UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NOS. 220 AND 201

TO FACILITY OPERATING LICENSE NOS. NPF-4 AND NPF-7

VIRGINIA ELECTRIC AND POWER COMPANY

NORTH ANNA POWER STATION, UNITS NO. 1 AND NO. 2

1.0 INTRODUCTION

In a license amendment request submitted by Virginia Electric and Power Company (Virginia Power) dated November 18, 1998 (Ref. 1), as supplemented October 22, 1999 (Ref. 2), Virginia Power requested to change the North Anna Power Station (NAPS), Units 1 and 2, technical specifications (TS) Surveillance Requirement 4.7.13.1, Ground Water Level Surveillance Requirements, and related Table 3.7-6, Allowable Groundwater Levels - Service Water Reservoir (SWR). The supplemental letter dated October 22, 1999, contained clarifying information only and did not change the initial no significant hazards consideration determination.

TS Surveillance Requirement 4.7.13.1 requires that the licensee, at least once per six months, verify that the groundwater level within the dike of the service water reservoir does not exceed the values established in Table 3.7-6. Furthermore, TS 4.7.13.1 requires that a measurement be made in each of three zones. TS 4.7.13.1 lists specific piezometer device numbers for each of the three zones:

- service water pump house (Nos. 11, 14 or 20), and
- southeast end of the reservoir (Nos. 10, 15, 21 or 22), and
- service water valve house (Nos 18 or 19).

In its submittal, Virginia Power has requested to eliminate the device numbers assigned to the piezometers and to identify the service water pump house as Zone 1, the southeast end of the reservoir as Zone 2, and the service water valve house as Zone 3.

Table 3.7-6, Service Water Reservoir - Allowable Groundwater Levels, specifies an allowable groundwater elevation (mean sea level in feet) for each piezometer device number specified in TS Surveillance Requirement 4.7.13.1 as well as an allowable drain flow rate (gallons per minute) for the service water reservoir. In addition, a specific measurement location is given for each of the piezometers specified in TS 4.7.13.1. Virginia Power has requested to (1) replace the "Device No." column of Table 3.7-6 by "Zone" with the three zones listed below, (2) revise the "Measurement Location" column to limit its description to the actual location of each measuring device in each zone, (3) change the allowable groundwater level for Zone 2

(southeast end of the reservoir) from 280 to 295 feet for the crest and from 277 to 280 feet for the toe of the embankment, and (4) add "Total" to clarify the heading "Allowable Drain Flow Rate."

2.0 EVALUATION

2.1 Proposed Changes to TS 4.7.13.1

To ensure that SWR seepage or elevated groundwater levels were not affecting the stability of the SWR embankment, Virginia Power installed nine pneumatic piezometers during the original construction of the SWR in 1972. The licensee installed pneumatic piezometers due to their ability to measure rapidly changing groundwater levels. However, as these piezometers have failed, Virginia Power has replaced them with open-tube piezometers, which are more reliable. Although open-tube piezometers have a longer response time in soils of low permeability than pneumatic piezometers, Virginia Power reports that since filling the SWR and the installation of horizontal drains near the Service Water Pump House (SWPH), groundwater levels have fluctuated slowly with seasonal variations in rainfall and a gradual increase in groundwater levels. Currently, there are at least two open-tube piezometers available for each of the three zones and in 1998, Virginia Power installed two additional open-tube piezometers at the toe of the slope at the southeast section of the SWR dike to provide actual rather than estimated water levels.

The licensee states that the proposed elimination of specific device numbers given by TS Surveillance Requirement 4.7.13.1 is necessary since the piezometer device numbers listed in TS 4.7.13.1 refer to pneumatic piezometers that have either been classified as inoperable or abandoned. Virginia Power will continue to meet the TS 4.7.13.1 requirement to make at least one measurement in each of the three zones and to ensure that this measurement is within the limits set by Table 3.7-6, Service Water Reservoir - Allowable Groundwater Levels. In its submittal the licensee states:

> Virginia Power plans to continue to monitor all open-tube piezometers installed within the SWR even though their individual measurement device numbers will be removed from the Technical Specifications and applicable sections of the UFSAR. The Technical Specifications continue to require measurement of groundwater by SWR quadrant irrespective of monitor type or present location. A current list of all open-tube piezometers will be monitored in accordance with applicable Periodic Test Procedures in order to obtain as much information as possible about groundwater levels.

A staff review of a recent Federal Energy Regulatory Commission (FERC) inspection report, dated March 20, 1997 (Ref. 3), of the NAPS SWR embankment, indicates that the device number originally assigned solely to represent a specific piezometer now aids in identifying the location of the piezometer, in terms of an SWR zone and a location within the zone (crest or toe of the dike), as well as the piezometer itself. Graphs from the licensee showing groundwater level measurements reflect this and they are labeled both with the piezometer device number and the measurement location. In addition, for Zone 2 of the SWR there are two piezometers located at the crest of the dike (P-21 and P-22) and three piezometers at the toe of the dike (P-24, P-10, and P-23). Thus, the device number helps to indicate the location of the piezometer within the zone as well as the piezometer itself. Finally, since all of the less reliable

pneumatic piezometers, except one, have been replaced by the more reliable open-tube piezometers and several new open-tube piezometers have been installed in the SWR embankment, the burden cited by the licensee to "initiate Technical Specifications changes whenever new piezometers are added, [or] older devices are replaced or abandoned in place" should be minimal for the future. For these reasons, the licensee's request to eliminate the specific device numbers given by TS 4.7.13.1 is denied. The second change proposed by the licensee to identify the service water pump house as Zone 1, the southeast end of the reservoir as Zone 2, and the service water valve house as Zone 3 will serve to clarify TS 4.7.13.1 and accompanying Table 3.7-6 as well as maps of the SWR; therefore, this proposed change is acceptable.

2.2 Proposed Changes To Table 3.7-6

Three of the four proposed changes to Table 3.7-6, Service Water Reservoir - Allowable Groundwater Levels, are minor changes to increase the clarity of column headings and reflect the changes made to TS 4.7.13.1. As such, the following proposed changes to Table 3.7-6 are acceptable:

- "Device No." column replaced by "Zone" with the three zones listed below,
- the elimination of zone identification in the "Measurement Location" column, and
- the addition of "Total" to clarify the "Allowable Drain Flow Rate" column heading.

However, the retention of the piezometer device numbers requires that the device numbers be added parenthetically to the "Measurement Location" column of Table 3.7-6.

Of more significance is the licensee's request to change the allowable groundwater elevations for the southeast end of the SWR (Zone 2) from 280 to 295 feet for the crest of the embankment and from 277 to 280 feet for the toe of the embankment. The groundwater level for the southeast end of the SWR embankment, as determined by the monitoring of piezometers P-10 and P-22, has risen slightly over the last 5 years. The water level, as measured by P-22, exceeded the TS limit of 280 feet on September 13, 1996, resulting in a Special Report to the staff dated December 10, 1996 (Ref. 4). The most recent measurements of groundwater level made earlier this year show that the groundwater elevation for the toe of the embankment (P-10) has decreased to 275 feet from the high of 277 feet measured in 1997. In addition, the groundwater elevation for the crest of the embankment, as measured by piezometer P-22, has decreased to 278.5 feet from the high of 281 feet measured in 1998. The licensee attributes the higher groundwater levels to (1) record rainfall amounts and (2) recharge from the SWR. The licensee states:

> Groundwater levels for the area adjacent to the lake have risen significantly since the North Anna River was dammed to form Lake Anna. Prior to filling the lake, the North Anna River elevation was at approximately elevation 200 ft. Currently, the lake is being maintained at el. 250 ft, which, over time, has gradually contributed to increasing the groundwater table in the immediate vicinity of the lake by approx. 50 ft. This rise in water level causes a reduction in the gradient of the difference in head of water over length, which results in slightly less water being discharged from the area near the SWR and a gradual build-up of water at the SWR.

Since the SWR was constructed in a relatively high area above the plant on partially saturated residual soil having low permeability, it also acts as a recharge basin. While the SWR is lined with a two foot impermeable soil liner, slow seepage of water from the SWR still percolates down through the partially saturated residual soil to the groundwater table. In this way the SWR recharges the area through seepage, however, if the recharge occurs at a faster rate than the horizontal groundwater movement away from the reservoir, a mound in the groundwater table at the SWR is created. Estimates of recharge versus horizontal flow indicate the recharge rate to be greater than the rate of horizontal groundwater movement. Based on this, it is reasonable to expect that the mound or saturation would increase as it has in recent years and this explains why water levels in the piezometers along the southeast segment of the dike show a greater increase in water levels than piezometers on the northeast, up-gradient side.

In addition, the licensee states that samples of water taken from piezometer P-22, which is located on the crest of the embankment, indicate that the sample water is not seepage from the SWR since the sample water does not contain any of the chemicals that are added to the SWR to protect service water piping. Therefore, the licensee concludes that (1) the contribution from seepage to the rise of the water level at the SWR is minimal compared to the natural rise in the groundwater table, and (2) the stability of the embankment remains adequate.

The licensee states in its submittal that the original design basis slope stability calculation of the southeast section of the SWR embankment (Zone 2), performed in 1974, contained three overly conservative assumptions. These are that:

- the slope in the original design basis calculation was assumed to be more than seven feet higher than the actual existing slope,

- the phreatic surface assumed in the original design base calculation is approximately 30 feet higher than the highest actual recorded water level along the southeast section to-date, and

- the SWR groundwater level in the original design basis calculation is 15 feet higher than the currently proposed SWR groundwater level.

These overly conservative assumptions were corrected in the licensee's Calculation CE-1386 (Ref. 2). According to the licensee, Calculation CE-1386 demonstrates that the limiting groundwater level or phreatic surface along the toe of the southeast dike section (Zone 2) can be raised from elevation 277 to 280 feet and the level of the crest can be raised from 280 to 290 feet without compromising the safety of the slope or lowering the factor of safety (FS) below the required 1.5, as defined by industry standards. The FS is the ratio of the resisting forces to the driving forces.

Calculation CE-1386 assumes that the failure circles are above 240 feet due to the presence of a rock layer at this depth, which possesses a much higher shear strength than the foundation soils. Furthermore, for CE-1386, the licensee conservatively assumed that the cohesion was zero in the foundation soils, random fill, and compacted core even though their laboratory tests of recompacted samples of the core material yielded a minimum cohesion of 2.3 psi and a failure angle of 26 feet. To find the critical failure circle (the failure surface with the lowest FS), the licensee used the slope stability computer program SB-SLOPE from Geosystems. This

computer program uses the Simplified Bishop method of stability analysis. The minimum FS for the computer-generated critical section was 1.56. The licensee verified the FS obtained for the critical circle by performing a hand calculation with fewer slices (12) than the computer program (over 1000). The hand calculation FS for the critical circle was 1.54. The NRC staff has reviewed the licensee's Calculation CE-1386 and finds that the licensee made conservative assumptions for the soil strength parameters and groundwater elevation levels and that the licensee has carried out a complete and thorough investigation of the stability of the southeast dike section. Therefore, the staff concludes that the licensee has demonstrated that increasing the allowable groundwater level of the southeast section of the SWR dike (Zone 2) will still provide an adequate FS for the stability of this dike section.

The staff concludes that the device number assigned to each piezometer should be retained in TS 4.7.13.1 and accompanying Table 3.7-6 since the device number helps to indicate the location of the piezometer within the zone (crest or toe of the dike) as well as the piezometer itself. The second change proposed by the licensee to identify the service water pump house as Zone 1, the southeast end of the reservoir as Zone 2, and the service water valve house as Zone 3 will serve to clarify TS 4.7.13.1 and accompanying Table 3.7-6 as well as maps of the SWR, therefore, this proposed change is acceptable. The three minor changes to Table 3.7-6 increase the clarity of column headings and reflect the changes made to TS 4.7.13.1. Thus, the staff concludes that the following proposed changes to Table 3.7-6 are acceptable:

- "Device No." column replaced by "Zone" with the three zones listed below,
- the elimination of zone identification in the "Measurement Location" column, and
- the addition of "Total" to clarify the "Allowable Drain Flow Rate" column heading.

Finally, the staff review of Calculation CE-1386 concludes that the licensee made conservative assumptions for the soil strength parameters and groundwater elevation levels and that the licensee has carried out a complete and thorough investigation of the stability of the southeast dike section. Therefore, the staff concludes that the licensee has demonstrated that increasing the allowable groundwater elevation of the toe from 277 to 280 feet and the crest from 280 to 295 feet of the southeast section of the SWR dike (Zone 2) will still provide an adequate FS for the stability of this dike section. Consequently, the proposed changes in groundwater elevation are acceptable.

3.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Virginia State official was notified of the proposed issuance of the amendments. The State official had no comment.

4.0 ENVIRONMENTAL CONSIDERATION

These amendments change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendments involve no significant increase in the amounts, and no significant change in the types, of any effluent that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that these amendments involve no significant hazards consideration and there has been no public comment on such finding (63 FR 69349). Accordingly, these amendments meet the eligibility criteria for categorical

exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendments.

5.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendments will not be inimical to the common defense and security or to the health and safety of the public.

6.0 REFERENCES

(1) Letter, James O'Hanlon of Virginia Electric and Power Company to the Nuclear Regulatory Commission, November 18, 1998, "Proposed Technical Specification Changes To Allowable Groundwater Elevations and Removal of Piezometer Device Numbers Associated With the Service Water Reservoir."

(2) Letter, Leslie N. Hartz of Virginia Electric and Power Company to the Nuclear Regulatory Commission, October 22, 1999, "Engineering Calculation to Support Proposed Technical Specification Changes Allowable Groundwater Elevations for the Service Water Reservoir."

(3) Letter, Gleny Marshall of Federal Energy Regulatory Commission to the Nuclear Regulatory Commission, March 20, 1997, "North Anna Nuclear Power Station Service Water Reservoir."

(4) Letter, James O'Hanlon of Virginia Electric and Power Company to the Nuclear Regulatory Commission, December 10, 1996, "Service Water Reservoir, Groundwater Level Evaluation, NAPS, NP-3141."

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