TVA

Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

August 14, 2007

TVA-SQN-TS-06-03 | 10 CFR 50.90

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

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) - UNITS 1 AND 2 - TECHNICAL SPECIFICATIONS (TS) CHANGE 06-03 "ULTIMATE HEAT SINK (UHS) TEMPERATURE INCREASE AND ELEVATION CHANGES - REQUEST FOR INFORMATION (RAI) NO. 2" (TAC NOS. MD2621 & MD2622)

References:

1. TVA Letter to NRC dated, July, 12, 2006, "Sequoyah Nuclear Plant (SQN) - Units 1 and 2 - Technical Specifications (TS) Change 06-03 'Ultimate Heat Sink (UHS) Temperature Increase and Elevation Changes'"

2. TVA Letter to NRC dated, December 7, 2006, "Sequoyah Nuclear Plant (SQN) - Units 1 and 2 - Technical Specifications (TS) Change 06-03 'Ultimate Heat Sink (UHS) Temperature Increase and Elevation Changes Supplemental Information' (TAC Nos. MD2621 and MD2622)"

3. NRC letter to TVA dated November 22, 2006, "Sequoyah Nuclear Plant, Units 1 and 2 - Request for Additional Information Regarding Technical Specification Change Request for Ultimate Heat Sink Temperature (TAC Nos. MD2621 and MD2622)"

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4. TVA letter to NRC dated January 26, 2007, "Sequoyah Nuclear Plant, Units 1 and 2 - Response to Request for Additional Information (RAI) for Technical Specifications (TS) Change 06-03 (TAC Nos. MD2621 and MD2622)"

5. TVA letter to NRC dated May 8, 2007, "Sequoyah Nuclear Plant, Units 1 and 2 - Technical Specifications (TS) Change 06-03 'Ultimate Heat Sink (UHS) Temperature Increase and Elevation Changes - Supplemental Information No. 2' (TAC Nos. MD2621 and MD2622)"

6. NRC letter to TVA dated July 5, 2007, "Sequoyah Nuclear Plant, Units 1 and 2 - Request Regarding Ultimate Heat Sink (TAC Nos. MD2621 and MD2622)"

7. TVA letter to NRC dated July 20, 2007, "Sequoyah Nuclear Plant, Units 1 and 2 - Technical Specifications (TS) Change 06-03 'Ultimate Heat Sink (UHS) Temperature Increase and Elevation Changes - Request for Information (RAI) No. 2 Extension (TAC Nos. MD2621 and MD2622)"

Pursuant to 10 CFR 50.90, Tennessee Valley Authority (TVA) submitted a request for a TS change to Licenses DPR-77 and DPR-79 for SQN Units 1 and 2 by Reference 1. Additional information was requested and/or provided by References 2, 3, 4, 5, and 6. By Reference 7, TVA informed NRC of the addition time needed for response to Reference 6 in light of clarifications provided by NRC. This letter provides the additional information requested by NRC in Reference 6 and as discussed in various teleconferences.

The addition information does not change the "No Significant Hazards Considerations" associated with the proposed change in Reference 1.

Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and enclosures to the Tennessee State Department of Public Health.

If you have any questions about this change, please contact me at 843-7170.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 14th day of August, 2007.

Sincerely,

Glenn W. Morris

Glenn W. Morris
Manager, Site Licensing and
Industry Affairs

Enclosures:
1) TVA's Response to NRC Questions
2) Vendor Data
3) Commitments

Enclosures
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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

TVA's Response to NRC Questions

NRC Questions regarding SQN License Amendment Request (LAR) dated July 12, 2006.

NRC QUESTION 1

Page E1-6: Only addresses design-basis accidents. Please identify and discuss any impacts the proposed increase in ultimate heat sink (UHS) temperature will have on licensing-basis criteria that specify time related criteria associated with plant shutdown, cooldown, or accident mitigation, such as the time after shut down to be on residual heat removal (RHR) cooling, or time to reduce containment pressure by half.

TVA RESPONSE 1

With respect to time related criteria, plant shutdowns and cooldowns are controlled by the existing technical specifications (TS). No changes have been identified to any required TS action as a result of the 2-1/2 degree Fahrenheit (°F) increase in the UHS temperature. The Appendix R safe shutdown requirement, that the plant be able to be cooled to 140°F in less than 72 hours, is maintained by the proposed change.

NRC QUESTION 2

Page E1-10: The table referred to in Item 7 provides information for the shell and tube sides of the component cooling system (CCS) heat exchangers. This information is suspect because the CCS HX is a plate (not a tube) HX. Please explain this apparent inconsistency. Also, the values listed in the table are said to be "assumed," and justification as to why these values are appropriate and conservative is required.

TVA RESPONSE 2

The CCS heat exchangers (HXs) are modeled by Westinghouse Electric Company in their standard design as shell and tube heat exchangers (STEs) in the containment analysis. The table provided in Item 7 is a summary of the required flow rates and heat transfer coefficient (UA) values from the containment analysis model, WCAP-12455, "TVA SQN Units 1 and 2 Containment Integrity Re-analyses Engineering Report," Revision 1 Supplement 1R, dated September 2001. TVA originally utilized STEs for the

CCS; however, these were replaced in the late 80's with the current plate HXs (PHEs). The replacement PHEs provide capacity equal to or greater than the original STEs.

TVA has verified by analyses that the CCS HX is capable of meeting or exceeding the assumed minimum UA value in the containment analysis. The supporting CCS HX calculations develop a U-ratio, which is defined as the actual overall heat transfer rate divided by the required heat transfer rate. This value must be equal to or greater than 1.0 to satisfy the containment heat removal assumptions. A U-ratio greater than 1.0 demonstrates essential raw cooling water (ERCW) flow margin (i.e., additional heat removal capability) to the CCS HX. There are no design basis cases where the U-ratio is less than 1.0.

The UA value utilized in the containment analysis is provided in the SQN Updated Final Safety Analysis Report (UFSAR). UFSAR Table 6.2.1-1, Sheet 8, compares the non-accident rated full capacity of the CCS HXs and the assumed accident values used for the containment analysis. Furthermore, UFSAR Table 6.2.1-1, Sheets 6 & 7, provide a table comparison of the non-accident rated full capacity of the other applicable HXs and the value used for the containment analysis. The assumed values provide the input requirements for the HXs and the model.

NRC QUESTION 3

Page E1-11: The last paragraph indicates that TVA continues to perform flow balance testing of the essential raw cooling water (ERCW) safety-related equipment and components served by ERCW. Explain how often ERCW flow balance testing is performed; when the most recent flow balance test was completed; how the specific flow rates were determined and corrected to account for the most limiting conditions and uncertainties (analytical and measurement), including how they were determined, validated and are assured to be correct over time; and what changes have been made to the system design or alignment during the period following completion of the most recent flow balancing determination and explain how the resultant ERCW flow rates were confirmed to be correct following implementation of these changes.

TVA RESPONSE 3

TVA performs flow balance testing of the lower containment vent coolers inside containment each unit refueling outage, in compliance with SQN TS surveillance requirement (SR) 4.6.2.2(b)(2). For components served by ERCW outside of containment, the most recent physical flow balance was performed in May 1997. Since that time, a system computer hydraulic model has been developed. This model was developed to closely match, as best possible, the system physical conditions by performance of an extensive data gathering test in 2002. Test data was

obtained for all available components (i.e., both large and small bore), including alignment with the small-bore throttle valves in fully opened position, as well as in a throttled position. The test data was used to modify the model's individual piping roughness factors, particular component pressure drops (i.e., valves and coolers, etc.), and pump performance for a realistic match with respect to actual plant components. Subsequent to model development, physical changes to system components have been incorporated into the model. The model is then re-validated using additional system data. A recent system change placed the small bore throttle valves in a full open position. This system change is acceptable because the original 2002 data used to baseline the model included the condition of the small bore throttle valves in the fully opened position.

The ERCW system hydraulic model is used analytically to determine the flow rates that the ERCW system will deliver to plant components. Analysis is performed for a number of plant design basis conditions. The analytical model is used as a more accurate, representative predictor of system performance over the physical flow balance test. The analytical model is an improvement because it can perform various alignments and design basis conditions that can not be performed or accurately simulated in the field during power operation of shutdowns. Examples include the ERCW system function of providing the safety-related source of water to all of the auxiliary feedwater pumps, traveling screen clogging, and ruptured or crimped off non-safety-related piping.

TVA has been validating flow rates to ensure that flow rates to individual components are in the expected range for both large and small bore components. This validation typically occurs multiple times per year during the performance of mollusk control activities. The validation is performed by measuring the flow values to the individual components and ensuring that the values are in the expected range for the conditions present at the time of the data taking. A discussion of uncertainty considered in the model is provided in response to Question Nos. 8 and 16.

NRC QUESTION 4

Page E1-12, top: The information provided indicates that the ERCW flow test method compensates for minimum pump performance. Explain how allowable pump degradation that is permitted by the in-service testing (IST) program is accounted for in this regard.

TVA RESPONSE 4

The ERCW system hydraulic model, described above, uses pump curves that allow for pump degradation in excess of the actual pump's performance. These curves are identical for each pump. The hydraulic model pump curves are the design minimum pump performance values, which are the limiting values provided in the

IST program. SQN has recently performed maintenance that has improved ERCW pump performance. Four of the pumps have been rebuilt since 2004 and SQN intends to rebuild the balance of pumps in the future.

NRC QUESTION 5

Page E1-17: The first paragraph indicates that ERCW will provide the auxiliary feedwater pumps with water at 87 degree Fahrenheit (°F) if the condensate storage tank (CST) is not available. This is not consistent with the information that was subsequently provided in the RAI response (Pages E1-23 and 24, Question 8). Also, part (b) of the response indicates that the proposed ERCW temperature increase is within the existing design limits of the auxiliary feedwater system (AFW) system, whereas part (c) indicates that the ERCW supply to the motor-driven AFW pumps may be as high as 126 °F (which exceeds the AFW design temperature limit of 120 °F). Explain these apparent inconsistencies. Also, if not addressed below in Question 16, describe the specific scenario that results in the highest temperature ERCW being supplied to the AFW pumps and, for this most limiting case, identify what the maximum ERCW supply temperature is and how the uncertainties were accounted for to assure conservative results, and compare the results to the AFW system design limits that apply.

TVA RESPONSE 5

a) The July 2006 LAR and the December 2006 LAR Supplement were not clear in the description of operating temperatures of the AFW pumps supply when served by the ERCW. The turbine-driven auxiliary feedwater pump (TDAFWP) is the largest capacity pump at 880 gallon per minute (gpm) total flow and serves all four steam generators. When supplied by the ERCW, the TDAFWP takes suction from either ERCW supply header with worst-case supply temperature of 87°F. The two motor-driven auxiliary feedwater pumps (MDAFWPs) each provide 440 gpm total flow. Each MDAFWP delivers flow to two steam generators. The ERCW water temperature to the MDAFWPs is a function of ERCW discharge header A and B and may be greater than 87°F under some scenarios. The ERCW temperature of 128°F is determined to be the most limiting case and only applies to the 1B-B and 2A-A MDAFWPs as a result of the suction piping configuration. The ERCW discharge water temperature to these two pumps is dominated by the 1B and 2A containment spray (CS) HXs' discharge, respectively, and only during a large break loss-of-coolant accident (LBLOCA) when on containment sump recirculation with minimum ERCW design flow of 3400 gpm and no CST availability. In contrast, the other two MDAFWPs, 1A-A and 2B-B, have ERCW suction pipe configurations that are further downstream and receive flow mixing from the CCS HX

discharges and remain at the 120°F AFW design temperature or less, see UFSAR Figure 9.2.2-2.

No changes are made to the AFW operating temperatures or limits as a result of the UHS change to 87°F. The modeled flows with 5 percent uncertainty to the CSS HXs under various LOCA conditions is shown to be greater than the 3400 gpm minimum design and is 3600 gpm or greater (December 2006 Supplement Table 9 Series Extract). Larger than design flows will suppress the AFW temperature to less than 128°F value.

SQN has historically justified the 1B-B and 2A-A MDAFWP design temperature excess (greater than 120°F) based on American Society of Mechanical Engineers (ASME) B31.1, "Power Piping," variations from normal operation. The associated piping stress limits have not been challenged because the ERCW and associated AFW suction piping and supports have been analyzed to 128°F.

Additionally, the 1A-A MDAFWP, which has the largest length of CST suction piping (i.e., furthest distance from the CST), was acceptably evaluated for net positive suction head up to 130°F for tritium production. TVA has entered the MDAFWP design temperature issue into its Corrective Action Program with an action to revise the suction piping design temperature to at least 128°F.

b) The maximum ERCW supply temperature is the proposed 87°F. The TS SR for temperature monitoring includes instrument loop measurement uncertainties. Current plant instrumentation loop error is approximately plus or minus 1.16°F. The main control room (MCR) indication is offset by a total of 1.5°F (i.e., plus 1.5°F), to ensure that the actual limiting condition of operation (LCO) temperature is never exceeded without taking appropriate actions.

NRC QUESTION 6

Page E1-17, Emergency Diesel Generator (EDG) Cooling: With respect to calculation MDQ 000 067 2003 0142, describe the most limiting scenario for the EDGs relative to temperature considerations and, for this most limiting case, explain what the most controlling temperatures are, including a discussion of how the uncertainties were accounted for to assure conservative results.

TVA RESPONSE 6

The 190°F case (Model No. 3, Section 6.10) is evaluated at the EDG thermal limits to determine the ERCW requirements and margins available. This case establishes the limiting temperature values such that a horsepower (hp) de-rate is not required and is

identified as an operating mode limit. Proto HX software is utilized in the calculation and is a common industry software application that is quality assured (QA). TVA uses the QA version such that discrepancies are identified in accordance with 10CFR21. The physical Proto HX model parameters were developed from the vendor EDG HX data sheet. An additional evaluation was performed (similar to Model No. 3) using Tubular Exchanger Manufacturers Association (TEMA) fouling factors and limiting EDG operating temperatures and ERCW flows. This model is further discussed in response to Question 19.

Uncertainties were handled in two respects: Foremost, Section 4.0 of the calculation addresses the conservative nature of the input parameters and assumptions to ensure that the heat load evaluated was maximized and that heat removal capacity is demonstrated. The test instrumentation utilized and the uncertainties considered are discussed in Section 4.8. The instrumentation meets the requirements of the ASME Performance Test Code (PTC) for Single Phase Heat Exchangers. The test results were treated as nominal values. Secondly, the appendix to the calculation contains a discussion of the formulation and process of the Proto HX software. An uncertainty evaluation package is part of the software capability and one of the test cases was evaluated. All parameters are varied and combined by the software program so that the maximum deviations can be evaluated. The resulting maximum possible fouling factor was shown to be 0.0012897 hour-square foot-degree Fahrenheit per British Thermal Unit (hr-ft2-°F/BTU). This value is within the expected results as described within the ASME PTC.

Model No. 4, Section 6.11, demonstrates ERCW operating margins based on the current flow balance and the various LOCA configurations.

NRC QUESTION 7

Page E1-17, Piping Impacts: The information that was provided indicates that the RHR system is cooled by CCS and does not receive ERCW water. Nonetheless, all other things being equal, increased ERCW temperature will result in an increase in CCS temperature, which will affect RHR. Either confirm that the resultant CCS supply temperature will continue to be bounded by existing analyses associated with the RHR system, or explain what impact the proposed increase in ERCW temperature will have on RHR, including how this determination was made.

TVA RESPONSE 7

The RHR system is not impacted. The ERCW and CCS interface point is the CCS plate HXs. For the proposed ERCW temperature increase, the CCS HX exit temperature is maintained at the current design temperature. This is accomplished by crediting

the increased ERCW flow rate. In addition, due to thermal conditions specified by piping analyses, a CCS design limit of 145°F is imposed on the RHR HX exit temperature. It is noted in both TVA CCS plate HX calculations 70D53EPMMCG021290 and 70D530HCGKBO102287 that there are some cases at the proposed design ERCW temperature of 87°F and including restraints of the CCS HX temperature, that the CCS piping temperature limit is exceeded. Acceptability of this excursion is further explained in TVA Response No. 8a under TVA letter dated December 7, 2006.

NRC QUESTION 8

Page E1-18, Measurement Equipment and Uncertainties: Identify and explain how all of the uncertainties (flow measurement, temperature measurement, modeling, and analytical) were quantified and accounted for to assure conservative results.

TVA RESPONSE 8

Measurement uncertainties were considered in the proposed UHS increase to ensure conservative results. Specifically, the supporting ERCW flow margin evaluations include a 5 percent flow measurement uncertainty that bounds the flow modeling input values. This is discussed in Assumption 4.3 of design calculation MDQ 000 067 2002 0109. Other conservative assumptions were utilized in this and the other mentioned calculations to ensure conservative results. Temperature measurement uncertainties are accounted for in the UHS TS SR as detailed in Response 5b. The instrument loop uncertainty is added to the MCR indication within the integrated computer system (ICS). This practice ensures that the observed SR value is less than the UHS TS safety analytical limit, which is the safety limit.

Additional discussion of how uncertainty is applied can be found in Responses 5, 6, and 17.

NRC QUESTION 9

Page E1-24: Explain to what extent Station Blackout analyses and commitments will be impacted by the proposed change to the UHS temperature limit.

TVA RESPONSE 9

In developing this LAR, TVA considered the UHS temperature averaging approach and the four acceptance conditions provided in the Improved Standard Technical Specification Change Traveler, "Technical Specification Task Force (TSTF) 330." Our determination in the July 2006 LAR submittal concluded the TSTF would not provide any benefit. Yet, as stated in the July 2006 LAR, several of the conditions would be met within the existing

design including SQN station blackout (SBO) requirements. Commitments made to bring SQN into conformance with 10CFR50.63 have been completed and continued compliance is not challenged by either the requested temperature increase or the single river elevation minimum limit. In particular, during a SBO, AFW is provided from a CST and not the UHS.

Overall, the proposed change to the UHS TS does not negatively impact or change the SBO outcome.

NRC QUESTION 10

Pages E4-5: The Technical Specifications (TSs) Bases Section does not appear to be entirely appropriate and consistent with the WStandard TSs (STS). In particular, the second paragraph refers to an "average" water temperature whereas the STS refers to the water temperature of the UHS; and the fourth paragraph credits "sensitivity analyses" for demonstrating that the containment will not be compromised (even under limiting large break loss of coolant accident [LBLOCA]) for UHS temperatures up to and including 90 °F whereas this information is not included in the STS, and sensitivity analyses are typically not credited for demonstrating acceptable performance of the containment. Revise as appropriate.

TVA RESPONSE 10

SQN has chosen at times to convert associated LCO Bases from their original format to the more informative Improved Standard Technical Specification (STS) format that is found in NUREG-1431, "Standard Technical Specifications Westinghouse Plants." The conversion, to the practical extent, retains the STS Bases formatting and those discussions which are applicable to the license-basis of SQN. In this case, SQN has not requested to adopt the STS UHS LCO nor TSTF-330 Revision 3 as discussed in the July 2006 LAR (pages E1-23 and E1-24), but does intend to revise SQN UHS Bases to be more informative.

The reference to "average water temperature" was based upon TVA's understanding of the 1988 LAR approval in which NRC defined "average" for the use in the SR. Averaging of the water temperature was provided by NRC under the statement "This temperature may be averaged over a period of not more than 24 hours." SQN has not proposed a change to how the SR is performed. As discussed in the June 22, 2007, teleconference, SQN explained that the UHS temperature is averaged on a rolling 24-hour basis using a one second sampling rate. Application in this manner would minimize short-term river temperature transients without needlessly cycling operations to enter and exit an LCO action (placing both units in hot standby within 6 hours only to find the river temperature has dropped thus allowing exit of the LCO action.) 24-hour averaging in effect

produces a lag function such that elevated temperature durations are weighted and captured, and if continued to upwardly elevate would result in exceeding the upper LCO average ERCW supply header limit at which time the appropriate "Action" would be entered. NRC informed TVA, during a teleconference on July 18, that time based averaging is not permitted except under the scheme in NUREG-1431, Revision 3. TVA has taken steps to ensure the UHS temperature limit does not go unnoticed and would be acted upon appropriately beyond the once per day SR. Instantaneous monitoring and alarms has been part of the ICS console in the MCR .

To maintain consistency with the LCO and SR requirements to average, TVA intends to average the UHS temperature between the A and B ERCW train headers, but will not perform time-based averaging. Either of these ERCW trains can supply the Unit 1 or 2 safety-related components. By this application, the Bases paragraph which discusses averaging is still appropriate.

As for the "sensitivity analyses", this is based upon the current containment integrity analysis discussed in the July 2006 LAR while only varying the UHS input temperature. It shows that margin exists for containment integrity (i.e., maximum pressure and temperature), above 87°F up to an UHS temperature value of 90°F during a LBLOCA. These analyses provide assurance that under a LBLOCA, additional margin is provided above the proposed changes. Nonetheless, the proposed Bases paragraph, paragraph 4 in section titled, "ACTIONS", will be removed as part of the approved TS implementation process (Commitment 1).

NRC Questions in regards to SQN Response to RAI dated December 7, 2006.

NRC QUESTION 11

Pages E1-1 through E1-3, Question 1 (also, Page E1-18, Question 5): Discuss measures that exist or will be established to ensure that TVA river operations practices are controlled in a manner that preserves the capability of the UHS to perform its functions in accordance with the analyses that have been completed.

TVA RESPONSE 11

For emergency situations, up to and including the loss of downstream dam (LODD) event, the TVA River Operations Emergency Response Plan proceduralizes steps to address postulated events or situations that have the potential to compromise the integrity of a water barrier in the River Operations system.

The plan provides the process procedure for identification and notification of a dam break within TVA and to the media. Notifications are made using a checklist such that the MCR is

notified in a timely manner and that Watts Bar Hydro Plant minimum discharge is established to maintain the required ERCW intake water elevation at SQN.

TVA document, "Monitoring and Moderating the SQN UHS," describes River Operations' special practices of the river system to mitigate the intake temperature at SQN. Special operations to control the intake temperature are planned, depending on the severity of the temperature problem. The special operations options are implemented in order of severity. In summary, by controlling the timing and quantity of releases from dams upstream and downstream of SQN, TVA has been able to reduce the peak summer water temperature at the SQN UHS intake and to maintain the water supply as established in Regulatory Guide 1.27 R0, although with potential environmental (i.e., aquatic life) and financial costs.

NRC QUESTION 12

Page E1-3, Question 1: The response states that the design basis temperature limits of safety-related equipment are not exceeded when operating at the increased UHS temperature limit. Confirm that equipment design limitations that have been established by component vendors will not be exceeded (e.g., the heating, ventilation and air conditioning compressors at Watts Bar were affected and required modification).

TVA RESPONSE 12

Most safety-related HXs were originally purchased to the preliminary safety analysis report (PSAR) value assumed for the UHS of 83°F. The metal materials involved with the components and HXs are typically rated for temperatures over 130°F including the gasket or elastomer materials. Changes made in 1988 increased the UHS to 84.5°F which was a 1-1/2 degree increase. The proposed July 2006 LAR further increases the temperature an additional 2-1/2 degrees. Safety-related components can operate at 87°F and were determined by calculational evaluations and reviews (i.e., reference calculation MDQ 000 067 2002 0110). Some components have a higher operating temperature than 87°F per the review. Others were evaluated by performing additional calculations or evaluations that demonstrate performance. The components are operating within their acceptable design range. No components need to be rebuilt, altered, or replaced.

NRC QUESTION 13

Page E1-16, bottom: With the exception of the 1°F temperature increase referred to for the boric acid transfer (BAT) and AFW coolers, confirm that no other cooler or HX ERCW outlet temperatures will increase as a result of the increased UHS

temperature limit with respect to any plant operating or postulated accident conditions.

TVA RESPONSE 13

Table 8 Extract, page E1-15 of the December 2006 LAR Supplement, listed all of the limiting components except for one additional component that was recently identified during an area cooler calculation revision.

The spent fuel pool and thermal-barrier booster pump area cooler 1B as shown on Table 4 Extract, page E1-10 of the Supplement, has 1.1 percent margin over the base 5 percent. During a recent calculation change it was identified that the Tcold out temperature used was 100.5°F. The correct value is only 99.2°F. Using the corrected delta-T, the resulting ERCW flow requirement at 87°F would be 0.5 gpm greater or 34.3 gpm and is less than the 1 percent margin criteria. TVA entered this issue into the Corrective Action Program. Further review of deviation shows that the cooler is within its design temperature limit and therefore not impacted. The resulting room temperature for accident conditions has been allowed to increase. However, the environmental qualification (EQ) temperature remains significantly less than the 135°F limit and does not have any significant impact for this mild environment. Other than the error found during the calculation revision, no other revised equipment flowrates dropped below the threshold limit of 1 percent set in the calculation.

NRC QUESTION 14

Page E1-16, bottom: Discuss whether or not the "other" assumption and methodology changes that were integrated into the July 2006 submittal require NRC review and approval, and provide the necessary justification as appropriate.

TVA RESPONSE 14

As described in the July 2006 LAR, SQN used the approved 1988 UHS LAR to build upon for this recent LAR and described those NRC reviews and approvals since 1988 that have impacted the design basis accidents. Two LARs were cited, in particular to the UHS. In the Section titled "Containment Pressure Analysis - Long-Term," an LAR (Reference 4 in the July 2006 LAR) approved in 2002 revised ice condenser ice weight. The supporting ice weight LAR analyses also proposed, including the contribution to containment pressure of accident-generated hydrogen in the containment pressure calculations, increasing the effectiveness of the CS HXs, increasing the UHS temperature, and decreasing the ERCW flow to the CS HX. Also mentioned was the Appendix R Safe Shutdown evaluation, which was evaluated as part of the 1.3 percent power uprate LAR (Reference 9 in the July 2006 LAR).

TVA discussed the change in the river recession analysis due to the revised failure assumptions for the Chickamauga Dam. This was further discussed in our January 2007 RAI submittal. To this end, TVA is only requesting approval of the proposed changes described in Section 2.0 "Proposed Change" of the July 2006 LAR.

NRC QUESTION 15

Page E1-19, Question 6: Explain how the most limiting heat transfer capability of the CCS HX is determined when evaluating the spent fuel pool cooling thermal analysis to assure conservative results. Also, the 183 °F exceeds the value of 182 °F referred to in the UFSAR Table 9.1.3-1, Sheet 2, which is not consistent with the plant licensing basis. Please explain.

TVA RESPONSE 15

In the early 1990's, SQN re-racked its SFP with high density racks to extend fuel storage capacity for more than 10 years. The SQN LAR provided analyses that included thermal-hydraulic evaluations for normal and abnormal condition heat loads. The analysis demonstrated compliance with Section III of the NRC document dated April 14, 1978, "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications." Also, decay heat loads were developed using the provision of NRC Branch Technical Position ASB 9-2, "Residual Decay Energy for Light Water Reactors for Long Terms Cooling, Revision 2 - July 1981." The analysis showed that the SFP maximum bulk temperature (i.e., 177.2°F) for the maximum normal heat load condition of the normal off-load scenario, including a single failure of the SFP cooling system (SFPCS), prevented thermal damage to the SFP and the SFP support systems' components. Other off-load scenarios included normal back-to-back unit core off-loads and normal back-to-back unit core off-loads with an unplanned core off-load. Under each of these scenarios with both cooling trains operating, bulk SFP temperature is limited to less than 150°F.

Transient analyses were performed for loss of forced cooling. The loss of cooling was assumed to occur coincident with the maximum bulk temperatures reached for each scenario evaluated. The limiting scenario results determined bulk boiling conditions in the SFP near 3.4 hours following the loss of forced cooling.

The analyses verified that no void formation occurs and cladding integrity is not threatened by calculating the maximum local water temperature and cladding temperatures. The analysis indicated for both unblocked and 50 percent blocked flow conditions, no incidence of nucleate boiling and no potential for fuel cladding damage.

SQN received NRC approval on April 28, 1993 (TAC Nos. M83068 and M83069), for the proposed re-rack LAR. NRC noted in the safety evaluation (SE), that for the scenarios presented, the staff's acceptance criterion for preventing thermal damage to the SFP and SFP cooling support system components by SFP temperature under maximum normal heat load conditions coincident with a single failure of the SFP cooling system were such that no damage would be expected. The staff's acceptance criterion for SFP temperature under maximum abnormal heat loads was found to be satisfied, which is to prevent bulk boiling in the SFP. This acceptance criterion applies to the staff's full-core off-load scenario (i.e., a back-to-back offload with full SFP assembly capacity and no equipment failure).

The staff concluded that adequate time is available to provide makeup water to the SFP prior to the onset of bulk boiling and subsequent loss-of-coolant inventory. This was determined by the scenarios reviewed, the limiting minimum time of 3.4 hours to reach bulk boiling conditions, and the number of available alternate sources of makeup water.

TVA has conservatively analyzed the scenario of back-to-back unit off-loads postulating single failure of the SFPCS including a 13^{th} fuel rack presently not installed in the cask pit. This analysis established the equipment design basis limit to prevent bulk pool boiling. The limiting SFP bulk temperature is 183°F as shown in the UFSAR Table 9.1.3-4. The lesser SFP bulk temperature of 182°F, shown in UFSAR Table 9.1.3-1 Sheet 2, corresponds to a similar scenario; however excludes the 13^{th} SFP rack. As shown in the UFSAR tables, operation of both SFPCS trains limits the SFP bulk temperature to less than 150°F.

By another effort, TVA submitted an LAR on September 21, 2001, TS Change 00-06 (TAC Nos. MB2972 and MB2973), with various proposed changes to its license in which to provide irradiation services for the U.S. Department of Energy (DOE). TVA's Watts Bar Nuclear Plant (WBN) had requested similar changes; however, their request proposed a new methodology for the SFP cooling analysis. TVA informed NRC that because of the timing of the WBN and SQN submittals, SQN would not duplicate the request of the new methodology, but would apply the requirement of 10CFR50.59 after NRC's approval of the WBN request. TVA did however provide NRC advanced information on May 25, 2001, under letter titled "Sequoyah Nuclear Plant (SQN)- Units 1 AND 2 - Information Related to SQN Tritium Program," regarding SQN's application of the new methodology to its plant conditions. This letter provided existing design limiting analysis values of the SFPCS which included, in part, maximum SFP bounding heat load of 45.3 MBTU/hr, HX fouling factors, maximum CCS temperature of 95°F for cooling water, maximum bulk SFP temperature of 183°F under single train operation, time to boil, and boil-off rates.

The new methodology supporting analysis determined the heat

rejection capacity of the SFPCS for the maximum allowable heat load. The analysis does consider heat loss to the air, but not through the SFP liner, concrete walls and floor, or un-insulated piping systems. The worst-case consideration includes a LBLOCA, loss-of-offsite power (LOOP), and LODD to which the non-LBLOCA unit is placed in hot standby and assumes the available train SFP cooling load. The CCS temperature is limited to no greater than 95°F to the non-LBLOCA unit, which is the design limiting temperature for the analysis. The limiting temperature of 95°F is captured in the CCS HX calculations and is assured by operator action as discussed in the December 2006 LAR Supplement. CCS temperature and SFP HX fouling factors are instrumental in this new methodology. SFP HX design fouling factors are 0.0005 hr-ft2-°F/BTU and 0.000575 hr-ft2-°F/BTU for the shell and tube sides, respectively. In the analysis, the thermal model was modified by the introduction of a performance factor that is a function of fouling. This allowed for a range of fouling factors to be analyzed. Based on SQN experience, actual HX fouling factors have been found to be less than design, with minimal negative trending over a long period of time. This experience is consistent with expectations, given that both the CCS and the SFPCS streams are clean water systems, approaching demineralized water in purity and clarity. With 20 plus years of operation without any specified cleaning, the results of the 2003 measured total fouling factor for the SFP HXs were 0.000220 and 0.000415 hr-ft2-°F/BTU. To this end, the analyses determined the upper limit decay heat (55MBTU/hr) capable of being removed to ensure the SFP design is maintained at or less than 183°F for varying fouling factors and CCS temperatures with a single train of SFP cooling. The licensing basis was considered in the analysis which assumes both trains of the SFPCS in operation, to which the same decay heat can be removed with the SFP bulk temperature less than or equal to 150°F.

The NRC concluded in Section 2.11 of the SE for TS Change 00-06, ". . . that the proposed alternative methodology for calculating the maximum SFPCS heat removal is acceptable since it utilizes the same basic methodology, equations, and data as the current analysis, and thus is essentially equivalent to the current method and maintains the currently established maximum temperature of the SFP water. The proposed alternative methodology incorporates the use of actual, rather than conservative, values for SFPCS HX fouling factors and CCS temperatures."; ". . . that the SFPCS can accommodate the additional decay heat load imposed by commencing the core offload as early as 100 hours and compensate for the projected increase in SFP decay heat from tritium production activities."; "For the increased heat load, the existing cooling system satisfies the requirements of GDC-61 of 10 CFR Part 50, Appendix A, with respect to provision of a residual heat removal capability having reliability that reflects the importance to safety of decay heat and other residual heat removal."; ". . . in the unlikely event that there is a complete loss of forced cooling, cooling the SFP

at SQN by adding makeup water conforms with the guidance described in the standard review plan (SRP) Section 9.1.3, and operation of the tritium production core (TPC) does not adversely affect the ability to maintain an adequate coolant inventory in the SFP under accident conditions."

NRC QUESTION 16

Page E1-20, Question 7: To the extent these items are not addressed above in response to Question 5: (a) For the LBLOCA case, explain in more detail how the TS shutdown/cooldown requirements will be satisfied for the non-accident unit, including worst-case considerations, most limiting CST inventory, how the AFW supply temperature compares to the maximum allowed value over time, controls that are credited to ensure that AFW design limits will not be exceeded, and how and when the TS shutdown/cooldown requirements will be satisfied and maintained without exceeding any design limitations while continuing to mitigate the LBLOCA condition; (b) for the shutdown of both units case, explain in more detail how the TS shutdown/cooldown requirements will be satisfied for both units, including a description of the worst-case scenario (e.g. seismic event with loss of downstream dam, loss of offsite power, single active failure, and no CST available), how the AFW supply temperature compares to the maximum allowed value over time, controls that are credited to ensure that AFW design limits will not be exceeded, and how and when the TS shutdown/cooldown requirements will be satisfied and maintained without exceeding any design limitations.

TVA RESPONSE 16

a) For the LBLOCA case, SQN TSs do not directly specify a manual trip of the non-accident unit. However, the maximum design basis heat loads on the CCS occur when the non-accident unit is in hot standby. Loss of off-site power, for example, would cause the non-accident unit to trip. The non-accident unit would then be held in Mode 3 (i.e., hot standby), until its shutdown/cooldown heat loads can be placed on the CCS. There is adequate volume in a CST or supply by ERCW for hot standby operation until such time that the accident unit's decay heat is substantially reduced and is operating in the LOCA-recirculation mode.

b) For shutdown of both units, the TS shutdown/cooldown requirements are satisfied for both units. Directed by the emergency operating procedures (EOP's), both units would be placed into hot standby one at a time. The first unit would eventually enter Mode 4 (i.e., Hot Shutdown). The second unit would be held in Mode 3 until the decay heat loads could be placed onto the CCS.

The limiting transients that define the AFW system performance requirements are:
- Loss of Main Feedwater (with LOOP)
- Rupture of a Main Feedwater Pipe
- Rupture of a Main Steam Pipe Inside Containment
- Small Break LOCA

The normal plant cooldown flow requirements from 100 percent power define the minimum storage capacity of a CST (TS 3/4.7.1.3). The CST level required is equivalent to a usable volume of at least 240,000 gallons, which is based on holding a unit in Mode 3 for 2 hours, followed by a cooldown to RHR entry conditions (Mode 4) within 6 hours for a total of 8 hours. The minimum usable volume was re-established under TS Change 02-06, "Increase CST Minimum Volume." The TS change also established the limiting conditions of 120°F CST maximum temperature, steam generator refill to 39 percent narrow range level at RHR cut-in, use of 1994 American Nuclear Society (ANS) decay heat standard, and employment of Babcock and Wilcox (B&W) Heavy Actinide model.

The AFW supply temperature does not vary over time and is analyzed at the CST maximum of 120°F for the AFW pumps. As with any reactor trip or shutdown, the EOP's direct the operators to ensure that AFW flows are monitored and are limited to ensure that overcooling of the reactor coolant system (RCS) does not occur. When supplied by a CST, no AFW design limits are exceeded under any shutdown scenarios.

The CSTs and ERCW supply to the AFW pumps are described in UFSAR Sections 9.2.6.2 and 9.2.6.3. Plant cooldown and worst single failure is described in UFSAR Section 10.4.7.2 as part of the AFW system.

The limiting AFW temperature when served by ERCW is discussed in response to Question 5.

NRC QUESTION 17

Page E1-24, Question 9: Part (a) indicates that certain manual valves have been fully opened to increase overall ERCW flows, and that the flow gains were confirmed by ERCW multiflow modeling. To the extent that this is not addressed in response to Question 3, describe how the increased ERCW flows that are being credited were actually confirmed to be correct after the changes were made and explain how the impact on other ERCW flow paths was determined and is assured to be conservative, including how the uncertainties in the ERCW flow rates were determined and accounted for in this regard.

TVA RESPONSE 17

Please see TVA's response to Question 3 for a discussion of the increased ERCW flows and how they are credited and confirmed.

TVA utilizes a self-developed code called Multiflow (Copyright © 2001). Multiflow is a steady-state hydraulic network analysis desktop computer code with multiple fluid choices including water (liquid and two-phase), air, oxygen, and nitrogen. Multiflow solutions for raw water and condensate systems are quality assured or QA solutions. The Multiflow software was developed around and makes extensive use of software previously developed and copyrighted by TVA employee Dr. G. A. Schohl. The ERCW Multiflow model is a comprehensive calculation of the ERCW piping system that determines the available steady-state flow to the links and nodes (components) within the network (system). The numerical methods of the software determine a definitive numerical solution. The numerical solution in itself contains no uncertainty. The network component flow losses through the various fittings, pipe, and valves; however, are based on empirical raw water test data gathered from TVA hydraulic experience and testing done at Norris Labs in Tennessee. There is some uncertainty and variations associated with solutions that use empirical data. TVA minimizes this modeling uncertainty in individual network branches by adjusting the model to agree with flow balanced conditions (tests) in the plant.

Fixed link flows and pipe break flows are modeled. Limiting accident cases are modeled to ensure adequate flows are available for those conditions since many of these alignments cannot be normally configured or aligned during power operation or during other modes of operation.

Flow measurement uncertainties in the ERCW analysis are discussed in response to Question 8.

NRC QUESTION 18

Page E1-26, Question 10: Explain what the basis/justification is for increasing the air flow for the BAT and AFW coolers, including a comparison with the design flow rates that were established by the equipment vendor.

TVA RESPONSE 18

The original equipment manufacturer (OEM) fan and motor capability for this area cooler is greater than 14,000 cubic foot per minute (cfm) as supplied under the purchase contract. The recent surveillance performance values have been above 14,000 cfm. The original purchase requirement for this cooler specified a minimum air flow of 11,700 cfm, but the operating design value has been 13,048 cfm for the cooler. TVA chose to use the available existing cfm margin; therefore, the minimum required design flow has been increased from 13,048 cfm to 14,000 cfm. Increasing the required design minimum flow is within the

demonstrated fan performance and ensures that the required heat removal for this cooler is achieved.

NRC QUESTION 19

Page E1-27, Question 11:
(a) The response indicates that various different fouling factors are used based on actual experienced values seen at the various components. Provide a listing of the limiting fouling factors that are used for all shell and tube HXs that provides a comparison of the assumed values to those specified by Tubular Exchanger Manufacturers Association (TEMA). Justify any inconsistencies that exist between the assumed values and the TEMA values, including supporting information that demonstrates that the assumed fouling factors are in fact conservative for the most limiting licensing basis conditions that are postulated (including, for example, those that would exist at the lower ERCW flow rates).

(b) Provide a listing of those shell and tube heat exchangers where the assumed heat transfer capability is different from the design capability that was specified by the vendor data sheet and explain/justify the different values that were used.

(c) Provide a copy of the vendor data sheets for the major heat exchangers referred to in (a), those referred to in (b), and copies of data sheets that are representative of the other shell and tube heat exchangers that are used.

(d) The response indicates that the CCS plate heat exchangers operate in continuous, high velocity, turbulent service. This is not consistent with the acceptance criterion that was established in the supporting calculations (for example, see assumptions 2.4 and 3 of Calculations 70D53EPMMCG021290 and 70D530HCGKBO102287, respectively). Explain this apparent inconsistency and how the higher flow rates are assured consistent with performance assumptions. Also, explain in detail how the performance of the plate heat exchangers was determined and is assured to be conservative for the lower ERCW flow rates that are postulated.

(e) Explain what provisions and design features exist to prevent clogging of the CCS plate heat exchangers, especially during postulated upstream dam failures.

(f) Explain why the actual measured EDG jacket water heat exchanger fouling factor is less than the design value.

TVA RESPONSE 19

a) Tables 1 and 2 in calculation MDQ 000 067 2002 0109 contain the listing of ERCW HXs. The following is the summarized list of those STEs.

Centrifugal Changing Pump (CCP) Gear & Bearing Oil Coolers (CLRs) 1A, 2A, 1B, 2B	Small HX
Safety Injection System Pump Oil CLRs 1A, 2A, 1B, 2B	Small HX
CSS HXs 1A, 2A, 1B, 2B	Largest HX
EDG HXs 1A, 2A, 1B, 2B pairs	Large HX
Electric Board Room (EBR) Condenser Units A, B	A/C package
MCR Condenser Units A, B	A/C package
Shutdown Board Room Chillers A, B	A/C package

The highest duty STEs are the containment spray system (CSS) HX with a heat transfer coefficient UA = 2.953E6 BTU/hr-°F and the EDG with a heat transfer (Q) of 7.365E6 BTU/hr.

The CSS HXs uses a TEMA design fouling factor of 0.0003 hr-ft2-°F/BTU for refueling water and sump water inside the tubes and 0.001 hr-ft2-°F/BTU for raw water outside the tubes.

TVA has further evaluated the EDG HXs for long-term operation and fouling. TEMA recommended fouling factors from both the 1968 edition and 1988 edition for river water and for engine jacket water have been considered as discussed below.

The EDG HXs were manufactured in 1971 to the 1968 TEMA Standards which utilized the recommended good practice for river water fouling with tube flow greater than three feet per second.

Summary of 1968 TEMA fouling:

Temp of Heating Medium	Up to 240°F	
Temp of Water	125°F	
	Water Velocity ft/sec	
	3 and less	Over 3
River Water (min)	0.002	**0.001**
Engine Jacket	0.001	0.001

TVA, during the SQN restart effort (1988), worked with Bruce GM Diesel and Thermxchanger (the HX manufacturer, now owned by Weigmann & Rose), and together re-specified the river water fouling value of 0.001 hr-ft2-°F/Btu and the jacket water fouling value of 0.0005 hr-ft2-°F/Btu. The data sheet was revised at that time for fouling factors, film coefficients, and overall heat transfer coefficient (U values). The TVA EDG Proto-HX Design model nearly matches the vendor data sheet. The limiting TVA EDG Proto-HX (Model No. 3, Section 6.10) determined that the calculated theoretical overall fouling is 0.001641 hr-ft2-°F/Btu based on the TEMA 0.001 hr-ft2-°F/Btu river water fouling and GM Diesel 0.0005 hr-ft2-°F/Btu jacket water fouling.

The 1988 TEMA Standards, 7th Edition, Section 10, Recommended

Good Practice (RGP-T-2.4 Design Fouling Resistances) has the identical minimum river water fouling value of 0.001 hr-ft2-°F/Btu but has added an additional line for average fouling with a value of 0.002 hr-ft2-°F/Btu. TVA has also considered the larger TEMA average river water value and has prepared another Proto-HX model case using 0.002 hr-ft2-°F/Btu for river water. The model was adjusted to utilize a lower U valve (i.e., Ufouled) of 260 Btu/hr-ft2-°F (rather than 307 for 0.001 fouling) in order to run this case. See the below Table 1.1 and Figures 1.1 and 1.2. The Proto-HX data sheet, Table 1.1, shows an overall fouling of 0.002752 hr-ft2-°F/Btu. The EDG heat rate is reduced to 34 BTU/min-hp resulting in a duty of 6.27 MBTU/hr and the ERCW flow is increased to 400 gpm. The modeling demonstrates that higher fouling can be utilized without de-rating of the EDG performance under the most limiting long-term (post-LOCA) requirements (Model No. 3). The EDG temperatures (shell inlet and exit) remain below 190° and 175°F, respectively, such that no de-rating of the EDG hp is required. In conclusion, the EDG HXs can remove the required long-term heat loads with increased fouling beyond the original design values.

TVA design configuration controls will ensure that the new minimum ERCW design flow to each EDG HX is at least 400 gpm (including 5 percent measurement uncertainties). The supporting diesel calculation MDQ 000 067 2003 142 will be revised to capture the revised values and TEMA references (Commitment 2).

The long-term EDG operating conditions assume that fouling will increase as a function of duty and time. The long-term operation utilizes the continuous 100 percent generator rating of 4400 kilowatts and TVA defines this operating period beginning two hours after the accident until 100 days later.

There are margins associated with long-term operation, which are not credited in this analysis, but are presented for completeness:

1) Long-term conditions and its impact on fouling could be evaluated at an ERCW cooling water average temperature of approximately 82°F normalized for the most limiting 100 day summer period rather than at 87°F. This recognizes the fact that ERCW temperature cannot exist at the maximum value of 87°F continuously for 100 days.

2) The minimum design ERCW flow is 400 gpm to each HX with flow margins including flows to account for the 5 percent flow measurement uncertainties. ERCW flow to the EDG HX's can be manually increased long-term by repositioning ERCW system valves.

3) The long-term steady state heat load on the EDG would most likely decrease as redundant pump flows and attendant equipment is no longer required and secured days after the accident.

4) ERCW system cooling water requirements decrease to the time-dependent components as accident and shutdown unit decay heat decreases.

Table 1.1

Calculation Specifications

Constant Heat Load/Cold Inlet Temperature Method Was Used
Extrapolation Was to User Specified Conditions
Design Fouling Factors Were Used

Test Data	Extrapolation Data	
Data Date	Tube Flow (gpm)	400.00
Shell Flow (gpm)	Shell Flow (gpm)	850.00
Shell Temp In (°F)	Tube Inlet Temp (°F)	87.00
Shell Temp Out (°F)	Constant Heat Load (BTU/hr)	6,270,000.00
Tube Flow (gpm)		
Tube Temp In (°F)		
Tube Temp Out (°F)		

Extrapolation Calculation Results

Shell Mass Flow (lbm/hr)	425,212.10	Overall Fouling (hr·ft²·°F/BTU)	0.002752
Tube Mass Flow (lbm/hr)	200,099.81	Shell-Side ho (BTU/hr·ft²·°F)	16,292.6
		Tube-Side hi (BTU/hr·ft²·°F)	1,095.0
Heat Transferred (BTU/hr)	6,270,000.73	1/Wall Resis (BTU/hr·ft²·°F)	2,958.0
LMTD	78.5	LMTD Correction Factor	1.0000
Effective Area (ft²)	334.0	U Overall (BTU/hr·ft²·°F)	239.2

Property	Shell-Side	Tube-Side		
Velocity (ft/s)	2.89	3.54	Shell Temp In (°F)	188.8
Reynold's Number	39,664	22,799	Shell Temp Out (°F)	174.1
Prandtl Number	2.1448	4.3934	Tav Shell (°F)	181.4
Bulk Visc (lbm/ft·hr)	0.8260	1.6001	Shell Skin Temp (°F)	180.3
Skin Visc (lbm/ft·hr)	0.8325	1.3207	Tube Temp In (°F)	87.0
Density (lbm/ft³)	60.5425	61.9597	Tube Temp Out (°F)	118.4
Cp (BTU/lbm·°F)	1.0024	0.9989	Tav Tube (°F)	102.7
K (BTU/hr·ft·°F)	0.3860	0.3638	Tube Skin Temp (°F)	122.1

Figure 1.1

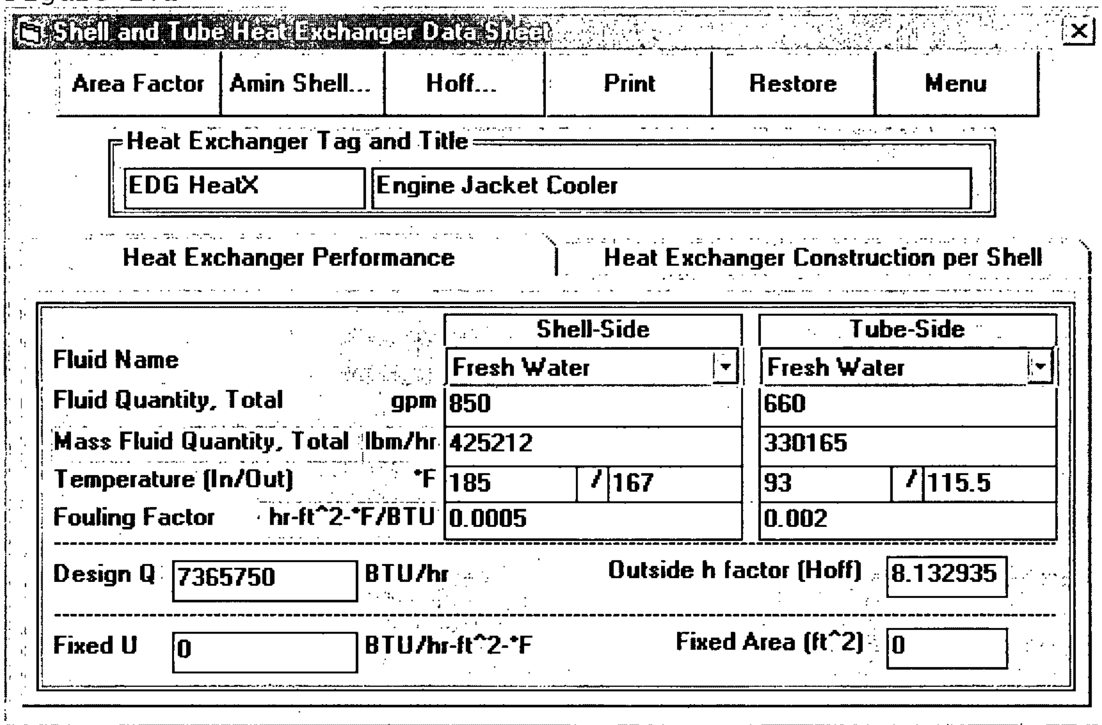
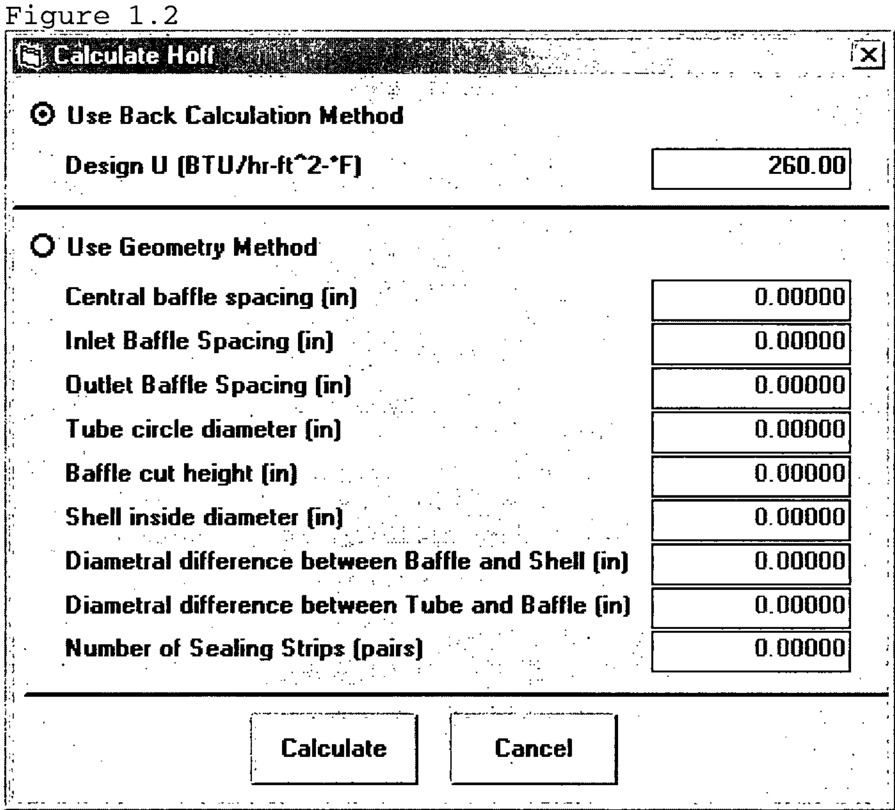


Figure 1.2



b) The referenced STEs are operated within the realm of the OEM specifications and their design capabilities are not exceeded. TVA has assumed that heat transfer capability of the CSS HX is less than the design capability that was specified by the vendor data sheet as a conservative input to

the containment analysis. Also, the TVA standardized CCP gear oil cooler (replaced in 2000) has a capacity of two times that of the original OEM design.

c) A copy of the CSS HXs (limiting HXs), MCR air conditioning (A/C) condenser unit, EBR A/C condenser unit, and shutdown board room chiller data sheets are provided in Enclosure 2. Also included in Enclosure 2 is a condenser operational chart for MCR A/C condenser unit and EBR A/C condenser unit. The condenser operational chart provides additional evidence that the equipment is within normal operational range. The EDG HX vendor data is contained in calculation MDQ 0000 067 2003 142, pages 43 and 44.

d) SQN normal operational flow in the CCS HXs exceeds the 1.5 ft/sec flow velocity (or equivalent to 4330 gpm for A-train, and 5871 gpm for B-train) discussed in the CCS HX calculations. The normal flows for the 1A CCS HXs ranges from 4800-5000 gpm, the 2A CCS HX is approximately 7,000 gpm, and the 0B CCS HX ranges from 7500-8400 gpm. These flow rates are achieved and maintained by the system physical arrangement and operating procedure valve alignments. As observed, flow differences exist between the A- and B-train CCS HXs and are based on the system flow balance. The B-train CCS HXs are physically larger than the A-train, and experience a lower pressure drop. The A-train ERCW supports the 1A1/1A2 CCS HXs and also the 2A1/2A2 CCS HXs while the B-train ERCW only supports 0B1/0B2 CCS HXs. Therefore, there is more available ERCW flow in the B-train CCS HX. The design flow rates for the A-train and B-train CCS HXs are different due to slightly different design heat load and also to a significant heat transfer area difference.

Thermal performance testing of the PHEs is performed quarterly for the A-train and during every refueling outage for the common B-train HXs. Results are trended and projected to ensure that the PHE thermal performance will exceed the design minimum values. Cleaning of the PHEs is scheduled based on the most recent test results, historical trending, adequacy of chemical treatments, and sensitivity to equipment availability.

Historical data is available for two occasions where a CCS HX experienced flow velocity less than 1.5 ft/sec for an extended period of time with thermal performance testing performed at the beginning and end of the time. The 1A CCS HX experienced an average flow rate of 3676 gpm for the timeframe of September 10, 1995, to March 5, 1996. During this time the total fouling factor increased from 0.00023 to 0.0004 hr-ft2-°F/BTU. The fouling factor change is approximately 9.6E-7 per day. The 2A CCS HX experienced an average flow rate of 3880 gpm for the timeframe of October 1997 to July 1998. Two tests were performed in August and

October 1997 with the average fouling factor being 0.00034 hr*ft2*°F/BTU. Three tests were performed in July 1998 with an average fouling factor of 0.00043 hr-ft2-°F/BTU. The fouling factor change is approximately 3.42E-7 per day.

In order to examine the issue of plate HX fouling rate, an informal sensitivity analysis of CCS HX thermal performance is provided here. The design heat removal requirement for the A train CCS HXs following a LOCA, is approximately 43.7 MBTU/hr, with core decay heat removal constituting 98 percent of the heat input. For the analyzed worst-case available ERCW flow of 3932 gpm, the maximum fouling factor that can exist with the ERCW temperature at 87°F is 0.00055 hr-ft2-°F/BTU in order for the design heat removal to occur. If the fouling factor were to increase to 0.001 hr-ft2-°F/BTU, the maximum heat rejection capability would be 37 MBTU/hr with the ERCW remaining at 87°F. If this fouling change occurred over a 30-day period, the fouling factor rate of change would be 1.5E-5 per day. This postulated rate of fouling greatly exceeds the fouling rate actually experienced under low flow conditions. In perspective, shutdown or accident core decay heat would decrease at a substantially rate faster than the rate of fouling would increase as described above during this timeframe. Therefore, increases in CCS HX fouling after an LOCA will not result in an inability to remove the required heat from the CCS.

e) The ERCW system has intake traveling screens with nominal 3/8-inch square openings, and contains strainers with nominal 1/32-inch opening. These features serve to protect system components from being fouled by debris from the river during postulated events, including loss of either the upstream or downstream dam. In particular, the CCS PHEs have flow passages that are larger than the strainer openings. SQN has proactive measures included in the technical requirement manual (TRM), Section 3.7.6, "Flood Protection," that includes requirements to have a flood protection plan ready for implementation to maintain the plant in a safe condition. Actions include staged plant flood preparation up to placing both units in hot standby with continued cooldown upon early warning notification from the TVA River Scheduling organization. These warnings are issued on major flood-producing rainfall conditions, combinations of flood-producing rainfall and possible dam failures or other dam related emergencies, or flood elevations predicted to exceed plant grade.

f) The EDG performance test was modeled using Proto-HX software as explained in calculation MDQ 000 067 2003 0142. Proto-HX Model No. titled "Design" utilized the vendor data sheet in order to build and validate the base model. Reasonable agreement was obtained between the model parameters and the

OEM data sheet. The overall-U value was nearly matched.

Proto-HX Model Nos. 1 and 2 utilized the actual field test data. The observed total fouling factors were 0.001080 and 0.001215 hr*ft2*°F/BTU, respectively, and are lower than the total design value of 0.001641 hr*ft2*°F/BTU. The uncertainty analysis performed in Proto-HX yielded a maximum possible total fouling of 0.001290 hr*ft2*°F/BTU.

Model Nos. 1 and 2 also show that the tube side velocity is greater than 3-1/2 ft/sec in one HX and greater than 5 ft/sec on the other. Tube side velocities above 3 ft/sec probably lend themselves to the lower than design fouling conditions seen in these HXs.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

Vendor Data
(15 Pages)

INDUSTRIAL PROCESS ENGINEERS

8 LISTER AVE. NEWARK, N. J.

HEAT EXCHANGER SPECIFICATION SHEET

COND. - A

Customer	TENNESSEE VALLEY AUTHORITY	Job No.	6662 & 6663
		Reference No.	33-92645
Address	Chattanooga, Tennessee	Proposal No.	10095
Plant Location	Sequoyah Nuclear Plant 1 & 2	Date	12/16/70
Service of Unit	Containment Spray Heat Exchangers	Item No.	---
Size	55-342 Type CFU (Special) (Vert)	Connected in	---
Sq. Ft. Surf./Unit (Eff.)	14130 Shells/Unit One	Sq. Ft. Surf./Shell (Eff.)	14130

PERFORMANCE OF ONE UNIT: Condition A

	Shell Side		Tube Side	
Fluid Circulated:	Cooling Water		Containment Spray Water	
Total Fluid Entering GPM	6,028		4,750	
Vapor:				
Liquid:	6,028		4,750	
Steam:				
Non-Condensables:				
Fluid Vaporized or Condensed:				
Steam Condensed:				
Gravity:				
Viscosity:				
Molecular Weight:				
Specific Heat		BTU/LB°F		BTU/LB°F
Thermal Conductivity:		BTU/HR-FT-°F		BTU/HR-FT-°F
Latent Heat:		BTU/LB		BTU/LB
Temperature In:	91	°F	156	°F
Temperature Out	123	°F	115	°F
Operating Pressure		PSIG		PSIG
No. Passes per Shell:	Two		Two	
Velocity:	3	Ft/Sec	3.5	Ft/Sec
Pressure Drop Allow/Calc	15 / 12	PSI	10 / 4.5	PSI
Fouling Resistance (Min.):	.001		0.0003	
Heat Exchanged - BTU/Hr	97,375,000	M.T.D. (Corrected) °F	28.3	
(1) Transfer Rate - Service:	245	Clean	380	

CONSTRUCTION OF ONE SHELL

	Shell Side		Tube Side	
Design Pressure		PSI		PSI
Test Pressure	"SEE CONDITION B"	PSI		PSI
Design Temperature		°F		°F

Tubes	No. O.D. B.W.G.	Length	Pitch
Shell	I.D. O.D.	Shell Cover	(Integ.)(Remov.)
Channel or Bonnet		Channel Cover	
Tubesheet - Stationary		Tubesheet - Floating	
Baffles - Cross	Type	Floating Head Cover	
Baffles - Long	Type	Impingement Protection	
Tube Supports			
Tube to Tubesheet Joint			
Gaskets			
Connections - Shell Side	In	Out	Rating
Connections - Channel Side	In	Out	Rating
Corrosion Allowance - Shell Side		Tube Side	
Code Requirements		T.E.M.A. Class	
Remarks:			

Gen Revision 1

P. 1-5

(1) Revised 3/26/71 (IP&E)

(Reference: T.V.A. P.O. No. 71C33 - 92645)

INDUSTRIAL PROCESS ENGINEERS

8 LISTER AVE. NEWARK, N. J.

HEAT EXCHANGER SPECIFICATION SHEET — COND. - B

Customer: TENNESSEE VALLEY AUTHORITY	Job No 0662 & 0663
	Reference No. 33-92645
Address: CHATTANOOGA, TENNESSEE	Proposal No. 19995
Plant Location: SEQUOYAH NUCLEAR PLANT 1 AND 2	Date 12/16/70
Service of Unit: CONTAINMENT SPRAY HEAT EXCHANGERS	Item No
Size: 55-342 Type: CFU (SPECIAL) (HORIZ.) (VERT.)	Connected in
Sq. Ft. Surf./Unit (Eff.) 14,130 Shells/Unit: ONE	Sq. Ft. Surf./Shell (Eff.) 14,130(1)

PERFORMANCE OF ONE UNIT

	Shell Side		Tube Side	
Fluid Circulated:	COOLING WATER		CONTAINMENT SPRAY WATER	
Total Fluid Entering GPM	6,028		4,750	
Vapor:				
Liquid:	6,028		4,750	
Steam:				
Non-Condensables:				
Fluid Vaporized or Condensed:				
Steam Condensed:				
Gravity:				
Viscosity:				
Molecular Weight:				
Specific Heat:		BTU/LB°F		BTU/LB°F
Thermal Conductivity:		BTU/HR-FT-°F		BTU/HR-FT-°F
Latent Heat		BTU/LB		BTU/LB
Temperature In	83	°F	146	°F
Temperature Out	115	°F	106	°F
Operating Pressure		PSIG		PSIG
No Passes per Shell:	TWO		TWO	
Velocity	3 (AXIAL FLOW)	Ft/Sec	3.5	Ft/Sec (1)
Pressure Drop: Allow/Calc.	15 / 12	PSI	10 / 4.5	PSI
Fouling Resistance (Min):	0.001		0.0003	
Heat Exchanged - BTU/Hr	95,000,000	MTD (Corrected) - °F	26.8	
Transfer Rate - Service:	252	Clean	371	(1)

CONSTRUCTION OF ONE SHELL

	Shell Side		Tube Side	
Design Pressure	150	PSI	300	PSI
Test Pressure	225	PSI	450	PSI
Design Temperature:	200	°F	300	°F

Tubes SA249, T-304 No. 1215 "U" OD 3/4 B.W.G. 20 Avg. Length 28'-6" Str. Pitch 15/16" △	
Shell SA515 Gr. 70 ('68) I.D. 55" O.D.	Shell Cover SA-515 Gr. 70 ('68) (Integ.) (Remov.)
Channel ~~or Bonnet~~ SA-515 Gr. 70 ('68) ***	Channel Cover SA-515 Gr. 70 ('68) ***
Tubesheet - Stationary SA-105 Cl. II ***	Tubesheet - Floating -----
Baffles - Cross Type.	Floating Head Cover -----
Baffles - Long SA515 Gr. 70 Type: LAMIFLEX	Impingement Protection: SA-515 Gr. 70 ('68)
Tube Supports SA-515 Gr. 70 ('68) 65% OPEN	
Tube to Tubesheet Joint ROLLED AND SEAL WELDED	
Gaskets FLEXITALLIC STYLE CG SS-304 WITH ASBESTOS FILLER WIRE	
Connections - Shell Side In * 18" Out * 18"	Rating 150# R. F. W. N.
Connections - Channel Side In 12" Out 12"	Rating BW
Corrosion Allowance - Shell Side 1/8"	Tube Side 1/8"
Code Requirements: **	T.E.M.A. Class R

Remarks: * SHELLSIDE INLET AND OUTLET NOZZLES CONSTRUCTED WITH 26" EXPANDED DIFFUSER DOMES TO ACCOMMODATE DOUBLE FLOW COND.

** ASME SEC. III CLASS "C" ON TUBESIDE; SEC. VIII DIV. 1 ON SHELLSIDE

*** OVERLAID WITH TYPE 308 STAINLESS STEEL

SGN REVISION 1

(1) REVISED 8/26/71 (1*P*5)

P. 1-6

(REFERENCE: TVA P.O. NO. 71C35-92645)

SHEET 15 of 17/18
SQN HVAC EQUIP YRAIF CALC
48 SHTDWN DL COOL EQUIP
EPM-RG-071087
CALC BY RG DTD 7-11-87
CK'D BY WVL DTD 7-13-87

ATTACHMENT 2

DUNHAM-BUSH

OPEN PACKAGE CHILLERS
PCX120-O THRU 350-O
CERTIFICATION DATA

UNIT MODEL (2) PCX 230-0-Q

→ CAPACITY 187 TONS; REFRIGERANT ☒ R-22 ☐ OTHER R-______ BHP 235

CONDITIONS: 2,244,000 Btuh

	CHILLER	CONDENSER
FLUID ☐ % BY VOLUME; ☐ % BY WEIGHT	H2O	H2O
FLOW RATE (GPM)	450	560
ENTERING FLUID TEMP (°F)	52	85 ←
LEAVING FLUID TEMP (°F)	42	95 ←
PRESSURE DROP (PSI OR FT.)	10	6
FOULING FACTOR	.0005	.002

COMPRESSOR MOTOR FURNISHED BY: ☒ DUNHAM-BUSH ☐ OTHERS

MOTOR 250 HP; 3600 RPM; TYPE: ☒ OPEN DRIP PROOF (STD.) ☐ OTHER ______ FRAME SIZE 445 TS

ELECTRICAL CHARACTERISTICS:

	COMPRESSOR	OIL PUMP MOTOR
LINE VOLTAGE	460 V/ 3 ϕ/ 60 Hz	460 V/ 3 ϕ/ 60 Hz
RATED LOAD AMPS (RLA)	284	3.9
LOCKED ROTOR AMPS (LRA)	WYE/DELTA 1825	31.0
CONTROL CIRCUIT	115V, 1ϕ/ 60 Hz	

WIRING DGM. # C5-DGM 1405(X1425)

STARTERS FURNISHED BY: ☐ DUNHAM-BUSH ☒ OTHERS**

☐ WYE DELTA OPEN TRANSITION ☐ WYE DELTA CLOSED TRANSITION ☐ ACROSS-THE-LINE ☐ AUTO TRANSFORMER (CLOSED TRANSITION)

STARTER OPTIONS:

☐ CONTROL TRANSFORMER ____3 KVA ____2 KVA ☐ AMMETER ____1 PHASE ____3 PHASE W/SWITCH

☐ COMBINATION/DISCONNECT ☐ FUSED ☐ UNFUSED ☐ CIRCUIT BREAKER

**DUNHAM-BUSH RESERVES THE RIGHT TO SELECT THE STARTER MANUFACTURER FOR ANY STARTER SUPPLIED BY DUNHAM-BUSH. SPECIAL MAKE STARTERS ARE AVAILABLE ON REQUEST. STARTERS MAY BE SUPPLIED BY OTHERS BUT MUST CONFORM TO DUNHAM-BUSH ENGINEERING SPECIFICATION LLC-55-9 AND MUST BE APPROVED BY THE DUNHAM-BUSH ENGINEERING DEPT.

STANDARD EQUIPMENT

1. DIRECT EXPANSION INNER-FIN CHILLER, ASME STAMPED WITH FLANGED CONNECTIONS.
2. WATER COOLED CLEANABLE CONDENSER, ASME STAMPED FLANGED CONNECTIONS.
3. COMPRESSOR, WITH COUPLING.
4. OIL SEPARATOR/SUMP OIL COOLER AND HERMETIC PUMP WITH MOUNTED AND WIRED starter.
5. INTERNAL CAPACITY CONTROL
6. CONTROL CENTER—CONTAINS NECESSARY SAFETY CONTROLS, GAUGES AND PILOT LIGHTS FOR COMPLETELY AUTOMATIC OPERATION. ADDITIONALLY SUPPLIED WITH ANTI-RECYCLE TIMER AND ELAPSED TIME METER.
7. FLOW SWITCH SUPPLIED UNMOUNTED FOR FIELD INSTALLATION.
8. COMPLETE WIRING WITH PROVISION FOR SAFETY INTERLOCKS BETWEEN CONDENSER AND CHILLER WATER PUMPS, COOLING TOWER FANS AND COMPRESSOR.
9. MANUALLY ADJUSTABLE LOAD/CURRENT LIMITING CONTROL
10. COMPLETE FACTORY SUPPLIED REFRIGERANT AND OIL OPERATING CHARGES.
11. VIBRATION PADS FOR NON-CRITICAL INSTALLATIONS.
12. FACTORY PERFORMANCE TEST.
13. START-UP SERVICE—FACTORY REPRESENTATIVE "ON LOCATION" FOR THREE CONSECUTIVE NORMAL WORKING DAYS.

OPTIONAL EQUIPMENT

☒ CHILLER AND REFRIGERATION INSULATION 1" ☐ VIBRATION ISOLATORS ☐ SPRING TYPE

☒ OTHER 3 KVA Transformer mtd on unit and factory wired with fuse on primary side.

Grounding Pads; OSHA Coupling Guard.

Seismic Testing

Flow Switch Press.Diff. Type.

Oil Temp. Gauge and T-Stat for Heaters.

APPROVED
TENNESSEE VALLEY AUTHORITY
MAY 6 1975
(MECH ENGR BR) By R. PATTERSON

N2M-409
MECH. ENGR. BR.
FILE

NOTES

TVA 3-7-75
SEQUOYAH 1 & 2
CONTRACT NO 75K35-83709-1
TITLE: WTR. CHILLING UNITS.
CHECKED: "A"

CONSULTING ENGINEER:

CUSTOMER: Tennessee Valley Authority

JOB: Sequoyah Nuclear Plant

DUNHAM-BUSH, INC.
WEST HARTFORD, CONN. 06110, U.S.A.

PLANT P.O. # 606466(X1425A&B)

CUST. P.O. # 75K35-83709-1

DATE February 21, 1975.

FORM NO. 6341.1

PERFORMANCE, DIMENSIONS AND SPECIFICATIONS ARE CERTIFIED CORRECT WHEN SIGNED BY AN AUTHORIZED EMPLOYEE OF DUNHAM-BUSH.

By ______ GENE BOLINO Date 2/24/75

TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee [illegible]
Telephone—Area Code [illegible]
TWX No. [illegible]

INVITATION, BID, AND ACCEPTANCE

[illegible]

State or Country Code	06
Vendor Code	
Buying Code	L B
Commodity Code	
Account Number	12 39

Contract [illegible]

TVA Contract No.	[illegible]
Contract Date	[illegible]
Total Amount $	[illegible]
Performance Date	[illegible]

INVITATION

Date August 12, 1971

A quotation IN DUPLICATE is requested on the items listed, subject to the conditions herein. Quotations will be received at this office until August 25, 1971

[illegible]

TENNESSEE VALLEY AUTHORITY, By J. C. Thornton
Purchasing Agent

Requisition Ref. No. N2893 Project Sequoyah Nuclear Plant

BID —

Date 8-20-71 Bidder's Reference Number 6820013[illegible]

In compliance with the invitation for bids, and subject to all the conditions thereof, the undersigned offers, and agrees if this bid be accepted within ______ days (30 days unless otherwise stated) from the date of the opening, to furnish the services and or sell and deliver the articles listed in any or all of the items at the price quoted opposite each. Bids may not be withdrawn after bid opening without the consent of the Contracting Officer.

Discounts will be allowed for payments as follows: NET 30 DAYS
Unless otherwise qualified by the bidder on this form: (1) discounts will be deducted from the gross contract price; and (2) time in connection with discounts offered will be computed from date of delivery of the supplies at destination, or from date of receipt of correct bill, whichever date is later.

The bidder represents:

That he is ___, is not X, a small business concern as defined in Code of Federal Regulations, Title 13, Chapter I, Part 121, Section 121.3-8. In connection with supply contracts, if bidder is a nonmanufacturer, he also represents that the products to be furnished hereunder will ___, will not X, be produced by a small business concern. In construction and construction-related nonpersonal service contacts, the preceding sentence is not applicable.

(Complete only when the aggregate amount of bid is $10,000 or more:)
That he is X a manufacturer of the articles, equipment, material or supplies quoted upon herein. That he is ___ a regular dealer in, and maintains a stock for sale to the general public of articles, equipment, materials, or supplies of the general character of that or those upon which he bids herein.

(Complete only when (a) the aggregate amount of bid in response to advertising is $25,000 or more, or (b) the aggregate amount of bid on a negotiated purchase is more than $1,000:)
That (a) he has ___, has not X employed or retained any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] to solicit or secure this contract; and (b) he has ___, has not X, paid or agreed to pay any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] any fee, commission, percentage, or brokerage fee, contingent upon or resulting from the award of this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

Bidder DUNHAM-BUSH, INC c/o ARC, INC.	P. O. Box Number 10161 Zip Code 37919
Street P.O. BOX 10161	Telephone No. 693-1991
City, State, and Zip Code KNOXVILLE, TN 37919	TWX No.

Person authorized to sign bid — Name and title (print or type) and signature
ROBERT N FOSTER
AGENT
Robert N. Foster

ARTICLES OR SERVICES AND ATTACHMENTS WHICH FORM PART OF CONTRACT

QTY

AIR CONDITIONING EQUIPMENT

Schedule of Prices (including Shipping Data)
Guaranteed Data
Equipment Data
Comparable Installations
Special Conditions
General Conditions (form 5052)
Walsh Healey Act
Equal Opportunity (forms 9923 &9925)
TVA Specifications 1254 (Revised), including Guide for Seismic Qualifications of Class I Mechanical Equipment

APPROVED: J.L.Williams,Jr. 9/10/71

CS 3
Bonine 4
CAB
TB
PAB
Sherrod
Specs. 9
Sisk

ACCEPTANCE

— Accepted only as to: ScheduleI (items 1 and 2, Item 3 if required and requested by TVA)
F.O.B. Destination--ship by prepaid motor freight
Submit drawings by October 12, 1971

TENNESSEE VALLEY AUTHORITY, By [signature]
Purchasing Agent

CONSIGN TO — TENNESSEE VALLEY AUTHORITY
Sequoyah Nuclear Plant, near Daisy, Tennessee

MARK: Contract 72C35-92693
For: Sequoyah Nuclear Plant
Attn: Chief Storekeeper

MAIL INVOICE in DUPLICATE to —
TENNESSEE VALLEY AUTHORITY
Construction Accounting Branch
400 Northshore Building
Knoxville, Tennessee 37902

Invoices must show contract number, discount or terms of payment applicable, item number, description of article or service, quantity, unit price, and total amount.

TVA USE ONLY I certify that the articles or services listed above have been received in quantity and quality specified except as noted.	Person receiving material	Date Material Received	G B L No.	Carrier's Charges Paid $ / Collect $
	Approved as reported above	Truck: Vendor / TVA; Common Carrier: Express (Air, R&A, UPS), Freight (Air, Bg., Mtr., Rail), Par. Post		Purchase Cost / Cash Discount—% / Carrier's Charges / Total Cost

TVA [illegible] (OP-7-70)

Contract File — Purchasing A File — Accounting Office — Consignee — N289-93

Schedule of Prices

No. [illegible]
Page No. [illegible]

Item No.	Articles or Services (Give Description or Catalog No.)	Quantity	Unit	Unit Price	Amount
	F.O.B.				
	Sequoyah Nuclear Plant, Tennessee, if by motor freight Cars, Daisy, Tennessee (CNO & TP Ry.), for switch delivery to Sequoyah Plant Site, if by rail freight				
	SCHEDULE I				
	The following refrigerant condensing units in accordance with TVA specification 1254.				
1	Main control room condensing units	2	each		See Below
2	Electrical board rooms condensing units	2	each		See Below
	Point of Manufacture West Hfd., Conn.				
	Drawing Submittal after Award 4 wks				
3	Services of startup Engineer if required by TVA		*Each per workday or fraction thereof	150.00	

*OVERTIME. Bidder shall state:

Hours constituting regular workday 7:30 a.m. to 4:30 p.m.

Days constituting regular workweek if other than Monday thru Friday ____________

Overtime rate for startup Engineer
Hours in excess of regular workday $28.50 per hour
Hours worked on other than regular workdays $28.[illegible] per hour

NOTE: See Special Condition "Services of Contractor's Engineers and/or Mechanics."

Total Schedule I $82,034[illegible]

TVA 8051 (DP-8-70)

BIDDER Dunham-Bush Inc.

No. [illegible]
Page No. 1

ITEM NO.		QUANTITY	UNIT	UNIT PRICE	AMOUNT
	Shipping Data. Bidder must state: Number of calendar days after award for delivery, days 16 WKS ARO. Point of shipment UD HTFD. CONN. Method of shipment and name of first carrier MF —— DUNHAM-BUSH Shipping weight, pounds 31,100 TENNESSEE VALLEY AUTHORITY SEISMIC REQUIREMENTS The undersigned bidder can and will comply with the Seismic requirement as specified in Section 19 of TVA Specification 1254 (Rev.) and Guide for Seismic Qualifications of Class I Mechanical Equipment. Dunham Bush Inc Bidder				

Dunham-Bush Inc.
BIDDER

Schedule of Prices

TVA 8091 (OP-2-6

Schedule of Prices

No. 35-88793
Page No. 8

ITEM NO.	ARTICLES OR SERVICES (ONE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE	AMOUNT

EQUAL OPPORTUNITY REPRESENTATION. The bidder represents that he:

1. Has participated in a previous contract or subcontract subject to the equal opportunity clause in form TVA 9923 or the almost identical equal opportunity clauses previously required under Executive Orders 10925 and 11114:
   Yes X No ___

2. Has 50 or more employees in his company: Yes X No ___
   If answered "Yes," answer A and B:

   A. Has developed a written affirmative action compliance program for each of his company's establishments to insure equal opportunity (see form TVA 9925):
   Yes X No ___

   B. Has 100 or more employees in his company: Yes X No ___
   If answered "Yes," has the company filed Employer Information Report EEO-1 (Standard Form 100) with the Joint Reporting Committee within the past 12 months? Yes X No ___

3. Has filed other equal opportunity compliance reports with Government contracting agencies as required by such agencies: Yes X No ___
   No such reports have been required: ___

4. Will obtain representations indicating submission of required compliance reports, signed by each proposed subcontractor, before awarding each subcontract of $10,000 or more: Yes X No ___

Labor Surplus Preference Certification. Has the bidder been certified by the Secretary of Labor as a firm eligible for preference in the placement of contracts in accordance with 29 CFR 8.7(b) (32 Fed. Reg. 14388)?

Yes /__/ No /XX/

If the answer is "Yes," the bidder shall furnish with his bid a copy of the certificate of eligibility furnished by the U. S. Department of Labor.

TVA 3031 (DP-8-70)

BIDDER Dynamic Rises Inc

TENNESSEE VALLEY AUTHORITY

GUARANTEED DATA

The bidder hereby guarantees that performance and characteristics of equipment bid upon will be as stated in following tabulation. In case of conflict between data furnished below and any other data furnished with bid, that furnished below shall govern.

TVA considers this information so material to its decision on whether or not a bid meets specifications that omission of any of it could make impossible such decision and cause the bid to be nonresponsive. A bidder leaves any space blank at his own risk. All of this information must be in bid when it is opened.

SCHEDULE I

General	Item 1 (MLR)	Item 2 (EBR)
Maximum capacity at specified gpm condenser water, tons	117	127 ×12,000 ✓
Condensing temperature, F	110	105
Overall floor space required	4'W x 13'L x 4'8"H	SAME
Maximum headroom	24" MIN	SAME
Compressor		
Rated capacity at specified conditions	117	127
Operating rpm	3600	3600
Suction temperature, F	38°	40° ✓
Suction pressure, psig	65.6	69 ✓
Discharge pressure, psig	226.4	210.0 ✓
Piston rated operating speed, fpm	SCREW	SCREW
Capacity reduction, steps	∞ TO 10%	∞ TO 10%
Maximum brake horsepower	125	119

GUARANTEED DATA (Continued)

[illegible]

MCR

Motor	Item 1	Item 2 GL.B4
Horsepower	125	125 ✓
Rated voltage	460/3/60	460/3/60
Full-load speed, rpm	3600	3600
Full-load current, amperes at 460 volts, 3 phase	138	138
Locked-rotor current at 460 volts, 3 phase, in percent of full load	628	628
Insulation, class and temperature rise	B, 90°	B, 90°

Condenser	Item 1	Item 2
Head loss at specified gpm, feet	5.21	5.98
Rated capacity at specified gpm at 85 F entering, tons	149 17	157 125
Liquid subcooling, F	10°	10°
Water side test, psi	150	150
Refrigerant side test, psi	300	300

Dunham-Bush Inc
Bidder

TENNESSEE VALLEY AUTHORITY

EQUIPMENT DATA

Each copy of proposal shall be accompanied by manufacturer's complete specifications for equipment included in proposal, and these specifications, upon award, will be incorporated in contract.

The manufacturer's specifications shall include but not be restricted to following:

a. Drawings or cuts in sufficient detail to permit a clear understanding of size and construction of equipment, and proportions of its principal parts.

b. Detailed data as follows:

SCHEDULE I

General	Item 1	Item 2
Manufacturer	Dunham Bush	Dunham Bush
Model No.	W125 K 1610 C18	W125 K 1610 C20
Overall length	166"	166"
Overall width	48"	48"
Overall height	58"	58"
Additional length required for tube removal	175"	175"
Refrigerant	R-22	R-22 ✓
Normal refrigerant change	280#	340#
Gross weight	7750	7800

EQUIPMENT DATA (Continued)

Compressor	Item 1	Item 2
Manufacturer	Dunham Bush	Dunham Bush
Model No.	163-105	163-105
Number of cylinders	Screw	Screw
Bore and stroke	"	"
Discharge line size	3"	3"
Suction line inlet size	4"	4'
Type of capacity reduction	Slide Valve	Slide Valve
Method of operating capacity reducer	Electric Hydraulic	Same
Oil carryover, ppm	1%	1%

Motor	Item 1	Item 2
Manufacturer	G.E.	G.E.
Type and frame No.	ODP 404	ODP 404
Horsepower	[illegible]	[illegible]
Breakdown torque at rated volts, percent of full-load torque	200%	200%
Pullup torque at rated volts, percent of full-load torque	100%	100%
Locked-rotor torque at rated volts, percent of full-load torque	100%	100%
Power factor at 100, 75, and 50 percent rated horsepower, percent	88%, 85%, 81%	88%, 85%, 81%
Efficiency at 100, 75, and 50 percent rated horsepower, percent	92.5%, 92%, 91%	93%, 92%, 91%
Type bearings	Ball	Ball
Bearing average expected life, hours	[illegible] Standard	
Gross weight	812 lbs	812 lbs

EQUIPMENT DATA (Continued)

	Item 1	Item 2
Drive		
Manufacturer (direct drive)	[illegible]	[illegible]
Manufacturer (belt drive)	—	—
Number of belts	—	—
Belt section	—	—
Horsepower rating per belt	—	—
Motor pulley, pitch diameter	—	—
Compressor pulley, pitch diameter	—	—
Condenser		
Manufacturer	Dunham Bush	Dunham Bush
Model No.	CSIC-18	CSIC-20
Performance factor at 0.002 fouling factor	1.7	1.7
Water inlet size	5	6
Water outlet size	5	6
Number of tubes	178	228
Length of tubes	153	153
Tube material	copper	copper
Tube size	.750	.750
Tube wall thickness	.042	.042
Number of passes	2	2
Condensing temperature, F	110	105

EQUIPMENT DATA (Continued)

Condenser, continued	Item 1	Item 2
Condenser refrigerant storage capacity	830	1020
Is receiver required?	NO	NO
Receiver storage capacity	—	—
Net weight	3190	3250

Oil Cooler	Item 1	Item 2
Manufacturer	Dunham Bush	Dunham Bush
Model No.	CC09EA	CC09EA
Water inlet size	2"	2"
Water outlet size	2"	2"
Number of tubes	64"	64"
Length of tubes	108"	108"
Tube size and thickness	5/8" - .049	5/8" - .049
Tube material	COPPER	COPPER
Number of passes	2	2
Performance factor at 0.002 fouling factor	1.7	1.7
Oil temperature	115	115

Water Regulating Valve	Item 1	Item 2
Manufacturer	Metrix Valve Co	SAME
Model No.	DE3130-F1-20	SAME
Size, inches	4"	SAME
Pressure drop at specified gpm, feet	23.1	25.2

EQUIPMENT DATA (Continued)

Capacity Controller	Item 1	Item 2
Manufacturer	Dunham Bush	Dunham Bush
Type	Electric - Hydraulic	
Number of control steps	100 to 10%	Same
Sensor manufacturer and model No.	Static "O" Ring No. 6HR31V	

Control Equipment

List of manufacturer's catalog designations, rated capacity of each piece of equipment and safety devices.

See attached schedule

Bidder offering helical rotary type compressors must furnish the following additional information:

List installations of comparable size and type built by bidder, giving name of purchaser, date of installation, capacity, approximate operating time, plant name and location.

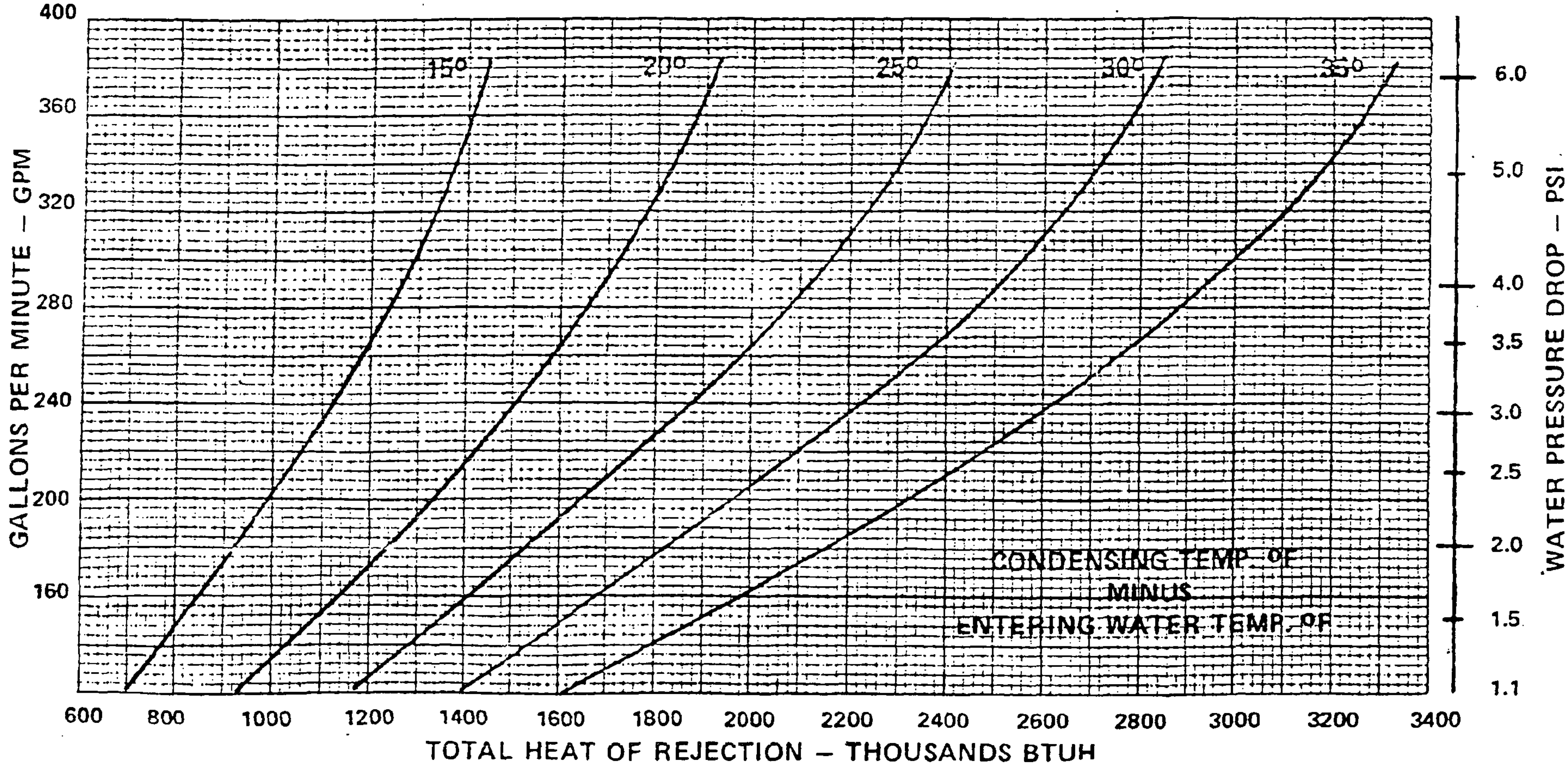
List availability and location of parts and repair service.

Note: Give complete data on Comparable Installation Sheet included in invitation.

Dunham Bush Inc
Bidder

CSTC 1860 – 2 PASS

COMPUTED RG DATE 8-1-87
CHECKED WVL DATE 8-4-87



ENCLOSURE 3

TENNESSEE VALLEY AUTHORITY (TVA)
SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

Commitments

1. The proposed Bases paragraph, paragraph 4 in section titled, "ACTIONS" will be removed following NRC approval and as part of TVA's TS implementation process.

2. TVA design configuration controls will ensure that the new minimum essential raw cooling water design flow to each emergency diesel generator heat exchanger is at least 400 gallons per minute (including 5 percent measurement uncertainties). The supporting diesel calculation MDQ 000 067 2003 142 will be revised to capture the revised values and Tubular Exchanger Manufacturers Association (TEMA) references.