WBN2Public Resource

From: Boyd, Desiree L [dlboyd@tva.gov]
Sent: Wednesday, December 22, 2010 6:15 AM
To: Epperson, Dan; Wiebe, Joel; Poole, Justin; Raghavan, Rags; Milano, Patrick; Campbell, Stephen
Cc: Crouch, William D; Hamill, Carol L; Boyd, Desiree L; Stockton, Rickey A
Subject: TVA letter to NRC_12-21-10_12-21-10_WBN U2 FSAR Section 9.1
Attachments: 12-21-10_WBN U2 FSAR Section 9 1_Final.pdf

Please see attached TVA letter that was sent to the NRC today.

Thank You,

~*~*~*~*~*~*~*~*~*~*~*~*~*~*~

Désireé L. Boyd
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~*~*~*~*~*~*~*~*~*~*~*~*~*~*~

Hearing Identifier: Watts_Bar_2_Operating_LA_Public
Email Number: 235

Mail Envelope Properties (7AB41F650F76BD44B5BCAB7C0CCABFAF1999B60B)

Subject: TVA letter to NRC_12-21-10_12-21-10_WBN U2 FSAR Section 9.1
Sent Date: 12/22/2010 6:15:17 AM
Received Date: 12/22/2010 6:16:08 AM
From: Boyd, Desiree L

Created By: dlboyd@tva.gov

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Post Office: TVANUCXVS2.main.tva.gov

Files	Size	Date & Time
MESSAGE	331	12/22/2010 6:16:08 AM
12-21-10_WBN U2 FSAR Section 9 1_Final.pdf		338380

Options
Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

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

December 21, 2010

10 CFR 50.4

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

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

Subject: WATTS BAR NUCLEAR PLANT (WBN) – UNIT 2 – FINAL SAFETY ANALYSIS REPORT (FSAR), SECTION 9.1, "FUEL STORAGE AND HANDLING"

The purpose of this letter is to provide a copy showing the planned changes to FSAR Section 9.1, ""Fuel Storage and Handling." This information is being submitted in order to facilitate an NRC review request.

The enclosure provides both the proposed mark-ups and the proposed revised cleaned pages (i.e., Pages 9.1-5, 9.1-10, and Table 9.1-1 of Section 9.1). No further changes are anticipated to Section 9.1. There are no new commitments made in this letter.

If you have any questions, please contact Bill Crouch at (423) 365-2004.

I declare under the penalty of perjury that the foregoing is true and correct. Executed on the 21st day of December, 2010.

Sincerely,

M. Bajestani

Masoud Bajestani
Watts Bar Unit 2 Vice President

Enclosure: - Revised pages for WBN Unit 2 FSAR Section 9.1, "Fuel Storage and Handling" cc (Enclosure)

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ENCLOSURE
Mark-up Proposed Pages
WBN Unit 2 FSAR Section 9.1, “Fuel Storage and Handling”

fuel pool water at or below 159.2°F in the worst case design basis single failure scenario.

The SFPCCS incorporates two trains of equipment (plus a spare pump capable of operation in either train). The flow through the pool provides sufficient mixing to ensure uniform water conditions throughout the pool. ~~For normal full core refueling and full core off load following normal refueling outages, the heat load in the spent fuel pool is normally limited to 25.61E+06 Btu/hr. Alternatively, up to 50.21E+06 Btu/hr can be placed in the spent fuel pool within specific limitations on spent fuel pool cooling heat exchanger fouling and component cooling system supply temperatures less than the design temperature of 95 degrees F. Sufficient spent fuel pool cooling equipment is operated and the rate of fuel transfer is controlled to assure that the spent fuel pool temperature does not exceed 150°F during anticipated refueling activities.~~Under design basis Ultimate Heat Sink (UHS) temperatures and heat exchanger fouling conditions, the heat load in the spent fuel pool is limited to 28.1E+06 BTU/hr during refueling outages. Under more favorable conditions, up to 50.2E+06 BTU/hr may be accommodated. Cycle specific calculations may be performed prior to the start of a refueling outage to determine the exact heat removal capability of the SFPCCS using recent heat exchanger performance testing and anticipated UHS temperatures; otherwise, 28.1E+06 BTU/hr may not be exceeded. The rate of fuel transfer from the reactor to the SFP is controlled such that, with one (1) train of SFPCCS in service, the SFP temperature will remain below 151.2 °F. Operating procedures provide the controls to ensure these limitations are met. A decay heat calculation is routinely performed at the end of each operating cycle to produce heat decay vs time curves for the core and spent fuel pool. This calculation can be used to determine the time to begin core offload and the rate at which the core can be off loaded.

9.1.3.1.2 Spent Fuel Pool Dewatering Protection

System piping is arranged so that failure of any pipeline cannot drain the spent fuel pool below the water level required for radiation shielding. A water level of ten feet or more above the top of the stored spent fuel assemblies is maintained to limit direct gamma dose rate.

9.1.3.1.3 Water Purification

The system's demineralizer and filter are designed to provide adequate purification to permit unrestricted access to the spent fuel storage area for plant personnel and maintain optical clarity of the spent fuel pool water surface by use of the system's skimmers, strainer, and skimmer filter.

9.1.3.1.4 Flood Mode Cooling

Section 2.4.14 presents the design basis operation of the SFPCCS when it may be used for reactor core cooling during flooded plant conditions.

9.1.3.2 System Description

The SFPCCS, shown in Figure 9.1-3, consists of two cooling trains (plus a backup pump capable of operation in either train), a purification loop, and a separate skimmer

9.1.3.3.3 Pool and Fuel Temperatures

The cooling of the spent fuel assemblies stored within the storage racks has been analyzed for effective and adequate cooling under all postulated pool storage conditions.

Two discharge scenarios have been evaluated for both single and dual SFP cooling train operation. Case one considers a full core discharge while a second case considers a full core discharge following a normal refueling. Each case considers the accumulated decay heat of all previously discharged spent nuclear fuel assemblies stored in the SFP. Maximum bulk water temperatures for each core off load scenario are given in Table 9.1-1. ~~With a 12 day decay time, the maximum heat load associated with a full core discharge is 39.06E+06 Btu/hr while the maximum heat load for a full core discharge following a normal refueling outage case is 25.61E+06 Btu/hr.~~Following unit shutdown, a decay time of approximately 33 days prior to the completion of core offload is required to maintain the total SFP decay heat below 28.1E+06 BTU/hr design basis limit.

~~For normal full core refueling and full core off load following a normal refueling outage, the heat load in the spent fuel pool is normally limited to 25.61E+06 Btu/hr. Alternatively, up to 50.21E+06 Btu/hr can be placed in the spent fuel pool within specific limitations on spent fuel pool cooling heat exchanger fouling and component cooling system supply temperatures less than the design temperature of 95°F.~~For full core offload following a normal refueling outage (Emergency Offload), it is assumed that a unit is required to shutdown 36 days after a refueling outage on the opposite unit. Following shutdown, it is assumed that core offload will be completed after a 60 day decay time. Under these conditions, the maximum SFP decay heat will be less than 25.61E+06 BTU/hr, which is less than the normal refueling case. Specific guidance in the form of allowable spent fuel pool decay heat curves for ~~less~~better than design conditions of spent fuel pool heat exchanger fouling and shell side cooling temperatures has been developed. Decay heat curves are provided which allow outage specific variation in maximum spent fuel pool decay heat load based on known values of spent fuel pool heat exchanger fouling factors and component cooling system temperatures. Sufficient spent fuel pool cooling equipment is operated and the rate of fuel transfer is controlled to assure that the spent fuel pool temperature does not exceed 150°F during anticipated refueling activities. Operating procedures provide the controls to ensure these limitations are met. A decay heat calculation is routinely performed at the end of each operating cycle to produce heat decay vs time curves for the core and spent fuel pool. This calculation may be used to determine the time to begin core off load and the rate at which the core can be off loaded.

The maximum local water temperature and maximum local fuel temperature have been determined to evaluate the possibility of nucleate boiling on the surface of the fuel assemblies. Analysis has shown that for any scenario with at least one SFPCCS train available, localized boiling does not occur within the fuel racks. The decay heat flux of the rods is greatest at the fuel mid-height. Mid height fuel cladding temperatures of 208.2°F, 217.1°F, and 208.9°F have been calculated based on no blockage, partial blockage, and off-center placement of an assembly in a rack cell respectively. Local

Table 9.1-1 SPENT FUEL POOL COOLING AND CLEANUP SYSTEM DESIGN PARAMETERS

Spent ~~f~~Fuel ~~p~~Pool ~~s~~Storage ~~c~~Capacity	1386 Assemblies
Spent ~~f~~Fuel ~~p~~Pool ~~w~~Water ~~v~~Volume~~, gal~~	372,460[(1)] gallons
Nominal ~~b~~Boron ~~c~~Concentration of the ~~s~~Spent ~~f~~Fuel ~~p~~Pool ~~w~~Water~~, ppm~~	2,000 ppm

	Decay Heat[(2)] (MB~~tu~~TU/hr)	Maximum SFP Temperature (2-Train) (°F)	Maximum SFP Temperature (1-Train) (°F)	SFP Loss of Cooling Heatup Rate (°F/hr)	Boil-Off Time to 10ft~~'~~ Above Rack With ~~N~~no Makeup (hr)~~s~~
Normal Full Core Discharge[(3)] ~~Case 1386 assemblies~~[~~(2)~~]	~~39.06~~28.1	~~124.7~~124.7	~~151.2~~151.2	~~12.80~~9.88	~~36.19~~47.4
Emergency Offload [(4)] ~~Unplanned Discharge Case~~[~~(3)~~]	~~25.61~~25.6	~~129.3~~129.3	~~159.2~~159.2	~~8.40~~8.40	~~55.19~~55.1
Optimum (Better than Design) Conditions [(5)] ~~Maximum Allowed Decay Heat at Sub-Design SFP HX Fouling and CCS temperatures~~	~~50.21~~50.2	~~129.3~~129.3	~~159.2~~159.2	~~16.46~~16.46	~~28.15~~28.1

(1) ~~Including cask pit area volume~~Including Cask Pit Area Volume

(2) ~~Stored plus an additional full core discharge (193 assemblies)~~Decay Heat in accordance with ANS Standard 5.1, "Decay Heat Power in Light Water Reactors," and USNRC Regulatory Guide 3.54, "Spent Fuel Heat Generation in an Independent Spent Fuel Pool Storage Installation."

(3) ~~1097 assemblies stored one additional 96 assembly discharge, following a full Core discharge (193 assemblies)~~Stored legacy fuel assemblies, plus an additional full core (193 assemblies) discharged after 33 days decay time at design basis heat exchanger fouling conditions and Technical Specification Ultimate Heat Sink (UHS) temperatures. The normal refueling interval for WBN is 18 months, with refueling outages typically scheduled in the spring and fall.

(4) Stored legacy fuel assemblies, plus 96 assemblies discharged the previous refueling outage, decayed 96 days, plus an additional full core (193 assemblies) discharged after 60 days decay time. The SFP has been analyzed

for a maximum water temperature of 159.2 °F.

(5) Considers better than design heat exchanger fouling and better than design UHS temperature

Clean Proposed Pages
WBN Unit 2 FSAR Section 9.1, "Fuel Storage and Handling"

fuel pool water at or below 159.2°F in the worst case design basis single failure scenario.

The SFPCCS incorporates two trains of equipment (plus a spare pump capable of operation in either train). The flow through the pool provides sufficient mixing to ensure uniform water conditions throughout the pool. Under design basis Ultimate Heat Sink (UHS) temperatures and heat exchanger fouling conditions, the heat load in the spent fuel pool is limited to 28.1E+06 BTU/hr during refueling outages. Under more favorable conditions, up to 50.2E+06 BTU/hr may be accommodated. Cycle specific calculations may be performed prior to the start of a refueling outage to determine the exact heat removal capability of the SFPCCS using recent heat exchanger performance testing and anticipated UHS temperatures; otherwise, 28.1E+06 BTU/hr may not be exceeded. The rate of fuel transfer from the reactor to the SFP is controlled such that, with one (1) train of SFPCCS in service, the SFP temperature will remain below 151.2 °F. Operating procedures provide the controls to ensure these limitations are met. A decay heat calculation is routinely performed at the end of each operating cycle to produce heat decay vs time curves for the core and spent fuel pool. This calculation can be used to determine the time to begin core offload and the rate at which the core can be off loaded.

9.1.3.1.2 Spent Fuel Pool Dewatering Protection

System piping is arranged so that failure of any pipeline cannot drain the spent fuel pool below the water level required for radiation shielding. A water level of ten feet or more above the top of the stored spent fuel assemblies is maintained to limit direct gamma dose rate.

9.1.3.1.3 Water Purification

The system's demineralizer and filter are designed to provide adequate purification to permit unrestricted access to the spent fuel storage area for plant personnel and maintain optical clarity of the spent fuel pool water surface by use of the system's skimmers, strainer, and skimmer filter.

9.1.3.1.4 Flood Mode Cooling

Section 2.4.14 presents the design basis operation of the SFPCCS when it may be used for reactor core cooling during flooded plant conditions.

9.1.3.2 System Description

The SFPCCS, shown in Figure 9.1-3, consists of two cooling trains (plus a backup pump capable of operation in either train), a purification loop, and a separate skimmer loop. The electrical logic control diagrams for this system are shown in Figures 9.1-4 and 9.1-5.

The SFPCCS removes decay heat from fuel stored in the spent fuel pool. Spent fuel is placed in the pool during the refueling sequence and stored there until it is shipped offsite. The system normally handles the heat load from either a full core or 1/3 of a core freshly discharged from each reactor plus the decreasing heat load from

Two discharge scenarios have been evaluated for both single and dual SFP cooling train operation. Case one considers a full core discharge while a second case considers a full core discharge following a normal refueling. Each case considers the accumulated decay heat of all previously discharged spent nuclear fuel assemblies stored in the SFP. Maximum bulk water temperatures for each core off load scenario are given in Table 9.1-1. Following unit shutdown, a decay time of approximately 33 days prior to the completion of core offload is required to maintain the total SFP decay heat below 28.1E+06 BTU/hr design basis limit.

For full core offload following a normal refueling outage (Emergency Offload), it is assumed that a unit is required to shutdown 36 days after a refueling outage on the opposite unit. Following shutdown, it is assumed that core offload will be completed after a 60 day decay time. Under these conditions, the maximum SFP decay heat will be less than 25.61E+06 BTU/hr, which is less than the normal refueling case. Specific guidance in the form of allowable spent fuel pool decay heat curves for better than design conditions of spent fuel pool heat exchanger fouling and shell side cooling temperatures has been developed. Decay heat curves are provided which allow outage specific variation in maximum spent fuel pool decay heat load based on known values of spent fuel pool heat exchanger fouling factors and component cooling system temperatures. Sufficient spent fuel pool cooling equipment is operated and the rate of fuel transfer is controlled to assure that the spent fuel pool temperature does not exceed 150°F during anticipated refueling activities. Operating procedures provide the controls to ensure these limitations are met. A decay heat calculation is routinely performed at the end of each operating cycle to produce heat decay vs time curves for the core and spent fuel pool. This calculation may be used to determine the time to begin core off load and the rate at which the core can be off loaded.

The maximum local water temperature and maximum local fuel temperature have been determined to evaluate the possibility of nucleate boiling on the surface of the fuel assemblies. Analysis has shown that for any scenario with at least one SFPCCS train available, localized boiling does not occur within the fuel racks. The decay heat flux of the rods is greatest at the fuel mid-height. Mid height fuel cladding temperatures of 208.2°F, 217.1°F, and 208.9°F have been calculated based on no blockage, partial blockage, and off-center placement of an assembly in a rack cell respectively. Local maximum water temperatures of 193.7°F, 204.1°F, and 195.2°F have been calculated for the no blockage, partial blockage, and off-center placement cases respectively. The local saturation temperature at the top of the racks (240.7°F) is greater than any calculated local water temperature, which precludes the possibility of nucleate boiling. Additionally, the local saturation temperature is greater than any calculated fuel cladding temperature, which would preclude the possibility of film boiling at the surface of the fuel rods.

The approach to localized boiling within the racks has been evaluated for highest allowable spent fuel decay heat load (50.21 Mbtu/hr) in Reference [1]. The conclusions of the evaluation indicate that greater than 6°F margin to localized boiling exist between the maximum calculated fuel clad temperature and the local saturation temperature even at the highest allowable heat load.

Table 9.1-1 SPENT FUEL POOL COOLING AND CLEANUP SYSTEM DESIGN PARAMETERS

Spent Fuel Pool Storage Capacity	1386 Assemblies
Spent Fuel Pool Water Volume	372,460[(1)] gallons
Nominal Boron Concentration of the Spent Fuel Pool Water	2,000 ppm

	Decay Heat [(2)] (MBTU/hr)	Maximum SFP Temperature (2-Train) (°F)	Maximum SFP Temperature (1-Train) (°F)	SFP Loss of Cooling Heatup Rate (°F/hr)	Boil-Off Time to 10ft Above Rack With no Makeup (hr)
Normal Full Core Discharge[(3)]	28.1	124.7	151.2	9.88	47.4
Emergency Offload [(4)]	25.6	129.3	159.2	8.40	55.1
Optimum (Better than Design) Conditions [(5)]	50.2	129.3	159.2	16.46	28.1

(1) Including Cask Pit Area Volume

(2) Decay Heat in accordance with ANS Standard 5.1, "Decay Heat Power in Light Water Reactors," and USNRC Regulatory Guide 3.54, "Spent Fuel Heat Generation in an Independent Spent Fuel Pool Storage Installation."

(3) Stored legacy fuel assemblies, plus an additional full core (193 assemblies) discharged after 33 days decay time at design basis heat exchanger fouling conditions and Technical Specification Ultimate Heat Sink (UHS) temperatures. The normal refueling interval for WBN is 18 months, with refueling outages typically scheduled in the spring and fall.

(4) Stored legacy fuel assemblies, plus 96 assemblies discharged the previous refueling outage, decayed 96 days, plus an additional full core (193 assemblies) discharged after 60 days decay time. The SFP has been analyzed for a maximum water temperature of 159.2 °F.

(5) Considers better than design heat exchanger fouling and better than design UHS temperature