

**UNITED STATES
NUCLEAR REGULATORY COMMISSION**

**BEFORE THE
ATOMIC SAFETY AND LICENSING BOARD**

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| -----X In re: License Renewal Application Submitted by Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc. -----X | Docket Nos. 50-247-LR; 50-286-LR ASLBP No. 07-858-03-LR-BD01 DPR-26, DPR-64 February 17, 2012 |
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DECLARATION OF DR. FRANÇOIS J. LEMAY

**IN SUPPORT OF THE STATE OF NEW YORK'S ANSWER TO ENTERGY'S
MOTION IN LIMINE TO EXCLUDE PORTIONS OF PRE-FILED TESTIMONY
AND EXHIBITS FOR CONSOLIDATED CONTENTION NYS-12C**

1. I am a professional engineer with a Ph.D. in Physics of Nuclear Reactors from the University of Birmingham, United Kingdom, with 27 years of experience in safety analysis, emergency response plans, procedures and systems, radiation protection, radiation transport, risk assessment, environmental impact assessment, standards and guidelines, audits and evaluations, emergency exercises, courses and training and international projects. As discussed in my pre-filed testimony (Exhibit NYS0000241), I currently offer an advanced level course on MELCOR Accident Consequence Code Systems 2 ("MACCS2") and COSYMA, a code from the European Union that is similar to MACCS, for health physicists and engineers. I have extensive experience with the MACCS and MACCS2 codes, including using the codes to calculate the consequences to the population for several accidents scenarios in the context of the Nanticoke

New Build Project for Bruce Power in Ontario. I also have extensive experience with COSYMA, a code from the European Union that is similar to MACCS, and have performed similar calculations for ESKOM in South Africa, Hydro-Quebec and New Brunswick Power in Canada, and the Canadian Navy. My education, professional qualifications, and experience are provided in Exhibit NYS000291.

2. I am currently Vice President of International Safety Research Inc. (“ISR”). ISR has been retained by the State of New York to provide expert assistance in the Nuclear Regulatory Commission (“NRC”) relicensing proceeding for Indian Point 2 and 3.

3. To perform the consequence portion of its SAMA analysis, Entergy used the MACCS2 computer model, which was developed by Sandia National Laboratories. Entergy used the MACCS2 code to estimate the cost of decontamination and cleanup after a severe accident at Indian Point.

4. MACCS2 is executed in three steps. The first module, ATMOS, calculates air and ground concentrations, plume size, and timing information for all plume segments as a function of downwind distance. The next module, EARLY, calculates the consequences due to exposure to radiation in the first seven days, which is the emergency phase of the accident. The last module, CHRONC, calculates the consequence of the long-term effects of radiation and computes the decontamination and economic impacts incurred due to the accident.

5. All of the MACCS2 inputs used by Entergy in its SAMA analysis that are associated with decontamination and cleanup costs, i.e. economic costs, are found in the CHRONC module.

6. In our December 21, 2011, report titled Review of Indian Point Severe Accident

Off Site Consequence Analysis (NYS000242), ISR conducted a sensitivity analysis to determine which CHRONC input parameters have the greatest effect on the offsite economic cost risk (“OECR”), which is the per year total economic cost of a severe accident used in the SAMA analysis.

7. For each of the sensitive parameters thus determined, ISR identified: the definition of the parameter; the input values chosen by Entergy; the explicit or implicit rationales for Entergy’s selection of those values; a range of more appropriate values (where applicable) based on available data and relevance to current site-specific conditions of the area surrounding Indian Point; and a re-calculation of the OECR using the more appropriate value(s).

8. In our report, there are two references to a modification of the MACCS2 source code:

- Page 22: “The MACCS2 code restricts decontamination costs (CDNFRM) to a maximum of \$100,000/person; therefore, ISR modified the source code to allow for the greater decontamination costs proposed here.”
- Page 24: “The MACCS2 code restricts the decontamination time input to a maximum of one year; therefore, ISR modified the source code to allow for greater decontamination times.”

9. The MACCS2 code distributed by NRC includes an executable form of the code, along with the source code and test files. Providing the source code and test files is standard practice for nuclear codes since these programs need to be maintained and ported to different compilers and operating systems. Computer technology evolves quickly while the regulatory-accepted models change slowly. In addition, providing the source code allows the analysts to

scrutinize the calculation models and to make modifications when changes that had not been anticipated by the code designers become necessary.

10. For the input parameters CDNFRM and TIMDEC, ISR had to modify the original MACCS2 source code file to allow us to run the model using higher decontamination costs and longer decontamination times than those that were envisioned when the code was developed. This was the only way to run the model using the input values we considered to be more appropriate for conducting a SAMA analysis for Indian Point. These changes were simple and obvious for an experienced nuclear analyst.

11. The new file created by ISR that contains these modifications is named MACCS2-ISR.FOR, and was provided to NRC Staff.

12. For the parameter CDNFRM, the range for the nonfarm decontamination cost for all decontamination levels is hard-coded to be between \$1/person to \$100,000/person. In order to determine the overall costs as a result of ISR's proposed ranges of CDNFRM, ISR modified the source code to increase the upper bound of CDNFRM to \$2,000,000/person. The change ISR made is shown in red below.

| File | Source code |
|------------------------|--|
| <i>from originally</i> | |
| MACCS2.FOR | CALL RGETN ('CHCDNFRM001', 0, CDNFRM, LVLDEC, 1.0, 1.E5, \$ RANGE, FOUND, 'INCHRN', 'CDNFRM') |
| <i>changed to</i> | |
| MACCS2-ISR.FOR | CALL RGETN ('CHCDNFRM001', 0, CDNFRM, LVLDEC, 1.0, 2.E6, \$ RANGE, FOUND, 'INCHRN', 'CDNFRM') |

13. For TIMDEC, the range for the decontamination time for all decontamination levels is hard-coded to be between 1.0E-6 seconds to 3.16E+7 seconds (1 year). In order to determine the overall costs as a result of our proposed ranges of TIMDEC, we modified the

source code to increase the upper bound of TIMDEC to 6.31152E+9 seconds (200 years). The change ISR made is shown in red below.

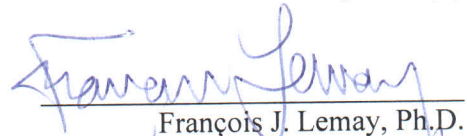
| File | Source code |
|----------------|---|
| | <i>from originally</i> |
| MACCS2.FOR | CALL RGETN ('CHTIMDEC001', 0, TIMDEC, LVLDEC, 1.E-6, 3.16E7, \$ RANGE, FOUND, 'INCHRN', 'TIMDEC') |
| | <i>changed to</i> |
| MACCS2-ISR.FOR | CALL RGETN ('CHTIMDEC001', 0, TIMDEC, LVLDEC, 1.E-6, 6.31152E9, \$ RANGE, FOUND, 'INCHRN', 'TIMDEC') |

14. These are the only two modifications ISR made to the MACCS2.FOR code.

15. These two modifications to the MACCS2 code simply increased the maximum input values the code would accept for CDNFRM and TIMDEC. These modifications allow the code to accept larger input values. Neither of these changes modified the algorithms used by MACCS2. Furthermore, ISR conducted extensive verifications on the modified code to ensure that it continued to give the same results as the unchanged code when the same set of input files was used.

16. I declare under penalty of perjury that my statements in the foregoing testimony and my statement of professional qualifications are true and correct to the best of my knowledge and belief.

Executed in Accord with 10 C.F.R. § 2.304(d)



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