TOLEDO EDISON

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Docket No. 50-346

License No. NPF-3

Serial No. 1118

January 29, 1985

Director of Nuclear Reactor Regulation
Attention: Mr. John F. Stolz
Operating Reactor Branch No. 4
Division of Licensing
United States Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Stolz:

By letter dated July 14, 1983 (Serial No. 972), Toledo Edison submitted to the NRC a request for approval for the alternative on-site disposal of very-low-level radioactively contaminated secondary-side clean up resins for the Davis-Besse Nuclear Power Station Unit No. 1. This request was made pursuant to the regulation of 10 CFR 20.302.

Your letter of May 4, 1984 (Log No. 1509) requested additional information to support our request for approval to dispose on-site certain very-low-level radioactively contaminated wastes. Toledo Edison submitted a response dated July 30, 1984 (Serial No. 1065), for the additional information.

During the month of November 1984, three additional questions were asked by the NRC in a telephone conversation with our Licensing personnel. Attachments 1 through 3 provide Toledo Edison's response to the questions.

Very truly yours,

RPC:DWB:lah

cc: DB-1 NRC Resident Inspector

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Attachment 1

RESPONSES TO NRC QUESTIONS DURING TELEPHONE CONVERSATION IN NOVEMBER 1984

Question 1: Estimate of the dose from ground water for the worst possible disposal site.

Response: The maximally exposed individual dose has been estimated to be less than 0.0002 mrem per year. Justification for this value is given in Attachment No. 2.

Question 2: Provide the basis for selecting the worst location and the principle parameters used in the dose estimate.

Response: The selection of the disposal area is not significant since the assumptions used to calculate the dose estimates for a maximum potential individual exposure with a groundwater well were based on the location of the well being in close proximity to the disposal area. Attachment No. 2 provides details of the calculations used to determine the dose.

Question 3: Provide a map indicating the location of the burial site and the worst location for the nearest well.

Response: Attachment No. 3 indicates the proposed disposal area and the nearest groundwater well to the disposal area. The water from the well is not used for drinking water. Samples are collected quarterly and analyzed for radioactivity as part of the environmental radiological monitoring program.

GROUNDWATER MIGRATION ANALYSIS FOR THE ON-SITE DISPOSAL OF LOW-LEVEL RADIOACTIVELY CONTAMINATED RESIN AT THE DAVIS-BESSE NUCLEAR POWER STATION

Introduction

By letter dated July 14, 1983, Toledo Edison Company submitted to the NRC a request for approval for the alternative on-site disposal of very-low-level radioactively contaminated secondary-side clean-up resin. The NRC has requested additional information related to the potential off-site doses due to groundwater migration. This report is an analysis of the potential, maximum dose to an individual due to groundwater migration of the very-low-level radioactive material contamination on the resin as per the proposed disposal.

The model used for evaluating the potential radiation exposures from groundwater migration has been based on the model used by the NRC for development of the regulations on shallow land disposal of radioactive material (10 CFR 61 rulemaking). Additionally, this model is currently being used by the NRC in their evaluation of de minimis levels of radioactivity for various type waste and disposal methods. The model and application are discussed in detail in NUREG/CR-3585, "De Minimis" Waste Impacts Analysis Methodology, and AIF/NESP-013, Generic Methodology for Assessment of Radiation Doses from Groundwater Migration of Radionuclides in LWR Wastes in Shallow Land Burial Trenches.

This model has been simplified for the evaluation of the groundwater migration for disposal of very-low-level radioactively contaminated resin at Davis-Besse by the following assumptions:

- in general, conservative application of default values for model parameters as discussed in NUREG/CR-3585;
- modeling of an intruder well, thereby maximizing the potential dose calculation; and
- no consideration of migration retention due to soil characterists.

In general, conservative assumptions have been used throughout in order to provide very conservative dose estimates for a maximum potential individual exposure with a groundwater well located in close proximity to the disposal area. By this approval, the final selection of the actual disposal area at the time of the dredging of the basin bottoms will not be limited by this analysis.

Conclusion

By the conservative application of the groundwater migration model, the maximumly exposed individual dose has been estimted to be less than 0.0002 mrem per year. Individual radionuclide dose calculations are summarized in Table 1.

Model Discussion

The model as used for the analysis is represented by the equation:

$$D = \sum_i f_o * f_d * f_w * f_s * C_i * PDCF_i$$

where:

- D = does or dose commitment
- f_o = time delay factor
- f_d = site design and operation factor
- f_w = waste form and package factor (m^3/yr)
- f_s = site selection factor (also called confinement or reduction factor, corresponding to the groundwater analogy of X/Q) (yr/M^3)
- C_i = concentration of radionuclide i in the disposed resins
- $PDCF_i$ = radionuclide specific pathway dose conversion factor (mrem/yr per uCi/ml)

For conservatism and consistency with the guidance of NUREG/CR-3585, the values of f_o and f_d have been set equal to unity, meaning that the groundwater migration is assumed to be initiated at the time of burial. This approach is consistent with the fact that no exterior containers will be used for the packaging of the bottoms prior to burial.

The waste form and package factor f_w is representative of the source term denoting the annual volume of contaminated water that enters the aquifier beneath the disposal area. This value is calculated by the equation:

$$f_w = fl * V_w * f_c$$

where:

- fl = fraction of the total disposed waste volume that is comprised of the waste stream (unitless)
- V_w = annual volume of water that percolates through the disposal facility cover (m^3/yr)
- f_c = fraction of waste radionuclide concentration transferred to the leachate (unitless)

For the Davis-Besse proposed disposal, the value of fl has been set equal to 1 (i.e., all materials placed in the disposal area will be comprised of the very-low-level radioactively contaminated basis bottoms).

The parameter V_w is simply the percolating infiltration multiplied by the effective disposal site surface area. For conservatism, it has been assumed that the dredged basin bottoms are disposed of in a manner that yields an effective surface area of 3.2E+03 m^2 (i.e., an effective depth of 1 foot for the total estimated volume of 34,000 ft^3 of bottoms to be disposed). Based on the guidance of NUREG/CR-3585, the percolating infiltration has been set equal to two times the percolation component V1 of 74 mm of water per year that is representative of the northeast. (The 2 * V1 approach for establishing the value of the infiltration is conservative, characteristic of an unattended open dump with pot holes and

subsidence depressions that result in concentrated sources of rain water infiltration.)

The value of f_c can be calculated by the equation:

$$f_c = M_i * t_c * 10^{(1-IA)}$$

where:

M_i = fraction of the specific radionuclide transferred from the disposed waste to the leachate due to contact of water at continuous full saturation (unitless)

t_c = fraction of the year that the infiltrating volume of water is in contact with the waste (unitless)

$10^{(1-IA)}$ = accessibility multiplier

Values for M_i have been taken from NUREG/CR-3585, Table 6-5. The parameter $10^{(1-IA)}$ is a multiplier due to the inaccessibilities of activated metals waste. For this evaluation, this parameter has been set equal to unity.

The value of t_c is calculated by the equation:

$$t_c = p \div (N * V)$$

where:

p = precipitation that infiltrates and comes in contact with the waste (m/yr)

N = waste effective porosity (unitless)

V = speed of the percolating water (m/yr)

The porosity has been conservatively assumed to be 25%; the speed of the percolating water has been set equal to 1E-04 cm/sec. (For Davis-Besse, the actual soil characterists yield soil permeabilities in the 10^{-5}% to 10^{-6} cm/sec range.) As assumed above, the percolating infiltration p has been set equal to (2 * V1) or 148 mm per year.

The site selection factor f_s is the groundwater migration analogy of the X/Q meteorological dispersion factor. This parameter is calculated by the equation:

$$f_s = (r_g + Q) \Sigma_j r_{tj}$$

where:

r_g = geometric reduction factor (unitless)

Q = dilution factor (m^3/yr)

r_{tj} = reduction factor due to migration and radioactive decay (unitless)

For conservatism, the geometric reduction factor r_g has been set equal to unity, its maximum value.

The dilution factor Q is representative of pumping rate of the groundwater well. A value of 3.84 gpm (7700 M^3/yr) has been selected, representative of a lower bound of the dilution volumes for an intruder well as discussed in the NUREG/CR-3585.

The migration reduction factor r_{tj} is a function of the retardation capabilities of the soils, the disposed waste characteristics and the distance to the location of exposure (i.e., distance from the disposal area to the well). Since, in general, the groundwater migration is not a controlling pathway, an indepth evaluation of the site/soil reduction is not necessary for demonstrating the resulting radiation exposures are inconsequential. Therefore, for conservatism, no credit has been taken for the migration reduction factor (i.e., r_{tj} = 1).

Incorporation of the assumed value for the parameters as described above within the dose assessment model yields the following simplified equation:

$$D = 1.1E\text{-}03 \sum_i M_i * C_i * PDCF_i$$

The radionuclide specific pathway dose conversion factor $PDCF_i$ for the groundwater pathway is simply the radionuclide ingestion dose factor (mrem/uCi, ingested) multiplied by the volume of water consumed (ml/yr). Conservatively assuming an individual obtains all daily water intake (2 liters per day) from the well, the parameter $PDCF_i$ simplifies to:

$$PDCF_i = 2\ l/d * 365\ d/y * 1000\ ml/l * DF_i$$

$$= 7.3E\text{+}05\ DF_i$$

where:

DF_i = radionuclide specific ingestion dose factor as presented in Table A-1 of the July 14, 1983 Toledo Edison submittal (mrem/uCi, ingested - effective total body)

Incorporating this dose factor conversion with the above equations yields:

$$D = 8.0E\text{+}02 \sum_i M_i * C_i * DF_i$$

where:

M_i = fraction of the specific radionuclide transferred from the disposed basin bottoms to the leachate due to contact of water at continuous full saturation (unitless, adapted from Table 6-5, NUREG/CR-3585)

C_i = average concentration of radionuclide i in the disposed basin bottoms (uCi/cm^3, from Toledo Edison Company response to NRC questions)

DF_i = effective total body dose factor for radionuclide i (mr em/uCi, ingested; from the July 14, 1983 Toledo Edison Company submittal)

For the principal radionuclides of concern, these values of M_i, C_i and DF_i as respectively adapted from NUREG/CR-3585 and the previous Toledo Edison Company submittals to NRC, are presented in Table 1.

By substituting the radionuclide specific factors in the equation, the maximum potential dose to an individual from the groundwater pathway can be determined. For the worst case, the dose is calculated to less than 0.0002 mrem per year. In essence, there is more than a factor of 5000 leeway in the calculation for inaccuracies (or non-conservatism) before the groundwater pathway becomes important.

Table 1

Radionuclide	Partition Ratio Between Waste and Leachate M_i	Average Concentration C_i (uCi/ml)	Ingestion Dose Factor DF_i (mrem/uCi, ingested)	Maximum Potential Individual Dose (mrem/yr)
Mn-54	1.3E-03	1.5E-07	2.5	3.9E-07
Co-58	1.5E-02	3.0E-06	5.0	1.8E-04
Co-60	1.5E-02	7.9E-08	2.5E+01	2.4E-05
Cs-134	1.6E-04	2.4E-06	7.1E+01	2.2E-05
Cs-137	1.6E-04	3.2E-06	5.0E+01	2.0E-05

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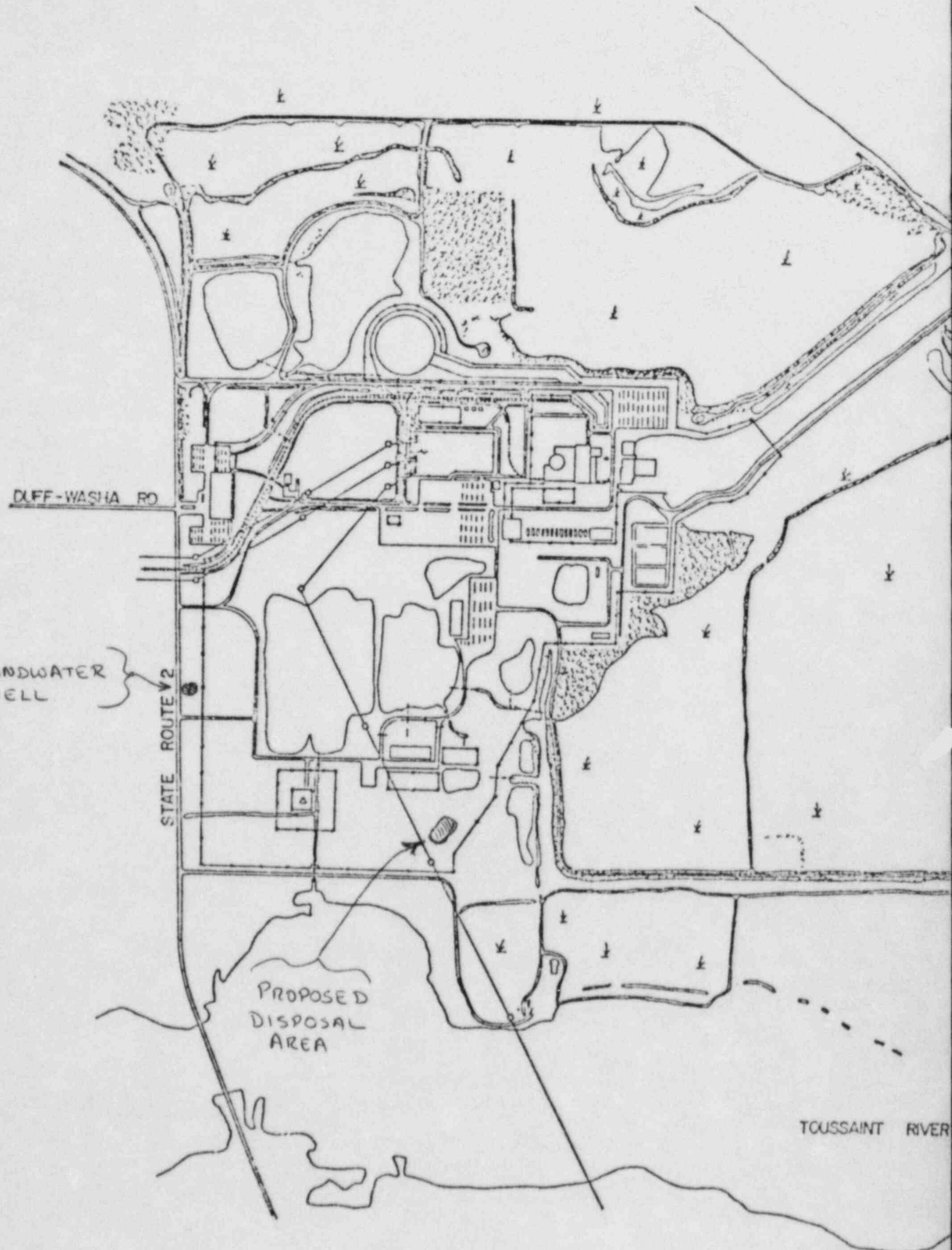
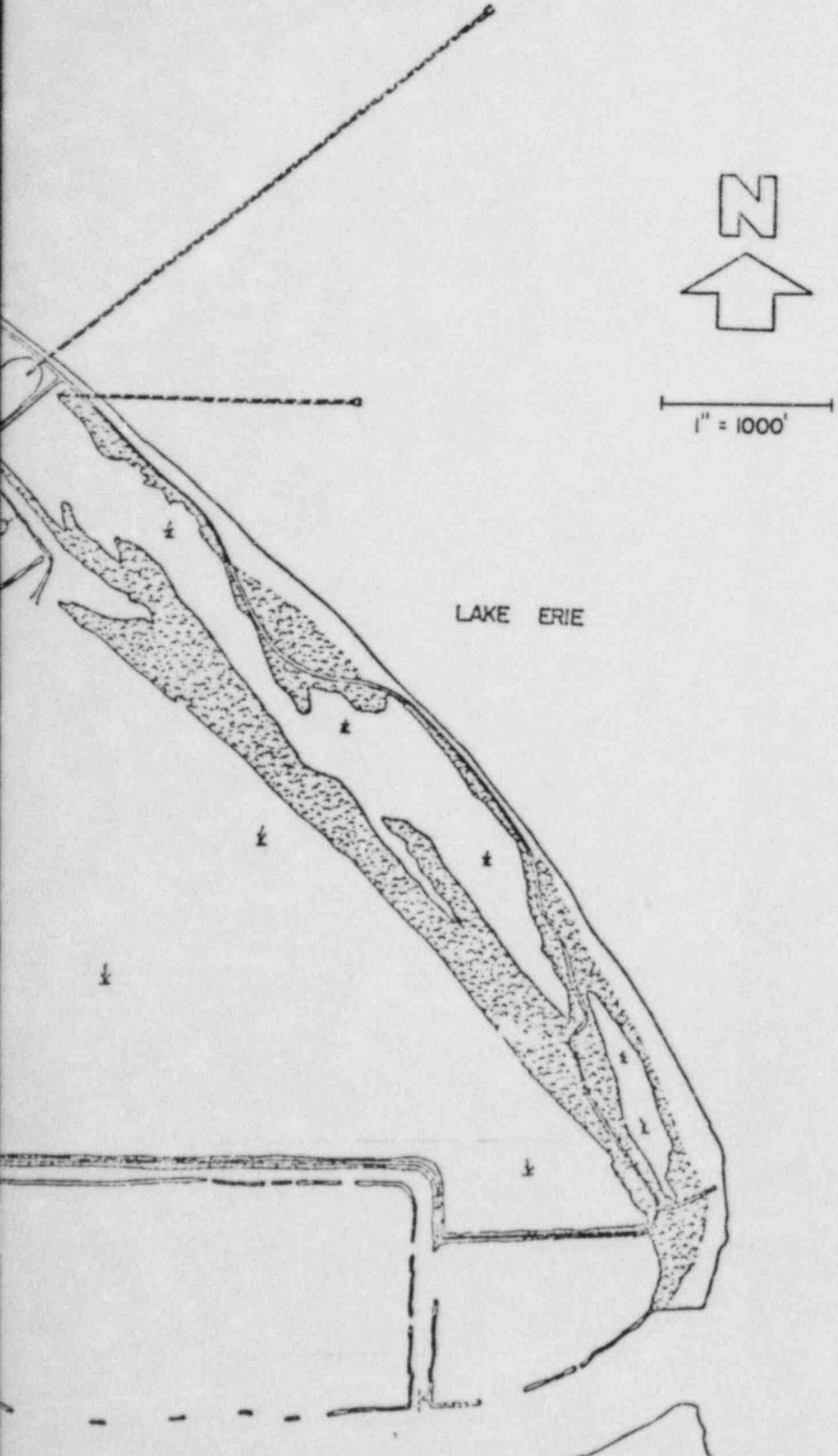

DUFF-WASHA RD
GROUNDWATER WELL
STATE ROUTE 2
PROPOSED DISPOSAL AREA
TOUSSAINT RIVER



Attachment No. 3

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