TECHNICAL REPORT
A-3875-T2C, Rev. 1

RISK-BASED INSPECTION GUIDE (RIG) FOR THE WOLF CREEK GENERATING STATION (Based on Generic PRA-Based Information for Pressurized Water Reactors)

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DEPARTMENT OF NUCLEAR ENERGY, BROOKHAVEN NATIONAL LABORATORY
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WOLF CREEK GENERATING STATION

1. INTRODUCTION

This inspection guide has been prepared to provide generic risk-based inspection guidance for Westinghouse PWRs based on review of several Probabilistic Risk Assessments (PRAs).[7.1.1-7.1.3] It is not intended to apply to CE or B&W plants. The guidance should be used to aid in the selection of areas to inspect and is not intended either to replace current NRC inspection guidance or to constitute an additional set of inspection requirements. Recent system experience, failures, and modifications should be considered when reviewing these tables. **Since plant modifications are normally an ongoing process, it is recommended that relevant changes be catalogued so that this inspection guidance can be periodically revised as required.**

2. GENERIC DOMINANT ACCIDENT SEQUENCES

Based upon a review of available PRAs for PWRs, eleven representative accident sequences were selected based on their contribution to core damage frequency or because of serious offsite consequences, as shown in Table 1. The details of these sequences are described below.

Table 1
Representative PWR Accident Sequences

Loss of Coolant Accident Sequences

1. Small or medium LOCAs with failure of high head injection or recirculation.
2. Medium or large LOCAs with failure of low head recirculation.
3. Medium or large LOCA with failure of low head injection.
4. LOCA outside containment.*

Transient Sequences

5. Loss of all CCW initiator with a subsequent RCP seal LOCA.
6. Loss of 125V dc bus initiator with failure of the auxiliary feedwater system (AFW).
7. Loss of offsite power (LOOP) initiator with failure of AFW and feed and bleed.
8. Station blackout with loss of the AFW system.
9. Station blackout with a subsequent RCP seal LOCA.
10. Loss of PCS initiator (or a general transient with loss of PCS) followed by loss of AFW.**

Anticipated Transient Without Scram (ATWS) Sequences

11. Transient initiator with failure to automatically and manually scram with failure of timely emergency boration.

* Specified because of serious offsite consequences.

** Specified based on a review of the studies that established precursors to potential severe core damage accidents (NUREG/CR-2497, 3591, 4674).

2.1 LOCAs

2.1.1 Small or Intermediate LOCAs (Sequence 1)

This accident sequence is initiated by a small ($\phi \leq 2$ in.) or intermediate (2 in $< \phi \leq$ 6 in.) LOCA which does not depressurize the Reactor Coolant System (RCS) below the shutoff head of the low head Emergency Core Cooling System (ECCS). The Reactor Protection System (RPS) successfully scrams the reactor but the high head ECCS fails to provide adequate makeup, either in the injection or recirculation phases, resulting in core damage. The high head ECCS includes the intermediate head Safety Injection System. Small LOCAs have actually occurred in commercial nuclear power plants and consist primarily of stuck open power operated relief valves (PORVs) and to a lesser degree reactor coolant pump (RCP) seal failures.

Failures during the injection phase are dominated by valve failures in the high head injection (HHI) common discharge or suction lines or in the mini-flow lines.

Failures during the high head recirculation (HHR) modes which can occur in the HHR system, or in any of the support systems required for long term LOCA mitigations, are the dominant contributors to these sequences. The HHR failures are themselves dominated by operator failure to correctly realign the system from the injection mode (for manual systems) or valve failures in the common discharge or suction lines or the mini flow line for those configurations with automatic realignment to the HHR mode, such as Wolf Creek. The Westinghouse HHR configuration takes suction from the low head recirculation (LHR) pump discharge. LHR malfunctions that disable HHR are the secondary contributor to HHR failures. The primary faults are LHR suction (containment sump) valve and pump malfunctions.

HHR room cooling failures are the last major contributor. Those are attributable to electrical component failures that disable room cooler fans or service water valve failures that disables the coolers themselves. Refueling Water Storage Tank (RWST) common mode level sensors miscalibration and Service Water/Component Cooling Water malfunctions that disable the HHR pump coolers are less important contributors.

2.1.2 Medium or Large LOCAs (Sequences 2,3)

In accident sequences 2 and 3, an intermediate or large LOCA occurs which rapidly depressurizes the reactor coolant system, followed by successful scram of the reactor.

Operation of the Low Head Injection (LHI) system is either successful but followed by failure of the LHR system, or the LHI system itself initially fails, either of which leads to core damage. The initiating event is an intermediate or large primary system pressure boundary failure from 6 to 29 in. in diameter. No actual industry failures of this magnitude have occurred.

2.1.2.1 Failures of the Low Head Recirculation (LHR) Mode (Sequence 2)

A major contributor to core damage for this sequence is the failure of the low head ECCS in the recirculation mode. LHR system failure is evenly divided between human errors and hardware failures. The dominant human error contributor is the failure to initiate LHR by manual realignment of the pump suction from the RWST to the containment sump. This failure dominates those plants with non-automatic pump suction realignment. As noted previously, Wolf Creek has automatic realignment.

Since boron precipitation in the reactor vessel can be minimized or prevented and steam voids in the Reactor Pressure Vessel (RPV) head can be condensed by a backflush of cooling water through the core to reduce boil-off and resulting concentration of boric acid in the water remaining in the reactor vessel, a second operator error is the failure to manually switch the LHR (SI) pump discharge from cold leg to hot leg recirculation after about 24 hours following an accident.

Hardware failures are the dominant contributors to LHR system failure for plants such as Wolf Creek with an automatic pump suction changeover feature. Important system valve malfunctions include failures of LHR containment sump valves to open or RWST suction valves to close, both including common cause failures. The failure of the low head pumps to continue to run (including common cause) is the remaining LHR hardware failure.

The common cause miscalibration of the RWST level sensors is the only major failure not directly associated with the low head ECCS. Other failures are predominantly valve failures such as rupture or failure to open of check valves, valves failing to remain open, service water to RHR heat exchanger valves failing to open, and operator failure to initiate recirculation cooling. Failures of LHR can also occur during the HHR operating mode as previously described in 2.1.1 above.

2.1.2.2 Failures in the Low Head Injection (LHI) Mode (Sequence 3)

A major contributor to core damage for Sequence 3 is the failure to provide short term core injection due to accumulator or low head injection malfunctions. The accumulator failure is attributed to discharge line failures, primarily check valve failures to open or MOV plugging. The LHI system failure is dominated by pump failure to start or run, including common cause. Human error contributors are the failure to restore the system to operable status after testing and the failure to stop the pumps if the miniflow valve fails to open. The dominant system valve failure is failure of the miniflow valve to open. Other failures include injection isolation valves failing to open or to remain open, check valves rupturing or pumps unavailable due to maintenance.

2.1.3 LOCAs Outside Containment (Sequence 4)

The commonly designated V sequence, here called LOCA outside containment, is initiated by a failure of any of the pairs of interface valves that isolate the high pressure reactor coolant system (RCS) from the RHR/LHI system. These include rupture of the pairs of check valves on the RHR discharge lines to the RCS and rupture or inadvertent opening of the motor operated valves in the RHR suction line from the RCS. The resultant overpressurization of the RHR system is assumed to rupture the piping or components outside the containment boundary. Although core inventory makeup by the high head injection and any available low head injection systems is initially available, the inability to switch to the recirculation mode eventually leads to core damage.

The discharge of the Wolf Creek LHI System consists of one line from each RHR pump with a normally open MOV. Downstream of these MOVs (toward the RCS) the piping is rated for primary loop conditions. The discharge lines divide to connect to each RCS cold leg. Each of these individual lines has one check valve resulting in two check valves in series. Small leakages through these valves can be accommodated without system overpressure. The failure modes of interest produce sudden, large back leakages through a pair of these interface check valves. The failure is postulated to occur in three ways:

- The dominant initiator mode is the rupture of one check valve with the previously undetected opening of the second valve. If one valve is holding pressure, the other valve can drift open and fail in the open position.
- The second initiator mode is the failure of one check valve to close upon repressurization, followed by a rupture of the second valve.
- The third initiator mode is the random rupture of the valve internals for both check valves. The gross failure of one valve could go undetected until the rupture of the second valve occurs.

The applicability of these initiator types to a specific plant is very dependent on the piping configuration of the LHI/RCS interface and the valve testing procedures. For example, Wolf Creek, like some other Westinghouse PWRs, has the accumulator discharge connected between the two interface check valves. This geometry imposes a specific interface valve failure order for the first and third initiator types. If the upstream (furthest from the RCS) valve fails first, the accumulator will discharge into the LHI piping, thereby alerting the operator.

The applicability of the second initiator type is dependent on the check valve test procedure. Plants that test the interface check valves when the system is depressurized are subject to this initiator type. There is no assurance that both of the valves remain closed on subsequent repressurizations. A test-procedure that requires valve testing upon every repressurization or use can eliminate the second initiator type from consideration. (The Wolf Creek check valve test procedure should be examined carefully to ensure that the potential for a test induced LOCA outside containment is minimized.)

A potential recovery action has been included to account for operator action to isolate the interfacing LOCA by manual closure of the LHI discharge MOV. The successful mitigation of this event is plant specific and is dependent on:

- LHI pump separation to minimize the environmental impact of RCS blowdown on the second train.
- The existence of two isolatable LHI discharge headers to enable the use of the other LHI loop, or the ability to use another system for RCS makeup.

- The capability of the LHI discharge MOV to isolate the interfacing LOCA. The valve may not be designed to close against such a high differential pressure. If not, attempting to close the valve before the RCS has depressurized may fail the valve in the open position.

A less significant initiator is the overpressurization and failure of the shutdown cooling suction line. The two, normally closed suction line MOVs are postulated to rupture or the downstream valve transfers open with a subsequent rupture of the upstream valve.

Based on a review of industry experience, there have been several events that are relevant to interfacing system LOCAs. The NRC is currently in the process of evaluating the significance of these events. Inadvertent opening of the RHR suction line MOVs due to human errors seems more important than assumed in previous PRAs.

For BWRs, the interface valves generally consist of one normally closed MOV and one check valve. Several BWRs have experienced pressurizations of the low pressure piping, primarily due to testing errors. No gross failures have occurred, due to the lower operating pressure of the BWR RCS.

2.2 Transient Sequences

2.2.1 Loss of All Component or Closed Cooling Water (Sequence 5)

Sequence 5 represents a complete loss of the component or closed cooling water (CCW) system which precipitates a reactor coolant pump (RCP) seal LOCA and also disables the high and low head ECCS. At Wolf Creek, both the charging pump seals and bearings are cooled by CCW. The inability to provide high pressure makeup results in core damage.

One major contributor to the loss of CCW initiator is a pipe rupture that drains the system inventory before the break can be located and isolated. The second contributor is the common cause failure of all operating CCW pumps, compounded by a failure of the standby pump(s) to start and run. The RCP seal LOCA and subsequent core damage is postulated to occur before CCW recovery actions can be completed.

2.2.2 Loss of DC Power (One 125V DC Bus) (Sequence 6)

This sequence is initiated by a non-recoverable loss of a 125V DC bus. The DC power system provides control power to various systems. There have been several partial losses of DC power at operating nuclear power plants, approximately one third of which were caused by the misalignment of breakers as part of system maintenance or surveillances. The remainder of the precursors are due to equipment failures. A loss of one DC bus will typically disable the main feedwater system, a portion of the auxiliary feedwater system, and various DC dependent valves possibly including a pressurizer PORV. This sequence postulates the failure of the remainder of the AFW system and the feed and bleed mode.

Failure of secondary heat removal results in core inventory losses due to PORV cycling and subsequent core damage.

The major contributor to this sequence is the failure of the remainder of the AFW system to supply sufficient flow to the steam generators. This typically involves the failure of two additional AFW trains.[1] The major cause is system hardware failure including: pump failure to start, and discharge line faults for both the turbine and motor driven trains. A secondary contributor is the failure to manually start a pump which is procedurally locked out or unable to start due to a malfunction of the auto start logic.

For those plants with DC controlled PORVs, the sequence success criteria for feed and bleed is plant specific. Some PRAs assume 2 PORVs are required for success (Sequoyah, NUREG/CR-4550). The Zion risk assessment concluded that a single PORV is sufficient for success. For Sequoyah, this initiator by definition fails one valve and eliminates the feed and bleed mode. Wolf Creek is similar to Sequoyah in that both PORVs are required.

2.2.3 Loss of Offsite Power/Station Blackout Initiators

Loss of offsite power accident sequences are characterized by loss of offsite power followed by at least partial success of onsite emergency AC power sources. In contrast, station blackout sequences are initiated by loss of offsite power followed by total failure of onsite emergency AC power sources.

2.2.3.1 Loss of Offsite Power Initiator (LOOP) with Failure of Auxiliary Feedwater (Sequence 7)

The dominant accident sequence involving LOOP is initiated by a loss of offsite power with successful operation of at least one source of emergency AC power. Main feedwater is unavailable due to the initiator. The Auxiliary Feedwater (AFW) system fails due to common mode failures or because of random failures, in concert with the partial system unavailability due to AC power failures. The feed and bleed mode is not successful, generally because of system failures. Since secondary heat removal is not available, the resultant boiloff of primary coolant leads to core damage.

The LOOP initiator is one of the more common operating transients, comprising approximately 21% of all precursors to potential core damage. Although some of these initiators are weather or grid related, about 50% of the LOOP precursors are localized failures due to human error such as: maintenance errors on the main generator or switch yard breakers, breaker misalignment during or post maintenance and errors related to manual breaker operation. In addition, several initiators were caused by station transformer faults. The subsequent failure of one or more sources of emergency AC power, usually emergency diesel generators (EDGs) failing to start or run, is important because it disables a portion of the Auxiliary Feedwater (AFW) system. The major contributor to this sequence is the failure

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[1]In some plants with two DC busses, to meet electrical separation requirements, the turbine-driven pump is supplied power from only one of the busses so that loss of that bus can fail both the turbine-driven pump and the respective motor-driven pump.

of the AFW system to provide sufficient flow to the steam generators, partially caused by the failure of one or more (but not all) EDGs. The remainder of the system fails due to a combination of unrelated faults, such as local failures (primarily valve related) of the AFW turbine steam admission line or the AFW pump discharge lines and local faults of the turbine driven (TD) pump. Another contributor is TD pump unavailability due to maintenance activities.

The major human error is plant specific. If the AFW system is normally configured so that one pump is locked out, the failure to manually start this pump when needed becomes critical.[2] The AFW system can also be subject to several common mode failures. All are highly plant specific. One is undetected flow diversion, typically to a second unit, or else back to the Condensate Storage Tank (CST) through the mini-flow line as in Wolf Creek. The second is steam binding of the pumps due to main feedwater leakage through the AFW pump discharge check valves which flashes to steam in the AFW pump. The last failure mode is the loss of the operating portion of the system due to a suction valve failure. Wolf Creek has a single suction line that serves all pumps so that a single suction valve closure would disable the AFW pumps and require operator action to realign the system suction to the Essential Service Water System.

The bleed and feed mode is the option of last resort. It is highly plant specific. In some PRAs, only one PORV is considered necessary for system success while in others, both are considered necessary, thereby significantly magnifying the importance of the PORVs themselves. At Wolf Creek, both PORVs are required for success. PORV system failures can be attributed to failure of a PORV to open on demand or prior closure of a PORV block valve, given loss of the EDG. The block valve requires AC power to reopen.

2.2.3.2 Station Blackout Sequences

The dominant accident sequences begin with LOOP as described in 2.2.3.1 followed by failure of all onsite power sources, resulting in a station blackout. One short term station blackout has occurred, during a loss of turbine generator and offsite power startup test. This was caused by an inadvertent isolation of the diesel generator start relays due to a failure to follow procedures.

2.2.3.2.1 Station Blackout with Failure of Decay Heat Removal (Sequence 8)

The loss of all AC power results in an immediate failure of all decay heat removal systems except for the turbine driven portion of the auxiliary feedwater system. The AFW system subsequently fails resulting in core damage. The major contributor to this sequence is the failure of all emergency AC power. This is dominated by the failures to start or run of all diesels or the unavailability of an EDG due to test or maintenance activities with the failure of the remaining units to start/run. The AFW system failures can occur in both the long or short term. Long term failures are attributable to station battery depletion, which results in

[2]In some Wolf Creek procedures, upon an SI signal, the operator places the motor-driven pumps in the pull-to-lock position until power is restored to at least one safeguards bus.

the loss of instrumentation and control power. Short term failures are due to turbine driven pump or AFW discharge valve failures or the failure to manually control the pump discharge air operated valves should the N_2 accumulators become depleted. At Wolf Creek, the latter valves fail open.

2.2.3.2.2 Station Blackout with RCP Seal LOCA (Sequence 9)

In this sequence, the loss of all AC power disables all primary system injection, as well as reactor coolant pump (RCP) seal cooling. A RCP seal LOCA occurs, accelerating the loss of the primary system inventory and the onset of core damage.

The major contributor to this sequence is the failure of all emergency AC power. This is dominated by the failure to start/run of both emergency diesel generators (EDGs) or the unavailability of one EDG due to test or maintenance with the failure of the remaining unit. The loss of all AC power results in a loss of cooling to the RCP seals. The RCP LOCA accelerates the loss of primary coolant and limits recovery measures to approximately one hour after the LOCA occurs. Major recovery actions are the recovery of AC power and successful restoration of the HPI component cooling.

2.2.4 Loss of Power Conversion System (PCS) or Transient Followed by Loss of PCS, with Loss of Decay Heat Removal (Sequence 10)

The loss of the power conversion system (PCS) (or a transient followed by a loss of PCS) with the subsequent failure of the AFW system causes the primary system to overheat. The resulting system over-pressurization causes PORV cycling, a loss of system inventory and subsequent core damage. Main feed pump trips comprise over 25% of the total precursor events which have occurred. These include valid, spurious or operator induced low suction pressure trips, feed pump turbine controller failures and gradual losses of condenser vacuum or hotwell level that were not considered to be valid by the operators. Steam dump valve closure failures, primarily due to positioner linkage problems, contributed approximately 15%. The remainder of the loss of PCS precursors are fairly evenly divided among condensate pump trips, feedwater recirculation, control and bypass valve malfunctions, feedwater controller failures and miscellaneous contributors including multiple stuck open relief valves and main turbine trips which induced PCS isolations. The loss of the auxiliary feedwater system is the main contributor to the sequence. The majority of the system unavailability is due to operator failures to manually start either a locked out pump or a pump with a disabled auto start circuit. Hardware failures include steam admission valve and pump local faults. The unavailability of a pump or a pump discharge valve due to maintenance activities or improper position of the manual valve on the pump suction from the Condensate Storage Tank are also contributors.

Failure of a vital AC bus, primarily due to an inverter failure, disables a steam admission valve and/or the auto start logic for a motor driven pump.

Dependent on plant specific considerations, the feed and bleed method may be used for decay heat removal. The failures associated with this method, and the specific Wolf Creek configuration, have been described previously in 2.2.3.1.

2.3 Anticipated Transient Without Scram (ATWS) Followed by Failure of Emergency Boration

This sequence is initiated by a transient from high power followed by an RPS failure to automatically scram the reactor. The RPV has survived the initial pressure transient due to a favorable moderator temperature coefficient. The attempts to manually scram are not successful and emergency boration also fails.

The initiator is a transient such as a MSIV closure, partial loss of feedwater, feedwater flow increase or a loss of reactor coolant system (RCS) flow that results in a turbine trip and PCS runback. The mismatch between core power production and secondary loop power removal results in RCS coolant loss through the PORVs. Core uncovery and damage occur in forty minutes or less. The Salem plant experienced a RPS automatic scram function failure that was caused by RPS breaker malfunctions, but manual scram was successful.

The failure to manually scram the reactor is attributed to hardware failures of the control rods or drives that prevent insertion or operator error. The failure of emergency boration is dominated by operator failure to initiate injection. System hardware faults have a smaller contribution. The operator actions to initiate boric acid injection is dependent on system design.

At Wolf Creek, two boric acid pumps are utilized discharging through a common, normally closed high flow line to the charging pump suction header. Operator action is required to start both and open the normally closed immediate boration control valve (BG HV-8104). This configuration is more vulnerable to hardware failures related to the use of a single normally closed MOV and/or the system success criterion that requires both boric acid pumps to operate. However, at Wolf Creek, there is an alternate immediate boration flow path through a normally closed manual valve (BG V-177) which must be locally operated in the Auxiliary Building.

3. COMMON CAUSE FAILURES

Certain common cause failures, either hardware or human related, appear as particularly important to the risk of core damage from a review of the eleven representative accident sequences. They are the following:

a) Loss of offsite power (LOOP).
b) Emergency Diesel Generators (EDGs) fail to start or continue to run.
c) Component Cooling Water (CCW) pumps fail to continue running.
d) Failure of high head injection (HHI) discharge valves to open.
e) Failure of LHI pumps to start or continue running.

4. IMPORTANT HUMAN ERRORS

Similar to the previous discussion of common cause failures, certain operator errors appear as particularly important to the risk of core damage from a review of the eleven representative accident sequences. These are:

a) Failure to recover offsite power due to human error.
b) Failure to switch from the Refueling Water Storage Tank (RWST) to the containment sump, i.e., failure to switch from the low head injection (LHI) phase to the low head recirculation (LHR) phase in response to a large or medium LOCA.
c) Failure to manually start locked out AFW pump, either turbine or motor driven.
d) Failure of manual SCRAM given ATWS or failure to initiate and successfully perform emergency boration.
e) Failure to successfully isolate an interfacing LOCA condition.

5. SYSTEMS INCLUDED IN GUIDE

Table 2 shows the systems which are important based on the representative accident sequences discussed previously, as well as other generic PRA-based information. The list is not intended to show the relative importance ranking of one system over another since the importance ranking of systems is difficult to achieve from generic insights.

In using the list, the inspector should select systems for inspection based on both knowledge of any recent operating problems or technical specification outages, as well as on the obviously broad or important effects of support systems due to the loads served by the particular system.

Table 2
Systems Included for Wolf Creek

1. Essential Service Water
2. Safeguards (AC) Power
3. DC Power
4. Component Cooling Water (CCW)
5. Reactor Protection System
6. High Head Injection (HHI)/Safety Injection (SI)/High Head Recirculation (HHR)[1]
7. Primary Pressure Relief System (PPRS)
8. Auxiliary Feedwater (AFW)
9. Low Head Injection (LHI) Low Head Recirculation (LHR).[2]
10. Engineered Safety Features Actuation System
11. Refueling Water Storage Tank (RWST)
12. Power Conversion System (PCS)
13. Emergency Boration/Chemical and Volume Control System (CVCS)

[1]HHR includes room coolers for HHI pumps. HHI includes the Safety Injection System (SIS) at Wolf Creek.
[2]LHR includes the Residual Heat Removal System (RHRS).

6. SYSTEM INSPECTION TABLES

For each of those systems in Table 2, inspection guidance is provided in the form of a failure mode table, an abbreviated walkdown checklist, and a simplified system diagram. Each of these is explained in detail below.

In using these tables, however, it is essential to remember that other systems and components are also important. If, through inattention, the failure probabilities of other systems were allowed to increase significantly, their contributions to risk might equal or exceed that of the systems in the following tables. Consequently, a balanced inspection program is essential to ensuring that the licensee is minimizing plant risk. The following tables allow an inspector to concentrate on systems and components that are most significant to risk. In so doing, however, cognizance of the status of systems performing other essential safety functions must be maintained.

APPENDIX A

Table AX-1 – System Failure Modes

The introduction to this table provides a brief description of the system and the success criteria to the extent these could be extracted from the system descriptions or other plant information. (Note that these success criteria may be different from the more conservative success criteria contained in the FSAR.)

The entries in this table are the dominant events (component failures, operator errors, etc.) contributing to system failure, provided in rank order according to their risk significance. Since most systems are designed with redundant trains, it will generally take more than one of these events to fail the entire system. No effort has been made to list all of the combinations of the events that are sufficient to produce system failure because that is usually apparent from the system description in the introduction. Where single events are sufficient to fail the entire system, that is noted in the brief discussion of the event. For certain events that are important primarily because of the circumstances of a particular accident sequence, that information is also noted.

Because PRAs do not contain the detail necessary to attribute the listed failures to the most probable specific root causes, it is necessary for the inspector to draw from experience, plant operating history, ASME Codes, NRC Bulletins and Information Notices, INPO SOERs, vendor notices and similar sources to determine how to actually conduct inspections of the listed items. Where appropriate, codes have been included following each event description to indicate which licensee programs/activities provide inspectable aspects of the risk. These codes are as follows:

- O Normal and emergency operating procedures, check-off lists, technical specifications, training, etc.
- S Periodic surveillance activities, procedures and training.
- M Preventive or unscheduled maintenance activities, technical specifications, procedures and training.
- T Periodic testing or in-service inspection activities, procedures, and training.
- C Periodic calibration activities, procedures, and training.

Each failure mode is correlated to the appropriate accident sequence(s) described in Table 1 and categorized as of high (H) medium (M) or low (L) importance. In nearly all cases, the importance categories are numerically based taking into account the event's contribution to the eleven representative accident sequences.

Table AX-2 – Modified System Walkdown

This table provides an abbreviated version of the licensee's system checklist, where available, but includes only those items which are related to the dominant failure modes. It is generally much less than the normal checklist. It can be used to rapidly review the line up of important system components on a routine basis. Caution should be observed when using the checklists, since they are based on certain versions of the licensee's system operating instructions. Valve numbers used are those identified in the licensee system checklists, or P&ID's.

Figure AX – Simplified System Diagram

A simplified line diagram is provided for each system treated. These are intended to aid in visualizing the system configuration and the location of the components discussed in the two tables. Since they are neither complete nor controlled, they should not be used in place of up-to-date P&ID's during inspection activities.

APPENDIX B

Table B1 – Plant Operations Inspection Guidance

This table is a collection of all of the risk significant operator actions listed in the preceding system tables. It is provided as a cross reference for use in observing operator actions and training.

Table B2 – Surveillance and Calibration Inspection Guidance

This table is a collection of all of the risk significant components listed in the preceding system tables that are considered to be significantly influenced by surveillance and calibration activities. It is provided as a cross reference to assist in selecting risk important activities for observation during inspections of the licensee's surveillance and calibration programs.

Table B3 – Maintenance Inspection Guidance

This table is a collection of the risk signific[illegible]mponents listed in the preceding system tables that are considered to be significantly [illegible]ced by maintenance activities. It is provided as a cross reference to assist the inspe[illegible] selecting risk important activities for observation during inspections of the licensee's m[illegible]ntenance program. Important factors include the frequency and duration of maintenance as well as errors that degrade the component or render it inoperable when it is returned to service.

APPENDIX C

Table C1 – Containment and Drywell Walkdown Table

Because they are normally inaccessible during operation, a separate walkdown checklist is provided for those components listed in the preceding system tables that are located inside the containment or drywell. This is intended for efficient inspection of those items when the opportunity arises.

7. REFERENCES

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7.2 Other References: Plant Specific Risk-Based Information

1. M.F. Hinton and R.E. Wright, "Pilot PRA Applications Program for Inspection at Indian Point Unit 2," Idaho National Engineering Laboratory, Informal Report EGG-EA-7136, Rev. 1, July 1986.

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3. C.L. Atwood, et al., "PRA Applications Program for Inspection at the Zion Nuclear Power Station Draft Report," Idaho National Engineering Laboratory, Informal Report EGG-EA-7304, June 1986.

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APPENDIX A

TABLES OF (1) IMPORTANCE BASIS AND FAILURE MODE IDENTIFICATION, AND (2) MODIFIED SYSTEM WALKDOWNS

Table A.1-1. Importance Basis and Failure Mode Identification

ESSENTIAL SERVICE WATER SYSTEM (ESWS)

Mission Success Criteria

The Essential Service Water System (ESWS) consists of two 100% capacity, identical redundant cooling water trains which cool plant components for the safe shutdown of the reactor following an accident. Water is drawn from the Ultimate Heat Sink (UHS) and circulated through the components and back to the UHS.

The ESWS also provides emergency makeup to the Spent Fuel Pool and the Component Cooling Water System (CCWS). The ESWS is the backup water supply for the Auxiliary Feed System. Each ESWS train consists of a single pump with an automatic, self cleaning strainer, a pump prelube storage tank, traveling water screen, supply and return piping, valves, associated instrumentation, and a discharge structure in the Ultimate Heat Sink (UHS).

The UHS is a normally submerged cooling pond, formed by providing a volume of approximately 440 acre-feet behind a dam built in one finger of the Main Cooling Lake. The ESW pumps draw water from the UHS at a maximum temperature of 90 degrees F and a minimum temperture of 32 degrees F, and supply it for cooling or makeup to the following components or systems:

- Component Cooling Water Heat Exchanger
- Containment Air Coolers
- Diesel Generator Coolers
- Component Cooling Water Pump Room Coolers
- Centrifugal Charging Pump Room Coolers
- Auxiliary Feedwater Pump Room Coolers
- Safety Injection Pump Room Coolers
- Residual Heat Removal Pump Room Coolers
- Containment Spray Pump Room Coolers
- Penetration Room Coolers
- Fuel Pool Cooling Pump Room Coolers

— Control Room Air Conditioning Condensers

— Class 1E Switchgear Air Conditioning Condensers

— Instrument/Service Air Compressors and After-Coolers

— Auxiliary Feedwater System

— Spent Fuel Pool Cooling and Cleanup System

— Component Cooling Water System

Each train of the ESWS is interconnected with the Service Water System (SWS). Two motor operated isolation valves are provided in each crosstie header where it connects to the SWS. These valves are located in the pipe chase area of the 1974 foot elevation of the Control Building. In addition cooling water flow is maintained following an accident to the safeguard powered air compressors (CKA01A and CKA01B) and associated after coolers. The air compressors are automatically isolated on high flow (indicative of leakage) or they can be manually isolated.

Flow restrictive bypass lines are provided at the outlet of the Component Cooling Water (CCW) heat exchangers. This provides a path for reduced flow during accident conditions. Motor operated bypass valves are also provided in the outlet lines from the containment air coolers, outside the containment. This provides an increased amount of flow through the coolers following a LOCA or loss of offsite power.

The ESWS normally supplies water at a higher pressure than the cooled safety-related components. Therefore, if leakage occurs it will be into the system being cooled or in the case of ESW piping and valves, into the floor drain system.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Failure of any of the following ESW valves which isolates ESW flow to CCW heat exchangers	1,5	H	S,M,T,C
Normally closed MOV fails to Open CCW HX EEG01A / CCW HX EEG01B Inlet: EF-HV-51 / EF-HV-52 Outlet: EF-HV-59 / EF-HV-60 EF-V058 / EF-V090			
Locked throttled return bypass valve inadvertently closed			
(Note: Either Train A or B MOVs are normally closed, but not both.)			
2. ESW Pump train A or B out for maintenance	1,5	M	M, T

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
3. ESW Pump PEF01A or PEF01B fails to start and run The ESW pumps are started by the diesel generator load sequencer upon either a Safety Injection or Loss of Offsite Power Signal. Failure of the signal inputs can prevent the pumps from auto starting when required. Failure of the ESW pump pre-lube storage tanks to supply sufficient water above the pit water level to prevent the pump line shaft bearings from running dry during start-up can also fail the ESWS pumps when required. The 43 gallon tank's size is based on supplying a minimum of a five-minute supply of water at six gpm, with no makeup from the pump discharge line. The tank is continuously supplied water by a connection on the ESW pump discharge, downstream of the discharge check valve and strainer, from the SWS pumps. The tank provides water to the lineshaft bearings and stuffing box continuously (provided the discharge line is pressurized) even during periods when the pumps are idle. When the ESW pump is running, flow in the supply line from the tank reverses and discharges through the overflow. Locked throttled manual valves V-245 and V-246, for Trains A and B, respectively, must remain Open to supply water to the tanks.	1,5	M	S,M,T
4. Pump discharge MOV, check valve or header isolation valve fails to open or remain open Both ESW pump discharge lines include a vent line with a normally open motor-operated valve, EF HV-97 for Train A and EF HV-98 for Train B. The vent valves remain open for 15 seconds after pump start, then automatically close. This is to vent the air in the pump column and discharge piping to prevent water hammer. Inadvertent closure of these valves when required can fail the ESWS. Each pump also contains a check valve in the discharge line prior to the self-cleaning strainer, V001 for Train A and V-004 for Train B. These check valves must open to allow ESWS flow. Locked open manual valves on the ESW pump discharge lines must remain open: (Train A / Train B) EFW Inlet Upstream Isolation: EF V104 / EF V113 EFW Inlet Downstream Isolation: EF V107 / EF V116	1,5	M	S,M,C

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
5. Non essential load isolation valves fail to close Following a LOCA or loss of offsite power, the safety-related signals isolate the SWS supply and discharge from the ESWS by closing the cross-tie line isolation valves. Two isolation MOVs are provided in each of the SWS supply and discharge lines to the ESWS: Train A / Train B Supply: EF HV-23, EF HV-24; EF HV-25, EF HV-26 Return: EF HV-39, EF HV-40; EF HV-41, EF HV-42 In addition, the normally closed MOVs, EF HV-37 for Train A and EF HV-38 for Train B must open to allow ESWS flow to discharge to the Ultimate Heat Sink, passing through a single locked open manual valve in each line, V108 in Train A and V117 in Train B.	1,5	L	S,M,T,C
6. Pump strainer plugged Two traveling water screens, DEF01A and DEF01B, are provided for each train which filter the pump suction from large debris. Spray flow from the ESW header downstream of the self cleaning strainers on the ESW pump discharge side, is provided by automatic opening of a throttle valve and MOV (EF HV-91, Train A and EF HV-92 Train B), upon ESW pump start. Small impurities and debris which may have washed through the traveling screens are filtered out by the ESW strainers, 1FEF02A and 1FEF02B. Failure of either the screens or strainers to function properly can cause loss of the ESWS.	1,5	L	S,M

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Train A ESW A Inlet Upstream Isolation	EF-V104		Locked Open	______ ______				
ESW A Inlet Downstream Isolation	EF-V107		Locked Open	______ ______				
ESW A to Ultimate Heat Sink Header Isolation	EF-V108		Locked Open	______ ______				
Traveling Water Screen 1A Wash Isolation	EF-V003		Locked Open	______ ______				
ESW Pump A Discharge Isolation	EF-V002		Locked Open	______ ______				
ESW Pump A Pre-Lube Storage Tank 1A Fill	EF-V245		Locked Throttled	______ ______				
ESW Pump A Pre-Lube Storage Tank Drain	EF-V162		Locked Closed	______ ______				
ESW Traveling Water Screen 1A Warm Water Header Upstream Isolation	EF-V262		Closed* Open	______ ______				

*In accordance with STN GP-001, EF-V262 and EF-V264 may need to be open to comply with seasonal requirements

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Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW Traveling Water Screen 1A Warm Water Header Down-stream Isolation	EF-V264		Closed* Open	______ ______				
ESW A to Air compressor/ Aftercooler A Isolation	EF-V045		Locked Open	______ ______				
Air Compressor/ Aftercooler A ESW A Return Isolation	EF-V143		Locked Throttled	______ ______				
Air Compressor A Aftercooler Check Valve EF-V046 Down-stream Isolation	EF-V346		Locked Open	______ ______				
Train B ESW B Inlet Upstream Isolation	EF-V113		Locked Open	______ ______				
ESW B Inlet Downstream Isolation	EF-V116		Locked Open	______ ______				

*In accordance with STN GP-001, EF-V262 and EF-V264 may need to be open to comply with seasonal requirements.

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Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW B to Ultimate Heat Sink Header Isolation	EF-V117		Locked Open					
Traveling Water Screen 1B Wash Isolation	EF-V006		Locked Open					
ESW Pump B Discharge Isolation	EF-V005		Locked Open					
ESW Pump B Pre-Lube Storage Fill	EF-V246		Locked Throttled					
ESW Pump B Pre-Lube Storage Tank B Isolation	EF-V163		Locked Closed					
ESW Traveling Water Screen 1B Warm Water Header Upstream Isolation	EF-V263		Closed* Open					
ESW Traveling Water Screen 1B Warm Water Header Downstream Isolation	EF-V265		Closed* Open					

*In accordance with STN GP-001, EF-V263 and EF-V263 may need to be open to comply with seasonal requirements.

Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW B to Air Compressor/ Aftercooler B Isolation	EF-V075		Locked Open	______ ______				
Air Compressor/ Aftercooler B ESW B Return Isolation	EF-V146		Locked Throttled	______ ______				
Air Compressor B Aftercooler Check Valve EF-V076 Down-stream Isolation	EF-V345		Locked Open	______ ______				
EF HV-23 ESW to SWS Isolation					NG 01AGF1	Control Building Train A	ON	______
EF HV-25 ESW to SWS Isolation					NG 02AHF1	Same	ON	______
EF HV-41 ESW to SWS Isolation					NG 01AFR4	Same	ON	______
EF HV-37 ESW to UHS Isolation					NG 01AER1	Same	ON	______
EF HV-39 ESW to SWS Isolation					NG 02AFR1	Same	ON	______
Traveling Water Screen Motor DFEF01A Space Heater					NG 05EBF211	ESW Pumphouse Train A	ON	______

Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
EF HV-91 Screen Wash Water Valve					NG 05EDF2	Same	ON	______
EF HV-97 ESW Pump Discharge Line Air Discharge Valve					NG 05EDF3	Same	ON	______
DFEF01A ESW Traveling Water Screen					NG05EDF4	ESW Pumphouse Train A	ON	______
EFPDV19 ESW Strainer Backwash Trash Valve					NG05EEF3	Same	ON	______
DFEF02A ESW Self-Cleaning Strainer					NG05EFF3	Same	ON	______
ESWA/SW Cross Connect Valve	EF HIS-25 (RL019)	Main Control Room Switch Lineup Train A	Open	______				
ESWA/SW Cross Connect Valve	EF HIS-23 (RL019)	Main Control Room Switch Lineup Train A	Open	______				
ESWA to SWS Isolation*	EF HIS-39 (RL019)	Main Control Room Switch Lineup Train A	Open/ Closed	______ ______				

*Valves will be closed when warming water is aligned to ESW Intake Bay IAW SYS EA-120.

Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESWA to SWS Isolation*	EF HIS-41 (RL019)	Main Control Room Switch Lineup Train A	Open/ Closed	______ ______				
ESWA to Ultimate Heat Sink	EF HIS-37 (RL019)	Main Control Room Switch Lineup Train A	Closed	______				
ESW Pump A	EF HIS-55A	Same	Normal	______				
ESW A Discharge Isolation	EF HIS-85	Same	Closed	______				
ESW Pump A Discharge Air Release Valve	EF HIS-97	Same	Open	______				
ESW Screen Wash Speed Selector Switch	EF HIS-3	Same	Fast	______				
ESW Traveling Water Screen A	EF HIS-3	Same	Auto	______				
ESW Pump A	EF HIS-55B	Same	Normal	______				

*Valves will be closed when warming water is aligned to ESW Intake Bay IAW SYS EA-120.

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Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW Self Cleaning Strainer	EF HIS-19	Same	Normal	________				
EF HV-24 ESW to SW Isolation					NG 01AGF2	Control Building Train B	ON	________
EF HV-42 ESW to SW Isolation					NG 01AFR3	Same	ON	________
EF HV-26 ESW to SW Isolation					NG 02AHF2	Same	ON	________
EF HV-38 ESW to UHS Isolation Valve					NG 02AHF3	Same	ON	________
EF HV-40 ESW to SW Isolation					NG 02AER4	Same	ON	________
Traveling Water Screen Motor DFEF01B Space Heater					NG 06EBP211	ESW Pumphouse Train B	ON	________
EF HV-92, Screen Wash Water Valve					NG 06EDF2	Same	ON	________
EF HV-98, ESW Pump Discharge Line Air Discharge Valve					NG 06EDF3	Same	ON	________

Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
DFEF01B ESW Traveling Water Screen					NG06EDF4	ESW Pumphouse Train B	ON	________
EFPDV20 ESW Strainer Back-wash Trash Valve					NG06EEF3	Same	ON	________
DFEF02B, ESW Self-Cleaning Strainer					NG06EFF3	Same	ON	________
ESWB/SW Cross Connect Valve	EF HIS-26 (RL019)	Main Control Room Switch Lineup Train B	Open	________				
Control Room Isolate Switch for EF HV-26	EF HS-26A (NG02A-HF2)	Same	Normal	________				
ESWB/SW Cross Connect Valve	EF HIS-24 (RL019)	Same	Open	________				
ESWB to SWS Isolation*	EF HIS-42	Same	Open/ Closed	________ ________				
ESWB to SWS Isolation*	EF HIS-40	Same	Open/ Closed	________ ________				

*Valves will be closed when warming water is aligned to ESW Intake Bay IAW SYS EA-120.

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESWB to Ultimate Heat Sink	EF HIS-38	Same	Closed	______				
Control Room Isolate Switch for EF HV-38	EF HS-38A ([illegible]2A-HF3)	Main Control Room Switch Lineup Train B	Normal	______				
ESW B Discharge Isolation	EF HIS-86	Same	Closed	______				
ESW Pump B	EF HIS-56A	Same	Normal	______				
ESW B Screen Wash	EF HIS-4	ESW Pumphouse Switch Lineup Train B	Auto	______				
ESW Screen B Spray Valve	EF HIS-92	Same	Auto	______				
ESW Pump B	EF HIS-56B	Same	Normal	______				
ESW Self Cleaning Strainer B	EF HIS-20	Same	Normal	______				

Essential Service Water System (ESWS)

TABLE A.1-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW Pump B Discharge Air Release Valve	EF HIS-98	Same	Open	________				
ESW B Screen Wash Speed Selection Switch	EF HS-4	Same	Fast	________				

WOLF CREEK GENERATING STATION
(ESWS)

TABLE A.1-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
Licensed Operator Initial Training Lesson:			
1. "Essential Service Water System"	LO 1408900	000	02/29/88
2. "Service Water System"	LO 1407600	001	02/25/87
Drawings			
1. SNUPPS "P&ID – Essential Service Water System"	M-12EF01	0	12/09/86
2. SNUPPS "P&ID – Essential Service Water System"	M-12EF02	0	12/09/86
3. SNUPPS "P&ID – Service Water System"	M-12EA01	0	08/07/84
4. SNUPPS "P&ID – Service Water System"	M-12EA02	0	08/14/85
Procedures			
1. "Essential Service Water Valve Breaker and Switch Lineup"	CKL-EF-120	12	02/10/89

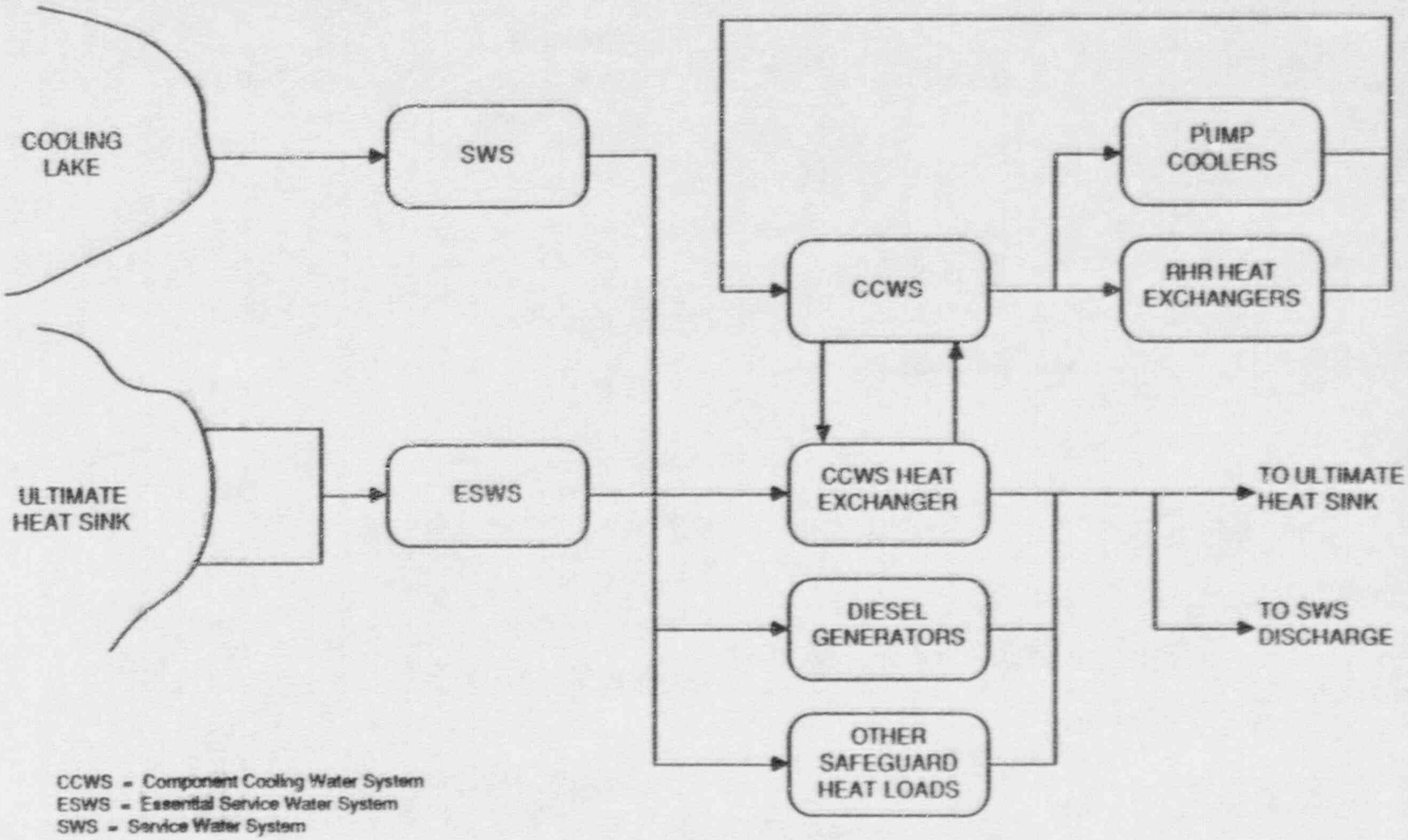

Figure A.1-1. "Wolf Creek Cooling Water Systems Functional Diagram"
(Source SAIC 88/1996, Figure 3.1)

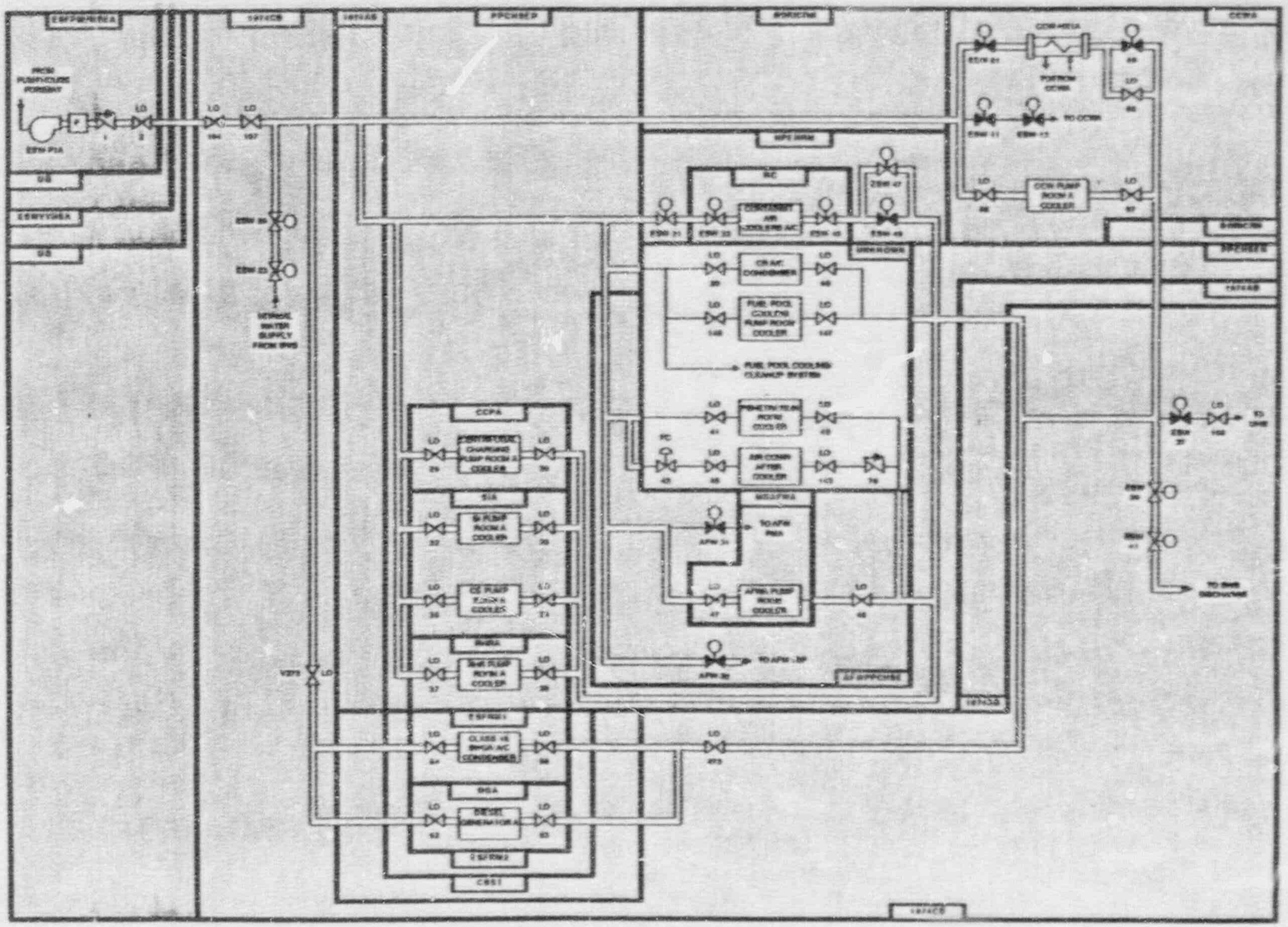

Figure A.1-2. "Wolf Creek Essential Service Water System Train A Showing Component Locations"
(Source SAIC 88/1996, Figure 3.8-2)

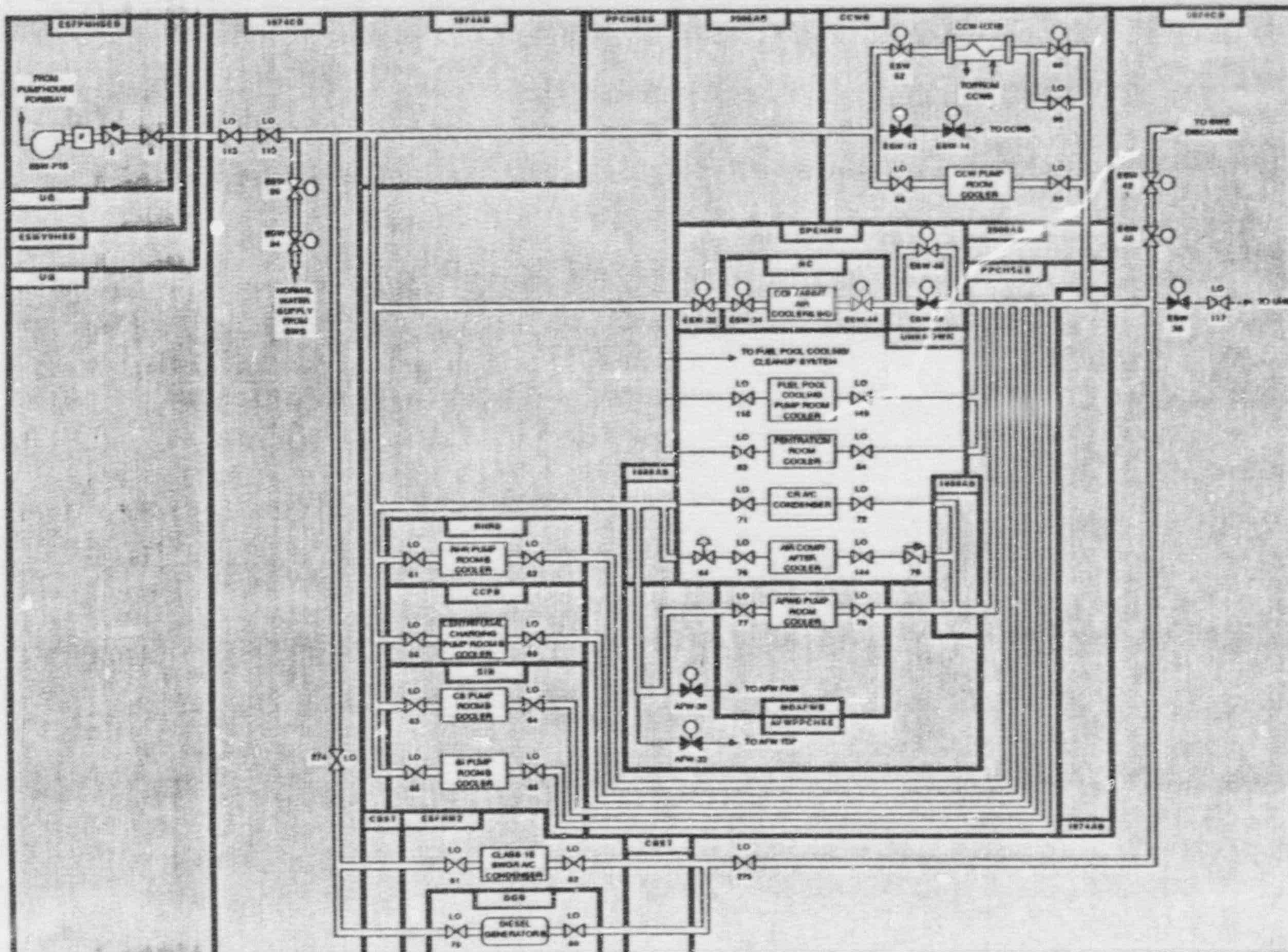

Figure A.1-3. "Wolf Creek Essential Service Water System Train B Showing Component Locations"
(Source SAIC 88/1996 Figure 3.8-4)

Table A.2-1. Importance Basis and Failure Mode Identification

SAFEGUARDS (AC) POWER SYSTEM

Mission Success Criteria

The Safeguards (AC) Power System consists of two 4160 VAC buses, four 480 VAC buses, four 120 VAC vital instrumentation buses, four 125 VDC buses, two dedicated diesel generators, and their associated motor control centers, breakers, transformers, chargers, inverters, and batteries.

Each 4160 VAC bus is normally powered from offsite power sources through either the No. 7 or startup transformer. On loss of offsite power the breakers open and the diesel generators start and their associated breakers close to load the diesels on the emergency buses. The 4160 VAC buses provide power to the large pumps such as the centrifugal charging, the safety injection, CCW and residual heat removal pumps.

Each 4160 VAC bus feeds two 480 VAC buses through transformers. The 480 VAC buses are primarily used to power a multitude of MOVs and small pumps such as the charging pump oil and diesel cooling water pumps. They also provide power to four battery chargers.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Failure of EDGs DGNE01, DGNE02 to start & run following loss of offsite power.	7,8,9	H	O,S,M,C
2. EDGs unavailable due to test or maintenance. For two diesels, this unavailability should be relatively important.	7,8,9	H	M
3. Failure to restore AC power after station blackout with concurrent RCP seal LOCA. (Refer to Emergency Procedure EMG CS-02 "Loss of All AC Power with SI Required.")	8,9	H	O
4. Loss of vital AC bus. (Refer to Off-Normal Procedure OFN 00-021, "Loss of Vital 120 VAC Instrument Bus", or OFN 00-027, "Loss of Vital 480 VAC Bus NG01, NG02, NG03 and NG04.")*	10	H	M,S,C
5. Improper EDG post maintenance valve or breaker lineup. ESW valves V052, V053, V079, V080	7,8,9	M	O,M
6. Cooling water valves for EDG fail closed.	7,8,9	L	S,M,C

*Vital AC is critical support to operation of turbine driven AFW pump for auto actuation and steam control valve. See Table A.10-1.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
7. Failure of EDG output breaker to close.	7,8,9	L	S,M,C
DGNE01, Breaker 152NB0111			
DGNE02, Breaker 152NB0211			
8. Failure to transfer to reserve source of AC power and failure of EDG start signal.	7,8,9	L	S,M
9. Failure of Inverter*	6,7,10	L	M,S,C
Inverter No. 11, Breaker No. 111			
Inverter No. 13, Breaker No. 311			
Inverter No. 12, Breaker No. 211			
Inverter No. 14, Breaker No. 411			

*Vital AC is critical support to operation of turbine driven AFW pump for auto actuation and steam control valve. See Table A.10-1.

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Safeguards (AC) Power System

TABLE A.2-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW A to Diesel Generator 1A Coolers and IE Swgr. Condenser 5A Isolation	EF-V272		Locked Open	______ ______				
ESW to Diesel Generator 1A Coolers Isolation	EF-V052		Locked Open	______ ______				
Diesel Generator 1A Coolers ESW A Return Isolation	EF-V053		Locked Throttled 40% Open	______ ______				
Diesel Generator 1A Coolers and IE Swgr. A/C Condenser 5A ESW Return Isolation	EF-V273		Locked Open	______ ______				
ESW B to Diesel Generator 1B Coolers and 1E Swgr. A/C Condenser 5B Isolation	EF-V274		Locked Open	______ ______				
ESW B to Diesel Generator B Coolers Isolation	EF-V079		Locked Open	______ ______				
Diesel Generator B Coolers ESW Return Isolation	EF-V080		Locked Throttled 30% Open	______ ______				

TABLE A.2-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Diesel Generator 1B Coolers and IE Swgr. Condenser 5B ESW B Return Isolation	EF-V275		Locked Open	________ ________				
ESW A to Penetration Room Coolers 15A Isolation	EF-V041		Locked Open	________ ________				
Penetration Room Cooler 15A ESW A Return Isolation	EF-V042		Locked Open	________ ________				
ESW B to Penetration Room Cooler 15B Isolation	EF-V083		Locked Open	________ ________				
Penetration Room Cooler 15B ESW B Return Isolation	EF-V084		Locked Open	________ ________				
Diesel Generator 1A Output Breaker					152NB0111		Open	________
Diesel Generator 1B Output Breaker					152NB0211		Open	________

NOTE: Electrical lineups for the Safeguards Power System loads are shown on the respective Modified System Walkdown Tables.

WOLF CREEK GENERATING STATION
[Safeguards (AC) Power System]

TABLE A.2-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
WCGS "Licensed Operator Training Document			
1. "AC Electrical Distribution"	LO 1506205	000	02/10/88
Procedures			
1. WCGS "Essential Service Water Valve, Breaker and	CKL EF-120	12	02/10/89
Switch Lineup"			
2. WCGS "Diesel Generator NE01 and NE02 Valve Checklist"	CKL KJ-121	6	08/23/87

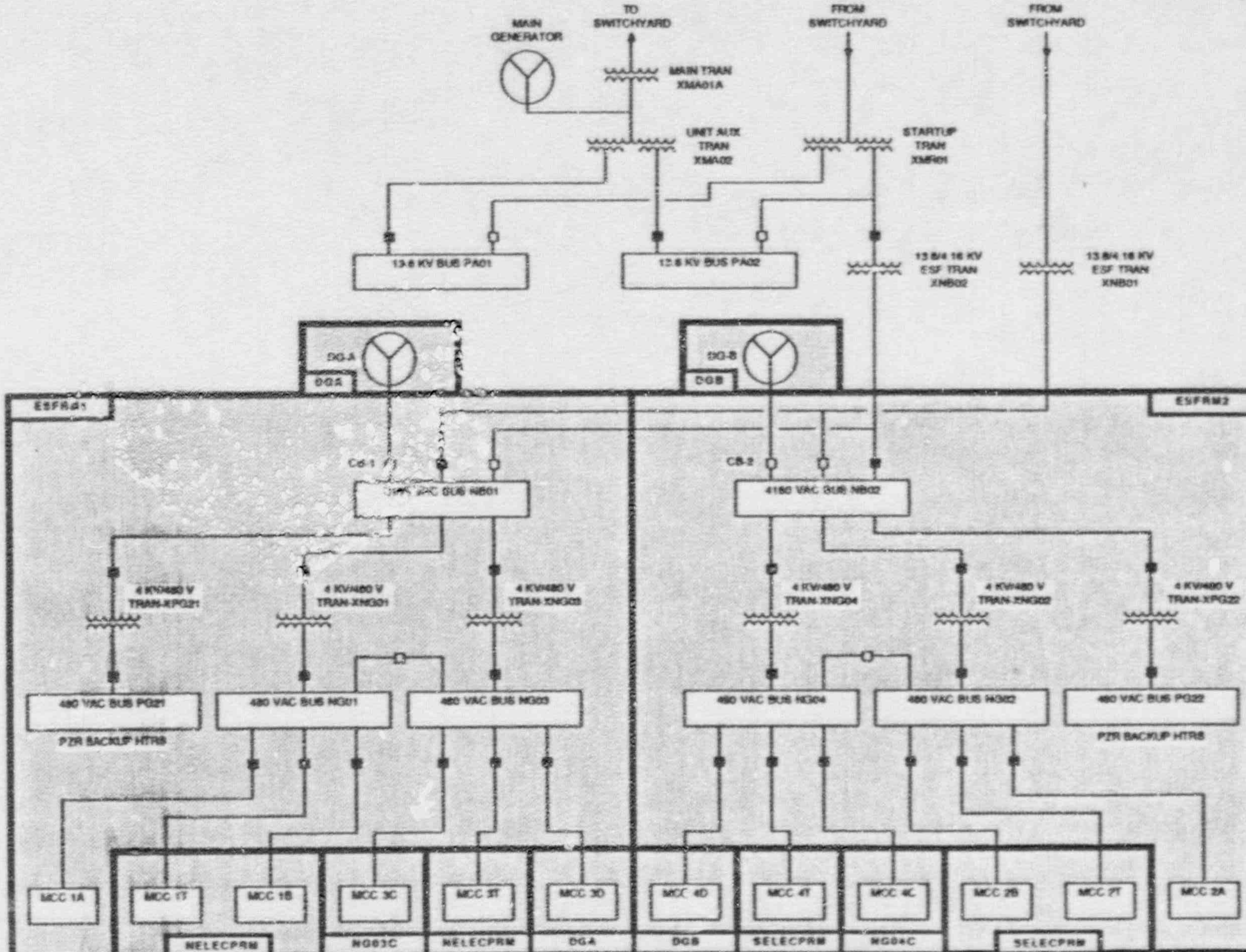


Figure A.2-1. "Wolf Creek 4160 VAC and 480 VAC Electric Power Distribution System Showing Component Locations"
(Source SAIC 88/1996, Figure 3.6-2)

WOLF CREEK GENERATING STATION

Table A.3-1. Importance Basis and Failure Mode Identification

DC POWER SYSTEM

Mission Success Criteria

Loss of 125V DC power is an accident sequence initiator which contributes to loss of decay heat removal capability through loss of PORV's and AFW. 125V DC power is supplied for the plant protection system, control and instrumentation and other loads for start-up, operation and shutdown modes of plant operation. The four 125V DC buses are supplied by four station batteries and also from the 480V AC buses through battery chargers. The 120V AC vital buses are fed from the 125V DC buses through four station inverters (uninterruptible power supplies).

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Loss of 125V DC bus	6	H	0,S,M,T,C
Train A			
BUS NK01 / **BUS NK03**			
Switches 89NK0101 / 89NK0301			
89NK0102 / 89NK0302			
Train B			
BUS NK02 / **BUS NK04**			
Switches 89NK0201 / 89NK0401			
89NK0202 / 89NK0402			
2. Failure of on line charger and failure of spare to energize on demand	6	M	S,M,T,C
Train A			
Charger NK21 / **Charger NK23**			
Breakers 52NG0103 / 52NG0303			
Switches 89NK0102 / 89NK0302			
Train B			
Charger NK22 / **Charger NK24**			
Breakers 52NG0203 / 52NG0403			
Switches 89NK0102 / 89NK0302			

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
3. Operational test or maintenance error resulting in a) deenergizing or cascading of DC power supplies b) failure to properly restore batteries or charger after maintenance Refer to Operating Procedure SYS NK-131 "Energization of 125V DC (Class IE) System (NK01, NK02, NK03, NK04)". **Train A** Battery NK11 — Battery NK13 Charger NK21 — Charger NK23 **Train B** Battery NK12 — Battery NK14 Charger NK22 — Charger NK24	6	L	O,M
4. Failure of Batteries Battery NK11, NK13 NK12, NK14 Battery failure typically occurs during extended station black-out scenarios where AC power is lost for several hours. Refer to Emergency Procedure EMG C-0 "Loss of All AC Power" for load shedding instructions	6	L	M,S,T
5. Loss of battery room ventilation. As in battery failure, loss of battery room ventilation is typically a long term failure occuring during extended station blackout scenarios. It can cause two types of faults: a. Hydrogen building with risk of explosion, and b. Temperature increase with risk of battery charge output failure.	6	L	M,S,T

DC Power System

TABLE A.3-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Bus NK01 Battery NK11 Output Switch	89NK 0101		Closed	______				
Bus NK01 Battery Charger NK21 Output Switch	89NK 0102		Closed	______				
Bus NK03 Battery NK13 Output Switch	89NK 0301		Closed	______				
Bus NK03 Battery Charger NK23 Output Switch	89NK 0302		Closed	______				
Bus NK02 Battery NK12 Output Switch	89NK 0201		Closed	______				
Bus NK02 Battery Charger NK28 Output Breaker	89NK 0202		Closed	______				

DC Power System

TABLE A.3-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

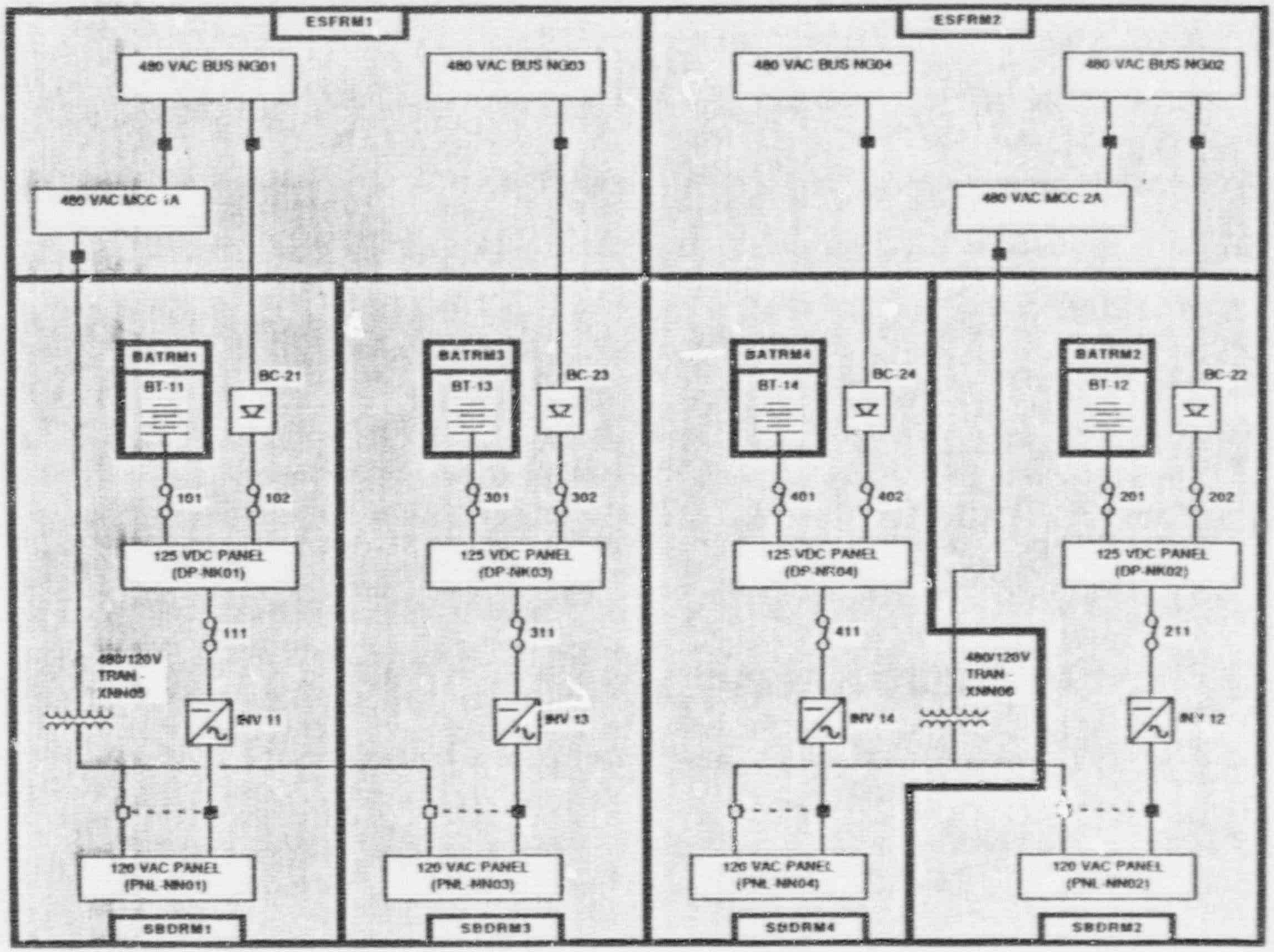
Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Bus NK04 Battery NK14 Output Switch	89NK 0401		Closed	______				
Bus NK04 Battery Charger NK24 Output Switch	89NK 0402		Closed	______				
480V Bus NG01 Input Breaker to Battery Charger NK21	52NG 0103		Closed	______				
480V Bus NG03 Input Breaker to Battery Charger NK23	52NG 0303		Closed	______				
480V Bus NG02 Input Breaker to Battery Charger NK22	52NG 0203		Closed	______				
480V Bus NG04 Input Breaker to Battery Charger NK24	52NG 0403		Closed	______				

WOLF CREEK GENERATING STATION
DC Power System

TABLE A.3-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
WCGS Licensed Operator Training Document			
1. "DC and Instrument Power Systems"	LO 1506300	000	02/03/88
Drawings			
1. "Class IE 125V DC System Meter & Relay Diagram"	E-01NK01(Q)	15	12/02/86
2. "Class IE 125V DC System Meter & Relay Diagram"	E-01NK02(Q)	17	
3. "Low Voltage System Class IE 480V Single Line Meter & Relay Diagram"	E-11NG01(Q)	1	07/14/87
4. "Low Voltage System Class IE 480V Single Line Meter & Relay Diagram"	E-11NG02(Q)	1	07/14/87



NOTE: LINES MAY NOT REPRESENT TRUE CABLE ROUTING BETWEEN ROOMS

Figure A.3-1. "Wolf Creek 425 VDC and 120 VAC Electric Power Distribution System Showing Component Locations"
(Source SAIC 88/1996, Figure 3.6-4)

Table A.4-1. Importance Basis and Failure Mode Identification

COMPONENT COOLING WATER SYSTEM

Mission Success Criteria

The component cooling water (CCW) system is a non-radioactive, closed loop cooling water system that removes heat generated by various plant components and transfers this heat to the Essential Service Water (ESW) system. The CCW system consists of two 100% capacity trains that provide cooling of engineered safety features and an additional loop that cools non-essential equipment. This non-essential loop is common to both trains and can be isolated during accident conditions. Mission success is provided by one of the two 100% capacity pumps and the one heat exchanger in one of the two essential trains.

The essential trains of the CCW system provide cooling for the following components:

SI containment spray pumps
Centrifugal charging pumps
RHR pumps and heat exchangers
Fuel pool cooling heat exchangers

Heat loads generated by the following components are removed by the non-essential CCW loop:

Letdown heat exchanger
Excess letdown heat exchanger
Positive displacement charging pump
Seal water heat exchanger
Reactor coolant pumps

Automatic control of certain CCW system components is provided. The automatic actions and initiation signals include the following:

— Automatic startup of the standby CCW pump in a train based on low discharge pressure on the operating pump.

— Automatic startup of a CCW pump based on startup of a centrifugal charging pump in the same train.

— CCW pump startup and isolation of the non-essential loop based on a safety injection signal.

— Automatic makeup to the CCW surge tanks from the demineralized water storage and transfer system.

— Non-essential loop isolation valve closure based on a high containment isolation signal.

— Isolation of the surge tank vent based on high radiation in any CCW system loop.

— Automatic closure of CCW heat exchanger ESW side motor-operated outlet valves upon a safety injection or loss of offsite power signal, thereby forcing all emergency CCW flow through lock-throttled, pre-adjusted manual valves which bypass the motor-operated outlet valves. (Specifically, CCW Train A heat exchanger, ESW outlet MOV 59 and Train B ESW MOV 60 close upon a SI or LOSP signal. CCW Train A heat exchanger, ESW inlet MOV 51 and Train B ESW inlet MOV 52 open upon either signal. All ESW flow is then throttled by locked open, pre-adjusted manual ESW Valve 58 for Train A and ESW Valve 90 for Train B.)

Remote manual operation of the CCW pumps, inlet isolation valves for the RHR heat exchangers, and cooling to the reactor coolant pumps and excess letdown heat exchanger is provided from the control room.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Pumps fail to start & run Pumps can fail to start after automatic initiation signals or manual initiation from the control room. **Train A** / **Train B** PEG01A / PEG01B PEG01C / PEG01D	1,5	H	S,M,T,C
2. Local fault of heat exchanger valves that isolate or severely restrict CCW flow **Train A** / **Train B** Heat Exchanger EEG01A / EEG01B Locked open manual valves CCW Inlet V019 / V044 Outlet V035 / V060			
3. CCW pumps out for maintenance (PEG01A and PEG01C) PEG01B and PEG01D			
4. Local fault of CCW pump suction and discharge valves restricting CCW flow			

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
	Train A		**Train B**
Pump suction valves	V132 (Pump PEG01A)		V138 (Pump PEG01B)
(Locked open manual valves)	V135 (Pump PEG01C)		V141 (Pump PEG01D)
(Normally open MOVS)	HV15 (Common)		HV16 (Common)
Pump discharge valves	V004 (Pump PEG01A)		V013 (Pump PEG01B)
	V008 (Pump PEG01C)		V017 (Pump PEG01D)
Suction check valves	V130 (Common)		V131 (Common)
Discharge check valves	V005 (Pump PEG01A)		V012 (Pump PEG01B)
	V007 (Pump PEG01C)		V016 (Pump PEG01D)
5. Local fault of manual valves restricting flow to ECCS pump coolers			
	Train A	**Train B**	
Locked open, manual valves:			
Safety Injection pump oil cooler:	V040	V065	
RHR pump seal cooler:	V042	V067	
Centrifugal charging pump oil cooler:	V039	V064	
Inlet header valve for all of the above components	V043	V063	

WOLF CREEK GENERATING STATION
RISK-BASED INSPECTION GUIDE

Component Cooling Water System (CCWS)

TRAIN A

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CCW Pump A Suction Isolation Valve	EG V132	CCWA	Locked Open					
CCW Pump A Discharge Isolation Valve	EG V004	CCWA	Locked Open					
CCW Pump C Suction Isolation Valve	EG V135	CCWA	Locked Open					
CCW Pump C Discharge Isolation Valve	EG V008	CCWA	Locked Open					
CCW Heat Exchanger A Inlet Isolation Valve	EG V019	CCWA	Locked Open					
CCW Heat Exchanger A Outlet Isolation Valve	EG V035	CCWA	Locked Open					
CCW Heat Exchanger A Temp Bypass Upstream Isolation Valve	EG V205	CCWA	Open					

Component Cooling Water System (CCWS)

TRAIN A

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CCW Heat Exchanger A Temp Bypass Downstream Isolation Valve	EG V206	CCWA	Open					
CCW Heat Exchanger A ESW Return Bypass	EF V058	CCWA	Locked/ Throttled					
CCW to Fuel Pool Cooling Isolation HX A	EG V200	FPHXA	Locked/ Throttled/ Open 6.25 turns					

WOLF CREEK GENERATING STATION
RISK-BASED INSPECTION GUIDE

Component Cooling Water System (CCWS)

TRAIN B

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CCW Pump B Suction Isolation Valve	EG V138	CCWB	Locked Open					
CCW Pump B Discharge Isolation Valve	EG V013	CCWB	Locked Open					
CCW Pump D Suction Isolation Valve	EG V141	CCWB	Locked Open					
CCW Pump D Discharge Isolation Valve	EG V017	CCWB	Locked Open					
CCW Heat Exchanger B Inlet Isolation Valve	EG V044	CCWB	Locked Open					
CCW Heat Exchanger B Outlet Isolation Valve	EG V060	CCWB	Locked Open					
CCW Heat Exchanger B Temp Bypass Upstream Isolation Valve	EG V207	CCWB	Open					

Component Cooling Water System (CCWS)

TRAIN B

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CCW Heat Exchanger B Temp Bypass Downstream Isolation Valve	EG V208	CCWB	Open					
CCW Heat Exchanger B ESW Return Bypass	EF V060	CCWB	Open					
CCW to Fuel Pool Cooling HX 1B Isolation	EG V201	FPHXB	Locked/ Throttled Open 6.25 turn.					

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CCW Pumps A&C Room Cooler SGL11A ESW Inlet Isolation	EF V056	Aux. Bldg. Ventilation ESW Train A	Locked Open	______ ______				
CCW Pumps A&C Room Cooler SGL11A ESW Outlet Isolation	EF V057	"	Locked Open	______ ______				
CCW Pump Room Cooler 11A ESW Return Isolation	GL V013	"	Locked Throttled	______ ______				
CCW HX1A ESW A Return HV-59 Bypass Isolation	EF V058	ESW Train A	Locked Throttled	______ ______				
ESW to CCW Pumps Train A Isolation	EG V182	"	Locked Throttled	______ ______				

Component Cooling Water System (CCWS)

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CCW Pumps B&D Room Cooler SGL11B ESW Inlet Isolation	EF V088	ESW Train B	Locked Open	________ ________				
CCW Pumps B&D Room Cooler SGL11B ESW Outlet Isolation	EF V089	ESW Train B	Locked Open	________ ________				
CCW Pump Room Cooler 11B ESW Return Isolation	GL V021	ESW Train [illegible]	Locked Throttled	________ ________				
CCW HX1B ESW B Return HV-60 Bypass Isolation	EF V090	ESW Train B	Locked Throttled	________ ________				
ESW to CCW Pumps Train B Isolation	EG V185	ESW Train B	Locked Throttled	________ ________				

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup Breaker #	Location	Required Position	Actual Position
ESW A to CCW HX A*	EF HIS-51	Main Control Room Switch Line-up Train A	Open/ Closed	______ ______				
ESW A Return from CCW HX A*	EF HIS-59	Same	Open/ Closed	______ ______				
EF HV-51 ESW Supply to CCW HX A Isolation					NG03CMF1	Auxiliary Building Train A	ON	______
EF HV-59 ESW from CCW HX A Isolation					NG03CHF2	Same	ON	______

*For NORMAL conditions only one CCW HX is in operation with the other Train HX on reduced flow through the Return Bypass. Either EF HIS-59 or EF HIS-6[illegible] should be OPEN.

Component Cooling Water System (CCWS)

TABLE A.4-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW B to CCW HX B*	EF HIS-52	Main Control Room Switch Line-up Train B	Closed/ Open	______ ______				
ESW B Return from CCW HX B	EF HIS-60	Same	Closed/ Open	______ ______				
EF HV-52 ESW Supply to CCW HX B Isolation					NG04CNF3	Auxiliary Building Train B	ON	______
EF HV-60 ESW from CCW HX B Isolation					NG04CHF2	Same	ON	______

*For NORMAL conditions only one CCW HX is in operation with the other Train HX on reduced flow through the Return Bypass. Either EF HIS-59 or EF HIS-60 should be OPEN.

WOLF CREEK GENERATING STATION
CCWS

TABLE A.4-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
Licensed Operator Initial Training Lesson			
1. "Component Cooling Water System"	LO 1400800	000	03/01/88
Drawings			
1. SNUPPS "P&ID - Component Cooling Water System"	M-12EG01	2	12/09/86
2. SNUPPS "P&ID - Component Cooling Water System"	M-12EG02	1	12/09/86
3. SNUPPS "P&ID - Component Cooling Water System"	M-02EG03	17	02/28/85
Procedures			
1. "Component Cooling Water System Valve, Switch and Breaker Lineup"	CKL-EG-120	9	11/09/87

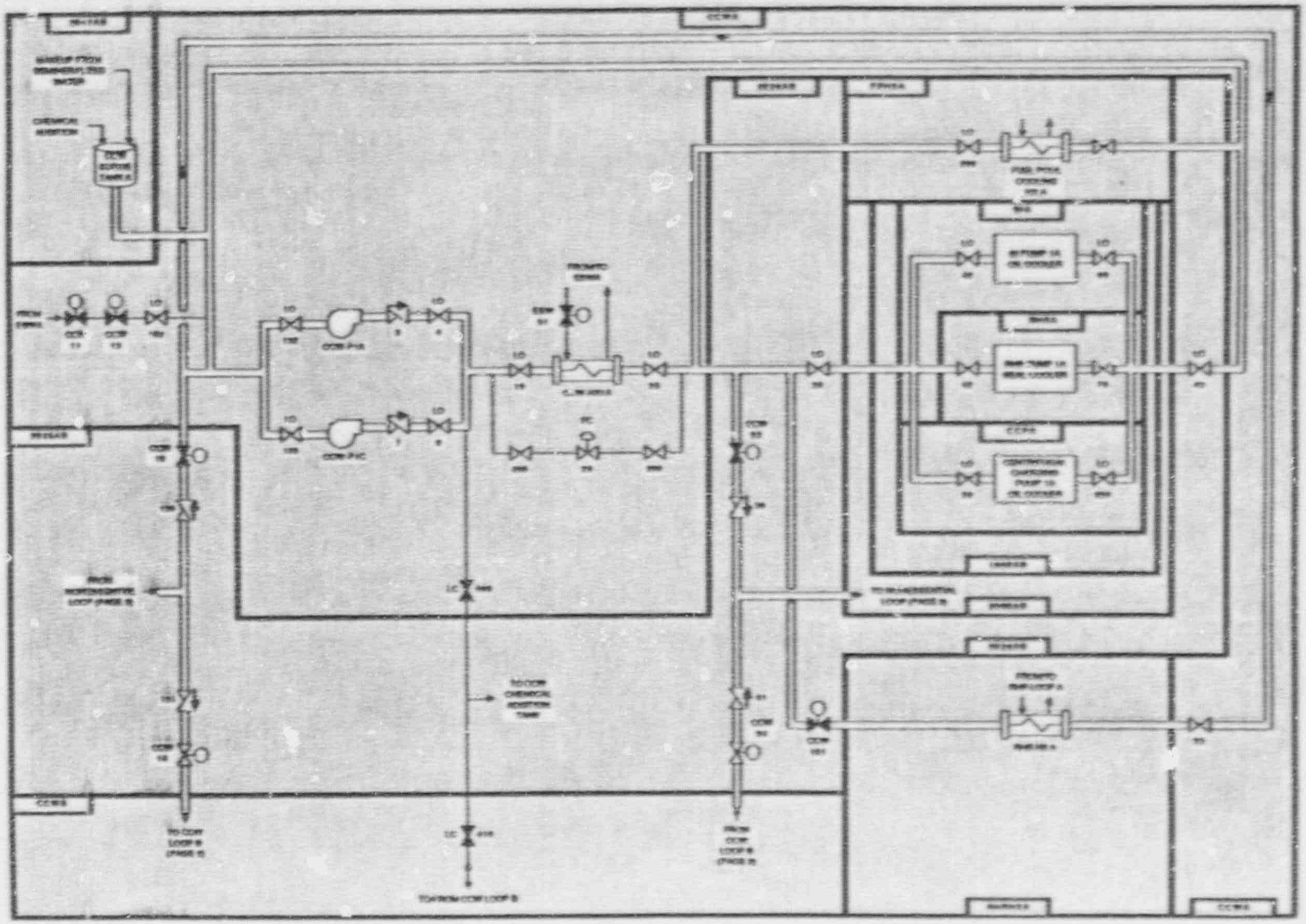


Figure A.4-1. "Wolf Creek Component Cooling Water System Showing Component Locations"
(Sheet 1 of 3)
(Source SAIC 88/1996, Figure 3.7-2)

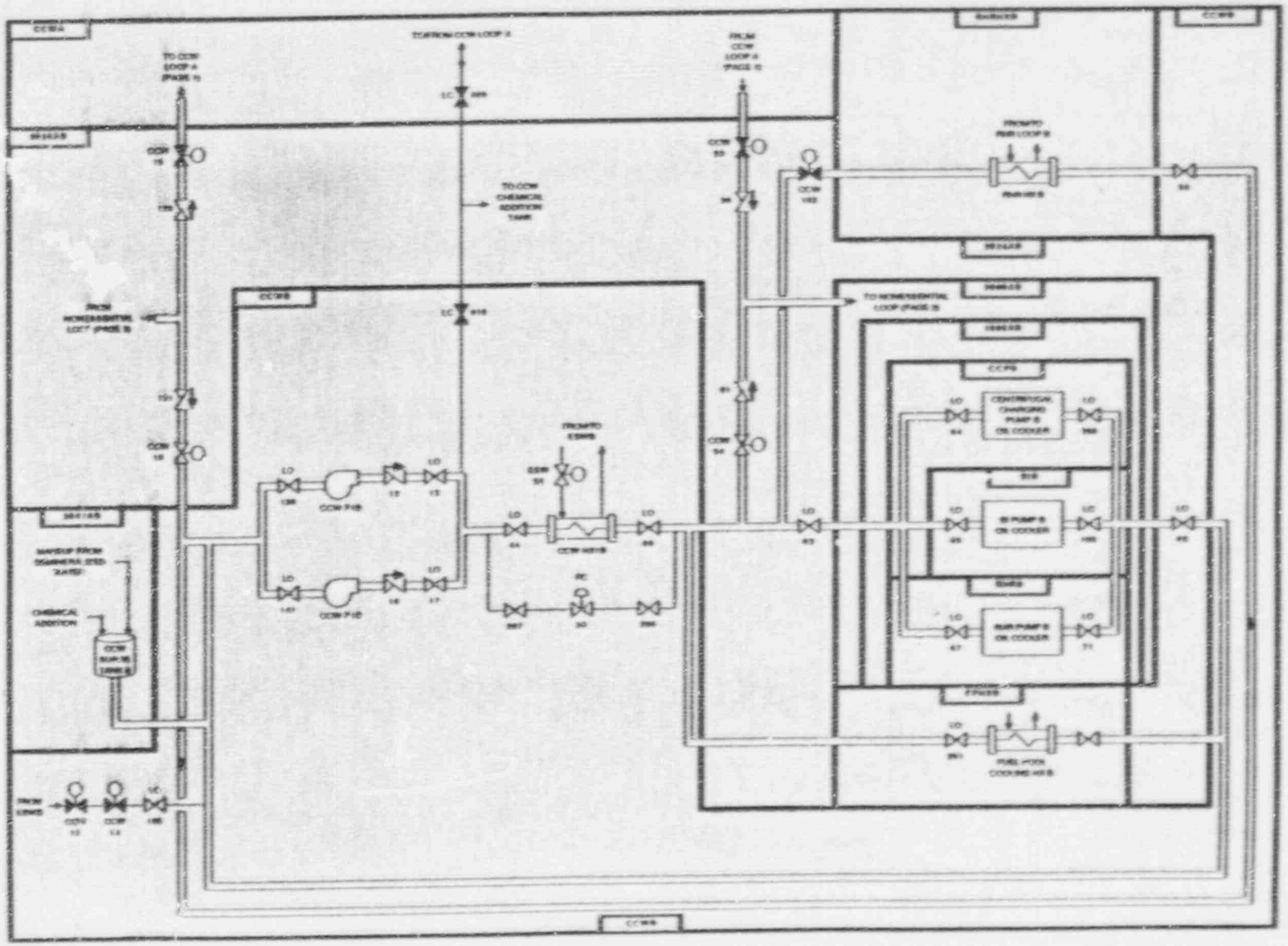


Figure A.4-1. "Wolf Creek Component Cooling Water System Showing Component Locations"
(Sheet 2 of 3)
(Source SAIC 88/1996, Figure 3.7-2)

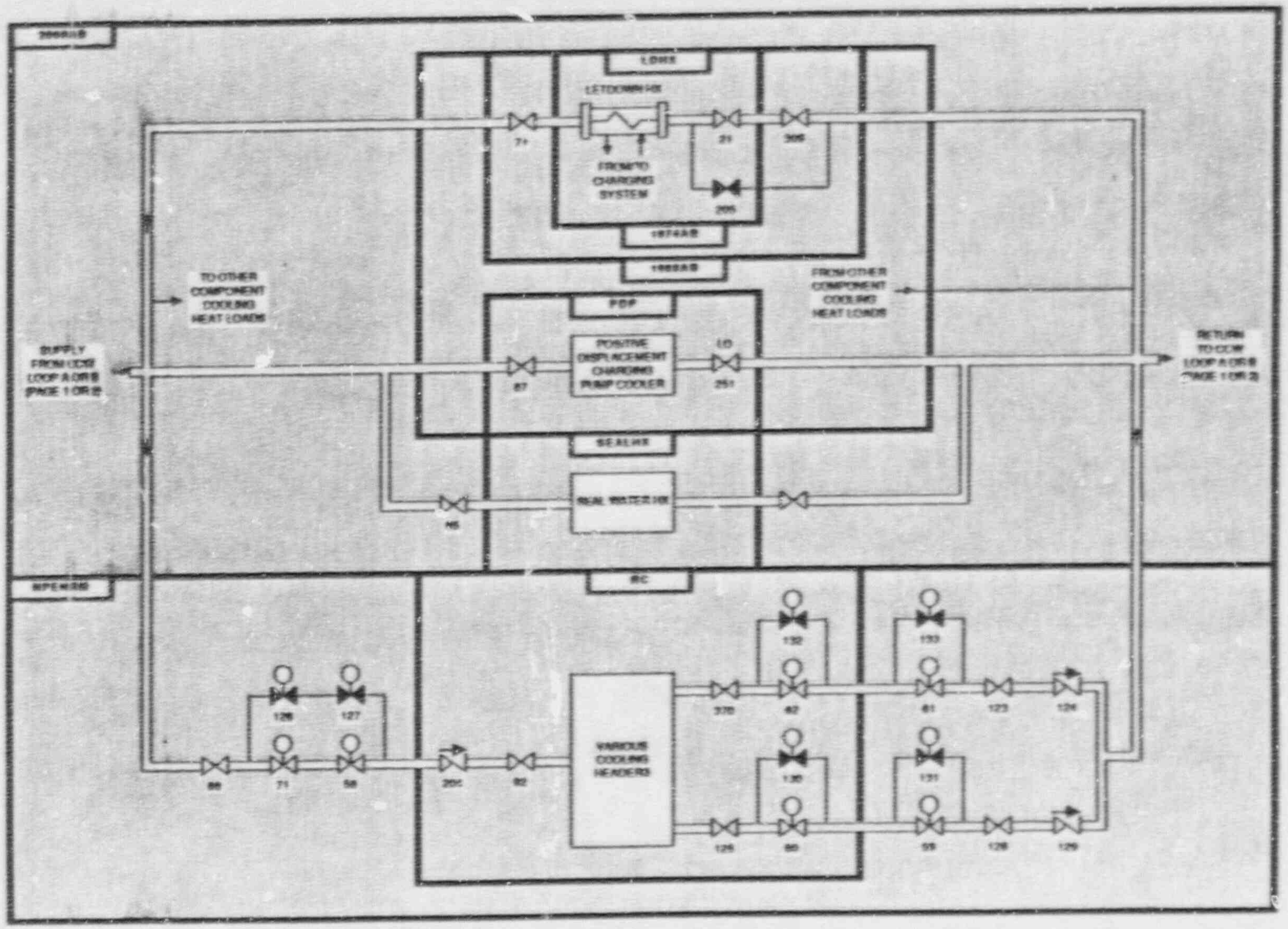


Figure A.4-1. "Wolf Creek Component Cooling Water System Showing Component Locations"
(Sheet 3 of 3)
(Source SAIC 88/[illegible]996, Figure 3.7-2)

Table A.5-1. Importance Basis and Failure Mode Identification

REACTOR PROTECTION SYSTEM (RPS)

Mission Success Criteria

The Reactor Protection System (RPS) automatically keeps the reactor operating within a safe region by shutting down the reactor whenever the limits of the region are exceeded (or reached). The system acts to limit the consequences of Condition II events (faults of moderate frequency, such as a loss of feedwater) by, at most, a shutdown of the reactor and turbine, with the plant capable of returning to operation after corrective action. Whenever a direct process or calculated variable reaches a setpoint the reactor will be shutdown in order to protect against either gross damage to fuel cladding or loss of system integrity which could lead to release of radioactive fission products into the Containment.

The following systems typically make up the Reactor Protection System.

a. Process Instrumentation and Control System

b. Nuclear Instrumentation System

c. Solid-State Logic Protection System

d. Reactor Trip Switchgear

e. Manual Actuation Circuit

The RPS contains sensors which, when connected with analog circuitry consisting of two to four redundant channels, monitor various plant parameters. The RPS also contains digital circuitry, consisting of two redundant logic trains, which receive inputs from the analog protection channels to complete the logic necessary to automatically open the reactor trip breakers.

Each of the two trains, A and B, is capable of opening a separate and independent reactor trip breaker, RTA and RTB, respectively and a bypass breaker, BYB and BYA, respectively. The two trip breakers in series connect three phase AC power from the rod drive motor generator sets to the rod drive power cabinets. During plant power operation, a DC undervoltage coil on each reactor trip breaker holds a trip plunger out against its spring, allowing the power to be available at the rod control power supply cabinets. For reactor trip, a loss of DC voltage to the undervoltage coil releases the trip plunger and trips open the breaker. When either of the trip breakers opens, power is interrupted to the rod drive power supply, and the control rods fall, by gravity, into the core. The rods cannot be withdrawn until the trip breakers are manually reset. The trip breakers cannot be reset until the abnormal condition which initiated the trip is corrected. Bypass breakers BYA and BYB are provided to permit testing of the trip breakers.

An Auto Shunt Trip modification has been implemented that provides trip signals to the shunt trip coils upon receipt of an automatic trip signal to the UV coils. The bypass breaker shunt trip coils will not receive an automatic trip signal.

The RPS provides for manual initiation of a reactor trip by the operator, and automatically initiates a reactor trip for various conditions. The reactor trip system also initates a turbine trip signal whenever a reactor trip is initiated. This is to prevent reactivity insertion that would otherwise result from excessive reactor system cooldown and to avoid unnecessary actuation of the Engineered Safety Features Actuation System (ESFAS).

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Instrument failure due to calibration/maintenance error, or random failure which inhibits initiation of reactor trip signal	11	H	S,M,C
2. Reactor trip breaker, 52/RTA or 52/RTB, or trip bypass breaker, 52/BYA or 52/BYB, fails to open	11	M	S,M,C
3. Operator failure to manually scram reactor following ATWS The WCGS UFSAR states that, pending implementation of equipment from sensor output to the final actuation device that is diverse from the reactor trip system which will automatically initiate the Auxiliary Feedwater System and a turbine trip under conditions indicative of an ATWS:	11	L	O

a. Emergency procedures have been developed to train operators to recognize ATWS events, including consideration of scram indicators, rod position indicators, flux monitors, pressurizer level and pressure indicators, pressurizer relief valve and safety indicators, and any other alarms annunciated in the control room, with emphasis on alarms not processed through the electrical portion of the reactor scram system.

b. Operators have been trained to take actions in the event of an ATWS, including consideration of manually scramming the reactor by using the manual scram button, prompt actuation of the auxiliary feedwater system to ensure delivery to the full capacity of this system, and initiation of turbine trip. The operators have also been trained to initiate boration by actuating safety-injection systems to bring the facility to a safe-shutdown condition.

TABLE A.5-2 MODIFIED SYSTEM WALKDOWN

The Reactor Protection System is a normally energized system whose operability must be assured by extensive surveillance testing. Observation of the conduct of this testing will provide the inspector with direct input regarding the safety function capability of the system. System walkdown during normal power operation will reveal little regarding the safety function status. However, the following may be checked:

COMPONENT	REQUIRED STATUS	ACTUAL STATUS
1. Reactor Trip Breakers	RTA Closed	________
	RTB Closed	________
2. Reactor Trip Bypass Breakers	BYA Open	________
	BYB Open	________
3. Annunciator Panel – RPS	No windows illuminated	________
4. RPS Trip Status Panel	No bypass lights illuminated;	________
	P-7, P-8, P-10, intermediate range hi flux, low power range hi flux permissive lights illuminated	________
5. RPS Permissive and Bypass Status Panel	No lights illuminated	________
6. Process Instrument Bistables Mode Switches	No RPS channel in test lights illuminated	________

WOLF CREEK GENERATING STATION
Reactor Protection System (RPS)

TABLE A.5-2

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
1. WCGS Updated Safety Analysis Report Section 7.2 "Reactor Trip System", Section 15.8 "Anticipated Transients Without Scram"	Issue 89-05		1989
2. WCGS Licensed Operator Training Document "Reactor Protection System"	LO 1301200	000	03/14/88

Table A.6-1. Importance Basis and Failure Mode Identification

HIGH HEAD INJECTION/SAFETY INJECTION/HIGH HEAD RECIRCULATION

Mission Success Criteria

The high head and safety injection systems (HHI/SI) provide core cooling and negative reactivity addition to the primary systems following small loss of coolant accidents (LOCAs) where reactor coolant system (RCS) pressure does not reduce sufficiently to permit flow from the low pressure injection system. The high head certrifugal changing pumps and the intermediate SI pumps provide injection flow up to the shutoff head of the charging pumps (2500 psig). These charging and SI pumps take suction from the refueling water storage tank (RWST); the normal suction path from the volume control tank to the charging pumps is automatically isolated based on a high h[illegible] initiation signal.

Major valves in the HHJ flow pat[illegible]ude locked open manual valves, check valves, and motor operated valves that are normally closed and open automatically based on a safety injection signal. In the safety injection flow path, normally open, motor-operated valves are located in the RWST suction line.

During the recirculation mode of operation, the residual heat removal (RHR) pumps supply provide cooled, recirculated water to the SI pumps for injection to the RCS. An automatic switchover to the containment sump for suction to the RHR pumps occurs as the water level is the RWST is reduced to approximately 36%. This level signal, combined with an active SI signal, causes the two, normally closed, containment sump to RHR pump suction MOVs to open. When these MOVs reach the full open position, a limit switch signals the MOVs in the RWST to RHR pump suction line to close. Thus, the containment sump provides the long term source of water to the RHR pumps. Manual actions required during this sequence include initiation of CCW flow to the RHR heat exchangers to provide cooling for the recirculated flow.

Mission success for the HHI and SI systems is provided by the operation of one of two centrigugal charging, safety injection and residual heat removal pumps during both the injection and recirculation phases of operation.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Failure to switch from RWST to the containment sump for the low pressure recirculation system. Automatic switch-over is provided based on low RWST level. MOVs EJ HV 8811 A/B open and BN HV 8812 A/B close. Operator action is required for initiation of CCW flow to the RHR heat exchangers. MOVs EG HV 101/102 must be opened from the Control Room	1	H	O
2. Failure of HHI discharge valves to open, including common cause failures (includes check valves) MOVs: EM HV-8803A (BIT Inlet) EM HV-8803B (BIT Inlet) EM HV-8837A EM HV-8837B EM HV-8801A (BIT Outlet) EM HV-8801B (BIT Outlet) Valves EM HV-8837 A/B are modulating solenoid valves that can be used as an alternate charging path Check Valves: BB V-8948A BB V-8948B BB V-8948C BB V-8948D EM HV-8481A EM HV-8481B	1	H	S,M,T,C
3. Failure of HPR suction valves to open, including common cause failure MOVs: EJ HV 8811A EJ HV 8811B (Normally closed, containment sump to RHR pump suction valves)	1	M	S,M,T,C
4. Failure of pump return line (miniflow) valve to open fails operating pump Centrifugal Charging Pumps: HV 8810 HV 8811 Safety Injection Pumps: HV-8814A HV-8814B	1	M	S,M,T,C
5. Electrical failures (power cable/breaker) disable HHR pump room coolers	1	M	S,M

	Circuit Breaker Train A	Circuit Breaker Train B
SI Pump Room Cooler	52NG01ABF3	52NG02ACF3

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
6. Failure of Service Water System valve to open or remain open di ables HHR pump room cooling **Manual Valves - Locked Open** TRAIN A EF-V032 SI Pump Room Cooler EF-V033 SI Pump Room Cooler Return EF-V037 RHR Pump Room Cooler EF-V038 RHR Pump Room Cooler Return EF-V029 Centrifugal Charging Pump Room Cooler EF-V030 Centrifugal Charging Pump Room Cooler Return EF-V056 CCW Pump Room Cooler EF-V057 CCW Pump Room Cooler Return TRAIN B EF-V065 SI Pump Room Cooler EF-V066 SI Pump Room Cooler Isolation EF-V061 RHR Pump Room Cooler EF-V062 RHR Pump Room Cooler Isolation EF-V068 Centrifugal Charging Pump Room Cooler EF-V069 Centrifugal Charging Pump Room Cooler Isolation EF-V088 CCW Pump Room Cooler EF-V089 CCW Pump Room Cooler Return	1	M	S,M,T
7. Local fault of pumps/pumps fail to start or run Safety Injection Pumps: PEM01A PEM01B RHR Pumps: PEJ01A PEJ01B Centrifugal Charging Pumps: PBG05A PBG05B	1	M	S,M,T,C
8. Failure of valve to open in the common portion of the HHI suction line from the RWST MOVs BN LCV-112 D/E are the RWST to centrifugal charging pump suction supply valves and open based on an SI signal.	1	M	S,M,T,C
9. Plugging of manual valve in the HHI and SI suction line (or in the containment sump strainers) MOVs EM HV-8924, EM HV 8807A and EM HV-8807B provide recirculation flow for both HHI and SI.	1	M	S,M

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
10. HHI and SI pump return line (miniflow) valve fails to close; interlock prevents HPR suction valves from opening	1	L	S,M,T,C
SI Pump: Normally open MOVs operated from the Main Control Room EM HV-8814A EM HV-8814B BN HV-8813			
Centrifugal Charging Pump: MOVs that cycle open and closed for flows between 174 gpm and 259 gpm upon an SI signal. Train A HV-8110 Train B HV-8111			
11. Local pump failures — failure of control cable to MCC — failure of pump breaker to close	1	L	S,M
Power Source ESFRM1 Centrifugal Charging Pump 1A ESFRM2 Centrifugal Charging Pump 1B ESFRM1 Safety Injection Pump 1A ESFRM2 Safety Injection Pump 1B ESFRM1 RHR Pump 1A ESFRM2 RHR Pump 1B			
12. Pump in maintenance Two CCP, SI, or RHR pumps should not be simultaneously out for maintenance	1	L	M

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
SI Pump B Discharge Isolation	EM-8921B		Locked Open					
SI Pump A Discharge Isolation	EM-8921A		Locked Open					
SI Pumps to Accum Injection Cold Leg 4 Throttle	EM-V098		Locked Throttled					
SI Pumps to Accum Injection Cold Leg 1 Throttle	EM-V095		Locked Throttled					
SI Pump B to RCS Hot Leg 4 Throttle	EM-V093		Locked Throttled					
SI Pump B to RCS Hot Leg 1 Throttle	EM-V091		Locked Throttled					

High Head Injection/Safety Injection/High Head Recirculation

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Boron Inj. to RCS Cold Leg 4 Throttle	EM-V110		Locked Throttled	_____ _____				
Boron Inj. to RCS Cold Leg 1 Throttle	EM-V107		Locked Throttled	_____ _____				
SI Pumps to Accum Injection Cold Leg 3 Throttle	EM-V097		Locked Throttled	_____ _____				
SI Pumps to Accum Injection Cold Leg 2 Throttle	EM-V096		Locked Throttled	_____ _____				
SI Pump A to RCS Hot Leg 3 Throttle	EM-V090		Locked Throttled	_____ _____				
SI Pump A to RCS Hot Leg 2 Throttle	EM-V089		Locked Throttled	_____ _____				

High Head Injection/Safety Injection/High Head Recirculation

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Boron Inj. to RCS Cold Leg 3 Throttle	EM-V109		Locked Throttled	______ ______				
Boron Inj. to RCS Cold Leg 2 Throttle	EM-V108		Locked Throttled	______ ______				
RWST Outlet Isolation Valve	BN-V011		Locked Open	______ ______				

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CCW Train A Supply Isolation Valve to Post Accident Sampling Coolers	EG-V414	CCWA	Open/ Locked Closed*	______ ______ ______				
CCW Train A Return Isolation Valve to Post Accident Sampling Coolers	EG-V416	CCWA	Open/ Locked Closed*	______ ______ ______				
RHR HX A CCW Outlet Isolation Valve	EJ-V033	CCWA	Locked Throttled	______ ______ ______				
CCW A to SIP/RHR Pump/CCP Coolers Isolation Valve	EG-V038	2026AB	Locked Open	______ ______				
CCW to SI Pump 1A Oil-Cooler Isolation Valve	EG-V040	SIA	Locked Open	______ ______				
SI Pump 1A Oil Cooler Outlet Isolation Valve	EM-V099	SIA	Locked Throttled 0.4 turns open	______ ______				
CCW to RHR Pump Seal Cooler 1A Isolation Valve	EG-V042	RHRA	Locked Open	______ ______				

*Idle train must be locked closed

WOLF CREEK GENERATING STATION
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High Head Injection/Safety Injection/High Head Recirculation

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RHR Pump A CCW Return Isolation Valve	EJ-V070	RHR A	Locked Throttled					
CCW to CCP Oil Cooler 5A Isolation Valve	EG-V039	CCPA	Locked Open					
CCP A CCW Return Isolation Valve	BG-V259	CCPA	Locked Throttled 1.4 turns open					
SIP/RHR/CCP Coolers Return Isolation Valve	EG-V043	2026AB	Locked Open					
CCW Pumps A&C Room Cooler SGL11A ESW Inlet Isolation	EF-V056	CCWA	Locked Open					
CCW Pumps A&C Room Cooler SGL11A ESW Outlet Isolation	EF-V057	CCWA	Locked Open					
CCW Train B Supply Isolation Valve to Post Accident Sampling Coolers	EG-V413	CCWB	Open/ Locked Closed*					
CCW Train B Return Isolation Valve to Post Accident Sampling Coolers	EG-V415	CCWB	Open/ Locked Closed*					

*Idle train must be locked closed

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RHR HX B CCW Outlet Isolation Valve	EJ-V038	CCWB	Locked Throttled	_____ _____				
Train B to SIP/RHR Pump/CCP Coolers Isolation Valve	EG-V063	2026AB	Locked Open	_____ _____				
SI Pump 1B Oil-Cooler Isolation Valve	EG-V065	SIB	Locked Open	_____ _____				
SI Pump 1B Oil-Cooler Outlet Isolation Valve	EG-V103	SIB	Locked Throttled 0.45 turns open	_____ _____				
CCW to RHR Pump Seal Cooler 1B Isolation Valve	EG-V067	RHRB	Locked Open	_____ _____				

High Head Injection/Safety Injection/High Head Recirculation

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RHR Pump B CCW Return Isolation Valve	EJ-V071	RHRB	Locked Throttled 0.2 turns open	________ ________				
CCW to CCP Oil Cooler 5B Isolation Valve	EG-V064	CCPB	Locked Open	________ ________				
CCP A CCW Return Isolation Valve	BG-V268	CCPB	Locked Throttled	________ ________				
SIP/RHR/CCP Coolers CCWB Return Isolation Valve	EG-V068	2026AB	Locked Open	________ ________				

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW A to Cent. Charging Pump Room Cooler 12A Isolation	EF-V029	CCPA	Locked Open	____ ____				
Cent. Charging Pump Room Cooler 12A ESW Return Isolation	EF-V030	CCPA	Locked Open	____ ____				
ESW A to SI Pump Room Cooler 9A Isolation	EF-V032	SIA	Locked Open	____ ____				
SI Pump Room Cooler 9A ESW A Return Isolation	EF-V033	SIA	Locked Open	____ ____				
ESW A to RHR Pump Room Cooler 10A Isolation	EF-V037	RHRA	Locked Open	____ ____				
RHR Pump Room Cooler 10A ESW A Return Isolation	EF-V038	RHRA	Locked Open	____ ____				

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RHR Pump Room Cooler 10A ESW Return Isolation	GL-V010	Auxiliary Building Ventilation ESW Train A	Locked Throttled	______ ______				
SI Pump Room Cooler 9A ESW Return Isolation	GL-V009	Same	Locked Throttled	______ ______				
Cent. Charging Pump Room Cooler 12A ESW Return Isolation	GL-V008	Same	Locked Throttled	______ ______				
Cent. Charging Pump Room Cooler 12B ESW Return Isolation	GL-V019	Auxiliary Building Ventilation ESW Train B	Locked Throttled	______ ______				
SI Pump Room Cooler 9B ESW Return Isolation	GL-V018	Same	Locked Throttled	______ ______				
RHR Pump Room Cooler 10B ESW Return Isolation	GL-V017	Same	Locked Throttled	______ ______				

TABLE A.6-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW B to RHR Pump Room Cooler 10B Isolation	EF-V061	RHRB	Locked Open	______ ______				
RHR Pump Room Cooler 10B ESW B Return Isolation	EF-V062	RHRB	Locked Open	______ ______				
ESW B to Cent. Charging Pump Room Cooler 12B Isolation	EF-V068	CCPB	Locked Open	______ ______				
Cent. Charging Pump Room Cooler 12B ESW B Return Isolation	EF-V069	CCPB	Locked Throttled	______ ______				
ESW B to SI Pump Room Cooler 9B Isolation	EF-V065	SIB	Locked Open	______ ______				
SI Pump Room Cooler 9B ESW B Return Isolation	EF-V066	SIB	Locked Open	______ ______				

WOLF CREEK GENERATING STATION
(ESWS)

TABLE A.6-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
Licensed Operator Initial Training Lessons:			
1. "Essential Service Water System"	LO 1408900	000	02/29/88
2. "Service Water System"	LO 1407600	001	02/25/87
3. "Emergency Core Cooling System and Safety Injection"	LO 1300600	000	01/28/88
4. "Residual Heat Removal System"	LO 1300500	001	08/10/88
Drawings			
1. SNUPPS "P&ID – Essential Service Water System"	M-12EF01	C	12/09/86
2. SNUPPS "P&ID – Essential Service Water System"	M-12EF02	0	12/09/86
3. SNUPPS "P&ID – Service Water System"	M-12EA01	0	08/07/84
4. SNUPPS "P&ID – Service Water System"	M-12EA02	0	
5. SNUPPS "P&ID - Chemical and Volume Control System"	M-12BG03	3	8/10/87
6. SNUPPS "P&ID - Chemical and Volume Control System"	M-12BG05	1	7/14/87
7. SNUPPS "P&ID - Residual Heat Removal System"	M-12EJ01	1	7/14/87
Procedures			
1. "Essential Service Water Valve Breaker and Switch Lineup"	CKL-EF-120	12	02/10/89
2. "Component Cooling Water System Valve, Breaker and Switch Lineup	CKL-EG-120	9	11/09/84
3. "Chemical and Volume Control System Normal Valve Lineup"	CKL-BG-120	12	01/08/89
4. "Chemical and Volume Control System Switch and Breaker Lineup"	CKL-BG-130	8	02/10/89
5. "Safety Injection System Lineup Checklists"	CKL-EM-120	7	04/20/88
6. "RHR Normal System Lineup"	CKL-EJ-120	9	08/13/88

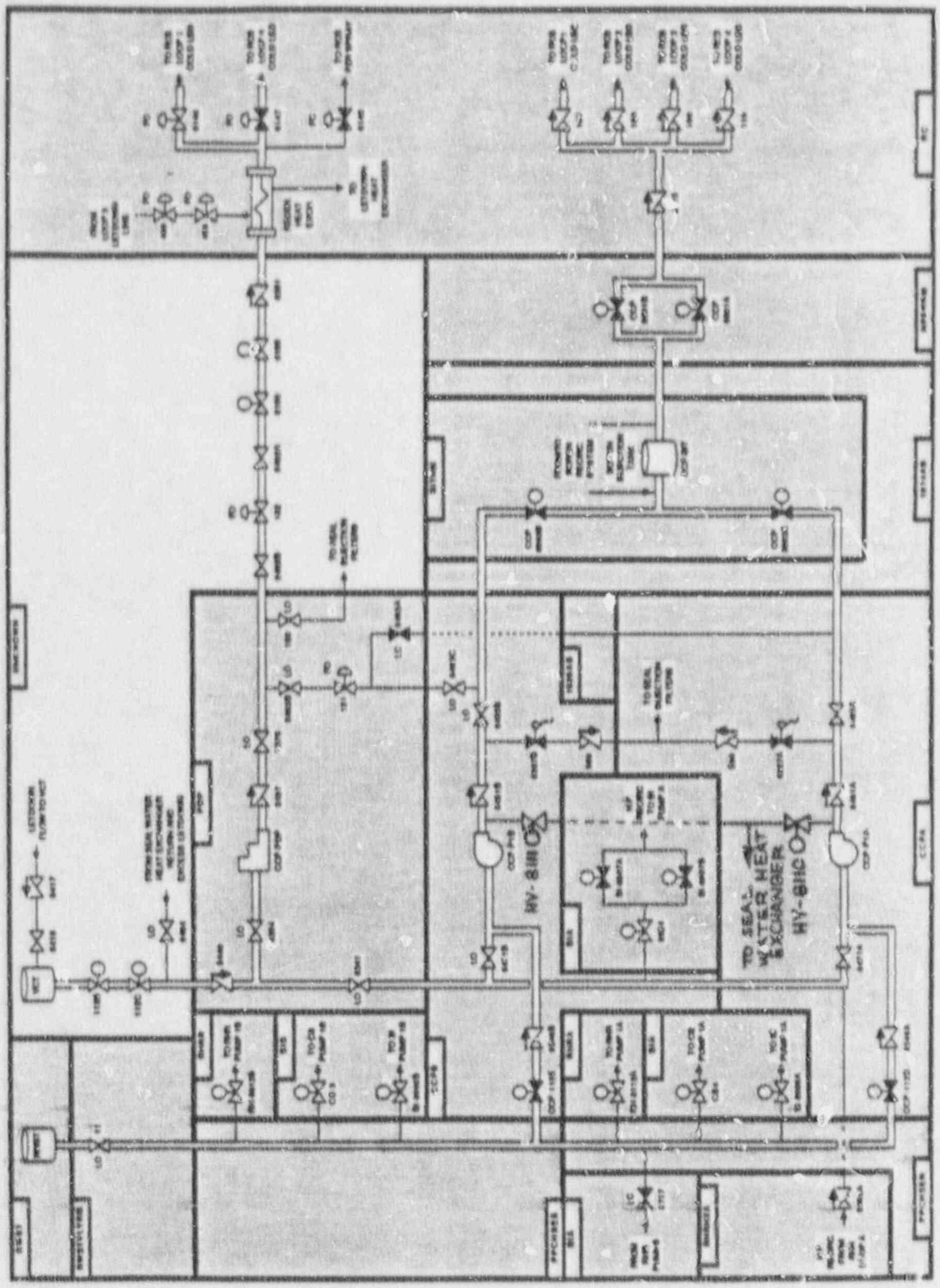

Figure A.6-1. "Wolf Creek Charging System Showing Component Locations" (Source SAIC 88/1996, Figure 3.4-2)

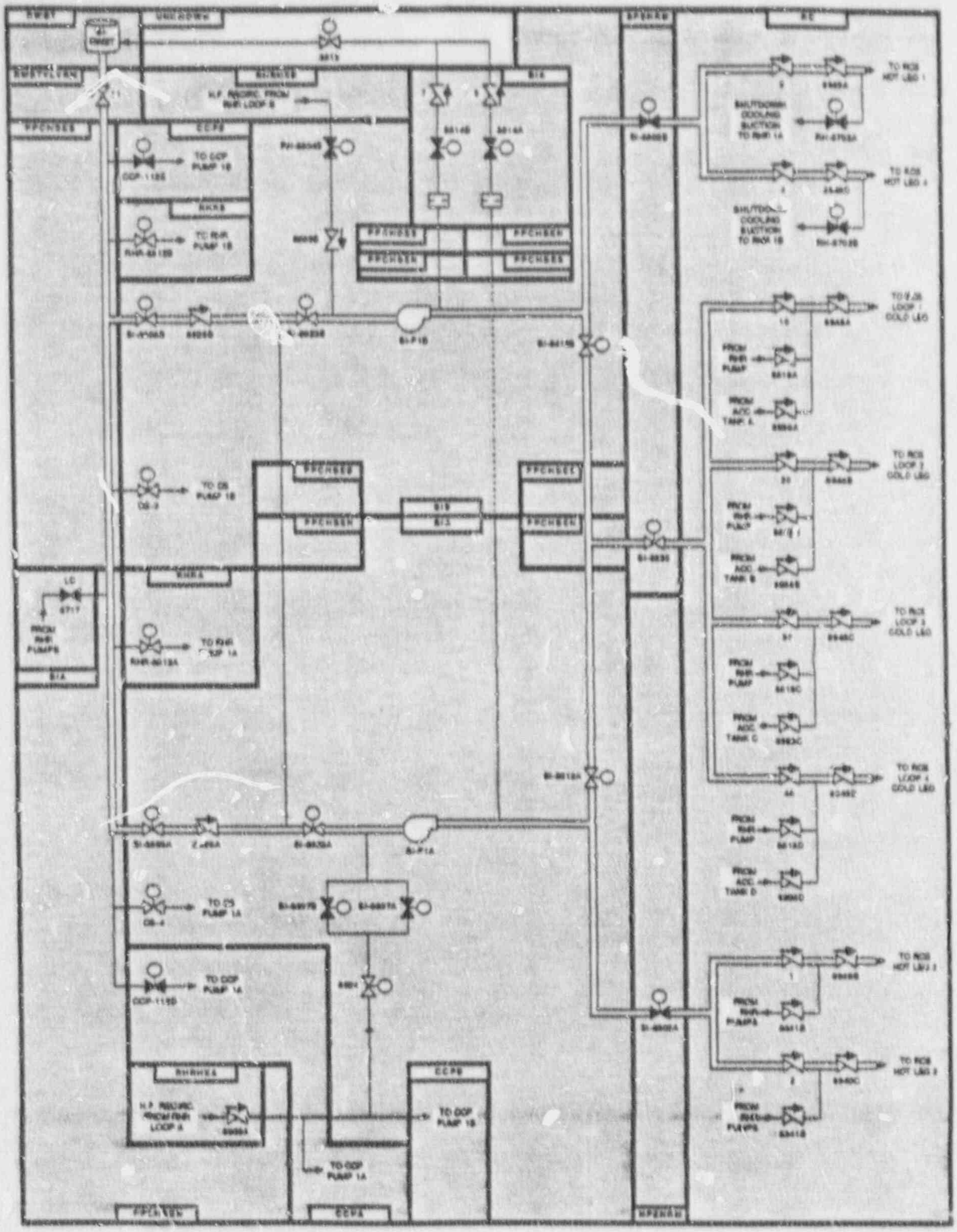

Figure A.6-2. "Wolf Creek Safety Injection System Showing Component Locations" (Source SAIC 88/1996, Figure 3.3-2)

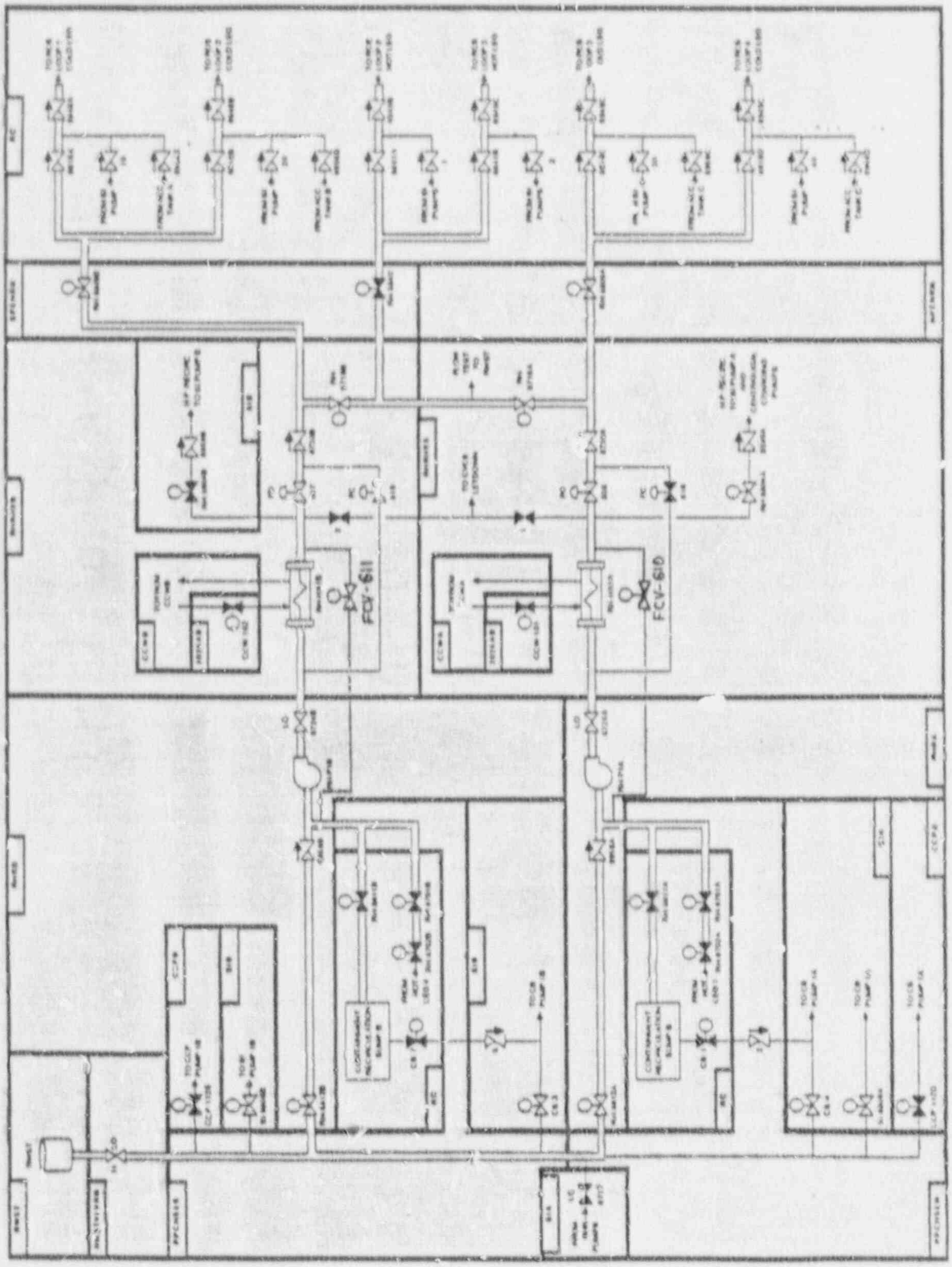

Figure A.6-3 "Wolf Creek Residual Heat Removal System Showing Component Locations" (Source SAIC 88/1996, Figure 3.3-4)

WOLF CREEK GENERATING STATION

Table A.7-1. Importance Basis and Failure Mode Identification

PRIMARY PRESSURE RELIEF SYSTEM

Mission Success Criteria

The primary pressure relief system (PPRS) provides protection from overpressurization of the primary system to ensure that primary integrity is maintained. The PPRS also provides the means to reduce the RCS pressure if necessary. The PPRS is composed of three code safety relief valves (SRV) and two power operated relief valves (PORVs). The code safety valves are important only for ATWS scenarios. The PORVs provide RCS pressure relief at a set point below the SRVs. The PORVs discharge to the pressurizer relief tank. Each PORV is provided with a motor operated block valve. The PORVs automatically open on high RCS pressure or are manually opened at the discretion of the operator. The block valves are normally open unless a PORV is leaking.

The success criteria for the PPRS vary depending on the application. The success criterion for the PPRS following a transient event demanding PORV opening is that the PORVs successfully reclose. The success criterion for the PPRS following a transient and failure of the AFWS is that both PORVs successfully open on demand. The success criterion for the PPRS following a small LOCA with failure of the AFWS and/or the support system function provided to HHI in the emergency boration mode is that both PORVs successfully open on demand. The success criterion for ATWS is that 3 SRVs or 2 SRVs and 2 PORVs open.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. PORV fails to open for bleed & feed mode PCV-455A, PCV-456A	6,7	H	S,M,T,C
2. Failure of PORV/SRV to reseat causing small LOCA PCV-455A, PCV-456A SRVs 8010 A,B,C	1	H	M
3. PORV block valve closed HV-8000A, HV-8000B	7	M	O,M
4. Operator error in bleed & feed activities causes lack of [illegible] cooling. See EMG FR-H1 "Response to Loss of Secondary Heat Sink".	6	M	O

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Primary Pressure Relief System

TABLE A.7-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Pressurizer PORV	PCV-455A	Containment El 2070'	Closed	________			Closed	________
Pressurizer PORV	PCV-456A	" 2070'	Closed	________			Closed	________
Pressurizer Safety Relief Valve	SRV-8010A	" 2080'	Not Gagged	________				
Pressurizer Safety Relief Valve	SRV-8010B	" 2080'	Not Gagged	________				
Pressurizer Safety Relief Valve	[illegible]V-[illegible]	" 2080'	Not Gagged	________				
Pressurizer PORV Block Valve (PCV-455A)	HV-8000A	" 2070'	Open	________				
Pressurizer PORV Block Valve (PCV-456A)	HV-8000B	2070'	Open	________				

TABLE A.7-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
PZR PORV BB PCV-455A	BB-HIS-455A	Main Control Board RL021	Closed/Auto	______ ______				
PZR PORV BB PCV-456A	BB-HIS-456A	Same	Closed/Auto	______ ______				
BB HV-8000A PZR Power Relief PCV-455A Inlet	BB-HIS-8000A	Same	Open	______				
BB HV-8000B PZR Power Relief PCV-456A Inlet	BB-HIS-8000B	Same	Open	______				
PZR Relief Isolation Valves (BB HV-8000A and BB PCV-455A)	BB-HIS-8000A	Same	Arm	______				
PZR Relief Isolation Valves (BB HV-8000B and BB PCV-456B)	BB-HIS-8000B	Same	Arm	______				
PZR Relief Isolation Valve (BB HV-8000A)	BB-HIS-8000C	Main Control Board NG01	Normal	______				
PZR Relief Isolation Valve (BB HV-8000B)	BB-HIS-8000D	Main Control Board NG02	Normal	______				

WOLF CREEK GENERATING STATION
WCGS
PPRS

TABLE A.7-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
Documents			
1. P. Saylor and P. Lobner (ed.), "Nuclear Power Plant	SAIC 88/1996	1	February 1989
System Sourcebook - Wolf Creek 50-482," Science			
Applications International Corp.			
Procedures			
1. Reactor Coolant System Lineup	CKL-BB-110	8	02/10/89

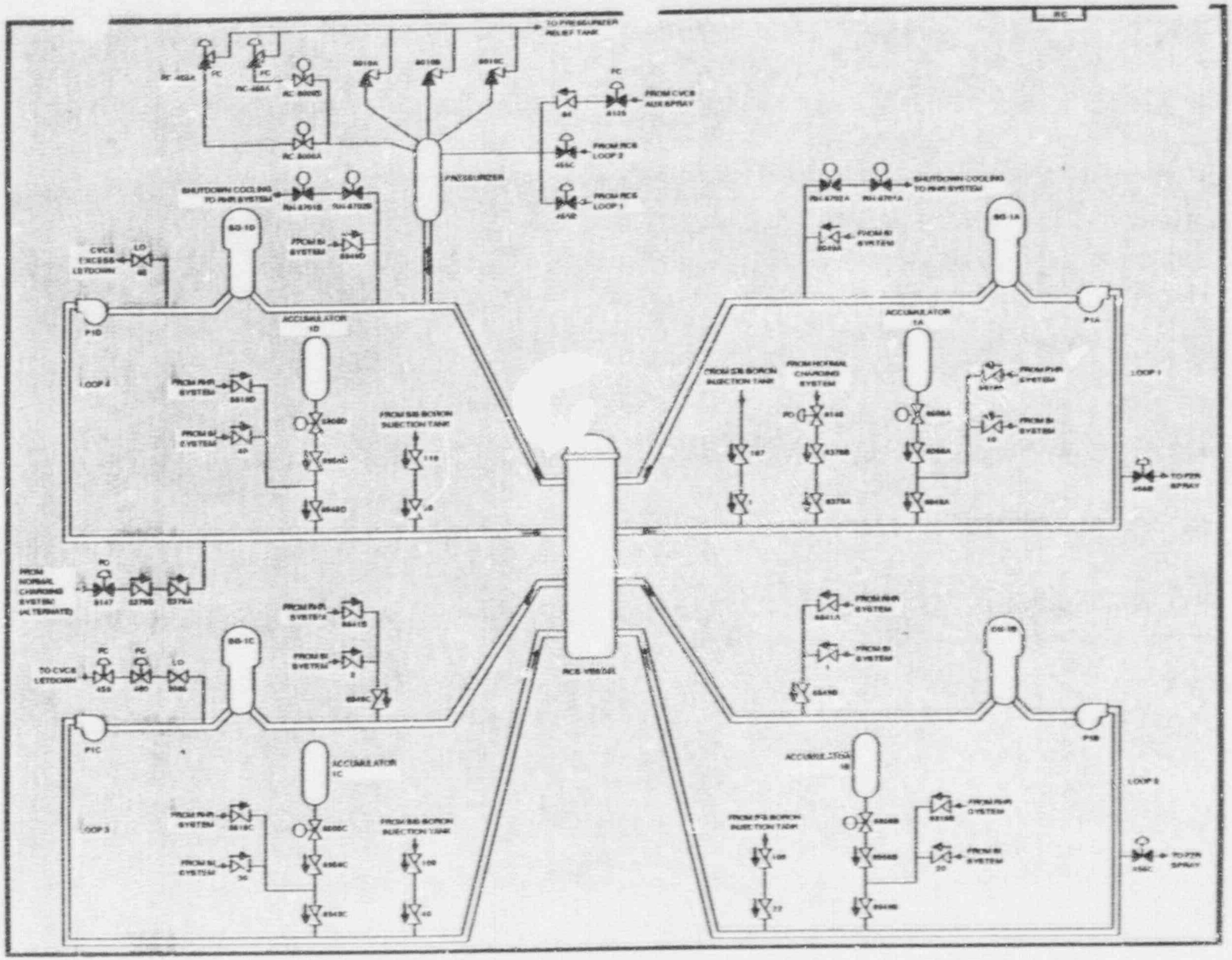

Figure A.7-1. "Wolf Creek Reactor Cooling System Showing Component Locations and Primary Pressure Relief System"
(Source SAIC 88/1996, Figure 3.1-3)

WOLF CREEK GENERATING STATION

Table A.8-1. Importance Basis and Failure Mode Identification

AUXILIARY FEEDWATER SYSTEM

Mission Success Criteria

The Auxiliary Feedwater (AFW) system provides feedwater to the steam generators (SGs) to allow continued heat removal from the primary system when main feedwater is unavailable. In this capacity the AFW system serves as one of the means to perform the safety function of early core heat removal following a transient or small LOCA.

The AFW system is a three train system which consists of two motor driven pumps (MDPs) and one turbine driven pump (TDP). Each MDP discharges to two of the four SGs. The TDP is twice the capacity of the MD pumps and discharges to all of the SGs. Each pump takes suction through a common header from the Condensate Storage Tank (CST) or from an Essential Service Water header. The CST has a capacity of approximately 466,200 gallons. The Technical Specifications require the CST to be operational with at least 281,000 gallons of water. Each flow path from an AFW pump discharge to a SG has two check valves in series and a normally open air operated valve.

The two MDPs start automatically on receipt of an AFW actuation signal (AFAS). This signal is generated in response to any of the following conditions: SG water level low-low, presence of the ESF signal, station blackout, or trip of main feedwater pumps. The same signal causes the TDP throttle/trip valve to open automatically starting the TDP. In the event that low AFW pump suction pressure is sensed, indicating faults in the condensate storage tank suction lines, suction is automatically switched to the ESW headers by opening the ESW header isolation valves.

The AFW system depends on AC power for motive power to MDP motors and for control power to AOVs, DC power for control power to MDP's, TD pump and the associated air-operated discharge valves, and AFAS for automatic actuation.

In addition to the dependencies listed above, the AFW system also interfaces with the instrument air system, and HVAC, and SWS. HVAC provides room cooling for the TDP and instrument air is provided to the TDP discharge valves.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Failure to manually start locked out standby pump According to WCGS training document LO 1406100 in some emergency procedures, upon a SI signal, the operator is instructed to place the motor-driven AFW pumps in the pull-to-lock position until power is restored to at least one safeguards bus.	7,10,6	H	O
2. Local fault of valve in turbine-driven pump discharge to steam generators. Inadvertent closure of locked open manual valve V055 prevents AFW flow to all four steam generators from the TDP.	6,8,7	H	S,M,T
3. Failure to manually start pump given auto-start failure MDP PAL01A [MDP PAL01B] can be manually started by the Control Room handswitch AL HIS 23A (RL005), [AL HIS 22A (RL005)], the handswitch at the Auxiliary Shutdown Panel (ASP) AL HIS 231, [AL HIS 22B (RP118)], and locally at the NB01 bus. TDP PAL02 is manually started by depressing the Actuate push button on Main Control Board Panel RL018 which in turn opens the three steam supply valves ABHV-5, ALHV-6, and FCHV 312.	10,6,7	H	O
4. Turbine driven pump PAL02 fails to start or run Several possible failure mechanisms can lead to failure to start or run, e.g. hardware failure of pump or turbine	10,8,7,6	H	S,M,T,C
5. Motor driven pump PAL01A or PAL01B fails to start or run Similarly, as in 3 above, failure to start or run can be caused by pump or motor hardware faults, etc.	6,10,7	H	S,M,T,C
6. Local fault of valve in motor-driven pump discharge to steam generator Inadvertent closure of locked open manual valve V045 prevents flow to Steam Generators B and C from MDP PAL01A. Similarly, inadvertent closure of locked open manual valve V031 prevents flow to Steam Generators A and D from MDP PAL01B.	6,7	H	S,M,T
7. Turbine driven pump PAL02in maintenance The Wolf Creek Tech. Specs. limit the allowed outage time of one AFW pump to 72 hours.	10,7,6	H	M
8. Steam supply valve or throttle/trip valve fails to open (or other valve faults in steam admission line) for turbine driven pump Steam for the TDP is supplied by normally closed air operated ABHV-5 from SG B and ABHV-6 from SG C, and through the normally closed trip and throttle valve FCHV-312. Failure of ABHV-5 and ABHV-6 to open or of FCHV-312 to open prevents operation of the TDP.	10,7,6	H	S,M,T,C

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
9. Local fault of suction valve fr[illegible] condensate storage tank (CST) Inadvertent closure of locked open manual valve V15 blocks all flow from the CST to the AFW pumps, forcing reliance upon the ESWS as a suction source	10,7	M	O,S,M
10. AFW flow control valve in maintenance fails delivery from TD pump The TDP discharges to the SGS through four air-operated discharge valves: **Valve No.** — **SG** ALHV8 — A ALHV10 — B ALHV12 — C ALHV6 — D Maintenance on any of the above prevents flow to the respective SG.	7,6,10	M	M
11. Undetected flow diversion Inadvertent closure of locked open manual valves V031, V045 or V055 described in 2 and 6 above diverts all flow back to the CST through the mini-flow line.	7	M	O
12. Undetected FW leakage back through pump discharge valves causes steam binding WCGS training document LO1406100 alerts the operator to this condition and indicates that it can be detected by routine temperature monitoring via the plant computer and manual local testing. The condition can be cleared by venting and running the affected pump.	7	M	O
13. Local fault of motor-driven pump power breaker (See AC power system)	10,7	M	S,M
14. Turbine driven pump in test Each AFW pump must be tested every 31 days according to the WCGS Tech Specs.	10,6	L	S

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
15. Local fault of AFW actuation signal logic fails to actuate MD pump and/or TD pump steam valves The MDPs are automatically actuated upon any one of the following signals: a) 2 of 4 low-low water levels in any one steam generator. b) SI signal. c) Loss of offsite power and station normal auxiliary power. d) Loss of both MFW pumps. The TDP automatically starts upon either of the following signals: a) 2 of 4 low-low water levels in any 2 of 4 steam generators. b) Loss of offsite power and station normal auxiliary power.	10	L	S,C
16. Failure to restore TD pump from testing The TDP is subject to periodic testing under procedure STS AL-103.	6	L	O
17. Failure to restore TD pump discharge valve V055 after test Locked open manual valve V055 does not have control room position indication.	6	L	O
18. Failure to manually open TD pump discharge AOVs ALHV 6, 8, 10, 12. Each valve has a 25 cu. ft. N_2 accumulator to backup the air supply should it be lost.	8	L	O
19. MD pump PAL 01A or 01B in maintenance. As in 10 above, each pump may be inoperable up to 72 hours, according to the Tech Specs.	10	L	M

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Auxiliary Feedwater System

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
CST Supply to AFW Pumps Suction Isolation Valve	AP-V015	Aux. Bldg. (AB) 014	Locked Open	______ ______				
AFW Pumps Miniflow to CST Isolation Valve	AP-V001	A.B. 024	Locked Open	______ ______				
TD AFW Pump Suction from ESW Train A Isolation	AL-V011	A.B. 125	Locked Open	______ ______				
TD AFW Pump Suction from ESW Train B Isolation	AL-V014	A.B. 125	Locked Open	______ ______				
MD AFW Pump A Suction from ESWS	AL-V008	A.B. 125	Locked Open	______ ______				
MD AFW Pump B Suction from ESWS	AL-V005	A.B. 125	Locked Open	______ ______				
MD AFW Pump A Miniflow to CST Isolation	AL-V040	A.B. 135	Locked Open	______ ______				
MD AFW Pump B Miniflow to CST Isolation	AL-V028	A.B. 135	Locked Open	______ ______				

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
MD AFW Pump A Suction Pressure Transmitter AL PT-25 Isolation	AL-V021	Aux. Bldg. (A.B.) 135	Open	______				
MD AFW Pump B Suction Pressure Transmitter AL PT-24 Isolation	AL-V018	A.B. 135	Open	______				
TD AFW Pump Suction Pressure Transmitter AL PT-26 Isolation	AL-V024	A.B. 135	Open	______				
TD AFW Pump Disch. Isolation	AL-V055	Aux. Bldg. (A.B.) 135	Locked Open	______ ______				
TD AFW Pump Miniflow Recirc. to CST Isolation	AL-V052	A.B. 135	Locked Open	______ ______				
MD AFW Pump A Discharge Isolation	AL-V043	A.B. 135	Locked Open	______ ______				
MD AFW Pump A Discharge to SGB HV-9 Inlet Isolation	AL-V047	A.B. 135	Locked Open	______ ______				
MD AFW Pump A Discharge to SGB Header Isolation	AL-V049	A.B. 135	Locked Open	______ ______				
MD AFW Pump A Discharge to SGC HV-11 Inlet Isolation	AL-V044	A.B. 135	Locked Open	______ ______				

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
MD AFW Pump A Discharge to SGC Header Isolation	AL-V046	A.B. 135	Locked Open	______ ______				
MD AFW Pump B Discharge Isolation	AL-V031	Aux. Bldg. (A.B.) 135	Locked Open	______ ______				
MD AFW Pump B Discharge to SCD HV-5 Inlet Isolation	AL-V035	A.B. 135	Locked Open	______ ______				
MD AFW Pump B Discharge to SGD Header Isolation	AL-V037	A.B. 135	Locked Open	______ ______				
MD AFW Pump B Discharge to SGA HV-7 Inlet Isolation	AL-V032	A.B. 135	Locked Open	______ ______				
MD AFW Pump B Discharge to SGA Header Isolation	AL-V034	A.B. 135	Locked Open	______ ______				
TD AFW Pump B Discharge to SGA HV-8 Inlet Isolation	AL-V056	A.B. 135	Locked Open	______ ______				
TD AFW Pump Discharge to SGA Header Isolation	AL-V058	Aux. Bldg. (A.B.) 135	Locked Open	______ ______				
TD AFW Pump Discharge to SGD HV-6 Inlet Isolation	AL-V061	A.B. 135	Locked Open	______ ______				

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Auxiliary Feedwater System

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
TD AFW Pump Discharge to SGD Header Isolation	AL-V063	A.B. 135	Locked Open	______ ______				
TD AFW Pump Discharge to SGB HV-10 Inlet Isolation	AL-V066	A.B. 135	Locked Open	______ ______				
TD AFW Pump Discharge to SGB Header Isolation	AL-V068	A.B. 135	Locked Open	______ ______				
TD AFW Pump Discharge to SGC HV-12 Inlet Isolation	AL-V071	A.B. 135	Locked Open	______ ______				
TD AFW Pump Discharge to SG-C Header Isolation	AL-V073	Aux. Bldg. (A. B.) 135	Locked Open	______ ______				
Main Steam Loop 2 to AFWP Turbine HV-5 Inlet Isolation	AB-V085	A.B. 145	Locked Open	______ ______				
Main Steam Loop 3 to AFWP Turbine HV-6 Inlet Isolation	AB-V087	A.B. 145	Locked Open	______ ______				
TD AFW Pump Discharge to SGD Isolation	AL HV-6	AFW D Valve Room	Locked Neutral	______ ______				
TD AFW Pump Discharge Header to SGA Isolation	AL HV-8	AFW A Valve Room	Locked Neutral	______ ______				

Auxiliary Feedwater System

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
TD AFW Pump Discharge Header to SGB Isolation	AL HV-10	AFW B Valve Room	Locked Neutral	______ ______				
TD AFW Pump Discharge Header to SGC Isolation	AL HV-12	AFW C Valve Room	Locked Neutral	______ ______				
Main Steam Loop 2 to AFWP Turbine Isolation	AB HV-5	Main Stream Tunnel BC	Locked Neutral	______ ______				
Main Steam Loop 3 to AFWP Turbine Isolation	AB HV-6	Same	Locked Neutral	______ ______				
ESW A to Aux FW Pump Room Cooler 2A Isolation	EF-V047	MD AFW A Pump Room	Locked Open	______ ______				
Aux FW Pump Room Cooler 2A ESW Return Isolation	EF-V048	Same	Locked Open	______ ______				
ESW B to Aux FW Pump Room Cooler 2B Isolation	EF-V077	MD AFW B Pump Room	Locked Open	______ ______				
Aux FW Pump Room Cooler 2B ESW B Return Isolation	EF-V078	Same	Locked Open	______ ______				

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
AL HV-30 ESW to MD AFW Pump B					52NG 04CCF3		Closed	________
AL HV-33 TD AFWP ESW Train B Suction Isolation					52NG 04CCF4		Closed	________
AL HV-34 Condensate Storage to MD AFWP B					52NG 04CNF1		Closed	________
AL HV-31 ESW to MD AFWP A					52NG 03CCF3		Closed	________
AL HV-32 TD AFWP ESW Train A Suction Isolation					52NG 03CCF4		Closed	________
AL HV-35 Condensate Storage to MD AFWP A					52NG 03CEF3		Closed	________
AL HV-35 Condensate Storage to TD AFWP					52NG 03CEF4		Closed	________
AL HV-5 MD AFWP B Discharge Header to SG D Isolation					NG04 CLF115		Closed	________
AL HV-7 MD AFWP B Discharge Header to SG A Isolation					NG04 CLF116		Closed	________

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Auxiliary Feedwater System

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
AL HV-9 MD AFWP A Discharge Header to SG B Isolation					NG 01BAR114		Closed	______
AL HV-11 MD AFWP A Discharge Header to SG C Isolation					NG 01BAR115		Closed	______
Panel RP053CC					PN0823		Closed	______
Panel RP053DB					NN0307		Closed	______
Panel RP053EB					PN0819		Closed	______
Panel RP053EA					PN0716		Closed	______
Panel RP053CD					PN0723		Closed	______
Panel RP053BC					NN0418		Closed	______
Panel RP053BC					NN0416		Closed	______

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Auxiliary Feedwater System

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd) (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Panel RP053AC					NN0120		Closed	______
Panel RP053AC					NN0116		Closed	______
Panel RP053DA					NN0208		Closed	______
Aux Relay Rack RP335					NK4419		Closed	______
AFW Pump DPAL01A Breaker					152NB0105		Racked Up	______
AFW Pump DPAL01B Breaker					152NB0205		Racked Up	______
MD AFWP DPAL01A Control Power (Via. SWGR NB01)					NK4101		On	______
MD AFWP DPAL01B Control Power (Via. SWGR NB02)					NK4401		On	______

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TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
SG D MDAFWP B Control Valve AL HV-5	AL HK-5A	Control Room RL006	Open	________				
SG D TDAFWP Control Valve AL HV-6	AL HK-6A	C.R. RL006	Open	________				
SG A MDAFWP B Control Valve AL HV-7	AL HK-7A	C.R. RL006	Open	________				
SG A TDAFWP Control Valve AL HV-8	AL HK-8A	C.R. RL006	Open	________				
SG B MDAFWP A Control Valve AL HV-9	AL HK-9A	C.R. RL006	Open	________				
SG B TDAFWP Control Valve AL HV-10	AL HK-10A	C.R. RL006	Open	________				
SG C MDAFWP A Control Valve AL HV-11	AL HK-11A	C.R. RL006	Open	________				
SG C TDAFWP Control Valve AL HV-12	AL HK-12A	C.R. RL006	Open	________				
ESW to MD AFWP B Valve AL HV-30	AL HIS-30A	C.R. RL005	Closed	________				

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd) (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
ESW to MD AFWP A Valve AL HV-31	AL HIS-31A	C.R. RL005	Closed	________				
ESW to TD AFWP Valve AL HV-32	AL HIS-32A	C.R. RL005	Closed	________				
ESW to TD AFWP Valve AL HV-33	AL HIS-33A	C.R. RL005	Closed	________				
CST to MD AFWP B Valve AL HV-34	AL HIS-34A	C.R. RL005	Open	________				
CST to MD AFWP A Valve AL HV-35	AL HIS-35A	C.R. RL005	Open	________				
CST to TD AFWP Valve AL HV-36	AL HIS-36A	C.R. RL005	Open	________				

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Auxiliary Feedwater System

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Loop 3 Steam to AFWP Turbine Valve AB HV-6	AB HIS-6A	Control Room RL005	Closed	________				
Loop 2 Steam to AFWP Turbine Valve AB HV-5	AB HIS-5A	C.R. RL005	Closed	________				
Loop 2 Warmup Steam to AFWP Turbine AB HV-48	AB HIS-48	C.R. RL005	Closed	________				
Loop 3 Warmup Steam to AFWP Turbine AB HV-49	AB HIS-49	C.R. RL005	Closed	________				
AFWP Turbine Bypass Trap to Cond. FC LV-10	FC HIS-10	C.R. RL005	Closed	________				
AFWP Trap Isol. Valve FC FV-310	FC HIS-310	C.R. RL005	Open	________				
AFWP Turbine Mech. Trip/ Throttle Valve FC HV-312	FC HIS-312A	C.R. RL005	Closed	________				
AFWP Turbine Speed Govenor Control	FC HIK-313A	C.R. RL005	3850 RPM	________				
AFWP PAL01A Motor Control Switch	AL HIS-23A	C.R. RL005	Normal After Stop	________ ________ ________				

TABLE A.8-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
AFWP PAL01B Motor Control Switch	AL HIS-22A	Control Room RL005	Normal After Stop	_____ _____ _____				
Control Room Isolate Switch	RP HIS-1	Remote Shutdown Panel	Normal	_____				
Control Room Isolate Switch	RP HIS-2	Remote Shutdown Panel	Normal	_____				

WOLF CREEK GENERATING STATION
AFWS

TABLE A.8-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
Documents			
1. Wolf Creek Generating Station Technical Specifications as in effect February 1988, "Condensate Storage Tank," Par. 3.7.1.4			
Licensed Operator Initial Training Lessons:			
1. WCGS "Licensed Operator Training Document – Auxiliary Feedwater"	LO1406100	001	12/29/87
Procedures			
1. WCGS "Auxiliary Feedwater Normal Lineup"	CKL-AL-120	11	01/08/89
Drawings			
P&ID – Auxiliary Feedwater System	M-12AL01(Q)	0	04/27/85

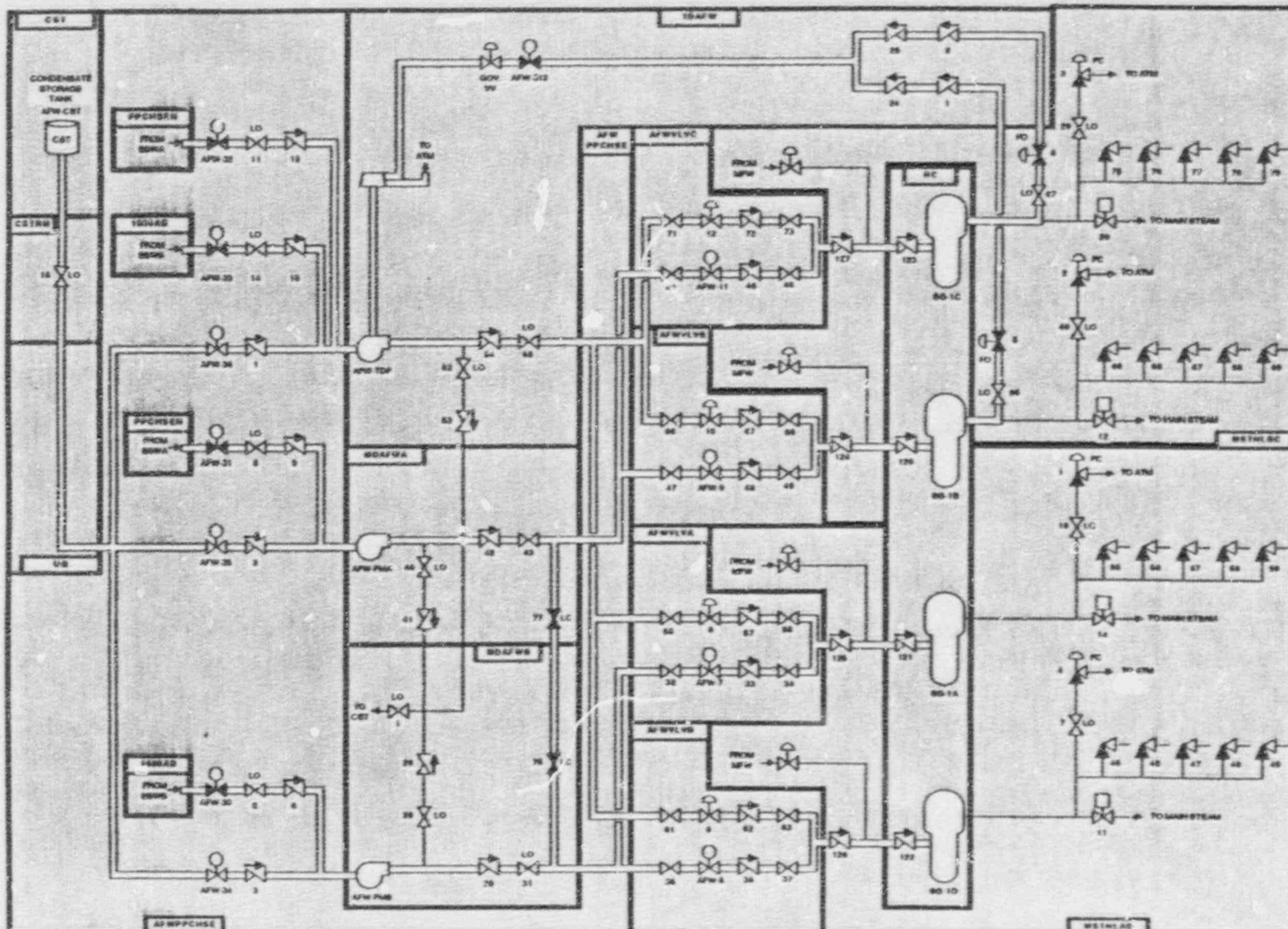

Figure A.8-1. "Wolf Creek Auxiliary Feedwater System Showing Component Locations"
(Source SAIC 88/1996, Figure 3.2-2)

Table A.9-1. Importance Basis and Failure Mode Identification

LOW HEAD INJECTION (LHI)/LOW HEAD RECIRCULATION (LHR)

Mission Success Criteria

The LHI/LHR system injects borated water from the Refueling Water Storage Tank (RWST) into the RCS to provide core cooling water during the injection phase of a large break LOCA. Refer to Figure A.6-3, page A-67.

Four accumulators are available to flood the core with borated water immediately following a large break LOCA. They are designed to minimize core damage until the safety injection pumps can provide adequate water for core cooling. Each tank is pressurized with nitrogen at 650 psig and contains a minimum water volume of 850 ft^3 with a minimum boron concentration of 2000 ppm.

The accumulators are self-contained, self-actuating, and passive in nature. Each tank is connected to the RCS at one of the reactor inlets (cold legs). Two check valves, held closed by RCS pressure, provide isolation during normal operation. The tanks can be isolated by motor-operated valves during plant shutdown and depressurization. The accumulators are not dependent on any support systems. Three of the four tanks provide sufficient water to cover the core following a Design Basis Accident (DBA), assuming the contents of one of the four tanks spilled through the break.

The LHI/LHR system can be aligned to take suction from the containment sump and maintain a borated water cover over the reactor core for extended periods of time in the recirculation phase. Manual startup of the CCW system is required to provide cooling to the RHR heat exchangers thereby cooling the recirculation flow.

The LHI/LHR system consists of two pumps taking suction from separate RWST discharge headers which discharge into cross-connected headers. Upon receipt of a SIAS, the two pumps will start and the injection line motor-operated valves will open. When RCS pressure drops below 600 psig, the LHI/LHR will begin to deliver flow to the cold legs. Mission success is accomplished by operation of one LHI pump following a DBA.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Accumulator failure including common mode check valve failure or plugging of MOVs Normally open (with breakers racked out) MOVs in the accumulator discharge lines EP HV-8808A,B,C, and D Check valves in the accumulator discharge lines Cold Leg 1 8956A 8945A Cold Leg 2 8956B 8945B Cold Leg 3 8956C 8945C Cold Leg 4 8956D 8945D	3	H	S,M,T
2. Operator failure to isolate interfacing LOCA RHR Train A HV-8809A RHR Train B HV-8809B These normally open MOVs isolate the flow from the LHI/RHR pumps to the cold leg loops 1 and 2 for Train A and loops 3 and 4 for Train B. Operator action would be required to close these valves if failure of the downstream check valves were to occur. If these valves are not designed to close against full RCS pressure, it would be necessary for the operator to wait for depressurization before isolating the LOCA to avoid destruction of the valves.	4	H	O
3. Operator failure to successfully switch from LHI to LHR including valve alignment errors The valve lineup for recirculation is automatic. Operator action is required to align the CCW system to provide cooling of the RHR heat exchangers during the recirculation phase.	2	H	O
4. LHI pump(s) fail to start or run including common cause failure Pumps PEJ01A PEJ01B These pumps start automatically based on a safety injection signal.	1,3	H	S,M,T,C
5. Failure of LHR suction (containment sump) valves to open MOVs: EJ HV-8811 A,B These valves are located outside containment but are contained by a pressure tight vessel rated at 60 psig.	1,2	H	S,M,T,C
6. Failure of LHI suction valve from RWST to close MOVs: HV-8812 A,B These valves are normally open and have position indication on the ESFAS panel.	1,2	M	S,M,T,C

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
7. Failure to realign system after testing	3	M	O
8. Cold leg isolation valve fails to close for switch to hot leg recirculation. Operator action is required to close these valves. EJ HV 8809 A and B	2	M	S,M,T,C
9. Pump discharge crossover valve fails to close Remotely operated MOVs: HV 8716 A and B	2	M	S,M,T,C
10. Failure to switch from cold leg to hot leg recirculation Switch to hot leg recirculation is accomplished by: Closing valves EJ HV 8809 A and B, Opening valves EJ HV 8716 A and B, and Opening valve EJ HV 8840.	2	M	S,M,T
11. LHI pump return line (miniflow) valve fails to open or remain open, including common cause and operator fails to stop pump Flow control valves: FCV 610 FCV 611	1,3	M	S,M,T,C
12. Containment sump plugs	1	L	S,M
13. LH hot leg recirculation discharge valve fails to open Motor operated valves HV 8802 A and B	2	L	S,M,T
14. Heat exchanger cooling water valves fail to open (CCW system failure) Motor operated valves: HV 101 (RHR HE A) HV-102 (RHR HE B)	2	L	S,M,T,C
15. Injection isolation valves fail to remain open Cold leg injection header valves: HV-8809 A and B SI pump suction (from RWST) HV-8923 A and B Hot leg injection header isolation valves HV-8802 A and B	1,2,3	L	S,M,T,C
16. Recirculation suction valves rupture/fail to remain closed Isolation valves that must be closed during recirculation include: Motor-operated valves: 8813, 8814 A and B (SI pump mini-flow lines) Motor-operated valves: LCV 112 D and E (RWST to charging pump suction) Motor-operated valves: 8806 A and B (RWST to SI pump suction)	2	L	S,M,T

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
17. RHR suction line MOVs rupture (interfacing LOCA) Motor operated valves: Normally closed HV-8701A and PV-8702A (RHR A to RCS Loop 1) interlocked with HV-8704A SI Pump A Suction Normally closed HV-8701B and PV-8702B (RHR B to RCS Loop 4) interlocked with HV-8704B SI Pump B Suction These MOVs are controlled from the main control room and are interlocked such that they cannot be opened if RCS pressure exceeds 360 psig and automatically close if RCS pressure exceeds 682 psig.	4	L	S,M,T
18. Injection check valves: failure modes include rupture (interfacing LOCA) failure to open, and failure to remain open. Cold leg injection check valves: Loop 1: 8948A and 8818A Loop 2: 8948B and 8818B Loop 3: 8948C and 8818C Loop 4: 8948D and 8818D Hot leg injection check valves: Loop 2: 8841A and 8949B Loop 3: 8841B and 8949C	4	L	M,T
19. Pumps unavailable due to maintenance One of two RHR pumps must be available (PEJ01A or PEJ02B)	1,2,3	L	M
20. Operator failure to initiate recirculation cooling Operator action is required to initiate CCW flow to the RHR heat exchangers. Inadequate CCW flow is annunciated until flow exceeds 7000 gpm.	2	L	O
25. Lifting of system relief valve below set point Relief valves: PSV 8856 A/B and PSV 8842. (Setpoint: 600 psig)	3	L	S,T

TABLE A.9-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RHR Pump B CCW Return Isolation	EJ-V071	RHR-B	Locked Throttled	______ ______				
RHR Pump B Discharge Isolation	EJ-8724B	RHR-B	Locked Open	______ ______				
RHR Pump A CCW Return Isolation	EJ-V070	RHR-A	Locked Throttled	______ ______				
RHR Pump A Discharge Isolation	EJ-8724A	RHR-A	Locked Open	______ ______				
ESW to RHR Pump Room Cooler 10B Isolation	EJ-V061	RHR-B	Locked Open	______ ______				
RHR Pump Room Cooler 10B ESW Return Isolation	GL-V017	RHR-B	Locked Throttled	______ ______				
RHR Pump Room Cooler 10B ESW Return Isolation	EJ-V062	RHR-B	Locked Open	______ ______				

Low Head Injection/Low Head Recirculation System

TABLE A.9-2 MODIFIED SYSTEM WALKDOWN (Co[illegible]

Decription	ID No.	Location	Desired Position	Actual Position	Pos[illegible]	Location	Required Position	Actual Position
RHR Pump Room Cooler 10A ESW Return Isolation	EF-V038	RHR-A	Locked Open	_____ _____				
R[illegible] Pump Room Cooler 1[illegible]A ESW Return Isolation	GL-V010	RHR-A	Locked Throttled	_____ _____				
ESW to R[illegible] Pump [illegible]oom Cooler 10A Isolation	EF-V037	RHR-A	Locked Open	_____ _____				
RHR Train B to CVCS Letdown Isolation	EJ-V002	RHR HXB	Closed	_____				
RHR Train A to CVCS Letdown Isolatin	EJ-V[illegible]01	RHR HXA	Closed	_____				

Low Head Injection/Low Head Recirculation System

TABLE A.9-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RHR HxB CCW Outlet Isolation Valve	EJ-V038	CCW-B	Locked Throttled	________ ________				
RHR HxA CCW Outlet Isolation Valve	EJ-V033	CCW-A	Locked Throttled	________ ________				
RHR Train A Mini Flow Valve	EJ-FCV-610	RHRHxA	Closed	________	52NG 01ACF6		ON	________
RHR Train B Mini Flow Valve	EJ-FCV-611	RHRHxB	Closed	________	52NG 02AGR3		ON	________
RHR Train A RCS-RHR Isolation Valve	EJ-HV-8701A	Containment El._	Closed	________	52NG 01BEF2		ON	________
RHR Train B RCS-RHR Isolation Valve	EJ-HV-8701B	Containment El._	Closed	________	52NG 01BDF3		ON	________

TABLE A.9-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RHR Train A Cross Tie Isolation Valve	EJ-HV-8716A	RHRHXA	Open	________	52NG 01BER1		ON	________
RHR Train B Cross Tie Isolation Valve	EJ-HV-8716B	RHRHXB	Open	________	52NG 02BDR3		ON	________
RHR Train A Sump to RHR Pump A	EJ-HV-8811A	Containment El._	Closed	________	52NG 01BFF3	NELEC PRM	ON	________
RHR Train B Sump to RHR Pump B	EJ-HV-8811B	Containment El._	Closed	________	52NG 02BEF2	SELEC PRM	ON	________
RHR Train A RHR to Cold Leg Isolation Valve	EJ-HV-8809A	NPENRM	Open	________	52NG 01BCR1		ON	________
RHR Train B RHR to Cold Leg Isolation Valve	EJ-HV-8809B	SPENRM	Open	________	52NG 02BBR2		ON	________
RHR to Hot leg Isolation Valve	EJ-HV-8840	SPENRM	Closed	________	52NG 02BBR3		ON	________

TABLE A.9-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
WCGS Licensed Operator Initial Training Documents			
1. "Emergency Core Cooling System and Safety Injection"	LO1300600	[illegible]	02/28/88
2. "Residual Heat Removal System"	LO1300500	001	08/10/88
Procedures			
1. WCGS "RHR Normal System Lineup"	CKL EJ-120	9	08/13/88
Drawings			
1. "P&ID – Residual Heat Removal System"	M-12EJ01(Q)	1	07/14/87
2. "P&ID – Reactor Coolant System"	M-12BB01(Q)	2	07/14/87

Table A.10-1. Importance Basis and Failure Mode Identification

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM (ESFAS)

Mission Success Criteria

The Engineered Safety Features Actuation System (ESFAS) is designed to sense selected plant parameters, determine whether or not predetermined safety limits are being exceeded, and, if they are, to form logic combinations based on exceedence of the selected parameter limits. Once the required logic combination has been formed, the ESFAS sends actuation signals to those ESF components that respond to the particular condition that exists.

The ESFAS consists of two portions of circuitry: Analog circuitry provides redundant channels that generate actuation signals concerned with the auxiliary feedwater and ventilation systems; the digital circuitry provides two redundant logic trains that receive inputs from the analog protection channels and provide the necessary logic to activate required ESF systems concerned with reactor safety and containment integrity. Each digital train is capable of actuating the required ESF equipment. The ESFAS depends on the electric power system to provide 120V AC for instrumentation and 125V DC for instrumentation and logic circuits.

The specific automatic actuation signals provided by the ESFAS include:

1. Safety Injection Signal (SIS)
2. Containment Isolation Signal Phase A (CISA)
3. Containment Isolation Signal Phase B (CISB)
4. Containment Purge Isolation Signal (CPIS)
5. Containment Spray Actuation Signal (CSAS)
6. Fuel Building Isolation Signal (FBIS)
7. Control Room Ventilation Isolation Signal (CRVIS)
8. Main Steam Isolation Signal (MSLIS)
9. Feedwater Isolation Signal (FWIS)
10. Auxiliary Feedwater Actuation Signal for Motor and Turbine Driven Pumps (AFAS-M, AFAS-T)
11. Auxiliary Feedwater Low Suction Pressure Switchover (LSP)
12. Steam Generator Blowdown and Sample Isolation Signal (SGBSIS)

Several plant parameters are monitored by the ESFAS to generate actuation signals for safety systems listed above. These plant parameters are given below with an indication of the coincidence required for mission success.

Low steamline pressure (2/3 coincidence for 1/4 steam generators)
High steamline pressure rate of decrease (2/3 coincidence for 1/4 steam generators)
Low pressurizer pressure (2/4 coincidence)
High containment pressure (2/3 coincidence)
Containment pressure high-3 (2/4 coincidence)
Containment pressure high-2 (2/3 coincidence)
NB Bus undervoltage condition (2/4 coincidence)
Steam generator level lo-lo (2/4 coincidence for 1/4 steam generators)
Steam generator level hi-hi (2/4 coincidence for 1/4 steam generators)
Low RCS T_{avg}
High containment atmosphere radiation level
High containment purge system radiation level
High fuel building ventilation system radiation level (1/2 coincidence)

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Failure of automatic initiation logic (most critical for Auxiliary Feedwater (AFW) initiation) through following scenarios:	6,10		
a) Instrument failure through calibration or maintenance error		M	O,S,M,T,C
NOTE: Motor driven AFW pumps are initiated on lo-lo steam generator level (2/4 coincidence on one steam generator) or on a trip of both main feed pumps. The turbine driven AFW pumps are initiated by a lo-lo steam generator level (2/4 coincidence on 2/4 steam generators on an undervoltage condition on bus NB011/NB02 (2/4 coinciden. ·).			
b) Logic relays fail to close		M	T,M
c) Failure of 120V vital AC (see Table A.2-1)		L	M,S,C

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Engineered Safety Features Actuation System (ESFAS)

TABLE A.10-2 MODIFIED SYSTEM WALKDOWN

The ESFAS is a normally energized system which must de-energize to actuate (close) the relay contacts (with the exception of the Containment High-High Pressure network which must energize to actuate). Operability must be assured by extensive surveillance testing, the observation of which will provide the inspector with direct input regarding the safety function capability of the system. System walkdown during normal power operation will only reveal whether certain circuits are properly aligned.

Such alignment checks could include:

a. Observing that channels are not bypassed or in test.
b. Ensuring that instrument root valves are open, particularly those instruments which initiate a reactor trip, safety injection, or start of auxiliary feedwater.

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
WCGS, Licensed Operator Initial Training Document			
1. "Engineered Safety Features Actuation System"	LO1301301	000	10/30/87

WOLF CREEK GENERATING STATION

Table A.11-1. Importance Basis and Failure Mode Identification

REFUELING WATER STORAGE TANK (RWST)

Mission Success Criteria

The Refueling Water Storage Tank (RWST), although a passive component, is the source of water supply during three safety significant modes of operation: high pressure injection, containment spray, and low pressure injection. It is also critical during the switchover, from the injection phase to high or low pressure recirculation from the containment sump upon receipt of a RWST low level signal.

During the injection phase, if primary system pressure remains above the SI pump shutoff head, the pumps discharge to the RWST through the minimum flow recirculation lines until the RCS pressure is sufficiently reduced to allow inflow.

If needed for ECCS injection, the RWST supplies the necessary amount of borated water to provide the required net positive suction head (NPSH) to the RHR pumps, prior to auto-switchover of the RHR pumps suctions to the containment sumps. This could occur as quickly as 14 minutes after actuation. This auto-switchover occurs at approximately 36% RWST level, on 2 out of the 4 Lo Lo-1 Level bistables. The operators initiate CCW flow to the RHR heat exchangers prior to reaching this setpoint. The operators also get a MCB annunciator at this level (1 out of 4 Lo Lo-1 level bistables) to alert them to verify that the auto switchover is occurring. The auto-switchover works on a 2 out of 4 level logic concurrent with an SIS. The auto-switchover annunciator annunciates when the first level detector reaches 36%; therefore the auto-switchover may occur sometime after the alarm is received.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Common cause miscalibration of RWST level sensors which fails manual realignment of high and low pressure ECCS: LT-930, LT-931, LT-932, LT-933	1,2	M	O,S,C
2. Failure to realign system after refueling outage, (see refueling procedures).	1	L	O,M

Refueling Water Storage Tank (RWST)

TABLE A.11-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
RWST LT-930 Isolation	BN-V007	713	Open	________				
RWST LT-931 Isolation	BN-V008	713	Open	________				
RWST LT-932 Isolation	BN-V009	713	Open	________				
RWST LT-933 Isolation	BN-V010	713	Open	________				

WOLF CREEK GENERATING STATION
RWST

TABLE A.11-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
WCGS Licensed Operator Initial Training Document			
1. "Emergency Core Cooling System and Safety Injection"	LO1300600	000	01/28/88

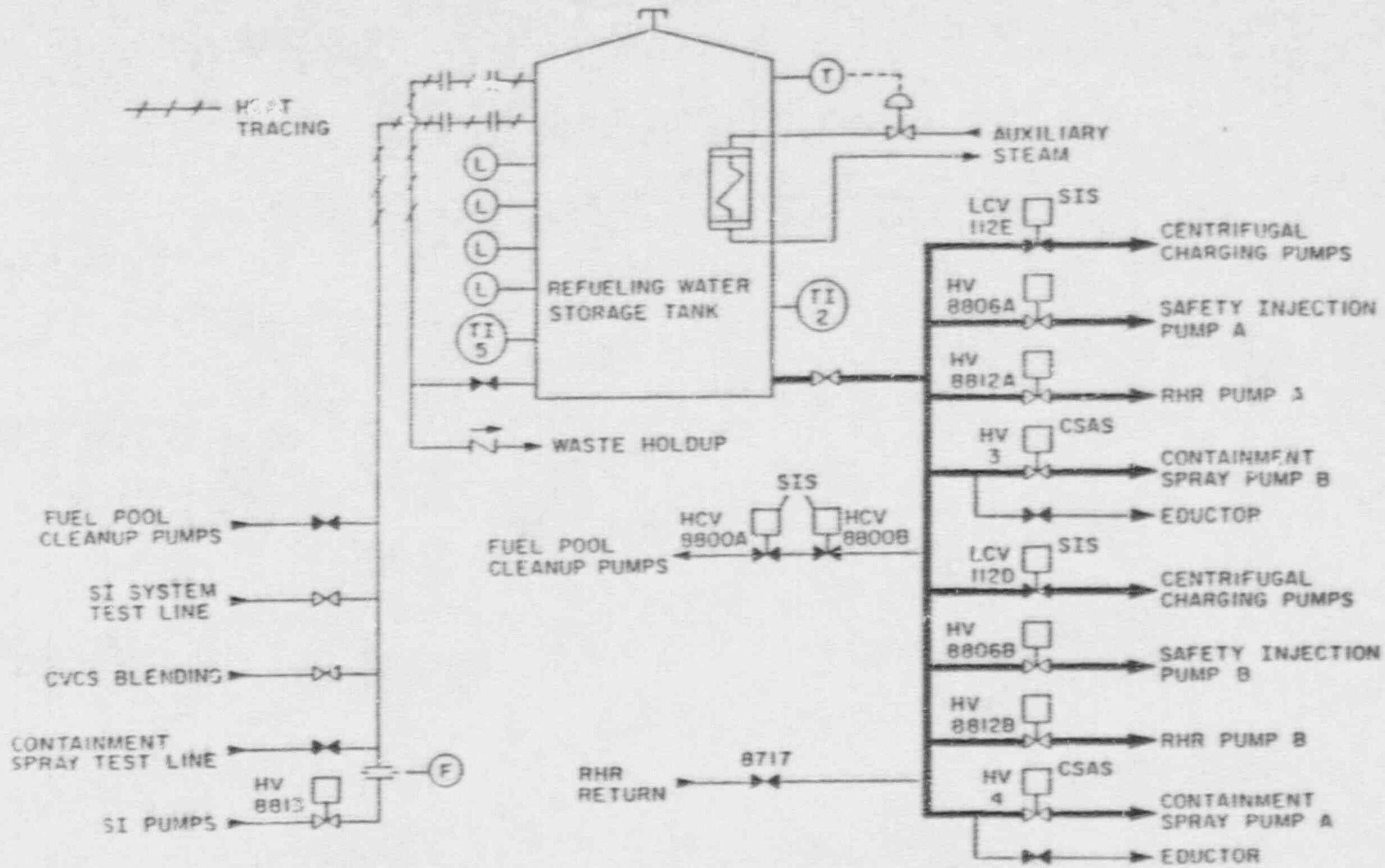

Figure A.11-1. "Wolf Creek Refueling Water Storage Tank"
(Source WCGS-Lesson Text LO 1300600, Rev-000 Figure 10)

WOLF CREEK GENERATING STATION

Table A.12-1. Importance Basis and Failure Mode Identification

POWER CONVERSION SYSTEM (PCS)

Mission Success Criteria

The power conversion system (PCS) can be used to provide feedwater to the steam generators following a transient. The PCS consists of two 67% capacity turbine driven main feedwater pumps, a motor-driven startup feedwater pump, three 50% capacity motor-driven condensate pumps, and the hotwell inventory. The inventory of the hotwell (with the CST as a backup supply) is assumed sufficient for all mission times of interest. The feedwater regulating valves will close after a reactor scram, due to plant control logic. The feedwater pumps remain on, and the miniflow valves will open. Feedwater can then be provided to the SGs, through the feedwater regulating valve bypass valve. The PCS is dependent on non-class 1E DC power and instrument air. The success criterion for the PCS is restoration of flow from one or more main feedwater pumps to one or more steam generators.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Loss of Power conversion System is an important transient event when coupled with loss of AFW. Failure modes for the PCS are:	10	H	
a) FW line break with failure of operator to isolate			O,T
b) Failure of main FW or condensate pumps to continue running. There are numerous trip initiators for the FW and condensate pumps.			S,M,T
c) Failure of main FW and condensate pumps to start and run following loss of DC bus (see Table A.3-1) The MFW pump turbines are each supported by separate emergency DC motor-driven oil pumps which start when the oil pressure in the line drops 25 psig below normal. Emergency pump A is powered from PJ-0106 and Pump B from PJ-0107.			O

Power Conversion System (PCS)

TABLE A.12-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Condensate Pump 1A Recirc. Valve FV-78 Inlet Isolation	AD-V092	422	Open	________				
Condensate Pump 1A Recirc. Valve FV-78 Outlet Isolation	AD-V093	422	Open	________				
Condensate Pump 1B Recirc. Valve FV-15B Inlet Isolation	AD-V090	422	Open	________				
Condensate Pump 1B Recirc. Valve FV-15B Outlet Isolation	AD-V091	422	Open	________				
Condensate Pump 1C Recirc. Valve FV-22B Inlet Isolation	AD-V088	422	Open	________				
Condensate Pump 1C Recirc. Valve FV-22B Outlet Isolation	AD-V089	422	Open	________				

TABLE A.12-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
Steam Seal & 9th Stage Exhaust Drain to LP Condenser Isolation	AD-V280	425	Locked Open*	________ ________				
Condenser Vacuum Breakers Valves (AD-HV113 A, B,C,D)	AD-HIS-113	Control Board RL023	Closed	________				
Condensate Pump A Recirc. Valve (AD-FV7B)	AD-FIK-7B	Same RL023	Auto	________				
Condensate Pump B Recirc. Valve (AD-FV15B)	AD-FIK-15B	Same RL023	Auto	________				
Condensate Pump C Recirc. Valve (AD-FV22B)	AD-FIK-22B	Same RL023	Auto	________				
AD-HV113B Vacuum Breaker Valve for IP Condenser	52 PG13 R JF2		On	________				

*Note: Valve must be locked open at all times except when line FC-005-BC-1 is depressurized (AFW Pump Turbine Condensate Drain Header).

Power Conversion System (PCS)

TABLE A.12-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
AD-HV113D Vacuum Breaker Valve for LP Condenser	52PG13 R CR2		On	____				
AD-HV113A Vacuum Breaker Valve for LP Condenser	52PG14 R EF4		On	____				
AD-HV113C Vacuum Breaker Valve for HP Condenser	52PG14 R EF5		On	____				
Motor Driven SGFW Pump Mini-Flow Isolation	AE-V342	431	Open	____				
SGFW Pump B Suction PT-5 Isolation	AE-V011	432	Locked Open	____ ____				
SGFW Pump B Suction Isolation	AE-V006	434	Open	____				
SGFW Pump A Suction Isolation	AE-V009	434	Open	____				
SGFW Pump A Suction PT-6 Isolation	AE-V013	442	Locked Open	____ ____				
SGFW Pump A Recirc. FV-2B Inlet Isolation	AE-V026	442	Locked Open	____ ____				

Power Conversion System (PCS)

TABLE A.12-2 MODIFIED SYSTEM WALKDOWN (Cont'd)

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
SGFW Pump B Recirc. FV-1B Inlet Isolation	AE-V024	442	Locked Open	______ ______				
Emergency Lube Oil Bearing Pump DPF0C3A	89 PJ0106		Open	______				
Emergency Lube Oil Bearing Pump DPF0C3B	89 PJ0107		Open	______				

WOLF CREEK GENERATING STATION
PCS

TABLE A.12-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
WCGS Licensed [illegible] Initial Training Documents:			
1. "Main Feedwater [illegible]	LO1505900	000	03/17/88
2. "Main Condensate System"	LO1505600	009	01/03/89
Procedures			
1. WCGS "Condensate System Valve and Breaker Lineup"	CKL AD-120	8	04/15/87
2. WCGS "Main Feedwater System Valve and Electrical Lineup"	CKL AE-120	10	03/31/88

CHEMICAL AND VOLUME CONTROL SYSTEM (CVCS) EMERGENCY BORATION

Mission Success Criteria

The chemical and volume control system (CVCS) provides several major functions during startup, normal operation, emergency operation, and shutdown of the reactor. The RCS boron concentration is normally controlled by the makeup portion of the CVCS. However, there are occasions when it is necessary to borate at a rate that exceeds the normal, maximum capability of the makeup system. In these situations, the CVCS is initiated either by a SIAS or manually to rapidly inject concentrated boric acid into the RCS. Of concern are the situations where the CVCS can be initiated only manually (i.e., following ATWS).

Immediate boration flow comes directly from the two boric acid tanks using both boric acid transfer pumps. It is sent directly to the suction of the charging pumps through immediate boration valve BG HV-8104, which in turn inject into the RCS cold legs. To initiate immediate boration, the Control Room operator must perform the following:

— Open the immediate boration control valve BG HV-8104.

— Start both boric acid transfer pumps.

— Observe the immediate boration flow meter on main control board panel RL002 for proper indication of flow.

Since the boration flow bypasses the normal Reactor Makeup System and its indication, there is no record of the total amount of boric acid that has been added. If it is required to add a specific amount of boric acid, the control room operator must manually calculate the boric acid addition by observing the boric acid flow rate and the time duration of the immediate boration.

Alternate immediate boration (manual immediate boration) is used if the normal immediate boration path is inoperable due to blockage or the immediate boration valve fails to function. This alternate immediate boration path is from the Boric Acid Transfer pumps through boric acid flow control valve BG FCV-110A (which is normally closed and fails open) to a manual valve, BG V-177, operated locally in the Auxiliary Building from the Safety Injection Pump room "A". When the alternate immediate boration valve BG V-177 is opened and the boric acid transfer pumps are started, boric acid will flow directly to the suction of the charging pumps. Indication of the boric acid flow will be available to the control room operator on the normal boric acid flow recorder. Also, the flow will be totalized on the boric acid counter.

Dominant Failure Modes	Accident Sequence	Importance Category	Inspection Activities
1. Failure to initiate and perform emergency boration. Initiation of emerging boration is a manual operation by the Control Room operator. Refer to Off-Normal Procedure OFN 00-009 "Immediate Boration")	11	H	O
2. Single valve failure to open preventing boric acid flow. Principal failure modes are power or critical circuit fault. MOV HV 8104 is the immediate boration valve and is controlled by the Control Room operator. Check valve V-174 must also allow passage of the boric acid. Normally closed boric acid flow control valve BG FCV-110A must successfully fail open, or be manually opened from the Control Room. Normally closed manual valve BG V-177 must be locally opened.	11	M	S,M,T
3. Failure of boric acid pumps to provide sufficient flow Boric Acid Transfer Pumps: PBG02A PBG02B	11	M	S,M,T
4. Charging pumps unavailable due to maintenance or failure to run Centrifugal Charging Pumps: PBG05A and PBG05B Positive Displacement Pump: PBG04	11	M	S,M,T

WOLF CREEK GENERATING STATION
RISK-BASED INSPECTION GUIDE

Chemical and Volume Control System (CVCS) Emergency Boration

TABLE A.13-2 MODIFIED SYSTEM WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position	Pow. Sup. Breaker #	Location	Required Position	Actual Position
BAT A Outlet Isolation Valve	8461A		Locked Open	_____ _____				
BAT B Outlet Isolation Valve	8461B		Locked Open	_____ _____				
Boric Acid Transfer Pump A Suction Isolation Valve	8463		Locked Open	_____ _____				
Boric Acid Transfer Pump A Discharge Isolation Valve	V148		Locked Open	_____ _____				
Boric Acid Transfer Pump B Suction Isolation Valve	8475		Locked Open	_____ _____				
Boric Acid Transfer Pump B Discharge Isolation Valve	V166		Locked Open	_____ _____				

WOLF CREEK GENERATING STATION
CVCS/I.B.

TABLE A.13-2 (Cont'd)

REFERENCE DOCUMENTS

TITLE	I.D. NO.	REV	DATE
WCGS Licensed Operator Initial Training Documents:			
1. "Chemical & Volume Control System"	LO1300440	000	12/29/89
Procedures			
1. WCGS Off-Normal Procedure "Immediate Boration"	OFN00-009	2	01/03/89
2. WCGS "Chemical and Volume Control System Normal Valve Lineup"	CKL BG-120	12	01/08/89
Drawings			
1. "P&ID Chemical & Volume Control System"	M-12BG01(Q)	0	04/27/85
2. "P&ID Same"	M-12BG02(Q)	2	07/14/87
3. "P&ID Same"	M-12BG03(Q)	3	08/10/87
4. "P&ID Same"	M-12BG04(Q)	0	10/22/84
5. "P&ID Same"	M-12BG05(Q)	1	07/14/87

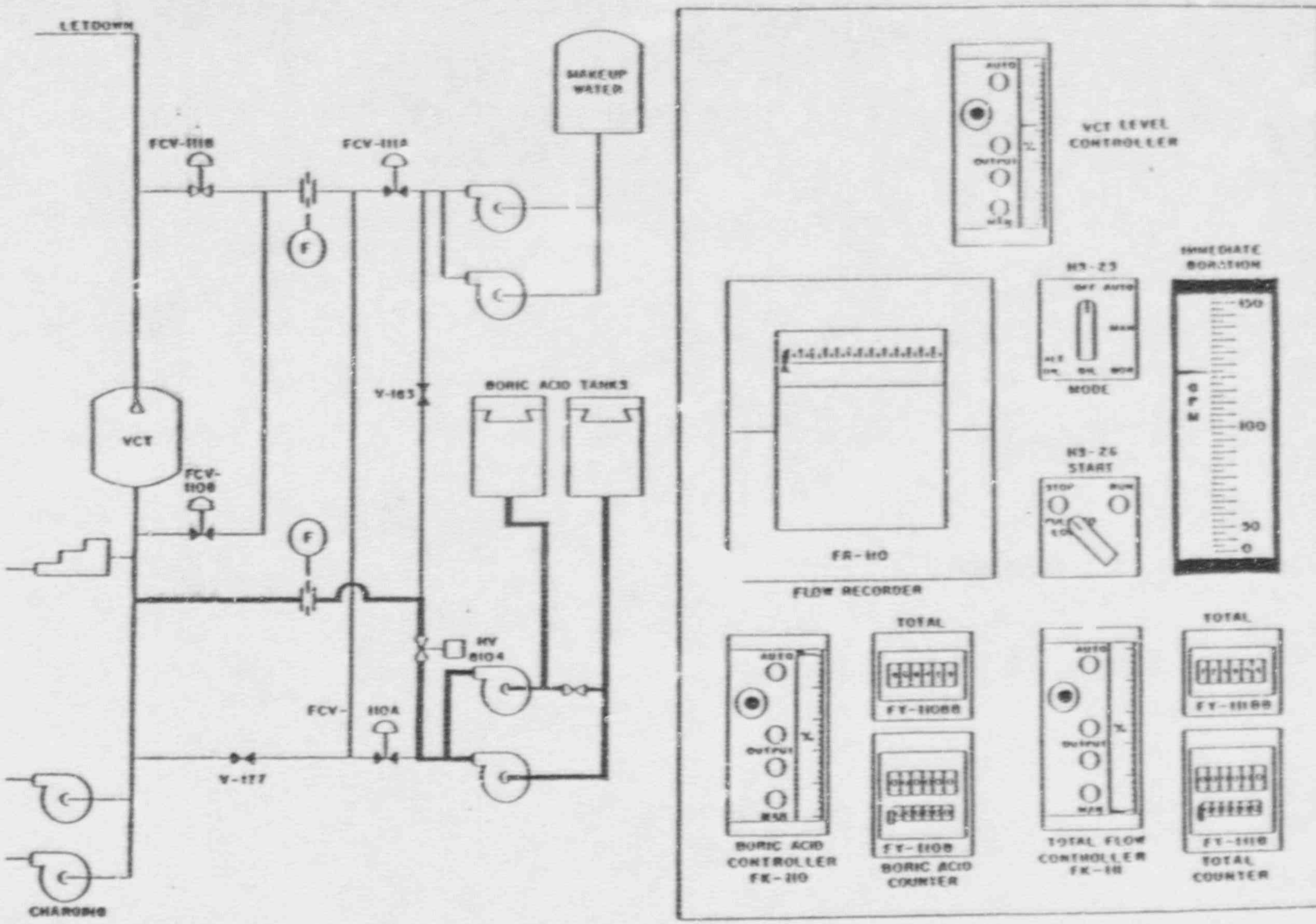

Figure A.13-1. "Wolf Creek Immediate Boration System"
(Source WCGS Lesson Text LO 1300400, Rev-000, Figure 9)

APPENDIX B

TABLES OF

(1) PLANT OPERATIONS INSPECTION GUIDANCE

(2) SURVEILLANCE AND CALIBRATION INSPECTION GUIDANCE

(3) MAINTENANCE INSPECTION GUIDANCE

Table B.1 Plant Operations Inspection Guidance

Recognizing that the normal system lineup is important for any given standby safety system, the following human errors are identified as important to risk.

Table B.1 Plant Operations Inspection Guidance

System	Failure	Discussion
Normal & Emergency AC Power	Failure of Emergency Diesel Generators (EDGs) to start or run [DGNE01,DGNE02]	Table A.2-1, Item 1
	Failure to restore AC power after station blackout w/concurrent RCP seal LOCA [See Table A.2-1, Item 3]	Table A.2-1, Item 3
	Improper EDG post maintenance valve or breaker lineup [ESW V052,V053,V079,V080]	Table A.2-1, Item 5
DC Power	Loss of 125V DC bus [See Table A.3-1, Item 1]	Table A.3-1, Item 1
	Operational test or maintenance error resulting in a) de-energizing or cascading of DC power supplies b) failure to properly restore batteries or charger after maintenance [See Table A.3-1, Item 3]	Table A.3-1, Item 3
Reactor Protection System (RPS)	Operator failure to manually scram reactor following ATWS	Table A.5-1, Item 3
High Head injection/ Recirculation	Failure to switch from RWST to the containment sump via the Low Head Recirculation system [See Table A.6-1, Item 1]	Table A.6-1, Item 1
Primary Pressure Relief System	PORV block valve closed [HV8000A,HV8000B]	Table A.7-1, Item 3
	Operator error in bleed and feed activities causes lack of RCS cooling	Table A.7-1, Item 4
Auxiliary Feedwater	Failure to manually start locked out standby pump [MDPPAL01A,B]	Table A.8-1, Item 1

Table B.1 Plant Operations Inspection Guidance (Cont'd)

System	Failure	Discussion
Auxiliary Feedwater (Cont'd)	Failure to manually start pump given auto-start failure [MDP PAL01A,B/TDP PAL02]	Table A.8-1, Item 3
	Local fault of valve in motor-driven pump discharge to steam generator [V045,V031]	Table A.8-1, Item 6
	Local fault of suction valve from the condensate storage tank (CST) [V055]	Table A.8-1, Item 9
	Undetected flow diversion [V031,V045,V055]	Table A.8-1, Item 11
	Undetectod FW leakage back through pump discharge valves causes steam binding	Table A.8-1, Item 12
	Failure to restore TD pump from testing [PAL02]	Table A.8-1, Item 16
	Failure to restore TD pump discharge valve after test [V055]	Table A.8-1, Item 17
	Failure to manually open TD pump discharge AOVs [ALHV6,8,10,12]	Table A.8-1, Item 18
Low Head Injection/ Recirculation	Operator failure to isolate interfacing LOCA [HV-8809 A,B]	Table A.9-1, Item 2
	Operator failure to successfully switch from LHI to LHR including valve alignment errors	Table A.9-1, Item 3
	Failure to realign system after testing	Table A.9-1, Item 7
	Operator failure to stop pumps if pump return line (miniflow) valve fails to open or remain open [FCV-610,FCV-611]	Table A.9-1, Item 12
	Operator failure to initiate recirculation cooling [See Table A.9-1, Item 23]	Table A.9-1, Item 23

Table B.1 Plant Operations Inspection Guidance (Cont'd)

System	Failure	Discussion
Engineered Safety Features Actuation	Failure of automatic initiation logic by instrument failure through calibration or maintenance error	Table A.10-1, Item 1
Refueling Water Storage Tank (RWST)	Common cause miscalibration of RWST level sensors which fails manual realignment of high and low pressure ECCS [LT-930,LT-931,LT-932,LT-933]	Table A.11-1, Item 1
Power Conversion	Loss of PCS (and AFWS) by a) FW line break with operator failure to isolate break c) Failure of MFW and condensate pumps to start or run following loss of DC bus [Buses PJ-0106,PJ-0107]	Table A.12-1, Item 1 (a) & (c)
Emergency Boration	Operator failure to initiate and perform emergency boration	Table A.13-1, Item 1

Table B.2 Surveillance and Calibration Inspection GUIDANCE

The listed components are the risk significant components for which surveillance and/or calibration should minimize failure.

Table B.2 Surveillance and Calibration Inspection Guidance

System	Failure	Discussion
Essential Service Water	Failure of valves which isolate SW flow to CCW heat exchangers [See Table A.1-1, Item 1]	Table A.1-1, Item 1
	Pumps fail to start or run [PEF01A,PEF01B]	Table A.1-1, Item 3
	Pump discharge MOV, check valve or header isolation valve fails to open or remain open [See Table A.1-1, Item 4]	Table A.1-1, Item 4
	Non-essential load isolation valves fail to close [See Table A.1-1, Item 5]	Table A.1-1, Item 5
	Pump strainers plugged [See Table A.1-1, Item 6]	Table A.1-1, Item 6
Normal and Emergency AC Power	Emergency diesel generators (EDGs) fail to start or run [DGNE01,DGNE02]	Table A.2-1, Item 1
	Loss of vital AC bus [See Table A.2-1, Item 4]	Table A.2-1, Item 4
	Cooling water valves for EDG fail to open [See Table A.2-1, Item 6]	Table A.2-1, Item 6
	Failure of EDG output breakers to close [See Table A.2-1, Item 7]	Table A.2-1, Item 7
	Failure to transfer to reserve source of AC power and failure of EDG start signal	Table A.2-1, Item 8
	Failure of inverter of MG set [See Table A.2-1, Item 9]	Table A.2-1, Item 9
DC Power	Loss of 125V DC bus [See Table A.3-1, Item 1]	Table A.3-1, Item 1

Table B.2 Surveillance and Calibration Inspection Guidance (Cont'd)

System	Failure	Discussion
DC Power (Cont'd)	Failure of on-line charger and failure of space to energize on dem nd [See Table A.3-1, Item 2]	Table A.3-1, Item 2
	Failure of batteries [NK11,NK12,NK13,NK14]	Table A.3-1, Item 4
	Loss of battery room ventilation [See Table A.3-1, Item 5]	Table A.3-1, Item 5
Component Cooling Water System	Pumps fail to start or run [PEG01A,1B,1C,1D]	Table A.4-1, Item 1
	Local fault of heat exchanger valves which isolate or severely reduce CCW flow [See Table A.4-1, Item 2]	Table A.4-1, Item 2
	Pump discharge or suction valves fail to open or remain open [See Table A.4-1, Item 4]	Table A.4-1, Item 4
	Failure to open or remain open of any local valve that disables all ECCS pump coolers [See Table A.4-1, Item 5]	Table A.4-1, Item 5
Reactor Protection	Instrument failure due to calibration/ maintenance error or random failure which inhibits initiation of reactor trip signal	Table A.5-1, Item 1
	Reactor trip breaker or trip bypass breaker fails to open [52RTA,52RTB,52BYA,52BYB]	Table A.5-1, Item 2
High Head Injection/ Recirculation	Failure of HPI discharge valves to open including common cause failure (includes check valves) [See Table A.6-1, Item 2]	Table A.6-1, Item 2
	Failure of HHR suction valves to open including common cause failure (includes check valves) [See Table A.6-1, Item 3]	Table A.6-1, Item 3
	Failure of pump return line (miniflow) valve to open fails operating pump [HV-8810,HF-8811,HV-8814A,HV-8814B]	Table A.6-1, Item 4

Table B.2 Surveillance and Calibration Inspection Guidance (Cont'd)

System	Failure	Discussion
HHI/HHR (Cont'd)	Electrical failures (power cable/breaker) disable HHR pump room cooling [See Table A.6-1, Item 5]	Table A.6-1, Item 5
	Failure of service water system valve to open or remain open disables HHR pump room cooling [See Table A.6-1, Item 6]	Table A.6-1, Item 6
	Local fault of pumps/pumps fail to start or run [PEM01A,B/PEJ01A,B/PBG05A,B]	Table A.6-1, Item 7
	Failure of valve to open in the common portion of the HHI suction line from the RWST [BN LCV-112 D/E]	Table A.6-1, Item 8
	Plugging of manual valve in the HHI and SI suction line (or in the containment sump strainers) [EM HV-8924/EM HV-8807A,B]	Table A.6-1, Item 9
	HHI and SI pump return line (miniflow) valve fails to close; interlock prevents HHR suction valves from opening [See Table A.6-1, Item 10]	Table A.6-1, Item 10
	Local pump failures: — failure of control cable to MCC — failure of pump breaker to close [See Table A.6-1, Item 11]	Table A.6-1, Item 11
Primary Pressure Relief System	PORV fails to open when required for feed and bleed mode [PCV-455A,PCV-456]	Table [illegible]-1, Item 1
Auxiliary Feedwater	Local fault of valve in turbine-driven pump discharge to steam generator [V055]	Table A.8-1, Item 2
	Turbine driven pump fails to start or run [PAL02]	Table A.8-1, Item 4

Table B.2 Surveillance and Calibration Inspection Guidance (Cont'd)

System	Failure	Discussion
Auxiliary Feedwater (Cont'd)	Motor driven pump fails to start or run [PAL01A,PAL01B]	Table A.8-1, Item 5
	Local fault of valve in motor driven pump discharge to steam generator [V045,V031]	Table A.8-1 Item 6
	Steam supply or throttle/trip valve fails to open (or other valve faults in steam admission line) for turbine driven pump [ABHV-5,ABHV-6,FCHV-312]	Table A.8-1, Item 8
	Local fault of suction valve from the CST [V15]	Table A.8-1, Item 9
	Local fault of motor-driven pump power breaker	Table A.8-1, Item 13
	Turbine-driven pump in test [PAL02]	Table A.8-1, Item 14
	Local fault of AFW actuation signal logic fails to actuate MD pump and/or TD pump steam valves [See Table A.8-1, Item 15]	Table A.8-1, Item 15
Low Head Injection/ Recirculation	Accumulator failure, including check valve failure or plugging of MOVs [See Table A.9-1, Item 1]	Table A.9-1, Item 1
	LHI pumps fail to start or run including common cause failure [PEJ-01A,PEJ-01B]	Table A.9-1, Item 4
	Failure of LHR suction (containment sump) valves to open [EJ HV-8811A,HV-8811B]	Table A.9-1, Item 5
	Failure of LHI suction valve from RWST to close	Table A.9-1, Item 6
	Cold leg isolation valve fails to close [EJ HV-8809A,HV-8809B]	Table A.9-1, Item 8

Table B.2 Surveillance and Calibration Inspection Guidance (Cont'd)

System	Failure	Discussion
LHI/LHR (Cont'd)	Pump discharge crossover valve fails to close [EJ HV-8716A,HV-8716B]	Table A.9-1, Item 9
	Failure to switch from cold leg to hot leg recirculation [See Table A.9-1, Item 10]	Table A.9-1, Item 10
	LHI pump return line (miniflow) valve fails to open or remain open, including common cause [EJ FCV-610,FCV-611]	Table A.9-1, Item 11
	Containment sump plugs	Table A.9-1, Item 12
	LH hot leg recirculation discharge valve fails to open [EJ HV-8802A,HV-8802B]	Table A.9-1, Item 13
	Heat exchanger cooling water valves fail to open (CCW failure) [HV-101(RHR HXA),HV-102(RHR HXB)]	Table A.9-1, Item 14
	Injection isolation valves fail to remain open [See Table A.9-1, Item 15]	Table A.9-1, Item 15
	Recirculation suction valves rupture/ fail to remain closed [See Table A.9-1, Item 16]	Table A.9-1, Item 16
	RHR suction line MOVs rupture (interfacing LOCA) [See Table A.9-1, Item 17]	Table A.9-1, Item 17
	Injection check valves rupture (interfacing LOCA), failure to open, failure to remain open [See Table A.9-1, Item 18]	Table A.9-1, Item 18
	Lifting of system relief valve below setpoint.	Table A.9-1, Item 21
Engineered Safety Features Actuation	Failure of automatic initiation logic by: a) instrument failure through calibration or maintenance error b) logic relays failing to close c) failure of 120V vital AC	Table A.10-1, Item 1

Table B.2 Surveillance and Calibration Inspection Guidance (Cont'd)

System	Failure	Discussion
Refueling Water Storage Tank (RWST)	Common cause miscalibration of RWST level sensors which fails manual realignment of high and low head ECCS [LT-930,LT-931,LT-932,LT-933]	Table A.11-1, Item 1
Power Conversion	Loss of PCS (& AFWS) by failure of MFW or condensate pumps to continue running [See Table A.12-1, Item 1(b)]	Table A.12-1, Item 1(b)
Emergency Boration (CVCS)	Single valve failure to open preventing boric acid flow due to power or control circuit fault [HV8104,FCV-110A]	Table A.13-1, Item 2
	Failure of boric acid pumps to provide sufficient flow [PBG02A,PBG02B]	Table A.13-1, Item 3
	Charging pumps unavailable due to maintenance or failure to run [PBG04,PBG05A,PBG05B]	Table A.13-1, Item 4

Table B.3 Maintenance Inspection Guidance

The components listed here are significant to risk because of unavailability for maintenance. The dominant contributors are usually frequency and duration of maintenance, with some contribution due to improperly performed maintenance.

Table B.3 Maintenance Inspection Guidance

System	Failure	Discussion
Essential Service Water	Failure of valves which isolate SW flow to CCW heat exchangers [See Table A.1-1, Item 1]	Table A.1-1, Item 1
	Pump train A or B out for maintenance	Table A.1-1, Item 2
	Pumps fail to start or run [PEF01A and PEF01B]	Table A.1-1, Item 3
	Pump discharge MOV, check valve or header isolation valve fails to open or remain open [See Table A.1-1, Item 4]	Table A.1-1, Item 4
	Non-essential load isolation valves fail to close [See Table A.1-1, Item 5]	Table A.1-1, Item 5
	Pump strainers plugged [See Table A.1-1, Item 6]	Table A.1-1, Item 6
Normal and Emergency AC Power	Emergency diesel generators (EDGs) fail to start or run [DGNE01,DGNE02]	Table A.2-1, Item 1
	EDGs unavailable due to maintenance [DGNE01,DGNE02]	Table A.2-1, Item 2
	Loss of a vital AC bus [See Table A.2-1, Item 4]	Table A.2-1, Item 4
	Improper EDG post maintenance valve or breaker lineup [ESW V052,V053,V079,V080]	Table A.2-1, Item 5
	Cooling water valves for EDG fail to open [See Table A.2-1, Item 6]	Table A.2-1, Item 6

Table B.3 Maintenance Inspection Guidance (Cont'd)

System	Failure	Discussion
Normal and Emergency AC Power (Cont'd)	Failure of EDG output breakers to close [See Table A.2-1, Item 7]	Table A.2-1, Item 7
	Failure to transfer to reserve source of AC power and failure of EDG start signal	Table A.2-1, Item 8
	Failure of inverter or MG set [See Table A.2-1, Item 9]	Table A.2-1, Item 9
DC Power	Loss of 125V DC bus [See Table A.3-1, Item 1]	Table A.3-1, Item 1
	Failure of on-line charger and failure of spare to energize on demand [See Table A.3-1, Item 2]	Table A.3-1, Item 2
	Operational test or maintenance error resulting in a) de-energizing or cascading of DC power supplies b) failure to properly restore batteries or charger after maintenance [See Table A.3-1, Item 3]	Table A.3-1, Item 3
	Failure of batteries [NK11,NK12,NK13,NK14]	Table A.3-1, Item 4
	Loss of battery room ventilation [See Table A.3-1, Item 5]	Table A.3-1, Item 5
Component Cooling Water System	Pumps fail to start or run [PEG01A,1B,1C,1D]	Table A.4-1, Item 1
	Local fault of heat exchanger valves which isolate or severely reduce CCW flow or SW coolant flow [See Table A.4-1, Item 2]	Table A.4-1, Item 2
	Pumps out for maintenance [PEG01A,1B,1C,1D]	Table A.4-1, Item 3
	Pump discharge or suction valves fail to open or remain open [See Table A.4-1, Item 4]	Table A.4-1, Item 4
	Failure to open or remain open of any local valve that disables all ECCS pump coolers [See Table A.4-1, Item 5]	Table A.4-1, Item 5

Table B.3 Maintenance Inspection Guidance (Cont'd)

System	Failure	Discussion
Reactor Protection	Instrument failure due to calibration/ maintenance error, or random failure which inhibits initiation of reactor trip signal	Table A.5-1, Item 1
	Reactor trip breaker or trip bypass breaker fails to open [52RTA,52RTB,52BYA,52BYB]	Table A.5-1, Item 2
High Head Injection/ Recirculation	Failure of HHI discharge valves to open including common cause failure (includes check valves) [See Table A.6-1, Item 2]	Table A.6-1, Item 2
	Failure of HHR suction valves to open including common cause failure (includes check valves) [See Table A.5-1, Item 3]	Table A.6-1, Item 3
	Failure of pump return line (miniflow) valve to open fails operating pump [HV8810,HV8811,HV-8814A,HV-8814B]	Table A.6-1, Item 4
	Electrical failures (power cable/ breaker) disable HHR pump room cooling [See Table A.6-1, Item 5]	Table A.6-1, Item 5
	Failure of service water system valve to open or remain open disables HHR pump room cooling [See Table A.6-1, Item 6]	Table A.6-1, Item 6
	Local fault of pumps/pumps fail to start or run [PEM01A,B/PEJ01A,B/PBG05A,B]	Table A.6-1, Item 7
	Failure of valve to open in the common portion of the HHI suction line from the RWST [BN LCV-112 D/E]	Table A.6-2, Item 8
	Plugging of manual valve in the common HHI suction line (or in the containment sump strainers) [EM HV-8924/EM HV-8807A,B]	Table A.6-1, Item 9

Table B.3 Maintenance Inspection Guidance (Cont'd)

System	Failure	Discussion
High Head Injection/ Recirculation (Cont'd)	HHI and SI pump return line (miniflow) valve fails to close; interlock prevents HHR suction valves from opening [See Table A.6-1, Item 10]	Table A.6-1, Item 10
	Local pump failures: — failure of control cable to MCC — failure of pump breaker to close [See Table A.6-1, Item 11]	Table A.6-1, Item 11
	Pump in maintenance [PEM01A,B/PEJ01A,B/PBG05A,B]	Table A.6-1, Item 13
Primary Pressure Relief System	PORV fails to open when required for feed and bleed mode [PCV-455A,PCV-456]	Table A.7-1, Item 1
	Failure of PORV/SRV to reseat causing small LOCA [PCV-455A,PCV-456/SRV-8010A,B,C]	Table A.7-1, Item 2
	PORV block valve closed [HV-8000A, HV-8000B]	Table A.7-1, Item 3
Auxiliary Feedwater	Local fault of valve in turbine-driven pump discharge to steam generator [V055]	Table A.8-1, Item 2
	Turbine driven pump fails to start or run [PAL02]	Table A.8-1, Item 4
	Motor driven pump fails to start or run [PAL01A,PAL01B]	Table A.8-1, Item 5
	Local fault of valve in motor driven pump discharge to steam generator [V045,V031]	Table A.8-1, Item 6
	Turbine driven pump in maintenance [PAL02]	Table A.8-1, Item 7

Table B.3 Maintenance Inspection Guidance (Cont'd)

System	Failure	Discussion
Auxiliary Feedwater (Cont'd)	Steam supply valve or throttle/trip valve fails to open (or other valve faults in steam admission line) for turbine driven pump [ABHV-5,ABHV-6,FCHV-312]	Table A.8-1, Item 8
	Local fault of suction valve from the CST [V15]	Table A.8-1, Item 9
	AFW flow control valve in maintenance fails delivery from TD pumps [ALHV6/ALHV8/ALHV10/ALHV12]	Table A.8-1, Item 10
	Local fault of motor-driven pump power breaker	Table A.8-1, Item 13
	Motor driven pump in maintenance [PAL01A,PAL01B]	Table A.8-1, Item 19
Low Head Injection/ Recirculation	Accumulator failure including check valve failure or plugging of MOVs [See Table A.9-1, Item 1]	Table A.9-1, Item 1
	LHI pumps fail to start or run including common cause failure [PEJ-01A,PEJ-01B]	Table A.9-1, Item 4
	Failure of LHR suction (containment sump) valves to open [EJ HV-8811A,HV-8811B]	Table A.9-1, Item 5
	Failure of LHI suction valve from RWST to close [EJ HV-8812A,HV-8812B]	Table A.9-1, Item 6
	Cold leg isolation valve fails to close [EJ HV-8809A,HV-8809B]	Table A.9-1, Item 8
	Pump discharge crossover valve fails to close [EJ HV-8716A,HV-8716B]	Table A.9-1, Item 9
	Failure to switch from cold leg to hot leg recirculation [See Table A.9-1, Item 10]	Table A.9-1, Item 10

Table B.3 Maintenance Inspection Guidance (Cont'd)

System	Failure	Discussion
Low Head Injection/ Recirculation (Cont'd)	LHI pump return line (miniflow) valve fails to open or remain open [EJ FCV-610,FCV-611]	Table A.9-1, Item 11
	Containment sump plugs	Table A.9-1, Item 12
	LH hot leg recirculation discharge valve fails to open [EJ HV-8802A,HV-8802B]	Table A.9-1, Item 13
	Heat exchanger cooling water valves fail to open (CCW failure) [HV-101(RHR HXA),HV-102(RHR HXB)]	Table A.9-1, Item 14
	Injection isolation valves fail to remain open [See Table A.9-1, Item 15]	Table A.9-1, Item 15
	Recirculation suction valves rupture/ fail to remain closed [See Table A.9-1, Item 16]	Table A.9-1, Item 16
	RHR suction line MOVs rupture (interfacing LOCA) [See Table A.9-1, Item 17]	Table A.9-1, Item 17
	Injection check valves rupture (interfacing LOCA), failure to open, failure to remain open [See Table A.9-1, Item 18]	Table A.9-1, Item 18
	Pumps unavailable due to maintenance [PEJ01A,PEJ01B]	Table A.9-1, Item 19
	Lifting of system relief valve below setpoint [PSV 8856A/B,PSV 8842]	Table A.9-1, Item 21
Engineered Safety Features Actuation	Failure of automatic initiation logic by: a) instrument failure through calibration or maintenance error b) logic relays failing to close c) failure of 120V vital AC	Table A.10-1, Item 1
Refueling Water Storage Tank (RWST)	Failure to realign system after refueling outage. [Refueling procedures]	Table A.11-1, Item 2

Table B.3 Maintenance Inspection Guidance (Cont'd)

System	Failure	Discussion
Power Conversion	Loss of PCS (& AFWS) by b) failure of MFW or condensate pumps to continue running [See Table A.12-1, Item 1(b)]	Table A.12-1, Item 1(b)
Emergency Boration (CVCS)	Single valve failure to open preventing boric acid flow due to power or control circuit fault [HV 8104,FCV-110A]	Table A.13-1, Item 2
	Failure of boric acid pumps to provide sufficient flow [PBG02A,PBG02B]	Table A.13-1, Item 3
	Charging pumps unavailable due to maintenance or failure to run [PBG04,PBG05A,PBG05B]	Table A.13-1, Item 4

APPENDIX C

CONTAINMENT AND DRYWELL WALKDOWN

WOLF CREEK GENERATING STATION
RISK-BASED INSPECTION GUIDE

Table C.1 Containment Walkdown

Discussion

Since the containment is generally inaccessible during normal plant operation, those components listed in the preceding tables which are located within the containment are listed below:

TABLE C.1 CONTAINMENT WALKDOWN

Description	ID No.	Location	Desired Position	Actual Position
RhR Train A RCS-RHR Isolation Valve	EJ-HV-8701A	Containment El.	Closed	______
RHR Train B RCS-RHR Isolation Valve	EJ-HV-8701B	Containment El.	Closed	______
Pressurizer PORV	PCV-455A	Containment El. 2070'	Closed	______
Pressurizer PORV	PCV-456A	" 2070'	Closed	______
Pressurizer Safety Relief Valve	SRV-8010A	" 2080'	Not Gagged	______
Pressurizer Safety Relief Valve	SRV-8010B	" 2080'	Not Gagged	______
Pressurizer Safety Relief Valve	SRV-8010C	" 2080'	Not Gagged	______
Pressurizer PORV Block Valve (PCV-455A)	HV-8000A	" 2070'	Open	______
Pressurizer PORV Block Valve (PCV-456A)	HV-8000B	" 2070'	Open	______

Note: Other components which may be worthwhile to examine are steam generator instrument root valves and other such instrumentation lines which are important for the ESFAS and for monitoring the RCS and SG conditions.