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Attachment 3

Millstone Unit No. 3

Boron Dilution Analysis

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Boron Dilution Analysis

Unborated water can be added to the reactor coolant system (RCS) via the chemical and volume and control system (CVCS), to increase core reactivity. This may happen inadvertently, because of operator error or CVCS malfunction, and cause an unwanted increase in reactivity and decrease in the shutdown margin. The operator must stop this unplanned dilution before the shutdown margin is eliminated. Since the sequence of events that may occur depend on plant conditions at the time of the unplanned moderator dilution, a broad range of initial operating conditions must be considered. The analysis presented below for Millstone Unit No. 3 includes plant operating conditions such as refueling, cold shutdown, hot shutdown, hot standby, startup and power operation.

Identification of Causes and Accident Description

The accident scenario considered here is the inadvertent opening of the primary water makeup control valve and failure of the blend system, either by controller or mechanical failure. The addition of unborated water to the RCS results in a positive reactivity insertion and an erosion of available shutdown margin. For at power and startup conditions, Technical Specification Modes 1 and 2, the dilution accident erodes the shutdown margin made available through reactor trip. For shutdown mode initial conditions, Technical Specification Modes 3, 4, 5 and 6, the dilution accident erodes the shutdown margin inherent in the borated RCS inventory and that which may be provided by control rods (control and shutdown banks) made available through reactor trip.

The accident is mitigated by the manual isolation of the dilution flow path and the initiation of borated flow to the RCS. Unchecked, the reactivity addition due to an inadvertent boron dilution may lead to the loss of shutdown margin. In Modes 1 and 2 (power and startup), this would result in an increase in power level and/or loss of the capability to maintain subcriticality following the trip of the control rods. In the shutdown modes, the reactivity insertion may cause criticality and complete loss of shutdown margin if all control rods are inserted or may cause complete loss of shutdown margin and criticality following reactor trip if rods were available for insertion.

For the at power modes, the analysis is performed to identify the amount of time available for operator mitigation of an inadvertent boron dilution prior to complete loss of shutdown margin. The calculated time is presented as that required for operator or automatic action to effectively mitigate the accident prior to complete loss of shutdown margin. For the shutdown modes, analyses are performed to define minimum shutdown margin requirements. These shutdown margin requirements ensure that minimum time requirements are met for the time from alarm/indication to loss of shutdown margin. The analyses for all modes are performed employing conservative assumptions.

Prior to complete loss of shutdown margin, RCS and core transient parameters are within the bounds of those calculated for other FSAR non-LOCA accidents. Therefore, the FSAR boron dilution accident is not limiting with respect to the critical non-LOCA acceptance criteria such as minimum DNBR, maximum RCS pressure, maximum steam generator secondary pressure and core decay heat removal. No other transient results are quantified or presented.

Limiting Dilution Flow Path Description

In reviewing the Millstone Unit No. 3 CVCS design, it was determined that the most probable, limiting dilution event is the misoperation of the CVCS reactor makeup control system (RMCS). The specific accident scenario identified is the inadvertent operation of the primary makeup control valve (FCV-111A) and failure of the blend system (either by controller or mechanical failure) which permits the primary makeup water system to inject directly to the charging pump suction (at the VCT outlet) without being blended with boric acid at the maximum rate permitted by the piping system (FT-111 fails forcing FCV-111A in the full-open position). The limiting dilution flow rate for this scenario has been concluded to be 150 gpm for Mode 1-manual through Mode 6, and 120 gpm for Mode 1-automatic. For conservatism, all the analyses for the boron dilution even assumed the 150 gpm dilution flow rate.

For these limiting flow rates to be valid, valve 8441 (V305(Z-)) is required to be under strict administrative procedures during Modes 1-6. This should have no impact on the Millstone Unit No. 3 analysis since the original design requirements specified that a locking device be installed on this valve and that the valve be locked closed when the path is not in use.

Safety Functions and Mitigating Systems

An inadvertent boron dilution event due to a CVCS malfunction may be manually terminated. Manual actions taken by the operator are as follows:

a. Identification of the accident
b. Isolation of the dilution flow path
c. Initiation of RCS boration
d. Manual reactor trip (if necessary)

All expected sources of dilution may be terminated by closing isolation valves in the CVCS, LCV-112B and C. The lost shutdown margin (SDM) may be regained by the opening of isolation valves to the Refueling Water Storage Tank (RWST), LCV-112D and E, thus allowing the addition of borated water from the RWST to the RCS.

The status of the RCS makeup is continuously available to the operator by the following:

a. Indication of the boric acid and blended flow rates

b. CVCS and Reactor Makeup Water System (RMWS) status lights for the following pumps:

   1. Charging pumps
   2. Boric Acid Transfer pumps
   3. Primary Grade Water Supply pumps

c. Deviation alarms, if the boric acid or blended flow rates deviate by more than 10 percent from the preset values

d. Source range neutron flux--when the reactor is subcritical

   1. Indicated source range neutron flux count rate
   2. Audible source range neutron flux count rate
   3. Source range neutron flux doubling alarm

e. When the reactor is critical

   1. Axial flux difference alarm (reactor power $\geq$ 50 percent RTP)
   2. Control rod insertion limit low and low-low alarms
   3. Overtemperature ΔT alarm (at power)
   4. Overtemperature ΔT turbine runback (at power)
   5. Overtemperature ΔT reactor trip
   6. Power range neutron flux--high, both high and low setpoint reactor trips.

<u>Safety Analysis Criteria & Regulatory Requirements</u>

This event is classified as an ANS Condition II incident and as such can, at worst, result in a reactor trip with the plant capable of complete recovery and resumption of plant operation within the requirements of the Technical Specifications. Condition II criteria are met if analyses results demonstrate the following:

1. Minimum DNBR is greater than or equal to the design limit,
2. Fuel centerline temperature is less than 4700°F,
3. Maximum reactor coolant system pressure is less than or equal to 110% of design pressure (2500 psia x 1.1 = 2750 psia).

These specific criteria satisfy the relevant requirements of 10CFR Part 50, Appendix A, GDC 10 and 15 and Section III, Article NB-7000 of the ASME Boiler and Pressure Vessel Code. The analysis assumptions used for this event satisfy the requirements of 10 CFR Part 50, Appendix A, GDC 26 by assuring that appropriate margin for malfunctions, such as stuck rods, are accounted for.

As discussed previously, the analysis for this event determines the amount of time available for operator mitigation of the boron dilution event prior to the complete loss of shutdown margin. If the calculated time is accepted as being sufficient, it can be assumed that manual actions will effectively prevent the complete loss of minimum allowable shutdown margin. Because shutdown margin is not lost, the condition of the plant at any point in the transient is within the bounds of those calculated for other Final Safety Analysis Report (FSAR) Condition II transients. If the above Condition II criteria are shown to be met for the balance of the FSAR Condition II transients and the calculated amount of time is accepted as sufficient for the successful mitigation of the dilution event, it can be concluded that the above criteria are met for the FSAR boron dilution accident.

Since the sequence of events that may occur depend on plant conditions at the time of the inadvertent dilution, a broad range of initial operating conditions must be considered. The operating modes to be considered are Refueling (Mode 6), Cold Shutdown (Mode 5), Hot Shutdown (Mode 4), Hot Standby (Mode 3), Startup (Mode 2), and Power (Mode 1 - both automatic and manual rod control). In all cases, the minimum time intervals available to the operator before a loss of shutdown margin occurs are calculated from the time an alarm alerts the operator to a dilution, <u>not</u> from the time the dilution begins. The minimum available operator action times for the various modes must be greater than or equal to the following:

Refueling	30 minutes
Cold Shutdown	15 minutes
Hot Shutdown	15 minutes
Hot Standby	15 minutes
Startup	15 minutes
Power	15 minutes

The above values follow Standard Review Plan (SRP) Section 15.4.6. Shutdown mode calculations in compliance with the SRP must quantify a time interval which begins with an alarm which alerts the operator to a boron dilution. The alarm preferred is a "dynamic alarm" in that there is specific logic to continuously adjust the annunciation point to the appropriate multiple of the current Source Range count rate. An alternative detection system may be "static," in which case no logic analysis assumes that the alarm setpoint is adjusted with respect to the Source Range count rate which exists at the beginning of the dilution. The existing design for the detection of an inadvertent Boron dilution event is a temporary system that is set up within the control room. The new design will add a shutdown margin monitor to both trains. These monitors (3NME&SMM1 & 2) will measure the count rate from the neutron counting instrument and identify any statistically significant increase that would indicate a loss of reactor shutdown margin.

The monitors will provide an alarm when the count rate increases by an amount equal to the alarm ratio that will be set into the shutdown monitors.

The monitors will follow the reactor shutdown, continuously reducing the alarm setpoint as the countrate reduces. When the countrate achieves a steady value and then eventually increases, the alarm setpoint will remain at it's lowest value. An alarm will occur when the countrate reaches a value equal to the alarm setpoint.

The input for the monitors will be obtained from the scaler output of the GAMMA-METRICS Wide Range Neutron-flux monitoring system which is located in the Fire Transfer Shutdown Panel and the wall mounted unit located next to the Auxiliary Shutdown Panel.

Two monitors will be provided, one per train. The monitors were procured from a qualified vendor to the requirements of IEEE 323-1974, and IEEE 344-1975. The power supplies for the monitors are from the Class 1E vital power source and qualified isolators are being used to provide the proper isolation between the monitors and nonclass 1E system (i.e., annunciation).

This system will improve the accuracy and reliability over the existing temporary system. These monitors will provide an alarm only and will not perform a protective function such as a reactor trip. The shutdown mode analyses performed for Millstone Unit No. 3 assume a detection system alarm setpoint of 2.0 (i.e., flux doubling). Other than a 10.0 second delay for the alarm response, there is no consideration for setpoint uncertainties.

Method of Analysis

Conservative analysis assumptions for each modes of operation were used, i.e., high RCS critical boron concentrations, high boron worths, minimum shutdown margins, and minimum RCS volumes. These assumptions result in conservative determinations of the time available for operator or system response after detection of a dilution transient in progress. For operating Modes 1 and 2, the boron dilution analysis is performed to identify the amount of time available from alarm to total loss of shutdown margin. The analysis is intended to verify that the calculated times are greater than the above specified minimum requirements.

For operating Modes 3, 4 and 5, the boron dilution event is analyzed to generate minimum shutdown margin requirements as a function of the critical boron concentration. The solution technique employed assumes the presence of the flux multiplication alarm discussed earlier and quantifies the amount of time available from the triggering of the alarm to the loss of shutdown margin. The actual calculations performed are iterative in nature.

For each shutdown mode considered, the dilution event is analyzed assuming a conservatively small dilution volume and the 150 gpm dilution flow rate previously defined. Combinations of initial and critical boron concentrations are determined that produce a predicted time to critical that corresponds to the minimum safety analysis acceptance criteria. The change in boron concentration from initial to critical, in combination with an appropriate boron worth, is then used to calculate a required shutdown margin. For modes 3, 4 and 5, the resulting shutdown margin versus critical boron concentration curves guarantee the operator a minimum of 15 minutes from alarm to criticality following initiation of the assumed boron dilution. The analysis assumes a fixed flux multiplication setpoint of 2.0 (i.e., alarm when flux doubling is detected) and includes consideration of a 10-second delay time in the actual alarm actuation. The alarm setpoint for the shutdown margin monitor will be included in the Core Operating Limits Report.

The discussion that follows applies to both four- and three-loop operation. When the values for four- and three-loop differ, the values for three-loop operation will appear in brackets ([]).

Dilution During Refueling (Mode 6)

An analysis is not performed for an uncontrolled boron dilution accident during refueling. In this mode, the event is prevented by administrative procedures for all potentially unborated water paths to the CVCS to preclude the addition of unborated water to the reactor vessel via the CVCS. As a minimum, these procedures should require the isolation valves in the paths from the unborated water sources to be locked closed or isolated by removal of instrument air or electrical power. Table 1 specifies the Millstone No. 3 CVCS related valves (paths) to which these procedures must be applied to preclude the boron dilution event in Mode 6.

As will be discussed further, the application of administrative procedures to the Table 1 valves may also be used to preclude a boron dilution event in Mode 5 when the RCS water level is drained down to the mid-plane of the hot leg. In either Mode 6 or Mode 5 - drained, locking out all unborated water sources could complicate providing RCS makeup or refilling the RCS. For this reason allowance has been made for placing valve operation under administrative control where shutdown margin would be continuously monitored.

Dilution During Cold Shutdown (Mode 5)

In Mode 5, the plant is being taken from a long-term mode of operation, Refueling (Mode 6), to a short-term mode of operation, Hot Shutdown (Mode 4). Typically, the plant is maintained in the Cold Shutdown mode when reduced RCS inventory is necessary or ambient temperatures are required. The water level can be dropped to the mid-plane of the hot leg for maintenance work that requires the steam generators to be drained. Throughout the cycle, the plant may enter Mode 5 if reduced temperatures are required in containment or as the result of Technical Specification action statement. The plant is maintained in Mode 5 at the beginning of cycle for startup testing of certain systems. During this mode of operation rod control is in manual and the rods can be partially withdrawn or fully inserted. The following conditions are assumed for an uncontrolled boron dilution during cold shutdown.

1. The assumed dilution flow (150 gpm) is the best estimate maximum flow from the RMCS assuming multiple simultaneous failures of control valves.

2. A minimum water volume (4231 ft^3) in the RCS is used. This is a conservative estimate of the active volume of the RCS while on one train of residual heat removal (RHR). This active volume does not include the reactor vessel upper head volume.

3. A conservative boron worth coefficient was assumed, with variable boron worth as a function of the critical boron concentration.

When the water level is drained down from a filled and vented condition in cold shutdown, an uncontrolled boron dilution accident may be prevented by administrative controls (see Table 1) which isolate the RCS from the potential source of unborated water. Nevertheless, analysis has been performed, and shutdown margin versus critical boron concentration plots provided for a Mode 5 drained case. The minimum water volume for this scenario in the RCS is 3624 ft^3.

The proposed Technical Specification Figures 3.1-4 and 3.1-5 show the required Mode 5 shutdown margin, as a function of critical boron concentration, to ensure at least 15 minutes from the time of the flux multiplication alarm to loss of shutdown margin. As noted earlier, a 10-second response time is considered in the development of the shutdown margin requirements.

<u>Dilution During Hot Shutdown</u> (Mode 4)

In Mode 4, the plant is being taken from a short-term mode of operation, Cold Shutdown (Mode 5), to a long-term mode of operation, Hot Standby (Mode 3). Typically, the plant is maintained in the Hot Shutdown mode to achieve plant heatup before entering Mode 3. The plant is maintained in Mode 4 at the beginning of cycle for startup testing of certain systems. Throughout the cycle, the plant will enter Mode 4 if reduced temperatures are required in containment or as a result of a Technical Specification action statement. During this mode of operation, rod control is in manual and the rods can be partially withdrawn or fully inserted. In Mode 4, the primary coolant forced flow which provides mixing can be provided by either the RHR system or a reactor coolant pump, depending on system pressure. The following conditions are assumed for an uncontrolled boron dilution during hot shutdown:

1. The assumed dilution flow (150 gpm) is the best estimate maximum flow from the RMCS assuming multiple simultaneous failures of control valves.

2. In this mode for Millstone Unit No. 3, RCS flow is conservatively assumed to be provided by the RHR system. With no RCP in operation during hot shutdown (with the required RHR pumps in operation), a conservatively low RCS water volume (4231 ft^3) is used. This active volume does not include the reactor vessel upper head volume.

3. The total RHR system flowrate which bypasses the core is 740 gpm. This is based on a nominal single-train, RHR system flowrate to the RCS of 4000 gpm.

4. A conservative boron worth coefficient was assumed, with variable boron worth as a function of critical boron concentration.

The proposed Technical Specification Figure 3.1-3 shows the required Mode 4 shutdown margin, as a function of critical boron concentration, to ensure at least 15 minutes from time of flux multiplication alarm until loss of shutdown margin. Again, a 10-second response time for the alarm is included in the analysis.

<u>Dilution During Hot Standby</u> (Mode 3)

During this mode, rod control is in manual and the rods can be either withdrawn to the hot zero power (HZP) insertion limits (preparation for entering Mode 2), or fully inserted (post-trip). In Mode 3 all reactor coolant pumps may not be in operation. In an effort to balance the heat loss through the RCS and the heat removal of the steam generators, one or more of the pumps may be shut off to decrease heat input into the system. In the approach to Mode 2 the operator must manually withdraw the control rods and may initiate a limited dilution according to shutdown margin requirements. If the control rods are withdrawn to the HZP insertion limits, the dilution scenario is similar to the Mode 2 analysis where the failure to block the source range trip results in a reactor trip and immediate shutdown of the reactor. The dilution scenario is more limiting if the control rods are not withdrawn and the reactor is shutdown by boron to the Technical Specifications' minimum requirement for Mode 3. The following conditions are assumed for an uncontrolled boron dilution during hot standby.

1. The assumed dilution flow (150 gpm) is the best estimate maximum flow from the RMWS assuming multiple simultaneous failures of control valves.

2. A minimum water volume (8881 [7572] ft^3) in the RCS is used. This volume corresponds to the active volume of the RCS with one RCP in operation, excluding the pressurizer and the surge line.

The volume specified here is conservative in that no consideration is given to mixing in the upper head region.

3. This mode is explicitly analyzed for both three- and four-loop operation.

4. A conservative boron worth coefficient was assumed, with variable boron worth as a function of critical boron concentration.

Figures 3.1-1 (4 loop) and 3.1-2 (3 loop) show the required Mode 3 shutdown margin, as a function of critical boron concentration, to ensure at least 15 minutes from time of flux multiplication alarm to loss of shutdown margin. Again, a 10-second response time for the alarm is included in the analysis.

Dilution During Startup (Mode 2)

In this mode, the plant is being taken from one long-term mode of operation, Hot Standby, to another, Power. The plant is maintained in the Startup mode only for the purpose of startup testing at the beginning of each cycle. Assumed conditions at Startup require the reactor to have available at least 1.30 percent ΔK shutdown margin. The following conditions are assumed for an uncontrolled boron dilution during startup:

1. Dilution flow is the maximum capacity of the RMWS pumps, 150 gpm.

2. A minimum RCS water volume of 9901 [8591] ft^3. This active RCS volume for Mode 2 includes the reactor vessel plus the active loops. Nonmixing regions, i.e., the pressurizer and surge line, are not included.

3. The initial boron concentration is assumed to be 2450 ppm, which is a conservative maximum value for the critical concentration at the condition of hot zero power, rods to insertion limits, and no xenon.

4. The critical boron concentration following reactor trip is assumed to be 1950 ppm, corresponding to the hot zero power, all rods inserted (minus the most reactive RCCA), no xenon condition. The 500 ppm change from the initial condition noted above is a conservative minimum value.

5. A constant boron worth of -12 pcm/ppm is conservatively assumed.

This mode of operation is a transitory operational mode in which the operator intentionally dilutes and withdraws control rods to take the plant critical. During this mode the plant is in manual control with the operator required to maintain a very high awareness of the plant status. For a normal approach to criticality, the operator must manually initiate a limited dilution and subsequently manually withdraw the control rods, a process that takes several hours. The operator determines the estimated critical position of the control rods prior to approaching criticality, thus assuring that the reactor does not go critical with the control rods below the insertion limits. Once critical, the power escalation must be sufficiently slow to allow the operator to manually block the source range reactor trip (nominally at 10^5 cps) after receiving P-6 from the intermediate range. Too fast a power escalation (due to an unknown dilution) would result in reaching P-6 unexpectedly, leaving insufficient time to manually block the source range reactor trip. Failure to perform this manual action results in a reactor trip and immediate shutdown of the reactor.

However, in the event of an unplanned approach to criticality or dilution during power escalation while in the Startup mode, the plant status is such that minimal impact will result. The plant will slowly escalate in power to a reactor trip on the power range neutron flux low setpoint (nominally 25 percent RTP). After reactor trip, there are approximately 82.9 [71.9] minutes for the operator to determine the cause of dilution, isolate the unborated water source, and initiate boration before the total shutdown margin is lost. Mode 2 results are summarized in Table 2.

Dilution During Full Power Operation (Mode 1)

Mode 1 is divided into two cases. The first case is with the reactor in the manual T-avg/rod control mode; the second case is with the reactor in automatic rod control. With the reactor in manual rod control, dilution will result in a positive reactivity insertion and the power and temperature rise will cause the reactor to reach the Overtemperature ΔT trip setpoint resulting in a reactor trip. In this case, the boron dilution transient up to the time of trip is essentially equivalent to an uncontrolled RCCA bank withdrawal at power. With the reactor in automatic rod control, the power and temperature increase from boron dilution results in insertion of the control rods and a decrease in the available shutdown margin. As the dilution and rod insertion continue, the rod insertion limit alarms (low and low-low settings) and axial flux difference alarm (delta-I outside the target band) alert the operator that a dilution event is in progress and that the Technical Specification requirement for shutdown margin may be challenged.

The effective reactivity addition rate primarily is a function of the dilution rate, boron concentration, and boron worth. The following conditions are assumed for an uncontrolled boron dilution during full power:

1. Dilution flow for the manual rod control case is the maximum capacity of two charging pumps, 150 gpm (analysis is performed assuming two charging pumps are in operation although only one is normally in operation).

2. A minimum RCS water volume of 9901 [8591] ft^3. This corresponds to a conservative estimate of the active RCS volume excluding the pressurizer and surge line.

3. The initial boron concentration is assumed to be 2450 ppm, which is a conservative maximum value for the critical concentration at the condition of hot full power [75% Rated Thermal Power], rods to insertion limits, and no xenon.

4. The critical boron concentration following reactor trip is assumed to be 1950 ppm, corresponding to the hot zero power, all rods inserted (minus the most reactive RCCA), no xenon condition. The 500 ppm change from the initial condition noted above is a conservative minimum value.

5. A 1.3% minimum shutdown margin is assumed in the analysis.

6. Bounding boron worths of -15 and -5 pcm/ppm are conservatively considered. The larger absolute value maximizes the reactivity insertion rate, while the smaller absolute value minimizes the reactivity insertion rate thereby delaying the time to reach the reactor trip setpoint.

With the reactor in manual control, a boron dilution event will result in an increase in the power and temperature followed by a reactor trip on the overtemperature ΔT trip setpoint if no operator action is taken. Following reactor trip, the operator has 77.6 [68.1] minutes to terminate the transient. In this case, the boron dilution accident up to the time of reactor trip is essentially identical to a RCCA withdrawal at power accident. In addition, prior to the overtemperature ΔT trip, an overtemperature ΔT alarm and turbine runback would be actuated. There is adequate time available after a reactor trip for the operator to determine the cause of dilution, isolate the unborated water source, and initiate reboration before the reactor can return to criticality. Mode 1 results are summarized in Table 2.

With the reactor in automatic control, the power and temperature increase from boron dilution results in insertion of the RCCAs and a decrease in the shutdown margin. The rod insertion limit alarms (low and low-low settings) provide the operator with 98.7 [86.8] minutes, adequate time, to determine the cause of the dilution, isolate the unborated water source, and initiate reboration before the total shutdown margin is lost. The maximum reactivity insertion rate for a boron dilution transient is conservatively estimated to be -1.77 [-2.01] pcm/sec.

Conclusions

For operating Modes 1 through 5, the results presented above show that adequate time is available for the operator to manually terminate the source of dilution flow, assuming the specified shutdown margin requirements are met. Following termination of the dilution flow, the operator can initiate reboration to recover the shutdown margin.

No analysis is presented for Mode 6 operation, since dilution during refueling is precluded by the indicated administrative controls.

TABLE 1

Description	Valve Number	Valve Position
a. Primary Grade Water to CVCS	V304(Z-)	Closed
b. BTRS Inlet	V119(Z-)	Closed
c. BTRS Outlet	V147(Z-)	Closed
d Failed Fuel Monitoring Flushing	V797(Z-)	Closed
e. Resin Sluice, CVCS Cation Bed Demineralizers	V100(Z-)	Closed
	V571(Z-)	Closed
	V111(Z-)	Closed
	V112(Z-)	Closed
f. Resin Sluice, CVCS Mixed Bed Demineralizer	V98(Z-)/V99(Z-)	Closed
	V569(Z-)/V570(Z-)	Closed
	V107(Z-)/V109(Z-)	Closed
	V108(Z-)/V110(Z-)	Closed

TABLE 2

Accident		Event	Time (sec)
1.	Dilution during startup	Reactor trip on power range high neutron flux, low setpoint	0
		Time to criticality for unmitigated event	4974 [4314]
2.	Dilution during full power operation		
	a. Automatic reactor control	Dilution begins	0
		Time to criticality for unmitigated event	5922 [5208]
	b. Manual reactor control	Dilution begins	0
		Reactor trip setpoint reached for OTDT [power range high neutron flux] and operator initiates corrective action	82.12 [83.06]
		Time to criticality for unmitigated event	4740 [4170]