Progress Energy

Serial: NPD-NRC-2009-065 10CFR52.79
April 6, 2009

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

LEVY NUCLEAR POWER PLANT, UNITS 1 AND 2
DOCKET NOS. 52-029 AND 52-030
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION LETTER NO. 021 RELATED TO ACCIDENTAL RELEASE OF RADIOACTIVE LIQUID EFFLUENTS IN GROUND AND SURFACE WATERS

Reference: Letter from Brian C. Anderson (NRC) to Garry Miller (PEF), dated March 6, 2009, "Request for Additional Information Letter No. 021 Related to SRP Section 2.4.13 for the Levy County Nuclear Plant, Units 1 and 2 Combined License Application"

Ladies and Gentlemen:

Progress Energy Florida, Inc. (PEF) hereby submits our response to the Nuclear Regulatory Commission's (NRC) request for additional information provided in the referenced letter. A response to the NRC request is addressed in the enclosure.

If you have any further questions, or need additional information, please contact Bob Kitchen at (919) 546-6992, or me at (919) 546-6107.

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

Executed on April 6, 2009.

Sincerely,

Garry D. Miller
General Manager
Nuclear Plant Development

Enclosure

cc : U.S. NRC Director, Office of New Reactors/NRLPO
U.S. NRC Office of Nuclear Reactor Regulation/NRLPO
U.S. NRC Region II, Regional Administrator
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Levy Nuclear Power Plant Units 1 and 2
Response to NRC Request for Additional Information Letter No. 021 Related to SRP Section 2.4.13 for the Combined License Application, dated March 6, 2009

NRC RAI #	Progress Energy RAI #	Progress Energy Response
02.04.13-1	L-0075	Response enclosed – see following pages

NRC Letter Number: LEVY-RAI-LTR-021

NRC Letter Date: March 6, 2009

NRC Review of Final Safety Analysis Report

NRC RAI #: 02.04.13-1

Text of NRC RAI:

SRP 2.4.13, under SRP Acceptance Criteria #5, references Branch Technical Position BTP 11-6, which provides guidance in assessing potential release of radioactive liquids at the nearest potable water supply located in an unrestricted area for direct human consumption or indirectly through animals, crops, and food processing. BTP 11-6 further states the evaluation of the release considers the use of water for direct human consumption or indirectly through animals (livestock watering), crops (agricultural irrigation), and food processing (water as an ingredient).

Applicant's analysis does not include a discussion of pathways other than drinking water. The analysis should discuss these other pathways, especially the pathways such as fish and crop irrigation that may result in concentration of the source term. Either discuss other pathways, or justify why they need not be included.

PGN RAI ID #: L-0075

PGN Response to NRC RAI:

As discussed in Section 2.2 of the Levy Environmental Report and shown in Table 2.2-2, the land uses in the vicinity (six mile radius) of the site are comprised predominately of forested lands at 68% with 8.6% devoted to residential areas and cropland/pasture and other agricultural lands encompassing 4.1% and 3.9%, respectively. Consequently crop irrigation, if required, in the site vicinity is expected to result in little or no dose consequence. Likewise, no commercial fishing is performed in the site area. Any recreational fishing performed would not provide enough of an aquatic food supply to provide significant dose as a result of ingestion.

Regardless, a basic evaluation of the dose consequence for these two pathways has been performed to demonstrate that in the unlikely event of a liquid effluent tank failure, there would be no significant dose due to these pathways.

According to Regulatory Guide (RG) 1.109, with similar discussion in NUREG-1555, Section 5.4.1, a pathway is considered significant if a conservative evaluation yields an additional dose increment equal to or greater than 10 percent of the total from all pathways.

Values for the infiltration factor for irrigation, contamination fraction, transfer factors, ingestion rates, and dose conversion factors are from the RESRAD-OFFSITE Version 2.0 — (Reference 1) default values, which in turn use Federal Guidance Report 11 (FGR 11).

Site-specific soil parameters given below are based on onsite measurements as given in FSAR Table 2.4.13-203 for hydraulic conductivity, soil density, and total porosity. The highest estimated post accident radionuclide source concentrations resulting from postulated tank failure are given in FSAR Table 2.4.13-205 for groundwater at the nearest well in the Floridan Aquifer. The estimated radionuclide concentrations in the Lower Withlacoochee

River, given in FSAR Table 2.4.13-204, are orders of magnitude lower and will result in an insignificant contribution to the total estimated dose. Based on Table 2.4.13-205, tritium with a concentration of 6.4E-06 uCi/cc is the only dose significant isotope since it accounts for greater than 99% of the detectable radioactive concentration in the receptor body. Isotopes of cesium (Cs) and strontium (Sr) are estimated at 3.2E-117 uCi/cc for Cs-137 and 3.5E-22 uCi/cc for Sr-90 in the groundwater. Bioaccumulation factors for these isotopes, as given in Table A-1 of RG 1.109, are ≤ 2.0E03 pCi/kg per pCi/L and concentration of these isotopes in the fish or invertebrate food chain will not result in a significant contribution to the total dose relative to tritium. Due to the extremely low source concentrations relative to the reconcentration values, this conclusion is also applicable to the dose receptors via the other terrestrial pathways such as crop irrigation.

Parameter	Floridan Aquifer	Surficial Aquifer
Hydraulic conductivity, K	6009 m/yr (54 ft/day)	3227 m/yr (29 ft/day)
Bulk density	2.4 g/cc	1.4 g/cc
Effective Porosity(1)	0.15	0.20
Tritium (H^3) concentration	6.4E+03 pCi/L	6.4E+03 pCi/L

Note 1: The value is conservatively selected by having the effective porosity equal to the total porosity to achieve maximum groundwater movement.

The annual dose for the fish and plant ingestion pathways is calculated below for tritium.

Fish Ingestion Dose Consequence:

The formula for calculating the dose due to the fish ingestion pathway is presented in Equation 1 from Reference 1, Section 6.4.

Equation (1) $$T_d = I * C_f * R_c * T_f * D_f$$

Where:

T_d = Total annual dose consequence (mrem/year)

I = Food consumption in kg per year

C_f = Contaminated food fraction

R_c = Radionuclide concentration in picocuries per liter

T_f = Radionuclide transfer factor in pCi/kg/pCi/L

D_f = Dose conversion factor in millirem per picocurie

The fish ingestion parameter values used in calculating the total annual dose consequences from the fish pathway are:

Parameter	Fish Ingestion	Reference
Food Consumption per year (I)	21 kg	Regulatory Guide 1.109,Table E-5
Contamination Food Fraction (C_f)	0.5	Reference 1 (Default Value)
Transfer Factor for H^3 (T_f)	1 pCi/kg/pCi/L	Reference 1 (Default Value)
H^3 concentration in water (R_c)	6.4E+03 pCi/L	FSAR Table 2.4.13-205
Dose Conversion Factor for H^3 (D_f)	6.4E-08 mrem/pCi	Reference 1, Table D.1

The calculated total annual dose due to fish ingestion from Equation (1) is:

$T_d = I * C_f * R_c * T_f * D_f$ = (21 kg)(0.5)(6.4E+03 pCi/L)(1 pCi/kg/pCi/L)(6.4E-08 mrem/pCi)

T_d = 4.30E-03 mrem/yr

Plant Ingestion Dose Consequence

Calculating the dose due to plant ingestion is slightly more complex. The first step is calculating the concentration of H^3 in the soil following irrigation. Using the annual average precipitation rate of 42.95 inches (109.1 cm) as documented in FSAR Table 2.3.2-244 and conservatively assuming one additional inch (2.54 cm) per month of irrigation water from the receptor water body gives a total plant water availability of 139.6 centimeters per year (2.54 * 12 +109.1) or 11.63 centimeters per month. This means the irrigation fraction (I_f) which is the inverse of availability is calculated to be I_f = 2.54 / 11.63 = 2.18E-01.

In order to calculate the soil water concentration, a saturation ratio must be determined. This is found using Equation 2 below, which is equation E.7 in the RESRAD Version 6 User manual (Reference 2).

Equation (2) $$R_s = [I / K_{sat}]^{1/(2b+3)}$$

Where:

R_S = Saturation ratio
I = Infiltration rate in meters per year
K_{sat} = Saturated zone hydraulic conductivity in meters per year
b = Soil specific exponential factor

From above, the saturation ratio (R_S) is determined based on the following parameters:

Parameter	Value	Basis
Infiltration rate (I) (1.396*0.8) (m/yr)	1.12	Reference 1 (0.1196 m/month x 12 = 1.396 m/yr * 80% of water available)
Saturated zone hydraulic conductivity (K_{sat}) - (m/yr) Floridan Aquifer Surficial Aquifer	 6009 3227	FSAR Table 2.4.13-203
Soil specific exponential factor (b) for: sand, (Floridan Aquifer) loamy sand (Surficial Aquifer)	 4.05 4.38	Reference 2, (Values from Table E.2)

$$R_s = [\, I / K_{sat}]^{1/(2b+3)}$$

$R_s = (1.12/6009)^{1/(2(4.05)+3)} = (1.86E\text{-}04)^{0.09} = 0.462$ for the Floridan Aquifer and

$R_s = (1.12/3227)^{1/(2(4.38)+3)} = (3.47E\text{-}04)^{0.085} = 0.508$ for the Surficial Aquifer

Assuming a soil makeup similar to the contaminated zone yields a site specific soil density from FSAR Table 2.4.13-203 of 2.4 and 1.4 g/cc for the Floridan and Surficial Aquifers, respectively.

The concentration of tritium in the soil water is determined from the following

Equation (3) $W_{H3} = (\rho_b * S_{H3}/P_t * R_s) * I_f$

based on the following soil water concentration parameter values

Parameter	Values		Basis
	Floridan Aquifer	Surficial Aquifer	
Bulk density of soil (ρ_b)	2.4 g/cm^3	1.4 g/cm^3	FSAR Table 2.4.13-203
Concentration of H^3 in soil (S_{H3})	6.4 pCi/g	6.4 pCi/g	FSAR Table 2.4.13-205 and Note 1.
Total porosity of soil (P_t)	0.15	0.20	FSAR Table 2.4.13-203
Saturation ratio (R_s)	0.462	0.508	Calculated from Equation 2
Irrigation fraction (I_f)	0.218	0.218	Calculated

Note (1): For simplicity, the concentration of H^3 in soil is conservatively assumed to be equal to the receptor water body concentration resulting from the postulated release. Consequently the H^3 concentration is converted from picocuries per liter to picocuries per gram by dividing the receptor water body concentration listed in Reference 7.6 by 1,000. In reality, the concentration would be much lower because of dilution in the soil, soil pore space, runoff, and other factors.

Concentration of H^3 in the soil water in pCi/cm^3 (W_{H3}) is as follows:

$$W_{H3} \text{ (Floridan Aquifer)} = [(2.4 * 6.4) / (0.15 * 0.462)]* 0.218 = 48.3 \text{ pCi/cc}$$

$$W_{H3} \text{ (Surficial Aquifer)} = [(1.4 * 6.4) / (0.20 * 0.508)]* 0.218 = 19.2 \text{ pCi/cc}$$

The dose due to plant ingestion is calculated by the following equation assuming the plant water content has a density of 1 g/cm^3:

Equation 4 $T_d = W_{H3} * P_c * (R * C_f) * D_f$

The plant ingestion parameter values are summarizes in the following tabulation:

Parameter	Value		Basis
	Floridan Aquifer	Surficial Aquifer	
H^3 soil water concentration (W_{H3})	48.3 pCi/cm^3	19.2 pCi/cm^3	Calculated from Equation 3
Plant water ratio (P_c)	0.8	0.8	Reference 2 Table L.1
Plant ingestion per year (R)	14,000 g	14,000 g	Reference 1
Plant Contamination Fraction (C_f)	0.5	0.5	Reference 1
Dose Conversion Factor for H^3 (D_f)	6.4E-08 mrem/pCi	6.4E-08 mrem/pCi	Reference 1

Total Dose from Plant Ingestion via Floridan Aquifer (T_d)

T_d = 48.3 * 0.8 * (14,000 * 0.5) * 6.4E-08 = **0.0173 mrem/yr**

Total Dose from Plant Ingestion via Surficial Aquifer (T_d)

T_d = 19.2 * 0.8 * (14,000 * 0.5) * 6.4E-08 = **0.00688 mrem**/yr

The total dose consequence from the fish and plant ingestion pathways is:

Pathway	Annual Dose (mrem/yr)	
Fish Ingestion	4.30E-03	
	Floridan Aquifer	Surficial Aquifer
Plant Ingestion	1.73E-02	6.88E-03
Total Dose Consequence	**2.16E-02**	**1.12E-02**

As shown, the total dose consequence for H^3 is well below 1 millirem per year. By comparison, 10 CFR 20 Appendix B Table 2 Column 2 values are based on an annual exposure of 50 millirem per year. The purpose of the accident evaluation was not to calculate the dose consequence, but rather the concentration in the receptor water body, therefore the direct comparison of the dose consequence is difficult. However, comparing the total of the fish and plant ingestion dose consequence to the basis for 10 CFR 20, Appendix B Table 2, Column 2, the dose consequence is approximately 0.04 percent (0.02/50) of the 10 CFR 20, Appendix B Table 2, Column 2 basis value. Therefore these are considered insignificant pathways and do not require further evaluation.

Because of the depth of the postulated release, other potential pathways, such as inhalation and direct gamma exposure, are eliminated from consideration.

REFERENCES

1. NUREG/CR-6937 User's Manual for RESRAD-OFFSITE Code, Version 2, Argonne National Laboratory, US Department of Energy, June 2007.
2. User's Manual for RESRAD Code, Version 6, Argonne National Laboratory / Environmental Assessment Division, US Department of Energy, July 2001.

Associated LNP COL Application Revisions:

None.

Attachments / Enclosures:

None.