Entergy

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Fred Dacimo
Vice President
License Renewal

February 05, 2008

Re: Indian Point Units 2 & 3
Docket Nos. 50-247 & 50-286

NL-08-028

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

SUBJECT: **Reply to Request for Additional Information Regarding License Renewal Application – Severe Accident Mitigation Alternatives Analysis**

Reference: NRC letter dated December 7, 2007; "Request for Additional Information Regarding Severe Accident Mitigation Alternatives for Indian Point Nuclear Generating Unit Nos. 2 and 3 License Renewal (TAC Nos. MD5411 and MD5412)"

Dear Sir or Madam:

Entergy Nuclear Operations, Inc is providing, in Attachment I, the additional information requested in the referenced letter pertaining to NRC review of the License Renewal Application for Indian Point 2 and Indian Point 3. The additional information provided in this transmittal addresses staff questions regarding Severe Accident Mitigation Alternatives analysis.

There are no new commitments identified in this submittal. If you have any questions or require additional information, please contact Mr. R. Walpole, Manager, Licensing at (914) 734-6710.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 2/5/08.

Sincerely,

Fred R. Dacimo
Vice President
License Renewal

A128
NRR

Attachment:

1. Reply to NRC Request for Additional Information Regarding License Renewal Application – Severe Accident Mitigation Alternatives Analysis

Enclosure:

1. Tourism and New York City's Economy Article (SAMA 4c Reference)

cc: Mr. Bo M. Pham, NRC Environmental Project Manager
Ms. Kimberly Green, NRC Safety Project Manager
Mr. John P. Boska, NRC NRR Senior Project Manager
Mr. Samuel J. Collins, Regional Administrator, NRC Region I
Mr. Sherwin E. Turk, NRC Office of General Counsel, Special Counsel
IPEC NRC Senior Resident Inspectors Office
Mr. Paul D. Tonko, President, NYSERDA
Mr. Paul Eddy, New York State Dept. of Public Service

ATTACHMENT I TO NL-08-028

REPLY TO NRC REQUEST FOR ADDITIONAL INFORMATION

REGARDING

LICENSE RENEWAL APPLICATION

<u>Severe Accident Mitigation Alternatives Analysis</u>

ENTERGY NUCLEAR OPERATIONS, INC
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 and 3
DOCKETS 50-247 and 50-286

INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 AND 3
LICENSE RENEWAL APPLICATION (LRA)
REQUESTS FOR ADDITIONAL INFORMATION (RAI)

The U.S. Nuclear Regulatory Commission (NRC or staff) has reviewed the information related to Severe Accident Mitigation Alternatives analysis provided by the applicant in the Indian Point Nuclear Generating Unit Nos. 2 and 3 (IP2 and IP3) LRA. The staff has identified that additional information is needed to complete the review as addressed below.

SAMA RAI 1

The SAMA analyses for Indian Point Nuclear Generating Unit No. 2 (IP2) and Unit No. 3 (IP3) are based on the most recent versions of the plant-specific Probabilistic Safety Analysis (PSA), i.e., Revision 1, April 2007 for IP2, and Revision 2, April 2007 for IP3. Provide the following information regarding the PSA models (for both units unless otherwise specified).

a. Describe major changes to the internal flood model in each of the PSA updates (the 2003, 2005, and 2007 updates for IP2, and the 2001 and 2007 updates for IP3).

b. Characterize the Westinghouse Owners Group (WOG) peer review findings related to the internal flood model (2002 review for IP2 and 2001 review for IP3). Identify any review comments not yet incorporated and discuss their impact on the SAMA analysis and results.

c. Characterize the major findings of the focused self-assessment and external reviews of Revision 0 (2005 update) of the IP2 PSA, and the outside consultant reviews and focused self-assessment of Revision 1 (2001 update) of the IP3 PSA. Identify any review comments not yet incorporated and discuss their impact on the SAMA analysis and results.

d. (IP2) Explain the plant features or models that result in the relatively low contributions to core damage frequency (CDF) from loss of 125 volts direct current (Vdc) bus and total loss of service water initiating events at IP2. Identify any plant features contributing to this result that are not in IP3.

e. Identify and discuss the plant features or modeling assumptions that result in the relatively high internal flooding contribution in both units.

f. For the steam generator tube rupture (SGTR) initiating event (IE-T7), it is stated (e.g., in Table E.1-2 and E.3-2) that many Phase I SAMAs have been implemented to mitigate this event, including improving detection and isolation capabilities, improving makeup capabilities to the reactor pressure vessel, and improving primary side depressurization reliability. Identify the specific improvements made and the updates made to PSA associated with each of these improvements.

g. Provide the truncation limit used for quantifying the PSA and its bases.

Response to SAMA RAI 1a

The major changes to the internal flooding models for IP2 and IP3 include the following.

IP2

2003 Update
As noted in Sections E.1.4 and E.1.4.3 of the license renewal application environmental report (LRA-ER), the IP2 internal flooding evaluation was performed as part of the individual plant examination for external events (IPEEE), and the 2003 IP2 probabilistic safety analysis (PSA) update was the first to incorporate the internal flooding events into the internal events model. The internal flooding model reflected the evaluation performed for the IPEEE with the exception of an additional flooding source located in a stairwell adjacent to the 480V switchgear room that was identified following that effort. The IP2 model was a support state (RISKMAN) model at that time.

2005 Update
The internal flooding model was updated to reflect changes in plant procedures.
The 2005 PSA model update included a transition from the support state (RISKMAN) modeling method to the CAFTA fault tree linking method. As a result, the plant response to flood initiators was made consistent with the converted internal events model. The most relevant change in the internal events model update with regard to internal flooding was incorporation of the Westinghouse Owners Group (WOG) 2000 reactor coolant pump (RCP) seal loss of coolant accident (LOCA) model. The relative importance of flooding events remained essentially the same.

2007 Update
The internal flooding model was not changed as part of this update. Although the relative contribution to overall core damage frequency (CDF) dropped slightly, this was a result of changes made to the internal events model, not to the internal flooding model itself.

IP3

2001 Update
The internal flooding model for the IP3 2001 update reflected

- Changes in plant procedures, including implementation of a procedure to verify the floor drains on the 15-ft elevation of the control building have a flow path to discharge.
- Changes to the calculated probabilities that submergence damage would occur such that an accident scenario would ensue.
- A reduction in the CDF criterion for screening flooding scenarios from 1E-8 to 1E-11 per reactor-year.

2007 Update
The internal flooding model was not changed in this update. Changes in the flooding event contributions to CDF were a result of changes in the plant response to the flood damage states due to changes in the internal events model, primarily related to incorporation of the WOG2000 RCP seal LOCA model.

Response to SAMA RAI 1b

IP2

There were only two WOG peer review findings associated with the internal flooding analysis. One finding related to a flooding event screening criterion of 1E-6 in the analysis. That criterion, however, was only applied to a scenario involving the potential for inter-compartmental flooding from the emergency diesel generator building to the electrical tunnel. That scenario involved leakage that could be accommodated by existing plant drains rather than catastrophic failure. Therefore, it was determined that screening of this scenario was appropriate and a model change was not needed. The second finding was a general concern that the flooding study had not been updated since 1993. The internal flooding analysis was updated in 2005.

Therefore, all internal flooding review comments that impact the model were addressed in the model used for the SAMA analysis.

IP3

The IP3 WOG peer review concluded that the internal flooding analysis demonstrated a superior combination of industry data and models to obtain plant-specific piping rupture frequencies. The peer review identified four findings and observations (F&Os) related to the internal flooding analysis. One F&O was a strength that warranted no change to the model. The other findings related to incorporation of historical data, assembly of walk down records, and consideration of applicable draft American Society of Mechanical Engineers (ASME) standards to enhance the flooding analysis. The findings related to incorporation of historical data and assembly of walk down records were resolved during preparation of the final version of Revision 1 (2001 update) of the IP3 PSA model. The draft ASME standards identified by the review team were reviewed and no modeling changes were warranted.

Therefore, all internal flooding review comments that impact the model were addressed in the model used for the SAMA analysis.

Response to SAMA RAI 1c

IP2

As noted in LRA-ER Section E.1.4.3, the significant findings of both the IP2 and IP3 WOG peer reviews were addressed in the 2005 IP2 update. The objective of the self-assessment performed following the 2005 update was to assess the quality of the updated IP2 PSA model against the Mitigating System Performance Index (MSPI) related elements of the ASME probabilistic risk assessment (PRA) Standard (ASME RA-Sa-2003). The team included all seven members of the in-house ENN PSA group as well as two external peer reviewers.

The overall finding of the self assessment was that the IP2 PSA is a high quality analysis of the risk of IP2, based on extensive documentation, detailed modeling and supporting analysis, and experience of the PSA analysts involved in preparing the PSA. In addition, the self assessment found that the IP2 PSA meets the MSPI related elements of the ASME PRA Standard.

While some enhancements were noted, no negative observations or areas for improvement in the IP2 PSA were identified that required model changes. No category A F&Os were identified. One category B F&O which involved the approach used for addressing conditional human error probabilities was resolved by a sensitivity study that showed no significant difference in results. The remaining F&Os are documentation issues and other issues that do not have a significant effect on the model and will be addressed in the next update.

Therefore, no outstanding review comments exist that would impact the SAMA analysis and results.

IP3

As discussed in LRA-ER Section E.3.4.1, the in-house and outside consultant reviews of the 2001 IP3 update were performed on a draft of the Revision 1 IP3 model prior to the WOG peer review. As a result, all significant review comments were incorporated or resolved prior to the WOG review. The resolutions of those comments were provided to the WOG review team prior to their review.

The independent team of outside consultants involved in the review of the draft of the Revision 1 model comprised three prominent outside experts from Scientech:

- Mr. Robert Bertucio

  Mr. Bertucio reviewed the entire plant model, including the accident sequence event trees, the system fault tree models and their associated system notebooks.

- Mr. Jeff Julius

  Mr. Julius reviewed the Human Reliability Analysis. His review included both the human reliability analysis approach and results.

- Mr. P. J. Fulford

  Mr. Fulford reviewed the Level II Containment Performance Analysis, including the following.

  - Bins and Plant Damage States
  - Containment Failure Characterization
  - Containment Event Tree
  - Radionuclide Release Characterization
  - Containment Event Tree Quantification.

The review team used criteria consistent with those embodied in the WOG and Nuclear Energy Institute (NEI) peer review processes. The comments from the outside consultants were incorporated in the final version of Revision 1 (2001 update) of the IP3 PSA model.

Therefore, no outstanding review comments exist that would impact the SAMA analysis and results.

Response to SAMA RAI 1d

IP2 has both primary and automatic backup direct current (DC) control power, from separate DC buses, to safety-related equipment such as the emergency diesel generators, auxiliary feedwater pumps, safety injection, residual heat removal (RHR) and recirculation pumps, service water pumps and component cooling water (CCW) pumps. This reduces the risk associated with losing any one DC bus. IP3 does not have this feature.

Both IP2 and IP3 have two separate service water subsystems, each of which has three service water pumps. The primary function of one header (labeled the "essential header") is to provide cooling to the emergency diesel generators and the containment fan cooler units. The primary function of the opposite train (labeled the "non-essential header") is to provide cooling to the CCW heat exchanger. Since the two subsystems are separate from each other during power operation, failure of either subsystem individually is modeled as a separate initiating event. In the absence of a LOCA, only one pump is required for success on each header. Since the headers are separate from each other during normal operation, a single pipe break cannot cause a total loss of service water event. As a result, a total loss of service water initiating event requires loss of flow from all six service water pumps. Therefore, this initiating event provides a relatively low contribution to CDF.

Response to SAMA RAI 1e

The relatively high internal flooding contribution for both IP2 and IP3 is a consequence of a design decision to place the 480V switchgear in the basement of the control building in a single room in which flood sources are present. The internal flooding contribution for both IP2 and IP3 is dominated by postulated failure of flooding sources located in, or adjacent to, the 480V switchgear room.

A dominant flooding source in both IP2 and IP3 is a three inch service water line, located in the 480V switchgear room, which provides cooling to instrument air equipment.

Adjacent to the IP2 480V switchgear room are a deluge room containing a ten inch fire protection line and a stairwell containing a four inch fire protection line. Although these lines are not in the switchgear room, water from failure of the lines can enter the room through openings in and around the partition doors.

Fire protection deluge piping is also located within a room adjacent to the IP3 switchgear room. Additional significant flooding sources adjacent to the IP3 switchgear room include service water piping in an alternating current (AC) equipment room and service water and fire protection piping in a connecting stairwell.

It is assumed that once a critical height of water is reached in the 480V switchgear room the flooding will fail all four 480V buses and will also result in an automatic or manual plant trip. Loss of the buses is assumed to be unrecoverable and require use of alternate safe shutdown (ASSS) equipment to safely shut down the plant. Both the IP2 and IP3 ASSS provide the necessary power to safely shut down the plant in the absence of a LOCA beyond the capability of a charging pump. The IP2 ASSS can provide power to emergency core cooling equipment through use of a casualty cable. The IP3 ASSS does not, however, provide power to emergency core cooling equipment.

Response to SAMA RAI 1f

The Phase 1 SAMA candidates referenced in the evaluation of the steam generator tube rupture (SGTR) initiating event (IE-T7) are candidates from industry documents that are already addressed by IP2 and IP3 operating procedures and practices. As a result, they were already reflected in the plant procedures and configuration as it was modeled in the PSA and are not associated with specific PSA model updates.

Table RAI 1-1 (IP2) and Table RAI 1-2 (IP3) list the Phase I SAMA candidates that mitigate SGTR events and are already addressed by existing procedures and practices.

Table RAI 1-1 IP2 Phase I SGTR SAMA Candidates

Phase I SAMA ID Number	**SAMA Title**	**Existing Indian Point 2 Capabilities**
Improve detection and isolation capabilities		
068	Revise emergency operating procedures to direct that a faulted steam generator be isolated	IP2 Emergency Operating Procedure (EOP) E-0, “Reactor Trip or Safety Injection,” directs the operators to transition to EOP E-2, “Faulted Steam Generator Isolation,” prior to entering EOP E-3, “Steam Generator Tube Rupture”. If a steam generator should become faulted while the crew is in E-3, the fold-out page directs entry / re-entry into EOP E-2 to isolate the faulted SG. EOP E-3 provides direction for isolating a ruptured steam generator by increasing the atmospheric dump valve setpoint, isolating main steam traps and blowdown, closing the main steam isolation valve (MSIV) and securing auxiliary feedwater flow.
071	Provide improved instrumentation to detect steam generator tube rupture, such as Nitrogen-16 monitors.	Nitrogen-16 monitors exist near the main steam lines in the auxiliary boiler feed pump building at IP2.
Improve makeup capabilities to the reactor pressure vessel		
112	Provide hardware and procedure to refill refueling water storage tank (RWST)	IP2 has procedure and capability to align primary water from the primary water storage tank to refill RWST.
118	Create the ability to manually align emergency core cooling system recirculation	IP2 emergency operating procedure direct the operator to manually aligned the emergency core cooling system to recirculation upon the low RWST level signal.
Improve primary side depressurization reliability		

Phase I SAMA ID Number	SAMA Title	Existing Indian Point 2 Capabilities
063	Install a redundant spray system to depressurize the primary system during a SGTR	Primary system can be depressurized via power-operated relief valves (PORVs), pressurizer spray valves and auxiliary valves.
070	Proceduralize use of pressurizer vent valves during SGTR sequences	IP2 EOP E-3, "Steam Generator Tube Rupture," directs the operators to use the pressurizer PORVs as a backup method to the normal spray valve to reduce primary system pressure following a SGTR. Additionally, if the pressurizer PORVs are unavailable, the procedure directs the operators to use the auxiliary spray valve.
Other SGTR mitigating improvements		
065	Implement a maintenance practice that inspects 100 percent of the tubes in a steam generator	IP2 has an existing steam generator inspection program, required by technical specifications, that requires that 100% of the steam generator tubes be inspected over a set operating time period. The initial interval is 144 months and becomes increasingly restrictive in subsequent intervals.
067	Replace steam generators with a new design	Replacement steam generators were installed at IP2.
069	Direct steam generator flooding after a SGTR, prior to core damage	IP2 EOP E-3, "Steam Generator Tube Rupture," contains guidance to feed the ruptured steam generator until narrow range level is greater than 10%. This provides steam generator tube coverage while limiting the potential for steam generator over-fill.

Table RAI 1-2 IP3 Phase I SGTR SAMA Candidates

Phase I SAMA ID Number	SAMA Title	Existing Indian Point 3 Capabilities
Improve detection and isolation capabilities		
068	Revise emergency operating procedures to direct that a faulted steam generator be isolated	IP3 EOP E-0, "Reactor Trip or Safety Injection," directs the operators to transition to EOP E-2, "Faulted Steam Generator Isolation," prior to entering EOP E-3, "Steam Generator Tube Rupture". If a steam generator should become faulted while the crew is in E-3, the fold-out page directs entry / re-entry into EOP E-2 to isolate the faulted steam generator. EOP E-3 provides direction for isolating a ruptured steam generator by increasing the atmospheric dump valve setpoint, isolating main steam traps and blowdown, closing the MSIV and securing auxiliary feedwater flow
071	Provide improved instrumentation to detect steam generator tube rupture, such as Nitrogen-16 monitors.	Main steam radiation monitors, steam generator liquid sample monitor, and condenser air ejector monitor steam generator tube leaks and provide signals to control room indicators at IP3.
Improve makeup capabilities to the reactor pressure vessel		
112	Provide hardware and procedure to refill RWST	IP3 has procedure and capability to align primary water from the primary water storage tank to refill RWST.
118	Create the ability to manually align emergency core cooling system recirculation	IP3 emergency operating procedure direct the operator to manually aligned the emergency core cooling system to recirculation upon the low RWST level signal.
Improve primary side depressurization reliability		
063	Install a redundant spray system to depressurize the primary system during a SGTR	Primary system can be depressurized via PORVs, pressurizer spray valves and auxiliary valves.
070	Proceduralize use of pressurizer vent valves during SGTR sequences	IP3 Emergency Operating Procedure E-3, "Steam Generator Tube Rupture," directs the operators to use the PORVs as a backup method to the normal pressurizer spray valves method to reduce primary system pressure following a SGTR. Additionally, if the pressurizer PORVs are unavailable, the procedure directs the operators to use the auxiliary spray valve.
Other SGTR mitigating improvements		

Phase I SAMA ID Number	SAMA Title	Existing Indian Point 3 Capabilities
065	Implement a maintenance practice that inspects 100 percent of the tubes in a steam generator	IP3 has an existing steam generator inspection program, required by technical specifications, that requires that 100% of the steam generator tubes be inspected over a set operating time period. The initial interval is 120 months and becomes increasingly restrictive in subsequent intervals.
067	Replace steam generators with a new design	Replacement steam generators were installed at IP3.
069	Direct steam generator flooding after a SGTR, prior to core damage	IP3 EOP E-3, "Steam Generator Tube Rupture," contains guidance to feed the ruptured steam generator until narrow range level is greater than 9%. This provides steam generator tube coverage while limiting the potential for steam generator over-fill.

Response to SAMA RAI 1g

A truncation limit of 1E-11/reactor-yr was used for both the IP2 and IP3 PSA models. A sensitivity analysis was performed to determine the impact on CDF of varying the truncation limit. The sensitivity analysis showed that lowering the truncation by an order of magnitude added less than 5% to the total CDF. Since the CDF is stable with respect to further reduction in the truncation value, a limit of 1E-11/ reactor-yr is appropriate.

SAMA RAI 2

Provide the following information relative to the Level 2 Analysis:

a. Provide a breakdown of the population dose (person-rem per year within 50 miles) by containment failure mode. Identify the contributions for SGTR, interfacing-systems loss-of-coolant accident (ISLOCA), and containment isolation failure.

b. Characterize the WOG and other peer review findings related to the Level 2 PSA model (2002 and 2005 reviews for IP2, and 2001 and 2007 reviews for IP3). Identify any review comments not yet incorporated and discuss their impact on the SAMA analysis and results.

c. Indicate the specific version of the modular accident analysis program (MAAP4) code used in the Level 2 analysis.

Response to SAMA RAI 2a

For IP2, as noted in Table E.1-14 of the LRA-ER, the total population dose for the base case is 22.0 person-rem per year within 50 miles. A breakdown of this value by containment release mode is provided in the following table.

IP2 Containment Failure Mode Release Information

Containment Failure Mode	Frequency	Population Dose Risk (person-rem/yr)	% Contribution
No Containment Failure	1.19E-05	0.03	0.12%
Basemat Melt-through	5.48E-07	1.07	4.85%
Steam/Noble Gas Overpressure	3.79E-06	7.39	33.63%
Late Hydrogen Burns	4.77E-07	0.93	4.23%
Early Hydrogen Burns	1.99E-07	2.11	9.61%
In-vessel Steam Explosion	1.32E-08	0.14	0.64%
Ex-vessel Steam Explosion	6.24E-11	0.0007	0.00%
Vessel Overpressure	9.44E-08	1.00	4.56%
Containment Isolation	8.63E-10	0.0092	0.04%
Interfacing System LOCA (ISLOCA)	1.52E-07	1.62	7.35%
SGTR[1]	7.24E-07	7.69	34.97%
Total	1.79E-5	2.20E+01	100.00%

Similarly, for IP3, as noted in Table E.3-14 of the LRA-ER, the total population dose for the base case is 24.5 person-rem per year within 50 miles. A breakdown of this value by containment release mode is provided in the following table.

IP3 Containment Failure Mode Release Information

Containment Failure Mode	Frequency	Population Dose Risk (person-rem/yr)	% Contribution
No Containment Failure	6.29E-06	0.02	0.10%
Basemat Melt-through	3.26E-07	0.63	2.59%
Steam/Noble Gas Overpressure	2.26E-06	4.40	17.92%
Late Hydrogen Burns	2.84E-07	0.55	2.25%
Early Hydrogen Burns	1.00E-07	0.82	3.32%
In-vessel Steam Explosion	6.61E-09	0.05	0.22%
Ex-vessel Steam Explosion	3.13E-11	0.0003	0.00%
Vessel Overpressure	4.74E-08	0.39	1.58%
Containment Isolation	4.34E-10	0.0035	0.01%
ISLOCA	1.32E-07	1.08	4.40%
SGTR[1]	2.04E-06	16.60	67.62%
Total	1.15E-05	2.45E+01	100.00%

Response to SAMA RAI 2b

IP2

The 2002 IP2 WOG peer review was performed on the RISKMAN model. There were two Level C F&Os from the WOG peer review team related to Level 2 analysis.

The IP2 large-early release frequency (LERF) model at that time did not address the potential for energetic failures to threaten containment. It was noted that this assumption was consistent

1 Includes SGTR with stuck open steam generator SRV, SGTR without stuck open steam generator SRV, and induced SGTR during the core melt accident progression.

with WOG guidance for large dry containments. It was recommended, however, for completeness and flexibility in potential future applications, that consideration be given to including the possibility of containment failure paths due to energetic failures, and assigning probabilities consistent with the available information. Therefore, the RISKMAN PSA model (5/2003) considered the following 'energetic failures': direct containment heating, hydrogen combustion, in-vessel steam explosions and ex-vessel steam explosions.

The second F&O noted that the possibility of a stuck open main steam safety valve was not addressed in the level 2 analysis and recommended that it be considered to properly address impacts on the level of release of fission products following an SGTR and the potential for an induced SGTR during a high pressure sequence. The Revision 1 (3/2007) SGTR model does differentiate between a stuck open safety valve and a cycling safety valve in determining LERF following a SGTR core damage event. SGTRs induced by high primary pressures following core damage are addressed in the model using the information from the NUREG-1150 In-Vessel Expert Panel. All such induced SGTRs are binned to LERF.

The IP2 Revision 0 (3/2005) model utilized the same approach and methodology as the IP3 Revision 1 (6/2001) model and incorporated all the peer review recommendations associated with the WOG review of that model as well (see discussion below). Since the methodology was consistent with the earlier treatment in the IP3 model, and the 2005 IP2 peer review was a limited review, it did not address the Level 2 model. The model changes in IP2 Revision 0 were reviewed for accuracy and consistency by members of the Entergy Nuclear Systems Analysis Group staff not directly involved in their implementation.

IP3

A draft of the revision 1 PSA model was peer reviewed in January 2001 by a WOG peer review team. There were six F&Os from the WOG peer review team related to Level 2 analysis.

- One F&O related to a plant specific containment structural analysis was considered a strength,
- one level A F&O recommended that the LERF definition include the release of Iodine (I) as well as Cesium (Cs) and Tellurium (Te),
- two level B F&Os related to justification for the value used for ex-vessel explosion, and an overestimation of the 'Alpha mode' induced containment failure probability,
- one level C F&O recommended crediting repair and recovery of systems that affect containment performance, and
- one level D F&O related to documentation.

All level A and B F&Os were resolved and changes were incorporated as necessary in the final version of Revision 1 (6/2001) of the IP3 PSA model. The level C and D F&Os were addressed as appropriate in the next revision of the model.

The IP3 Revision 2 PSA model was issued in April 2007. The model changes in this update were reviewed for accuracy and consistency by members of the Entergy Nuclear Systems Analysis Group staff not directly involved in their implementation.

Response to SAMA RAI 2c

The version of the MAAP4 computer used in the Level 2 analysis is MAAP4.0.5.

SAMA RAI 3

Provide the following information regarding the treatment and inclusion of external events in the SAMA analysis:

a. Provide a listing of the dominant seismic scenarios and their CDFs for both the individual plant examination of external events (IPEEE) and the latest update.

b. Section E.1.3.2 indicates that the dominant fire sequences were reevaluated as part of the IP2 SAMA analysis. Section E.3.3 indicates that the seismic and fire PSAs were updated as part of the IP3 SAMA. Describe the quality controls that were applied to these updates and any peer reviews that were performed.

c. (IP2) Section E.1.3.2 indicates that the fire reevaluation resulted in a revised fire CDF of 9.11E-6 per reactor year for IP2. However, Table E.1-11 indicates a total fire CDF of 6.45E-6 per year (for the fire zones listed). Address this discrepancy. Provide a more complete accounting of the dominant CDF contributors in the revised analysis. Confirm whether the CDF is per year or per reactor year.

d. (IP3) Discuss the impact of the current operational scheme with block valve open on the control room fire in panels FBF or FCF for IP3. Identify other external event scenarios including the seismic events that could have been affected by this change in the operation.

e. (IP3) State the features associated with the 480 VAC Switchgear Room (Fire Zone 14) that contribute to its 1.3E-05 per year fire CDF for IP3. Include a description of the fire scenarios that are significant contributors to the calculated risk.

Response to SAMA RAI 3a

Neither the IP2 nor the IP3 seismic risk analysis has been updated since the IPEEE was performed. The re-evaluation of IP3 seismic risk performed in support of the SAMA evaluation was a limited scope effort to reflect updated random component failure probabilities and to model recovery of onsite power and local operation of the turbine driven auxiliary feedwater (AFW) pump. This effort did not extend to developing a scenario breakdown. However, the changes were not extensive enough to have significant impact on the relative contributions to CDF predicted in the IP3 IPEEE (described below).

Dominant IP2 IPEEE Seismic Scenarios

The total seismic CDF found during the IPEEE was 1.46×10^{-5} per reactor-year. The dominant contributors are discussed below.

Loss of Instrumentation and Control

Approximately 45% of the seismic CDF resulted from loss of instrumentation and control sequences, which were assumed to lead directly to loss of all power, and core damage. Failure of the IP2 turbine building frame and assumed consequential failure of the control building contributed 54% toward this dominant sequence, while collapse of the Unit 1 superheater stack onto the control building or the emergency diesel generator building contributed the remaining 46%.

Loss of Component Cooling Water

Approximately 29% of the seismic CDF was related to failure of CCW, primarily due to failure of the CCW surge tank hold down bolts. This caused loss of cooling to the RCP seals and to the charging, RHR, and safety injection (SI) pumps. A consequential seal LOCA was assumed to occur, which, without safety injection for mitigation, resulted in core damage.

Loss of 480 VAC Electric Power

Approximately 9% of the seismic CDF was related to failure of the 480V emergency electric power system. This failure causes station blackout, eventual failure of decay heat removal, and core damage. The two equally dominant contributors were seismic failure of cable trays, which was assumed to be sufficiently widespread to cause loss of all electric power, and seismic failure of the 480V motor control centers. It was conservatively assumed that the motor control center failures were totally correlated, such that if one failed, they were all assumed to fail.

Loss of Service Water

Approximately 9% of the seismic CDF was related to failure of the service water system (SWS), which provides cooling to the emergency diesel generators (EDGs) and the CCW heat exchangers. Loss of the service water system will quickly result in loss of the EDGs, causing station blackout, and core damage. Seismic failure of the SWS pumps was the dominant contributor.

Other Sequences

Seismic-induced loss of offsite power sequences, with subsequent non-seismic failures, contributed approximately 3% to the seismic CDF. Other lesser sequences included loss of the condensate storage tank and RWST, unmitigated anticipated transient without scram (ATWS) caused by failure of the reactor internals, and ATWS with seismic failure of the RWST.

As discussed above, during the course of the seismic IPEEE effort, it was determined that, although the CCW surge tank met its design basis, the capacity of the tank to withstand beyond design basis seismic events was limited by the capacity of the hold down bolts. As a result of this IPEEE finding, the hold down bolts were replaced by higher tensile strength bolts. This effectively eliminated the contribution from that sequence and reduced the IPEEE total seismic CDF to approximately 1.1×10^{-5} per reactor-year.

Dominant IP3 IPEEE Seismic Scenarios

The total seismic CDF found during the IPEEE was 4.4×10^{-5}/reactor-year. Six types of seismic-induced accidents dominated the IP3 seismic CDF: station blackout (SBO), RCP seal LOCA, loss-of-offsite power (LOSP) transients, surrogate element, ATWS, and small break LOCA seismic accidents. The dominant accident sequences are discussed below.

Loss of 480 VAC Electric Power

Approximately 43% of the seismic CDF was related to seismic-induced loss of all AC power. In this sequence, although the AFW steam-turbine-driven pump may be available for secondary-side cooling, the loss of RCP seal cooling leads to an unmitigated RCP seal LOCA and core damage. Key contributors are seismic failures of systems that support emergency diesel generator operations (switchgear and service water pumps).

Loss of Component Cooling Water

Approximately 23% of the seismic CDF was related to failure of CCW. With loss of CCW and no subsequent charging pump flow to the RCP seals, seal degradation and consequential RCP seal LOCA occur. All core cooling systems eventually fail as a result of inadequate CCW flow. Key contributors are seismic failures of the CCW surge tank and heat exchangers.

Loss of Offsite Power (Onsite Power Available)

Approximately 21 percent of the seismic CDF was related to loss of offsite power, successful onsite emergency diesel power and seismic failures of the RHR heat exchangers, the condensate storage tank, containment instrument racks that delay bleed-and-feed core cooling, and the AFW system.

Surrogate Element

Approximately 8% of the seismic CDF was due to a seismic initiating event with failure of the surrogate element. The surrogate element represents screened out, rugged components and structures. By definition, failure of the surrogate leads to core damage.

Seismic-Induced ATWS

Approximately 5% of the seismic CDF was due to seismic-induced ATWS sequences. Key contributors are the seismic-induced failure of control rods to insert, seismic failure of control room racks, seismic failure of the boric acid storage tanks, seismic failures of the charging pumps, seismic failures of switchgear and seismic failures of the service water pumps.

<u>Response to SAMA RAI 3b</u>

<u>IP2</u>

There has been no formal IP2 fire PSA model update since the IPEEE. The IP2 fire analysis methodology and modeling were not revised as part of the SAMA analysis. Evaluation of the model for the SAMA analysis was limited to review of dominant sequences to determine if conservatisms existed that could be revised to provide a more realistic external event factor for the SAMA evaluation. The results of this evaluation were reviewed by members of the Entergy Nuclear Systems Analysis Group staff not directly involved in evaluation. Additional details are provided in response to RAI 3c.

IP3

There has been no formal IP3 fire PSA model update since the IPEEE. The IP3 fire PSA was peer reviewed as part of the original IPEEE submittal. The fire PSA was reviewed and specific fire zones were requantified as a result of plant modifications and plant model improvements to provide a more realistic external event factor for the SAMA evaluation. The results of this review and requantification were reviewed by members of the Entergy Nuclear Systems Analysis Group staff not directly involved with the revision of the model.

Similarly, there has been no formal IP3 seismic update since the IPEEE. The seismic PRA has been re-evaluated to reflect updated random component failure probabilities and to model recovery of onsite power and local operation of the turbine-driven AFW pump. The results of this re-evaluation were reviewed by members of the Entergy Nuclear Systems Analysis Group staff not directly involved in the re-evaluation.

Response to SAMA RAI 3c

This discrepancy resulted from an inadvertent inclusion of preliminary results for this re-evaluation in the LRA-ER. The final values should have reflected a subsequent application of NUREG/CR-6850 guidance regarding ignition frequency to only specific control room cabinets (resulting in a higher revised control room cabinet CDF than shown in Table E.1-11) and a corrected value for the electrical penetration area.

The total revised CDF should be 8.42E-6/rx-yr, which provides a reduction factor of 2.19. Therefore, the reduction factor of two used in the SAMA analysis is not impacted by these changes.

Revisions to the appropriate Section E.1.3.2 paragraph on page E.1-75 and to Table E.1-11 on page E.1-78 are provided below.

Table E.1-11 provides the dominant CDF contributors by fire zone in the revised analysis. Additional details regarding the specific scenarios within each zone are provided in the following table (the remaining zones in Table E.1-11 are not shown since they did not contain sequences above 1E-7/rx-yr and were not revised).

Fire Zone	Fire Zone Description	IP2 Description of Dominant Scenarios
1A	electrical tunnel / pipe penetration area	The fire causes an induced LOCA through a pressurizer PORV due to a hot short opening a PORV and loss of power to the associated block valves. Although the block valves are normally maintained in a closed position, the fire may allow them to open prior to failure. The fire also precludes recirculation phase heat removal using either the fan coolers or RHR heat exchangers.

Fire Zone	Fire Zone Description	IP2 Description of Dominant Scenarios
2A	primary water makeup area	1) The fire causes a loss of power to the charging pumps and CCW pumps. Operators fail to align the ASSS in time to prevent an RCP seal LOCA. High pressure injection is successful but recirculation capability is degraded and the remaining capability subsequently fails (not due to the fire). 2) The fire causes an induced LOCA through a pressurizer PORV due to a hot short opening of a PORV and loss of power to the associated block valve. Although the block valves are normally maintained in a closed position, the fire may allow them to open prior to failure. High pressure injection is successful but recirculation capability is degraded and the remaining capability subsequently fails (not due to the fire).
11	cable spreading room	1) The fire causes an induced LOCA through a pressurizer PORV due to a hot short opening of PORV 455C and loss of power to the associated block valve. Although the block valve is normally maintained in a closed position, the fire may allow it to open prior to failure. High pressure injection is successful but recirculation capability is degraded and the remaining capability subsequently fails (not due to the fire). 2) The fire causes a loss of power to the charging pumps and non-essential service water pumps. Operators fail to align ASSS in time to prevent an RCP seal LOCA. High pressure injection is successful but recirculation is degraded and the remaining capability subsequently fails (not due to the fire). 3) The fire fails all power from vital buses. Alternate safe shutdown power is not aligned in time to preclude an RCP seal LOCA. ASSS power is subsequently aligned to the supported charging pump but the RCP seal LOCA flow rate is beyond the charging pump capability. 4) The fire impacts the AFW pumps and requires local operation of the remaining turbine driven AFW pump and valves. The operator fails to maintain control of the turbine driven AFW pump or align ASSS power to the motor driven AFW pump. Although main feedwater (MFW)/condensate is not impacted by the fire, it is not credited for this scenario.
14	switchgear room	1) The fire impacts the AFW pumps and requires local operation of the remaining turbine driven AFW pump and valves. The operator fails to maintain control of the turbine driven AFW pump or align ASSS power to the motor driven AFW pump. Although MFW/condensate is not impacted by the fire, it is not credited for this scenario. 2) The fire causes an induced LOCA through a pressurizer PORV due to a hot short opening of PORV 455C and loss of power to the associated block valve. Although the block valve is normally maintained in a closed position, the fire may allow it to open prior to failure. High pressure injection is successful but recirculation capability is degraded and the remaining capability subsequently fails (not due to the fire). 3) The fire fails all power from vital buses. Alternate safe shutdown power is not aligned in time to preclude an RCP seal LOCA. Alternate safe shutdown power is subsequently aligned to the supported charging pump but the RCP seal LOCA flow rate is beyond the charging pump capability.
15	control room	1) The fire results in abandonment of the control room and use of the ASSS. ASSS

Fire Zone	Fire Zone Description	IP2 Description of Dominant Scenarios
		power is not aligned in time to preclude an RCP seal LOCA. Alternate safe shutdown power is subsequently aligned to the supported charging pump but the RCP seal LOCA flow rate is beyond the charging pump capability. 2) The fire causes an assumed loss of all vital buses and use of the ASSS. The fire also causes an induced LOCA through a pressurizer PORV due to a hot short opening a PORV and loss of power to the associated block valve. Although the block valve is normally maintained in a closed position, the fire may allow it to open prior to failure. The flow rate from the stuck open PORV is beyond the charging pump capability. 3) The fire causes an assumed loss of all vital buses and use of the ASSS. ASSS power is not aligned in time to preclude an RCP seal LOCA that cannot be mitigated with remaining equipment. 4) The fire causes a loss of power to the charging pumps and non-essential service water pumps. The supported SWS pump fails randomly and operators fail to align the supported charging pump. An RCP seal LOCA results and cannot be mitigated.
74A	electrical penetration area	1) Induced LOCA through a pressurizer PORV due to a hot short opening a PORV and loss of power to the pressurizer block valves. Although the block valves are normally maintained in a closed position, the fire may allow them to open prior to failure. The fire also precludes recirculation phase heat removal using either the fan coolers or RHR heat exchangers

As discussed in the IP2 IPEEE, fire frequency calculations were performed using the methods provided in the FIVE methodology document and generic fire data information provided in the Fire Events Database (NSAC-178L). Those frequencies are given in events per reactor year.

Revised Paragraph for Section E.1.3.2, page E.1-75

The dominant IPEEE fire sequences (sequences with CDF contributions > 1 x 10^{-7}) were re-evaluated to reduce the conservatisms associated with main feedwater and condensate unavailability, PORV block valves, and RCP seal LOCAs. Sequences with contributions of less than 1 x 10^{-7} were conservatively left as is. Also, the fire ignition frequency for the central control room main control board cabinets was reduced in accordance with current guidance provided in NUREG/CR-6850 [Reference E.1-24]. This re-evaluation resulted in a revised fire CDF of ~~9.11~~**8.42** x 10^{-6} per reactor-year, which represents a reduction of ~~2.02~~**2.19**. Therefore, a reduction factor of two was applied in determining the external event multiplier described in Section 4.21.5.4.

Revised Table E.1-11

Table E.1-11

IP2 Fire Updated CDF Results

Fire Zone	Fire Zone Description	CDF/year	New Estimate CDF/year
1A	electrical tunnel / pipe penetration area	9.19 X 10^{-7}	6.55 X 10^{-7}
2A	primary water makeup area	1.05 X 10^{-6}	5.13 X 10^{-7}
11	cable spreading room	4.28 X 10^{-6}	2.04 X 10^{-6}
14	switchgear room	3.84 X 10^{-6}	1.40 X 10^{-6}
15	control room	7.07 X 10^{-6}	~~1.43~~**2.97** X 10^{-6}
74A	electrical penetration area	1.11 X 10^{-6}	~~2.97~~**7.26** X 10^{-7}
6A*	drumming and storage station	1.53 X 10^{-9}	1.53 X 10^{-9}
32A*	cable tunnel	9.62 X 10^{-8}	9.62 X 10^{-8}
1*	CCW pump room	2.19 X 10^{-9}	2.19 X 10^{-9}
22/63A*	service water intake	7.46 X 10^{-9}	7.46 X 10^{-9}
23*	AFW pump room	6.15 X 10^{-9}	6.15 X 10^{-9}

* Note: These fire zones had no sequences with CDF contribution greater than 1 X 10^{-7} and were conservatively not re-evaluated

Response to SAMA RAI 3d

The PORV block valves at IP3 are normally maintained in the open position. This was also the operational scheme at the time the IPEEE was performed.

This assures that the PORVs are available to provide pressurizer overpressure protection to minimize challenging the code safety relief valves. Should a postulated fire in control room panel FBF or FCF result in spurious opening of either or both PORVs, the operators would be made immediately aware via several annunciators. The following alarms would be received as result of spurious PORV operation

On control room panel SAF-

- Pressurizer Relief Line High Temp
- Pressurizer PORV and Safety Acoustic Monitoring
- Pressurizer Low Pressure

On control room panel SBF-

- PCV-455C PCV-456 Not Fully Closed.

Operator response to these alarms as a result of equipment failure, is to verify that the PORV(s) operation is not valid, then

- Close the PORV(s)
- Close the associated block valve(s)
- Remove the power fuses for the affected PORV solenoid(s)
- Dispatch NPO to de-energize the affected PORV block valve at its motor control center cubicle.

Additionally, the IP3 safe shutdown analysis identified an alternate means to effect PORV closure which requires opening two circuit breakers at the DC distribution panel in the control room.

There are no other external event scenarios which would adversely impact either the power operated relief valves or their associated block valves. These components are designed, installed, tested and maintained to quality assurance class 1 and seismic class I requirements.

Response to SAMA RAI 3e

IP3 has one 480V switchgear room which contains circuits for both divisions of AC power. Approximately 50% of the fire risk in this 480V switchgear room comes from fires in the switchgear that grow beyond incipient stage and involve significant amounts of combustibles (i.e., cables) within the switchgear. Both switchgear are vented high and have exposed cable trays overhead that can be damaged and ignited prior to successful suppression, resulting in loss of one division. The CO_2 suppression system is automatically actuated with manual initiation available outside the switchgear room. Should the CO_2 suppression system fail to be activated, the heat generated from cable trays above the first switchgear is sufficient to cause damage to the other switchgear division. Approximately 49% of the fire risk in the switchgear room results from oil fires at the instrument air compressors or instrument air closed loop cooling water pumps which propagate to overhead cable trays and result in loss of both switchgear. In the event of loss of both divisions, safe shutdown is accomplished through manual local operation of the auxiliary feedwater pump and use of bus 312 with the Appendix R diesel generator. Success of this activity is driven by successful alignment of the Appendix R diesel generator to bus 312 following the loss of the two 480V switchgear and offsite power.

General Zone Description

The 480V switchgear room is on the 15-ft elevation of the control building and has a floor area of 2985 ft^2 and a 16-ft ceiling. Appendix A barriers separate it from adjacent control building zones; Appendix R barriers separate it from other fire areas. The north, south and west walls and ceiling are 3-hour fire rated barriers; the remaining barriers are non-rated. Two doors open into other fire zones within the control building while a third door opens into the turbine building fire area. The doors have 3-hour fire ratings. Fire dampers FD-1 and FD-2 (with a 3-hour rating) and FD-9 (with a 1.5-hour rating) are also in the zone. The fire dampers have electro-thermal links which close dampers automatically if temperatures at the dampers exceed 165°F. The dampers are also closed manually upon actuation of the CO_2 system. An outside air intake louver with a motor operated damper is located in the southwest corner of the room. The damper is normally closed and opens when the second exhaust fan is started.

Suppression and Detection

This fire zone has an area-wide, automatic, total flooding CO_2 system. Manual actuation of the CO_2 system can be accomplished outside the switchgear room. Area-wide smoke and thermal detection systems annunciate in the control room. Two separate ionization smoke detection systems are mounted on the ceiling. Ceiling-mounted thermal detectors provide the actuation signal for the CO_2 system at a temperature of 225°F. The earliest indication of a fire in the switchgear room is likely to be provided by either smoke detectors or room temperature detectors. The high room temperature alarms are set to alert the control room if the temperature in the exhaust duct reaches 100°F.

The fire brigade may choose to extinguish the fire by means of manual CO_2, halon, dry chemical or water extinguishers available in the vicinity. In addition, a hose station is present outside the switchgear room in the turbine building.

Significant Ignition Sources

Significant ignition sources in the room comprise the instrument air compressors and instrument air closed cooling pumps (with their respective oil inventories), 480-V switchgear cabinets, station service transformers, battery charger 33 and transient combustibles. Other electrical cabinets and equipment within the zone are not considered ignition sources since they have no openings through which a fire could propagate or because potential targets are outside critical damage distances.

Fire Scenarios

Fire at 480-V Switchgear 31

This case addresses an electrical cabinet fire in 480V switchgear 31. In this scenario, internal ignition of the switchgear affects the EDG 32 bus duct, three overhead raceways in the plume of the fire, and a vertical riser. The bottom tray of the overhead raceway is located above the EDG 32 bus duct and is approximately 3 ft from the top of the switchgear cabinet. Smoke detector actuation occurs within 1 minute. If CO_2 suppression is not activated within 11 minutes, propagation of the source fire to overhead cable trays results in a hot gas layer (HGL) temperature of 117°F, which is assumed to fail the 480V switchgear. However, offsite power to Appendix R bus 312 is still available. Should suppression fail to be activated within 31 minutes, fire propagation to overhead cable trays results in an HGL temperature of 700°F. This temperature is sufficient to cause widespread damage to cables and equipment throughout the room, including offsite power cables.

In summary, damage from a fire at 480V switchgear 31 will be limited to the EDG 32 bus duct, raceways 78N-DD, 76N-DB and 62P-JB, and vertical riser 91N-DB if the suppression system is activated within 11 minutes. The conditional core damage probability (CCDP) calculated for this scenario is 2.13×10^{-2}. Should suppression fail to be activated within 11 minutes, the CCDP (without recovery) is 1.0. If suppression is activated within 31 minutes, offsite power to bus 312 remains available. Core damage can be prevented using the alternate safe shutdown equipment. If suppression fails, the Appendix R diesel generator must be used to supply power to bus 312.

Fire at 480V Switchgear 32

This case addresses an electrical cabinet fire in 480V switchgear 32. In this scenario, the internal ignition of the cabinet affects three raceways in the plume of the fire. The bottom tray is located approximately 2 ft above the switchgear cabinet. Smoke detector actuation occurs within 1 minute. If suppression is not activated within 11 minutes, propagation of the source fire to overhead cable trays results in a HGL temperature of 117°F, which is assumed to fail the 480V switchgear. However, offsite power to Appendix R bus 312 is still available. Should suppression fail to be activated within 31 minutes, fire propagation to overhead cable trays results in an HGL temperature of 700°F. This temperature is sufficient to cause widespread damage to cables and equipment throughout the room, including offsite power cables.

In summary, damage from a fire at 480V switchgear 32 will be limited to raceways 47N-CC, 48N-FB/CC, 56N-DA and 61N-DC if the suppression system is activated within 11 minutes. The CCDP calculated for this scenario is 2.03×10^{-2}. Should suppression fail to be activated within 11 minutes, the CCDP (without recovery) is 1.0. If suppression is activated within 31 minutes, offsite power to bus 312 remains available. Core damage can be prevented using the alternate safe shutdown equipment. If suppression fails, the Appendix R diesel generator must be used to supply power to bus 312.

Fire at 31 or 32 Instrument Air Compressor

This case addresses an oil fire at an instrument air compressor, conservatively assuming the entire inventory of oil spreads onto the compartment floor and ignites. Each instrument air compressor contains approximately 4.5 gallons of oil. Smoke detector actuation occurs within one minute. The CCDP for this scenario is 1.51×10^{-3}.

Fire at 32 Instrument Air Closed Cooling Pump

This case addresses an oil fire at an instrument air closed cooling pump. Each instrument air closed loop cooling pump contains approximately 0.25 gallons of oil. Conservatively assuming the entire inventory of oil from the No. 32 pump spreads evenly on the compartment floor and ignites, an HGL of 117°F could occur if suppression is not activated within 12 minutes, resulting in loss of the 480-V switchgear. In addition, because offsite power could be lost within the first minute, alternative safe shutdown would require use of the Appendix R diesel generator. This scenario would be limited to a loss of offsite power and damage to raceways 85N-DB, 85N-CB, 85N-CD and 46N-CD and riser 90N-DD should suppression be successful within 12 minutes. The resulting CCDP for this scenario is 1.81×10^{-3}. Should suppression efforts fail, the resultant CCDP (without recovery) is 1.0, and alternative safe shutdown would require use of the Appendix R diesel generator to supply power to bus 312.

An oil fire caused by the No. 31 pump was determined to pose no threat to overhead raceways and would only impact the No. 31 and 32 instrument air closed cooling pumps. The resulting CDF is negligible compared to the other sources of fire in the 480V switchgear room.

SAMA RAI 4

Provide the following information regarding the MACCS2 analyses:

a. Provide the date of issuance and a brief description of the Westinghouse analyses cited as the basis for the reactor core radionuclide inventories used in the MACCS2 analyses (Reference E.1.22 for IP2 and Reference E3.23 for IP3).

b. Confirm whether there are any planned future changes to reactor power level or fuel management strategies that would impact the reactor core radionuclide inventory used in the MACCS2 analysis. If so, provide an assessment of their impact on the population dose and on the SAMA screening and evaluation.

c. The analysis assumes that the 2004 transient to permanent population ratio will be representative of the ratio in 2035. Discuss the uncertainty associated with this assumption and its impact on the SAMA evaluation.

d. The environmental report (ER) indicates that a "no evacuation scenario" was assumed to conservatively estimate the population dose. Confirm that this same scenario was used to estimate economic impacts. Clarify how other early and long-term protection actions were modeled in this scenario (specifically sheltering, relocation, interdiction, and decontamination) and describe the associated assumptions and criteria (including the distances over which these actions were assumed to be taken). Discuss how the warning times provided for each release category (e.g., in Table E.1-10 for IP2) are used in the analysis.

e. Provide the technical basis for the value of non-farm wealth ($208,838 per person) used in sensitivity case 3 to show the economic impact of lost tourism and business. Explain why the impact of lost tourism and business was addressed as a sensitivity case rather than including these impacts in the base case analysis. Provide an assessment of the impact on the SAMA analysis (in the sensitivity study) results (base case and uncertainty case) if the higher value of non-farm wealth were used in the base case analysis.

f. Briefly describe other key MACCS2 input assumptions that contribute to the offsite economic cost risk (e.g., daily cost for relocated individuals, the costs to relocate an individual, daily cost for relocated individuals, cost of farm and non-farm decontamination, the value of farm and non-farm wealth, cost of decontamination labor, property depreciation rate, investment rate of return). Justify that the input values used for these parameters are reasonable for the Indian Point site/region.

g. Three problems related to use of the SECPOP2000 code have recently been identified, and publicized throughout the industry. These deal with: (1) a formatting error in the regional economic data block text file generated by SECPOP2000 for input to MACCS2 which results in MACCS2 mis-reading the data, (2) an error associated with the formatting of the COUNTY97.DAT economic database file used by SECPOP2000 which results in SECPOP2000 processing incorrect economic and land use data (i.e., missing entries in the "Notes" column result in data being output for the wrong county), and (3) gaps in the numbered entries in the COUNTY97.DAT economic database file which result in any county beyond county number 955 being handled incorrectly in SECPOP2000. Confirm whether the SECPOP2000 was used to derive MACCS2 input parameters, and if so, that the three identified problems were addressed in the SAMA analyses.

Response to SAMA RAI 4a

IP2 Reference E.1.22: Westinghouse Electric Company, Core Radiation Sources to Support Indian Point 2 Power Uprate Project, CN-REA-03-4, dated 3/7/2005. The reference provided the most current and bounding core inventory developed from ORIGEN2 results using the fuel management data for the proposed fuel management designs for Cycles 16, 17, 18, and 19 for an assumed power level of 3280 MWt at IP2.

IP3 Reference E. 3.23: Westinghouse Electric Company, Core Radiation Sources to Support Indian Point 3 SPU Project, CN-REA-03-40, dated 5/19/2005. The reference provided the most current and bounding core inventory developed from ORIGEN2 results using the fuel management data for the proposed fuel management designs for Cycles 14, 15, and 16 for an assumed power level of 3280 MWt at IP3.

Response to SAMA RAI 4b

There are no planned future changes to reactor power level or fuel management strategies that would impact the reactor core radionuclide inventory used in the MACCS2 analysis.

Response to SAMA RAI 4c

The permanent population projections were developed from United States Census data, which are the most reliable publicly available information. Historic records of transient information are not consistently maintained on a county or state level. The transient to permanent population ratio was developed from the most recent transient information available from state tourism agencies as a means of relating that portion of the population to projections based on United States Census data. In this manner, transient population projection was developed consistently across the region.

Use of this ratio assumes that there is connection between the number of transients visiting the area and the permanent population. Economist Jason Bram noted the impact of the tourism industry on the local economy [see **Enclosure 1**, attached]. Data in this article implies that an increase/decrease in the number of tourists would be accompanied by an increase/decrease in the number of permanent residents to support the growth/decline in tourism. Similarly, an increase/decrease in business transient population is assumed to be supported by an increase/decrease in the permanent resident population to support the increase/decrease in business. Therefore, it is reasonable to assume any increase in transient population will be supported by a need for increased employment and permanent population to support the growth of transients passing through the area. As transient visits increase or decrease, it is likely that the permanent population will react similarly. Thus, there is connection between the number of transients visiting the area and the permanent population.

The transient population is subject to short-term variation. For example, devaluation of the United States currency may encourage an increase in international tourism, while an increase in the currency exchange rate would discourage international tourism. Similarly, growth of the economy, or recession, may create changes in the number of business transients visiting the New York City area. While the transient population is related to economic trends and could be compared to economic data such as employment, relating transient population to projections of permanent population is more simple, and can be based on more readily available county, state, and metropolitan population data (i.e., United States Census Bureau estimates).

Population projections to 2035 are based on United States Census data, which are reliable. The 2004 transient population was related to the people (permanent population) and activities (tourism industry or things to see and do, and business) within the region, and helped to support the 2004 population that existed within the region. The ratio of 2004 transients to the 2004 United States Census population was assumed to be constant throughout the period projected to 2035. While there are uncertainties, discussed above, related to short-term variations in transients visiting the region, it is reasonable to assume the rate of change in daily transient population values will remain proportional to the rate of change of permanent population values since they are interrelated. The transient to permanent population ratios estimated in this study range from 0.1 to 0.25. Since the ratios are small and they are not subject to much variation over time, the impact of this assumption on the calculated population dose and, in turn, on the SAMA analysis is not significant.

Response to SAMA RAI 4d

The same "no evacuation scenario" was used to estimate population dose and economic impacts.

The "no evacuation scenario" assumes that individuals within the typically assumed 10-mile evacuation zone continue normal activity following a postulated accident without taking emergency response actions such as evacuation or sheltering.

The relocation action is still active, so individuals within hot-spots or high radiation areas are assumed to be relocated outside the 50-mile zone until long-term protection actions reduce radiation levels. When evacuation is modeled, relocation applies only to locations outside the evacuation zone, but within a 50-mile radius of the plant. In the "no evacuation scenario", relocation applies to all locations within a 50-mile radius of the plant.

Long-term protective actions such as decontamination and interdiction are activated when the total dose received by a person in an area exceeds 4 rem. Two levels of decontamination were considered in this analysis: one with a dose reduction factor of 3 and another with a factor of 15. If decontamination by itself is not sufficient to reduce radiation levels below the limit, then a period of interdiction is evaluated. During the interdiction period, radioactive decay and weathering are the primary mechanisms for reducing the contamination over time. When evacuation is modeled and in the "no evacuation scenario", decontamination and interdiction apply to all locations within a 50-mile radius of the plant.

The "no evacuation scenario" conservatively estimates the population dose since individuals within the evacuation zone do not evacuate or take shelter.

The warning time is used to establish the initiation time for evacuation and sheltering actions. Because evacuation and sheltering were not considered in the "no evacuation scenario," the warning time was not used.

Response to SAMA RAI 4e

The typical MACCS2 basis for non-farm wealth is based upon fixed reproducible tangible wealth, a measure of the durable goods (things) that are owned in an area. It was obtained from first developing an estimate of the MACCS2 non-farm value (VNFRM). VNFRM is the average non-farm value ($/person) calculated with data that are based on reproducible tangible wealth. The United States Bureau of Economic Analysis last calculated average non-farm value for the year 1995. In the absence of more recent data, county values for VNFRM data were obtained from the SECPOP2000 data set. For the Queens economic region, however, the non-farm property values (VNFRM) for four small counties within New York City (New York, Hudson, Queens, and Bronx counties) were combined as a weighted average (weighted by population) to be certain that economic information pertaining to New York City was included in the analysis.

MACCS2 input requires a regional average value of non-farm wealth (VALWNF). This value is VNFRM weighted by the area each of the 28 counties have in the IPEC 50-mile radius area, and was calculated as $163,631/person. This value for non-farm wealth was used as the base case SAMA MACCS2 input consistent with other SAMA analyses completed for license renewal.

The impact of lost tourism and business is not specifically modeled in MACCS2 since the level of tourism and business activity can be re-established in time. Therefore, lost tourism and business was addressed as a sensitivity case. The value of non-farm wealth used in sensitivity case 3 was developed as follows.

Measures of total economic activity were obtained by examining a suite of products related to the national Gross Domestic Product (GDP), which measures the total value of goods and services produced in an area. GDP and the analogous Gross State Product (GSP) are estimated by the Bureau of Economic Analysis, U.S. Department of Commerce. Gross Metro Product (GMP) is the metro-area equivalent of GSP and was derived by Global Insight using state GSP data. GMP is reported in Global Insight 2006 by Metropolitan Statistical Area (MSA) or Division (MSD) standards defined by the Office of Management and Budget (OMB) in Federal Register 65 No. 249 (pages 82228-82238). MSAs are associated with at least one urbanized area, have a population of at least 50,000, and comprise a central county or counties containing the core area, plus adjacent outlying counties that are economically integrated with the central county. MSDs have a core with a population of at least 2.5 million and consist of one or more main/secondary counties that represent an employment center or centers, plus adjacent counties associated with the main county or counties through commuting ties.

There are three MSDs and five MSAs within the 50-mile radius area surrounding IP2 and IP3 which include all counties within the study area except two (Litchfield, CT and Sullivan, NY).

The GDP/person values for 2004 were developed to estimate the total value of goods and services produced in the area. This is essentially all the items that were manufactured or produced in the area in 2004, plus "services" that produce economic activity in that year. The modified VNFRM values, therefore, were a measure of the people's non-farm wealth (stuff they own) as well as a measure of their economic output.

The average value of non-farm wealth (VALWNF) was developed based upon the most recent and complete tourism and economic dataset available at the time of the SAMA analysis (2004) for the counties within the 50-mile radius using the modified VNFRM values. The revised estimate of VALWNF was $208,838.49/person.

The sensitivity case 3 results with uncertainty have been assessed and are given in the following tables.

Sensitivity Case 3 Results for IP2

IP2 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
001 - Create an independent RCP seal injection system with a dedicated diesel.	$202,981	$427,328	$1,137,000
002 - Create an independent RCP seal injection system without a dedicated diesel.	$186,800	$393,263	$1,000,000
003 - Install an additional CCW pump.	~$0	~$0	$1,500,000
004 - Enhance procedural guidance for use of service water pumps.	$44,633	$93,964	$1,750,000
005 - Improve ability to cool the RHR heat exchangers by allowing manual alignment of the fire protection system.	$56,813	$119,606	$565,000
006 - Add a diesel building high temperature alarm.	$28,451	$59,897	$274,000
007 - Install a filtered containment vent to provide fission product scrubbing.	$584,856	$1,231,276	$5,700,000
008 - Create a large concrete crucible with heat removal potential under the base mat to contain molten core debris.	$1,803,647	$3,797,152	$108,000,000
009 - Create a reactor cavity flooding system.			$3,714,000
010 - Create a core melt source reduction system.			$90,000,000
011 - Provide a means to inert containment.	$744,362	$1,567,078	$10,900,000

Sensitivity Case 3 Results for IP2

IP2 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
012 - Use the fire protection system as a backup source for the containment spray system. 013 - Install a passive containment spray system. 016 - Install a redundant containment spray system.	~$0	~$0	$565,000 $2,000,000 $5,800,000
014 - Increase the depth of the concrete base mat or use an alternative concrete material to ensure melt-through does not occur.	$408,990	$861,032	>$5,000,000
015 - Construct a building connected to primary containment that is maintained at a vacuum.	$1,599,152	$3,366,636	$61,000,000
017 - Erect a barrier that provides containment liner protection from ejected core debris at high pressure.	$396,721	$835,202	$2,900,000
018 - Install a highly reliable steam generator shell-side heat removal system that relies on natural circulation and stored water sources.	$16,360	$34,442	$7,400,000
019 - Increase secondary side pressure capacity such that a SGTR would not cause the relief valves to lift.	$1,234,705	$2,599,379	$13,000,000
020 - Route the discharge from the main steam safety valves through a structure where a water spray would condense the steam and remove most of the fission products.	$130,877	$275,531	$9,700,000

Sensitivity Case 3 Results for IP2

IP2 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
021 - Install additional pressure or leak monitoring instrumentation for ISLOCAs. 024 - Ensure all ISLOCA releases are scrubbed.	$461,981	$972,592	$2,300,000 $9,700,000
022 - Add redundant and diverse limit switches to each containment isolation valve. 023 - Increase leak testing of valves in ISLOCA paths.	$228,945	$481,989	$1,000,000 $7,964,000
025 - Improve MSIV design.	$28,629	$60,272	$476,000
026 - Provide additional DC battery capacity. 027 - Use fuel cells instead of lead-acid batteries. 029 - Increase/ improve DC bus load shedding.	$44,633	$93,964	>$1,875,000 $2,000,000 >$160,000
028 - Provide a portable diesel-driven battery charger.	$440,908	$928,227	$494,000
030 - Create AC power cross-tie capability with other unit.	$52,724	$110,998	$1,156,000
031 - Create a backup source for diesel cooling (not from existing system). 032 - Use fire protection system as a backup source for diesel cooling.	$36,542	$76,931	$1,700,000 $497,000
033 - Convert under-voltage AFW and reactor protective system actuation signals from 2-out-of-4 to 3-out-of-4 logic.	~$0	~$0	$1,254,000

Sensitivity Case 3 Results for IP2

IP2 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
034 - Provide capability for diesel-driven, low pressure vessel makeup. 037 - Provide capability for alternate injection via diesel-driven fire pump.	$4,090	$8,611	$>632,000 $750,000
035 - Provide an additional high pressure injection pump with independent diesel. 039 - Replace two of three motor-driven SI pumps with diesel-powered pumps.	$24,450	$51,474	$5,000,000 $2,000,000
036 - Create automatic swap-over to recirculation cooling upon RWST depletion.	$81,086	$170,707	>$1,000,000
038 - Throttle low pressure injection pumps earlier in medium or large-break LOCAs to maintain reactor water storage tank inventory.	$20,360	$42,863	$82,000
040 - Create/enhance a reactor coolant depressurization system.	$151,148	$318,206	>$1,000,000
041 - Install a digital feed water upgrade. 043 - Add a motor-driven feed water pump.	$105,536	$222,181	$900,000 $2,000,000
042 - Provide automatic nitrogen backup to steam generator atmospheric dump valves.	$12,270	$25,832	$214,000
044 - Use fire water system as backup for steam generator inventory.	$1,017,222	$2,141,520	$1,656,000
045 - Replace current pilot operated relief valves with larger ones such that only one is required for successful feed and bleed.	$393,782	$829,015	$2,700,000

Sensitivity Case 3 Results for IP2

IP2 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
046 - Modify emergency operating procedures for ability to align diesel power to more air compressors.	~$0	~$0	$82,000
047 - Add an independent boron injection system.	~$0	~$0	$300,000
048 - Add a system of relief valves that prevent equipment damage from a pressure spike during an ATWS.	$48,723	$102,575	$615,000
049 - Install motor generator set trip breakers in control room. 050 - Provide capability to remove power from the bus powering the control rods.	$28,451	$59,897	$716,000 $90,000
051- Provide digital large break LOCA protection.	~$0	~$0	$2,036,000
052 - Install secondary side guard pipes up to the MSIVs.	$77,619	$163,408	$1,100,000
053 - Keep both pressurizer PORV block valves open.	$385,691	$811,981	$800,000
054 - Install flood alarm in the 480V switchgear room.	$1,808,621	$3,807,623	$200,000
055 - Perform a hardware modification to allow high-head recirculation from either RHR heat exchanger. 058 - Provide procedural guidance to allow high-head recirculation from either RHR heat exchanger.	~$0	~$0	$1,330,000 $82,000
056 - Keep RHR heat exchanger discharge motor operated valves (MOVs) normally open.	$44,633	$93,964	$82,000
057 - Provide DC power backup for the PORVs.	$44,811	$94,339	$376,000

Sensitivity Case 3 Results for IP2

IP2 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
059 - Re-install the low pressure suction trip on the AFW pumps and enhance procedures to respond to loss of the normal suction path.	$20,360	$42,863	$318,000
060 - Provide added protection against flood propagation from stairwell 4 into the 480V switchgear room.	$408,278	$859,533	$216,000
061 - Provide added protection against flood propagation from the deluge room into the 480V switchgear room.	$898,176	$1,890,897	$192,000
062 - Provide a hard-wired connection to an SI pump from ASSS power supply.	$285,759	$601,598	$722,000
063 - Provide a water-tight door for additional protection of the RHR pumps against flooding.	$36,542	$76,931	$324,000
064 - Provide backup cooling water source for the CCW heat exchangers.	$36,542	$76,931	$710,000
065 - Upgrade the ASSS to allow timely restoration of seal injection and cooling.	$1,808,621	$3,807,623	$560,000
066 - Harden the EDG building and fuel oil transfer pumps against tornados and high winds.	$1,601,977	$3,372,583	>$10,000,000
067 - Provide hardware connections to allow the primary water system to cool the charging pumps.	$8,091	$17,034	$576,000
068 - Provide independent source of cooling for the recirculation pump motors.	$12,181	$25,644	$710,000

Sensitivity Case 3 Results for IP3

IP3 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
001 - Create an independent RCP seal injection system with a dedicated diesel.	$141,552	$205,148	$1,137,000
002 - Create an independent RCP seal injection system without a dedicated diesel.	$100,223	$145,251	$1,000,000
003 - Install an additional CCW pump.	~$0	~$0	$1,500,000
004 - Improved ability to cool the RHR heat exchangers by allowing manual alignment of the fire protection system.	$41,459	$60,086	$565,000
005 - Install a filtered containment vent to provide fission product scrubbing.	$534,701	$774,929	$5,700,000
006 - Create a large concrete crucible with heat removal potential under the base mat to contain molten core debris. 007 - Create a reactor cavity flooding system. 008 - Create a core melt source reduction system.	$1,467,457	$2,126,749	$108,000,000 $3,714,000 $90,000,000
009 - Provide means to inert containment.	$594,112	$861,032	$10,900,000
010 - Use the fire protection system as a backup source for the containment spray system. 011 - Install a passive containment spray system. 014 - Install a redundant containment spray system.	~$0	~$0	$565,000 $2,000,000 $5,800,000
012 - Increase the depth of the concrete base mat or use an alternative concrete material to ensure melt-through does not occur.	$308,938	$447,736	>$5,000,000

Sensitivity Case 3 Results for IP3

IP3 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
013 - Construct a building connected to primary containment that is maintained at a vacuum.	$1,354,576	$1,963,154	$61,000,000
015 - Erect a barrier that provides containment liner protection from ejected core debris at high pressure.	$273,292	$396,075	$2,900,000
016 - Install a highly reliable steam generator shell-side heat removal system that relies on natural circulation and stored water sources.	$379,844	$550,499	$7,400,000
017 - Increase secondary side pressure capacity such that an SGTR would not cause the relief valves to lift.	$3,141,560	$4,552,986	$13,000,000
018 - Route the discharge from the main steam safety valves through a structure where a water spray would condense the steam and remove most of the fission products.	$724,817	$1,050,459	$9,700,000
019 - Install additional pressure or leak monitoring instrumentation for ISLOCAs. 022 - Ensure all ISLOCA releases are scrubbed.	$498,795	$722,891	$2,300,000 $9,700,000
020 - Add redundant and diverse limit switches to each containment isolation valve. 021 - Increase leak testing of valves in ISLOCA paths.	$243,457	$352,836	$1,000,000 $10,604,000
023 - Improve MSIV design.	~$0	~$0	$476,000

Sensitivity Case 3 Results for IP3

IP3 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
024 - Provide additional DC battery capacity. 025 - Use fuel cells instead of lead-acid batteries. 026 - Increase/ improve DC bus load shedding. 042 - Provide hookup for portable generators to power the turbine-driven AFW pump after station batteries are depleted. 056 - Install pneumatic controls and indication for the turbine-driven AFW pump.	$35,259	$51,100	>$1,875,000 $2,000,000 >$160,000 $1,072,000 $982,000
027 - Create AC power cross-tie capability with other unit.	$64,706	$93,777	$1,156,000
028 - Create a backup source for diesel cooling (not from existing system). 029 - Use fire protection system as a backup source for diesel cooling.	$11,753	$17,033	$1,700,000 $497,000
030 - Provide a portable diesel-driven battery charger.	$100,482	$145,626	$494,000
031 - Convert under-voltage, AFW and reactor protective system actuation signals from 2-out-of-4 to 3-out-of-4 logic.	$29,706	$43,052	$1,254,000
032 - Provide capability for diesel-driven, low pressure vessel makeup. 035 - Provide capability for alternate injection via diesel-driven fire pump.	$5,941	$8,610	>$632,000 $750,000

Sensitivity Case 3 Results for IP3

IP3 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
033 - Provide an additional high pressure injection pump with independent diesel. 037 - Replace two of three motor-driven SI pumps with diesel-powered pumps.	$35,517	$51,474	$5,000,000 $2,000,000
034 - Create automatic swap-over to recirculation upon RWST depletion.	$346,376	$501,994	>$1,000,000
036 - Throttle low pressure injection pumps earlier in medium or large-break LOCAs to maintain reactor water storage tank inventory.	$11,753	$17,033	$82,000
038 - Create/enhance a reactor coolant depressurization system.	$71,164	$103,136	$4,600,000
039 - Install a digital feed water upgrade. 041 - Add a motor-driven feedwater pump.	$212,070	$307,348	$900,000 $2,000,000
040 - Provide automatic nitrogen backup to steam generator atmospheric dump valves.	$65,223	$94,526	$214,000
043 - Use fire water system as backup for steam generator inventory.	$195,022	$282,641	$1,656,000
044 - Replace current pilot operated relief valves with larger ones such that only one is required for successful feed and bleed.	$355,821	$515,683	$2,700,000
045 - Add an independent boron injection system.	~$0	~$0	$300,000
046 - Add a system of relief valves that prevent equipment damage from a pressure spike during an ATWS.	$182,623	$264,671	$615,000

Sensitivity Case 3 Results for IP3

IP3 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
047 - Install motor generator set trip breakers in control room. 048 - Provide capability to remove power from the bus powering the control rods.	$23,506	$34,067	$716,000 $90,000
049 - Provide digital large break LOCA protection.	~$0	~$0	$2,036,000
050 - Install secondary side guard pipes up to the MSIVs.	$646,935	$937,587	$1,100,000
051 - Operator action: Align main feedwater for secondary heat removal.	$11,753	$17,033	$55,000
052 - Open city water supply valve for alternative AFW pump suction.	$71,164	$103,136	$50,000
053 - Install an excess flow valve to reduce the risk associated with hydrogen explosions.	$160,152	$232,104	$228,000
054 - Provide DC power backup for the PORVs.	~$0	~$0	$376,000
055 - Provide hard-wired connection to a SI or RHR pump from the Appendix R bus (MCC 312A).	$1,346,177	$1,950,981	$1,288,000
057 - Provide backup cooling water source for the CCW heat exchangers.	$41,200	$59,710	$109,000
058 - Provide automatic DC power backup.	$76,459	$110,810	$1,868,000
059 - Provide hardware connections to allow the primary water system to cool the charging pumps.	~$0	~$0	$576,000
060 - Provide independent source of cooling for the recirculation pump motors.	~$0	~$0	$710,000
061 - Upgrade the ASSS to allow timely restoration of seal injection and cooling.	$1,436,340	$2,081,652	$560,000

Sensitivity Case 3 Results for IP3

IP3 Phase II SAMA	Sensitivity Case 3 Baseline with Loss of Tourism and Business	Sensitivity Case 3 Results With Uncertainty	Estimated Cost
062 - Install flood alarm in the 480 VAC switchgear room.	$1,436,340	$2,081,652	$196,800

Sensitivity case 3 results with uncertainty indicate that two additional SAMAs (009 and 053) for IP2 and one additional SAMA (053) for IP3 are potentially cost beneficial.

Following are clarifications to information provided in the LRA-ER.

The estimated cost for IP2 SAMA 050 and IP3 SAMA 048, "Provide capability to remove power from the bus powering the control rods," is $90,000 as indicated in LRA-ER table E.2-2 (the value was incorrectly listed as $45,000 in LRA-ER tables E.2-3, E.4-2 and E.4-3). This correction does not change the results of the SAMA analysis.

The estimated cost for IP2 SAMA 009 and IP3 SAMA 007, "Create a reactor cavity flooding system," is $3,714,000 as indicated in LRA-ER tables E.2-2, E.2-3, and E.4-2 (the value was incorrectly listed as $8,750,000 in LRA-ER table E.4-3). This correction does not change the results of the SAMA analysis.

Response to SAMA RAI 4f

NUREG-1150 provides a summary of objectives for a severe accident analysis, and provides guidance to produce MACCS2 input variables. NUREG-1150 provides a summary of assessment of severe accident risks, and references supporting studies that provide detailed discussion. NUREG-1150 underwent two extensive peer reviews of its assessment of quantitative and qualitative PRA information on nuclear power plants of different design with respect to severe accident sequences, and provides the NRC an important resource as a means for investigating where safety improvements might best be pursued, the cost-effectiveness of possible plant modifications, the importance of generic safety issues, and the sensitivity of risks to issues. NUREG-1150 is supported by NUREG/CR-4551 which provides the detailed substance of risk studies at five nuclear power plants. The economic variables (EVACST, RELCST, CDFRM, CDNFRM, VFRM, VNFRM, DLBCST, DPRATE, and DSRATE) are described in NUREG/CR-4551. The summary discussions in NUREG-1150 reference NUREG/CR-4551.

The key MACCS2 input data that contribute to the offsite economic costs were developed from NUREG/CR-4551 Volume 2, Revision 1, Part 7. The input assumptions are presented in Chapter 5 of this NUREG. Table 5.1 provides default economic parameters for MACCS (DPRATE, DSRATE, EVACST, FNFIM, POPCST, RELCST, and VALWNF), while the remainder (DLBCST, CDFRM, and CDNFRM) are provided in Appendix A. As described in NUREG/CR-4551 Section 5.2.1 (and NEI-05-01 Section 3.4.2 Economic Data), economic data should be expressed in today's dollars. The default values for these parameters in NUREG/CR-4551 are presented in 1986 dollars, and therefore were modified for presentation in 2005 dollars (the most recent year for which data were available for IP2 and IP3 SAMA analysis). These NUREG/CR-4551 default values are appropriate for use for SAMA, and have been used by other license renewal applicants. The applicable method for conversion of the NUREG default values recommended in NUREG-4551 Section 5.2.1 (and NEI-05-01 Section 3.4.2) is to use the ratio of current to past consumer price indices (CPI). Entergy developed this ratio to update the default values to 2005 dollars, which generated the values in the tables in ER sections E.1.5.2.4 and E.3.5.2.4.

As noted above, development of the indicated offsite economic cost risks was in accordance with applicable NRC guidance. These economic cost parameters were developed based on assumptions of cost related to averages developed from the regions studied by the NRC and its contractors. However, these costs are reasonable for the Indian Point region because the initial development included heavily populated regions. In some cases, such as VNFRM and VALWNF, the MACCS2 parameters were derived from the most recent publicly available US Census of Agriculture and US Department of Commerce Bureau of Economic Analysis data for counties within the 50-mile radius of Indian Point. In other cases, such as EVACST and RELCST, the costs are related to where evacuees stay after evacuation, which may include regions outside the immediate area of Indian Point, for which the average as provided in NUREG/CR-4551 default values are applicable. Decontamination parameters likewise are reasonable for the Indian Point region, since reliable estimates of decontamination costs (such as those provided in NUREG/CR-4551) are based upon levels of contamination and population rather than upon the region in which the contamination occurs. While some of the region within a 50-mile radius of Indian Point has relatively high-density, other portions are similarly low-density (e.g., due to the high proportions of local, state and federal parkland and other rural property).

In summary, the default economic risk cost parameters adjusted to 2005 dollars using the CPI ratio are reasonable for the Indian Point region, and are considered to be the most reasonable estimates available based on industry reviewed studies.

Response to SAMA RAI 4q

The SECPOP2000 program was not used for the IP2 and IP3 SAMA analyses. As mentioned in above responses, a data file on the SECPOP2000 CD was used to provide data to estimate non-farm property value (VNFRM). However, the SECPOP2000 software was not used in any other way. Therefore, the problems related to use of the SECPOP2000 code have no impact on the IP2 and IP3 SAMA analyses.

SAMA RAI 5

The following additional information is needed for the Analysis Cases identified below:

a. **Additional CCW Pump.** The analysis case sets the common cause failure probability for the component cooling water (CCW) pumps to zero and indicates that this results in no change in the CDF. Describe the plant features or modeling assumptions that make the CCW pumps unimportant.

b. **Containment Sprays.** The analysis case indicates that eliminating containment spray system failures has no impact on CDF or offsite dose. Describe the plant features or modeling assumptions that make containment spray unimportant for both CDF and offsite dose. Discuss the impact of containment spray in terms of decontamination factors, containment failure modes involving core concrete interactions, and containment heat removal.

c. **SGTR Fission Product Scrubbing.** The analysis case assumes the addition of a water spray would result in a factor of 2 reduction in source terms for SGTR sequences. Provide the basis of this reduction factor and an assessment of the impact of this assumption on the results of the SAMA evaluation.

d. **ISLOCA Valves.** The analysis case assumes a reduction of 50 percent in ISLOCA initiating events. Provide the basis of this reduction value.

e. **MSIV Design.** The analysis case indicates that eliminating MSIV failures to isolate a faulted steam generator has zero benefit. Describe the plant features or modeling assumptions that yield this result.

f. (IP2) **DC Power** and (IP3) **DC Power/AFW Control System Changes.** The analysis case for both units involves changing the time available to recover offsite power before local operation of the auxiliary feedwater (AFW) steam-driven pump is required from two hours to 24 hours during station blackout (SBO) scenarios. For IP2, Table E.1-2 appears to indicate that basic event OAFWT (failure to manually control turbine-driven AFW Pump 22 after battery depletion) addresses the control of AFW following battery depletion. Explain why a similar action for IP3 was not identified in Table E.3-2. Describe the approach used by operators to control steam generator level during an SBO event, and the modeling of the turbine-driven pump and associated operator actions in the probabilistic risk assessment (PRA) for each unit. Describe any differences in plant design/operation and PRA modeling between IP2 and IP3, including the reasons why the analysis case is defined differently for the two units. Justify that the analysis case represents a bounding analysis for both units.

g. **Alternate Battery Charger Capability.** The analysis case for IP2 involves setting the failure to locally control the turbine-driven AFW pump to zero, whereas the analysis case for IP3 involves changing the time available to recover offsite power before local operation of AFW is required from two hours to 24 hours during SBO scenarios, and reducing internal switchgear room floods five percent to account for local operation of the turbine-driven AFW pump. Explain why the assumptions used to quantify the benefits for IP2 and IP3 are different. For IP2, verify that the operator action that is set to zero is basic event OAFWT. Also, justify the significant difference in the estimated benefits for the "Alternate Battery Charger Capability" and the "DC Power" analysis cases ($420K and $44K, respectively). For

IP3, SAMA candidates 30 (Provide a portable diesel-driven battery charger) and 42 (Provide hookup for portable generators to power the turbine-driven AFW pump) appear to be related but the associated analysis cases and the benefit values are not comparable (i.e., Alternate Battery Charger Capability for SAMA 30 with a benefit of $509K, and DC Power/AFW System Changes for SAMA 42 with a benefit of $35K). Clarify the differences between SAMA 30 and SAMA 42.

h. **Improve 118 Vac System.** The analysis case is stated as being used to evaluate the change in plant risk from plant modifications to convert signals from 2-of-4 to 3-of-4 logic. Explain how setting the common cause failure of the 118 Vac transformers to zero bounds the benefit.

i. **Main Feedwater System Upgrade.** The analysis case states that the bounding analysis for digital feedwater upgrade and installing a motor-driven feedwater pump achieved by setting the feedwater initiator to zero. Explain how this treatment addresses the improved post-trip operation of Main Feedwater for other initiating events.

j. **Independent Boron Injection System.** The analysis case states that setting common cause failure of the boric acid transfer pumps to zero is bounding for determining the benefit of installing an independent boron injection system. Explain how setting the common cause failure to zero bounds the benefit. Describe the plant features or modeling assumptions that cause this analysis to yield zero benefit for both units.

k. **Control Room ATWS Mitigation.** Explain the plant features that result in small benefit associated with the bounding analysis that sets failure to trip the control rods motor generator sets to zero. Describe the anticipated transient without scram (ATWS) mitigation actions including the credited operator actions, their failure probabilities and bases.

l. **Pressurizer PORV Block Valves.** State the scope of the change necessary to change the pressure-operated relief valve (PORV) block valves from closed to open. Specifically provide the basis for the $800,000 improvement cost.

m. (IP3) **Appendix R Power to the SI or RHR Pump.** Explain whether the baseline benefit of $11,274,888 provided for the analysis case is an error. If so, provide the correct value.

n. **CCW Heat Exchanger Alternate Cooling Supply.** The description of this analysis case suggests that the back up service water pumps could be used for both essential and non-essential service water rather than essential service water only. Explain all the contributions included in the benefit side in terms of reduced initiator frequency, increased support system reliability (e.g.CCW), and impact on reactor coolant pump (RCP) seal failure.

o. **Upgrade Alternate Safe Shutdown System for RCP Seal Cooling.** This analysis case states that a bounding analysis is obtained by setting the control building flooding initiators to zero. However, the benefit of the SAMAs addressed by this case could impact other external initiators. Identify all other external initiators that can benefit from implementation of this SAMA candidate. Explain in more detail the proposed modification. Discuss any impact that installing the Unit 2 Appendix R DG and potential decommissioning of the turbine generators will have on this SAMA candidate. Explain the relationships between setting flooding initiating events to zero and the loss of the 480VAC buses.

Response to SAMA RAI 5a

IP2 and IP3 are unique in that the capability exists to initiate backup cooling to key components should the primary CCW cooling function be lost. In both IP2 and IP3, city water can be aligned to the charging pumps upon loss of CCW. The use of backup city water cooling to the charging pumps supports continued seal injection and, therefore, reduces the likelihood of an RCP seal LOCA. In addition, both IP2 and IP3 utilize high temperature RCP seals. Since a key function of the CCW system is LOCA mitigation, this also reduces the importance associated with that function.

In addition, although the design differs between the units, backup cooling is also provided to certain emergency core cooling system components upon loss of CCW to those components. In IP2, this includes use of either city water or primary water to cool the SI and RHR pumps. In IP3, city water backup is provided to cool RHR pump 31. Also, CCW is not required in either plant during the injection phase of the response to a LOCA. During a LOCA with loss of offsite power, the CCW pumps are not loaded on to the EDGs until switchover to recirculation.

Finally, both IP2 and IP3 have containment fan cooler units. In addition to their function of maintaining containment integrity, these units provide a heat removal function which serves as a backup to the RHR heat exchangers during a LOCA. This reduces the significance of loss of CCW cooling to those heat exchangers.

Both units have three CCW pumps and, although some operator action may be required, success generally requires only one of the three pumps. Since addition of another pump would not impact the need for operator action when required, the pump redundancy reduces the value of adding a fourth pump.

Response to SAMA RAI 5b

The containment spray system has two modes of operation; injection (CSS) and recirculation (CSR).

CSS is designed for short-term operation. The containment spray pumps take water from the RWST and deliver it to the containment via spray headers to achieve short-term containment depressurization by removing heat from the containment following a LOCA or main steam line break inside containment. CSS does not provide reactor coolant system (RCS) makeup capability; hence, it has no impact on CDF.

CSR is designed to provide long-term containment pressure control in response to transients and LOCAs. CSR operates after manual switchover from CSS when the water level in the RWST falls to the low-level alarm setpoint. In the CSR mode, containment spray can be provided by internal or external operation. Internal CSR uses the recirculation pumps (located inside containment) to draw water from the recirculation sump and discharge it to containment through the containment spray headers and containment spray nozzles after cooling it in the RHR heat exchangers. External CSR uses the RHR pumps (located outside containment) to draw the water from the containment sump and discharge it to containment through the containment spray headers and containment spray nozzles after cooling it in the RHR heat exchangers. As with the CSS mode, CSR does not provide water to the RCS directly, hence it also has no impact on the CDF.

During a severe accident core melt progression, CSS can provide a method to scrub fission products from the containment atmosphere. In addition, CSS provides a source of water to cool ex-vessel core debris in the containment reactor pit (cavity) and thus prevent core-concrete interaction and the release of radionuclides and non-condensible and combustible gases. Since the CSS mode can operate only until RWST depletion, the benefits of CSS to provide scrubbing of fission products are limited to early releases (RWST inventory is depleted for late releases). Since early releases are dominated by containment bypass events (SGTR and ISLOCA), CSS impact on offsite dose is minimal.

CSR can also scrub fission products released into the containment atmosphere and supply water to cool the molten core after it has penetrated the reactor vessel. Through these two processes, CSR can influence the course of the accident to avert or reduce the severity of radionuclide releases to the environment. However, the Level 2 containment performance analysis considers other factors that limit CSR effectiveness in reducing offsite dose. The dominant contributors to loss of containment sprays (plant operators fail to implement CSR; severe environmental conditions inside containment expose the recirculation pump motors to temperatures above their peak qualification temperature for a prolonged period; and CSR piping inside containment is failed by severe accident phenomena), would also contribute to failure of proposed redundant containment spray systems. Also, containment fan coolers are modeled as an alternative method to control containment temperature and pressure by removing heat in the containment during the core melt progression. This modeling appropriately reduces the importance of containment spray. Hence, containment spray has minimal impact on offsite dose release.

Response to SAMA RAI 5c

Effectiveness of using a water spray to scrub SGTR releases is highly dependent on the radionuclide mix associated with a specific scenario and the actions taken in accordance with plant severe accident management guidelines for the scenario. Therefore, assuming that the water spray system would be 100% effective in preventing radionuclide release following an SGTR is unreasonable and a value representing 50% effectiveness was chosen by engineering judgment. Since these SAMAs are specifically associated with SGTR initiating events, application of the external event multiplier to these SAMAs represents an additional conservatism.

However, if the assumption of 100% effectiveness had been made, IP2 SAMA 020 and IP3 SAMA 018 would still not be cost effective. Analysis case "Secondary Side Pressure Capacity" eliminated the probability of failure to isolate the ruptured steam generator during an SGTR. This analysis assumes 100% effectiveness in preventing radionuclide release following an SGTR. This analysis case resulted in a benefit of $1,144,727 for IP2 and $2,909,856 for IP3. Since the cost of a water spray system is estimated to be $9,700,000, IP2 SAMA 020 and IP3 SAMA 018 remain not cost effective with this assumption.

Response to SAMA RAI 5d

These SAMAs address increased periodic testing of ISLOCA valves and adding redundant or diverse limit switches. These potential changes would not be as effective as the continuous leakage monitoring and submergence proposed in the ISLOCA mitigation analysis case, due to the periodic nature of the enhanced testing and the fact that limit switches would not identify all modes of valve leakage or failure. Also, given the specific nature of these SAMAs, they would not be expected to reduce the risk from external events and application of the external event multiplier to these SAMAs represents an additional conservatism. Given these facts, a reduction of 50 percent was chosen based on engineering judgment of conservative impact.

The benefit of a 100 percent reduction in ISLOCA frequency can be seen in Table E.2-2 for IP2 Phase II SAMAs 021 and 024 and in Table E.4-2 for IP3 Phase II SAMAs 019 and 022. If this assumption is used for the ISLOCA valves analysis case, the conclusion that IP2 Phase II SAMAs 22 and 23 and IP3 Phase II SAMAs 20 and 21 are not cost effective does not change.

Response to SAMA RAI 5e

This analysis case evaluates the change in plant risk from improving MSIV design. A bounding analysis was performed by assuming MSIV hardware failures would not occur during an SGTR or main steamline break event. This resulted in zero benefit because the SGTR and main steamline break scenarios are dominated by:

1) operator action in failing to perform early or late cooldown and depressurization of the RCS during an SGTR event,

2) operator action in failing to perform early isolation of the ruptured steam generator (these operator failure results in steam generator overfill and a stuck open relief valve), and

3) operator action in failing to isolate a faulted steam generator (for main steamline breaks inside or outside containment).

Since improving MSIVs only impacts the occurrence of MSIV hardware failures during an SGTR or main steamline break event, and does not influence the required operator actions in mitigating SGTR or main steamline breaks events, it results in no benefit.

Response to SAMA RAI 5f

Basic event OAFWT (failure to manually control turbine-driven AFW Pump (TDAFWP) 22 after battery depletion) in Table E.1-2 addresses the control of the TDAFWP following battery depletion for IP2. Table E.3-2 does not have a similar event because manual operation of the TDAFWP following battery depletion is not modeled for IP3. IP2 has pneumatic level and pressure instruments that do not require electric power, and allow the operator to monitor these key parameters and effectively control AFW flow. However, IP3 does not have these instruments. Although it is still possible for the operators to manipulate AFW flow, since these key monitoring parameters are not available, the IP3 model does not credit this manual operation.

Upon loss of all AC power, plant operators in both IP2 and IP3 would transition to emergency operating procedures. Since AC power is not available during an SBO, the TDAFWP is the only available means for providing decay heat removal prior to restoration of an AC power source. Although the TDAFWP will start, operator action is required to throttle flow to the steam generators by manually adjusting the auxiliary feedwater regulating valves from the control room. In addition, on both IP2 and IP3, the operator can manually reset the turbine overspeed trip, or take control of the TDAFWP should it fail to start on demand as a result of the failure of the turbine controls. The operator can also maintain the level of water in the steam generators from the control room by positioning the hand controllers of the AFW flow control valves, or by locally operating these valves.

A difference in response between the two units occurs upon depletion of the station batteries. IP2 has pneumatic level and pressure instruments that do not require electric power. These instruments allow the operator to monitor these key parameters and effectively control AFW flow after the batteries have depleted. Unlike IP2, however, IP3 does not have separate pneumatic instrumentation to monitor key parameters following battery depletion. Although it is still possible for the operators to manipulate AFW flow, since these key monitoring parameters are not be available, the current IP3 model does not credit this manual operation.

Absence of the pneumatic instruments on IP3 is also the reason why the analysis case descriptions are different. The SAMAs included within this analysis case for both units extend the time that DC power is available under station blackout conditions. For both units, this analysis case is used to evaluate providing additional DC battery capacity (IP2 SAMA 026, IP3 SAMA 024); using fuel cells instead of lead acid batteries (IP2 SAMA 027, IP3 SAMA 025); improving DC bus load shedding (IP2 SAMA 029, IP3 SAMA 026); and creating an AC power cross-tie with the other unit (IP2 SAMA 030, IP3 SAMA 027). For IP3, the analysis case is also used to evaluate installing pneumatic instruments on IP3 (IP3 SAMA 056) and providing portable power to the TDAFWP and controls following battery depletion (IP3 SAMA 042).

The analysis approach was the same for both units since all of the SAMAs extend the time that DC power is available under station blackout conditions. In this analysis case, the time available to recover offsite power before local operation of the TDAFWP is required was changed from 2 hours to 24 hours during SBO scenarios in the level 1 PSA model. This extends the time that DC power is available and essentially negates the need for manual operation of the TDAFWP following battery depletion. Therefore, this is a bounding approach for the SAMAs on both units.

Response to SAMA RAI 5g

As discussed in response to RAI 5.f, local operation of the TDAFWP following battery depletion is more likely to be successful in IP2 due to the availability of pneumatic operated steam generator level and pressure instrumentation. Using a portable diesel-driven battery charger was conservatively assumed to prevent battery depletion for both LOSP and internal flood initiated SBOs. If the batteries don't deplete, there is no need to manually control the TDAFWP. Thus, for IP2, failure of operator action OAFWT (manual control of the turbine-driven AFW pump after battery depletion) was set to zero, providing an appropriate bounding case for IP2.

For IP3, the ability to monitor steam generator level and pressure after battery depletion does not exist. Consequently, no credit is taken in LOSP induced SBO sequences for continued local operation of the TDAFWP following battery depletion. The bounding case for IP2 could not, therefore, be used for IP3. Given this limitation, increasing the time available to recover power in IP3, which does not eliminate, but does substantially reduce the need for operator action, results in a reasonably bounding analysis of the reduction in risk of LOSP induced SBOs that would be obtained by using a portable diesel-driven battery charger.

Additional model changes were necessary to assess the impact of using a portable diesel-driven battery charger on internal flooding sequences that occur inside the IP3 control building switchgear room. In these sequences, power recovery from the normal power feeds (through the 480V switchgear) to AFW pumps or existing battery chargers is not possible, and therefore not modeled. Therefore, increasing the time available for normal power recovery does not impact these sequences. Consequently, the CDF contribution from internal switchgear room floods was reduced 5 percent to account for the impact on these sequences. The 5 percent reduction was selected by determining the change in IP3 CDF if an operator action for continued operation of the TDAFWP following battery depletion (as IP2 has) was included in the model. Including this action changed the IP3 CDF by approximately 3%. Therefore, a 5 percent reduction in the internal switchgear room flood contribution would bound the benefit on these sequences of using a portable diesel-driven battery charger.

During the review of this analysis case for the RAI response, an error was found in the analysis. The CDF contribution from internal switchgear room floods was actually reduced by more than 5%. Since this is beyond the intended bounding case, the impact has been re-evaluated, resulting in a baseline benefit of $100,482 and IP3 SAMA 030 no longer being potentially cost beneficial. Changes to the LRA-ER due to the reevaluation of IP3 SAMA 030 are provided below.

IP2 analysis case "Alternate Battery Charger Capability" was used to model the benefit of SAMA 028, provide a portable diesel-driven battery charger. IP2 analysis case "DC Power" was used to evaluate providing additional DC battery capacity (IP2 SAMA 026), using fuel cells instead of lead acid batteries (IP2 SAMA 027), and improving DC bus load shedding (IP2 SAMA 029). The alternate battery charger (SAMA 028) would provide continued availability of DC power, whereas SAMAs 026, 027, and 029 would extend battery life but would still ultimately result in battery depletion. As a result, the SAMA 028 evaluation assumed that battery depletion does not occur (and local operator action is therefore not required), while the evaluation for SAMAs 026, 027 and 029 use an extended time for power recovery prior to needing the local operator action. Therefore, the benefit estimated for SAMA 028 is larger than that estimated for SAMAs 026, 027, and 029.

The evaluation of the IP3 SAMA 030, provide a portable battery charger, assumes that the portable battery charger is used to provide power to the monitoring instrumentation necessary to allow manual operation of the TDAFWP. This modification would bypass the switchgear room and therefore would provide benefit for switchgear room floods. IP3 SAMA 042, provide hookup for portable generators to power the TDAFWP after station batteries are depleted, assumes that a portable generator would be hooked up to the turbine driven AFW pump and alternate DC power would be provided to the required monitoring instrumentation. Due to the expected complexity of achieving both of these tasks while responding to a switchgear room flood, the evaluation of SAMA 042 did not provide any additional benefit for switchgear room floods. Therefore, the benefit estimated for IP3 SAMA 030 is larger than that estimated for SAMA 042. The re-evaluation of SAMA 030 discussed above also significantly reduces the difference in benefit between these two IP3 SAMAs.

Changes to the LRA-ER due to reevaluation of IP3 SAMA 030

Section 4.21.6, pg. 4-73 is revised as follows.

Four~~Five~~ Phase II SAMA candidates (i.e., ~~30,~~ 52, 55, 61 and 62) presented in Table 4-5 were found to be potentially cost beneficial for mitigating the consequences of a severe accident for IP3.

- ~~A plant modification was recommended to provide a portable diesel-driven battery charger to improve DC power reliability.~~

Table 4-5, pg. 4-77 is revised to remove the line item for IP3 SAMA 030.

Section E.4.3, pg. E.4-9 is revised as follows.

Alternate Battery Charger Capability

This analysis case was used to evaluate the change in plant risk from plant modifications to provide alternate battery charging capability by installing a portable diesel-driven battery charger. The proposed plant modification involves purchasing, installing and maintaining a diesel-driven generator to charge the 125VDC batteries. Safety-related quick disconnects would be used to charge the selected battery. The diesel generator would be installed in a weather enclosure outside the turbine or control building, requiring fire barrier penetration sealing. The location would be as close as possible to the batteries to decrease power loss along the cable. Calculation of cable size would have to be performed. In addition, procedure development and training would be required. A bounding analysis was performed by changing the time available to recover offsite power before local operation of AFW is required from 2 hours to 24 hours during SBO scenarios and reducing internal switchgear room floods 5 percent to account for local operation of the turbine-driven AFW pump. This resulted in a baseline benefit of approximately $**100,482**~~509,643~~. This analysis case was used to model the benefit of Phase II SAMA 030.

Table E.4-2, pg. E.4-49 is revised as follows (Assumptions column is unchanged and not reproduced below).

Phase II SAMA	**CDF Reduction**	**Offsite Dose Reduction**	**OECR Reduction**	**Baseline Benefit**	**Baseline Benefit With Uncertainty**	**Estimated Cost**	**Conclusion**
Alternate Battery Charger Capability 030 - Provide a portable diesel-driven battery	**3.69%** ~~8.73%~~	**0.82%** ~~6.94%~~	**0.95%** ~~6.06%~~	$100,482 ~~$509,643~~	**$145,626** ~~$738,613~~	$494,000	**Not cost effective** ~~Retain~~

charger.							

Table E.4-3, pg. E.4-73 is revised as follows.

Phase II SAMA	**Baseline Benefit 20 yrs Remaining, 7% Discount Rate**	**Sensitivity Case 1 28 yrs Remaining, 7% Discount Rate**	**Sensitivity Case 2 20 yrs Remaining, 3% Discount Rate**	**Sensitivity Case 3 Baseline with Loss of Tourism and Business**	**Estimated Cost**
Alternate Battery Charger Capability 030 - Provide a portable diesel-driven battery charger.	**$100,482** ~~$509,643~~	**$125,876** ~~$609,400~~	**$126,307** ~~$676,899~~	**$100,482** ~~$551,231~~	$494,000

Response to SAMA RAI 5h

Converting the signal from 2-of-4 to 3-of-4 logic will reduce the probability of an inadvertent actuation signal. Improving the reliability of the 118VAC power supply will have the same impact. The 118VAC system function associated with these SAMAs is derived from two sources – from the backup AC power source (motor control center) through the 118VAC transformer and from the static inverters associated with the primary DC power source. Due to the design redundancy and the need to fail at least two trains to make up the current 2-of-4 logic, individual component failures do not have a significant impact in the baseline model. Setting common cause failure, which was based directly on the current 2-of-4 logic, to zero was considered more appropriate. This was done for the specific components in each model for which common cause failure was modeled. Changing to a 3-of-4 logic would reduce the common cause contribution but not eliminate it. Therefore, the benefit of converting signals from 2-of-4 to 3-of-4 logic is bounded by setting this failure to zero.

Response to SAMA RAI 5i

The MFW system is not an emergency system. It is used post-trip only when emergency systems have failed and the operators are directed to try to recover the MFW system in IP2 or the condensate system in IP2 or IP3. The CDF contribution from post-trip operation of the MFW system is dominated by failure of the operators to utilize the system. This operator action would be unaffected by providing a digital feedwater upgrade or additional MFW pump. Consequently, the risk reduction worths of components associated with the MFW system are all less than 1.0 and any impact from setting those component basic events to zero would be insignificant. The loss of feedwater initiator accounts for failures of the MFW controls, pumps and other hardware that result in a plant transient due to loss of feedwater. Installing a digital feedwater upgrade and an additional motor-driven feedwater pump would reduce the probability of a plant transient due to loss of feedwater. Thus, setting the loss of MFW initiator to zero provides a bounding analysis of the benefits achievable from installing a digital feedwater upgrade and from installing an additional motor-driven feedwater pump.

Response to SAMA RAI 5j

The chemical and volume control system (CVCS) provides emergency boration flow to the RCS for shutdown of the reactor if the control rods fail after a reactor trip event. In its emergency boration mode of operation, the CVCS uses the charging pumps, boric acid transfer pumps and the associated valves, piping, instrumentation and controls to provide borated water from the RWST or the boric acid storage tank to the RCS.

Emergency boration consists of three pathways. These are

1. Emergency boration, using the boric acid transfer pumps through motor-operated valve 333.

2. Emergency boration using borated water from the RWST.

3. Emergency boration through the normal boration flow path (flow control valves FCV-110A and FCV-110B and manual valve 297) This path is not credited in the PSA model, because there is insufficient time to perform the required actions to align the system in time to provide effective boration.

Use of each emergency boration pathway requires operator action within 10 minutes following failure of the reactor to trip. As a result of the redundancy in hardware and the high degree of dependence between the operator actions associated with these paths (due to the limited time available to perform emergency boration during an ATWS event), the human failure events dominate the ATWS emergency boration response and hardware failures are not significant contributors to failure of this function. Since it was assumed that additional emergency boration capability provided under this SAMA would still require operator action, setting the human failure event to zero was not valid.

The common cause failures for the boric acid transfer pumps, in their emergency boration function, were set to zero since they are in the primary emergency boration path. Since the RWST path is redundant, it is not necessary to also set that path to zero to provide a bounding assessment of the benefit from adding an independent emergency boration system. Although the charging pumps are also required for successful emergency boration (through both credited paths), they are also modeled for other, significant mitigating functions (such as providing water to the RCP seal water injection system or to provide borated make-up water to the RCS in the event of a small-small LOCA). Therefore, it was not considered appropriate during the SAMA evaluation to set failure of those pumps to zero. Nonetheless, a review of the IP2 and IP3 cutsets with common cause failure of the charging pumps set to zero has been performed and also shows no significant change in the CDF contribution from ATWS scenarios.

Response to SAMA RAI 5k

The small benefit associated with setting the operator failure to trip the motor-generator (MG) sets to zero is reflective of the redundancy and high reliability of the reactor protection system (RPS) in the baseline model, even with very little credit taken for operator action.

The probability for failure to trip the reactor (i.e., RPS failure probability) for ATWS sequences is derived from a fault tree model of the RPS which is based on NUREG/CR-5500, Volume 2, "Reliability Study: Westinghouse Reactor Protection System,1984-1995," December 1998.

The RPS fault tree used in the baseline IP2 PSA model includes three operator actions:

- Failure of the operator to trip the reactor with no RPS signal available. While this action is included in the fault tree, no credit is taken for it (human error probability (HEP) = 1.0)
- Failure of the operator to trip the reactor with an RPS signal present (HEP = 0.1)
- Failure of the operator to trip the MG sets given failure of the reactor trip breakers to open. Given the local action needed and the short timeframe available, no credit is taken for this recovery action (HEP = 1.0).

The IP3 RPS fault tree model includes the first two operator actions shown above, but does not include the tripping of the MG set. In effect, not crediting the operator action to trip the MG sets following failure of the reactor trip breakers in the IP3 baseline model is equivalent to setting this HEP to 1.0 (as in the IP2 model). Since it does not exist in the IP3 model, however, a bounding analysis was performed for IP3 by directly setting the failure probability of the reactor trip breakers to 0.0. This resulted in a small benefit due to the redundancy and high reliability of the RPS system in the baseline model.

Response to SAMA RAI 5l

An IP 2 modification was installed allowing closure of the block valves when operating pressure is less than 2235 psig. If the reactor coolant pressure increases to 2300 psig, instrumentation initiates an alarm, and sends a signal to open the block valves

The SAMA improvement would be to develop a new modification that would reverse that operating approach, including the analysis behind it. It may also include adding or changing the auto-open feature to a lower value.

Specific issues to be addressed for this modification include the following.

1) Change licensing basis, which may require Nuclear Regulatory Commission involvement.
2) Change alarm and interlock setpoints, which includes calculations. This could involve adding a new setpoint and bistable.
3) Revise procedures and training.
4) Install and test hardware.
5) Change various documents, i.e. Technical Specification Basis, Final Safety Analysis Report, system descriptions, design basis documents, preventative maintenance tasks.

6) Change simulator and associated procedures.
7) Change fire protection program (credit taken in Appendix R analysis for decreased risk associated with hot shorts since block valves were closed during plant operation).

The following is a breakdown of the cost estimate

Task Description	Cost $
Develop modification documents, including calculations and drawings	114,000
Procedure changes and training	25,000
Misc. material and labor	200,000
Safety related cost increase i.e. quality assurance, quality control, material increase, etc	90,000
Project management	44,000
Installer mobilization, tools and training, construction management fee, insurance, performance bond	80,000
Contingency considering lack of design details	236,000
Total	792,000 (rounded to 800,000)

<u>Response to SAMA RAI 5m</u>

The value reported on Page E.4-14 is a typographical error. The correct value is $1,274,884 (as shown in Tables E.4-2 and E.4-3).

<u>Response to SAMA RAI 5n</u>

For both IP2 and IP3, normal cooling water to the CCW heat exchangers is provided by the non-essential service water header. If non-essential service water is lost, the CCW system cannot perform its intended function, which is to provide cooling to the RCP thermal barrier, charging pumps, safety injection pumps, recirculation pumps, RHR pumps and RHR heat exchangers. Also, prolonged loss of component cooling is assumed to result in an RCP seal LOCA if backup city water cooling is not provided to the charging pumps.

SAMA 064 (IP2) and SAMA 057 (IP3) are evaluated as a means to provide alternate cooling water to the CCW heat exchangers. This alternate cooling water for IP2 could be supplied by the IP1 wash water pumps (these were referred to in ER Section E.2.3 as backup service water pumps; however, they are not part of the service water system) and for IP3, by backup service water pumps (three backup service water pumps are available to provide cooling water from the discharge canal to essential service water in the unlikely event that the service water intake structure is lost). The benefit of providing alternate cooling is that the CCW system will be able to perform its intended function after loss of the non-essential service water pumps. Therefore, the benefit value was estimated by determining the change in plant risk from assuming that the loss of non-essential service water initiator does not occur (the loss of non-essential service water initiator was set to zero). This provides a conservative estimate of the benefit of providing an alternate cooling alignment because it eliminates the need for such alternate cooling, which is equivalent to assuming that implementing alternate cooling when non-essential service water is lost is always successful.

Addition of an alternate cooling alignment would not change the loss of non-essential service water initiator frequency because these backup cooling systems are not automatically implemented. The backup cooling system requires operator actions to align alternative cooling, and hence is considered a recovery action. In addition, it would do nothing to prevent loss of the non-essential service water header (piping and valves). It does, however, increase the availability of the CCW system and reduces the likelihood of losing RCP seal cooling, by enabling the CCW system to perform its function after loss of the non-essential service water pumps.

Response to SAMA RAI 5o

IP2

Although it is possible that the potential upgrade of the ASSS could have benefit following some subset of fires postulated to occur in the control building, other external event impacts at IP2 are driven by structural failures, and are unlikely to be significantly impacted by the SAMA addressed by this analysis case.

As discussed in the LRA-ER, the IPEEE fire risk model (as well as the other external event models) are not living models and cannot be practically manipulated to develop a more accurate impact. Therefore, while this analysis case was evaluated by setting the control building flooding event probability to zero, the result was also subjected to the external event factor of 2.8 to account for the additional impact of external events. An additional uncertainty factor of 2.1 was applied in addition to the external event factor. This method of addressing the external event impact of SAMAs is in accordance with NEI 05-01, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document," endorsed in ISG 2006-03. Thus, the benefit estimate presented in the ER includes the impact of this SAMA on external initiators.

SAMA 065, "Upgrade the ASSS to allow timely restoration of seal injection cooling," would enable alignment of the ASSS power supply directly from the control room to allow timely seal cooling recovery. This currently requires local field actions to align the ASSS to specific shutdown equipment (i.e. service water pumps and CCW pumps, or charging pumps) using transfer switches and casualty cable. The modification includes installation of 500 feet of multi-conductor cabling to the control room, control room penetration and sealing, installation of control switches in the control room, seismic evaluations, procedure changes and training.

The SAMA analyses did not generally assume replacement of the gas turbines with the new IP2 Appendix R diesel generator (DG). ER Section E.1.4.3 indicates that sensitivity studies showed that the results of the SAMA analysis would remain unchanged if the PSA model included the Appendix R DG in place of the gas turbines. The study showed that including the Appendix R DG in the model in place of the gas turbines would decrease the internal events CDF by about 1% due to the increased reliability of the Appendix R DG when compared with that of the gas turbines. Since the benefit analysis used a bounding assumption that mitigation of all flooding events is successful, the source of ASSS power does not directly impact the results.

Consequently, both the baseline CDF and the analysis case CDF would be changed by the same amount if the Appendix R DG was in the model in place of the gas turbines, resulting in no change to the benefit estimate. Thus, the conclusion that this SAMA is cost beneficial would not be impacted by the change from the gas turbines to the Appendix R DG.

The four 480V vital buses are located in a single switchgear room on the lower elevation of the plant. Significant flooding of that room is assumed to result in an unrecoverable failure of the 480V safeguards buses. The control building internal flooding initiating event frequencies correspond to flooding events that are not mitigated prior to reaching the critical height in the 480V switchgear room. Mitigation requires alignment of the ASSS power supply, which runs outside the switchgear room to specific shutdown equipment using transfer switches and casualty cable, rather than re-powering the 480V buses.

<u>IP3</u>

Although it is possible that the potential upgrade of the ASSS could have benefit following some subset of fires postulated to occur in the control building, other external event impacts at IP3 are driven by structural failures, and are unlikely to be significantly impacted by the SAMA addressed by this analysis case.

As discussed in the LRA-ER, the IPEEE fire risk model (as well as the other external event models) are not living models and cannot be practically manipulated to develop a more accurate impact. Therefore, while this analysis case was evaluated by setting the control building flooding event probability to zero, the result was also subjected to the external event factor of 2.8 to account for the additional impact of external events. An additional uncertainty factor of 2.1 was applied in addition to the external event factor. This method of addressing the external event impact of SAMAs is in accordance with NEI 05-01, "Severe Accident Mitigation Alternatives (SAMA) Analysis Guidance Document," endorsed in ISG 2006-03. Thus, the benefit estimate presented in the ER includes the impact of this SAMA on external initiators.

SAMA 061, "Upgrade the ASSS to allow timely restoration of seal injection cooling," would enable alignment of the ASSS power supply directly from the control room to allow timely seal cooling recovery. This currently requires local field actions to align the ASSS power supply, which runs outside the switchgear room to specific shutdown equipment (i.e. service water pumps and component cooling pumps, or charging pumps) using transfer switches and casualty cable. The modification includes installation of 500 feet of multi-conductor cabling to the control room, control room penetration and sealing, installation of control switches in the control room, seismic evaluations, procedure changes and training.

Installing the IP2 Appendix R DG and potential decommissioning of the turbine generators will have no impact on IP3 SAMA 061.

The four vital 480V buses are located in a single switchgear room on the lower elevation of the plant. Significant flooding of that room is assumed to result in an unrecoverable failure of the 480V safeguards buses. The control building internal flooding initiating event frequencies correspond to flooding events that are not mitigated prior to reaching the critical height in the 480V switchgear room. Mitigation requires alignment of the ASSS power supply, which runs outside the switchgear room to specific shutdown equipment using transfer switches and casualty cable, rather than re-powering the 480V buses.

SAMA RAI 6

Explain why the assumptions used to quantify the benefits for IP2 and IP3 are different for the following analysis cases: (a) AC Power Cross-Tie with Alternate Unit, (b) Alternate Battery Charger Capability, and (c) Alternate Water Sources to Steam Generators.

Response to SAMA RAI 6

(a) AC Power Cross-Tie with Alternate Unit

This analysis case addresses procedure and hardware changes needed to allow the vital busses to be cross-tied between IP2 and IP3. The IP2 model contains logic to use the IP3 alternate emergency power source (Appendix R diesel generator) to recover power. Assuming that this recovery always occurs provides a bounding assessment of the impact on IP2 of cross-tying the vital busses since the cross-tie would provide an additional means of recovering power. Similarly, the IP3 model contains logic to use the IP2 alternate emergency power source (gas turbines) to recover power. Assuming that this recovery always occurs provides a bounding assessment of the impact on IP3 of cross-tying the vital busses since the cross-tie would provide an additional means of recovering power. Since both cases assume that failure of the opposite unit's alternate emergency power supply does not occur, the assumptions for the two cases are not different.

(b) Alternate Battery Charger Capability

See the response to RAI 5g, which poses the same question.

(c) Alternate Water Sources to Steam Generators

This analysis case evaluates the change in plant risk from providing emergency connections to the fire water system as backup to feed the steam generators. The difference in assumptions for this case is a result of design differences between the two plants. IP2 has pneumatic indications that support operator control of the TDAFW pump following battery depletion and do not require electrical support. IP3 does not have this capability. As a result, credit is taken in the IP2 model for manual control of the TDAFW pump following battery depletion but no credit for such action is taken in the IP3 model. Continued secondary side cooling in IP3 therefore requires recovery of power. Given this difference, the bounding analysis for each unit examined the impact of assuming recovery of secondary side cooling using the backup source by eliminating loss of offsite power sequences (including SBO sequences) that involved loss of the TDAFW pump due to either equipment failure or battery depletion. The loss of the pump was addressed similarly for both units. The failure due to battery depletion was addressed in IP2 by assuming successful manual operation and in IP3 by assuming successful power recovery.

SAMA RAI 7

Explain why the estimated benefits for IP2 and IP3 are significantly different for the following analysis cases: (a) Automatic Recirculation Cooling Swap-Over ($81K for IP2 and $340K for IP3), (b) MSLB Inside Containment ($73K for IP2 and $611K for IP3), (c) Pressurizer PORV DC Power ($40K for IP2 and $0 for IP3), (d) Alternate Water Sources to Steam Generators ($985K for IP2 and $183K for IP3).

Response to SAMA RAI 7

(a) Automatic Recirculation Cooling Swap-Over ($81K for IP2 and $340K for IP3)

The higher value for IP3 is driven by a conservative assumption in the IP3 human reliability analysis (HRA). The IP3 HRA assumes that the operators have the same amount of time available to swap-over to recirculation cooling following a random single RCP seal LOCA as they have following a small LOCA. However, the maximum flow rate for a single seal LOCA is less than 500 gpm, which is far less than the flow rate assumed for a small LOCA. Therefore, more time is actually available to swap-over to recirculation cooling following a random single RCP seal LOCA. This conservative assumption results in a larger human error probability for failure to align recirculation cooling. This conservative assumption was not made in the IP2 HRA (due to analyst's preference). As a result, the random RCP seal LOCA cutsets are a more significant contributor for IP3 and setting failure to align recirculation cooling to zero produces a greater benefit.

(b) MSLB Inside Containment ($73K for IP2 and $611K for IP3)

Although the title of this analysis case is "Main Steam Line Break inside Containment", the accompanying paragraph describes it as a main steam line break (MSLB) inside and outside of containment (upstream of the MSIVs). The evaluations for both IP2 and IP3 bound the benefit of installing secondary side guard pipes up to the MSIVs by eliminating all MSLBs.

The IP3 model contains a basic event, with a value of 0.15, that represents the percentage of main steam piping outside of containment that is located upstream of the MSIVs. The IP2 model does not include this event and instead assigns the break to a location downstream of the MSIV (based on the short run of piping upstream of the MSIV). While this allows the IP2 model to take credit for both early and late depressurization, the IP2 model assumes a moderate dependency between those actions. Removing credit for early depressurization in the IP2 model would force late depressurization, making it logically equivalent to the IP3 model.

While the IP3 model assumes the need for late depressurization, the IP3 model used a very conservative approach for evaluating the HEP (it actually addresses the actions and timing required to preclude overfill and not for long-term depressurization, which would be the actual response). The HEP associated with long-term depressurization in the IP2 model uses a less conservative but more accurate treatment rather than the more conservative approach used in the IP3 model.

As a result of these differences, if we were to apply the IP3 factor of 0.15 to the IP2 model, along with removal of credit for early depressurization for those cutsets and corresponding removal of the IP2 dependency factor between early and late depressurization, the dominant cutset for this scenario in IP2 would contribute approximately 3.26E-9 per reactor year. This is actually lower than the existing dominant cutset associated with breaks downstream of the MSIVs. Other existing IP2 cutsets related to failure of early termination in the baseline MSLB model would become non-minimal. As a result, the benefit determined for IP2 by eliminating the existing MSLB cutsets is greater than would be obtained by applying the IP3 approach described above.

Although the IP3 approach is considered conservative, since it is already shown as not being cost effective, no change to that case is necessary.

(c) Pressurizer PORV DC Power ($40K for IP2 and $0 for IP3)

The higher value for IP2 is due to conservatisms in the analysis case modeling. The IP2 model structure is slightly different than IP3 for this system and isolating the PORV DC power dependencies was more difficult. Therefore, the changes made to the IP2 model to remove the PORV DC power dependencies also removed some auxiliary feedwater component DC power dependencies. As a result, the IP2 benefit was estimated to be higher than it would have been if PORV DC dependencies could have been completely isolated. The IP3 model structure was more amenable to this evaluation and the changes made more directly correspond to the benefit of removing only the PORV dependencies.

(d) Alternate Water Sources to Steam Generators ($985K for IP2 and $183K for IP3).

The bounding analysis for each unit examined the impact of assuming recovery of secondary side cooling using the backup source by eliminating loss of offsite power sequences (including SBO sequences) that involve loss of the TDAFW pump due to either equipment failure or battery depletion. The loss of the pump was addressed similarly for both units. The failure due to battery depletion was addressed in IP2 by assuming successful manual operation and in IP3 by assuming successful power recovery.

The difference in the impact for the two units is attributable to the position of the pressurizer PORV block valves during normal operation. In IP2, the block valves are normally closed, such that specific AC power failures result in the consequential loss of bleed capability. In IP3, the block valves are normally open. The ability to use the PORVs for bleed and feed cooling is therefore more likely at IP3 given similar partial power loss events. Since AC power failures contribute to loss of bleed capability at IP2, loss of offsite power sequences that involve loss of the TDAFW pump contribute more to the CDF for IP2. Thus, elimination of these sequences results in a higher benefit. [IP2 SAMA 053 evaluates the change in plant risk from changing the IP2 PORV block valves to the normally open position.]

SAMA RAI 8

Explain the plant features that resulted in the following cost-beneficial (or low cost) SAMAs not being included in the list of potential SAMAs for the opposite unit: (a) SAMAs 56, 60, and 61 for IP2, which have no corresponding SAMAs for IP3, and (b) SAMAs 42, 52, and 55 for IP3, which have no corresponding SAMAs for IP2.

Response to SAMA RAI 8

IP2 SAMAs not considered for IP3

The following provides an explanation of the plant features that resulted in proposed IP2 SAMAs not considered for IP3.

- IP2 SAMA 056 - Keep RHR heat exchanger discharge MOVs 746 and 747 normally open.

  For IP3, this SAMA is not applicable because IP3 MOVs 746 and 747 are already normally open.

- IP2 SAMA 060 – Provide added protection against flood propagation from stairwell 4 into 480V switchgear room.

  As described in ER Section E.2.3, the proposed modification for IP2 involves installation of a reverse door swing, additional ductwork and a check valve to reduce flood propagation from stairwell 4 into the 480V switchgear room. IP3 has a similar scenario in which flood propagation can occur from the east stairwell into the 480V switchgear room. However, due to the differences in building layout, a similar modification would not be effective for diverting the flood water at IP3. The SAMA proposed to mitigate this flood in IP3 is Phase II SAMA 062 (Install flood alarm in the 480V switchgear room).

- SAMA 061 – Provide added protection against flood propagation from the deluge room into the 480V switchgear room.

  The potential change proposed for IP2 involves diversion of flood water into the turbine hall rather than into the switchgear room. This is possible in IP2 since the deluge room is an intermediate room between the turbine hall and the switchgear room. Although the deluge station in IP3 is located in a room separated from the switchgear room by a door, that door opens into the switchgear room and there is no separate egress path into the turbine hall. Therefore, the potential change proposed for IP2 is not applicable to IP3.

IP3 SAMAs not considered for IP2

The following provides an explanation of the plant features that resulted in proposed IP3 SAMAs not considered for IP2.

- IP3 SAMA 042 - Provide hookup for portable generators to power the turbine-driven AFW pump after station batteries are depleted.

  IP2 has pneumatic instrumentation that allows the operators to effectively control the turbine driven AFW pump manually following battery depletion. Therefore, the benefit from this SAMA for IP2 would be less than for IP3 so it was not considered to be potentially cost beneficial and was screened out in Phase I.

- IP3 SAMA 052 - Open city water supply valve for alternative AFW pump suction.

  The IP3 AFW pumps have a low suction flow trip which protects the pumps upon loss of the normal condensate storage tank suction. This allows the operators time to switch over to the backup city water tank. This trip does not exist for the IP2 AFW pumps. IP2 SAMA 059, "Re-install the low pressure suction trip on the AFW pumps and enhance procedures to respond to a loss of the normal suction path," provides the same improvement. This SAMA would re-install the low pressure suction trip to ensure that the IP2 pumps are protected from a loss of the normal suction path from the condensate storage tank and allow swap over to the alternate city water suction path.

- IP3 SAMA 055 – Provide hard-wired connection to one SI or RHR pump from the Appendix R bus (MCC 312A).

  IP2 already has the ability to supply Appendix R power to an SI or RHR pump. Use of that power supply, however, requires use of a staged casualty cable. The corresponding SAMA for IP2 is SAMA 062, "Provide a hard-wired connection to an SI pump from ASSS power supply." This would upgrade the power supply to an SI pump by providing a direct hard-wired connection from an ASSS power supply.

SAMA RAI 9

For certain SAMAs considered in the ER, there may be lower-cost alternatives that could achieve much of the risk reduction at a lower cost. In this regard, discuss whether any lower-cost alternatives to those Phase II SAMAs considered in the ER would be viable and potentially cost-beneficial. Evaluate the following SAMAs (previously found to be potentially cost-beneficial at other plants), or indicate if the particular SAMA has already been considered. If the latter, indicate whether the SAMA has been implemented or has been determined to not be cost-beneficial at IP2 or IP3:

a. To aid in the mitigation of a SGTR, the implementation of improved instrumentation and procedures to help cool down and depressurize the reactor cooling system (RCS) prior to refueling water storage tank depletion.

b. To aid in the mitigation of a SGTR , the implementation of a procedure for recovery of steam dump to condenser from the unaffected steam generator.

c. To aid in the mitigation of a SGTR, the implementation of a procedure for recovery of the main feedwater valve/condensate post SI actuation.

d. Reactivate the IP3 post-accident containment venting system (B5b information implies that this is still active on IP2 but was deactivated on IP3).

Response to SAMA RAI 9a

This SAMA has already been considered and implemented for both IP2 and IP3.

Operator actions to cool and depressurize the RCS to cold shutdown conditions following an SGTR in order to terminate leakage from the RCS into the secondary-side prior to depleting RWST inventory are contained in emergency operating procedures. The action involves cooling the RCS using the condenser steam dumps or atmospheric dump valves and then depressurizing the RCS using either the pressurizer spray valves or power operated relief valves.

With RWST level low without a corresponding increase in recirculation sump water level or if the ruptured steam generator narrow range level is high, emergency procedures direct plant personnel to initiate RWST makeup.

Response to SAMA RAI 9b

In response to a SGTR, IP2 and IP3 emergency operating procedures indicate that the preferred method of RCS cooldown is by dumping steam to the condenser via the steam dumps. One of the IP3 long-term cooldown procedures allows the operator to use the steam dumps, and includes explicit direction to open unaffected steam generator MSIVs. The corresponding IP2 procedure directs the operators to dump steam from intact steam generator if the condenser is available.

Since procedures for recovery of steam dump to condenser from the unaffected steam generator are currently available at both units, this SAMA has already been implemented at IP2 and IP3.

Response to SAMA RAI 9c

IP2

Procedural guidance to re-establish main feedwater or condensate flow currently exists.

Should the auxiliary feedwater system initially not function or subsequently fail during implementation of the EOPs, the operators are directed to attempt to establish secondary heat sink with auxiliary feedwater, main feedwater or condensate. Therefore, this SAMA has already been implemented at IP2.

IP3

Procedural guidance to re-establish condensate flow currently exists.

Should the auxiliary feedwater system initially not function or subsequently fail during implementation of the EOPs, the operators are directed to attempt to establish secondary heat sink with auxiliary feedwater or condensate.

IP3 currently has no procedural guidance to use main feedwater following a loss of secondary heat sink event. Hence, Phase II SAMA 051 "Operator action: Align main feedwater for secondary heat removal" was evaluated for IP3.

Response to SAMA RAI 9d

In lieu of the post-accident containment venting system, IP3 has three alternate methods of containment depressurization and combustible gas control available. These methods are backflow to the steam ejector line, containment pressure relief line, and the containment purge system. These methods are considered in the severe accident management guidelines. Therefore, adequate capabilities exist for purging and controlled venting of containment to reduce containment overpressure conditions and as a combustible gas control strategy. Furthermore, all of the venting functions require similar operator actions. Failure of the hardware would be a small contributor compared to failure of the operator action. Since adding a vent path would result in little benefit, this change would not be cost-beneficial and was not evaluated as a SAMA.

ENCLOSURE 1 TO NL-08-028

Tourism and New York City's Economy Article

(SAMA 4c Reference)

ENTERGY NUCLEAR OPERATIONS, INC
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Tourism and New York City's Economy

Jason Bram

In New York City, tourism has made impressive gains in recent years, particularly in the foreign visitor segment. While not large enough to propel the city's economy, this long-term growth industry is critical to maintaining the local export base and providing jobs to low-skilled workers.

Tourism is one of the few bright spots in New York City's economy. Between 1977 and 1994, employment growth in local tourist-related industries was more than six times the rate for the city as a whole. At the end of that period, hotel occupancy rates reached a six-year high, and in 1995 they are expected to rise even further. Besides providing direct benefits to local businesses, tourism has helped to maintain the city's export base, which has suffered from declines in manufacturing.[1]

What forces drive foreign and domestic tourism in New York City? How profoundly does this industry affect the city's economy? This edition of *Current Issues* explores these questions by measuring tourism's contribution to employment, earnings, and retail sales in New York City, and by comparing the results with figures for the United States as a whole. It also discusses the critical role of foreign visitors and introduces an exchange rate affordability index that can help assess conditions for foreign tourism.

How does the analysis add up? Tourism is a small but growing industry that can provide important economic and social benefits to New York City now and in the years ahead.

Who Are New York City's Tourists?

A discussion of the economic impact of the tourism industry requires that we first define the term "tourist." Are visitors, business travelers, visiting friends, and relatives from out of town considered tourists? According to the most commonly accepted definition of the term, the answer is "yes." Specifically, New York City tourists include all foreign and domestic visitors from outside the metropolitan area, except for commuters.[2] The tourism industry, in turn, comprises the business these individuals generate through spending while in the area.[3] Tourist expenditures are a more effective measure of tourism's impact than number of visitors because the duration and nature of visits vary substantially. For example, one person on a day trip to the city will spend substantially less than a person who stays for a week.[4]

The majority of visitors to New York City come from the Northeast. According to a comprehensive study on tourism in the region, close to two-thirds of visitors reside within 250 miles of the city (Port Authority 1994). However, because many come on day trips, their share of total tourist expenditures is relatively low—less than 30 percent.

Visitors from other parts of the United States account for roughly 30 percent of spending, which is fairly evenly distributed among tourists from the West, Midwest, and the South (excluding areas within a 250-mile radius of New York City, such as Washington, D.C.).

But it is foreign tourists who play the most important role in New York City's tourism industry. They represent just 15 percent of visitors but more than 40 percent of all tourism expenditures (Port Authority 1994).

The Unique Role of Foreign Tourists

Besides generating nearly half of New York City's tourism revenues, the foreign visitor segment is a strategic part of the city's economy for several reasons. First, since overseas business cycles can be out of sync with local ones, foreign tourism can grow while the local economy is stagnant or contracting. As a result, in slow periods, this segment of the industry can serve as a stabilizing economic force.

Second, New York City's unparalleled diversity of attractions and cultures gives it an enduring competitive advantage in attracting visitors from abroad. Fifteen percent of tourists to the area are from foreign countries, compared with less than 5 percent nationally (Port Authority 1994).

Finally, this segment's contribution has substantial growth potential. Worldwide tourism is expanding at a much faster pace than the U.S. market—a trend that is projected to continue.

What Drives Tourism?

To answer this question, we developed a crude statistical model that uses hotel occupancy rates as a proxy for tourism (see box below). Tests of the model suggest that the value of foreign currencies against the dollar appears to be an important determinant of foreign tourism. For example, in the mid-1980s, while the Northeast economy was booming, the strong dollar clearly deterred foreign visitors. Conversely, in 1987-88, a plunging dollar gave the industry a boost (Chart 1).

A Statistical Model of Tourism

Using hotel occupancy rates (PKF Consulting) as a rough proxy for local tourism, we developed an equation to identify the factors that most influenced tourism in the 1976-94 period. The two variables that proved to be significant were foreign exchange rates (for foreign tourism) and changes in employment levels in the Northeastern United States (for domestic tourism). National employment and income trends were also tested as a factor but did not prove to be significant.

To develop a single measure of foreign exchange rates, we first created indexes based on U.S. dollar per currency unit for each of eight countries: Canada, the United Kingdom, Japan, Germany, France, Italy, Switzerland, and Spain. These countries together accounted for two-thirds of visitors to New York City in 1992. Each country's index was then weighted according to the 1992 distribution of foreign visitor expenditures in New York City (Port Authority 1994). The resulting index, used in the equation, serves as a measure of exchange-rate affordability for the home countries of most visitors to New York City.

For the other variable, regional job trends, we used a two-year moving average of the percent change in total employment in twelve Northeastern states (Connecticut, Massachusetts, Rhode Island, Maine, New Hampshire, Vermont, New York, New Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia) excluding the New York City metropolitan area. The selection of these states was based on research showing that most domestic visitors come from within 250 miles of the city (Port Authority 1994). The two-year growth rate was used to capture the cumulative impact of trends in employment.

While the sample period is fairly small and the hotel occupancy rate is an imperfect barometer of tourism, the relationship between these two variables and tourism is clearly significant. When taken together, the measures can explain about 80 percent of the variation in hotel occupancy. The following example illustrates the relative effects of the two variables: in the regression, a 0.5 percentage point increase in regional job growth—or a 6.7 percent appreciation of foreign currencies against the dollar—will tend to push hotel occupancy rates up by 1 percentage point.

The model does not explicitly differentiate between foreign and domestic tourism. However, it is logical to conclude that exchange rates affect foreign tourism, while regional growth relates to domestic tourism. Thus, to separate out foreign effects, we factored the exchange rate index into the model and held the domestic variable constant at its average level. Conversely, we estimated the domestic tourism effects by factoring in regional job growth and holding the exchange rate constant. Chart 1 shows patterns in actual hotel occupancy rates and the predicted values based on domestic and foreign variables over the past two decades.

Similarly, in recent years, a weak dollar has brought droves of tourists from overseas. (Special events, such as the World Cup matches, may also have helped attract foreign visitors in 1994.) Since Western Europeans account for more than half of foreign visitor spending, the strength of European currencies against the dollar helped the industry in 1995—to date, hotel bookings and retail spending in tourist-intensive industries are reportedly strong (Kamen 1995).

New York City's unparalleled diversity of attractions and cultures gives it an enduring competitive advantage in attracting visitors from abroad.

Not surprisingly, domestic tourism, which accounts for more than half the market, is driven by conditions close to home. In tests of the model, changes in employment levels in the Northeast[5] proved to be a major factor, while employment trends in the rest of the United States did not. The fact that nationwide economic conditions do not play much of a role may reflect a substitution effect: in other words, U.S. residents' tendency to travel less during economic slumps is offset by a shift in preference toward New York City over more exotic—and expensive—overseas destinations. This substitution effect is not evident among visitors from the Northeast. In contrast to tourists from other parts of the country, this group appears to curtail its visits to New York City during periods of high regional unemployment.

Thus, the 1991-93 slump in tourism (Chart 1) was apparently due, in large part, to a severe regional recession, exacerbated by a hotel-room surtax instituted in 1990. In 1994, however, regional job growth was at its strongest in six years, and the tax was repealed. Both factors evidently contributed to a rebound in tourism.

How Important Is Tourism?

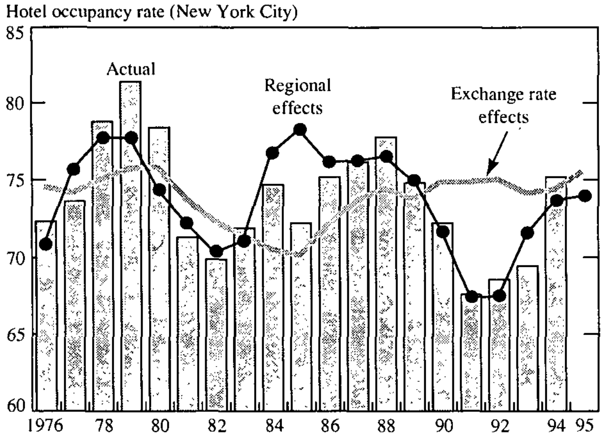
A very broadly defined industry, tourism is larger than most narrowly defined sectors in New York and nationwide. But compared with other broad industry groups such as finance, business services, and even manufacturing, tourism is relatively small. A special study conducted by the New York Convention and Visitors Bureau estimated that visitors to the city spent $10.5 billion in 1992, equal to 5.5 percent of city personal income. For that year, this revenue directly supported 4 percent of local employment (131,000 jobs) but only 2.5 percent of wage earnings, because tourism-related jobs tend to be low paying. Estimates by the Port Authority for the same year show similar results.[6]

The industry's true impact on the local economy is difficult to assess. Because tourism represents a market of end-users rather than a particular category of goods or services, it is not defined as a discrete industry in the codes used for government statistics. Therefore, we use tourist-intensive industries (such as hotels, restaurants, and museums) as proxies to measure tourism sales,

Chart 1

The Determinants of Tourism

Effects of Exchange Rates and Regional Growth on Hotel Occupancy Rates



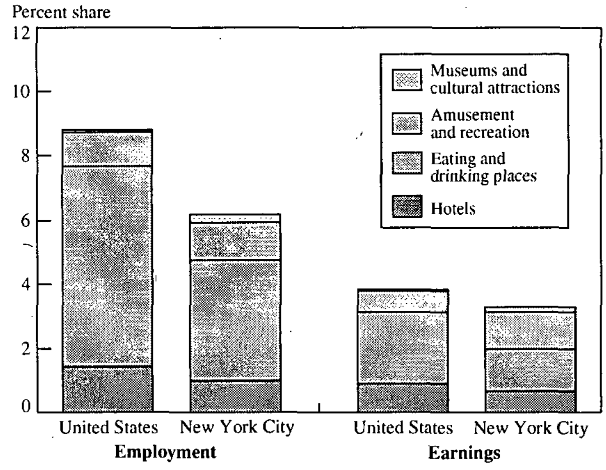
Source: Hotel occupancy rates are based on data from PKF Consulting.

Note: The chart is based on a regression of hotel occupancy rates against regional job growth and exchange rates (see box on p. 2). Regression results are available from author on request.

Chart 2

Share of Employment and Earnings in Tourist-intensive Industries

New York City Relative to the United States



Sources: U.S. Bureau of Labor Statistics; New York Department of Labor.

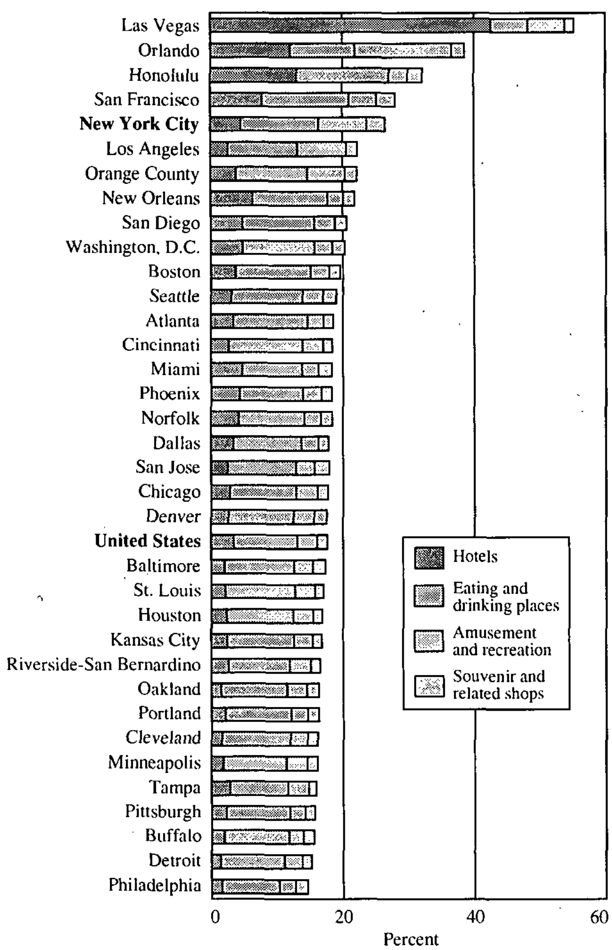
employment, and earnings. To assess tourism's relative importance to New York City, we then compare its share of economic activity locally with its share nationwide.

Employment and Earnings: By this measure, tourism's contribution to the area's economy appears to be modest. The hotel industry—the most relevant sector because it almost exclusively services visitors—employs 1 percent of New York City's workers and accounts for just 0.7 percent of total wage earnings. Both of these proportions are well below the national average. For a broader range of tourist-intensive industries—eating and drinking places, amusement and recreation services, museums and cultural attractions—tourism still accounts for a smaller share of both employment and earnings in New York City than nationally (Chart 2).[7]

Retail Sales: The share of retail and related sales in tourist-intensive sectors such as hotels, restaurants, and souvenir shops tells a different story.[8] By this crude measure, New York City surpasses the United States overall and is outranked by just four other metropolitan areas[9]—Las Vegas, Orlando, Honolulu, and San Francisco (Chart 3). New York City also outstrips Buffalo–Niagara Falls and all other Second District metropolitan areas, which rate slightly below the national average (Chart 4).[10]

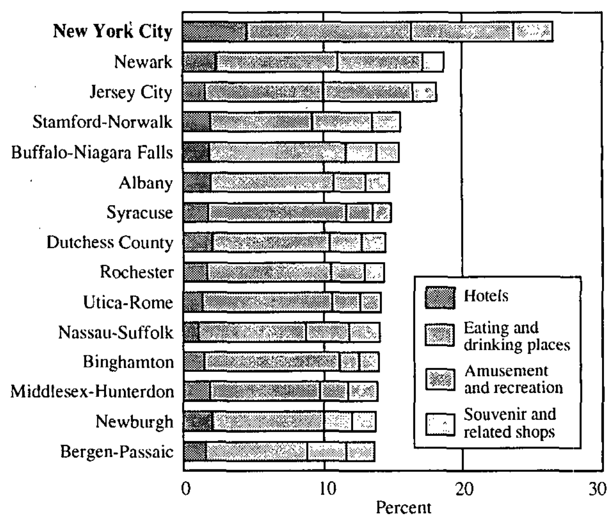
What, specifically, do tourists spend their money on? On average, visitors to New York City allocate less of their budgets to hotels than do visitors to virtually all other cities. The modest amount tourists spend on lodging evidently reflects the large number of day-trippers and visitors staying with friends and relatives.[11] In contrast, outlays at eating and drinking places, amusement and recreation services (which include the arts), and souvenir or gift shops are relatively high. In addition, the city's status as a fashion center evidently boosts visitor spending at apparel stores—sales are substantially higher than can be accounted for by resident purchases. These spending patterns are consistent with survey findings showing that the city's primary draws are shopping, dining, and the arts (Port Authority 1992).

Chart 3
Share of Business Sales in Tourist-intensive Industries: U.S. Metropolitan Areas



Sources: 1992 Census of Retailing; 1992 Census of Services.

Chart 4
Share of Business Sales in Tourist-intensive Industries: Second District Metropolitan Areas



Sources: 1992 Census of Retailing; 1992 Census of Services.

Why the Difference? The two proxies—employment/earnings and retail sales—are not necessarily contradictory. Tourism's impact may appear large in terms of retail sales but modest in terms of employment and earnings because New York City's economy is dominated by nonretail industries, most notably financial services. Because retailing on the whole is a much smaller part of the city's economy than the nation's, using retail sales as a base overstates tourism's relative importance. Nevertheless, visitor outlays flow into the city's economy not only through wages, but also through profits, sales taxes, rents, and other expenses, all of which are high in New York City. As a result, employment and earnings tend to understate tourism's contribution.

Tourism tends to benefit the local economy more than intraregional commerce because of indirect "multiplier" effects.

A Positive Impact

Clearly, tourism cannot make or break the city's economy, but it does play a positive role in several ways. First, by generating many low-skill (albeit low-paying) jobs, tourism provides much-needed employment opportunities for poorer segments of the population.

Second, as an export industry, tourism tends to benefit the local economy more than intraregional commerce because of indirect "multiplier" effects. Inflows of money from outside the region can generate additional waves of economic activity—for example, a hotel maid will use part of her earnings to go out to the movies, or a restaurant will draw on its income to print up menus. These multiplier effects are estimated to equal about 37 percent of tourism spending (New York Convention and Visitors Bureau [1993]).

Third, tourism, though small, is growing. Between 1977 and 1994,[12] New York City employment grew just 4 percent overall, but it rose by 35 percent in the hotel industry and 26 percent in other tourist-related sectors (restaurants and bars, amusement and recreation services, and museums and galleries). The growth potential of foreign tourism in particular is significant.

Conclusion

Unlike the U.S. industry, which is dominated by domestic travelers, New York City tourism benefits greatly from foreign visitors. The strength of foreign currencies led record numbers of overseas visitors to New York City in 1994 and early 1995. The city's ability to draw foreign visitors is a big plus because foreign tourism is relatively immune to local recessions and has the potential to grow rapidly in the years ahead.

While tourism—both domestic and foreign—is critical to hotels, theaters, and a wide range of local retail industries, it is not large enough to propel the city's economy. Still, as a growing export industry that employs a significant number of low-skilled workers, tourism has clear benefits for the metropolitan area.

Notes

1. In a regional context, the term "export" refers to sales to individuals from outside the region, though not necessarily from outside the country. The region, in this case, is the New York City metropolitan area.

2. In most cases in this article, the metropolitan area refers to New York City plus twelve counties within commuting distance: Nassau, Suffolk, Westchester, Rockland, Passaic, Bergen, Essex, Hudson, Union, Middlesex, Morris, and Somerset.

3. The tourism industry, as defined here, excludes outlays for transportation to and from New York City (for example, air and rail fares). Such expenditures are as indicative of local residents' travel outside the region (imports) as visitors' travel to the region (exports). Moreover, transportation revenues do not necessarily accrue to the local economy.

4. In citing numbers of visitors in this article, we count the number of distinct trips rather than the number of people.

5. The Northeast, as defined here, includes New England, the Middle Atlantic states (excluding the New York City metropolitan area), as well as Delaware, Maryland, and Washington, D.C. New York City is excluded because residents cannot be tourists to the area.

6. In separate studies, the New York Convention and Visitors Bureau and the Port Authority have estimated the size of the local tourism industry by attributing specific shares of various industries to tourism and aggregating those segments. The Bureau's study covers only the city proper, while the Port Authority's study covers the metropolitan area, which also includes twelve nearby counties. Unfortunately, these measures are not tracked over time, nor are they available nationwide or for other cities based on comparable methodologies.

7. Clearly, these tourist-intensive industries service the local community as well as visitors. Moreover, other industries that are not included (particularly clothing and other retailers) also service tourists. Therefore, while employment and earnings can be used as a crude proxy for the relative importance of tourism, it should not be used as an estimate of the actual volume of tourism business.

8. Information on retail sales is drawn from the 1992 Census of Retail Trade and 1992 Census of Service Industries. Specific Standard Industrial Classification (SIC) codes include: eating and drinking places (58); souvenir and related retailers (5943, 5945-5949); amusement and recreation services excluding movie production (783, 784, 79); and museums, zoos, and galleries (84).

9. Here, metropolitan areas refer to Primary Metropolitan Statistical Areas (PMSAs) as defined by the Census Bureau. New York City's PMSA includes the city's five boroughs as well as Westchester, Rockland, and Putnam counties.

10. The Buffalo–Niagara Falls metropolitan area enjoys limited benefits from Niagara Falls' status as a tourist destination because most of the attractions are in Canada. Still, while direct tourist expenditures are evidently modest, tourism may have a significant (but hard to measure) indirect effect on metropolitan Buffalo's economy.

11. A tourist is more likely to have friends or relatives in the New York City metropolitan area because it is the most densely populated in the nation. According to the Port Authority's 1992 study, 27 percent of both foreign and domestic tourists came to the New York City area to visit friends and relatives.

12. This interval was selected because it begins and ends at similar points in the business cycle: 1977 and 1994 were both years in which the city was emerging from severe recession.

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