Nuclear Regulatory Commission
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North Anna 3 Combined License Application

Part 2: Final Safety Analysis Report

Revision 1
December 2008

The second paragraph of this SSAR section is supplemented as follows with information to show that flood protection measures are not required for the Unit 3 site.

NAPS COL 2.0-21-A

A local PMP drainage analysis was performed assuming, conservatively, that all underground storm drains and culverts are clogged. Details of the local PMP analysis and the resulting flood levels are presented in Section 2.4.2.3. The maximum PMP water level in the power block area is predicted to be at Elevation 87.5 m (287.2 ft) msl, which is 0.9 m (2.8 ft) below Elevation 88.4 m (290.0 ft) msl, the design plant grade elevation for safety-related facilities. Thus, no Unit 3 safety-related structure is subject to static or dynamic loading due to flooding as a result of design basis flood events or local PMP events. No flood protection measures are required for the Unit 3 site. Additionally, no technical specifications or emergency procedures are required to implement flood protection activities.

2.4.11 Low Water Considerations

NAPS COL 2.0-22-A

The information needed to address DCD COL Item 2.0-22-A is included in SSAR Section 2.4.11, which is incorporated by reference with the following supplements.

2.4.11.5 Plant Requirements

This SSAR section is supplemented as follows with information on the operational modes for the circulating water cooling system (CIRC) with respect to low water conditions.

NAPS ESP COL 2.4-10

The Unit 3 CIRC operates in either of two operating modes:

- Energy Conservation (EC)—The dry cooling array is bypassed and cooling water is circulated directly to the hybrid tower with a provision for cold weather bypass.
- Maximum Water Conservation (MWC)—The dry cooling tower and hybrid cooling tower operate in series with a provision for cold weather bypass.

Generally, when the North Anna Reservoir water level is at or above Elevation 76.2 m (250 ft) msl at the dam, and adequate reservoir discharge is being maintained, the EC mode is used. However, if the reservoir water level falls below Elevation 76.2 m (250 ft) msl and is not restored within a reasonable period of time, the MWC mode is used. While in the MWC mode, the dry tower fans may be turned off to provide additional electrical output during hours of peak demand.

As discussed in Section 2.4.14, Unit 3 will be shut down when the water level in Lake Anna drops below Elevation 73.762 m (242.0 ft) msl.

2.4.11.6 Heat Sink Dependability Requirements

This SSAR section is supplemented as follows with information on the effect of low water conditions on the UHS.

NAPS COL 2.0-22-A

The Unit 3 UHS is described in DCD Section 9.2.5. Lake Anna is not relied on as a safety-related source of water withdrawals for emergency cooling.

2.4.12 Groundwater

NAPS COL 2.0-23-A

The information needed to address DCD COL Item 2.0-23-A is included in SSAR Section 2.4.12, which is incorporated by reference with the following supplements and variances.

2.4.12.1.2 Local Hydrogeology

The third paragraph of this SSAR section is supplemented as follows based on additional borings.

NAPS COL 2.0-23-A

Borings drilled as part of the ESP subsurface investigation program (SSAR Appendix 2.5.4B) and the Unit 3 subsurface investigation program (Appendix 2.5.4AA) penetrated saprolite to depths ranging from about 1.52 m (5 ft) to 24.99 m (82 ft). The saprolite penetrated by these borings is classified as a micaceous, silty-clayey, fine to coarse sand or sandy silt, with occasional (less than 10 percent) to some (between 10 and 50 percent) rock fragments.

The fifth paragraph of this SSAR section is supplemented as follows with information on additional groundwater level measurements data.

Groundwater at the Unit 3 site occurs in unconfined conditions in both the saprolite and underlying bedrock. The results of previous investigations at the site indicate that a hydrologic connection exists between the saprolite and the bedrock. (SSAR Reference 45) This condition has been confirmed as part of the ESP and Unit 3 subsurface investigation programs (SSAR Appendix 2.5.4B and Appendix 2.5.4AA) by the

Conservatively ignoring hydrodynamic dispersion, this equation can be restated as:

$$F_{GW} = n_e v C_{GW} A \qquad (2.4.13\text{-}21)$$

where: F_{GW} = total radionuclide flux in groundwater; C_{GW} = radionuclide concentration in the groundwater; A = cross-sectional area normal to the direction of groundwater flow; and the other terms are as defined previously. The cross-sectional area of the plume is conservatively assumed to extend over the entire saturated thickness of the unconfined aquifer and the entire length of the radwaste building. The saturated thickness is taken to extend from the water table to the top of the Zone III-IV, slightly weathered to moderately weathered rock. In the vicinity of the radwaste building, Figure 2.4-207 through Figure 2.4-214 indicate a water table elevation of about 82.30 m (270 ft) msl, while Table 2.5-208 indicates the Zone III-IV top of rock elevation to be 74.37 m (244 ft) msl. These values result in a saturated thickness of about 7.92 m (26 ft). DCD Figure 1.2-25 indicates the radwaste building to be 65 m (213 ft) in length normal to the direction of groundwater flow. The assumption that the plume extends the entire length of the building is conservative because the characteristic dimensions of the sources from which a release is postulated are a relatively small fraction of the 65 m length. The cross-sectional area is then the product of 26 ft and 213 ft, or 5540 ft^2.

The total radionuclide flux in the surface water of Lake Anna, induced by pumping from the water-supply intake for Unit 3, is calculated as:

$$F_{SW} = Q C_{SW} \qquad (2.4.13\text{-}22)$$

where: F_{SW} = total radionuclide flux in surface water; Q = surface water flow rate; and C_{SW} = radionuclide concentration in the surface water. This approach for calculating the radionuclide flux in surface water is justified, considering that any radionuclides released to the groundwater would likely discharge to the Unit 3 intake forebay area, which has been isolated from the rest of the lake and from which the water intake for Unit 3 will obtain water. The surface water flow is determined by the water supply requirements for Unit 3, which total 1.42 m^3/s (50 cfs) when running in the energy conservation mode and 0.96 m^3/s (34 cfs) in the maximum water conservation mode. There are times of the year when the combination wet and dry cooling towers used for normal plant cooling could function in a completely dry mode, particularly during cold weather. Under these conditions, no make-up water is required for the normal plant circulating water system, which comprises most of the total demand. However, these conditions are expected to persist for relatively short durations and are not representative of transport conditions over longer time scales.

Because the total radionuclide flux must be conserved, radionuclide concentrations in the surface water are estimated by equating Equation 2.4.13-21 and Equation 2.4.13-22 and solving for C_{SW}:

$$C_{SW} = \frac{n_e v A}{Q} C_{GW} \tag{2.4.13-23}$$

where the quantity $n_e vA/Q$ defines the dilution factor. Assuming for conservatism that the plant is operating in the maximum water conservation mode, the dilution factor is calculated using the previously defined values for n_e, v, A, and Q to be:

$$\frac{n_e v A}{Q} = \frac{0.25 \times 0.54 / 86,400 \times 5540}{34} = 2.56 \times 10^{-4}$$

This dilution factor is applied to the H-3, Sr-90, Y-90, and Pu-239 concentrations reported in Table 2.4-209 to account for dilution in addition to radioactive decay and adsorption. Table 2.4-210 summarizes the resulting concentrations, which represent the concentrations in the surface water withdrawn by the water-supply intake for Unit 3. It is seen that the concentrations of each of these radionuclides are below their respective ECLs.

Most of the 0.96 m^3/s (34 cfs) withdrawn from Lake Anna is used as make-up water to replenish evaporative losses from cooling towers that are part of closed-cycle cooling systems. As discussed in Section 2.4.13.1.2, the non-volatile radionuclides concentrate in the circulating water by a factor of about four, prior to being discharged to the discharge canal. Even then, concentrations are well below ECLs. It should also be noted that radionuclides released in cooling tower blowdown discharge would mix with circulating water discharge from Units 1 and 2 (up to 120.2 m^3/s (4246 cfs)) as long as these units are operating. If Units 1 and 2 are shutdown, a minimum of 15.04 m^3/s (531 cfs) will continue to be circulated to provide adequate dilution for normal plant releases. These flows from Units 1 and 2 would further