RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: **123-7920**

SRP Section: **11.01 – Source Terms**

Application Section: **11.01 – Source Terms**

Date of RAI Issue: **08/04/2015**

Question No. 11.01-3

ISSUE

The staff has performed a review of the LADTAP and GASPAR files provided by the applicant. Based on the review of the calculation input and output files and DCD tables the staff is unable to determine the default design parameters that were used in place of site specific data.

The applicant LADTAP input files indicate that Consumption Factors referenced in the application from RG 1.109 in Tables E-4 and E-5 are questionable when compared to the actual values in the Regulatory guide. Also upon review of the applicants LADTAP input and output files, the NRC staff notes that the applicant output files display individual consumption rates as 5.2 kg for Adults, 6.3 kg for Teen, and 5.2 kg for Child. These consumption rates are 100 times less than the values reported in the LADTAP input files provided and 100 times less than the values reported in RG 1.109 Table E-5.

INFORMATION NEEDED

The staff is requesting a calculation package that describes all input parameters and their source used within the LADTAP and GASPAR effluent dose codes. Provide the basis for all design parameters and values used in the LADTAP II and GASPAR II code calculations. Staff requests that these calculation packages include value derivations and references to sources of the data to support the review and evaluation of compliance with 10 CFR 50 Appendix I design dose requirements for liquid and gaseous effluents.

The staff is also requesting the applicant to confirm the values being reported in the LADTAP input and output files and results being reported in DCD Table 11.2-5.

Please address these items and provide a mark up for the proposed DCD changes. It may be necessary to provide this information in an audit.

Response

As pointed out by the staff, the LADTAP input values for maximum individual consumption rates of 5.2 kg for Adults, 6.3 kg for Teen, and 5.2 kg for Child used to calculate the offsite dose due to liquid effluents were incorrect. This was due to the wrong positioning of the input values in the columns of the LADTAP code input deck. KHNP corrected these parameters to be 520 kg for Adult, 630 kg for Teen and 520 kg for Child in order to be consistent with the values in Table E-5 of RG 1.109. Therefore, the results of the offsite doses in DCD Table 11.2-5 have been revised. As shown in the updated Table 11.2-5, the individual doses still comply with the dose criteria specified in 10 CFR 50 Appendix I.

The basis for the input parameters used in the LADTAP II and GASPAR II codes are provided in DCD Tables 11.2-4 and 11.3-5, respectively. Since there is no site-specific data for the DC application, most of the parameter values are based on the default values in RG 1.109. The basis for the other parameter values is also briefly described in the two tables.

The dilution factor of 5 used in LADTAP II code calculation is an assumed value based on a paper titled “Verification of aquatic dilution factors for liquid effluents released from a nuclear power plant”, Health Physics, 1993. This paper concludes that the dilution factor of 5 from Fermi 2 NPP to Lake Erie is verified as supported by the models and site-specific data.

The irrigation rate of 16.67 L/m2·month (0.5 m/yr) used in the LADTAP II calculation is based on a document titled “Data collection handbook to support modeling impacts of radioactive material in soil”, Argonne National Laboratory, 1993. This document provides the definitions and values that can be used in RESRAD code analysis. In Section 11.3 of the document, the default value for the irrigation rate is 0.2 m/yr, which represents the conditions of a relatively humid region. For LADTAP II code calculation, a conservative value of 0.5 m/yr was selected.

For the GASPAR II code calculation, all the input parameter values were obtained from the default values in RG 1.109 except for the atmospheric dispersion factors.

The electronic input and output files of the updated LADTAP II code calculation are provided for the staff’s review in Attachments 2 and 3, respectively.

Impact on DCD

DCD 11.2.3.1 and Table 11.2-5 will be updated as indicated in Attachment 1.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Reports.

$$C(i) = \frac{R(i) \times MF_i}{F_{dil}}$$

Where:

C(i) = design basis liquid effluent concentration for the i^{th} isotope, Bq/L

R(i) = total annual release rate of the i^{th} isotope, Bq/yr (Table 11.2-1)

MFi = multiplication factor for the ith isotope (ratio of 1 % fuel defect design basis radionuclide concentration to ANSI/ANS-18.1-1999 expected concentration)

F_{dil} = dilution flow rate at discharge point, L/yr

The sum of concentration ratios for the design basis fuel leakage is 0.18, as presented in Table 11.2-10. This value is less than 1.0, which indicates that the releases meet the regulatory limit.

Offsite doses received by individuals as a result of radioactive liquid releases are calculated using the LADTAP II Code (Reference 29). The input parameters of the LADTAP II Code (Reference 29) are presented in Table 11.2-4. The dilution factor for aquatic food, boating, shoreline, swimming, and drinking water is assumed to be 5 for the normal operating conditions. The results of the dose calculation are presented in Table 11.2-5. The values are compared with the corresponding limits of 10 CFR 50, Appendix I (Reference 4). The maximum individual dose to total body is ~~0.018~~ mSv/yr for ~~an adult.~~ a child. This value is less than the regulatory limit of 0.03 mSv/yr presented in 10 CFR 50, Appendix I (Reference 4). The maximum dose to any individual organ is ~~0.023~~ 0.0276 mSv/yr, which is the dose to a child's liver. This value is less than the limitation of 0.1 mSv/yr presented in 10 CFR 50, Appendix I (Reference 4).

0.0405

The COL applicant is to calculate the dose to members of the public following the guidance of NRC RG 1.109 (Reference 30) and NRC RG 1.113 (Reference 31) using site-specific parameters and to compare the doses due to liquid effluents with the numerical design objectives of Appendix I to 10 CFR 50 (Reference 4), 10 CFR 20.1302 (Reference 32), and 40 CFR 190 (Reference 33) (COL 11.2(13)).

Table 11.2-5 (1 of 2)

Individual Doses from Liquid Effluents (mSv/yr)

Age Group	Skin	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Fish								
ADULT	-	1.54E-02	1.53E-02	1.12E-02	3.37E-04	5.14E-03	1.77E-03	4.47E-03
TEEN	-	1.65E-02	1.57E-02	6.62E-03	2.89E-04	5.20E-03	2.02E-03	3.29E-03
CHILD	-	2.08E-02	1.37E-02	2.99E-03	2.76E-04	4.38E-03	1.60E-03	1.30E-03
Drinking								
ADULT	-	2.07E-04	6.68E-03	6.61E-03	6.85E-03	6.53E-03	6.44E-03	7.55E-03
TEEN	-	1.98E-04	4.77E-03	4.63E-03	4.89E-03	4.63E-03	4.55E-03	5.35E-03
CHILD	-	5.71E-04	9.18E-03	8.80E-03	9.60E-03	8.90E-03	8.73E-03	9.47E-03
INFANT	-	5.93E-04	9.14E-03	8.60E-03	9.97E-03	8.75E-03	8.58E-03	9.03E-03
Shoreline Activity								
ADULT	2.13E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05
TEEN	1.19E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04
CHILD	2.48E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05
Irrigated food: Vegetables								
ADULT	-	4.12E-06	5.01E-05	4.88E-05	4.84E-05	4.72E-05	4.55E-05	6.65E-05
TEEN	-	6.85E-06	6.34E-05	5.86E-05	6.00E-05	5.86E-05	5.59E-05	8.22E-05
CHILD	-	1.63E-05	1.01E-04	9.02E-05	9.73E-05	9.31E-05	8.86E-05	1.09E-04
Irrigated food: Leafy Vegetables								
ADULT	-	4.12E-06	5.01E-05	4.88E-05	4.84E-05	4.72E-05	4.55E-05	6.65E-05
TEEN	-	6.85E-06	6.34E-05	5.86E-05	6.00E-05	5.86E-05	5.59E-05	8.22E-05
CHILD	-	1.63E-05	1.01E-04	9.02E-05	9.73E-05	9.31E-05	8.86E-05	1.09E-04
Irrigated food: Milk								
ADULT	-	2.78E-06	4.93E-05	4.81E-05	4.71E-05	4.64E-05	4.54E-05	4.52E-05
TEEN	-	4.65E-06	6.20E-05	5.78E-05	5.82E-05	5.73E-05	5.58E-05	5.52E-05
CHILD	-	1.11E-05	9.89E-05	8.93E-05	9.37E-05	9.09E-05	8.83E-05	8.72E-05

Replace this table with "A" after this table

Table 11.2-5 (2 of 2)

Age Group	Skin	Bone	Liver	T. Body	Thyroid	Kidney	Lung	GI-LLI
Irrigated Food: Meat								
ADULT	-	8.86E-06	4.65E-05	4.71E-05	4.59E-05	6.02E-05	4.51E-05	5.44E-04
TEEN	-	1.52E-05	5.75E-05	5.77E-05	5.63E-05	8.12E-05	5.53E-05	6.93E-04
CHILD	-	3.74E-05	9.13E-05	9.23E-05	8.99E-05	1.32E-04	8.76E-05	5.97E-04
Sum of All Pathways								
ADULT	2.13E-05	1.56E-02	2.22E-02	1.80E-02	7.39E-03	1.19E-02	8.41E-03	1.28E-02
TEEN	1.19E-04	1.68E-02	2.08E-02	1.16E-02	5.51E-03	1.02E-02	6.89E-03	9.65E-03
CHILD	2.48E-05	2.15E-02	2.33E-02	1.22E-02	1.03E-02	1.37E-02	1.07E-02	1.17E-02
INFANT	0.00E+00	5.93E-04	9.14E-03	8.60E-03	9.97E-03	8.75E-03	8.58E-03	9.03E-03

Replace this table with "A" after this table

A

Table 11.2-5

Individual Doses from Liquid Effluents (mSv/yr)

Age Group	Skin	Bone	Liver	T.body	Thyroid	Kidney	Lung	GI-LLI
Fish								
ADULT	-	1.54E-02	1.53E-02	1.12E-02	3.37E-04	5.14E-03	1.77E-03	4.47E-03
TEEN	-	1.65E-02	1.57E-02	6.62E-03	2.89E-04	5.20E-03	2.02E-03	3.29E-03
CHILD	-	2.08E-02	1.37E-02	2.99E-03	2.76E-04	4.38E-03	1.60E-03	1.30E-03
Drinking								
ADULT	-	2.07E-04	6.68E-03	6.61E-03	6.85E-03	6.53E-03	6.44E-03	7.55E-03
TEEN	-	1.98E-04	4.77E-03	4.63E-03	4.89E-03	4.63E-03	4.55E-03	5.35E-03
CHILD	-	5.71E-04	9.18E-03	8.80E-03	9.60E-03	8.90E-03	8.73E-03	9.47E-03
INFANT	-	5.93E-04	9.14E-03	8.60E-03	9.97E-03	8.75E-03	8.58E-03	9.03E-03
Shoreline Activity								
ADULT	2.13E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05	1.81E-05
TEEN	1.19E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04	1.01E-04
CHILD	2.48E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05	2.12E-05
Irrigated food : Vegetables								
ADULT	-	4.02E-04	4.99E-03	4.86E-03	4.58E-03	4.70E-03	4.54E-03	6.56E-03
TEEN	-	6.67E-04	6.31E-03	5.83E-03	5.63E-03	5.84E-03	5.58E-03	8.11E-03
CHILD	-	1.59E-03	1.01E-02	8.99E-03	8.98E-03	9.28E-03	8.84E-03	1.08E-02
Irrigated food : Leafy vegetables								
ADULT	-	5.07E-05	6.17E-04	6.00E-04	5.92E-04	5.81E-04	5.60E-04	8.17E-04
TEEN	-	4.56E-05	4.23E-04	3.90E-04	3.97E-04	3.91E-04	3.73E-04	5.47E-04
CHILD	-	8.13E-05	5.06E-04	4.51E-04	4.82E-04	4.66E-04	4.43E-04	5.43E-04
Irrigated food:Milk								
ADULT	-	1.65E-04	2.94E-03	2.87E-03	2.78E-03	2.76E-03	2.71E-03	2.69E-03
TEEN	-	2.94E-04	3.93E-03	3.67E-03	3.65E-03	3.63E-03	3.54E-03	3.50E-03
CHILD	-	6.99E-04	6.27E-03	5.66E-03	5.84E-03	5.76E-03	5.60E-03	5.53E-03
Irrigated food : Meat								
ADULT	-	1.79E-04	9.82E-04	9.94E-04	9.53E-04	1.26E-03	9.54E-04	1.11E-02
TEEN	-	1.50E-04	5.92E-04	5.94E-04	5.68E-04	8.27E-04	5.70E-04	6.90E-03
CHILD	-	2.82E-04	7.19E-04	7.26E-04	6.89E-04	1.03E-03	6.90E-04	4.55E-03
Sum of all Pathways								
ADULT	2.13E-05	1.64E-02	3.15E-02	2.72E-02	1.61E-02	2.10E-02	1.70E-02	3.32E-02
TEEN	1.19E-04	1.80E-02	3.18E-02	2.18E-02	1.55E-02	2.06E-02	1.67E-02	2.78E-02
CHILD	2.48E-05	2.40E-02	4.05E-02	2.76E-02	2.59E-02	2.98E-02	2.59E-02	3.22E-02
INFANT	0.00E+00	5.93E-04	9.14E-03	8.60E-03	9.97E-03	8.75E-03	8.58E-03	9.03E-03