Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

January 12, 2012

10 CFR 50.34(b)
10 CFR 50.4

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Chapter 15.2.4 Inadvertent Boron Dilution

Reference: 1. TVA letter to NRC dated July 29, 2011, "Watts Bar Nuclear Plant (WBN) Unit 2 – Response to Request for Additional Information (RAI) Regarding June 28, 2011 NRC Audit – Steam Line Break (SLB) and other Miscellaneous RAIs"

This letter provides information on Unit 2 to address the inadvertent boron dilution event in the hot standby, hot shutdown and cold shutdown operational modes in accordance with Regulatory Guide 1.70 Revision 2 and the associated Standard Review Plan.

Analyses of the inadvertent boron dilution event in hot standby, hot shutdown, and cold shutdown have been performed for WBN. Enclosure 1 provides changes in assumptions used for these new plant-specific analyses as compared to the assumptions currently in the FSAR for this event. The enclosure also identifies plant modifications and additional operational controls that will be implemented prior to fuel loading on Unit 2. Enclosure 2 provides the proposed FSAR changes to Chapter 15 providing the results of the new analyses. These plant-specific analyses showed that there would be at least 20 minutes available after an alarm before shutdown margin would be lost for the operators to terminate the dilution event. This is longer than the minimum time required for operator action provided in NRC regulatory guidance for these modes of operation.

TVA will provide a submittal documenting that the physical modifications and the additional administrative controls have been completed. The FSAR will be updated in a future amendment. These regulatory commitments are provided in Enclosure 3.

D030
NRR

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 12th day of January, 2012.

Respectfully,

David Stinson
Watts Bar Unit 2 Vice President

Enclosures:

1. Updated Boron Dilution Input Assumptions
2. FSAR Chapter 15.2.4 Mark-ups
3. Regulatory Commitments

cc (Enclosures):

U. S. Nuclear Regulatory Commission
Region II
Marquis One Tower
245 Peachtree Center Ave., NE Suite 1200
Atlanta, Georgia 30303-1257

NRC Resident Inspector Unit 2
Watts Bar Nuclear Plant
1260 Nuclear Plant Road
Spring City, Tennessee 37381

Enclosure 1

Updated Boron Dilution Input Assumptions

Additional analyses have been performed for Unit 2 to explicitly look at boron dilution events in hot standby, hot shutdown, and cold shutdown. Westinghouse performed analyses to determine time margins available to the operators based on conservative assumptions of initial conditions, shutdown margin, dilution flow rates and reactor coolant system (RCS) volume.

The boron dilution analyses currently in the WBN FSAR used a dilution flow rate of 235 gpm. This is a conservative number that has been routinely used by Westinghouse for many years for evaluating dilution events. This value represented the total flow rate from two centrifugal charging pumps and one positive displacement charging pump. The WBN FSAR also discussed a dilution flow rate of 300 gpm that was the rated flow from both primary water makeup pumps assuming that the RCS was depressurized.

The FSAR discussion credited the high flux at shutdown alarm as the alarm that alerts the plant operators that a dilution event has potentially occurred during hot standby, hot shutdown, or cold shutdown. The FSAR states that the alarm setpoint was ½ decade above the background. This alarm was designed to automatically adjust the setpoint down to account for fission product decay.

The following alarms and plant conditions were incorporated in the new analyses.

The maximum dilution flow rate was determined to be 160 gpm. The basis for the flow rate is that there is a main control panel annunciator alarm on high charging flow. The alarm setpoint including uncertainty is 158 gpm. A higher flow rate will result in an immediate alarm on high charging flow and thus will not be the limiting condition. Boron dilution paths are isolated if the reactor coolant pumps (RCPs) are not running. The charging system is required to be in operation when one or more RCP is in service, thus a 160 gpm dilution flow is the limiting condition for hot standby and hot or cold shutdown.

The actual high flux at shutdown alarm setpoint is 1.3 times background, not 5 times background. This will result in an alarm much sooner during a boron dilution event.

The following plant changes will be made to Unit 2 and will be installed prior to initial operation. A Boron Dilution alarm will be added to a main control room annunciator panel. The alarm will be actuated when the volume control tank (VCT) level reaches 63 percent.

The following additional administrative controls will be incorporated into the operating procedures prior to initial startup of the unit. General Operating Instruction GO-6, "Unit Shutdown from Hot Standby to Cold Shutdown," will be revised to add the following actions:

1. At entry into Hot Shutdown, only one primary water pump may remain in service.
2. Potential boron dilution paths shall be isolated in accordance with GO-6, "Unit Shutdown from Hot Standby to Cold Shutdown," and/or SI-62-1, "Uncontrolled Boron Dilution Paths," prior to removing the last RCP from operation in preparation for refueling or maintenance activities.

Enclosure 2

FSAR Chapter 15.2.4 Mark-ups

For RCCA misalignments with one RCCA fully inserted, the DNBR does not fall below the limiting value. This case is analyzed assuming the initial reactor power, pressure, and RCS temperatures are at their nominal values, including uncertainties but with the increased radial peaking factor associated with the misaligned RCCA.

Violation of the DNB design basis does not occur for the RCCA misalignment incident and thus the ability of the primary coolant to remove heat from the fuel rod is not reduced. The peak fuel temperature corresponds to a linear heat generation rate based on the radial peaking factor penalty associated with the misaligned RCCA and the design axial power distribution. The resulting linear heat generation is well below that which would cause fuel melting.

Outside the scope of this Markup

15.2.3.3 Conclusions

For cases of dropped RCCAs or dropped banks, the DNBR remains greater than the limit value; therefore, the DNB design basis is met.

For all cases of any RCCA fully inserted, or bank D inserted to its rod insertion limits with a single RCCA in that bank fully withdrawn (static misalignment), the DNBR remains greater than the limiting value.

15.2.4 UNCONTROLLED BORON DILUTION

15.2.4.1 Identification of Causes and Accident Description

~~Reactivity can be added to the core by feeding primary grade water into the RCS via the reactor makeup portion of the CVCS. Boron dilution is a manual operation under strict administrative controls with procedures calling for a limit on the rate and duration of dilution. A boric acid blend system is provided to permit the operator to match the boron concentration of reactor coolant makeup water during normal charging to that in the RCS. The CVCS is designed to limit, even under various postulated failure modes, the potential rate of dilution to a value which, after indication through alarms and instrumentation, provides the operator sufficient time to correct the situation in a safe and orderly manner.~~

Insert D Here

~~The opening of the primary makeup water control valve provides makeup to the RCS which can dilute the reactor coolant. Inadvertent dilution from this source can be readily terminated by closing the control valve. In order for makeup water to be added to the RCS at pressure, at least one charging pump must be running in addition to a primary makeup water pump.~~

~~The rate of addition of unborated makeup water to the RCS when it is not at pressure is limited by the capacity of the primary water makeup pumps. Normally, only one primary water supply pump is operating while the other is on standby. However, these pumps will be deenergized when the primary water storage tank is being bypassed. The primary makeup water will be supplied from the demineralized water and cask decontamination system. With the RCS at pressure, the maximum delivery rate is limited by the control valve.~~

~~The boric acid from the boric acid tank is blended with primary grade water in the blender and the composition is determined by the preset flow rates of boric acid and primary grade water on the control board. In order to dilute, two separate operations are required:~~

~~(1) The operator must switch from the automatic makeup mode to the dilute or alternate dilute mode.~~

~~(2) The start handswitch must be actuated.~~

~~Omitting either step would prevent dilution.~~

~~Information on the status of the reactor coolant makeup is continuously available to the operator. Lights are provided on the control board to indicate the operating condition of the pumps in the CVCS. Alarms are actuated to warn the operator if boric acid or demineralized water flow rates deviate from preset values as a result of system malfunction. The signals initiating these alarms will also cause the closure of control valves terminating the addition to the RCS.~~

15.2.4.2 Analysis of Effects and Consequences

15.2.4.2.1 Method of Analysis

s

cold shutdown, hot shutdown, hot standby,

Boron dilution during refueling, startup, and power operation ~~is~~ considered in this analysis. Table 15.2-1 contains the time sequence of events for this accident.

are

15.2.4.2.2 Dilution During Refueling

An uncontrolled boron dilution accident cannot occur during refueling. This accident is prevented by administrative controls which isolate the RCS from the potential source of unborated water.

Various combinations of valves will be closed during refueling operations. These valves will block the flow paths which could allow unborated makeup to reach the RCS. Any makeup which is required during refueling will be borated water supplied from the refueling water storage tank (RWST) by the RHR pumps. The operating procedures specify the various valve combinations.

Add Insert A Here

~~15.2.4.2.3~~ 15.2.4.2.6 Dilution During Startup

In this mode, the plant is being taken from one long-term mode of operation (hot standby) to another (power). Typically, the plant is maintained in the startup mode only for the purpose of startup testing at the beginning of each cycle. During this mode of operation, rod control is in manual. All normal actions required to change power level, either up or down, require operator initiation. Conditions ~~assumed~~ used for the analysis are as follows:

INSERT A

15.2.4.2.3 Dilution During Cold Shutdown

In this mode, the plant is being taken from a long-term mode of operation (refueling) to a short term mode of operation (hot shutdown). 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 cold shutdown if reduced temperatures are required in containment or as the result of a Technical Specification action statement. The plant is maintained in cold shutdown at the beginning of the cycle for start-up testing of certain systems. Dilution with reduced inventory cannot occur due to administrative controls which isolate the RCS from the potential source of diluted water prior to terminating flow from the RCPs and initiating flow via the RHR system. Conditions used for the analysis are as follows:

(1) At operating temperature (between 68°F and 200°F) and pressure, dilution flow is limited by the maximum delivery capacity of one primary water pump, 150 gpm.

(2) A minimum RCS water volume of 8,451 ft^3. This corresponds to the active RCS volume excluding the pressurizer and the reactor vessel upper head.

(3) The initial boron concentration is 1,302 ppm, which corresponds to a concentration that maintains the reactor subcritical by the required shutdown margin (1.0 $\%\Delta\rho$), assuming all RCCAs inserted except for the most reactive RCCA.

(4) A conservative, maximum boron concentration at which the reactor will return to critical with all RCCAs inserted except for the most reactive RCCA, at the most reactive cycle burnup time without xenon, is 1,194 ppm. The 108 ppm change from the initial condition noted above is a conservative minimum value.

(5) Operator notification occurs via a high VCT level alarm with a setpoint of 68.1% span (including uncertainties). The alarm time is a function of the minimum letdown flow rate, which is 75 gpm.

15.2.4.2.4 Dilution During Hot Shutdown

In this mode, the plant is being taken from a short-term mode of operation (cold shutdown) to a long term mode of operation (hot standby). Typically, the plant is maintained in the hot shutdown mode to achieve plant heatup before entering hot standby. The plant is maintained in this mode at the beginning of cycle for start-up testing of certain systems. Throughout the cycle, the plant will enter hot

Insert A (Continued)

shutdown if reduced temperatures are required in containment or as a result of a Technical Specification action statement. In hot shutdown, primary coolant forced flow is provided by at least one Reactor Coolant Pump (RCP). Conditions used for the analysis are as follows:

(1) At operating temperature (200°F to 350°F) and pressure, dilution flow is limited by the maximum delivery capacity of one primary water pump, 150 gpm.

(2) A minimum RCS water volume of 8,451 ft^3. This corresponds to the active RCS volume excluding the pressurizer and the reactor vessel upper head.

(3) The initial boron concentration is 1,348 ppm, which corresponds to a concentration that maintains the reactor subcritical by the required shutdown margin (1.6 %$\Delta\rho$), assuming all RCCAs inserted except for the most reactive RCCA.

(4) A conservative, maximum boron concentration at which the reactor will return to critical with all RCCAs inserted except for the most reactive RCCA, at the most reactive cycle burnup time without xenon, is 1,165 ppm. The 183 ppm change from the initial condition noted above is a conservative minimum value.

(5) Operator notification occurs via a high VCT level alarm with a setpoint of 68.1% span (including uncertainties). The alarm time is a function of the minimum letdown flow rate, which is 75 gpm.

15.2.4.2.5 Dilution During Hot Standby

In this mode, the plant is being taken from one short-term mode of operation (hot shutdown) to another (startup). The plant is maintained in hot standby at the beginning of cycle for startup testing of certain systems and to achieve plant heatup before entering the startup mode and going critical. During operation of the cycle, the plant will enter this mode following a reactor trip or as the result of a Technical Specification action statement. During hot standby, all reactor 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 pumps may be shut off to decrease heat input into the system. The more limiting hot standby dilution scenario is with the control rods not withdrawn and the reactor shut down by boron to the Technical Specifications minimum requirement for this mode. Conditions used for the analysis are as follows:

(1) At operating temperature (350°F to 557°F) and pressure, dilution flow is limited to 160 gpm by the high charging flow alarm (including uncertainties). Any flow rate greater than this will result in an immediate alarm and ample operator action time.

Insert A (Continued)

(2) A minimum RCS water volume of 8,451 ft^3. This corresponds to the active RCS volume excluding the pressurizer and the reactor vessel upper head.

(3) The initial boron concentration is 1,300 ppm, which corresponds to a concentration that maintains the reactor subcritical by the required shutdown margin (1.6 $\%\Delta\rho$), assuming all RCCAs inserted except for the most reactive RCCA.

(4) A conservative, maximum boron concentration at which the reactor will return to critical with all RCCAs inserted except for the most reactive RCCA, at the most reactive cycle burnup time without xenon, is 1,100 ppm. The 200 ppm change from the initial condition noted above is a conservative minimum value.

(5) Operator notification occurs via a high VCT level alarm with a setpoint of 68.1% span (including uncertainties). The alarm time is a function of the minimum letdown flow rate, which is 75 gpm.

(1) At operating temperature and pressure, dilution flow is limited ~~by the maximum delivery of three charging pumps~~ to, 235 gpm. ~~However, one of the charging pumps, the positive displacement pump, has been abandoned and no longer contributes to the dilution flow. The assumption of three charging pumps contributing to the flow is conservative.~~

(2) A minimum RCS water volume of 8,451 ft^3. This corresponds to the active RCS volume excluding the pressurizer and the reactor vessel upper head.

(3) The initial boron concentration is ~~assumed to be~~ 1,600 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.~~ corresponds to a critical, hot zero power condition with the control rods at the rod insertion limits providing a shutdown margin of 1.6%.

(4) The critical boron concentration following reactor trip is ~~assumed to be~~ 1,400 ppm, which is a conservative maximum value corresponding to ~~the~~ a hot zero power condition with all ~~rods~~ RCCAs inserted ~~(minus the most reactive RCCA), no xenon condition~~ except for the most reactive RCCA at the most-reactive cycle burnup time without xenon. The 200 ppm change from the initial condition noted above is a conservative minimum value.

~~15.2.4.2.4~~ 15.2.4.2.7 Dilution at Power

In this mode, the plant may be operated in either automatic or manual rod control. Conditions ~~assumed~~ used for the analysis are as follows:

(1) At operating temperature and pressure, dilution flow is limited ~~by the maximum delivery of three charging pumps,~~ to 235 gpm. ~~However, one of the charging pumps, the positive displacement pump, has been abandoned and no longer contributes to the dilution flow. The assumption of three charging pumps contributing to the flow is conservative.~~

(2) A minimum RCS water volume of 8,451 ft^3. This corresponds to the active RCS volume excluding the pressurizer and the reactor vessel upper head.

(3) The initial boron concentration is ~~assumed to be~~ 1,500 ppm, which ~~is a conservative maximum value for the critical concentration at the condition of hot full power, rods to insertion limits, and no xenon.~~ corresponds to a hot full power condition with the control rods at the rod insertion limits providing a shutdown margin of 1.6%.

(4) The critical boron concentration following reactor trip is ~~assumed to be~~ 1,250 ppm~~,~~ which is a conservative maximum value corresponding to ~~the~~ a hot zero power~~, all rods~~ condition with all RCCAs inserted ~~(minus the most reactive RCCA), no xenon condition~~ except for the most reactive RCCA at the most-reactive cycle burnup time without xenon. The 250 ppm change from the initial conditions noted above is a conservative minimum value.

15.2.4.3 Conclusions

15.2.4.3.1 For Dilution During Refueling

Dilution during refueling cannot occur due to administrative controls (see Section 15.2.4.2). The operator has prompt and definite indication of any boron dilution from the audible count rate instrumentation. High count rate is alarmed in the reactor containment and the control room. In addition, a source range high flux level is alarmed in the control room. The count rate increase is proportional to the subcritical multiplication factor.

15.2.4.3.2 For Dilution During Startup

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 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 Technical Specifications require that the operator determine 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 after receiving P-6 from the intermediate range.

The accidental dilution increase causes a more rapid power escalation such that insufficient time would be available following P-6 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. Continued dilution decreases the shutdown margin such that criticality could eventually be regained.

For dilution during startup, there are more than 15 minutes available for operator action from the time of alarm (reactor trip on source range high flux) to loss of shutdown margin.

15.2.4.3.3 For Dilution Following Reactor Shutdown

Replace with Insert B

Following reactor shutdown, when in hot standby, hot shutdown, and subsequent cold shutdown condition, and once below the P-6 interlock setpoint, and 10^4 counts per second, the high flux at shutdown alarm setting will be automatically adjusted downward as the count rate reduces.

Surveillance testing will ensure that the alarm setpoint is operable. The operator does not depend entirely on this alarm setpoint but has audible indication of increasing neutron flux from the audible count rate drawer and visual indication from counts per second meters for each channel on the main control board and source range drawer.

15.2.4.3.4 For Dilution During Full Power Operation

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. The rod insertion limit alarms (LOW and LOW-LOW settings) alert the operator that a dilution event is in progress. There are more than 15 minutes available for operator action from the time of alarm (LOW-LOW rod insertion limit) to loss of shutdown margin.

With the reactor in manual control and no operator action taken to terminate the transient, the power and temperature rise will cause the reactor to reach the

INSERT B

In cold shutdown, hot shutdown and hot standby, the reactor operators are relied upon to detect and recover from an inadvertent boron dilution event. Numerous alarms from the chemical and volume control system, the reactor makeup water system and the nuclear instrumentation system are available to provide assistance to the reactor operator in the detection of an inadvertent boron dilution event. In the analyses of the event initiated from these modes, the high Volume Control Tank (VCT) level alarm with an analysis setpoint of 68.1% span is modeled and provides the operator with timely indication that an event is occurring. The analyses have demonstrated that the reactor operators have at least 15 minutes in which to initiate actions to terminate the dilution and initiate boration of the RCS from the time of the alarm to loss of shutdown margin.

overtemperature ΔT trip setpoint resulting in a reactor trip. The boron dilution transient in this case is essentially the equivalent to an uncontrolled RCCA bank withdrawal at power. The reactivity insertion rate for a boron dilution accident is conservatively estimated to be about 0.6 pcm/sec, which yields the longest time to reach reactor trip. There are more than 15 minutes available for operator action from the time of alarm (overtemperature ΔT) to loss of shutdown margin.

For all cases, the reactor will be in a stable condition following termination of the dilution flow. The operator will then initiate reboration to recover the shutdown margin, using the CVCS. If the reactor has tripped, operating procedures call for operator action to control pressurizer level using the CVCS and to maintain steam generator level through control of the main or auxiliary feedwater system. Any action required of the operator to maintain the plant in a stabilized condition are in a time frame in excess of ten minutes following reactor trip.

15.2.5 PARTIAL LOSS OF FORCED REACTOR COOLANT FLOW

15.2.5.1 Identification of Causes and Accident Description

A partial loss of coolant flow accident can result from a mechanical or electrical failure in a reactor coolant pump, or from a fault in the power supply to the pump or pumps supplied by a reactor coolant pump bus. If the reactor is at power at the time of the accident, the immediate effect of loss of coolant flow is a rapid increase in the coolant temperature. This increase could result in DNB with subsequent fuel damage if the reactor is not tripped promptly.

Outside the Scope of this Markup

Normal power for the reactor coolant pumps is supplied through individual electrical boards from a transformer connected to the generator. When a generator trip occurs, the boards are automatically transferred to a transformer supplied from external power lines, and the pumps will continue to provide forced coolant flow to the core. Following a turbine trip where there are no electrical faults or a thrust bearing failure which requires tripping the generator from the network, the generator remains connected to the network for approximately 30 seconds. The reactor coolant pumps remain connected to the generator thus ensuring full flow for approximately 30 seconds after the reactor trip before any transfer is made. Since each pump is on a separate board, a single board fault would not result in the loss of more than one pump.

The necessary protection against a partial loss of coolant flow accident is provided by the low primary coolant flow reactor trip which is actuated by two out of three low flow signals in any reactor coolant loop.

Above approximately 48% power (Permissive 8), low flow in any loop will actuate a reactor trip. Between approximately 10% power (Permissive 7) and the power level corresponding to Permissive 8, low flow in any two loops will actuate a reactor trip.

Following a RCP trip, if the cause of the shutdown is immediately resolved, a restart of the pump may be attempted if reactor power is reduced to less than 10% and there is ample time to meet the Technical Specifications Limiting Condition for Operation (LCO) action statement.

Table 15.2-1 Time Sequence Of Events For Condition II Events (Page 2 of 5)

Accident	Event	Time (sec.)
Uncontrolled Boron Dilution		
	Add Insert C here	
4. ~~1.~~ Dilution During Startup	Dilution begins	(Unspecified)*
	Reactor trip on source range high flux	0
	Shutdown margin lost	≈1584
5. ~~2.~~ Dilution During Full Power Operation		
a. Automatic Reactor Control	Dilution begins	0
	Shutdown margin lost	≈2057 ~~≈2058~~
b. Manual Reactor Control	Dilution begins	0
	Reactor trip setpoint reached for overtemperature ΔT	77.5 ~~78~~
	Rods begin to fall into core	79
	Shutdown margin lost (if dilution continues after trip)	≈2057 ~~≈1980~~
* The results of the analysis are not impacted by the time of dilution initiation		
Partial Loss of Forced Reactor Coolant Flow (four loops operating, one pump coasting down)	One pump begins coasting down	0
	Low flow trip setpoint reached	1.32
	Rods begin to drop	2.52
	Minimum DNBR occurs	3.7
Loss of External Electrical Load		
1. With pressurizer control (BOL)	Loss of electrical load	0
	High pressurizer pressure reactor trip point reached	9.6
	Rods begin to drop	11.1

INSERT C

1.	Dilution During Cold Shutdown – RCS filled	Dilution Begins	0
		High VCT Level Alarm Sounds	820
		Shutdown Margin is Lost	≈2186
2.	Dilution During Hot Shutdown	Dilution Begins	0
		High VCT Level Alarm Sounds	820
		Shutdown Margin is Lost	≈3552
3.	Dilution During Hot Standby	Dilution Begins	0
		High VCT Level Alarm Sounds	820
		Shutdown Margin is Lost	≈3563

INSERT D

15.2.4.1 Identification of Causes and Accident Description

Reactivity can be added to the core by feeding primary grade water into the RCS via the reactor makeup portion of the CVCS. Boron dilution is a manual operation under strict administrative controls with procedures calling for a limit on the rate and duration of dilution. The primary causes of an inadvertent boron dilution event are the opening of the primary water control valve and failure of the blend system either by controller or mechanical failure. The CVCS, including the blend system is designed to limit, even under various postulated failure modes, the potential rate of dilution to a value which, after indication through alarms and instrumentation, provides the operator sufficient time to correct the situation in a safe and orderly manner.

Inadvertent dilution from reactor water make-up can be readily terminated by closing the control valve. All expected sources of dilution may be terminated by closing isolation valves FCV-62-128 and FCV-62-144. In order for makeup water to be added to the RCS at pressure, at least one charging pump must be running in addition to a primary makeup water pump. The rate of addition of unborated makeup water to the RCS when it is not at pressure is limited by the capacity of the primary water makeup pumps. Normally, only one primary water supply pump is operating while the other is on standby. With the RCS at pressure, the maximum delivery rate is limited by the control valve.

The boric acid from the boric acid tank is blended with primary grade water in the blender and the composition is determined by the preset flow rates of boric acid and primary grade water on the control board. In order to dilute, two separate operations are required:

(1) The operator must switch from the automatic makeup mode to the dilute or alternate dilute mode.

(2) The start handswitch must be actuated.

Failure to carry out either of these actions prevents the initiation of dilution. During normal operation the operator may add borated water to the RCS by blending boric acid from the boric acid storage tanks with primary grade water. This requires the operator to determine the concentration of the addition and setting the blended flow rate and the boric acid flow rate. The makeup controller will then limit the sum of the boric acid flow rate and primary water flow rate to the blended flow rate.

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

a. Indication of the boric acid and blended flow rates,

b. CVCS, boric acid, and primary water pump and valve status lights,

c. Audible clicker on primary water addition

d. Deviation alarms if the boric acid or blended flow rates deviate from the preset values

e. Source range neutron flux – when the reactor is subcritical

  1) High flux at shutdown alarm

  2) Indicated source range neutron flux count rates,

  3) Audible source range neutron flux count rate, and

  4) Source range neutron flux – alarm on increase of 1.3 times base count rate

f. "Boron Dilution" alert alarms

  1) VCT high level

  2) Source range neutron flux increase

Primary water inadvertently added to the RCS via the charging system is a mass addition to the RCS. As primary water is added through the charging system, an equal amount of water is no longer being removed from the VCT. When this occurs, VCT level will increase. The system is designed to automatically divert water to the hold-up tank to prevent overfilling the VCT. A signal from redundant high VCT level switches result in a main control room alarm and lighting of an annunciator window. The alarm setpoint is the same level as when the divert valve starts to open. The divert valve will not fully open until VCT level reaches 93%. Thus letdown flow will not be diverted to the holdup tank prior to the alarm on high VCT level. The FSAR for Unit 1 and U2 have described the high flux at shut down alarm and stated that the alarm set point is maintained within 1/2 decade of the source flux level. Following reactor shutdown, when in the hot standby, hot shutdown, or subsequently the cold shutdown condition, and once below the P-6 interlock setpoint, and 104 counts per second, the high flux at shutdown alarm setting is automatically adjusted downward as the count rate reduces. The actual setpoint is maintained at 1.3 times background rather than at five times background as currently described in the FSAR. In addition to the high VCT level alarm set at 63% level, there is a high-high level alarm if the VCT level exceeds 93%.

Enclosure 3

Regulatory Commitments

1. Incorporate the information provided in Enclosure 2 in a future amendment to the WBN Unit 2 FSAR.
2. Submit a letter to NRC documenting that the plant modifications to add a high VCT level alarm to the main control room annunciator system have been completed.
3. Submit a letter to NRC documenting that procedure changes associated with limiting the number of operating primary water pumps and isolating potential boron dilution paths have been made.