Form 01077 (R7-89) | FORM 101.1 | REVISION 13

CERTIFICATION OF ENGINEERING CALCULATION

STATION AND UNIT NUMBER Oconee Nuclear Station Units 1, 2, and 3

TITLE OF CALCULATION USQ Evaluation of CBAST Changes (S/EX, CBAST*)

CALCULATION NUMBER OSC-4851

ORIGINALLY CONSISTING OF:

PAGES 1 THROUGH 7

TOTAL ATTACHMENTS 1 TOTAL MICROFICHE ATTACHMENTS 0

TOTAL VOLUMES 1 TYPE I CALCULATION/ANALYSIS YES ☐ NO ☑

TYPE I REVIEW FREQUENCY ______

THESE ENGINEERING CALCULATIONS COVER QA CONDITION 1 ITEMS. IN ACCORDANCE WITH ESTABLISHED PROCEDURES, THE QUALITY HAS BEEN ASSURED AND I CERTIFY THAT THE ABOVE CALCULATION HAS BEEN ORIGINATED, CHECKED OR APPROVED AS NOTED BELOW:

ORIGINATED BY KW Sandel DATE 7/30/92

CHECKED BY Wm. R. Darling DATE 7/30/92

APPROVED BY T.A. Saville DATE 7/30/92

ISSUED TO TECHNICAL SERVICES DIVISION KW Sandel DATE 8/3/92

RECEIVED BY TECHNICAL SERVICES DIVISION [illegible] DATE 8/3/92

MICROFICHE ATTACHMENT LIST: ☐ Yes ☑ No SEE FORM 101.4

REV. NO.	CALCULATION PAGES (VOL)			ATTACHMENTS (VOL)			VOLUMES		ORIG / DATE	CHKD / DATE	APPR / DATE	ISSUE DATE / REC'D DATE
	REVISED	DELETED	ADDED	REVISED	DELETED	ADDED	DELETED	ADDED				
1	–	1,2,3, 4,5,6, 7	1,2,3, 4,5,6, 7	–	–	2	–	–	KW Sandel 1/14/93	ED Price Jr 1-14-93	TA Saville 1-14-93	

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Form 101.2 Revision 1
26184 (R9-89)

File/Calculation No. OSC-4851

REVISION DOCUMENTATION SHEET

Revision Number	Review Frequency Changed Yes/No	Revision Description
1	No	Addressed changes to previous proposed Technical Specification bases change. Also revised to state RC Bleed # Transfer pump "B" header path was operable.

Purpose

The purpose of this calculation is to determine if the use of a new operating curve showing concentrated boric acid storage tank (CBAST) equivalent solutions and the use of the Boric Acid Transfer pumps and the RC Bleed Transfer pumps to transfer the CBAST water will create any unreviewed safety questions (USQs) using the criteria of 10 CFR 50.59, paragraph (a) (2). This calculation is QA Condition 1 because it determines the presence or absence of a USQ.

Background

Technical Specification 3.2.2 requires that one source of concentrated soluble boric acid, in addition to the borated water storage tank, be available and operable. This source is stated to be the CBAST and it is to contain the volume and boron concentration within the limits of the Core Operating Limits Report with a temperature at least 10 F above the crystallization temperature. System piping and valves necessary to establish a flowpath from the tank to the High Pressure Injection (HPI) System are also to be operable and are to have the same temperature requirement as the CBAST. At least one channel of heat tracing capable of meeting the above temperature requirement is to be in operation. One associated boric acid pump is to be operable. The bases to this Technical Specification state that the quantity of boric acid in storage in the CBAST is sufficient to borate the Reactor Coolant System (RCS) to a 1% delta k per k subcritical margin at cold conditions (References 2 and 15).

In previous revisions of Technical Specification 3.2.2 and associated bases, the CBAST was specified to contain the equivalent of 1100 ft^3 of 11,000 ppm boron as boric acid solution. The NRC inspectors reviewed Oconee's compliance with Technical Specification 3.2.2 when these parameters were in the Technical Specifications. The inspectors had questions concerning the justification for the equivalence of 1100 ft^3 of 11,000 ppm boron and also the justification of the operating curve Oconee uses to determine this equivalence. The inspectors considered that the word equivalent only applied to the effective volume of the CBAST (i.e., the CBAST must contain an effective volume of 1100 ft^3) and not to the boron concentration required to be maintained. Oconee's position is that if the CBAST level (relating to the tank's volume) and boron concentration are within the limits of an operating curve showing allowable level versus boron concentration, the CBAST contained the equivalent of 1100 ft^3 of 11,000 ppm boron (Reference 3). This evaluation addresses the new operating curve for CBAST solutions that consist of at least the equivalent of 1100 ft^3 of 11,000 ppm boron as boric acid solution. The NRC has now approved a Duke Technical Specification change submittal (including bases change) which removed the specific information on these parameters and replaced them with references to the Core Operating Limits Report (References 14 and 15).

The use of the Concentrated Boric Acid Transfer pumps and the RC Bleed Transfer pumps for meeting the Technical Specification requirements of providing adequate boration is also addressed (Reference 4).

The bases to Technical Specification 3.2 are to be changed to address the use of the Boric Acid Transfer pumps and the RC Bleed Transfer pumps and the time required to add the boron solution from the CBAST. The references in the bases to Technical Specification 3.2 are also being revised to refer to the general Technical Specification 3.0, instead of the more specific Technical Specification 3.3. A draft of the proposed bases is included as Attachment 2 (Reference 16). The bases are not part of the Technical Specifications and thus do not require prior NRC approval before the change is made (Reference 8).

Safety Review

The CBAST contains a concentrated boric acid solution available to the HPI System for injection into the RCS (References 1 and 5).

The pipe from the CBAST is QA Condition 1 (safety related) only to the first normally closed valves. Other pipe and valves in the associated flowpaths are non-QA Condition (non-safety related). The CBAST is not required for any accident mitigation or prevention (References 1, 4, and 5).

Reference 4 documents the basis for a new CBAST concentration versus level curve for the volume and boron concentration concentrations listed above. The upper limit on concentration is based on the requirement that the temperature be maintained at least 10 F above the crystallization temperature. The lower

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limit is based on the time allowed for reaching cold shutdown and the length of time required for getting the volume of a lower concentration of borated water into the RCS. The volume required for making up the RCS shrinkage was also considered in the CBAST boron concentration lower limit (Reference 4). The new curve is provided as part of Engineering Instructions (Reference 9). The addition of concentrations of borated water to the RCS higher than 11,000 ppm does not cause a concern (Reference 12). The function of the CBAST has not changed.

The Technical Specification requires one associated boric acid pump to be operable. The Technical Specification does not specify which pump is required to provide the adequate boration so any pump capable of pumping the contents of the CBAST in an adequate time frame and within the temperature limits is considered to meet the Technical Specification. Previous Technical Specification bases revisions gave some general information on approximately how long a 10 gpm boric acid pump would take to inject the required boron (approximately 12.7 hours). This flowrate and time was removed in Amendments 197/197/194. The time was previously changed in Amendments 105/105/102 from 12.25 hours to 12.7 hours when the CBAST volume was changed from 995 ft^3 to 1020 ft^3. In the NRC's Safety Evaluation Reports (SER) for these Amendments, the NRC did not address the time changes. The review of the licensing documentation indicates the time previously given in the Technical Specification bases is not part of the design bases. The time was provided for information only. Reference 4 determines what the minimum Technical Specification time is for reaching cold shutdown conditions. This time is 36 hours. The use of a Boric Acid Transfer pump (most restrictive flow of 7 gpm) provides adequate boration for bringing the reactor to a cold shutdown condition within the Technical Specification limits for time required to reach cold shutdown using the required maximum volume in the operating curve. The RCS volume shrinkage is made up by using the higher capacity RC Bleed Transfer pumps. The use of RC Bleed Transfer Pumps (nominal flow of 100 gpm) for providing adequate boration is also within the Technical Specification time limits (References 2, 4, 6, 7, 14, and 15).

The CBAST and the pipe associated with the flowpath from the CBAST to the HPI System are required to be wrapped with heat tracing to keep the fluid at least 10 F above the crystallization temperature (Reference 2 and 15). Flowpaths from the CBAST through the Concentrated Boric Acid Transfer pumps and the RC Bleed Transfer pumps are wrapped with heat tracing. The flowpath through the RC Bleed Transfer pump "B" was previously thought to use piping that was not heat traced. A Problem Investigation Report (PIR) was written and the associated operability evaluation recommended that the "B" header be declared inoperable. Further review determined that procedures allowed only a flowpath through the "B" pump that is already heat traced (References 10, 11, and 13).

USQ Evaluation

As a result of these changes:

1) May the probability of an accident previously evaluated in the SAR be increased?

   No. These changes do not create any conditions or events which lead to accidents previously evaluated in the SAR. Adequate boron is available in the CBAST to reach cold shutdown conditions within Technical Specification time requirements so too low a boron concentration in the RCS should not occur.

2) May the consequences of an accident previously evaluated in the SAR be increased?

   No. The CBAST is not required for mitigation of any accident previously evaluated in the SAR.

3) May the possibility of an accident which is different than any already evaluated in the SAR be created?

   No. No accidents different than already evaluated in the SAR are postulated. The additions of concentrations of borated water to the RCS higher than 11,000 ppm does not cause a concern. The function of the CBAST has not changed.

4) May the probability of a malfunction of equipment important to safety previously evaluated in the SAR be increased?

   No. Flowpaths from the CBAST through the Concentrated Boric Acid Transfer pumps and the RC Bleed Transfer pumps are wrapped with heat tracing to keep the fluid at least 10 F above the crystallization temperature.

The use of a Boric Acid Transfer pump or a RC Bleed Transfer pump provides adequate boration for bringing the reactor to a cold shutdown condition within the Technical Specification limits for time required to reach cold shutdown using the required maximum volume in the operating curve.

5) May the consequences of a malfunction of equipment important to safety previously evaluated in the SAR be increased?

No. Failure of valves to be positioned properly or the failure of pumps to start may prevent the contents of the CBAST from reaching the RCS via the HPI System. This failure mode is the same failure mode as currently exist.

6) May the possibility of malfunctions of equipment important to safety different than any already evaluated in the SAR be created?

No. No new failure modes are created.

7) Will the margin of safety as defined in the bases to any Technical Specification be reduced?

No. These changes do not adversely affect any plant safety limits, set points, or design parameters.

Conclusions

The new operating curve showing CBAST equivalent solutions (consisting of at least the equivalent of 1100 ft^3 of 11,000 ppm boron as boric acid solution) and the use of the Boric Acid Transfer pumps and the RC Bleed Transfer pumps to transfer the CBAST water involve no USQs or safety concerns. No FSAR or technical specification changes are required.

The bases to Technical Specification 3.2 are to be changed to address the use of these different pumps. The bases are not part of the Technical Specifications and thus do not require prior NRC approval before the change is made.

References

1) Oconee Nuclear Station Final Safety Analysis Report (FSAR), 1991 Update, Sections 5.1.1.4.7, 9.3.1.2.2, 9.3.4, 9.3.5,

15.0, and Table 9-10.

2) Oconee Nuclear Station Technical Specifications, as amended to 10/13/92, Sections 3.2, 3.3, 4.5, and also including approved Amendments 197/197/194 listed below as Reference 15.

3) Letter dated 4/24/92 from A. R. Herdt (NRC) to J. W. Hampton (Duke Power Company), addressing Oconee's compliance with bases of Technical Specification 3.2.

4) Calculation OSC-4708, "CBAST Concentration vs. Level Curve", Revision 1.

5) Flow diagrams OFD-101A-1.2 (Revision 7), OFD-101A-2.2 (Revision 10), OFD-101A-3.2 (Revision 10), OFD-106A-1.1 (Revision 4), OFD-106A-1.2 (Revision 4), OFD-106A-2.1 (Revision 3), OFD-106A-2.2 (Revision 2), OFD-106A-3.1 (Revision 6), OFD-106A-3.2 (Revision 4).

6) Letter dated 5/29/81 from A. C. Thies (Duke Power Company) to J. F. Stolz (NRC), sending proposed Technical Specification changes, which include CBAST volume and pumping time changes.

7) Letter dated 11/30/81 from P. C. Wagner (NRC) to W. O Parker (Duke Power Company), sending approved Technical Specification changes.

8) Code of Federal Regulations, Title 10, Part 50, Section 36, revised as of January 1, 1992.

9) Engineering Instructions ONEI-5-106A-0001-001 through -007, Revision 1, approved 9/28/92, CBAST level versus boron concentration curve (transmitted by Exempt Change OE-4652, resolved 10/9/92).

10) PROFS note dated 7/29/92 from Steve Nader, MOSA, to K. W. Sandel, MONE, stating all paths have heat tracing except RC Bleed Flush Header "B" (Attachment 1).

11) PIR 0-092-0224, originated 6/30/92, proposed resolution to PIR approved 7/23/92 (with correction from "A" train to "B" train dated 7/24/92), and operability evaluation for PIR, approved 7/29/92 (operability evaluation references

calculation OSC-4783, revision 1).

12) Conversation on 7/30/92 between Steve Nader, MOSA, and Ken Sandel, MONE, stating that the addition of concentrations of borated water to the RCS higher than 11,000 ppm is not a concern.

13) Letter dated 10/15/92 from J. W. Hampton (Duke Power Company) to the NRC, stating the LER informing the NRC about inoperable "B" Bleed Transfer Pump flowpath was in error. Procedure lineup using "B" pump did use heat traced piping.

14) Letters dated 7/13/92 and 12/1/92 from J. W. Hampton (Duke Power Company) to the NRC, sending proposed Technical Specification changes with removal of CBAST specific volume and boron concentration requirements and reference to Core Operating Limits Report.

15) Letter dated 1/5/93 from L. A. Wiens (NRC) to J. W. Hampton (Duke Power Company), sending approved Technical Specification change for Amendments 197/197/194.

16) Proposed bases for Technical Specification 3.2 provided by Phil North, Oconee Compliance, including copy marked with changes and unmarked copy (Attachment 2).

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Attachment 1
Sheet 1 of 1

From: SLN8374 --PRDC   Date and time   07/29/92 14:21:44
To: KWS1379 --PRDC   Kenneth W. Sandel

STEVE NADER
OCONEE MECHANICAL SYSTEMS
Oconee Complex #2176 Phone: 885-4376
Subject: Heat Tracing
All paths for which credit is taken in satisfying TS 3.2.2 have been verified as being heat traced. The RC Bleed Flush Header 'B' (which was discovered to NOT be heat traced) will be heat traced by exempt change. PIR 0-092-0224 will state the heat tracing requirement as a corrective action, and Lee Underwood in the Electrical group will be the main contact for resolution.

If you need any more info, please contact me.

STEVE

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Attachment 2
Sheet 1 of 4
Added in Rev. 1

Proposed New Bases Draft - Marked Copy

Bases

The high pressure injection system and chemical addition system provide control of the reactor coolant system boron concentration.(1) This is normally accomplished by using any of the three high pressure injection pumps in series with a boric acid pump associated with either the boric acid mix tank or the concentrated boric acid storage tank (CBAST) or a bleed transfer pump aligned to take suction from the CBAST. The boric acid pump associated with the CBAST is normally used for small additions during operation and the bleed transfer pumps are utilized when larger volumes are to be added. An alternate method of boration will be the use of the high pressure injection pumps taking suction directly from the borated water storage tank (BWST).(2)

The quantity of boric acid in storage in the ~~concentrated boric acid storage tank~~CBAST or the ~~borated water storage tank~~BWST is sufficient to borate the reactor coolant system to a 1% Δk/k subcritical margin at cold conditions (70°F) with the maximum worth stuck rod and no credit for xenon at the worst time in core life. The current cycles for each unit are analyzed with the limits presented in the Core Operating Limits Report. The cycle specific analyses determine the volume and boron concentration requirements for the BWST and CBAST necessary to borate to cold shutdown. The volume requirements include a 10% margin and, in addition, allow for a deviation of 10 EFPD in the cycle length. The specification assures that two supplies are available whenever the reactor is critical so that a single failure will not prevent boration to a cold condition.

One of the supplies requires the operability of the CBAST with an associated pump and flow path to ensure the capability to borate the RCS to a cold condition. This requirement is not one which must be immediately available since the shortest required timeframe to reach cold conditions is 36 hours.(3) Thus the required boric acid from the CBAST can be added by either of the bleed transfer pumps manually aligned to take suction from the CBAST and discharging to the inlet of the makeup filters at nominal flow rates of 100 gpm. Since there is sufficient time to make the alignment, manual alignment of the bleed transfer pumps is acceptable. This flow path and the associated pumps are equivalent from safety-related and seismic criteria to that of the CBAST pump and are capable of adding the required volume from the CBAST well within the minimum 36 hours. Equivalent volumes with lower concentrations will take longer than those volumes with higher concentrations, however, both can be added within the required timeframe.

During operation, the CBAST pump is normally aligned to the CBAST and discharges to the inlet of the makeup filters. Each CBAST pump is capable of delivering the required boric acid to the RCS within the required timeframe at a minimum flow of 7 gpm. Small volume additions from the CBAST will normally be added with the CBAST pump with the bleed transfer pumps being utilized for larger volume additions. An alternate method of addition is to inject boric acid from the BWST using the high pressure injection pumps.

The concentration of boron in the ~~concentrated boric acid storage tank~~CBAST may be higher than the concentration which would crystallize at ambient conditions. For this reason, and to assure a flow of boric acid is available when needed, these tanks and ~~their~~the associated piping for the flowpaths will be kept at least 10°F above the crystallization temperature for the concentration present. Once in the high pressure injection system, the concentrate is sufficiently well mixed and diluted so that normal system temperatures assure boric acid solubility.

REFERENCES

(1) FSAR, Sections 9.3.1, and 9.3.2
(2) FSAR, Figure 6.0.2
(3) Technical Specification ~~3.33.0~~

Proposed New Bases Draft - Unmarked Copy

Bases

The high pressure injection system and chemical addition system provide control of the reactor coolant system boron concentration.(1) This is normally accomplished by using any of the three high pressure injection pumps in series with a boric acid pump associated with either the boric acid mix tank or the concentrated boric acid storage tank (CBAST) or a bleed transfer pump aligned to take suction from the CBAST. The boric acid pump associated with the CBAST is normally used for small additions during operation and the bleed transfer pumps are utilized when larger volumes are to be added. An alternate method of boration will be the use of the high pressure injection pumps taking suction directly from the borated water storage tank (BWST).(2)

The quantity of boric acid in storage in the CBAST or the BWST is sufficient to borate the reactor coolant system to a 1% $\Delta k/k$ subcritical margin at cold conditions (70°F) with the maximum worth stuck rod and no credit for xenon at the worst time in core life. The current cycles for each unit are analyzed with the limits presented in the Core Operating Limits Report. The cycle specific analyses determine the volume and boron concentration requirements for the BWST and CBAST necessary to borate to cold shutdown. The volume requirements include a 10% margin and, in addition, allow for a deviation of 10 EFPD in the cycle length. The specification assures that two supplies are available whenever the reactor is critical so that a single failure will not prevent boration to a cold condition.

One of the supplies requires the operability of the CBAST with an associated pump and flow path to ensure the capability to borate the RCS to a cold condition. This requirement is not one which must be immediately available since the shortest required timeframe to reach cold conditions is 36 hours.(3) Thus the required boric acid from the CBAST can be added by either of the bleed transfer pumps manually aligned to take suction from the CBAST and discharging to the inlet of the makeup filters at nominal flow rates of 100 gpm. Since there is sufficient time to make the alignment, manual alignment of the bleed transfer pumps is acceptable. This flow path and the associated pumps are equivalent from safety-related and seismic criteria to that of the CBAST pump and are capable of adding the required volume from the CBAST well within the minimum 36 hours. Equivalent volumes with lower concentrations will take longer than those volumes with higher concentrations, however, both can be added within the required timeframe.

During operation, the CBAST pump is normally aligned to the CBAST and discharges to the inlet of the makeup filters. Each CBAST pump is capable of delivering the required boric acid to the RCS within the required timeframe at a minimum flow of 7 gpm. Small volume additions from the CBAST will normally be added with the CBAST pump with the bleed transfer pumps being utilized for larger volume additions. An alternate method of addition is to inject boric acid from the BWST using the high pressure injection pumps.

The concentration of boron in the CBAST may be higher than the concentration which would crystallize at ambient conditions. For this reason, and to assure a flow of boric acid is available when needed, these tanks and the associated piping for the flowpaths will be kept at least 10°F above the crystallization temperature for the concentration present. Once in the high pressure injection system, the concentrate is sufficiently well mixed and diluted so that normal system temperatures assure boric acid solubility.

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Attachment 2
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Added in Rev. 1

REFERENCES

(1) FSAR, Sections 9.3.1, and 9.3.2
(2) FSAR, Figure 6.0.2
(3) Technical Specification 3.0