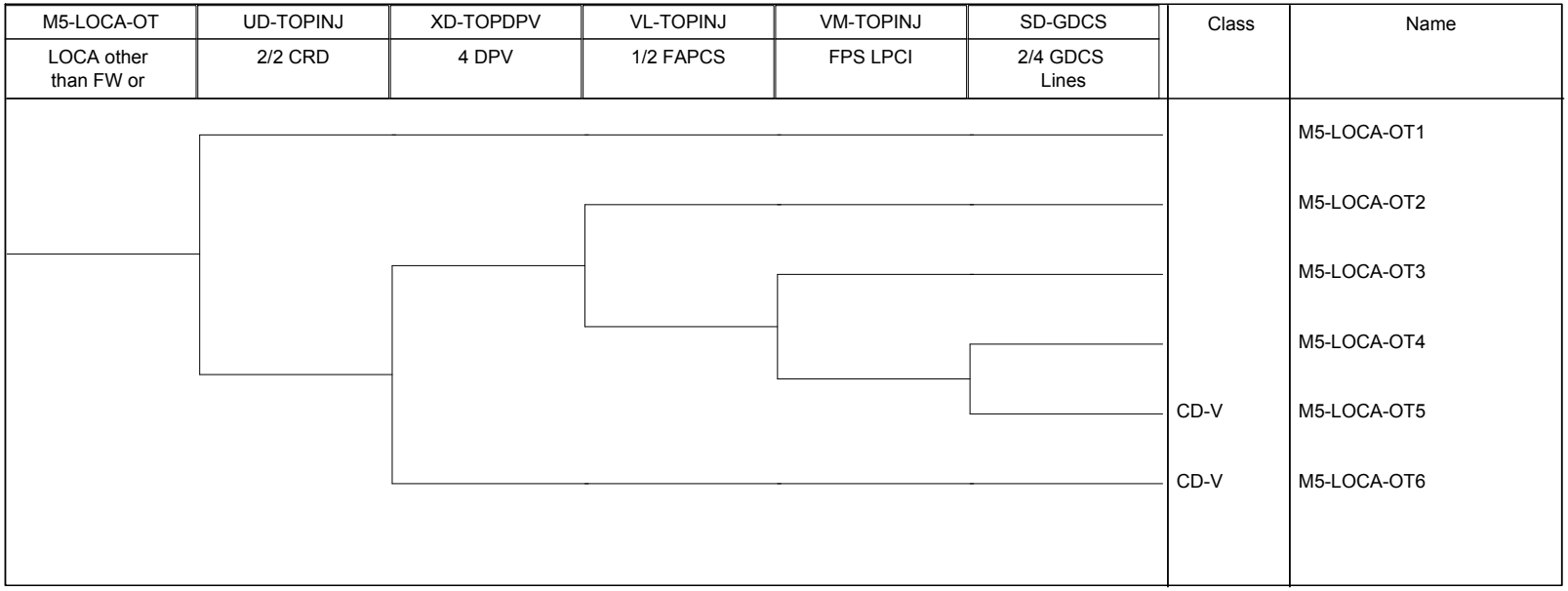


Figure 16.4-12. LOCA other than FW or GDCS (Mode 5)

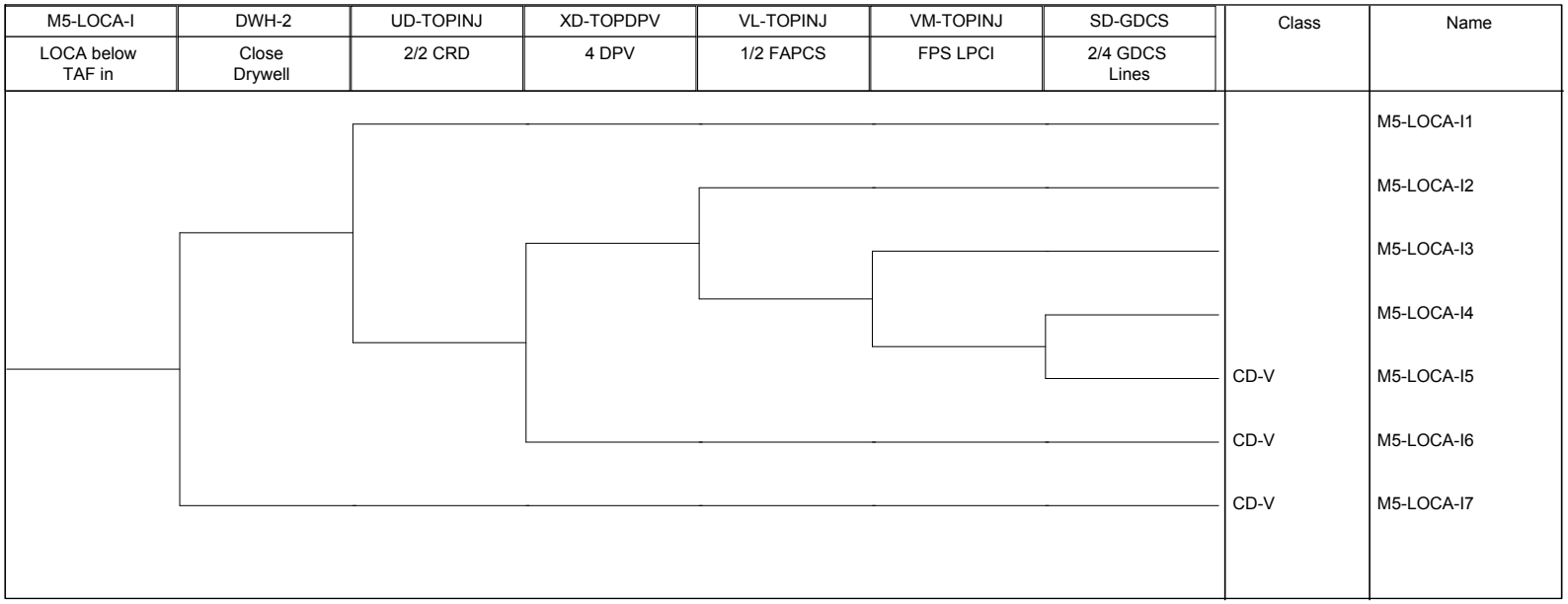


Figure 16.4-13. LOCA below TAF in Instrument line (Mode 5)

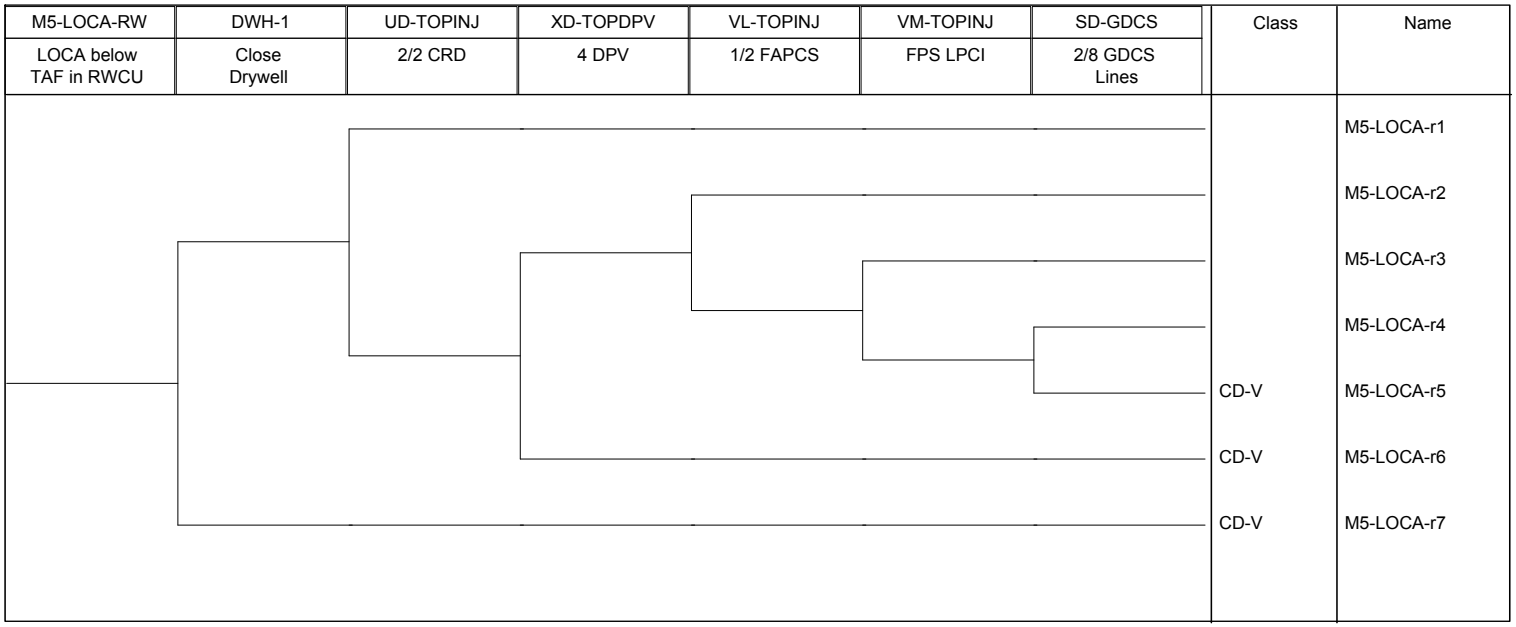


Figure 16.4-14. LOCA Below TAF in RWCU Drain Line (Mode 5)

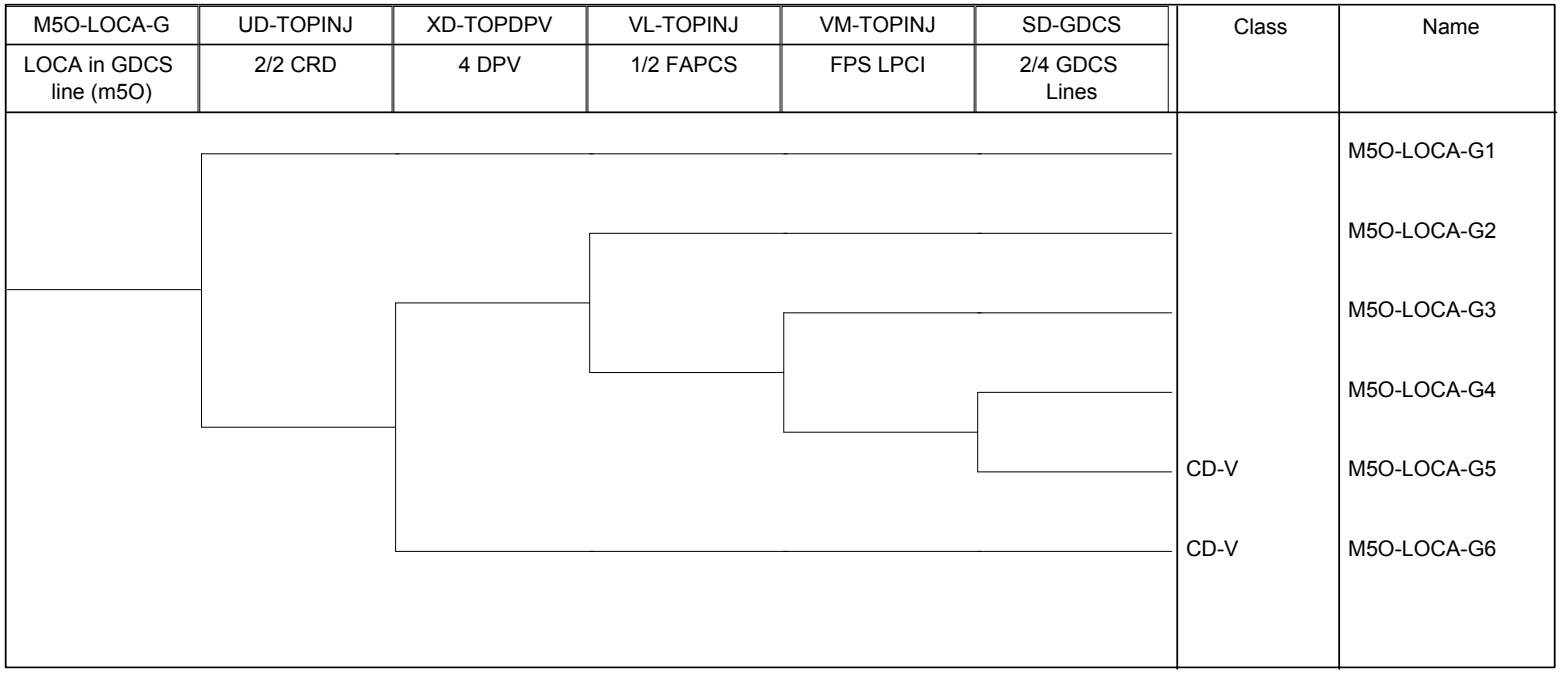


Figure 16.4-15. LOCA in GDCS line (Mode 5 Open)

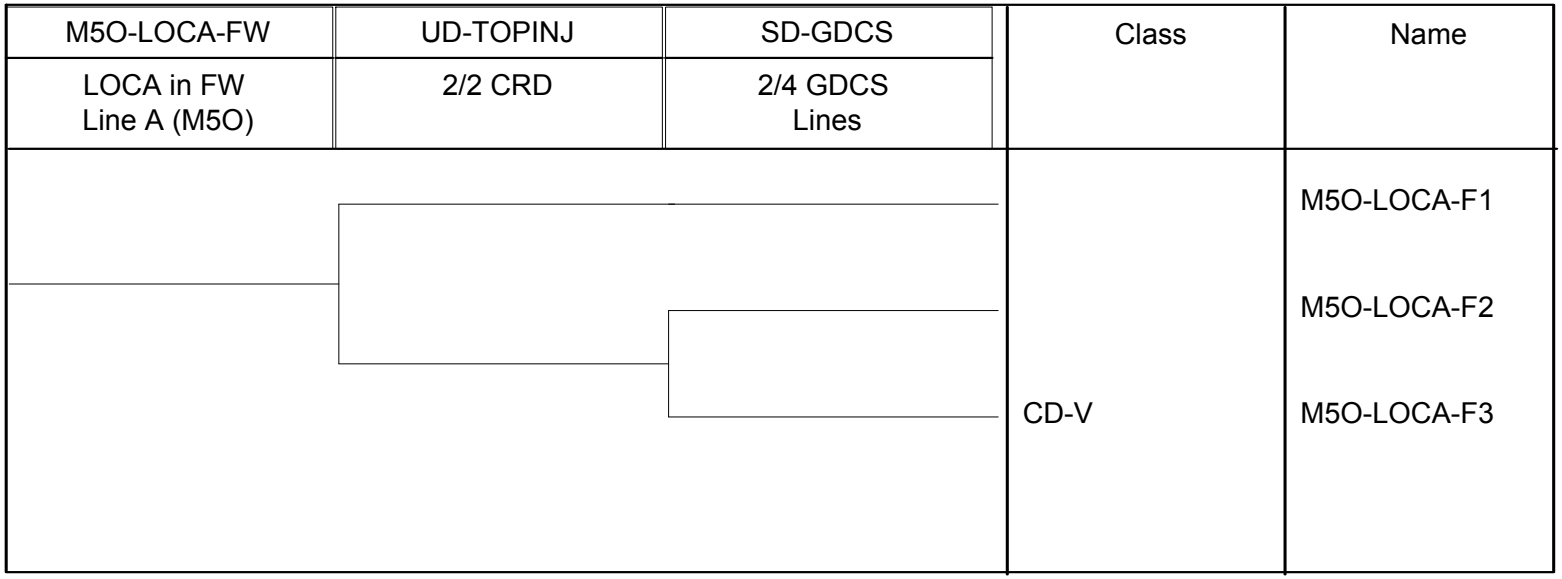


Figure 16.4-16. LOCA in Feedwater line (Mode 5 Open)

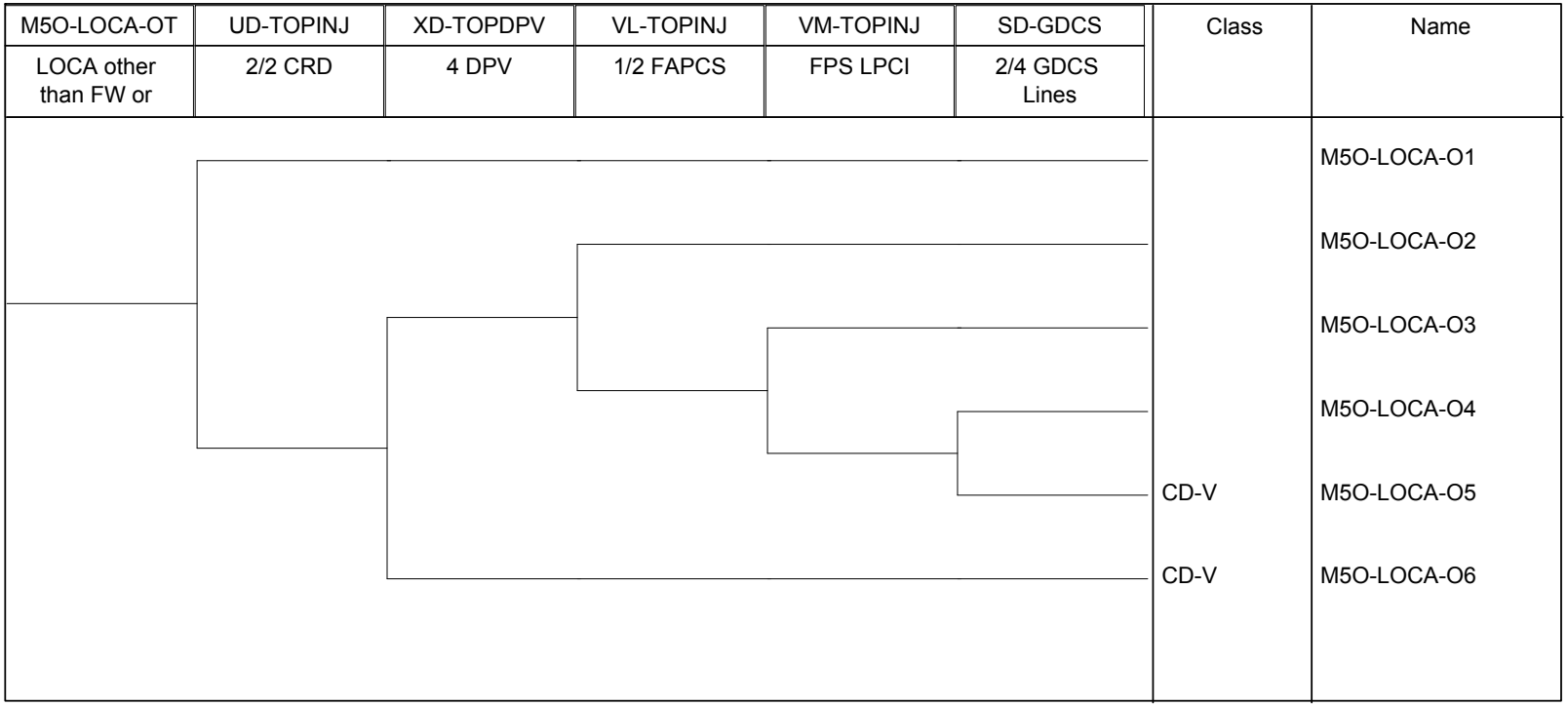


Figure 16.4-17. LOCA in Line Other than Feedwater or GDCS (Mode 5 Open)

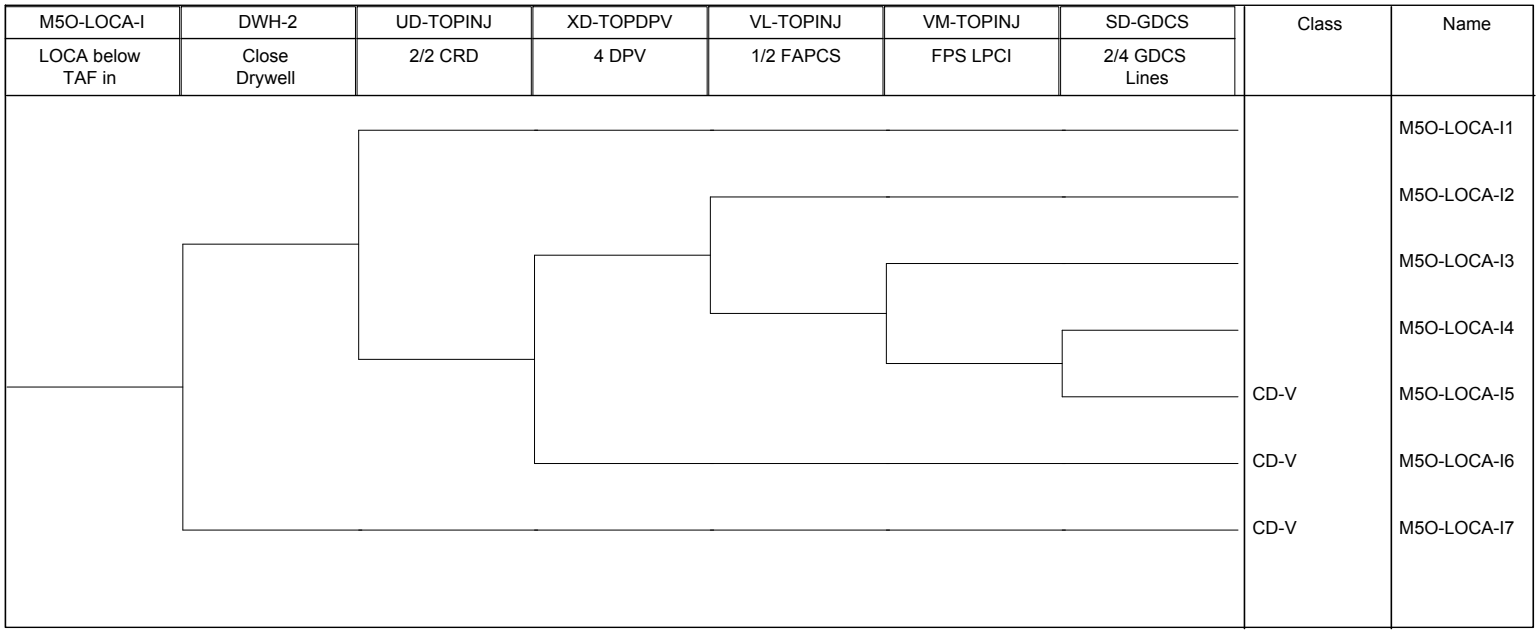


Figure 16.4-18. LOCA Below TAF in Instrument Line (Mode 5 Open)

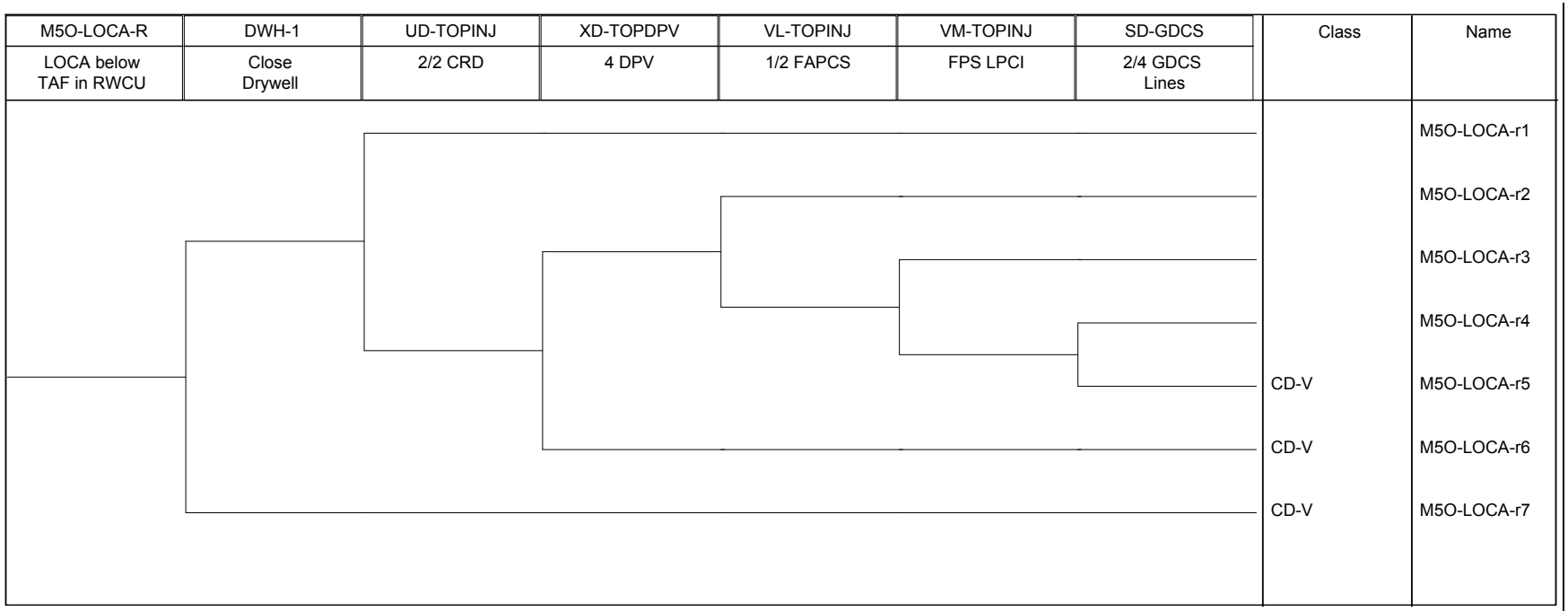


Figure 16.4-19. LOCA Below TAF in RWCU Drain Line (Mode 5 Open)

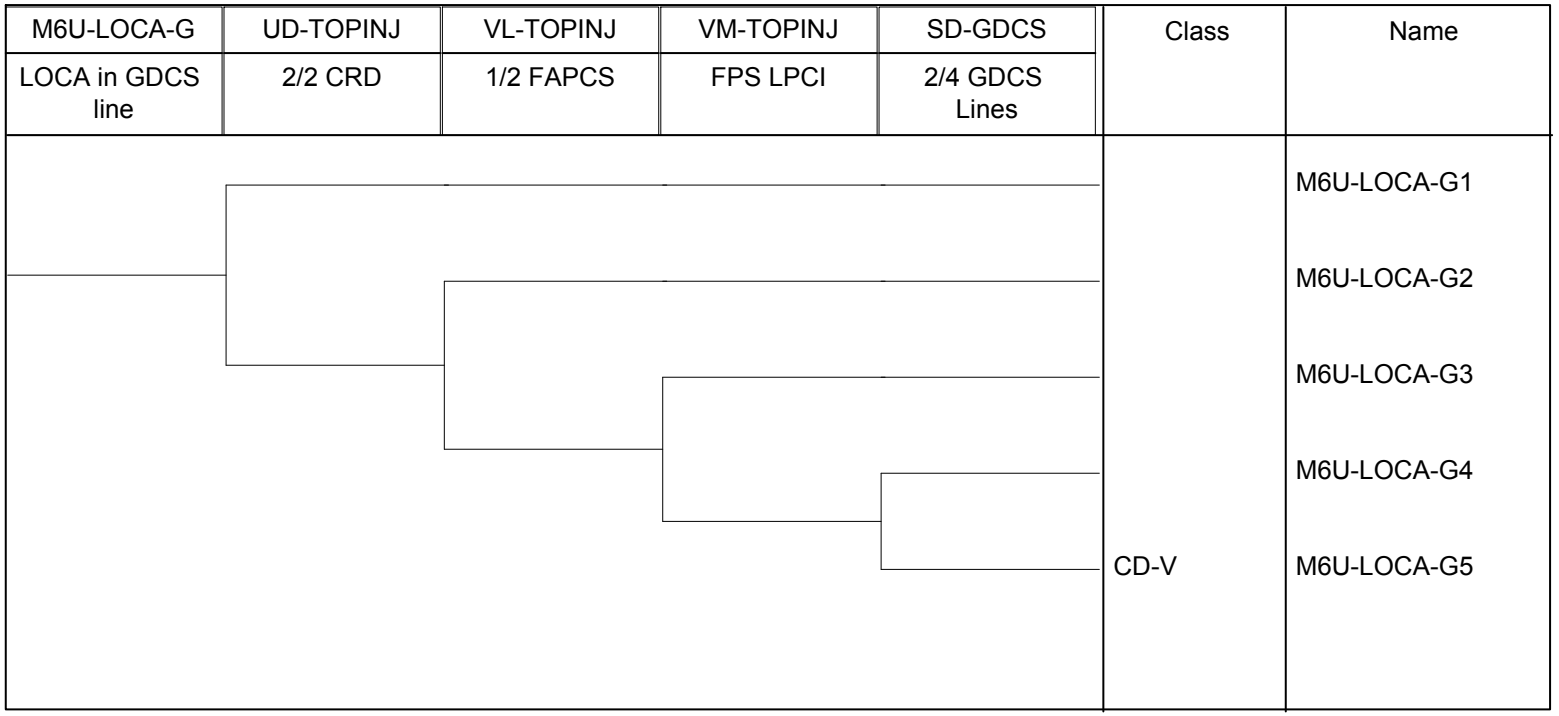


Figure 16.4-20. LOCA in GDCS line (Mode 6 Unflooded)

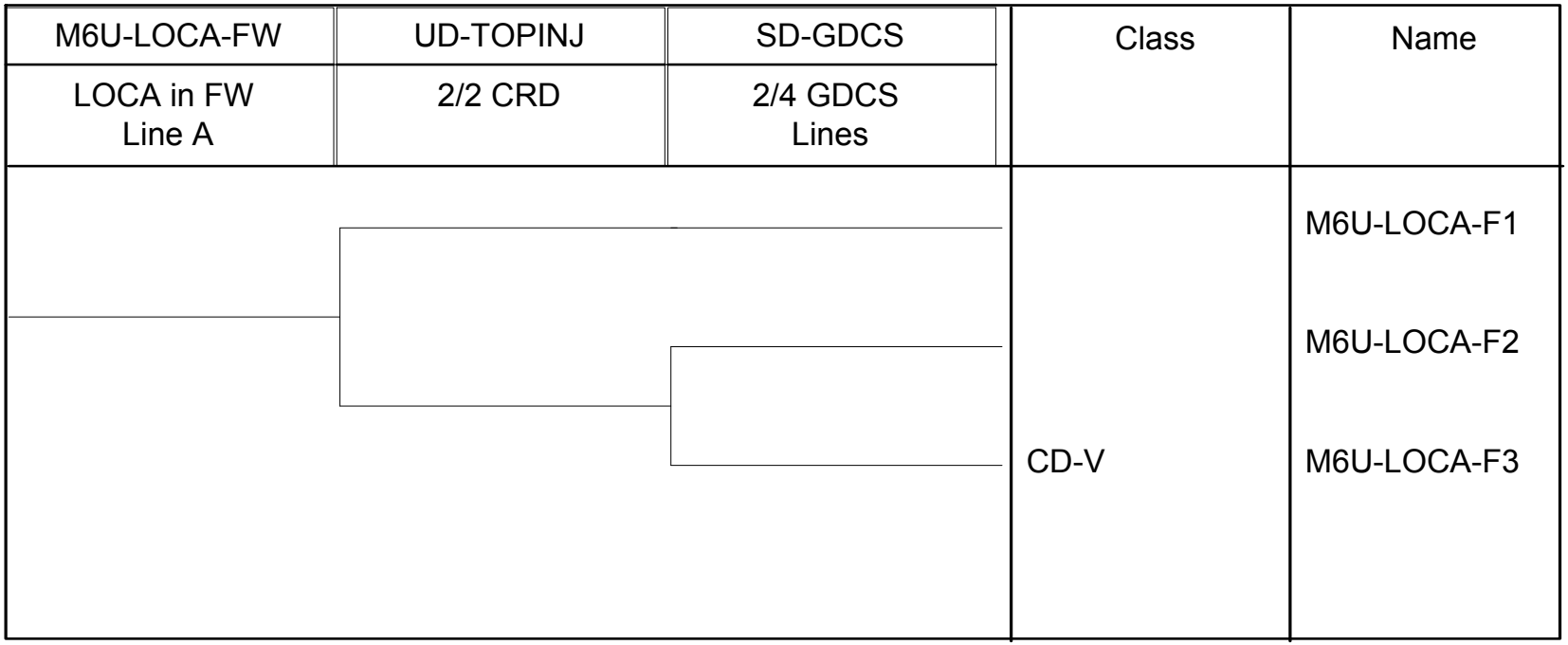


Figure 16.4-21. LOCA in Feedwater line (Mode 6 Unflooded)

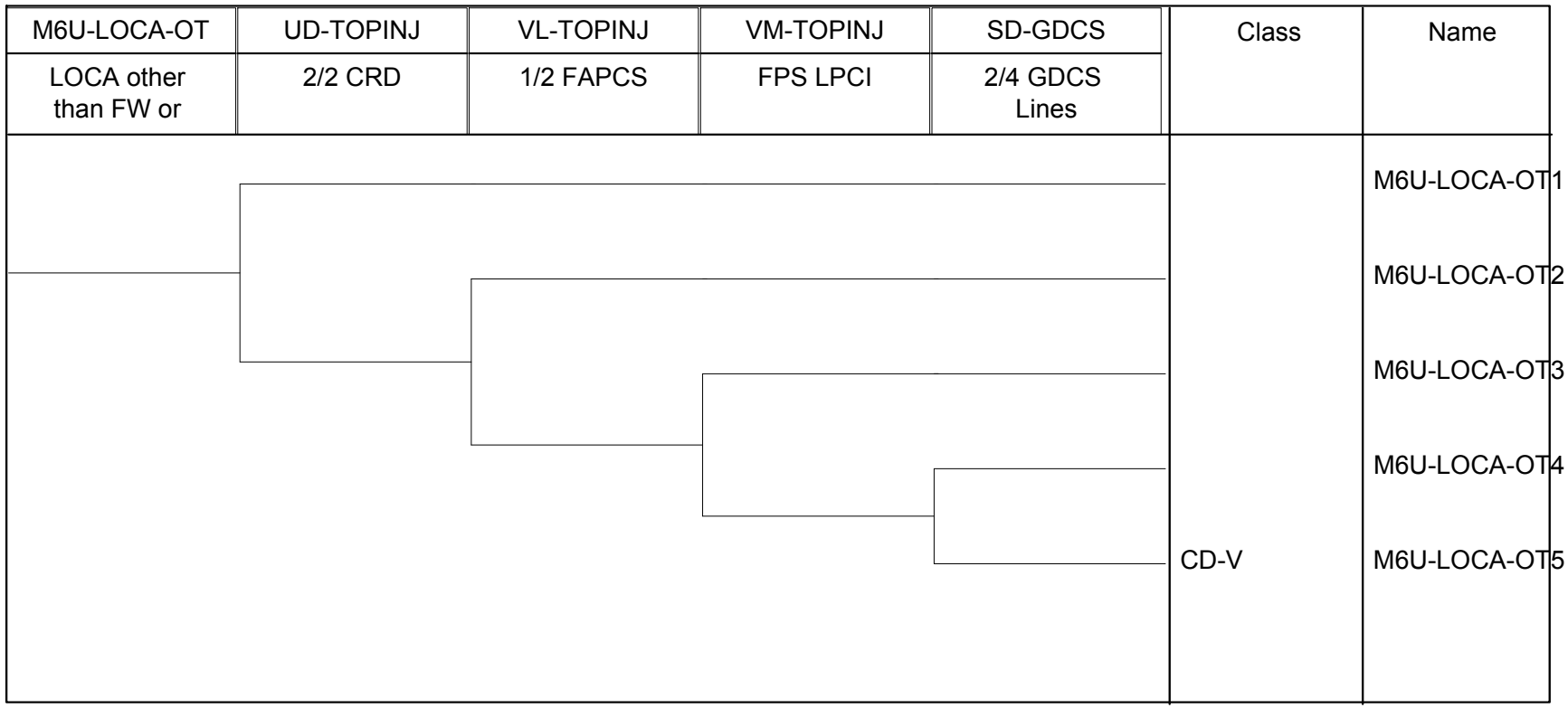


Figure 16.4-22. LOCA in line other than Feedwater or GDCS (Mode 6 Unflooded)

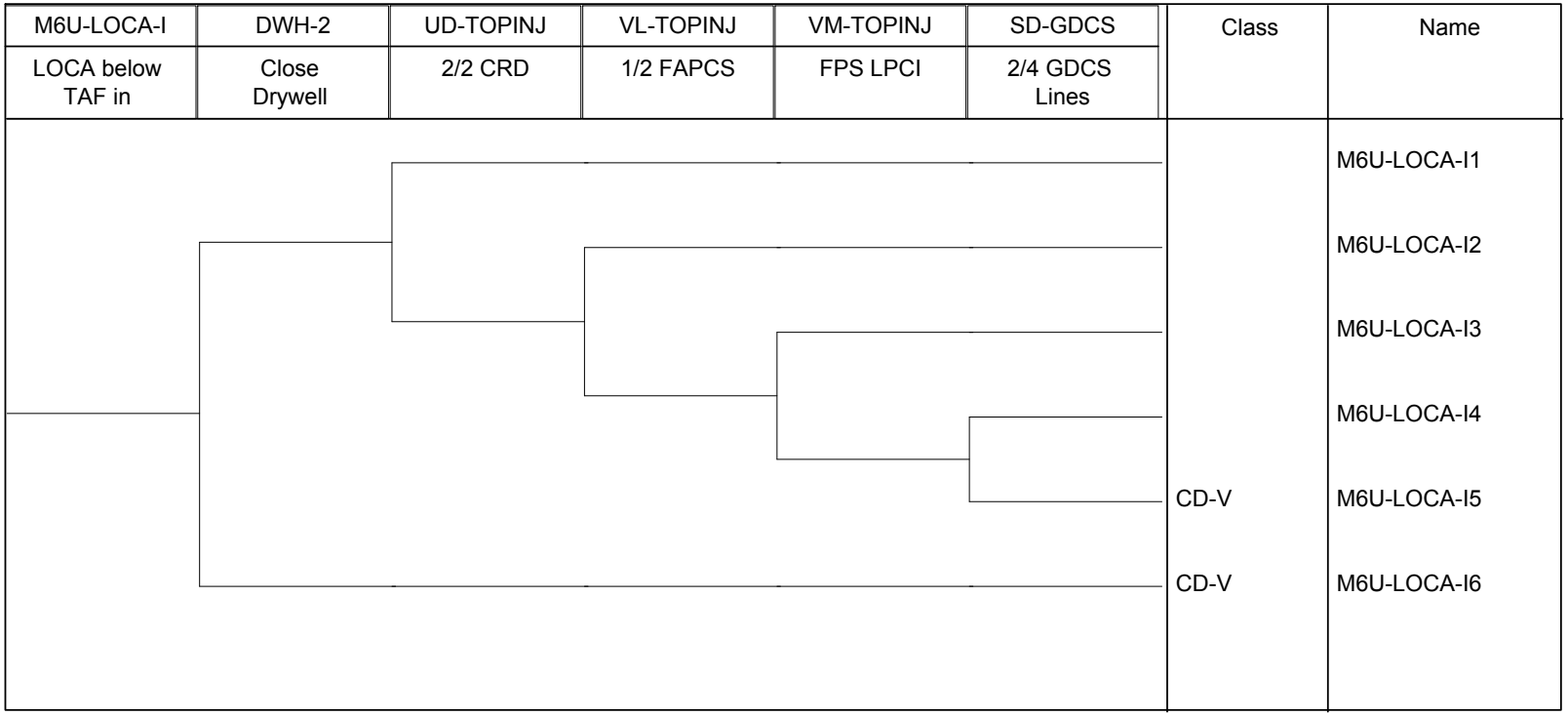


Figure 16.4-23. LOCA below TAF in Instrument line (Mode 6 Unflooded)

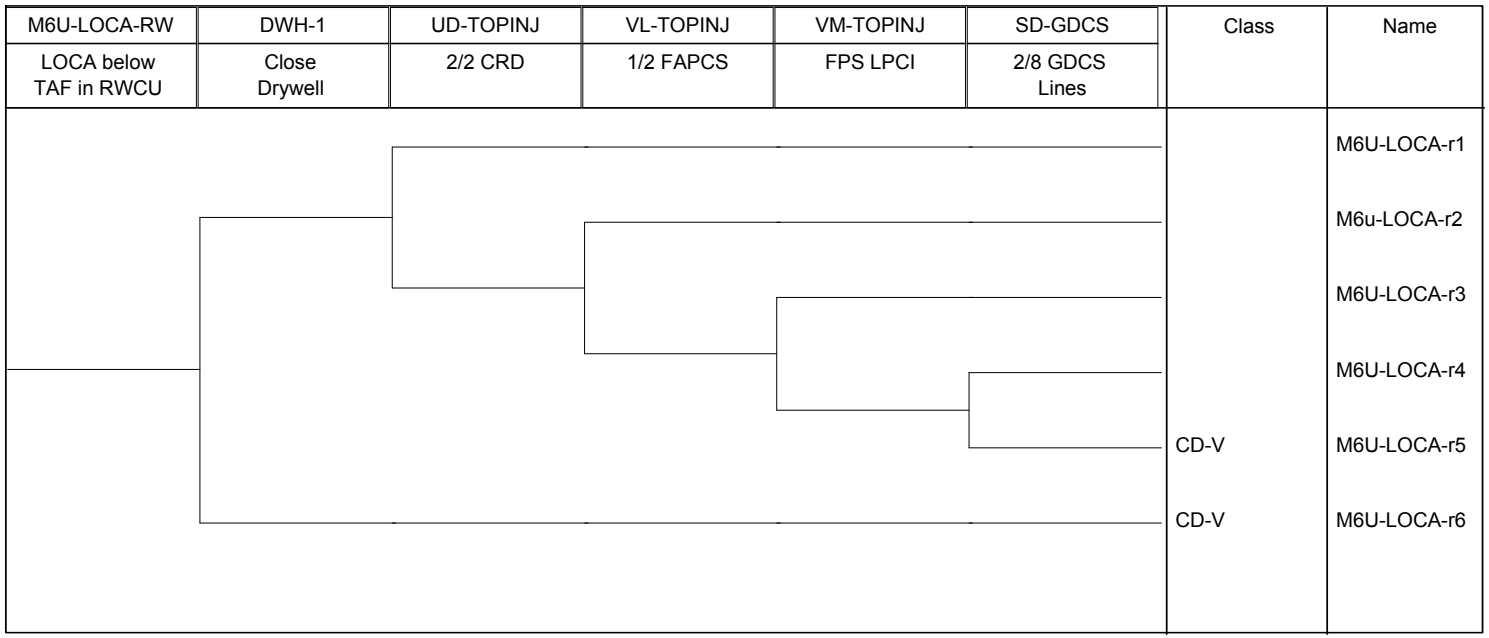


Figure 16.4-24. LOCA below TAF in RWCU drain line (Mode 6 Unflooded)

M6F-LOCA_I	DWH-2	Class	Name
LOCA below TAF in Instrument line	Close Drywell Hatch -2		
			M6F-LOCA-I1
		CD-V	M6F-LOCA-I2

Figure 16.4-25. LOCA below TAF in Instrument line (Mode 6 Flooded)

M6F-LOCA_R	DWH-1	Class	Name
LOCA below TAF in RWCU/SDC drainlines	Close Drywell Hatch -1		
		CD-V	M6F-LOCA-R1 M6F-LOCA-R2

Figure 16.4-26. LOCA below TAF in RWCU drain line (Mode 6 Flooded)