NRC FORM 366 (4-95) U.S. NUCLEAR REGULATORY COMMISSION

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EXPIRES 04/30/98

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Davis-Besse Unit Number 1	05000346	1 OF 29

TITLE (4)
Inadequate Testing of Safety Related Logic

EVENT DATE (5)			LER NUMBER (6)			REPORT NUMBER			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
03	18	97	97	-- 008 --	12	03	20	98		05000
									FACILITY NAME	DOCKET NUMBER 05000

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)							
POWER LEVEL (10)	100		20.2201(b)		20.2203(a)(2)(v)	X	50.73(a)(2)(i)		50.73(a)(2)(viii)
			20.2203(a)(1)		20.2203(a)(3)(i)		50.73(a)(2)(ii)		50.73(a)(2)(x)
			20.2203(a)(2)(i)		20.2203(a)(3)(ii)		50.73(a)(2)(iii)		73.71
			20.2203(a)(2)(ii)		20.2203(a)(4)		50.73(a)(2)(iv)		OTHER
			20.2203(a)(2)(iii)		50.36(c)(1)		50.73(a)(2)(v)		Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(iv)		50.36(c)(2)		50.73(a)(2)(vii)		

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER (Include Area Code)
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COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)			EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
X	YES (If yes, complete EXPECTED SUBMISSION DATE)	NO		10	30	98

ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)

During the review requested by Generic Letter 96-01, "Testing of Safety-Related Logic Circuits," conditions were discovered where approved Surveillance Test procedures did not completely meet the applicable Technical Specification Surveillance Requirements. The affected plant equipment included the Safety Features Actuation System, the Anticipatory Reactor Trip System, the Reactor Protection System, the Steam Feedwater Rupture Control System, the Emergency Diesel Generator load sequencers, the Emergency Core Cooling System, the Auxiliary Feedwater System, the Component Cooling Water System, and the Containment Air Cooling System. These conditions represent conditions prohibited by the plant's Technical Specifications, and are therefore being reported in accordance with 10CFR50.73(a)(2)(i)(B). Testing was performed to verify equipment operability, and the appropriate testing will continue to be performed at the required frequency. Review of safety-related logic circuits as requested by Generic Letter 96-01 is ongoing, and any future Surveillance Test deficiencies discovered as a result of this review will be reported in supplements to this Licensee Event Report.

Description of Occurrence:

On January 10, 1996, the NRC issued Generic Letter 96-01. This Generic Letter requested licensees take the following actions:

1) Compare electrical schematic drawings and logic diagrams for the reactor protection system, emergency diesel generator load shedding and sequencing, and actuation logic for the engineered safety features systems against plant Surveillance Test procedures to ensure that all portions of the logic circuitry, including the parallel logic, interlocks, bypasses and inhibit circuits are adequately covered in the Surveillance procedures to fulfill the Technical Specification requirements. This review should also include relay contacts, control switches, and other relevant electrical components within these systems, utilized in the logic circuits performing a safety function.

2) Modify the Surveillance procedures as necessary for complete testing to comply with the Technical Specifications. Additionally, the licensee may request an amendment to the Technical Specifications if relief from certain testing requirements can be justified.

Completion of these actions was requested to be accomplished prior to startup from the first refueling outage commencing one year after the issuance of the Generic Letter. In a letter dated April 16, 1996, (Serial Number 2370), Toledo Edison committed to completing this review prior to startup from the eleventh refueling outage, which is currently scheduled to start in April 1998. During this review, the following conditions were discovered.

Condition 1: A review of the Safety Features Actuation System (SFAS) [Energy Industry Identification System Code: JE] was conducted. Davis-Besse Technical Specification Surveillance Requirement 4.3.2.1.1 states that each SFAS output logic functional unit shall be demonstrated operable by performing a monthly channel functional test in Modes 1-4 and in Mode 6 if using the SFAS area radiation monitors to support core alterations or movement of irradiated fuel within containment. The Technical Specifications also specify an 18 month channel calibration and a shiftly channel check for these same functional units. On March 18, 1997, at 1015 hours with the plant in Mode 1 operating at 100 percent power, it was determined that the Technical Specification requirement for an 18 month calibration of all SFAS output logic is equivalent to the Technical Specification requirement to perform a monthly channel functional test. The existing monthly functional tests do not provide a complete check of the two-out-of-four logic gates in the individual SFAS output modules. The 18 month Surveillance Test performs a check of the logic gates not checked in the monthly channel functional tests. The last time these Surveillance Requirements were met was on November 20, 1996, when the 18 month test was performed. Since the existing monthly functional tests did not provide a complete check of the two-out-of-four logic gates in the individual SFAS output modules, the Technical Specification Surveillance Requirements were not adequately fulfilled within the appropriate time frame, so the plant was being operated in a condition that was

Description of Occurrence: (Continued)

prohibited by the plant's Technical Specifications. This placed the plant in Technical Specification 3.0.3, which requires actions to be initiated within one hour to place the unit in a Mode in which the Specification does not apply. The 24 hour time period permitted by Technical Specification 4.0.3 was invoked to allow completion of the 18 month Surveillance Test. The 18 month test was completed on March 18, 1997, at 1300 hours, demonstrating that all channels of SFAS were operable; therefore, the plant exited Technical Specification 3.0.3.

Condition 2: Because of the discovery of condition 1, a review of the Anticipatory Reactor Trip System (ARTS) was conducted. Technical Specification Surveillance Requirement 4.3.2.3 states that each ARTS output logic functional unit shall be demonstrated operable by performing a monthly channel functional test in Mode 1. On April 3, 1997, at 1331 hours with the plant in Mode 1 operating at 100 percent power, it was determined that the refueling interval periodic testing of all ARTS output logic is equivalent to the Technical Specification requirement to perform a monthly channel functional test. The existing monthly functional tests do not provide a complete check of the two-out-of-four logic gates in the individual ARTS output logic. Every refueling outage, a non-Technical Specification required interchannel logic test is performed to check the logic gates not checked in the monthly functional tests. Since the existing monthly functional tests did not provide a complete check of the two-out-of-four logic gates in the ARTS output logic, the Technical Specification Surveillance Requirement was not adequately fulfilled within the appropriate time frame. The last time a complete check of the ARTS output logic was performed was on May 20, 1996, when the interchannel logic test was performed. This placed the plant in Technical Specification 3.0.3, and the 24 hour time period permitted by Technical Specification 4.0.3 was invoked to allow performance of an interchannel logic test. Testing was completed on April 3, 1997, at 1718 hours, demonstrating that all channels of ARTS were operable; therefore, the plant exited Technical Specification 3.0.3.

Condition 3: A review of the emergency diesel generator (EDG) [EK] load shedding and sequencing circuitry was conducted. Technical Specification Surveillance Requirement 4.8.1.1.2.d.2 (a.& b.) states that each diesel generator shall be demonstrated operable by simulating a loss of offsite power in conjunction with a SFAS test signal every 18 months and verifying (a) de-energization of the essential busses and load shedding from the essential busses, and (b) the diesel starts on the auto-start signal, energizes the essential busses with permanently connected loads, energizes the auto-connected loads through the load sequencer, and operates for greater than or equal to 5 minutes while its generator is loaded with the essential loads. On May 12, 1997, at 1455 hours with the plant in Mode 5, it was determined that this Technical Specification requirement was not completely satisfied because all required loads were not verified to be load shed or verified to be energized through the load sequencer every 18 months. Specifically, the equipment with an alternate or swing component (such as Component Cooling Water Pump 3, Service Water Pump 3, and Containment Air Cooler 3) was only tested on an alternating outage periodicity under the SFAS

Description of Occurrence: (Continued)

integrated time response test. This test was written to check train 1 and train 2 components during one refueling outage, and then check the swing components as train 1 and train 2 components during the subsequent outage. Based on testing done by other procedures, only the following two conditions were not properly tested within the required time frame: loading logic of Component Cooling Water Pump 3 aligned as pump 1, and load shedding of Service Water Pump 3 aligned as pump 1 and as pump 2. Since all necessary components were not tested every 18 months, the Technical Specification Surveillance Requirements were not adequately fulfilled within the appropriate time frame. Further reviews completed on May 16, 1997, at 1105 hours with the plant in Mode 5, determined that testing of Component Cooling Water Pump 3, aligned as Pump 1, shall be completed to satisfy Surveillance Requirement 4.7.3.1.b.2. This surveillance requirement also verifies that each component cooling water pump starts automatically on an SFAS test signal. The last time that portions of the circuitry, not tested within the last 18 months, were tested satisfactorily was on November 5, 1994. These circuits were successfully tested on May 16, 1997, demonstrating that this circuitry was operable prior to the plant entering Mode 4 and was in compliance with both surveillance requirements.

Condition 4: A review of the SFAS Level 5 actuation circuitry was performed. Technical Specification Surveillance Requirement 4.3.2.1.3 states that the Safety Features response time of each SFAS function shall be demonstrated to be within the limit at least once per 18 months. Each test shall include at least one functional unit such that all functional units are tested at least once every N times 18 months, where N is the total number of redundant functional units for a specific SFAS function. On May 14, 1997, at 1615 hours with the plant in Mode 5, it was determined that an SFAS output logic functional unit begins at the output of the bistable isolators. With this interpretation, it was determined that the SFAS logic, consisting of at least the output modules, had not been response time tested at the frequency specified in Surveillance Requirement 4.3.2.1.3. Specifically, the response time of output logic functional units for Incident Levels 1 through 4 for SFAS channels 3 and 4 had not been tested within the appropriate Technical Specification Surveillance Requirement time frame. The last time the response times for these SFAS channel 3 and 4 instruments were tested satisfactorily was during the 1991 to 1993 time frame. Response time testing was completed on May 14 through 17, 1997, demonstrating that all channels of SFAS were operable prior to the plant entering Mode 4.

Condition 5: A review of the Reactor Protection System (RPS) [JC] circuitry was conducted. Technical Specification Surveillance Requirement 4.3.1.1.1 requires a quarterly channel calibration of the flux-delta flux-flow trip channels while in Modes 1 or 2. The flow rate measurement sensors are excluded from the quarterly calibration by the Technical Specifications, but are required to be calibrated at least once every 18 months. On May 21, 1997, at 1715 hours with the plant in Mode 4, it was determined that this Technical Specification requirement was not completely satisfied because the current-to-voltage

Description of Occurrence: (Continued)

converters associated with the flow transmitters should be calibrated quarterly. These converters are not flow rate measurement sensors, therefore, they cannot be excluded from quarterly calibration. Since the existing quarterly Surveillance Tests did not check the calibration of these converters, the Technical Specification Surveillance Requirements were not adequately fulfilled within the appropriate time. The last time this Surveillance Requirement was met was during the last refueling outage, when the 18 month Surveillance Test was performed prior to the outage ending on June 2, 1996. These converters were successfully tested on May 23 and 24, demonstrating that all channels of RPS were operable prior to the plant entering Mode 2.

Condition 6: Continued review of the EDG load sequencing circuitry identified another discrepancy. Technical Specification Surveillance Requirements 4.8.1.1.2.a.7 and 4.8.1.1.2.c.7 state that each diesel generator shall be demonstrated operable at least once per 31 days by verifying that the automatic load sequence timer is operable with each load sequence time within +/- 10% of its required value. On September 23, 1997, at 1500 hours with the plant in Mode 1 at 100 percent power, it was determined that this Technical Specification requirement was not completely satisfied due to the accuracy of the equipment used to measure the load sequence times. Each load sequence timer has initiating setpoints that are set at five second intervals. Applying the percentage specified in the surveillance requirement to this five second interval yields a tolerance of 0.5 seconds. However, current monthly testing utilizes the plant computer to verify sequence time, which has a resolution of approximately one second. Additionally, it was determined that the duration of the sequencer "unblock" timing interval was not being checked on a monthly basis, which is necessary to meet the operability requirements of the Surveillance Requirement. The last time the proper accuracy of the load sequencer and the duration of the "unblock" interval was verified was during the last refueling outage, when the SFAS Integrated Time Response Test (DB-SC-03114) was performed prior to the outage ending on June 2, 1996. This test utilizes a pen recorder with an accuracy of approximately 0.2 seconds to check for drift of the sequencer time intervals. Since the existing monthly Surveillance Tests did not properly check the load sequence timers, the Technical Specification Surveillance Requirements were not adequately fulfilled within the appropriate time frame. This placed the plant in Technical Specification Action Statement 3.8.1.1.e for both EDGs being inoperable. The 24 hour time period permitted by Technical Specification 4.0.3 was invoked to allow performance of the SFAS Channel Functional Tests. Testing was completed on September 23, 1997, at 2058 hours, demonstrating that all SFAS automatic load sequence timers were operable; therefore, the plant exited Technical Specification 3.8.1.1.e.

Description of Occurrence: (Continued)

Condition 7: A review of the Steam Feedwater Rupture Control System (SFRCS) [JB] circuitry was conducted. Technical Specification Surveillance Requirement 4.3.2.2.1 states that each SFRCS instrumentation channel shall be demonstrated operable by the performance of the channel check, channel calibration and channel functional test during the Modes and at the frequencies shown in Table 4.3-11. Table 4.3-11 specifies that the SFRCS Instrumentation Channels shall be functionally tested on a monthly basis. This table also specifies an 18 month channel calibration and a shiftly channel check for these instrumentation channels.

On October 7, 1997, at 1550 hours with the plant in Mode 1 operating at 100 percent power, it was determined that the Technical Specification requirement to perform a monthly channel functional test on the SFRCS output logic of the Main Steam Isolation Valve (MSIV) Bypass Valves [SB-ISV] was not being conducted. The MSIV bypass valves are provided to allow equalization of pressure around the MSIVs prior to opening the MSIVs. These bypass valves are interlocked with a position switch on the MSIVs so the bypass valves are closed when the MSIVs are open. As a result, the bypass valves are maintained in the closed position in Modes 1 and 2. The performance of the SFRCS monthly channel functional tests sends a signal to de-energize the bypass valve relay coils, but since the valves were already closed and the relay coils were already de-energized due to the interlock with the MSIVs, the relay contacts were not verified to change from a non-tripped to a tripped state.

Since the existing monthly functional tests did not adequately check the proper functioning of the SFRCS output logic, the Technical Specification Surveillance Requirement was not adequately fulfilled within the appropriate time frame. The last time this Surveillance Requirement was met was during performance of the 18 month Surveillance Tests prior to the end of the tenth refueling outage on June 2, 1996.

The Shift Supervisor reviewed the Technical Specifications for SFRCS to determine the required actions for this issue, and determined that the appropriate actions were to declare the MSIV Bypass valves inoperable due to the untested SFRCS logic. Upon reviewing the Technical Specifications and the SFRCS Operating Procedure (DB-OP-06404), the Shift Supervisor determined that no Technical Specifications Action Statements existed for the output logic of SFRCS. This determination was due in part to the similarity in design between the SFRCS and the SFAS. The Technical Specifications for SFAS have separate entries to address both input and output logic, but the Technical Specifications for SFRCS seem to only address the input instrumentation strings. To ensure timely resolution of this issue, actions were initiated to test each SFRCS channel bypass valve output logic circuitry during the next required channel functional test. It was believed that this action, which is Action 16 of Technical Specification Table 3.3-11, was only required when one SFRCS input logic channel was inoperable.

Description of Occurrence: (Continued)

Upon further review of Condition 7, on October 16, 1997, at 1455 hours, it was determined that the SFRCS logic shown in the Technical Specifications is for both the input and output portions of the logic circuitry. Technical Specification 3.3.2.2, Table 3.3-11, Action 16, states that with the number of operable channels one less than the total number of channels, startup and/or power operation may proceed until performance of the next required channel functional test provided the inoperable section of the channel is placed in the tripped condition within 1 hour. Since the output logic associated with the MSIV Bypass Valves was not tested for both channels of SFRCS, the plant was in a condition prohibited by the Technical Specifications. This placed the plant in Technical Specification 3.0.3 since the Limiting Condition for Operation was not met. The 24 hour time period permitted by Technical Specification 4.0.3 was invoked to allow the subject logic circuitry to be tested. Testing was completed on October 16, 1997 at 2126 hours, demonstrating that all channels of SFRCS were operable and Technical Specification 3.0.3 was exited.

Condition 8: Continued review of the SFAS Incident Level 5 actuation circuitry identified another discrepancy. Technical Specification 4.3.2.1.1 states the SFAS Incident Level 5 output logic channel for the containment sump recirculation permissive shall be functionally tested every 31 days in Modes 1-4, and verified to be properly calibrated every refueling outage.

Following a loss of coolant accident, it is desired to transfer the water from the Borated Water Storage Tank (BWST) into the containment sump for long term recirculation. This is a manual operator action which is blocked until the proper level is reached in the BWST. The permissive circuitry performs two separate safety functions:

1. The permissive prevents repositioning of the Emergency Core Cooling System (ECCS) suction valves until proper BWST level is attained. This prevents the use of the containment sump until adequate net positive suction head for the ECCS Pumps is developed by sufficient inventory transfer from the BWST.

2. When the proper level is reached, the permissive allows the ECCS pump suctions to be aligned to the Containment Sump. Current plant operating procedures direct the operator to realign the valves at a level of 8 feet in the BWST, and thus the valves should be realigned soon after the SFAS Level 5 permissive contacts close. It is necessary that the operator performs this action before the BWST level is too low. Otherwise, vortexing could occur in the BWST, causing a loss of suction and possible damage to the ECCS pumps.

The BWST level functional unit trip setpoint is listed in the Technical Specifications as having a high and a low value, indicating that a window of opportunity exists to perform the ECCS pump suction transfer from the BWST to the containment sump. On October 21, 1997, at 1600 hours with the plant in Mode 1, it was determined that the Technical Specification requirement to perform a

Description of Occurrence: (Continued)

monthly channel functional test on the SFAS Incident Level 5 actuation circuitry was incomplete in that it did not verify the permissive was blocked until the proper BWST level was attained. The test procedures used to perform the channel functional test are also used to perform the channel calibration test. Therefore, it was also determined that the permissive was not verified to be blocked prior to attaining the proper BWST level during the channel calibration test required to be performed every 18 months.

Since the Technical Specification Surveillance Requirements were not adequately fulfilled within the appropriate time frame, the SFAS Incident Level 5 Output Logic was declared inoperable, placing the plant in Technical Specification 3.3.2.1 Action 11. The 24 hour time period permitted by Technical Specification 4.0.3 was invoked to allow the subject logic circuitry to be tested. Testing was completed on October 22, 1997 at 0440 hours, demonstrating that all channels of SFAS were operable; therefore, the plant exited Technical Specification 3.3.2.1.

Condition 9: Continued review of the EDG load sequencing circuitry identified another discrepancy. Technical Specification Surveillance Requirement 4.3.2.1.1 states that each SFAS sequencer logic functional unit shall be demonstrated operable by the performance of a channel functional test every 31 days in Modes 1-4. Each of the four SFAS channel sequencer circuitry contains a K04 relay. Two complementary channel K04 relay contact pairs are connected in parallel to actuate one SFAS output logic SAX relay. Only one K04 relay is required to energize and close its normally open contacts to energize the SFAS output logic SAX relay whenever the SFAS sequencer is enabled. Operation of the SAX relay is necessary for proper SFAS sequencer operation during an event where a loss of offsite power is followed by a SFAS initiation signal.

On November 25, 1997, at 1005 hours with the plant in Mode 1 at 100 percent power, it was determined that this Technical Specification Surveillance Requirement was not completely satisfied. The operability of the sequencers had been verified using auxiliary contacts of the K04 relays, but all of the safety contacts of the K04 relays were not verified operable monthly. Furthermore, the safety contacts of the K04 relays were only verified as a parallel unit every 18 months, with no verification of the individual K04 relay safety contacts. The Technical Specifications describe a total number of four units for the sequencer, therefore, individual verification of the safety contacts is required. Since the existing Surveillance Tests did not properly check the operability of the SFAS sequencer circuitry, the Technical Specification Surveillance Requirement was not being fulfilled within the appropriate time frame. All four SFAS sequencer logic functional units were declared inoperable, and in accordance with Technical Specification 3.3.2.1, both Emergency Diesel Generators were declared inoperable. This placed the plant in Technical Specification 3.8.1.1 Action e. for both EDGs being inoperable. The 24 hour time period permitted by Technical Specification 4.0.3 was invoked to allow

Description of Occurrence: (Continued)

performance of the SFAS Channel Functional Tests. At 1710 hours, testing of SFAS Channel 1 sequencer was completed, demonstrating EDG 1 operable. The plant remained in Action b. of Technical Specification 3.8.1.1 due to EDG 2 being inoperable. At 1832 hours, testing of SFAS Channel 2 sequencer was completed, demonstrating EDG 2 operable, therefore the plant exited Technical Specification 3.8.1.1. All associated testing was completed on November 25, 1997, at 1842 hours, demonstrating that all SFAS automatic load sequence timers were operable; therefore, the plant exited Technical Specification 3.3.2.1.

Condition 10: A review of the SFRCS bypass circuitry was conducted. Technical Specification Surveillance Requirement 4.3.2.2.2 states that the logic for the SFRCS bypasses shall be demonstrated operable during the monthly at power channel functional test of channels affected by bypass operation. This bypass is used during normal plant shutdowns to prevent a low main steam line pressure trip. This Surveillance Requirement requires that the bypass circuitry be tested to verify the bypass is not enabled prior to the established setpoint, and that the bypass is automatically removed prior to its reset setpoint.

On December 1, 1997, at 1300 hours with the plant in Mode 1 operating at 100 percent power, it was determined that the monthly Technical Specification requirement was not adequately fulfilled. Specifically, it was not verified that both bypass pressure switches were necessary to enable the bypass permissive, and it was not verified that actuation of the bypass push-button with the main steam line pressure above the permissive setpoint would not result in a bypass of the low pressure trip. The last time this Surveillance Requirement was fulfilled was during the last refueling outage, when the 18 month Surveillance Test was performed prior to the outage ending on June 2, 1996. Since the existing monthly functional tests did not adequately check the proper functioning of the SFRCS low pressure bypasses, the Technical Specification Surveillance Requirement was not being fulfilled within the appropriate time frame. This placed the plant in Technical Specification 3.0.3, and the 24 hour time period permitted by Technical Specification 4.0.3 was invoked in order to complete the required testing. Testing was completed on December 1, 1997, at 2045 hours, demonstrating that the bypass circuitry of all SFRCS channels was operable; therefore, the plant exited Technical Specification 3.0.3.

Condition 11: Because of the discovery of condition 10, a review of the SFAS bypass circuitry was conducted. Technical Specification Surveillance Requirement 4.3.2.1.2 states that the logic for the SFAS bypasses shall be demonstrated operable during the monthly at power channel functional test of channels affected by bypass operation. This bypass is used during normal plant shutdowns to prevent low and low-low Reactor Coolant System (RCS) pressure trips. This Surveillance Requirement has been conservatively interpreted to require that the bypass circuitry be tested to verify the bypass is not enabled prior to the established setpoint, and that the bypass is automatically removed

Description of Occurrence: (Continued)

prior to its reset setpoint. On December 4, 1997, at 1410 hours with the plant in Mode 1 operating at 100 percent power, it was determined that the monthly Technical Specification requirement was not adequately fulfilled. Specifically, it was not verified that actuation of the bypass push-button with the Reactor Coolant System pressure above the permissive setpoint would not result in a bypass of the respective trip, and it was not verified that the low pressure trips would not be bypassed when the established setpoint was reached without actuation of the bypass push-buttons. Since the existing monthly functional tests did not adequately check the proper functioning of the SFAS low pressure bypasses, the Technical Specification Surveillance Requirement was not being fulfilled within the appropriate time frame. This placed the plant in Technical Specification 3.0.3, and the 24 hour time period permitted by Technical Specification 4.0.3 was invoked in order to complete the required testing. Testing was completed on December 4, 1997, at 2321 hours, demonstrating that the bypass circuitry of all SFAS channels was operable; therefore, the plant exited Technical Specification 3.0.3.

Condition 12: A review of the pressurizer heater [AB] interlock circuitry was conducted. Technical Specification Surveillance Requirement 4.5.2.d.1 states that each ECCS subsystem shall be demonstrated operable at least once per 18 months by verifying that the interlocks close valves DH-11 and DH-12 and deenergize the pressurizer heaters, if either DH-11 or DH-12 is open and a simulated reactor coolant system pressure which is greater than the trip setpoint (<438 psig) is applied. This Surveillance Requirement also states that the interlock to close DH-11 and/or DH-12 is not required if the valve is closed and 480 volt AC power is disconnected from its motor operators. This interlock is provided to prevent overpressurizing the Decay Heat system in the event the valves are inadvertently left open during heatup or if an operator prematurely tries to open the valves during cooldown. This interlock is in addition to the relief valves provided in the Decay Heat suction line to protect the system from overpressure.

The number two non-essential pressurizer heater bank control switch has an Auto plus Base Load position, which allows a portion of this heater bank to remain continually energized to replace ambient heat losses. The rest of the heater bank is controlled in response to Reactor Coolant System pressure. This Auto plus Base Load position is in addition to an Auto position, which allows the entire heater bank to be controlled in response to Reactor Coolant System pressure.

On January 20, 1998, at 1230 hours with the plant in Mode 1 at 100 percent power, it was determined that this Technical Specification Surveillance Requirement was not completely satisfied. The operability of the pressurizer heater interlock had been verified by observing that the lights on the control room switch extinguish when expected. However, this did not verify the operability of all of the devices that comprise the interlock, including the

Description of Occurrence: (Continued)

contactors that actually deenergize the pressurizer heaters. Furthermore, the logic involving the base load portion of the number two non-essential heater bank was not verified to deenergize upon receipt of a low pressure signal withthe control switch in the Auto plus Base Load position. Since the existing Surveillance Tests did not properly check the operability of the pressurizer heater interlock circuitry, the Technical Specification Surveillance Requirement was not being fulfilled within the appropriate time frame. Both trains of ECCS subsystems were declared inoperable, placing the plant in Technical Specification 3.0.3, and the 24 hour time period permitted by Technical Specification 4.0.3 was invoked in order to complete the required testing. Testing was completed on January 20, 1998, at 1615 hours, demonstrating that the pressurizer heater interlock circuitry was operable; therefore, the plant exited Technical Specification 3.0.3.

Condition 13: A review of the Auxiliary Feed Pump and Turbine [BA] Interlocks was conducted. Technical Specification Surveillance Requirement 4.7.1.2.1.e states that the Auxiliary Feed Pump Suction Pressure Interlocks shall be demonstrated operable by performance of a channel functional test at least once per 31 days. These interlocks are provided to protect the Auxiliary Feedwater Pumps from cavitation damage that may occur due to operating for an extended period of time with low pump suction pressure. Surveillance Requirement 4.7.1.2.2 states the Auxiliary Feed Pump Turbine Inlet Steam Pressure Interlocks shall be demonstrated operable when the steam line pressure is greater than 275 psig by performance of a channel functional test at least once per 31 days. These interlocks are provided to isolate the steam lines to the Auxiliary Feed Pump Turbines in the event of a steam line break in these lines. These inlet steam pressure interlocks are required for high energy line break concerns. Both the pump suction pressure interlocks and the inlet steam pressure interlocks function to close the Auxiliary Feed Pump Turbine steam inlet valves as well as prevent the steam inlet valves from opening in response to a signal from the Steam Feedwater Rupture Control System (SFRCS).

On January 22, 1998, at 1300 hours with the plant in Mode 1 at 100 percent power, it was determined that these Technical Specification Surveillance Requirements were not completely satisfied. The portions of these interlocks that prevent the re-opening of the steam isolation valves had not been verified operable on a monthly basis. Since the existing Surveillance Tests did not properly check the operability of either the low pump suction pressure interlock circuitry or the steam inlet pressure interlock circuitry, the Technical Specification Surveillance Requirements were not being fulfilled within the appropriate time frame. Both trains of Auxiliary Feedwater were declared inoperable, placing the plant in Technical Specification 3.0.3, and the 24 hour time period permitted by Technical Specification 4.0.3 was invoked in order to complete the required testing. Testing on Auxiliary Feedwater Train 1 was completed on January 22, 1998, at 1640 hours, demonstrating that the interlocks for Auxiliary Feedwater Train 1 were operable; therefore, the plant exited

Description of Occurrence: (Continued)

Technical Specification 3.0.3. Testing on Auxiliary Feedwater Train 2 was completed on January 22, 1998, at 1805 hours, demonstrating that the interlocks for Auxiliary Feedwater Train 2 were operable; therefore, the plant exited Technical Specification 3.7.1.2.

Condition 14: Further review of the RPS circuitry was conducted. Technical Specification Surveillance Requirement 4.3.1.1.1, Table 4.3-1, Item 8, requires a channel check of the High Reactor Flux/Number Of Reactor Coolant Pumps On Functional Units be performed every shift, and a channel calibration be performed on a quarterly frequency. These Surveillance Requirements are only applicable when the plant is in Modes 1 or 2. These functional units provide protection for changes in the reactor coolant flow due to the loss of multiple Reactor Coolant Pumps. These functional units also prevent operation with both pumps in either coolant loop tripped, when core flow and core fluid mixing would be insufficient for adequate heat transfer.

If a Reactor Coolant Pump motor current is low, indicating the motor has tripped, or if the current is high, indicating a locked rotor condition, an input is provided to one of four input signal conditioner networks of each functional unit. A light in each network, which is dim with the respective Reactor Coolant Pump motor in operation, would change to bright to indicate a tripped condition on the motor. Procedure DB-OP-03006, Miscellaneous Instrument Shift Check, verifies the lights in the input signal conditioner networks are dim every shift while the plant is in Mode 1 or 2, or that the lights are bright due to a tripped Reactor Coolant Pump. This procedure does not verify the status of these lights while the plant is in Modes 3 through 6.

On January 26, 1998, at 1432 hours with the plant in Mode 1 at 100 percent power, it was determined that the Technical Specification Surveillance Requirement to perform a channel calibration may not be completely satisfied for all possible operating conditions while the plant is in Modes 1 or 2. The test procedures (DB-MI-03205 through DB-MI-03208) used to satisfy the quarterly channel calibration requirement open the four current test switches for the Reactor Coolant Pump motor current monitors and then verify the lights in the four input signal conditioner networks are bright. However, the channel calibration tests do not verify that the lights are dim prior to opening the test switches. During normal plant operations, the Technical Specification Surveillance Requirement for the channel calibration is adequately fulfilled because the lights are verified to be dim every shift by performance of procedure DB-OP-03006. However, if the channel calibration tests are performed with any Reactor Coolant Pump not in operation, the lights would be bright prior to opening the current test switches. This would result in a portion of the input signal conditioner network in the RPS contact monitor module not being adequately tested.

Description of Occurrence: (Continued)

This condition was verified to have occurred during the startup from the last two refueling outages in May, 1996, as well as in November, 1994. The channel calibration tests were performed prior to entering Mode 2 during these plant startups with less than four Reactor Coolant Pumps operating. This condition may also have occurred in the past when the channel calibration tests were performed during Mode 1 operation with only three Reactor Coolant Pumps operating.

Because all four Reactor Coolant Pumps were in operation on January 26, 1998, when this condition was discovered, the operability of the circuit was being properly verified in accordance with the Technical Specification Surveillance Requirements by overlap testing of the channel calibration tests with the shiftly check of the circuit. However, since the existing Surveillance Tests did not properly check the operability of the High Reactor Flux/Number Of Reactor Coolant Pumps On Functional Units for all operating conditions in the past, the Technical Specification Surveillance Requirement was not adequately fulfilled, resulting in operation of the plant in violation of the Technical Specifications.

Condition 15: A review of the Component Cooling Water (CCW) Pump [CC] starting circuitry was conducted. Technical Specification Surveillance Requirement 4.7.3.1.b.2 requires each CCW Pump be started automatically during a plant shutdown on an SFAS test signal at least once every refueling interval (a recent change to the Technical Specifications changed this time period from every 18 months to every refueling interval, with a refueling interval defined as 24 months). During normal operations, one CCW Pump is operating and one CCW Pump is in a standby condition. The standby CCW Pump will automatically start upon a SFAS signal. A third CCW Pump is also available that can be manually aligned to supply either safety train 1 or safety train 2 equipment.
In the CCW Pump starting circuitry there is a pair of parallel contacts, 52s2b and say/13 (say/24 for train 2). One of these two contacts must be closed so the CCW Pump Motor breaker can close and start the CCW Pump on a SFAS start signal. The say/13 relay is picked up by a 52s1a contact off the EDG output breaker. This 52s1a contact is always in the opposite state of the 52s2b contact off the same EDG output breaker. Thus either the 52s2b contact or the say/13 contact is always closed. The 52s2b contact is used to start the CCW Pump via SFAS whenever the EDG output breaker is open. The say/13 contact would be used during the following scenario to start the CCW Pump:

1. The CCW Pump for the respective safety train is in the standby condition.
2. A loss of power is experienced on the electrical bus for the safety train.
3. The EDG for the safety train starts and its output breaker closes, reenergizing the bus.
4. Within 40 seconds of the EDG output breaker closing, a SFAS actuation occurs.

A separate 2x relay within the CCW Pump starting circuitry actuates approximately 40 seconds after the EDG output breaker closes to start the CCW

Description of Occurrence: (Continued)

Pump and ensure the EDG has a source of cooling water. This 2x relay is not in the SFAS portion of the CCW Pump start circuitry.

On February 11, 1998, at 1425 hours with the plant in Mode 1 at 100 percent power, it was determined that the Technical Specification Surveillance Requirement to automatically start each CCW Pump on a SFAS test signal at least once every refueling interval was not completely satisfied. The test procedures(DB-SP-03090 through -03092 along with DB-SC-03114) used to satisfy this Surveillance Requirement do not verify the CCW pumps can be started on a SFAS test signal via the say/13 contacts for the scenario described above. Since the CCW Pumps were not adequately tested to ensure they were able to be started on a SFAS test signal for all potential operating conditions, the Surveillance Requirements were not met in the appropriate time frame. Both trains of CCW were declared inoperable, placing the plant in Technical Specifications 3.0.3 and 3.7.3.1, and the 24 hour time period permitted by Technical Specification 4.0.3 was invoked in order to complete the required testing. The EDG Monthly Tests, DB-SC-03070 and -03071, were changed to verify the say/13 contacts function properly with the EDG operating. Testing on CCW Train 1 was completed on February 11, 1998, at 2108 hours, demonstrating CCW Train 1 was operable; therefore, the plant exited Technical Specification 3.0.3. Testing on CCW Train 2 was completed on February 12, 1998, at 0105 hours, demonstrating CCW Train 2 was operable; therefore, the plant exited Technical Specification 3.7.3.1. Testing on each CCW train included the applicable portions of CCW Pump 3 starting circuitry.

Condition 16: A review of the Containment Air Cooler (CAC) [BK] starting circuitry was conducted. Technical Specification Surveillance Requirement 4.6.2.2.b requires each CAC be verified operable by verifying it starts automatically in low speed upon receipt of a SFAS test signal at least once every 18 months. During normal operations, two CACs are operating in high speed. A third CAC is also available that can be manually aligned to supply either safety train 1 or safety train 2 equipment.

Upon a SFAS signal, the two operating CACs are shifted from high to low speed operation to prevent the fan motors from overloading because of the dense atmosphere in containment following an accident. Due to the design of the control circuitry, in order for a CAC to shift from high to low speed operation, it must first be tripped off high speed operation. The CAC is then restarted in low speed operation without waiting for the fan to come to a complete stop.

On February 19, 1998, at 1456 hours with the plant in Mode 1 at 100 percent power, it was determined that the Technical Specification Surveillance Requirement to automatically start CAC 3 aligned to safety train 2 in low speed on a SFAS test signal at least once every 18 months was not completely satisfied. The test procedure (DB-SP-03299) used to satisfy this Surveillance

Description of Occurrence: (Continued)

Requirement verifies CAC 3 can be started in low speed when aligned to both safety train 1 and safety train 2. The test procedure also verifies that CAC 3 can be tripped from high speed operation when aligned to safety train 1, but does not verify that CAC 3 can be tripped from high speed operation when aligned to safety train 2.

CAC 3 was aligned to safety train 2 from December 17, 1997, to December 28, 1997, to fulfill Limiting Condition for Operation (LCO) 3.6.2.2, which states at least two independent CACs shall be operable in Modes 1 through 3. This condition existed for 11 days, which is longer than the 72 hours allowed by LCO 3.6.2.2 for only one CAC to be operable. Since CAC 3, when aligned to safety train 2, was not adequately tested to ensure it was able to trip from high speed and start in low speed on a SFAS test signal, the Surveillance Requirement was not met in the appropriate time frame. At the time of discovery, CAC 1 and CAC 2 were in operation to satisfy LCO 3.6.2.2, and CAC 3 aligned to safety train 2 was already being tracked as inoperable for other administrative reasons. A Unit Log entry was made documenting CAC 3 was inoperable when aligned to safety train 2 due to this inadequate testing, and the inoperable equipment tracking log was updated appropriately.

The test procedure was revised on February 26, 1998, to verify CAC 3 can be tripped from high speed operation when aligned to safety train 2. Testing was performed on March 17, 1998, with no deficiencies, demonstrating that CAC 3 was operable when aligned to safety train 2.

All of these events represent conditions prohibited by the plant's Technical Specifications, and are therefore being reported in accordance with 10CFR50.73(a)(2)(i)(B).

Apparent Cause of Occurrence:

Conditions 1 and 2: Licensee Event Report (LER) 85-021, submitted to the NRC on December 2, 1985, identified the System Review and Test Program SFAS review revealed a portion of the two-out-of-four SFAS output logic was not tested regularly. This output logic was tested prior to initial plant operations. The apparent cause was that the Surveillance Test review process was not technically detailed enough to ensure that all functions of all components were being addressed. The condition was reported as a procedure inadequacy that could have allowed the failure of a component in a safety system to go undetected. Testing of the logic gates was conducted as part of the System Review and Test Program. Subsequently, a Surveillance Test was developed to test these logic gates on an 18 month frequency. At this time it was believed that not all logic gates were required to be tested to satisfy the Technical Specification monthly channel functional test Surveillance Requirement, as evidenced by prescribing testing on an 18 month frequency.

Apparent Cause of Occurrence: (Continued)

LER 88-020, submitted to the NRC on September 16, 1988, identified ARTS and SFAS monthly channel functional testing did not completely meet Technical Specification Surveillance Requirements 4.3.2.3 and 4.3.2.1.1. The apparent cause was that the testing provisions provided in the vendor drawings did not facilitate monthly testing of those portions of a coincidence logic circuit that receive an actual (i.e., other than test) demand. This condition occurred, in part, because the circuits were not wired per logic drawings (design drawing), but instead were wired per the vendor drawings. The LER recognized the SFAS gates that were not tested in the monthly channel functional test were tested in the 18 month integrated SFAS testing. The condition was reported as a condition prohibited by the plant's Technical Specifications. ARTS and SFAS logic wiring were corrected to allow monthly testing per the original design intent.

LER 91-001, submitted to the NRC on April 10, 1991, identified the RPS monthly channel functional testing did not completely meet Technical Specification Surveillance Requirement 4.3.1.1.1. Prior to 1981, the test procedure included steps to verify that all combinations of the trip logic were tested. In 1981, the test procedure was revised and the measurement of voltage to each Control Rod Drive trip device was eliminated as it was deemed unnecessary. The apparent cause of this procedure deficiency was inadequate technical review. No further checks of other systems, such as ARTS and SFAS, were performed at this time to determine if the existing Surveillance Tests satisfied the Technical Specification Requirements. This was based upon the review that was performed in 1988 for LER 88-020. However, the review performed for LER 88-020 was incomplete due to a lack of understanding of the full intent of the definition of a channel functional test, and due to the belief that the existing licensing bases supported the existing methods used to accomplish Surveillance Tests.

The apparent cause for conditions 1 and 2 is personnel error in failing to fully understand the Technical Specification Surveillance Requirements for a channel functional test as applied to channel output logic. Technical Specification Definition 1.11, Channel Functional Test, identifies a channel functional test to be the injection of a simulated signal into the channel as close to the primary sensor as practicable to verify operability, including alarm and/or trip functions for analog channels, and the injection of a simulated signal into the channel sensor to verify operability, including alarm and/or trip functions for bistable channels. The ARTS and SFAS monthly channel functional tests do inject a simulated signal into the channel output logic to verify the channel output logic trip function. However, the monthly channel functional tests did not satisfy the applicable Surveillance Requirement because the tests did not functionally verify the operability of all components that could complete the logic and cause a trip in the ARTS or SFAS output logic. A contributing factor is the generic nature of the Technical Specification definition of the channel functional test and the application of the definition to channel output logic.

Apparent Cause of Occurrence: (Continued)

Condition 3: The apparent cause for condition 3 is personnel error in that the requirement to test all components (including swing components) was never considered a strict surveillance requirement. Testing one component per train was previously considered adequate. There is clearly no exception stated in the Technical Specifications that allows excluding the logic circuits of the alternate components.

Condition 4: The apparent cause for condition 4 is personnel error during development of the response time Surveillance Tests. The inconsistency between the Technical Specification functional unit labels and the Updated Safety Analysis Report descriptions of SFAS channels led to the test procedure preparers misunderstanding the Technical Specification requirements.

Condition 5: The flow transmitters originally installed at Davis-Besse, model BY transmitters manufactured by Bailey, provided an output of 0 to 10 volts dc. These transmitters were replaced in 1984 with new transmitters, model 1153 transmitters manufactured by Rosemount. The new Rosemount transmitters produce an output of 4 to 20 milliamps. A current-to-voltage converter was installed with the new Rosemount transmitters to provide an output of 0 to 10 volts dc to the Reactor Protection System. Since these converters, in conjunction with the Rosemount transmitters, replaced the original flow transmitters, they were assumed to be a part of the flow sensor. Therefore the converters were not included in the quarterly calibration test. The issue of calibrating these converters quarterly was raised in 1990, and it was again determined that these converters were part of the sensors, and quarterly calibration was not required. The apparent cause for condition 5 is personnel error during development of the modification that changed the flow transmitters, in that the quarterly calibration test procedures were not changed to include them within the scope of testing.

Condition 6: Davis-Besse's plant computer and associated equipment has a number of time intervals that it can use to monitor the status of equipment. These time intervals vary from a small fraction of a second for sequence of events parameters to 30 seconds or more for non-critical parameters. Timing of the automatic load sequence timer by the plant computer was believed to adequately meet any required accuracy measurements. Also, the Surveillance Requirement listed an accuracy requirement of +/- 10% without stating whether this applied to the time interval between sequence steps, or the total time of sequencer operation (25 seconds). This lack of clarity in the Surveillance Requirement resulted in a misinterpretation of the requirement, which was reflected in the surveillance test procedures. It was determined that the step setting accuracy of +/- 10% must be applied to the time interval between sequence steps to meet the most conservative interpretation of the accuracy requirement, and to ensure proper operation of the system. It was also not recognized that the duration of the "unblock" timing interval was necessary to verify proper operation of the automatic load sequence timers for compliance with the operability requirements of the Surveillance Requirement.

Apparent Cause of Occurrence: (Continued)

Condition 7: In 1994, the issue of testing the actuation logic for the MSIV bypass valves was raised. After evaluation of the issue, it was decided that monthly testing of the MSIV bypass valve actuation logic was not required. This was based on the fact that the bypass valves are maintained in the closed position in Modes 1 and 2 due to the interlock with the MSIVs, even though the SFRCS is required to be operable in Modes 1, 2 and 3. A Safety Evaluation as required by 10CFR50.59 was performed in 1994 to update the Updated Safety Analysis Report (USAR) to document the MSIV bypass valve actuation circuitry was not tested during power operation. This Safety Evaluation and subsequent USAR change were in conflict with the monthly requirement to perform channel functional testing as defined in Technical Specification Definition 1.11:

"A CHANNEL FUNCTIONAL TEST shall be:

a. Analog channels - the injection of a simulated signal into the channel as close to the primary sensor as practicable to verify OPERABILITY including alarm and/or trip functions.
b. Bistable channels - the injection of a simulated signal into the channel sensor to verify OPERABILITY including alarm and/or trip functions."

This Safety Evaluation acknowledged that the Technical Specifications required monthly testing of the logic associated with the MSIV bypass valves, but no License Amendment Request was processed to exclude the MSIV bypass valves from this monthly Surveillance Requirement.

The apparent cause for the failure to fulfill the Technical Specification Surveillance Requirement is a failure to fully understand the Surveillance Requirements for a channel functional test as applied to channel output logic. The monthly channel functional tests did not satisfy the applicable Surveillance Requirement because the tests did not functionally verify the operability of all components that could complete the logic and actuate the subject components. A contributing factor is the generic nature of the Technical Specification definition of the channel functional test and the application of the definition to channel output logic.

When it was determined that the output logic associated with the MSIV bypass valves was inoperable due to the lack of testing on October 7, 1997, the Shift Supervisor reviewed the Technical Specifications to determine the necessary actions. The SFRCS and SFAS consist of two actuation channels, with each actuation channel consisting of two logic channels for each input function. The SFRCS logic requires both inputs from the same parameter in the same actuation channel to actuate equipment. The SFAS only requires any two of four inputs of the same parameter to actuate equipment. Even though the actuation logic of these two systems are similar, the Technical Specifications addressing this actuation logic is different, which led to confusion in the past when applying the Technical Specification Limiting Conditions for Operation. Because of the similarity between the SFRCS and SFAS circuitry, but difference between the

Apparent Cause of Occurrence: (Continued)

applicable Technical Specifications, the Shift Supervisor erroneously determined that no Technical Specification Actions were specified for the inoperable SFRCS output logic circuitry. The Shift Supervisor did verify that the MSIV bypass valves were in their SFRCS required position, had an SFRCS signal maintaining the valves in that position, and were interlocked closed by the open MSIVs. These actions would have complied with the Technical Specification Action for inoperable output logic in the SFAS had this circuitry been a part of the SFAS. This error was discovered on October 16, 1997, and since this condition was outside the Limiting Condition for Operation listed in Technical Specification 3.3.2.2, Table 3.3-11, Action 16, Technical Specification 3.0.3 was entered and the 24 hour time period permitted by Technical Specification 4.0.3 was invoked until the subject logic circuitry was tested satisfactorily.

Condition 8: The majority of the setpoints listed in the Technical Specifications are listed with only one value. The listed value accounts for all expected operating conditions, and is set to account for instrument inaccuracies while ensuring the equipment performs its intended safety function. The BWST level functional unit trip setpoint is listed in the Technical Specifications with a dual-sided tolerance band. The permissive must be blocked prior to reaching the upper value of the tolerance band, and enabled prior to reaching the lower value of the tolerance band to ensure adequate net positive suction head is maintained for the ECCS pumps. The associated SFAS terminating relays were being verified to operate within the dual-sided tolerance band by observing the operation of an auxiliary set of relay contacts. The apparent cause for the failure to fulfill the Technical Specification Surveillance Requirement was a failure to recognize that the terminating relay safety contacts were required to be verified open to ensure the permissive was blocked until the proper BWST level was attained.

Condition 9: The apparent cause for condition 9 is that sufficient consideration was not given to all of the logic circuitry associated with proper SFAS sequencer operation. In particular, a relay in each of the four SFAS channels associated with ensuring sequencer initiation under the various accident scenarios (a loss of offsite power preceding, coincident with, or followed by an SFAS initiation signal) was not adequately considered, and therefore was not adequately tested. Since the sequencer's function is to provide timing signals, it appears the monthly testing focused on ensuring the timing output capabilities, but neglected to fully test additional logic in each SFAS channel required to support sequencer initiation.

Condition 10 and 11: The apparent cause for conditions 10 and 11 is that sufficient consideration was not given to all of the logic circuitry associated with the SFRCS and SFAS low pressure operating bypasses. It was discovered that certain logic gates could only be verified by attempting to use the bypasses when they are not expected to be used. Logic testing to this level of detail had not been considered in the past.

Apparent Cause of Occurrence: (Continued)

Condition 12: The apparent cause for condition 12 is that sufficient consideration was not given to all of the logic circuitry associated with proper operation of the pressurizer heater interlock. Logic testing to this level of detail had not been considered necessary in the past.

Condition 13: The apparent cause for condition 13 is that testing of only the closure of the Auxiliary Feed Pump Turbine steam inlet valves upon the receipt of the low pump suction pressure or low inlet steam pressure signals was considered to be necessary in order to satisfy the Technical Specification Surveillance Requirements. The other contacts within the steam inlet valve circuitry that opened to block the SFRCS actuation of the same valve in the opposite direction were not deemed necessary to be tested in order to satisfy the Technical Specification Surveillance Requirements, and therefore were not included in the surveillance test.

Condition 14: The apparent cause for condition 14 is that the scope of testing necessary in order to satisfy the Technical Specifications Surveillance Requirements for a channel calibration were not fully understood prior to reviewing the guidance contained in Generic Letter 96-01. Therefore, the channel calibration test procedures for the High Reactor Flux/Number Of Reactor Coolant Pumps On Functional Units were incomplete and did not verify all necessary portions of the circuitry.

Condition 15: The apparent cause for condition 15 is that the scope of testing necessary to satisfy the Technical Specifications Surveillance Requirement was not fully understood prior to reviewing the guidance contained in Generic Letter 96-01. Therefore, the test procedures used to start the CCW Pumps on a SFAS test signal were incomplete and did not verify all necessary portions of the circuitry.

Condition 16: As stated previously, the scope of testing necessary to satisfy Technical Specification Surveillance Requirements was not fully understood prior to reviewing the guidance contained in Generic Letter 96-01. Therefore, the test procedures did not identify that the portion of the test that tripped a CAC from high speed was necessary to satisfy Surveillance Requirement 4.6.2.2.b. The current test procedures for CAC 1 and CAC 2 (DB-SP-03297 and DB-SP-03298, respectively) adequately test the CAC trips from high speed, even though this is not an acceptance criteria for the test. Revision 0 of the test procedure for CAC 3 (DB-SP-03299) also adequately tested that CAC 3 tripped from high speed when aligned to both safety train 1 and safety train 2. However, when this procedure was revised on July 29, 1993, the procedure step that verified CAC 3 tripped from high speed when aligned to safety train 2 was removed without explanation. This was most likely a result of personnel oversight during the procedure revision, since the step for CAC 3 aligned to safety train 1 remained in the procedure.

Apparent Cause of Occurrence: (Continued)

Based on the number of events discovered resulting from the Generic Letter 96-01 Review Program, a multi-discipline team was assembled to identify the overall root cause. This multi-discipline team will evaluate the apparent cause of all events involving inadequate testing discovered under the Generic Letter 96-01 Review Program in determining the overall root cause.

Analysis of Occurrence:

Conditions 1 and 2: The portions of the output logic circuits for ARTS and SFAS that were not tested in the past during monthly testing are part of integrated circuits and solid state components. Past experience has shown that these components are highly reliable. Multiple failures in redundant components are required to prevent the system from tripping during actual demands for system actuation. In no case was the capability of manually tripping the logic circuits compromised. Operator training on the plant's simulator emphasizes manual initiation of a safety system when automatic initiation does not occur.

All of the logic circuits for SFAS that were not tested during monthly testing were previously tested satisfactorily on November 20, 1996, by performance of the 18 month Surveillance Test. Performance of the 18 month Surveillance Test on March 18, 1997, revealed no equipment deficiencies. Based upon this successful test, it is concluded that plant safety was not compromised. Results from previous performances of the 18 month Surveillance Test determined that SFAS was capable of performing its designated safety function at the time of the test. All of the logic circuits for ARTS that were not tested during monthly testing were previously tested satisfactorily on May 20, 1996, by performance of the interchannel logic test. Performance of the interchannel logic test on April 3, 1997, revealed no equipment deficiencies. Based upon this successful test, it is concluded that plant safety was not compromised. Results from previous performances of the interchannel logic test determined that ARTS was capable of performing its designated safety function at the time of the test.

Condition 3: The portions of the emergency diesel generator load shedding and sequencing circuitry, not tested within the last 18 months, were previously tested satisfactorily on November 5, 1994, by performance of the 18 month Surveillance Test. Testing of these circuits on May 16, 1997, revealed no equipment deficiencies. Based upon this successful test, it is concluded that plant safety was not compromised. Results from previous performances of the 18 month Surveillance Test indicated that the emergency diesel generator was capable of performing its designated safety function at the time of the test.

Condition 4: All of the logic circuitry for the sensor parameters that were not tested within the specified Surveillance Requirement was previously tested satisfactorily during the 1991 to 1993 time frame by performance of the applicable Surveillance Tests. Response time testing of these circuits on May

Analysis of Occurrence: (Continued)

14 through May 17, 1997, revealed no equipment deficiencies. Based upon this successful test, it is concluded that plant safety was not compromised. Results from previous performances of the applicable Surveillance Tests determined that the logic circuitry was capable of performing its designated safety function at the time of the test.

Condition 5: The current to voltage converters associated with the RPS flow transmitters were previously tested satisfactorily during the last refueling outage by performance of the 18 month Surveillance Tests prior to the end of the outage on June 2, 1996. Calibration of these converters on May 23 and 24, 1997, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised. Results from previous performances of the 18 month Surveillance Tests determined that these converters were capable of performing their designated safety function at the time of the test.

Condition 6: The SFAS automatic load sequence timers are comprised of solid state components. Past experience has shown that these components are highly reliable. The timers were being tested on a monthly basis by the SFAS Channel Functional Tests, using the plant computer. Any gross deficiencies in the load sequence times would have been realized by the performance of these tests. Furthermore, the timers were tested at the required accuracy, which also verified the duration of the sequencer "unblock" timing intervals, during the last refueling outage using a pen recorder. No equipment deficiencies were noted. Testing of these timers on September 23, 1997, also revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised. Results from recent performances of the 18 month Surveillance Tests determined that these timers were capable of performing their designated safety function at the time of the test.

Condition 7: The portion of the SFRCS output logic circuit that was not tested in the past during monthly testing is comprised of integrated circuits, solid state components, and electro-mechanical relays. Past experience has shown that these components are highly reliable. Multiple failures in redundant components are required to prevent the system from tripping during actual demands for system actuation. In no case was the capability of manually tripping the logic circuits compromised. Operator training on the plant's simulator emphasizes manual initiation of a safety system when automatic initiation does not occur.

All of the logic circuitry for the MSIV bypass valves that was not being tested on a monthly basis was previously tested satisfactorily during the last refueling outage by performance of the 18 month integrated tests of SFRCS actuation channel logic prior to the end of the outage on June 2, 1996. Testing of this circuitry on October 16, 1997, revealed no equipment deficiencies.

Analysis of Occurrence: (Continued)

Based upon this successful testing, it is concluded that plant safety was not compromised. Results from previous performances of the 18 month Surveillance Tests determined that this circuitry was capable of performing their designated safety function at the time of the test.

The bypass valves are maintained closed in their safety position during Modes 1 and 2 by the interlock with the MSIVs. Their operation is controlled by plant procedures such that the only time the bypass valves would have been opened in Modes 1 through 3 would have been following a plant trip with an SFRCS actuation, to allow an MSIV to be re-opened.

Condition 8: The SFAS Incident Level 5 actuation circuitry enables the permissive to allow recirculation of the containment sump. Testing was not previously performed to verify the permissive was disabled prior to the level in the BWST dropping to 100.5 inches. However, current plant operating procedures direct the operator to not initiate the realignment of the ECCS pump suction valves until the BWST level has reached 8 feet (96 inches). This would have prevented the operator from realigning the ECCS pump suction valves prior to sufficient inventory being transferred from the BWST to the containment sump. Existing testing verified that the ECCS pump suction valves could be realigned once the proper BWST level was attained, thus ensuring that the ECCS pumps could perform their intended safety function.

The only portion of the SFAS output logic circuitry not appropriately tested in the past was the safety contacts of the SFAS terminating relays. Past experience has shown these relays are highly reliable. Multiple failures in redundant components are required to prevent the system from performing its intended safety function. Testing of the SFAS Incident Level 5 actuation circuitry on October 21, 1997, revealed no equipment deficiencies. Based upon this successful testing, it is concluded plant safety was not compromised.

Condition 9: The portion of the SFAS automatic load sequence circuitry that was not tested in the past during monthly testing consists of electro-mechanical relay contact pairs. Past experience has shown that these components are highly reliable. Multiple failures in redundant components are required to prevent the system from operating as designed. Testing of this circuitry on November 25, 1997, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised.

Condition 10: The portion of the SFRCS low main steam line pressure trip bypass circuitry that was not tested in the past during monthly testing is comprised of integrated circuits and solid state components. Past experience has shown that these components are highly reliable. Multiple failures in redundant components are required to prevent the circuitry from operating as designed. This circuitry was previously tested satisfactorily during the last refueling outage

Analysis of Occurrence: (Continued)

by performance of the 18 month integrated tests of SFRCS actuation channel logic prior to the end of the outage on June 2, 1996. Testing of this circuitry on December 1, 1997, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised.

Condition 11: The portion of the SFAS low RCS pressure trip bypass circuitry that was not tested in the past during monthly testing is comprised of integrated circuits and solid state components. Past experience has shown that these components are highly reliable. Multiple failures in redundant components are required to prevent the circuitry from operating as designed. Testing of this circuitry on December 4, 1997, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised.

Condition 12: The portion of the pressurizer heater interlock circuitry that was not tested in the past is comprised of electro-mechanical relays. Past experience has shown that these components are highly reliable. Any malfunction of this circuitry would be detected upon a plant shutdown, as the heaters would have remained energized, which could have hindered completion of the plant shutdown until the cause was found and corrected. Testing of this circuitry on January 20, 1998, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised.

Condition 13: The portions of the Auxiliary Feed Pump suction pressure and Turbine inlet steam pressure interlock circuitry that were not tested in the past during monthly testing are comprised of electro-mechanical relays. Past experience has shown that these components are highly reliable. A valid Auxiliary Feed Pump low suction pressure condition renders the respective train of Auxiliary Feedwater inoperable due to the loss of suction source. A failure of the interlock to maintain the Auxiliary Feed Pump Turbine inlet steam valve closed may cause additional hardware damage to the already inoperable pump as a result of the low suction pressure. Likewise, a valid low steam inlet pressure condition would render the respective train of Auxiliary Feedwater inoperable by closure of the steam isolation valve to the affected turbine. A failure of the interlock to maintain the Auxiliary Feed Pump Turbine inlet steam valve closed would release additional steam into the plant because of the potential steam line break. Flow restrictors are installed upstream of the inlet steam valves to reduce the energy released from any possible steam line breaks. As documented in the Davis-Besse Nuclear Power Station's Updated Safety Analysis Report, any steam line break in the Auxiliary Feed Pump Turbine steam supply lines does not adversely affect essential structures or equipment, including the opposite train of Auxiliary Feedwater. Testing of these interlock circuits on January 22, 1998, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised.

Analysis of Occurrence: (Continued)

Condition 14: The portion of the High Reactor Flux/Number Of Reactor Coolant Pumps On Functional Units that was not tested in the past is comprised of integrated circuits and solid state components. Past experience has shown that these components are highly reliable. Testing of this circuitry subsequent to the deficient testing performed during the plant startups in May, 1996, and November, 1994, with all four Reactor Coolant Pumps operating, revealed no equipment deficiencies. Based upon this successful testing and the most recent testing of these functional units, it is concluded that plant safety was not compromised.

Condition 15: The portions of the CCW Pump start circuitry that were not tested in the past are comprised solely of electro-mechanical relays. Past experience has shown that these components are highly reliable. Testing performed on February 11 and 12, 1998, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised. Additionally, in the event that the say/13 relay would not have functioned to start a CCW Pump, the 2x relay would have actuated approximately 40 seconds after the EDG output breaker closed to start the CCW Pump aligned to the same safety train. This 2x relay, although not in the SFAS portion of the CCW Pump start circuitry, is tested every other refueling interval to ensure proper operation.

Condition 16: The portions of the CAC 3 start circuitry for safety train 2 that were not tested in the past are comprised solely of electro-mechanical relays. Past experience has shown that these components are highly reliable. Testing performed on March 17, 1998, revealed no equipment deficiencies. Based upon this successful testing, it is concluded that plant safety was not compromised.

Therefore, even though portions of the affected systems were not tested in accordance with the Technical Specification Surveillance Requirements, these events had minimal safety significance.

Corrective Actions:

Condition 1: On March 18, 1997, the 18 month Surveillance Test (DB-SC-03115, SFAS Interchannel Logic Test) was performed and completed satisfactorily with no equipment deficiencies. The combination of this test and the existing monthly tests provide an overlapping check of all required two-out-of-four logic in the output modules of SFAS. The 18 month Surveillance Test will continue to be performed on a monthly frequency along with the monthly tests so that a complete check of the two-out-of-four logic gates in the individual SFAS output modules is performed.

Corrective Actions: (Continued)

Condition 2: On April 3, 1997, the interchannel logic test (DB-MI-03355, ARTS Interchannel Logic Test) was approved, performed, and completed satisfactorily with no equipment deficiencies. The combination of this test and the existing monthly tests provide an overlapping check of all required two-out-of-four logic in the output logic of ARTS. The interchannel logic test will continue to be performed on a monthly frequency along with the monthly tests so that a complete check of the two-out-of-four logic gates in the individual ARTS output logic is performed. Additionally, the existing periodic test (DB-MI-04020), written to be performed in an outage, will be changed to a surveillance test and performed prior to entering Mode 1 after every refueling outage, as required by the Surveillance Test schedule.

Condition 3: On May 16, 1997, the portions of the emergency diesel generator load shedding and sequencing circuitry that had not been tested within the last 18 months were tested satisfactorily with no equipment deficiencies. This testing in combination with other Surveillance Testing provided an overlapping check of all the required circuitry. The refueling interval Surveillance Test (DB-SC-03114, SFAS Integrated Time Response Test) will be revised prior to the next scheduled performance of the test during the Eleventh Refueling Outage. This revision will address logic testing of alternate components such that overlapping testing with other Surveillance Tests continues to verify the require circuitry. The Component Cooling Water Pump 3 Refueling Test (DB-SP-03092) will also be revised prior to its next scheduled performance during the Eleventh Refueling Outage to require testing of CCW Pump 3 as both train 1 and train 2.

Condition 4: On May 14 through May 17, 1997, the Surveillance Tests to measure the response time for affected logic circuitry were performed satisfactorily with no equipment deficiencies. The Surveillance and Periodic Test Schedule was updated on May 19, 1997, to reflect the required testing interval for the logic of the three sensor parameters of SFAS having response time requirements.

Condition 5: The quarterly Surveillance Tests (DB-MI-03057 through DB-MI-03060, RPS Channel Calibration of Overpower, Power/Imbalance/Flow, and Power/Pumps Trip Functions) were changed to include the calibration of the current-to-voltage converters. These tests were performed satisfactorily on May 23 and 24, 1997, with no equipment deficiencies.

Condition 6: The four monthly SFAS Channel Functional Surveillance Tests (DB-SC-03110 through DB-SC-03113) were changed to time the automatic load sequence timers correctly. These tests were completed satisfactorily on September 23, 1997, at 2058 hours, with no equipment deficiencies. Additionally, acceptance criteria will be added to the SFAS Integrated Time Response Test (DB-SC-03114) prior to its next performance during the Eleventh Refueling Outage to ensure that the automatic load sequence timers are tested appropriately.

Corrective Actions: (Continued)

Condition 7: On October 16, 1997, the two monthly Channel Functional Tests Of SFRCS Actuation Channel Logic For Mode 1 Surveillance Tests (DB-MI-03211 and -03212) were changed so the MSIV bypass valves could be tested during power operation with the MSIV open. These tests were completed satisfactorily on October 16, 1997, at 2126 hours, with no equipment deficiencies. Additionally, the Channel Functional Tests Of SFRCS Actuation Channel Logic (DB-MI-03209 and -03210) will be revised prior to their next performance to ensure testing of the MSIV bypass valve logic circuitry is conducted. These tests are utilized for testing of the SFRCS in plant Modes 2 through 5, and have been inactivated to ensure they are revised prior to their next performance.

Because of the delay that existed between determining the SFRCS output logic was inoperable and the appropriate actions to comply with the Technical Specifications were taken, revision 6 of this LER was reviewed by all Senior Reactor Operators by December 2, 1997. These operators will also be trained on this event by March 31, 1998, to ensure they are aware of the requirements of the SFRCS Technical Specifications. Additionally, this Technical Specification will be evaluated by March 31, 1998, to determine if clarifications can be made to eliminate this source of confusion.

Condition 8: On October 21, 1997, the SFAS Channel Functional Tests (DB-SC-03110, -03111, -03112, and -03113) were changed to ensure the SFAS Incident Level 5 associated terminating relay permissive safety contacts change state within the tolerance band specified in the Technical Specifications. These tests were completed satisfactorily on October 22, 1997, at 0440 hours, with no equipment deficiencies.

Condition 9: The four monthly SFAS Channel Functional Tests (DB-SC-03110 through DB-SC-03113) were changed to ensure adequate testing of the SFAS sequencers, including testing of each K04 relay. These tests were completed satisfactorily on November 25, 1997, at 1842 hours, with no equipment deficiencies.

Condition 10: The two monthly SFRCS Channel Functional Tests utilized in Mode 1 (DB-MI-03211 and -03212) were changed to ensure that both low main steam line pressure trip bypass switches were necessary to enable the bypass permissive, and that actuation of the bypass push-button with the main steam line pressure above the permissive setpoint does not result in a bypass of the low pressure trip. These tests were completed satisfactorily on December 1, 1997, at 2045 hours, with no equipment deficiencies. Additionally, the SFRCS Channel Functional Tests utilized in Modes 2-5 (DB-MI-03209 and -03210) will be revised prior to their next performance to ensure adequate testing of the low main steam line pressure trip bypass logic circuitry is conducted. These tests are utilized for testing of the SFRCS in plant Modes 2 through 5, and have been inactivated to ensure they are revised prior to their next performance, currently scheduled for the Eleventh Refueling Outage.

Corrective Actions: (Continued)

Condition 11: The four monthly SFAS Channel Functional Tests (DB-SC-03110 through DB-SC-03113) were changed to ensure that actuation of the low and low-low RCS pressure trip bypass push-buttons with the RCS pressure above the permissive setpoint does not result in a bypass of the respective trip, and that the low pressure trips are not bypassed when the established setpoint is reached without actuation of the bypass push-buttons. These tests were completed satisfactorily on December 4, 1997, at 2321 hours, with no equipment deficiencies.

Condition 12: The Decay Heat Removal System Isolation Test procedure (DB-SP-03130) was revised so the necessary pressurizer heater interlock circuitry components could be tested with the plant operating in Mode 1, to fulfill the Technical Specification Surveillance Requirements. This test was performed satisfactorily on January 20, 1998, at 1615 hours, with no equipment deficiencies identified. The pressurizer heater interlock circuitry is normally tested only with the plant shutdown (Modes 4 through 6) to ensure performance of the test does not adversely affect plant operations. Therefore, this test procedure will be revised prior to its next scheduled performance during the Eleventh Refueling Outage.

Condition 13: The two Auxiliary Feedwater Level Control, Interlock, and Flow Transmitter Test procedures (DB-SP-03152 for train 1 and DB-SP-03161 for train 2) were revised to test the necessary Auxiliary Feedwater Pump and Turbine interlock circuitry components to fulfill the Technical Specification Surveillance Requirements. These tests were performed satisfactorily on January 22, 1998, at 1640 and 1805 hours, respectively, with no equipment deficiencies identified.

Condition 14: The quarterly channel calibration test procedures for the High Reactor Flux/Number Of Reactor Coolant Pumps On Functional Units (DB-MI-03205 through -03208) will be revised to ensure the test procedures are adequate for all potential plant operating conditions. This will be done by verifying the lights in the input signal conditioning networks of the RPS contact monitor module are dim when a normal Reactor Coolant Pump motor current is simulated through the use of test equipment, and that the lights are bright when the motor current monitors are tripped. These tests will be revised prior to their next performance with less than four Reactor Coolant Pumps operating. These tests will be revised no later than May 7, 1998, when these tests are scheduled to be performed during the Eleventh Refueling Outage and all four Reactor Coolant Pumps may not be operating.

Condition 15: The EDG Monthly Tests, DB-SC-03070 and -03071, were changed on February 11, 1998, and performed on February 11 and 12, 1998, to verify the say/13 contacts function properly with the EDG operating to fulfill Surveillance Requirement 4.7.3.1.b.2. The SFAS Integrated Time Response Test (DB-SC-03114)

Corrective Actions: (Continued)

will be revised prior to the next required performance to fulfill Surveillance Requirement 4.7.3.1.b.2 to demonstrate the CCW Pumps can be started automatically on a SFAS test signal.

Condition 16: The CAC 3 18 Month Test (DB-SP-03299) was revised on February 26, 1998, to add a step to verify CAC 3 trips from high speed operation when aligned to safety train 2 upon receipt of a SFAS test signal. This test was performed satisfactorily on March 17, 1998, with no equipment deficiencies.

Review of safety-related logic circuits as requested by Generic Letter 96-01 is ongoing. This review will be completed prior to startup from the eleventh refueling outage, which is currently scheduled to start in April 1998. Any future deficiencies discovered as a result of this review will be reported in supplements to this LER. Based on the number of events discovered resulting from the Generic Letter 96-01 Review Program, a multi-discipline team was assembled, and a task plan was developed on July 1, 1997, to identify the overall root cause. This multi-discipline team will evaluate the apparent cause of all events discovered under the Generic Letter 96-01 Review Program in determining the overall root cause. The overall root cause evaluation will be completed by September 30, 1998, and the results of this evaluation will be reported in a supplement to this LER.

Failure Data:

Previous reports involving safety system logic testing that was inadequate that relate to conditions 1 and 2 described above are LER 91-001, LER 88-020, and LER 85-021. LER 91-001 involved a procedural deficiency that was caused by an inadequate procedure revision. LER 88-020 reported a procedure deficiency that was caused by the field wiring of test switches not being per drawings in SFAS and the Anticipatory Reactor Trip System. LER 85-021 reported that some logic gates in SFAS were not covered by testing, which was caused by the Surveillance Test review process not being technically detailed enough to ensure that all functions of all components were being addressed. Previous supplements to this LER reported conditions 1 through 15 as events involving inadequate safety system logic testing. LER 97-011 documents an event where the wrong Technical Specification Limiting Condition for Operation was entered to perform maintenance on plant equipment.

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PCAQRs 97-0364, 97-0430, 97-0624, 97-0640, 97-0659, 97-0694, 97-1257, 97-1325, 97-1357, 97-1378, 97-1531, 97-1546, 97-1571, 98-0081, 98-0103, 98-0134, 98-0232, 98-0273