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U. S. Nuclear Regulatory Commission
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Subject: Arkansas Nuclear One - Unit 2
Docket No. 50-368
License No. NPF-6
Response to Request for Additional Information from the NRC Plant Systems Branch Regarding the Power Uprate License Application

Gentlemen:

In a letter dated December 19, 2000 (2CAN120001), Entergy Operations, Inc. submitted a license application for Arkansas Nuclear One, Unit 2 (ANO-2) to increase the authorized power level from 2815 megawatts thermal to 3026 megawatts thermal. NRC personnel from the Plant Systems Branch asked four questions regarding the December 19, 2000, application. Verbal responses to these questions were discussed during a telephone conference call between members of the NRC and ANO staffs on April 17, 2001. The NRC staff requested written responses to the four questions. Attachment 1 contains the written responses. Attachment 2 lists the regulatory commitments contained in this submittal.

I declare under penalty of perjury that the foregoing is true and correct.

Very truly yours,

Jimmy D. Vandergrift
Director, Nuclear Safety Assurance

JDV/dwb
Attachments/enclosure

A001

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Attachment 1

NRC Plant System Branch Questions and ANO Responses

<u>NRC Question 1:</u>

Page 2-10, Section 2.3.1.1 – "You state that the analysis of record is still bounding for the fuel pool system. Supporting information is needed. Please explain the rationale behind the statement including a description of what evaluations were performed and what the results were."

<u>Response:</u>

For the spent fuel system, there are three separate analyses of record: the spent fuel cooling system capacity analysis, the makeup to the fuel pool from service water analysis, and the fuel bundle thermal hydraulic analysis. The Safety Analysis Report (SAR) dose rate figures (Figures 9.1-3 and 9.1-4) are not associated with these analyses and will not be updated for power uprate. The effect of power uprate may be estimated by increasing the dose rates from the figures by 7.5%; however, no need has been found for this information. The figures were originally used to verify acceptable doses in the spent fuel pool area.

The analysis of record (AOR) for the fuel pool system related to pool temperature verifies the heat removal capacity of the spent fuel pool cooling system. The cooling medium for the system is service water which is supplied by Lake Dardanelle. In accordance with the administrative process which governs refueling, the decay heat load is conservatively calculated for the fuel being offloaded for each outage. Then, before performing a core offload, actual service water temperature and decay heat loads are compared to the analysis of record for spent fuel pool heat exchanger heat removal capacity. If the actual values are bounded by the AOR values, then the heat removal capacity will not be exceeded and offloading may commence.

When the December 19, 2000, application for license amendment to increase the ANO-2 authorized power level (i.e., the Power Uprate Licensing Report) was submitted, the intent was to continue to use the bounding values in the AOR as the limits for assessing refueling decay heat loads. These bounding values, based on the SAR description of the system, were 85° F service water and the heat load in SAR Table 9.1-6, which is 32.49 MBtu/hr for Cycle 15. Even though power uprate will cause an increase in the decay heat load for a full core offload, this would not be a concern unless it exceeded 32.49 MBtu/hr. At this point, the heat removal capacity of the spent fuel cooling system would be verified based on actual service water temperature, which is generally less than 85° F during refueling outages. In this way, the AOR was considered to be bounding and the administrative process for controlling fuel unloading would ensure that the heat removal capacity of the cooling system was not exceeded.

Based on discussions which took place during the preparation to respond to the staff's question, the decision was made to enhance the analysis of record. At the time the power uprate submittal was prepared, the AOR simply verified that the cooling capacity of the spent fuel cooling heat exchangers with 85° F service water was adequate for a theoretical maximum heat load.

The AOR has since been refined by the addition of a graph (see enclosure) showing fuel pool heat exchanger capacity versus service water temperature and pump configuration (running one or both of the fuel pool cooling system pumps). For future cycles, the administrative controls will remain the same, except the projected heat load will be compared to the graph to determine the maximum service water temperature allowable for a full core offload. If service water temperature is too high for the heat load, then core offload will be delayed until service water temperature or decay heat load decreases sufficiently to be bounded by the graph.

The maximum theoretical full core offload heat load after power uprate has been conservatively calculated to be 38.10 MBtu/hr. For this heat load, 150° F can be maintained in the fuel pool with a maximum service water temperature of about 78° F. A history of Lake Dardanelle water temperature data taken at the intake structure shows that temperatures are generally less than 78° F except from mid-May to mid-September.

While there were no plans to update the SAR at the time the Power Uprate Licensing Report was submitted, based on the above discussion, the SAR will now be revised to include the heat exchanger heat removal capacity graph and the power uprate maximum theoretical decay heat load. Descriptions of the fuel pool system affected by this change will also be revised in accordance with the requirements of 10CFR50.59.

The AOR relating to emergency makeup to the spent fuel pool is bounding for power uprate conditions. The service water system serves as the assured source of makeup for the spent fuel pool by providing a seismic Category I source of makeup. A separate connection is provided from each service water loop. The emergency cooling mechanism for the pool is evaporation and boil-off with makeup from the service water system. The heat removal capacity of the service water makeup to the fuel pool documented in the AOR is more than sufficient for power uprate decay heat loads. The AOR assumes a service water temperature of 121° F, based on using the emergency cooling pond (the ultimate heat sink) as the source. At this temperature, the cooling capacity for Loop I service water is 106.6 MBtu/hr, and the capacity of Loop II is 59.75 MBtu/hr. Therefore, power uprate will not impact the ability of the service water system to function as an assured source of cooling.

The fuel bundle thermal hydraulic analysis of record assumes a maximum decay heat load of 34.341 MBtu/hr. Since this value bounded the SAR value of 32.49 MBtu/hr, no change was considered necessary to this AOR. However, with the calculation of a power uprate maximum theoretical heat load, this analysis will be revised to assume 38.10

MBtu/hr. Because of the margin in the analysis, no problems are anticipated with the higher heat load.

NRC Question 2:

Page 2-11, Section 2.3.2.2 - "You state that no changes are required for essential service water. Please provide the rationale behind that statement including a description of what evaluations were performed and what the results were."

Response:

Essential service water is the service water supplied to engineered safety features (ESF) equipment under design basis accident (DBA) conditions. The demand for essential service water during a DBA is less than the service water demand during normal operations. This can be seen on SAR Table 9.2-1 (SAR Figure 9.2-22 in Amendment 16), which lists the service water system loads and flow rates for various configurations, including a DBA. As discussed below, only the flow rate for emergency feedwater is affected by power uprate, and this change is insignificant. No modifications to essential service water are necessary for power uprate.

The effect of power uprate on the major service water system components was evaluated as part of the containment uprate for ANO-2. The revised heat load was accommodated by the existing service water/ultimate heat sink analysis.

Power uprate will cause higher containment temperatures and sump temperatures during a DBA. This was discussed in the following submittals regarding containment uprate:

- the ANO-2 containment uprate technical specification change request dated November 3, 1999 (2CAN119903);
- the ANO-2 containment coolers technical specification change request dated June 29, 2000 (2CAN060003);
- the ANO-2 response to questions on the emergency cooling pond, the ultimate heat sink, dated August 16, 2000 (2CAN080010);
- the ANO-2 response to questions on the cooling system analysis dated October 4, 2000 (2CAN100004);
- the NRC safety evaluation for containment uprate (Amendment 225) dated November 13, 2000 (2CNA110002); and
- the NRC safety evaluation for containment coolers (Amendment 226) dated November 13, 2000 (2CNA110003).

Peak service water temperature during a DBA with service water supplied by the emergency cooling pond is projected to be 121° F. As discussed in the referenced correspondence, this peak analytical value is not increased by power uprate. Therefore, no changes to the ultimate heat sink are required by power uprate and no equipment changes are required due to higher service water temperatures.

The increased heat load on the containment coolers was addressed in the technical specifications change request and related correspondence referenced above. The fan blade pitch was changed during refueling outage 2R14 and the containment cooling technical specifications were revised to require that both units in each group of containment coolers be operable in Modes 1, 2, 3, and 4. No additional modifications were required for the containment coolers for power uprate and service water flow rates were unchanged.

The containment uprate analysis also considered the effect of power uprate on the shutdown cooling heat exchangers, which serve as containment spray heat exchangers during sump recirculation. Acceptable results were obtained with no increase in service water flow or equipment modifications.

The remaining major ESF service water load is cooling for the emergency diesel generators. Since emergency diesel generator loads for power uprate are bounded by the analysis of record (see Section 2.2.4 of the Power Uprate Licensing Report), the cooling demand is unaffected.

Service water also provides an assured source of emergency feedwater (EFW). With increased decay heat loads, a negligible increase to the minimum required flow rate is needed (about 16 gpm). As a conservative recommendation, the value in the SAR table will be changed from 250 gpm to 300 gpm. The effect on the total service water demand, which exceeds 13,000 gpm, is insignificant.

The remaining essential service water loads are small and either not affected by power uprate (e.g., electrical equipment room coolers) or the effect is acceptable (e.g., high pressure safety injection pump coolers and high pressure safety injection pump room unit coolers). The higher sump temperatures are well within the design temperatures of the high pressure safety injection and containment spray pumps, and room temperatures have been evaluated and found to be acceptable.

NRC Question 3:

Page 9-1, Section 9.1.1, 3rd paragraph - "You state that the new value for zirconium mass reflects current design and the original value was overly conservative. Why is the original value considered to be overly conservative and why is the new value more representative?"

Response:

The mass of zirconium used in previous hydrogen analyses was based on a Cycle 1 estimated value presented in the Final Safety Analysis Report. As a part of the reanalysis effort for steam generator replacement, the hydrogen analysis inputs related to zirconium mass in the fuel was reexamined. Current fuel cycle design documentation specifies the weight of zircaloy used in the fuel and thus provided an improved basis for the input value. The previously assumed weight of zirconium (45,301 lbm) was actually about

2.3% larger than the current core design value (44,278 lbm). A margin of 2%, or 886 lbm, has been maintained to accommodate future design changes, such that the mass assumed in the new analysis (45,164 lbm) is only about 0.3% smaller than the previously used value.

NRC Question 4:

Page 9-1, Section 9.1.1, last paragraph - "A correction was made to the calculation for the value of dissolved hydrogen. Please explain the correction made to the calculation."

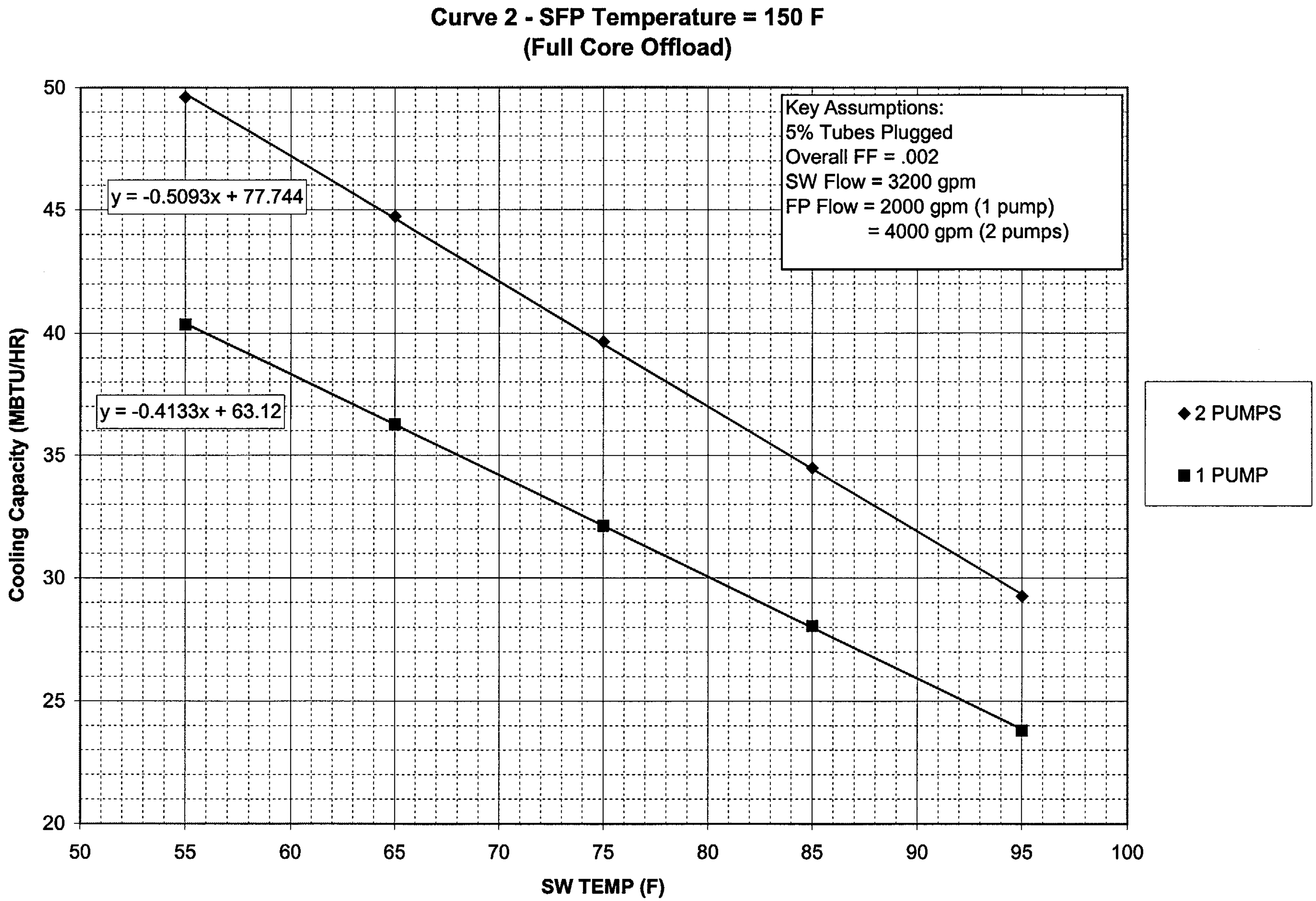
Response:

The examination of hydrogen analysis identified an improperly applied conversion factor used in the determination of dissolved hydrogen in the RCS in the original hydrogen analysis. A conversion from lbm to kgr was inappropriately inverted. The correct application of the conversion factor significantly reduced the estimate of the dissolved hydrogen, from 1680 ft^3 to 345 ft^3. The new analysis has used a conservatively higher value of 500 ft^3.

Attachment 2

Licensee Identified Commitments for 2CAN050105

COMMITMENT	TYPE	
	One-Time Action	**Continuing Compliance**
The SAR will be revised to include the heat exchanger heat removal capacity graph and the power uprate maximum theoretical decay heat load.	✓	
The fuel bundle thermal hydraulic analysis of record will be revised to assume a maximum decay heat load of 38.10 Mbtu/hr	✓	
Service water also provides an assured source of emergency feedwater (EFW). With increased decay heat loads, a negligible increase to the minimum required flow rate is needed (about 16 gpm). As a conservative recommendation, the value in the SAR table will be changed from 250 gpm to 300 gpm.	✓	


Curve 2 - SFP Temperature = 150 F
(Full Core Offload)
Key Assumptions:
5% Tubes Plugged
Overall FF = .002
SW Flow = 3200 gpm
FP Flow = 2000 gpm (1 pump)
= 4000 gpm (2 pumps)
y = -0.5093x + 77.744
y = -0.4133x + 63.12
2 PUMPS
1 PUMP
Cooling Capacity (MBTU/HR)
SW TEMP (F)
50
45
40
35
30
25
20
50
55
60
65
70
75
80
85
90
95
100