UNITED STATES
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD

In re:	Docket Nos. 50-247-LR; 50-286-LR
License Renewal Application Submitted by	ASLBP No. 07-858-03-LR-BD01
Entergy Nuclear Indian Point 2, LLC, Entergy Nuclear Indian Point 3, LLC, and Entergy Nuclear Operations, Inc.	DPR-26, DPR-64 January 22, 2014

DECLARATION OF DR. FRANÇOIS J. LEMAY IN SUPPORT OF THE STATE OF NEW YORK'S MOTION TO REOPEN THE RECORD AND FOR RECONSIDERATION OF CONTENTION NYS-12C

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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. 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 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. ISR's findings were documented in an expert report.[1] I provided pre-filed testimony and also testified in person at the evidentiary hearing on Track 1 contentions before the Atomic Safety and Licensing Board in Tarrytown, New York, on October 17 and 18, 2012.[2]

[1] ISR Report: Review of Indian Point Off Site Consequence Analysis (Dec. 21, 2011) (Exhibit NYS000242), as updated in Exhibit NYS000430.

[2] Initial Pre-filed Written Testimony of New York State Expert Dr. François Lemay of ISR regarding Contention NYS-12C ("Lemay Initial Test.") (Dec. 21, 2011) (Exhibit

3. On December 7, 2013, while I was out of the country on previously-scheduled business with the International Atomic Energy Agency, my colleague at ISR, Timothy Mahilrajan, submitted a declaration (ML13341A003, Attachment 2) explaining that, based on his review of MACCS2 input and output files, NRC used a 365-day decontamination time, TIMDEC, when it ran the MACCS2 code for the recent Spent Fuel Pool Consequence Study[3].

4. On December 23, 2013, in response to the Mahilrajan declaration, NRC Staff submitted the Affidavit of S. Tina Ghosh. The Ghosh affidavit represents the first time that Staff has attempted to explain why a 365-day TIMDEC was used in the MACCS2 analysis for the Consequence Study, and why NRC maintains that 60 and 120 days are still appropriate values for the MACCS2 analysis for the Indian Point Severe Accident Mitigation Alternatives (SAMA) analysis.

5. After reviewing the Ghosh affidavit, I conclude that NRC's use of a 365-day TIMDEC value in the Consequence Study provides further support for the unreasonableness of 60 and 120 days for the Indian Point SAMA analysis. In sum, if NRC used a 365-day TIMDEC for the Consequence Study, it should have used at least a 365-day TIMDEC in the Indian Point SAMA analysis.[4]

NYS000241); Rebuttal Pre-filed Testimony of New York State Expert Dr. François Lemay of ISR regarding Contention NYS-12C ("Lemay Rebuttal Test.") (June 29, 2012) (Exhibit NYS000420); Tr. 1780-2083.

[3] Consequence Study of a Beyond Design Basis Earthquake Affecting the Spent Fuel Pool for a U.S. Mark 1 Boil Water Reactor, Attachment 7, ML13256A342 (final) October 2013, and Attachment 3, ML13133A132 (draft) June 2013.

[4] TIMDEC values longer than one year may be appropriate for Indian Point given the high building density and high population density surrounding the site. *See, e.g.*, Exhibit NYS000430 at Table 13 (for light decontamination one to fifteen year TIMDEC values would be appropriate; for heavy decontamination, two to thirty year TIMDEC values would be appropriate).

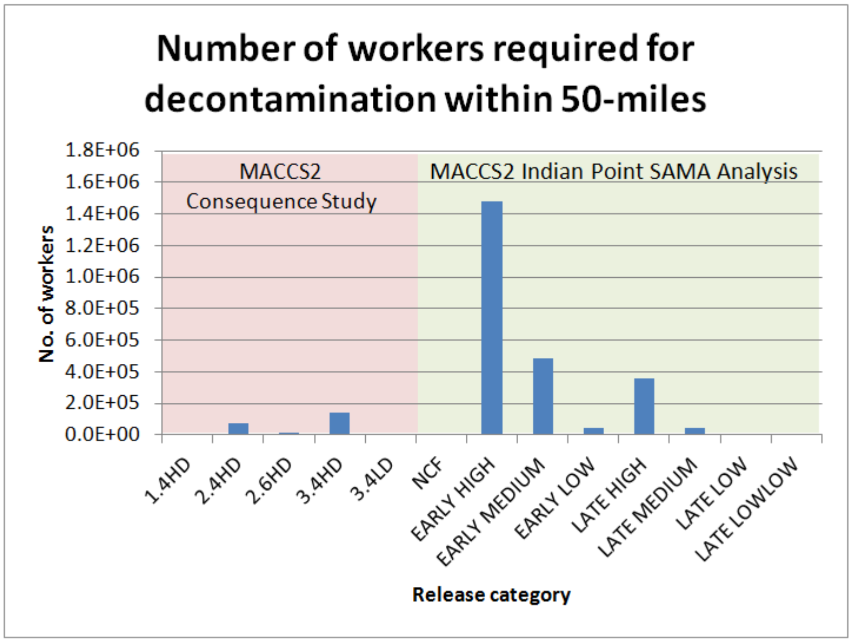
6. Various factors affect TIMDEC. In my opinion, source term, contaminated land area, and affected population are all factors that should inform the choice of TIMDEC in the MACCS2 code. Greater amounts of contamination, larger areas of contaminated land, and larger populations in contaminated areas should contribute to longer decontamination times.

7. In attempting to distinguish the MACCS2 Consequence Study from the MACCS2 Indian Point SAMA analysis, however, Dr. Ghosh overlooks the impact of population on decontamination time, especially in an area that is as densely populated as the area surrounding Indian Point. While Dr. Ghosh's statement that "the calculated source terms and contaminated land areas [in the Consequence Study] were significantly larger than those calculated in typical reactor accident probabilistic risk assessments (PRAs)" (Ghosh Aff. ¶ 3) is generally correct, it is incomplete. She fails to acknowledge that the affected population and population density are just as important as "the calculated source terms and contaminated land areas" in determining TIMDEC. The Ghosh affidavit presents an incomplete picture of the factors relevant to TIMDEC – this has particular significance for the Indian Point proceeding since the area surrounding Indian Point has the highest population density of all nuclear sites in the USA.

8. Building upon the position set out in the Ghosh affidavit, the more complete way to take into account all of the factors that inform TIMDEC is to calculate the number of workers required to decontaminate a particular accident in a particular timeframe in much the same way that the MACCS2 code already calculates this value internally.[5] To calculate the number of workers, ISR used the information contained in the MACCS2 output files supplied by US-NRC for the five reference accident scenarios examined in the Consequence Study and the MACCS2

[5] The MACCS2 code internally calculates the number of workers to determine the radiation dose to workers.

output files supplied by Entergy for the eight release categories examined in the Indian Point SAMA analysis, and the methodology used in NUREG/CR-3673 (Exhibit NRC00058).[6] As shown in the chart below, when all factors relevant to TIMDEC are taken into account—including source term, land area, and affected population—the number of workers required to decontaminate within the TIMDEC used[7] is much greater for the Indian Point SAMA analysis.



As shown in the chart, the number of workers required to decontaminate an affected area within 50 miles of Indian Point following an EARLY HIGH accident (1.5 million workers), EARLY MEDIUM accident (490,000 workers), or LATE HIGH accident (360,000 workers) at Indian

[6] This calculation is explained in more detail in Exhibit NYS000431.

[7] For light and heavy decontamination respectively, US-NRC used a TIMDEC of 365 days and 365 days in the Consequence Study (pink area in the chart), and Entergy used a TIMDEC of 60 days and 120 days for the Indian Point SAMA Analysis (green area in the chart). NUREG/CR-3673 uses 90 days, which represents the mean of 60 and 120 days, to calculate number of workers. Exhibit NRC00058 at 6-24 to 6-25.

Point Unit 2 are completely unreasonable.[8] Increasing the TIMDEC to 365 days or greater for the Indian Point SAMA analysis would decrease the number of workers required because the workers would have more time to complete decontamination. Without an appropriately long TIMDEC value, resulting in a realistic number of workers, the Indian Point SAMA analysis is unrealistic and unreasonable. In seeking to justify the staff's selection of a 365-day TIMDEC input in the Consequence Study as well as Staff's acceptance of 60-day and 120-day TIMDEC inputs in the Indian Point analysis, the Ghosh affidavit overlooked the population differences between the two studies and the role population and population density play in TIMDEC as evidenced in the number of decontamination workers. In summary, the source term and the contaminated land area are relevant factors that affect the number of workers required for decontamination, but the population density is the most important factor for the Indian Point SAMA analysis and it justifies using a longer TIMDEC value.

9. NRC has previously stated that TIMDEC values of 60 and 120 days represent average values that apply to all release categories.[9] In the Ghosh affidavit, NRC now acknowledges that the severity of the release category is a relevant factor in setting the value of TIMDEC. The goal of the MACCS2 analysis is to estimate the economic cost and population dose risk, which are then used as inputs in the SAMA analysis. By using an unreasonably short decontamination time for the most severe accidents at Indian Point, the off-site economic cost risk (OECR) is underestimated significantly.

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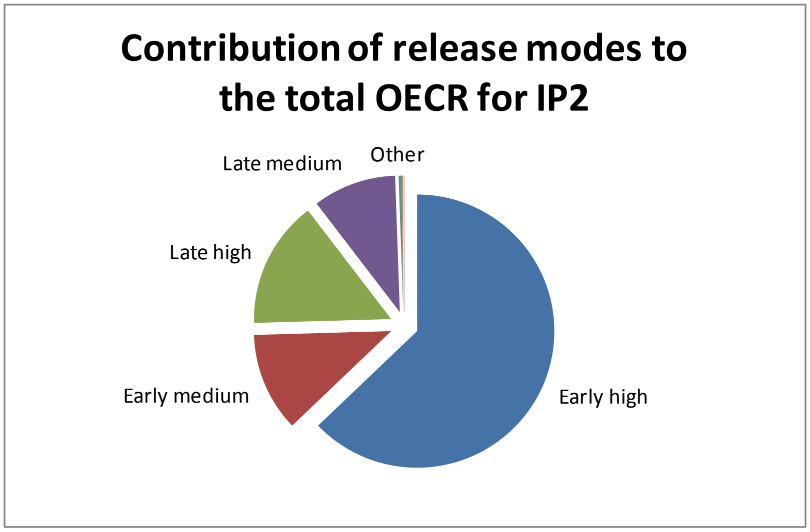
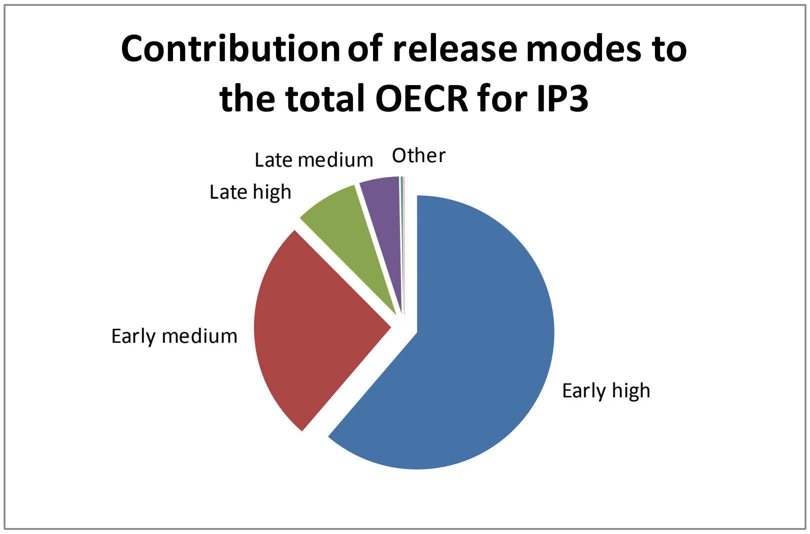
[8] Similar numbers of workers are required to decontaminate an affected area following similar accidents at IP3. The number of workers required to decontaminate following the Consequence Study scenarios 2.4HD (73,000) and 3.4 HD (140,000) in one year may also be unreasonable, but the Indian Point values are completely unrealistic.

[9] *See, e.g.*, Exhibit NRC000041 at 89, 90.

10. It is particularly important to use reasonable values for THE EARLY HIGH, EARLY MEDIUM, LATE HIGH, AND LATE MEDIUM release categories, since the OECR associated with these release categories drives the total OECR for Indian Point, as shown in the pie charts below.





In the above charts, the narrow "Other" wedge combines the following four accident scenarios: NO-CONTAINMENT FAILURE (or NCF), LATE LOW, LATE LOW LOW, and EARLY LOW. These charts are based upon the Indian Point SAMA analysis calculations Entergy provided in Exhibit ENT000464 Table 5 and Table 6, reproduced below.

Table 5 IP2 Mean PDR and OECR Using Year 2000 Meteorological Data

Release Mode	Frequency (/yr)	Population Dose (person-sv)*	Offsite Economic Cost ($)	Population Dose Risk (PDR) (person-rem/yr)	Offsite Economic Cost Risk (OECR) ($/yr)
NCF	1.19E-05	4.75E+01	9.98E+04	5.64E-02**	1.18E+00
EARLY HIGH	6.50E-07	6.51E+05	2.05E+11	4.23E+01	1.33E+05
EARLY MEDIUM	4.23E-07	1.94E+05	5.87E+10	8.21E+00	2.48E+04
EARLY LOW	1.11E-07	7.93E+04	6.39E+09	8.81E-01	7.10E+02
LATE HIGH	6.88E-07	1.63E+05	4.64E+10	1.12E+01	3.19E+04
LATE MEDIUM	3.43E-06	6.87E+04	6.06E+09	2.36E+01	2.08E+04
LATE LOW	6.43E-07	1.61E+04	6.59E+08	1.04E+00	4.24E+02
LATE LOWLOW	5.82E-08	1.38E+04	5.62E+08	8.04E-02	3.27E+01
			Totals	8.74E+01	2.12E+05

Table 6 IP3 Mean PDR and OECR Using Year 2000 Meteorological Data

Release Mode	Frequency (/yr)	Population Dose (person-sv)*	Offsite Economic Cost ($)	Population Dose Risk (PDR) (person-rem/yr)	Offsite Economic Cost Risk (OECR) ($/yr)
NCF	6.30E-06	8.04E+01	2.95E+05	5.06E-02**	1.86E+00
EARLY HIGH	9.43E-07	5.08E+05	1.70E+11	4.79E+01	1.60E+05
EARLY MEDIUM	1.24E-06	2.00E+05	5.55E+10	2.47E+01	6.87E+04
EARLY LOW	1.46E-07	5.21E+04	3.58E+09	7.59E-01	5.21E+02
LATE HIGH	4.23E-07	1.63E+05	4.61E+10	6.89E+00	1.95E+04
LATE MEDIUM	2.01E-06	6.85E+04	6.06E+09	1.37E+01	1.22E+04
LATE LOW	3.75E-07	1.61E+04	6.58E+08	6.03E-01	2.47E+02
LATE LOWLOW	5.66E-08	1.38E+04	5.62E+08	7.81E-02	3.18E+01
			Totals	9.48E+01	2.61E+05

11. In her affidavit, Dr. Ghosh also states that "Often the most probable reactor accidents are those which do not result in large areas of contaminated land, for example, in the bin of 'no containment failure.'" Ghosh Aff. ¶ 4. As noted above, the narrow wedge labeled "Other" in the pie charts below includes the release category of NCF or "no containment failure." As can be seen from the pie chart, the no containment failure release category makes an insignificant contribution to the total OECR. Thus, the statement by Dr. Ghosh in no way invalidates the point that some release categories contribute to OECR more than others. The relative impact of assigning a specific TIMDEC value for each release category is examined in the following paragraph.

12. As shown in the table below, three approaches to TIMDEC are compared relative to their impact on the total OECR. Column two shows the values previously calculated by Entergy for the Indian Point SAMA analysis, using a TIMDEC of 60 days and 120 days for all of the eight release categories. This was the approach that was accepted by NRC Staff. Column three reports the results of an ISR run that replicated the Entergy analysis, but used a TIMDEC of 365 days and 365 days, as in the Consequence Study. ISR kept all other input parameters the same as entered by Entergy. Column four lists the OECR based on the TIMDEC values used in the Entergy Indian Point SAMA analysis for the four release categories with less severe consequences (NCF, EARLY LOW, LATE LOW, and LATE LOW LOW), and on the TIMDEC values used in the Consequence Study for the other four release categories, which result in more severe consequences (EARLY HIGH, EARLY MEDIEUM, LATE HIGH, and LATE MEDIUM).

Release Category	OECR ($/yr) with TIMDEC = 60 d (DF=3)/120 d (DF=15)*	OECR ($/yr) with TIMDEC = 365 d (DF=3)/365 d (DF=15)*	OECR ($/yr) with specific TIMDEC for each release category
NCF	1.19E+00	3.07E+00	1.19E+00
EARLY HIGH	1.33E+05	2.18E+05	2.18E+05
EARLY MEDIUM	2.48E+04	5.50E+04	5.50E+04
EARLY LOW	7.09E+02	1.62E+03	7.09E+02
LATE HIGH	3.19E+04	7.29E+04	7.29E+04
LATE MEDIUM	2.08E+04	4.63E+04	4.63E+04
LATE LOW	4.24E+02	8.94E+02	4.24E+02
LATE LOWLOW	3.27E+01	6.98E+01	3.27E+01
TOTAL	**2.12E+05**	**3.95E+05**	**3.93E+05**

*DF represents decontamination factor. Values shaded in gray are the values used in the last column. All OECR values are for Indian Point Unit 2 and are in 2005 USD/yr.

The fourth column shows a total OECR that is not significantly different from the total OECR in column three. Thus, even when the Consequence Study TIMDEC values are only used for the most severe accidents, and 60 and 120 day values are used for the less severe accidents such as

no containment failure, the effect on OECR is significant—the OECR is double that calculated by Entergy.

13. I declare under penalty of perjury of the laws of the United States of America that the foregoing is true and correct.

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

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