UNITED STATES

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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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,	DPR-26, DPR-64
Entergy Nuclear Indian Point 3, LLC, and	
Entergy Nuclear Operations, Inc.	June 29, 2012

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PRE-FILED WRITTEN REBUTTAL TESTIMONY OF

DR. FRANÇOIS J. LEMAY

REGARDING CONSOLIDATED CONTENTION

NYS-12C (NYS-12/12A/12B/12C)

On behalf of the State of New York ("NYS" or "the State"), the Office of the Attorney General hereby submits the following rebuttal testimony of François J. Lemay regarding Consolidated Contention NYS-12C (NYS-12/12A/12B/12C).

I. INTRODUCTION

Q. Please state your full name.

A. François Jean Lemay.

Q. Dr. Lemay, could you briefly summarize the testimony you provided on December 21, 2011?

A. International Safety Research ("ISR") was retained by NYS in connection with the State's Consolidated Contention 12C. In my December 21, 2011 testimony, I explained ISR's analysis and conclusion that Entergy and Nuclear Regulatory Commission (NRC) Staff underestimated the total economic cost of a severe nuclear accident at Indian Point (IP). This underestimation is primarily a result of their use of Sample Problem A input values, which are not specific to the conditions at IP because they include costs and times for decontamination that are unrealistic given current known decontamination data and the complexities of an urban to hyper-urban area such as that surrounding IP.

Q. What is the purpose of this rebuttal testimony you are now providing?

A. NYS has asked me to respond to Entergy's March 30, 2012 and NRC Staff's March 30, 2012 testimony on Consolidated Contention 12C.

Q. Have you read the testimony submitted by Entergy and by NRC Staff on NYS's Consolidated Contention 12C?

A. Yes. I have reviewed Entergy's Statement of Position (ENT000449), Entergy's Pre-Filed Written Testimony (ENT000450) (Entergy Testimony), and the supporting exhibits filed by

Entergy on March 30, 2012. I have also reviewed NRC Staff's Statement of Position (NRC000039), NRC Staff's Pre-Filed Written Testimony (NRC000041) (NRC Staff Testimony), and the supporting exhibits filed by NRC Staff on March 30, 2012.

Q. What are your overall conclusions regarding NRC Staff and Entergy's testimony?

A. Neither Entergy nor NRC Staff have provided a documented basis for the cost of the decontamination value used in their calculation of the economic costs associated with a severe accident at IP. The decontamination time value selected by Entergy represents a scenario that appears unreasonable and unrealistic, based on past experiences and especially in light of the currently unfolding experience at Fukushima.

Even after performing additional calculations to account for some of the relevant points raised by Entergy and NRC Staff, ISR concludes that the values used by Entergy lead to an underestimation of the offsite economic cost risk (OECR) by a factor between 3 and 7 for IP2. Furthermore, ISR concludes that a similar underestimation factor range applies to IP3.

II. PREPARATION FOR REBUTTAL TESTIMONY

Q. Have you reviewed any additional documents since your December 21, 2011 testimony in preparation for this rebuttal testimony?

A. Yes.

Q. I show you Exhibits NYS00422A through NYS000431. Do you recognize these documents?

A. Yes. These are true and accurate copies of the documents that were referred to, used and/or relied upon in preparing this rebuttal testimony. They include documents prepared by ISR in support of this testimony, documents prepared by government agencies, peer reviewed published articles, recent reports related to Fukushima, and documents prepared by Entergy, Sandia National Laboratories, Pacific Northwest Laboratory, NRC or the utility industry.

Q. How do these documents relate to the work that you do as an expert in forming opinions such as those contained in this testimony?

A. These documents represent the type of information that persons within my field of expertise reasonably rely upon in forming opinions of the type offered in this testimony.

III. SCOPE OF CONSOLIDATED CONTENTION NYS-12C

Q. Dr. Lemay, I'd like to start off by clarifying the scope of work ISR completed for NYS. Did NYS ask you to perform an independent Severe Accident Mitigation Alternatives (SAMA) analysis for IP?

A. No, the ISR report (NYS000242) was not intended to be an alternative SAMA analysis.

Q. What was the scope of your analysis in connection with NYS 12C?

A. The purpose of our analysis, as stated on the first page of the ISR report (NYS000242), was to "assess Entergy's use of the [MELCOR Accident Consequence Code System 2] MACCS2 code to estimate the economic costs." NYS asked ISR to review and analyze Entergy's use of the MACCS2 code to estimate the economic costs associated with a severe accident at IP, and to review NRC Staff's evaluation of Entergy's SAMA analysis, which relied upon those economic costs, as part of the Final Supplemental Environmental Impact Statement (FSEIS). NYS asked ISR to assess whether the MACCS2 input values related to economic costs at IP were reasonable and, if not, to provide a reasonable range of input values.

Q. Does the ISR report (NYS000242) offer a critique of the MACCS2 code itself or suggest that the code should not have been used?

A. No. ISR has not commented on the use of the MACCS2 code itself or any limitations of the MACCS2 code. Instead, ISR's analysis focuses on the inputs to the MACCS2 code that are used to calculate the costs associated with a severe accident.

Q. How did ISR conduct its analysis of the MACCS2 code input values used for IP?

A. ISR's analysis is focused on the effect of the critical input parameters on the total economic cost of a severe nuclear accident. After performing a sensitivity analysis to identify the input parameters that had the largest impact on the OECR, ISR compared Entergy's input values with values calculated from data produced by other analysts in the field. In other words, ISR's Report (NYS000242) sought to "benchmark" Entergy's input values against others values and to provide a range of reasonable, site-specific, and appropriate input values. This concept of benchmarking is not foreign to the IP SAMA Analysis since it was used by Entergy to compare its SAMA candidates with those for other operating plants that have submitted license

renewal applications as discussed in Appendix G of the FSEIS (NYS00133I at G-1).

Q. What do you mean by benchmarking?

A. Benchmarking is often used to validate codes and methodologies when an exact solution or experimental data is available. It is also used when there is no unique solution to a problem, or when considerable uncertainty is associated to a result.

In that context, benchmarking consists of establishing points of reference by comparing one's current practices with what others in the field are doing. In the nuclear industry, benchmarking is an essential exercise because it provides for an important exchange of information amongst experts in the field, leading to the use of the best data and methodologies.

Q. How did ISR compare Entergy's values to literature-derived values?

A. We relied on our experience and also reviewed the literature to identify and calculate a range of site-specific input values that experts in the field of accident mitigation would use to calculate the economic costs associated with an accident at IP. For many sensitive input parameters, ISR found that the input values used by Entergy and accepted by NRC Staff

were outside the range of reasonable values identified in the literature. Because of this, Entergy and NRC Staff underestimated the total OECR by a factor of at least 3 to as much as 7.

Q. Did either Entergy or NRC Staff perform a benchmarking exercise for Entergy's inputs to the MACCS2 code?

A. No, neither Entergy nor NRC Staff have attempted to benchmark (i.e., quantify the reasonableness) the MACCS2 input parameters used to calculate the OECR. This is inconsistent with Entergy and NRC Staff's approach to other parts of the SAMA analysis.

Q. Please explain how Entergy's lack of benchmarking for the MACCS2 input parameters is inconsistent with their work on other parts of the SAMA analysis.

A. As NRC Staff explained, their SAMA analysis for Indian Point uses probabilistic risk assessments (PRA).

The PRA for a commercial power reactor has traditionally been divided into three levels: Level 1 is the evaluation of the combinations of plant failures that can lead to core damage; Level 2 is the evaluation of core damage progression and possible containment failure resulting in an environmental release for each core-damage sequence identified in Level 1; and

Level 3 is the evaluation of the consequences that would result from the set of environmental releases identified in Level 2. All three levels of the PRA are required to perform a SAMA analysis, and the MACCS2 code is used to perform the consequence analysis in the Level 3 portion of the PRA.

NRC and Entergy expended considerable effort to verify the source term and core damage frequency used in accident assessment—Level 1 and Level 2. This is explained in Appendix G of the FSEIS (NYS00133I at G-1 to G-10). Entergy conducted peer reviews and benchmarking to verify the reasonableness and robustness of the Level 1 and Level 2 PRA as described in Attachment I to NL-08-028 (ENT000460). These initiatives allowed Entergy to quantify the uncertainties on the key parameters of the Level 1 and Level 2 PRA and to account for these uncertainties with multipliers. Specifically, Entergy applied a multiplier of 8 to account for internal and external events (i.e. PRA Levels 1 and 2) and the corresponding uncertainty (Entergy Testimony A62).

There is no evidence that Entergy's calculation of the cost and duration of the decontamination for IP has been documented and that Entergy performed the same peer review or benchmarking for the Level 3 PRA, with the exception of the VALWNF value,

which was later revised by Entergy to address the loss of tourism and business. Entergy has not explained why they conducted the benchmarking exercise for the Level 1 and Level 2 PRA, but not the Level 3 PRA.

Q. What effect does the lack of Level 3 benchmarking have on the SAMA analysis?

A. Without this benchmarking, Entergy and NRC have not quantified the reasonableness and the uncertainty of the key parameters they used to calculate the OECR. In short, Entergy's SAMA analysis is not defensible because the portion of the SAMA analysis that relies upon the MACCS2 code lacks a documented cost basis, a robust peer review, and a benchmarking exercise.

Q. But in A6b, NRC Staff's experts claim that the "existing margin in the SAMA analysis account for uncertainties." Their experts then go on to conclude that this margin accounts for uncertainties in all three levels of the PRA. Do you agree with this assertion?

A. No. The multipliers for the Level 1 and 2 analyses do not account for uncertainties in the Level 3 assessment, such as those for the decontamination cost or time. As I just explained, Entergy and NRC have not attempted to quantify the

uncertainty of the Level 3 PRA and therefore, cannot account for the magnitude of the uncertainty.

IV. RESPONSE TO ENTERGY'S AND NRC STAFF'S CLAIM THAT FUKUSHIMA REPRESENTS A WORST-CASE SCENARIO AND IS NOT RELEVANT

Q. Dr. Lemay, please explain how the MACCS2 code models severe accidents and ultimately calculates OECR.

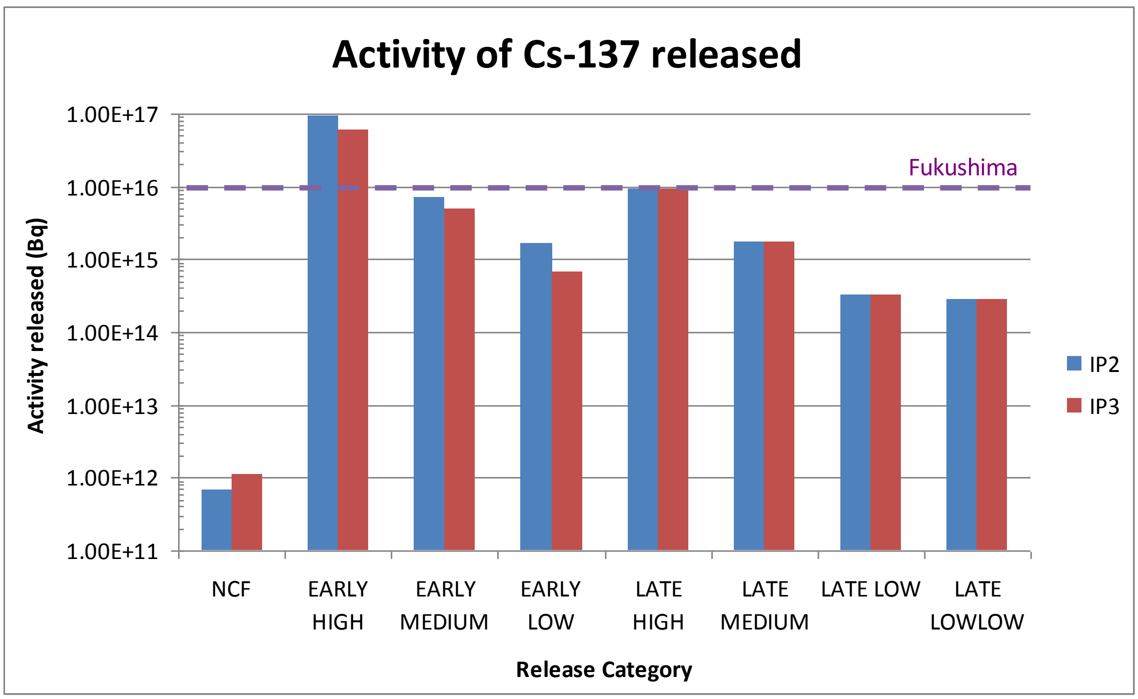
A. The MACCS2 code models eight different categories of severe accidents, called release categories. As I explained in my December 21, 2011 testimony and report, the OECR calculated by the MACCS2 code is a frequency-averaged cost. The OECR is obtained by adding the total offsite economic cost for each of eight release categories after weighting them by their respective frequencies.

Q. Are the eight release categories defined by the user?

A. Yes. Typically, the eight release categories are selected by the user to represent a range of severe accidents, from lower consequence/higher probability accidents to higher consequence/lower probability accidents. In the case of the IP SAMA analysis, the eight release categories were defined by Entergy.

Q. Dr. Lemay, how do the eight release categories, as modeled by Entergy compare to last year's nuclear disaster at Fukushima?

A. The bar chart below was created by ISR for this testimony. It shows the activity of Cs-137 released during the Fukushima accident compared to that of each release category used by Entergy (ENT000464).



The source of the Fukushima release used in the bar chart are the reports by the Investigation Committee on the Accident at Fukushima Nuclear Power Stations of Tokyo Electric Power Company, Chapter 5, December 26, 2011, attached hereto as Exhibit NYS00422A-NYS00422C; and Institut de Radioprotection et

de Sûreté Nucléaire, Note d'information, 22 mars 2011, attached hereto as Exhibit NYS000423.

As shown in the chart of the 8 release categories modeled by Entergy, the activity of Cs-137 released at Fukushima is actually six to ten times lower than the activity that Entergy modeled for the simulated release category "EARLY HIGH."

Q. Do you agree with Entergy and NRC Staff's criticism of your work saying that Fukushima would be considered a "worst-case scenario" accident?

A. No. Fukushima is severe, but not worst-case. As I previously explained and as seen on the bar chart, Fukushima fits within the range of severe accidents defined by Entergy.

Q. Dr. Lemay, why did you use data from the Fukushima accident to estimate consequences at IP?

A. The accident at Fukushima gives us the most recent information available on the timeline and the magnitude of decontamination efforts following a severe accident. It is a real-world point of reference for assessing the cost of a severe accident at IP.

Q. What impact do the eight release categories have on OECR?

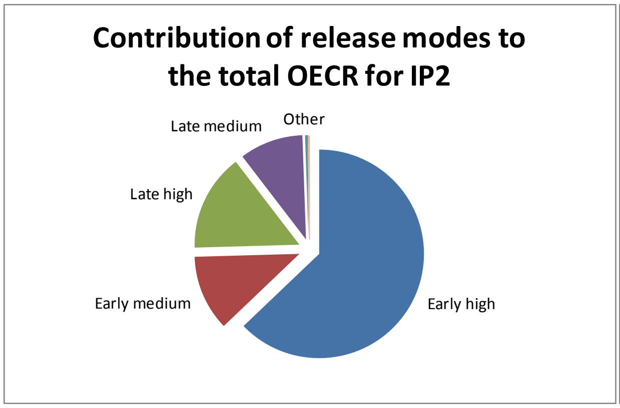
A. Some of the eight release categories have a relatively small economic impact, while some have a relatively large economic impact. Tables 5 and 6 from ENT000464, reproduced below, show the contribution of each release category to the total OECR.

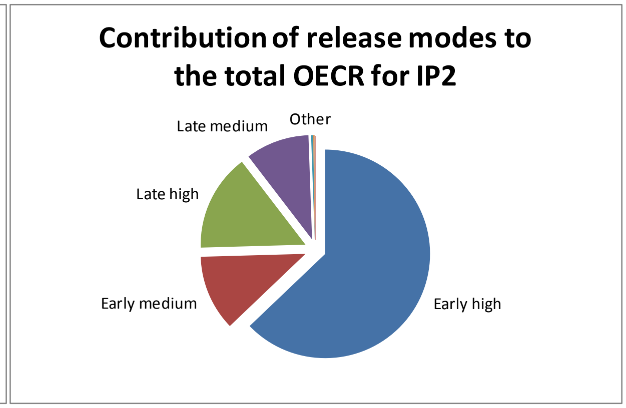
Table 5 IP2 Mean PDR and OECR Using Year 2000 Meteorological Data

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





As can be seen from the numbers circled in red, release category "EARLY HIGH" contributes over 60% to the total OECR for IP2 and IP3. "EARLY HIGH," "EARLY MEDIUM," and "LATE HIGH," contribute over 90% to the total OECR.

On the other hand, release categories "NCF," "EARLY LOW," "LATE LOW," and "LATE LOWLOW" combined contribute less than 1% to the total OECR for IP2 and IP3.

Q. Do you agree with NRC Staff, that input parameters that represent an average of all the release categories are appropriate to use, as they suggest in NRC Staff Testimony A6d?

A. No, particularly if the use of average parameters gives unrealistic results for the release categories that contribute the most to the OECR. In general, Entergy selected input parameters that are appropriate for the release category being modeled (release fractions, release duration); however, for TIMDEC and CDNFRM, they used the same values derived from

Sample Problem A for every release category. The suggestion by NRC Staff that it is acceptable to average input parameters over all release categories is wrong. In fact, the relative contribution of all release categories is determined when the Offsite Economic Cost is multiplied by the frequency to obtain the OECR.

If Entergy and NRC Staff insist on using a single value for the input parameters related to the cost of decontamination, it would be appropriate to use input parameters that more closely align with the more severe end of the release spectrum because the three most severe release categories make the largest contribution to the total OECR.

V. <u>RESPONSE TO ENTERGY AND NRC'S TESTIMONY REGARDING THE HISTORY AND PEDIGREE OF NUREG-1150</u>

Q. In their testimony, both NRC Staff and Entergy argue that the only appropriate values for decontamination time and costs which should be used to analyze offsite economic costs in the area around IP come from NUREG-1150 (NRC Staff Testimony at A39, Entergy Testimony at A51). Are they referring to the "Sample Problem A" values discussed in the ISR report (NYS000242)?

A. Yes. The Sample Problem A values are the same as the values for the Surry nuclear power plant in NUREG-1150.

Q. What is your understanding regarding NRC Staff and Entergy's rationale for only using values from Sample Problem A?

A. NRC Staff and Entergy focus on what Entergy calls the "pedigree" of NUREG-1150 (Entergy Testimony at A26, A72, A76, A95). They argue that the Sample Problem A values found in NUREG-1150 are widely recognized and accepted in the nuclear community. Both parties also justify the appropriateness of the values found in Sample Problem A by stating that NUREG-1150 was subject to extensive peer review and public comment (Entergy Testimony at A26; NRC Staff Testimony at A39).

Q. Were the Sample Problem A values from NUREG-1150 developed specifically for IP?

A. No. As I explained in my previous testimony (NYS000241) and the ISR report (NYS000242), these values were developed for the Surry site surrounded by farmland in rural Virginia.

Q. NRC Staff (A39) supports the use of values from Sample Problem A by discussing the fact that NUREG-1150 was properly vetted because it was subject to public comment. Have you

evaluated whether any public comments were received on the economic cost portion of NUREG-1150?

A. Yes, the following comments were included in NUREG-1150d (NYS00252D at D-31 to D-32):

> [PUBLIC] COMMENT: The models used in calculating the cost of a severe accident lack many factors that should be taken into account. Many of the assumptions are questionable and unfounded. The models have not been benchmarked. Some interpretations and conclusions that were made in draft NUREG-1150 are questionable. The cost estimates need to be more thoroughly documented to understand and evaluate the calculations.
>
> [NRC] RESPONSE: The present version of NUREG-1150 provides a limited set of risk-reduction calculations, principally related to the potential benefits of accident management strategies in reducing core damage frequency. It does not assess the costs of these or other improvements. Such analyses are more properly considered in the context of specific regulatory action.

* * *

[PUBLIC] COMMENT: Decontamination costs used in the calculations may be based on decontamination of test sites in deserts instead of agricultural, residential, and commercial property.

[NRC] RESPONSE: The draft NUREG-1150 cost/benefit analyses reflected the conventional NRC methods for assessing costs and benefits. Because cost/benefit analyses are more properly considered in the context of specific regulatory activities, they are not provided in this version of NUREG-1150.

Q. Do the public comments and NRC's responses to comments on NUREG-1150 shed any light on how economic costs associated with a severe accident should be calculated?

A. Yes, NRC's responses to the comments I just cited suggest that the authors of NUREG-1150 expected NRC Staff to require site-specific assessments of the costs of decontamination "in the context of specific regulatory activities," such as those currently being conducted at IP. The responses from the authors of NUREG-1150 do not justify the use

of the Sample Problem A inputs at IP or any other particular reactor.

Q. What is NUREG-1150's justification for the Sample Problem A decontamination times of 60 days and 120 days for light and heavy decontamination, respectively?

A. NUREG-1150d, page D-30 (NYS00252D) states:

> A reduction by a factor of three was assumed to require 60 days of decontamination work; a reduction by a factor of 15 was assumed to require 120 days of decontamination work. The decontamination efforts were assumed to commence at the end of the 7-day emergency phase.

NUREG-1150 has no further justification for the use of the decontamination times in Sample Problem A.

Q. What other support does NUREG-1150 have for the Sample Problem A cost and decontamination time values?

A. NUREG-1150 (NYS00252A) states on p. 2-20 that "the reader seeking extensive discussion of the methods used is directed to [r]eference [NUREG/CR-4551 (NRC000057), a companion study published in December 1990] and [r]eference [NUREG/CR-4691, the MACCS manual] which discusses the computer code used

to perform the offsite consequence analysis (i.e., the MELCOR Accident Consequence Code System (MACCS), Version 1.5)."

Q. Did you review NUREG/CR-4551, referenced by NRC Staff (A39, A61, A81) and Entergy (A35, A36, A70, A72, A76, A77, A88, A107), for documentation on how the Sample Problem A decontamination times and costs were derived?

A. Yes, the document only contains the Sample Problem input files for each of the five sites (including the Surry Site). NUREG/CR-4551 discusses many of the MACCS2 input parameters, but does not discuss how the decontamination time and cost of decontamination were obtained.

Q. Do NRC Staff and Entergy cite any other documents to support the pedigree of NUREG-1150 and the decontamination times they used from Sample Problem A?

A. Yes. While NUREG-1150 and NUREG/CR-4551 provide no detailed explanation for decontamination times, in A81 of NRC Staff's testimony, Staff cites an additional document published in April 1984 as support. This document is NUREG/CR-3673, "Economic Risks of Nuclear Power Reactor Accident" (NRC000058).

NUREG/CR-3673 does describe a timeline for the duration of decontamination, but its description in Figure 4.2 (NRC000058 at 4-5) is not entirely consistent with the description contained

in NUREG-1150. In NUREG/CR-3673, the first 30 days after the start of the accident sequence are used for the "collection of dose-rate information for decision making." Thus, decontamination starts at 30 days and ends at 120 days. In NUREG-1150, decontamination starts at 7 days. This discrepancy illustrates that there is no single documented basis for the cost and time of decontamination.

Q. Did you make any observations regarding the timeline for the duration of decontamination which was discussed in NUREG/CR-3673?

A. Yes, I have concluded that the assumptions made in NUREG/CR-3673 are unreasonable for a severe accident at IP.

To conclude that average clean-up at Surry would take 90 days with approximately 46,000 workers, NUREG/CR-3673 (NRC00058 at 4-20) assumed labor comprises half the cost of decontamination and that a worker would cost $30,000 per year.

Applying the same methodology as NUREG/CR-3673 to the cost of decontamination calculated by Entergy for the "EARLY HIGH" release category at IP2, a total of 1.5 million workers (363,000 worker-years) would be required to decontaminate the affected area in 90 days. It is not reasonable to conclude that 1.5 million workers would be available and therefore, used to

decontaminate an affected area after a severe accident. Therefore, the assumptions regarding the timeline in NUREG/CR-3673 are invalid.

Even if we assumed that decontamination will take a full year, 363,000 workers would still be required. This too is unlikely and leads me to conclude that the average time for decontamination would be more than a year.

ISR created an exhibit containing the details of the analysis I just explained, which is attached hereto as Exhibit NYS000431.

Q. Does NUREG/CR-3673 provide any support for the Sample Problem A decontamination cost?

A. On page 4-15, NUREG/CR-3673 (NRC00058) gives approximate costs of decontamination that, once adjusted for CPI, match the values used in Sample Problem A. It further states:

> The cost estimates used in this study for various levels of decontamination effort in an area are taken from a detailed review of decontamination effectiveness and costs performed at Sandia National Laboratories (SNL) [Os84].

There is no further discussion of the cost estimates in the NUREG/CR-3673 document. It thus appears that the costs contained in Sample Problem A are documented in the document referred to as "[Os84]."

The references section of NUREG/CR-3673 lists [Os84] as "Ostmeyer, R.M., and G.E. Runkle, An Assessment of Decontamination Costs and Effectiveness for Accident Radiological Releases. Albuquerque, N.M.: Sandia National Laboratories, to be published." NRC00058 at 8-8.

Q. Does Os84 shed light on what data the Sample Problem A values were based upon?

A. The document [Os84] upon which the Sample Problem A cost estimates are based, as stated in NUREG/CR-3673, does not appear to exist in a published form and therefore was not likely to have been subject to peer review or public comment. Therefore, it is not a reliable source upon which experts in this field would base any findings.

We conducted a search and could not locate [Os84]. We asked NYS for a copy, but NYS was not able to locate the reference.

Q. Has Entergy or NRC Staff offered any document that shows the calculations and/or data that support the use of the values found in Sample Problem A?

A. No.

VI. EFFECT OF NRC'S PRIOR SITE-SPECIFIC ANALYSIS OF DECONTAMINATION FOR INDIAN POINT

Q. Other than the ISR report (NYS000242), are you aware of any site-specific analysis of the economic costs associated with a severe accident at IP?

A. I am not aware of any site-specific analyses performed by Entergy.

However, while researching the "pedigree" of NUREG-1150 we learned that in the 1980s NRC Staff contracted with Battelle Pacific Northwest Laboratory (PNL) to conduct a case study of the economic costs associated with severe accidents at IP. This site-specific case study is described in Chapter 5 of "NUREG/CR-5148 Property-Related Costs of Decontamination," dated February 1990 and attached hereto as Exhibit NYS00424A-NYS00424BB.

Q. How did you locate NUREG/CR-5148?

A. When attempting to respond to NRC's testimony regarding the appropriateness of Sample Problem A and its roots

in the “pedigree” of NUREG-1150, ISR researched the origins of the economic cost parameter input values reported in NUREG-1150.

NUREG-1150 contained a citation to a document which appeared to form the basis of the Sample Problem A values entitled: “NUREG/CR-3413 Off-Site Consequences of Radiological Accidents: Methods, Costs and Schedules for Decontamination,” which was completed in November 1984, published in August 1985, and is attached hereto as Exhibit NYS00425A-NYS00425G. NUREG/CR-3413 explains the results of a PNL study commissioned by NRC following the accident at Three-Mile Island. It further describes a database and computer program called DECON that was developed to conduct a decontamination analysis of a large, radiologically contaminated area. DECON was designed to be used with CRAC2, a predecessor to the MACCS2 code. The methodology used by DECON appears to be very similar to that of CONDO (NYS000250).

ISR was interested in learning more about the database and DECON program, but could not find any use or mention of the DECON code past the mid-1980s. Through internet searching, ISR located an email address for one of the NUREG/CR-3413 authors, J.J. Tawil. On May 2, 2012, ISR sent Dr. Tawil an email inquiring about the history of the DECON program and what became

of it. Our email exchange with Dr. Tawil is attached hereto as Exhibit NYS000426.

Dr. Tawil wrote:

> I think the primary difficulty was that my last project for the NRC was to characterize the off-site consequences of reactor accidents . . . for three reactor sites, one of which was Indian Point . . . . I think the NRC was a little shocked at the magnitude of the off-site consequences of an SST-5 at Indian Point and decided not to publish the report.

After receiving this email from Dr. Tawil, we shared it with NYS. It's my understanding that the NYS librarian was able to locate NUREG/CR-5148 based on the information in Dr. Tawil's email and a reference to a to-be-published 1990 document in Sandia *Site Restoration*.

Q. How do the decontamination values in the NUREG/CR-5148 IP case study compare to ISR's analysis of decontamination costs using CONDO?

A. The methodology employed by PNL using the DECON code provides further support for using data to develop site-specific MACCS2 input values.

It is not possible to directly compare the decontamination costs contained in NUREG/CR-5148 with those calculated by Entergy because they use different habitability criteria, different decontamination factors (DFs) and different source terms.

However, the detailed calculations performed by Dr. Tawil (NYS00424A-NYS0424BB) show that in urban areas, the cost of decontamination of building contents can exceed the cost of decontamination of land and structures (NYS000424G, Figure 4.3, at 4.26 - 4.28). He also finds that in urban areas, decontamination of building contents is labor intensive and labor costs are a large fraction of the cost of decontamination (NYS000424B - NYS000424E, Section 2.4, at 2.8 - 2.71).

Q. Has either Entergy or NRC Staff explained why they did not rely on the database and DECON program developed by PNL or NUREG/CR-5148 IP case study to develop site-specific inputs for the IP SAMA analysis?

A. No.

Q. Given the history and lack of documented support for the Sample Problem A values, is it reasonable for Entergy and NRC Staff to rely on Sample Problem A and ignore the data and literature cited in the ISR report and the NUREG/CR-5148 IP site-specific case study commissioned by NRC?

A. No. At a minimum, Entergy and NRC Staff should have benchmarked the Sample Problem A values from NUREG-1150, to verify their robustness when applied to determine the OECR at IP. Such a benchmarking exercise cannot replace a detailed calculation of the cost or time of decontamination, but it can give confidence that the values are reasonable.

ISR conducted such a benchmarking exercise. However, Entergy and NRC Staff have dismissed the wealth of other relevant literature and data upon which ISR relied:

- Experience at Chernobyl (NYS000249, NYS000250, NYS000251, NYS000263)
- Experience at Fukushima (NYS000264, NYS000265, NYS000266, NYS000267, NYS000268, NYS000269)
- Data from CONDO Report (NYS000250)
- Data from RISO (NYS000251, NYS000253)
- Data from Luna Report (NYS000255)
- Data from *Site Restoration* Report (NYS000249)

- Data from Reichmuth Report (NYS000256)

Q. Is Entergy's statement in A72 that "[a]lthough the basis for the NUREG-4551 cost estimate for farm decontamination is not fully explained in that document, we know of no more appropriate decontamination data that is readily available to licensees to use in a SAMA analysis" reasonable?

A. No. As shown in the ISR report, many other data sources exist that Entergy could have relied upon for benchmarking purposes or to generate site-specific input values.

VII. RESPONSE TO ENTERGY AND NRC STAFF TESTIMONY REGARDING ISR'S MACCS2 INPUT CALCULATIONS

Q. Are there any topics discussed in NRC Staff or Entergy's testimony that ISR does not contest?

A. Yes, in their testimony, NRC Staff and Entergy discuss some points that are not part of Contention 12C or that have no impact on the conclusions of reached by ISR. In reaching its conclusions, ISR did not rely on challenges to the following points:

- MACCS2 code (Entergy Testimony at A26, A37 to A52; NRC Staff Testimony at A60): Contention 12C does not contest the use of MACCS2 for SAMA analysis. ISR agrees that MACCS2 input parameters represent suitable

averages for the cost and decontamination time in a grid element.

- Dose reduction factor (Entergy Testimony at A87; NRC Staff Testimony at A52): and deposition velocity (NRC Staff Testimony at A41 to A43). ISR's calculations used the same dose reduction factors (3 and 15) as Entergy uses. ISR did not modify or contest the use of the deposition velocity chosen by Entergy for its calculations. In fact, ISR agrees that MACCS2 uses dose reduction factors that are related, but not identical to DFs.
- Cesium (Entergy Testimony at A126; NRC Staff Testimony at A20 and A21): ISR recognized and agreed that Cesium is the most important radionuclide of consideration for decontamination following a severe accident at a nuclear reactor.

Q. What is your response to Entergy's argument (ENT000449 at 27-28) that the SAMA analysis "estimates average consequence results for the entire 50-mile radius region around the IP site (an area of approximately 7,854 square miles), not just the comparatively small region of New York City, which comprises approximately 2%" and that the State "attempt[s] to scale up

certain cost estimates related to the New York City portion without including commensurate scaling down of estimates for the 98% of the SAMA analysis region that is outside of New York City?"

A. We disagree with Entergy. Using the data from *Site Restoration* as a starting point, there is no need to scale down the cost of decontamination in the region outside of New York City because the population density (790 pers per km^2) is comparable to the density around Albuquerque (700 pers per km^2).

In our original calculation, the NYC area accounted for 2% of the 50 mile area around IP. After removing the surface area which could be accounted for by water and farmland, our revised calculations show that the area with more than 10,000 persons per km^2 (i.e. what we classified as the NYC metro area) is 4% of the total non-farmland area.

ISR is well aware that the SAMA analysis estimates average consequences for the entire 50-mile radius region and we have averaged the costs on the basis of land use area. To be clear, ISR did not apply the same cost to the 4% non-farmland area that represents NYC as to the remaining 96%. We only assigned the high cost per km^2 for decontaminating NYC to a very small area (4%). We assigned the lower cost of decontaminating the

remaining urban or semi-urban area to the rest of the 50 mile area around IP that is not farmland or water, an area that is 76% of the total area. The other 20% accounting for water and farmland is not included in our calculation.

A. <u>ISR's Response to Testimony Regarding the Calculation Of Population Dose Risk (PDR)</u>

Q. In A82, Entergy claims that ISR should have considered not only OECR, but also the changes in Population Dose Risk (PDR). What is your response?

A. ISR provided all of the MACCS2 output files, which also contain the population dose results for the calculations of PDR.

ISR agrees that changes in some of the input parameters may affect PDR, and the costs associated with PDR, in a different manner than how they affect OECR. In response to Entergy and NRC Staff's arguments, ISR checked the impact of the input parameter changes discussed in the ISR report on the dollar value equivalent of PDR.

Q. What is the effect of the changes to input parameters discussed in the ISR report on PDR?

A. For all of the MACCS2 runs that we used to justify our conclusions, we have now calculated the present dollar value

equivalent of the total off-site population dose from the PDR and the total OECR using the equations provided in the Entergy report: Re-Analysis of IP2 and IP3 SAMAs (ENT000459). The total present dollar value equivalent for ISR report's maximum input values (NYS000242, Table 13), decreases from $17.8M to $17.1M if the cost associated with the decrease in PDR is included.

In summary, the change in PDR as calculated in our MACCS2 runs has no impact on our conclusions. It changes the total cost by less than 4%.

Q. Do ISR's conclusions apply only to IP2?

A. No. In the ISR report (NYS000242), ISR ran the MACCS2 code for IP2 to illustrate the changes in the calculated OECR when the sensitive inputs are changed.

In A27 and A28, NRC Staff challenged this by saying that IP2 has a higher source term than IP3. As I explained above, the source term is the activity released during the accident and in MACCS2, it is specified as a release fraction of the core inventory in units called Becquerel. For the SAMA analysis, the activity of Cesium-137 released is the parameter of interest.

It's true that IP2 has a higher source term than IP3, but it's also true that IP3 has higher release mode (or release category) frequencies. The release mode frequency is a measure

of the likelihood of this particular release mode (or release category) and it multiplies the off-site economic cost to obtain the OECR. The effect on OECR by the higher source term for IP2 is offset by the effect of the higher release mode frequencies for IP3 and, therefore, the resulting OECR values for IP2 and IP3 are comparable. They are $2.12E+05/yr for IP2 and $2.61E+05/yr for IP3.

In response to Entergy's and NRC staff's testimony, ISR re-ran the MACCS2 simulations using the ATMOS input file for IP3 and ISR’s proposed input values (i.e. in the CHRONC input file) to verify that there is no material difference between IP2 and IP3. The results for IP3 were comparable to IP2. The underestimation of the OECR calculated by Entergy resulted in a factor between 3.2 and 7.6 for IP3, compared to 3.0 and 6.9 for IP2. These are the revised factors after ISR’s calculations were adjusted to account for the comments made by Entergy and NRC Staff.

B. ISR’s Response to Testimony Regarding Nonfarm Decontamination Cost (CDNFRM)

Q. Did ISR evaluate whether assumptions regarding CDNFRM raised by Entergy and NRC Staff would affect the ultimate calculation of OECR?

A. ISR determined that although much of the testimony presented by Entergy and ISR had no bearing on our analysis, some of the testimony required further analysis in order to determine whether the ultimate calculation of the OECR would change based on the assumptions Entergy and NRC Staff provided in their testimony. We performed further analysis of several parameters (e.g., the cost of decontamination per unit area) used to calculate CDNFRM.

Q. What is your response to NRC Staff's argument in NRC Staff A64 and A65 that the area ISR used to calculate CDNFRM improperly includes surface water and farmland?

A. In response to Entergy and NRC Staff's point that surface water and farmland should not be included in the area used to calculate CDNFRM, ISR recalculated the values for CDNFRM, subtracting surface water and farmland from the area. As shown in Table 13 of the revised tables from the ISR report that ISR created for this testimony, attached hereto as NYS000430, the impact of this change is a decrease of 13% at the low end of the range for the OECR. There is no change at the high end of the range. Thus, even when surface water and farmland are removed from the area, Entergy and NRC Staff have still underestimated OECR by, at minimum, a factor of 3.

Q. In NRC Staff A64 and A65, Staff claims that ISR incorrectly accounted for parkland in the calculation of CDNFRM. Is this true?

A. No, ISR's approach to parkland is correct. Based on the Entergy MACCS2 site input file, parkland area was not accounted for as farmland and therefore must be included in the only other category, as nonfarm land area.

In our calculations, we implicitly categorize parkland as the area outside the NYC metro area, which is either semi-urban or urban. This is justifiable because in order to retain the value of the parks, the cost of decontamination (principally tree felling and removal) and replacement of trees, soil and grass is likely comparable to a semi-urban or urban area on a per square kilometer basis.

This approximation is valid since park land accounts for about 10% of the urban or semi-urban area outside NYC metro area and is therefore, not a large component of the cost.

(1) <u>ISR's Response to Testimony Regarding the Use of *Site Restoration* and the Use of the Reichmith Study</u>

Q. What is your response to Entergy's Testimony at A121 that ISR should not have included the cost of compensation in

calculating CDNFRM in Approach A (*Site Restoration*/Luna) and Approach B (Reichmuth)?

A. We removed the compensation costs and re-calculated CDNFRM for Approaches A and B, as shown in the tables attached hereto as NYS000430. The resultant effect on the OECR is a decrease of the upper bound by 5%.

Q. What is your response to Entergy's assertion in A121 that ISR ignores differences between New York and Albuquerque and, thus, improperly extrapolates data from *Site Restoration*?

A. In A121, Entergy asserts that "[d]econtamination costs would be expected to be generally proportional to [interior] square footage for a residence." Entergy claims that the interior square footage for housing is greater in Albuquerque compared to New York City (NYC), and that there should be a reduction in the decontamination costs using *Site Restoration*/Luna for NYC. Entergy further states the same would be expected for commercial property.

Reference ENT000469 shows that average homes in the five boroughs of NYC are smaller than in Albuquerque. There is no evidence, however, that the multi-story residential and commercial buildings that are common in the NYC area would have

less interior square footage than in Albuquerque, which has fewer multi-story buildings.

Furthermore, Entergy (A121, A129) claims that the housing density in the area outside the NYC metro region is about 50% that of the City of Albuquerque, so there should be a reduction in the decontamination costs for this region.

The authors of the *Site Restoration* Report state that they "visited several residential, commercial, and industrial sites in and near Albuquerque, NM." (NYS000249) Therefore, if housing density is used to assess the cost, the whole area around Albuquerque City must be considered. From the New Mexico: 2000 Population and Housing Unit Counts (Census Bureau), attached hereto as NYS000427, the housing density of the Albuquerque census county division is approximately 700 units/square mile, which is comparable to the 790 units/square mile reported by Entergy for the area outside the NYC Metro region.

Q. What is your response to Entergy's testimony in A129 that the data from *Site Restoration* is inappropriate for the calculation of CDNFRM since it is based on a plutonium dispersion scenario, for which decontamination is more expensive than for a nuclear reactor accident?

A. Our use of *Site Restoration* was intended to be a point of reference in a benchmarking exercise that illustrates various approaches to determining the cost of decontamination ($/km^2) and the resulting CDNFRM ($/person). For estimation purposes, the two parameters extracted from *Site Restoration*: the decontamination cost per area and the corresponding DF, are irrespective of the geographic extent and severity of the accident.

The data from *Site Restoration* is one way to calculate CDNFRM, and the ISR report explains how the *Site Restoration* costs can be adjusted to be more applicable to a nuclear accident (NYS000242, Approach A at 16-18). For example, the ISR report assumed that the costs of a nuclear reactor accident would be one to two times higher than the costs of a plutonium dispersion scenario. This is because Cs-137, as well as the remaining gamut of radionuclides released (including Pu-239) from the reactor, must be considered when decontaminated, in addition to Pu-239.

Q. What is your response to Entergy's testimony in A122 and A134 that the data from *Site Restoration* focuses on a small geographical area, and did not account for economies of scale that could be realized for larger areas?

A. It is reasonable that economies of scale are possible during the decontamination of large areas, such as farmland. However, NUREG/CR-5148 (NYS00424A-NYS0424BB) shows that a large part of the cost of decontamination in urban areas is related to the labor intensive tasks of cleaning the buildings' contents. There appears to be no practical way to scale these tasks economically.

In addition, the logistics of planning a large scale decontamination program, including budget approval, approval for waste repositories, and set up times would be long, contentious and difficult. For comparison, it has taken one year to finalize plans and budgets for preliminary remediation efforts in the Fukushima Prefecture as shown in the Road to Recovery, attached hereto as NYS000428.

Q. What is your response to Entergy's testimony in A135 that consideration of on-site waste disposal and waste volume reduction, as discussed in *Site Restoration*, would lead to significantly lower estimates of decontamination costs?

A. There are significant issues concerning on-site waste disposal for a severe nuclear accident. The approval and planning for on-site waste repositories is a long and contentious process (NYS000264). In a hyper-urban region such as

NYC, on-site disposal is likely impossible due to the lack of suitable space. For the rest of the 50-mile SAMA region, there would be long drawn out negotiations to identify suitable locations for on-site disposal. Wherever such repositories are located, they would result in a decline in property values, which is currently not considered in the MACCS2 calculation. Therefore, we believe it may be more cost-effective to employ off-site waste disposal.

The waste volume reduction of 50-60% considered in *Site Restoration* is for farmland or rangeland decontamination. Our use of *Site Restoration* data is solely for the determination of CDNFRM, which is only for nonfarm land. Therefore, this waste volume reduction does not apply to our calculations.

(2) ISR's Response to Testimony on the Use of CONDO

Q. What is your response to Entergy's testimony in A143 that when using the CONDO approach, the decontamination techniques that ISR chose are not consistent with the DFs for light and heavy decontamination?

A. We disagree. ISR selected decontamination techniques from the lists contained in CONDO (NYS000250 at Table A7 of Appendix A) that most closely represented light and heavy decontamination. Some techniques, such as felling and removal

(DF=10) of trees are essentially the only option for both levels of decontamination. Vacuuming, cleaning and washing (DF=5) for building interiors are also the only option for both levels of decontamination. After removing these techniques and other outliers such as removal (DF=1.4) for plants and shrubs and removal and replacement (DF=50) for paved areas, light decontamination techniques have a DF of 3 to 5, and heavy decontamination techniques have a DF of 10.

Q. What is your response to Entergy's testimony in A145 that ISR's approach to adding a "hyper-urban" designation for the NYC metro region and classifying the remaining area as urban is unjustifiable when using the CONDO methodology?

A. The CONDO methodology classifies environments according to their population density: rural (<25 per km^2); semi-urban (25 to 1000 per km^2); and urban (>1000 per km^2) (NYS000250 at 54). With the revisions made to the nonfarm land area I discussed on page 36 of this testimony, there are two population grid elements (designated as the NYC Metro area) that have a population density that exceeds 10,000 per km^2, based on the Entergy MACCS2 site input file. The remaining grid elements have a population density between 25 and 10,000 per km^2. Therefore, ISR determined that it was necessary to add a "hyper-

urban" designation for the NYC Metro area, given its extraordinarily high population density.

To define a range, we calculated the minimum value based on the assumption that the NYC Metro region is urban, and the remaining area is semi-urban. This is supported by the aforementioned classifications provided in CONDO.

Q. What is your response to NRC Staff's testimony in A69 that MACCS2 assumes that contamination is spread over a flat plane and that it implicitly addresses 3-D structures through the use of per capita costs like CDNFRM and, thus, ISR should not have included multipliers in the CONDO approach to address 3-D aspects of decontamination?

A. First, it appears that NRC Staff is describing contamination by gravitational settling. Gravitational settling only applies to very large particles (>100 µm), and is only important close to the release point.

In the MACCS2 model, airborne contamination is transferred to a surface through a transfer coefficient called the dry deposition velocity. This transfer coefficient is a function of the particle size, the chemical form of the particles, the chemical affinity of the surfaces and the roughness of the

topography. This transfer coefficient applies to vertical and horizontal surfaces, and even to leaves in the trees.

Second, the cost of urban decontamination ($\$/km^2$) is proportional to building density and internal space density. All four ISR approaches (A to D) began with a calculation of the decontamination cost per unit area of nonfarm land ($\$/km^2$) with consideration of 3-D buildings and structures. In order to account for floor and building density, multipliers must be used. The use of multipliers is consistent with CONDO and other costing tools such as DECON, which is presented in NUREG/CR-3413 and which I discussed on pages 26-28 of this testimony.

With the appropriate multipliers, the cost per unit area of nonfarm land ($\$/km^2$) is multiplied by the area of nonfarm land and then divided by the population to obtain a value for CDNFRM. In the absence of a documented methodology for the costs used by Entergy to determine CDNFRM as discussed in Section V of this testimony, this is the reasonable and most appropriate method to calculate CDNFRM.

Q. What is your response to NRC Staff's testimony in A74 that ISR's assumption of uniformity for the exteriors and interiors of buildings renders ISR's cost estimates unrealistic and unreasonable?

A. NRC Staff is correct that contamination would not be uniform on building roofs, exterior walls, and interior space; but it is not cost effective to differentiate between the portions of surfaces which would require decontamination and those that would not in any given building. It is more likely that bulk decontamination, such as hosing or vacuuming, would take place first followed by verification for hot spots. Our assumption is reasonable given the likely operational efforts and strategies which would be employed in the event of a severe accident.

Q. In A140, Entergy suggests that your use of spreadsheets based on the CONDO database, instead of the code, may have errors, inaccuracies or biases. Is this plausible?

A. We have included these spreadsheets along with any assumptions in Annex C of our report (NYS000242 at 46-56). As such, they are available for review and criticism. Any other claims regarding our calculations using the CONDO data were addressed in preceding responses of this testimony.

(3) <u>ISR's Response to Testimony on the Use of RISO</u>

Q. What is your response to Entergy's critique of the RISO approach in A149 and A150?

A. For the RISO approach, Entergy claims in A149 and A150 that two decontamination techniques/surface pairs were excluded as compared to the CONDO approach, and of the decontamination techniques considered, some are compatible with heavy decontamination instead of light decontamination. Furthermore, Entergy claims in A150 that the cost data is not evident from the RISO reference.

We excluded plants and shrubs, and trees—both of which were not available in RISO and did not significantly contribute to the total cost in the CONDO approach because they were less than 1% of the total cost. The only techniques with a heavy-decontamination-like DF were vacuuming, cleaning, and washing, which are the only RISO techniques for interior decontamination. All other RISO techniques referred to in our report have a DF less than 3, which is representative of light decontamination. The cost data was based on the RISO document but is explicitly described in the RODOS Report: Estimation of the unit costs of decontamination techniques, attached hereto as Exhibit NYS000429.

C. ISR's Response to Testimony Regarding Decontamination Time (TIMDEC)

Q. Has ISR reviewed its estimates for TIMDEC in light of testimony provided by Entergy (A102 and 103) and NRC Staff (A57)?

A. Yes, ISR has considered this testimony by NRC Staff and Entergy. As I discussed earlier in this testimony, the only real support NRC Staff or Entergy's testimony provides for the Sample Problem A TIMDEC values is NUREG-1150 and NUREG/CR-3673 (NRC000058). As I also discussed earlier in this testimony on pages 22-23 of this testimony, the Sample Problem A TIMDEC values are not reasonable, and NUREG-1150 describes an idealistic decontamination scenario based on these unrealistic values, without justifying their use or showing how they were calculated. Additionally, I explained how the discussion of decontamination time in NUREG/CR-3673 is based on unreasonable assumptions.

In preparing this rebuttal testimony, ISR also reviewed reports regarding decontamination following Fukushima that have been published since December 2011. In light of these recent reports on decontamination efforts in the Fukushima Prefecture (NYS000428), there is support for changing the lower bound of

TIMDEC to 1 and 2 years for light and heavy decontamination, respectively.

According to these reports, full-scale decontamination for the outer edges of the plume deposition began one year after the accident. Since it is on the outer edges of the plume deposition, it is representative of light decontamination. Amongst other things, the delays have been caused by the lengthy time it has taken to develop a decontamination plan, which is dependent on detailed radiation surveys and procurement of suitable and efficient decontamination equipment and materials, and by the time it has taken to gain approval of the supplementary budget by the government. Another reason for the delay is the need to secure approval from the local communities for storage sites for decontamination waste. (NYS000265). These delays would be expected following a severe accident at IP and have nothing to do with the direct damage caused by the Tsunami.

It is therefore possible that residents from some areas will be allowed back to their home after a delay of more than a year. Therefore, at the low end, a minimum TIMDEC of 1 year is justifiable by the recent reports.

If light and heavy decontamination is conducted in series (i.e., light decontamination first and then heavy) as is the case for the Fukushima Prefecture, a minimum TIMDEC of 2 years for heavy decontamination is also reasonable. In MACCS2, the cost associated with TIMDEC is solely the decline in property value during inhabitation. The impact of the change in TIMDEC on the OECR is a 30% decrease at the low end of the cost.

Q. Both the NRC (A57) and Entergy (A102, A160) have reiterated that the intention of the MACCS2 decontamination model is to restore property to habitability based on the defined dose criterion, not to entirely decontaminate the area. Based on this, they infer that the ISR estimates of TIMDEC are too large. Do you agree?

A. TIMDEC represents the average time from evacuation of a population to return to their original home in a given grid element. It is possible that within that grid element, some people will return to their property more quickly than TIMDEC, and that decontamination efforts may continue long after TIMDEC. Given the large uncertainty in determining this time, we defined a range of values based on real-world experience with actual severe accidents—Fukushima and Chernobyl.

As discussed in the previous answer, we now consider that the minimum time between evacuation and return home for areas requiring light decontamination is 1 year and 2 years for heavy decontamination. This appears reasonable, from the current experience in the Fukushima Prefecture. Maximum times of 15 and 30 years respectively represent upper bounds based again on the decontamination plans in the Fukushima Prefecture (NYS000269). An appropriate average value would be somewhere between these minimum and maximum values.

Q. What is ISR's response to Entergy's claim in A103 that the costs associated with large TIMDEC values are due to per diem expenses for relocated individuals and, thus, ISR's analysis results in an "intentional defeating of [the] MACCS2 decontamination optimization model"?

A. Entergy misunderstands how the MACCS2 inputs of TIMDEC and POPCST work. Interdiction costs are the sum of relocation costs, such as per diem expenses for relocated individuals, and the decrease in property value during decontamination. TIMDEC is only a factor in the decrease in property value during decontamination. Relocation costs are solely a function of the POPCST value and the population. As discussed in the ISR report

(NYS000242 at 28-29) for the POPCST parameter, relocation costs are assumed for a duration between 20 and 93 weeks.

Q. Entergy and NRC Staff make several arguments about various decontamination techniques, including leaving contamination in place and new methods. (Entergy Testimony at A91; NRC Staff Testimony at A38) What is your response to this testimony?

A. In A91, Entergy claims that leaving contamination in place, but burying it may be a financially attractive alternative that reduces the dose. This issue has no bearing, positive or negative, on our calculations and final conclusions. We agree that this technique could work well in farmland where deep-plowing can bury the contamination, but it is less applicable to the urban areas of NYC where concrete and paved surfaces are predominant.

In addition, no matter what the decontamination technique, it is difficult to achieve a high dose reduction factor (DRF=15) where cesium is present, even if some surfaces can be decontaminated perfectly (DF>100). As an example, it may be easy to decontaminate the glass surfaces with a DF>100. However it may not be possible to decontaminate the brick to a DF>5. The actual DRF achieved near the building will be much less than

DF>100 and closer to the DF=5. The lowest DF determines the achievable DRF, so even though the glass is thoroughly decontaminated, the dose reduction factor will not be as high due to the remaining cesium contamination in the brick.

D. <u>ISR's Response to Testimony Regarding Other Entergy and NRC Staff Comments About MACCS2 Parameters</u>

Q. What is your response to Entergy's testimony in A153 regarding the VALWNF parameter, specifically that the increased factor associated with lost tourism and business bounds the increased factor associated with scaling up the 1997 SECPOP2000 values to 2004 values?

A. The values taken from SECPOP2000 represented the 1997 value of possessions such as houses, automobiles, etc. Entergy used the 2004 Gross County Product (GCP) to additionally account for lost tourism and business in the calculation of VALWNF. In general, the GCP is the total value of goods and services produced. NYS00270A-NYS00270B.

From the above, SECPOP2000 values and GCP values account for two separate things and they cannot bound one another. Both values are needed in the calculation of VALWNF, and both should be in 2004 dollars.

Q. Regarding the POPCST parameter, Entergy suggests in A157 that the long-term relocation cost should be based on historical unemployment durations instead of the current term for unemployment benefits. What is your response?

A. The unemployment as a result of a severe nuclear accident, potentially affecting up to 20 million people, would not be comparable to traditional, historical unemployment. Given that the unemployment in 2005 had an average duration of 18 weeks (Entergy Testimony at A157), a range of 20 to 93 weeks would be reasonable for unemployment triggered by a severe nuclear accident.

Q. What is your response to Entergy's testimony in A99-A101 regarding the reasonableness of the calculations performed with the MACCS2 code as modified by ISR?

A. Entergy incorrectly testifies that the modified MACCS2 code did not run properly. The original set of runs performed with the MACCS2 code modified by ISR failed to run to completion because a single carriage return character was missing at the end of the input files. When that carriage return character was added, the input files ran to completion without error and gave the results presented in the ISR Report.

Furthermore, ISR is well aware of the verification requirements when performing nuclear safety calculations. In accordance with ISR's rigorous internal QA Standards, we ran all the sample problems provided by Sandia and all input files prepared by Entergy using the MACCS2 executable provided by Sandia and the version modified by ISR in order to ensure that the model was running properly. Our results were identical to those published by Sandia and by Entergy. The modified code provides correct results.

IX. CONCLUSION

Q. Does the testimony from NRC Staff and Entergy affect ISR's overall conclusions about the economic cost estimates used in the SAMA analysis for IP?

A. No. The analysis conducted by ISR shows that Entergy's input parameters to the MACCS2 code significantly underestimated the total economic cost of a severe nuclear accident at IP.

I have reviewed all the exhibits referenced herein. True and accurate copies are attached.

UNITED STATES

NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

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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,	DPR-26, DPR-64
Entergy Nuclear Indian Point 3, LLC, and	
Entergy Nuclear Operations, Inc.	June 29, 2012

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DECLARATION OF DR. FRANÇOIS J. LEMAY

I, Dr. François J. Lemay, do hereby declare under penalty of perjury that my statements in the foregoing rebuttal 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)

François J. Lemay, Ph.D.
Vice-President International Safety Research
38 Colonnade Road North
613-241-4884
FrancoisLemay@i-s-r.ca

June 29, 2012