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SOUTHERN COMPANY

November 30, 2012

Docket Nos.: 50-321
50-366

NL-12-2273

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

Edwin I. Hatch Nuclear Plant
Request to Revise the Plant Service Water Pump Well Minimum Water Level
Response to Request for Additional Information
Regarding Support of Post-Accident Cooling Requirements for 30 Days

Ladies and Gentlemen:

On July 5, 2012, Southern Nuclear Operating Company (SNC) requested amendments to the Edwin I. Hatch Nuclear Plant (HNP) Units 1 and 2 Technical Specifications (TS). The proposed amendments would revise the minimum water level referenced in the Units 1 and 2 TS Surveillance Requirement (SR) associated with the Limiting Condition for Operation (LCO) for the plant service water (PSW) system and ultimate heat sink (UHS) (LCO 3.7.2).

By letter dated October 31, 2012, the NRC requested additional information regarding the demonstration that the proposed PSW pump well minimum water level of 60.5 feet mean sea level will ensure sufficient water over a 30 day period post-accident to support cooling requirements. Enclosure 1 provides the response to the NRC request for additional information (RAI).

This letter contains no NRC commitments. If you have any questions, please contact Ken McElroy at (205) 992-7369.

Edwin I. Hatch Nuclear Plant
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Enclosure 1

Response to Request for Additional Information
Regarding Support of Post-Accident Cooling Requirements for 30 Days

Mr. M. J. Ajluni states he is Nuclear Licensing Director of Southern Nuclear Operating Company, is authorized to execute this oath on behalf of Southern Nuclear Operating Company and, to the best of his knowledge and belief, the facts set forth in this letter are true.

Sworn to and subscribed before me this 30th *day of* November *, 2012.*

Nancy Louise Henderson
Notary Public

My commission expires: March 23, 2014

Respectfully submitted,

Mark J Ajluni

M. J. Ajluni
Nuclear Licensing Director

MJA/CLT/lac

Enclosure: 1. Response to Request for Additional Information Regarding Support of Post-Accident Cooling Requirements for 30 Days

cc: Southern Nuclear Operating Company
Mr. S. E. Kuczynski, Chairman, President & CEO
Mr. D. G. Bost, Executive Vice President & Chief Nuclear Officer
Mr. D. R. Madison, Vice President – Hatch
Mr. B. L. Ivey, Vice President – Regulatory Affairs
Mr. B. J. Adams, Vice President – Fleet Operations
RType: CHA02.004

U. S. Nuclear Regulatory Commission
Mr. V. M. McCree, Regional Administrator
Mr. R. E. Martin, NRR Senior Project Manager – Fleet
Mr. E. D. Morris, Senior Resident Inspector – Hatch

State of Georgia
Mr. J. H. Turner, Environmental Director Protection Division

NRC Question 1

As stated in the license amendment request (LAR), Edwin I. Hatch Nuclear Plant, Units 1 and 2 (HNP 1 and 2), uses a recession formula equation to compute the projected time (in days) for the plant service water (PSW) pump well level to reach 60.0 ft mean sea level (MSL), which is the minimum level required for post-loss-of-coolant-accident cooling requirements as limited by the Standby Service Water Pump. This formula contains a recession constant represented by the letter "k" (also known as depletion factor) which represents the type of flow (surface runoff, interflow, or base flow) that dominates the area being studied. Furthermore, the LAR states that it uses a value of 0.995 (base flow in stream flow is dominant) for the recession constant when using the equation.

However, reference 3 of the LAR states that the overlapping ranges for the selection of "k" values represent the inherent difficulties in identifying a particular recession as being surface runoff, interflow, or base flow. Furthermore, Reference 3 also lists the range for baseflow as being between 0.93 - 0.995 and the LAR states that its baseflow "k" range goes from 0.995 - 0.997.

a) Please provide additional information on the general process, criteria and analysis that has been used by the licensee in order to determine the recession constant "k" value of 0.995 for the site, with special emphasis on how the aforementioned limitations of Reference 3 were resolved, if applicable. These limitations include, but are not limited to, establishing distinctions between interflow and baseflow, seasonally variable components of baseflow analyzed over a specified period of time, etc.

b) Please provide an explanation on what effect or consequences, if any, is presented by the licensee selecting a baseflow range (0.995 -0.997) for "k" that is higher than that stated by the source reference listed in the LAR (0.93 - 0.995). The explanation should also have a special emphasis on the acceptability of the licensee selecting values higher than those stated in the reference paper (Reference 3 of the LAR). Additionally, the LAR states that the recession formula has been used for a number of years. Therefore past precedence and/or references should be included as part of the response, if available.

c) Please clarify if the recession formula was used using the same "k" value (0.995) for each river level in the discharge rating table or if different "k" values, as permitted by the HNP 1 and 2 range (0.995 - 0.997), were used when determining the projected time to reach 60.0 ft MSL. If a range of values were used, additional information that justifies this method and demonstrates added conservatisms should be included. In addition, past precedence and/or references should be included as part of the response, if available.

<u>SNC Response</u>

a) The following is the section in the LAR which is referenced in NRC question 1:

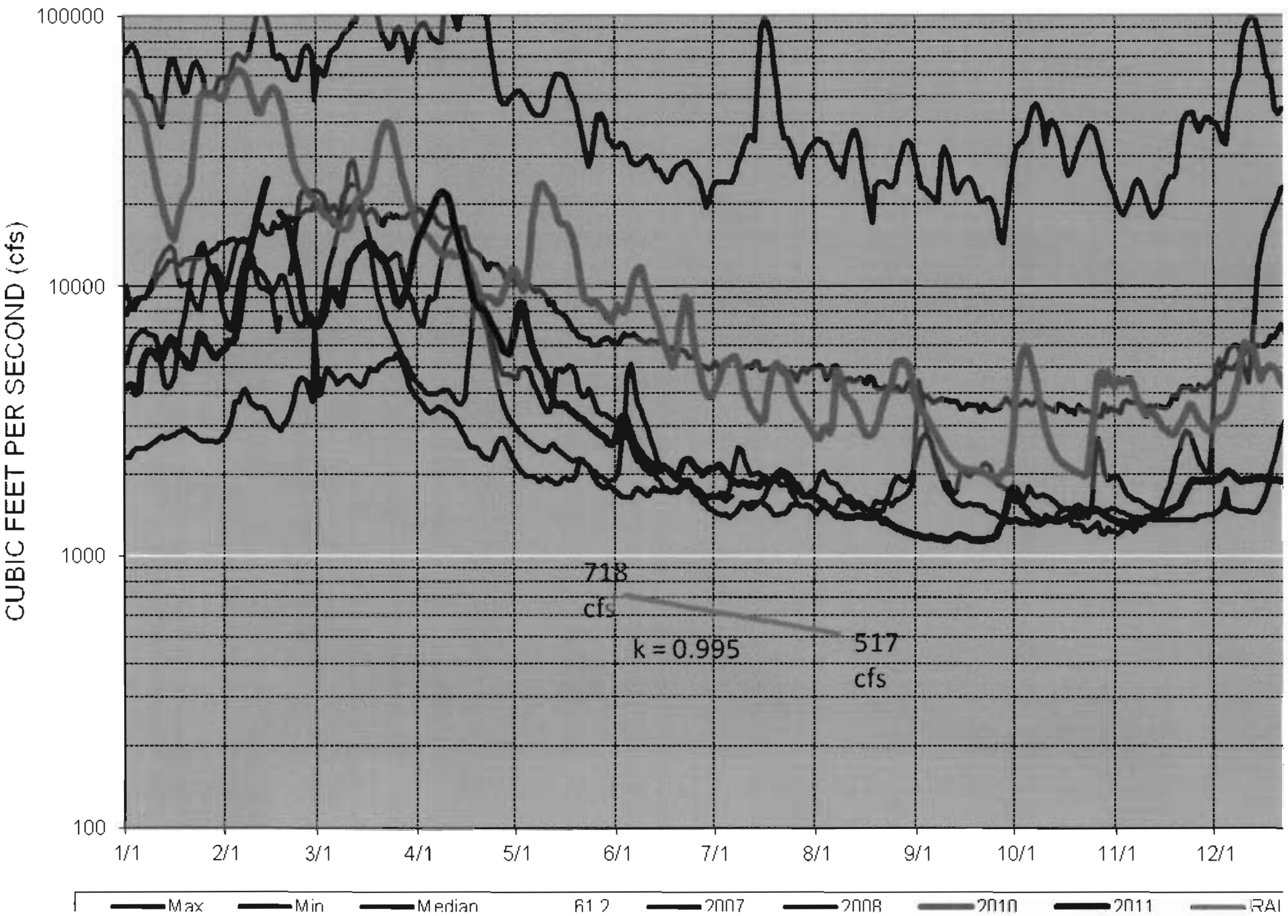
> "The recession formula (References 2 and 3) is expressed as $Q_t = Q_0 e^{-\alpha t}$, where Q_t is the stream flow at time t, Q_0 is the initial stream flow. The term $e^{-\alpha}$ in this equation is replaced by 'k', called the recession constant or depletion factor, which is commonly used as an indicator of the extent of baseflow. The typical ranges of recession constants for streamflow components are 0.2 – 0.8 for runoff (hi water), 0.7 - 0.94 for interflow and 0.93 - 0.995 for groundwater flow (baseflow) and they do overlap. High recession constants (e.g., > 0.9) tend to indicate dominance of baseflow in streamflow (Reference 3). The 'k' value used typically at HNP is 0.995; the range for the 'k' value being from 0.995 to 0.997."

As stated in the LAR, SNC is using a recession formula, also referred to as a normal groundwater-depletion curve, to determine the number of days it will take for the PSW pump well water level to decrease from the proposed TS SR 3.7.2.1 minimum level of 60.5 ft MSL to the minimum water level at which post-accident cooling requirements can be met which is 60.0 ft MSL. The 'k' value range used for HNP is based on applicable river flow data, also referred to as river discharge, at the HNP intake.

A review of river flow data for the last 12 years supports a value of 0.995 for 'k' as demonstrated by the following Figure 1. For each day on the annual timeline the respective maximum flow, median flow, and minimum flow is selected from the river flow data since the year 2000. Figure 1 shows this data graphically with the maximum flow line showing the highest of the high flows for each day and the minimum flow line showing the lowest of the low flows for each day for years 2000 through 2011.

Using data from the minimum flow line over a selected period of days one can solve for the value of 'k'. Examples of solving for 'k' are provided following Figure 1. Example 1 provides the equations (method) for solving for 'k' based on river flow. Example 2 demonstrates solving for 'k' using two points that are 30 days apart from the minimum flow line on Figure 1. Example 3 demonstrates solving for 'k' using the river flows interpolated from the SNC July 5, 2012 LAR Enclosure 1 Table 2 for PSW pump well water levels of 60.5 ft MSL and 60.0 ft MSL, specifically 718 cfs and 517 cfs (see the SNC response to NRC question 3a for the basis for these water levels and flows). Both examples 2 and 3 show that using 0.995 for 'k' is supported by the historical river flow data.

Figure 1
Altamaha River Flow Data at Hatch since the Year 2000



<u>Examples of Solving for 'k':</u>

1) $Q_t = Q_0 \times k^t$
$Q_t/Q_0 = k^t$
$\text{Log}(Q_t/Q_0) = t \times \text{Log } k$
$\text{Log}(Q_t/Q_0)/t = \text{Log } k$
$10^{\text{Log}(Qt/Q0)/t} = 10^{\text{Log } k}$
$10^{\text{Log}(Qt/Q0)/t} = k$

2) Solving for 'k' using two points 30 days apart from the minimum flow line on Figure 1:

$Q_0 = 1650$ cfs   June 4 point from minimum flow line
$Q_t = 1400$ cfs   July 4 point from minimum flow line
t = 30 days

$1400 = 1650 \times k^{30}$
$1400/1650 = k^{30}$
$\text{Log}(1400/1650) = -0.071356 = 30 \times \text{Log } k$
$\text{Log}(1400/1650)/30 = -0.00238 = \text{Log } k$
$10^{\text{Log}(1400/1650)/30} = 10^{-0.00238} = k$

0.99454 = k

3) Solving for 'k' using the river flows interpolated from SNC July 5, 2012 LAR Enclosure 1 Table 2 for 60.5 ft MSL and 60.0 ft MSL, specifically 718 cfs and 517 cfs. Please reference the line labeled RAI on Figure 1.

$Q_0 = 718$ cfs
$Q_t = 517$ cfs
t = 66 days

$517 = 718 \times k^{66}$
$517/718 = k^{66}$
$\text{Log}(517/718) = -0.1426 = 66 \times \text{Log } k$
$\text{Log}(517/718)/66 = -0.00216 = \text{Log } k$
$10^{\text{Log}(517/718)/66} = 10^{-0.00216} = k$

0.995036 = k

Based on the historical data continuing to support use of 0.995 for 'k', the recession formula, using 0.995, is currently used for the annual updating, per SNC procedure, of the time (in days) for the PSW pump well level to reach 60.0 ft MSL when starting from the TS SR 3.7.2.1 minimum level. HNP low river level procedural actions, which start at a river level of 62.5 ft MSL, include required more frequent river level projections as river level gets closer to the SR 3.7.2.1 minimum level. Again those projections use the recession formula with a 'k' value of 0.995 and also consider the trend of current river flow data.

The distinction between interflow and baseflow is determined by a graphical review of the historical river flow data in Figure 1, specifically looking for a change in slope of the minimum flow line. Based on the graphical review, flows above 2000 cfs are generally considered interflow and flows below 2000 cfs are considered baseflow. However, the distinction of interflow vs. baseflow is not relevant to a conservative demonstration of being able to support post-accident cooling requirements for 30 days. Use of a 'k' value appropriately supported by river flow data is technically justified.

LAR References 2 and 3 serve as sources for the recession curve methodology. The introduction of the terms runoff, interflow, and baseflow with "typical" ranges of recession constants from Reference 3 was to describe what a recession formula models, specifically the decreasing river flow after a river crests due to a rainfall event. As demonstrated by the previous discussion, the 'k' value used at HNP is determined by historical river flow data at the HNP intake. Therefore, the aforementioned distinctions between interflow and baseflow of LAR Reference 3 are not applicable to HNP.

b) As covered in the SNC response to NRC question 1a, the 'k' value used by HNP is based on historical river flow data at the HNP intake and appropriate consideration of the trend of current river flow data when operating under HNP low river level procedural actions. The HNP low river level procedural actions start at a river level of 62.5 ft MSL and include more frequent river level projections as river level gets closer to the SR 3.7.2.1 minimum level. A 'k' value of 0.995 is typically used at the beginning of the dry season and generally is not changed to a higher value because 0.995 has a steeper drop than 0.997, thus providing a faster decay rate. Again the LAR Reference 3 baseflow range of 0.93 - 0.995, which was only referenced in the LAR as typical, is not applicable to HNP since SNC is basing 'k' on both historical river flow data at the HNP intake and, when appropriate, the trend of current river flow data.

   This supports a HNP specific determination of the number of days it will take for the PSW pump well water level to decrease from the proposed TS SR 3.7.2.1 minimum level of 60.5 ft MSL to the minimum water level at which post-accident cooling requirements can be met which is 60.0 ft MSL.

   Finally, as noted in the SNC July 5, 2012 LAR Enclosure 1 section 3.2, SNC requested review of the application of this recession formula by the USGS. The USGS letter documenting their review was provided in the LAR Enclosure 4. USGS concluded the following:

   > "The stated objective of this analysis is to 'verify sufficient water supply at river intake for low flows'. The normal groundwater-depletion curve method that you have used predicts the decreased streamflow during extended dry conditions. Our review indicates that your methods are conservative and satisfactory for your stated objective."

c) As covered in the SNC response to NRC questions1a and 1b, the 'k' value of 0.995 is used by HNP, based on historical river flow data at the HNP intake. A change of that 'k' value would only be necessitated by a change in the river flow data or, when appropriate, the trend of current river flow data. Therefore, the 'k' value is the same whether we are projecting the duration in days for the water level to drop from the current TS SR 3.7.2.1 minimum level of 60.7 ft MSL to 60.0 ft MSL or the duration for the water level to drop from the proposed TS SR 3.7.2.1 minimum level of 60.5 ft MSL to 60.0 ft MSL.

It is noted that the referenced 'k' value is not used in the development of the HNP intake structure discharge rating table, specifically the SNC July 5, 2012 LAR Enclosure 1 Table 2. The following from LAR Enclosure 1 section 3.2 describes how Table 2 was developed:

> "For development of an HNP intake structure discharge rating table, the Baxley gage discharge data retrieved on August 22, 2011 provides the most representative data for predicting decreased streamflow during extended dry conditions. The river discharge rating table at the HNP intake structure is updated on at least an annual basis per SNC procedure. When updating the HNP intake structure discharge rating table, the Baxley gage discharge data is adjusted to:
>
> - Reflect an estimated static drop of 0.24 ft from the USGS gage to inside the intake structure, specifically a drop of 0.14 ft from the USGS gage to the intake structure and an additional 0.1 ft drop through the traveling water screens.
>
> - Reflect the reference elevation at the Baxley gage of 61.08 feet. The reference elevation is used because a datum elevation is not provided for the current Baxley gage by USGS."

NRC Question 2

Reference 3 of the LAR states that any individual recession is a short-term event that varies from successive recessions based on several factors. Therefore, for longer period events, it is necessary to combine individual base flow recessions in order to provide an average characterization of base flow, called a master recession curve (MRC). Furthermore, it states that the MRC represents the most frequent depletion simulation since recession rates are influenced by antecedent recharge conditions.

a) Please provide a detailed explanation that clarifies the threshold of what constitutes a short-term event versus a long-term event in terms of having to calculate a single recession or a MCR curve. The response should emphasize why the option selected to characterize baseflow at HNP 1 and 2 is acceptable in comparison to the single versus average methods and demonstrate that the most frequent depletion simulation has been obtained based on the method selected and, therefore, used to determine the projected time to reach 60.0 ft MSL. In addition, past precedence and/or references should be included as part of the response, if available.

SNC Response

a) As covered in the SNC response to NRC question 1, the 'k' value used by HNP is based on historical river flow data at the HNP intake from years 2000 through 2011 and appropriate consideration of the trend of current river flow data when operating under HNP low river level procedural actions. This methodology appears to approximate the use of a MRC curve as described in NRC question 2a.

SNC use of river flow data from years 2000 through 2011 supports development of a 'k' value based on long-term trends vs. potential short-term perturbations. As stated previously, when operating under HNP low river level procedural actions as river level gets closer to the TS SR 3.7.2.1 minimum level, appropriate consideration of the trend of current short-term river flow data may result in a change to the 'k' value. However, based on past experience, use of a 'k' value different than 0.995 is rare.

NRC Question 3

The LAR states that, based on Table 2 of the LAR and the use of the recession equation, the time (in days) for the water level to drop to 60.0 ft MSL would be 66 days. However, it is not clear from Table 2 how this value was obtained.

a) Please provide a summary of the calculations performed in order to obtain the value of 66 days from Table 2 of the LAR.

b) Please provide a graphical representation, similar to the example of Figure 3 provided in the LAR, which visually shows the "River Level versus Time" plot using the obtained results from the recession equation and discharge table. This figure should clearly demonstrate the availability of water for 66 days before reaching river level 60.0 ft MSL, as required by the limiting Standby Service Water Pump.

SNC Response

a) The recession formula, as covered earlier, is expressed as $Q_t = Q_0 e^{-\alpha t}$,

where Q_t is the stream flow at time *t*, Q_0 is the initial stream flow. The term $e^{-\alpha}$ in this equation is replaced by 'k'. The 'k' value used is 0.995. The flow values of Q_0 = 718 cfs and Q_t =517 cfs are obtained by interpolation of the data in SNC July 5, 2012 submittal Enclosure 1 Table 2's third and fourth columns as stated in Enclosure 1 section 3.2 as follows:

> "Based on consideration of river flow and the limiting minimum submergence of 60.0 ft MSL (based on minimum submergence of 60.0 ft MSL for the standby service water pump), safe shutdown cooling requirements can be met at a PSW pump well water level of 60.0 ft MSL.

The proposed PSW pump well minimum water level of 60.5 ft MSL provides margin to assure that the UHS would remain available for 30 days post-LOCA. As interpolated from Table 2, the river flows would be 718 cfs at 60.5 ft MSL and 517 cfs at 60.0 ft MSL, with both flows sufficient to support safe shutdown cooling requirements.

The river flows from the HNP intake structure discharge rating table, Table 2, are used as input to demonstrate that the proposed PSW pump well minimum water level of 60.5 ft MSL provides margin to assure that the UHS would remain available for 30 days post-LOCA."

By solving for time t as shown below the duration of 66 days is obtained.

Q_0 = 718 cfs
Q_t = 517 cfs
k = 0.995

$Q_t = Q_0 \times k^t$
$517 = 718 \times 0.995^t$
$517/718 = 0.995^t$
$\mathrm{Log}(517/718) = t \times \mathrm{Log}(0.995)$
$t = \mathrm{Log}(517/718)/\mathrm{Log}(0.995) = -0.143/-0.002177$

t = 65.6 days

b) Since the recession formula is expressed in terms of river flows, please reference the line labeled RAI on Figure 1 for the requested graphical representation using the results from the recession formula and Table 2.