May 21, 2008

Mr. Michael P. Gallagher
Vice President License Renewal Projects
AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR THREE MILE ISLAND NUCLEAR STATION, UNIT 1, LICENSE RENEWAL (TAC NO. MD7702)

Dear Mr. Gallagher:

The U.S. Nuclear Regulatory Commission staff has reviewed the Severe Accident Mitigation Alternatives analysis submitted by AmerGen Energy Company, LLC, regarding its application for license renewal for Three Mile Island Nuclear Station, Unit 1, and has identified areas where additional information is needed to complete its review. Enclosed is the staff's request for additional information.

We request that you provide your responses to these questions within 60 days of the date of this letter, in order to maintain the environmental review schedule. If you have any questions, please contact me at 301-415-1147 or by e-mail at sarah.lopas@nrc.gov.

Sincerely,

\RA

Sarah Lopas, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket Nos. 50-289

Enclosure:
As stated

cc w/encl: See next page

May 21, 2008

Mr. Michael P. Gallagher
Vice President License Renewal Projects
AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR THREE MILE ISLAND NUCLEAR STATION, UNIT 1, LICENSE RENEWAL (TAC NO. MD7702)

Dear Mr. Gallagher:

The U.S. Nuclear Regulatory Commission staff has reviewed the Severe Accident Mitigation Alternatives analysis submitted by AmerGen Energy Company, LLC, regarding its application for license renewal for Three Mile Island Nuclear Station, Unit 1, and has identified areas where additional information is needed to complete its review. Enclosed is the staff's request for additional information.

We request that you provide your responses to these questions within 60 days of the date of this letter, in order to maintain the environmental review schedule. If you have any questions, please contact me at 301-415-1147 or by e-mail at sarah.lopas@nrc.gov.

Sincerely,

\RA

Sarah Lopas, Project Manager
Projects Branch 1
Division of License Renewal
Office of Nuclear Reactor Regulation

Docket Nos. 50-289

Enclosure:
As stated

cc w/encl: See next page

DISTRIBUTION: See next page

ADAMS Accession No: ML081330714

OFFICE	LA:DLR	PM:DLR:RPB1	BC:DLR:RPB1	OGC
NAME	IKing	SLopas	LLund	BMizuno
DATE	5/12/08	5/13/08	5/20/08	5/21/08

OFFICIAL RECORD COPY

Letter to M. Gallagher from S. Lopas, dated May 21, 2008

DISTRIBUTION:

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION REGARDING SEVERE ACCIDENT MITIGATION ALTERNATIVES FOR THREE MILE ISLAND NUCLEAR STATION, UNIT 1, LICENSE RENEWAL (TAC NO. MD7702)

HARD COPY:
DLR RF

EMAIL:
PUBLIC
RidsNrrDlr
RidsNrrDlrRpb1
RidsNrrDlrRpb2
RidsNrrDlrRerb
RidsNrrDraApla
RidsOgcMailCenter

LLund
DWrona
SLopas
PBamford
RPalla
MRubin
BMizuno, OGC
MModes, RI
NSheehan, RI OPA
RConte, RI
RBellamy, RI
DKern, RI
DBrand, RI

REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE ANALYSIS OF SEVERE ACCIDENT MITIGATION ALTERNATIVES
FOR THREE MILE ISLAND NUCLEAR STATION, UNIT 1

1. Provide the following information regarding the development of the Three Mile Island Nuclear Station, Unit 1 (TMI-1) probabilistic risk assessment (PRA) used for the severe accident mitigation alternative (SAMA) analysis:

   a. Discuss any peer reviews of the internal events model revisions subsequent to the August 2000 model, including the June 2007 model, used for the SAMA analysis. Describe any significant review comments and their potential impact on the results of the SAMA analysis.

   b. Discuss any peer reviews of the external events PRA, including the external flooding analysis used for the SAMA analysis. Describe any significant review comments and their potential impact on the results of the SAMA analysis.

   c. Section E.2.2.1 and Table E.2-1 of the Environmental Report (ER) provide a chronology of the development of the TMI-1 PRA. However, it is unclear what plant and PRA model changes were incorporated in each version of the PRA subsequent to the individual plant examination (IPE). Clarify into which PRA model revision each of the 12 plant and procedure changes listed on pages E-4 and E-5 were originally incorporated.

   d. Identify the major PRA model changes incorporated in the August 2000 model.

   e. Identify any plant changes since the June 2007 model, and provide a qualitative assessment of their potential impact on the PRA and the results of the SAMA analysis.

2. Provide the following information relative to the Level 2 PRA analysis:

   a. The ER mentions updated MAAP analyses in the context of re-evaluating success criteria for the 2003 PRA update (Section E.2.2.2), and enhancing the Oconee containment event tree model for TMI-specific analysis (Section E.2.2.3). However, it is not clear whether the MAAP source term calculations have been updated since the IPE. Describe the MAAP source term calculations used to support the SAMA analysis. Confirm whether these calculations were performed for the 9 major release categories or the complete set of 39 release categories.

   b. Provide additional discussion of how the source term frequencies for external floods in Table E.2-23 were derived. Describe how the release categories and release frequencies in Table E.2-23 relate to those shown in Figure E.2-3. Explain the relevance of the steam generator tube rupture (SGTR) frequency in Table E.2-23 to external flood events.

   c. Table E.2-21 indicates a core damage frequency (CDF) of 2.5E-07 per year for external floods <305 feet. However, Table E.2-23 indicates a source term frequency for floods <305 feet of 4.01E-07 per year. Address this discrepancy.

ENCLOSURE

3. Provide the following information with regard to the treatment and inclusion of external events in the SAMA analysis:

   a. In Section E.5.1.6.1, AmerGen provides the CDF for the five largest contributing fire scenarios, and identifies SAMAs that would help reduce the fire risk for each fire area. Identify other fire areas that were screened on low CDF and that have a fire CDF greater than 3.0E-7 per year (approximately equivalent to an averted cost risk of $50,000). Provide a discussion of each additional fire area, including identification and assessment of SAMAs to reduce the associated fire risk.

   b. For each of the dominant fire areas, explain what measures have already been taken to reduce risk. Identify in the response: areas that are equipped with fire detection systems or enhanced fire suppression capabilities (e.g., CO_2), changes that have been made to improve cable separation, and administrative procedures/controls for monitoring and controlling the quantity of combustible materials in critical process areas.

   c. Section E.5.1.6.1 provides a list of PRA topics that are claimed to prevent the effective comparison of the CDF between the internal events PRA and the fire PRA. These topics appear to be derived from Nuclear Energy Institute (NEI) 05-01, and are provided as general statements rather than specific arguments applicable to the TMI-1 fire PRA. Describe how each of these items specifically apply to the TMI-1 fire PRA.

   d. Flood gate installation failure is a significant contributor to external flooding, CDF for floods between 305 and 310 feet. No SAMAs are proposed for reducing the failure frequency because of the long period of time that is available to properly install the gates. The individual plant examination of external events (IPEEE) indicates that 15 hours are required to install the flood gates after a hydrograph warning is issued, yet the time available to respond to a fast developing flood such as a flood surge caused by a hurricane is less than 10 hours (which is the time interval for a fast developing flood to rise from 302 to 310 feet). Provide clarification regarding the time available for operator response to a fast developing flood and further justification for why potential SAMAs to reduce this response time were not evaluated (e.g., pre-staging of cranes and other equipment needed to install the flood gates).

   e. The maximum cost-risk for high winds, aircraft impact, and hazardous chemicals is estimated in the ER to be $23,753, $12,073, and $4,908, respectively. These values were calculated by scaling the internal events maximum averted cost-risk (MACR) by the ratio of the relevant event CDF to the total external events CDF. However, the denominator in the ratio should be the total internal events CDF, not total external events CDF. Confirm that the revised cost-risk for high winds, aircraft impact, and hazardous chemicals would therefore be approximately

$107,000, $54,500, and $22,100, respectively. Discuss whether any additional SAMAs would be identified based on these increased cost-risk estimates. If so, provide a cost-benefit analysis for each.

f. AmerGen doubled the estimated benefits for internal events to account for additional SAMA benefits in external events. However, the total CDF from external events, including seismic and fire (but excluding external flooding since external flood SAMAs are assessed separately), is a factor of 4.5 greater than the internal events CDF. This would suggest that a multiplier of 5.5 rather than 2 be used to account for external events. In Section E.4.6.3, AmerGen justified the use of a multiplier of 2 on the basis that the seismic CDF is conservative, and that the use of an over-inflated multiplier could skew the results of the analysis. AmerGen's approach effectively discounts the possibility that SAMAs for internal events could also provide benefits in seismic events. Based on the information presented, the NRC staff does not agree that the seismic CDF can be entirely discounted in assessing SAMA benefits. Provide additional justification why the seismic risk contribution and CDF would realistically be much lower than implied by the seismic CDF in the IPEEE. Include an assessment of the plant-specific applicability of the conservatisms identified in Section E.5.1.6.2.1 and the impact of any plant improvements implemented since the IPEEE. Provide a revised multiplier based on the more realistic estimate of seismic CDF, if appropriate.

g. Provide an assessment of the impact on the initial and final screenings if the internal events risk reduction estimates are increased by a factor of 5.5, or the revised multiplier based on the more realistic estimate of seismic CDF. This assessment need only be performed for those SAMAs that would offer additional risk reduction in seismic events.

4. Provide the following information concerning the MACCS2 analyses:

a. In Section E.7.3.2, population sensitivity case TMI30INC shows that increasing the (baseline) year 2034 population by 30 percent results in a 28 percent increase in population dose and offsite economic cost risk (OECR). In contrast, population sensitivity case TMISIT00 shows that use of year 2000 census data rather than year 2034 population results in a 29 percent decrease in population dose and OECR. However, the year 2034 population data reported in Tables E.3-1 and E.3-2 appears to represent only a 12 percent increase in population relative to year 2000 census data (USCB 2000). Explain the disproportionately larger sensitivity to population change in case TMISIT00. Provide the URL address for both the 1990 and 2000 census data used in AmerGen's analysis.

b. Section E.7.6.4 provides a breakdown of the population dose-risk and OECR results by release category for internal events, after the SECPOP2000 correction. Provide a corresponding breakdown (by release category) for the external flooding events.

5. Provide the following with regard to the SAMA identification and screening process:

a. None of the 33 identified SAMAs were screened out in the Phase I evaluation. However, the identification of potential SAMAs in the Level 1 and 2 importance lists (Tables E.5-1 and E.5-2) indicate that at least two potential SAMAs were pre-screened: (1) independent DHR/injection system (i.e., events %SBL, NOEXSCRUBEFF, NONCGASHIGH), and (2) flooded rubble bed (i.e., event MELT). Identify all SAMAs that were pre-screened prior to the Phase I evaluation, and the bases for their dispositioning.

b. In Table E.5-2, it is indicated that event GADF-PALL6-CP2FS (common cause failure of the emergency diesel generator standby pump) is addressed by a similar event in the Level 1 importance list. However, no event by this name is in the Level 1 importance list. Clarify this discrepancy. Explain if this event is mitigated by existing Phase II SAMAs 2 and 11. If not, identify a SAMA to mitigate this event and provide an associated cost-benefit analysis.

6. Provide the following with regard to the Phase II cost-benefit evaluations:

a. Section E.6 provides various references regarding implementation costs, including cost estimates from other SAMA evaluations. However, for most SAMAs an explanation for the cost estimate is not provided, nor are sufficient details describing the modification. Provide additional details regarding the cost estimates and modification details for Phase II SAMAs 1, 2, 3, 5, 6, 10, 11, 14, 15, 20, 21, 26, 27, 28, 29, 31, 32, and 33.

b. The cost estimates for SAMA 13 ($950K), SAMA 16 ($1.1M), and SAMA 17 ($950K) seem high for what appear to be just logic changes. Provide additional justification for these cost estimates.

c. In assessing the benefits for seismic-related SAMAs (SAMAs 27, 28, 29, 30, and 31), AmerGen assumed that the MACR for external events is equal to that for internal events, and applied a multiplier of 0.786 (the ratio of seismic CDF to total external event CDF, excluding external flooding) to estimate the maximum benefit associated with seismic events. However, the CDF for seismic events is 3.5 times the internal events CDF. Thus, the maximum benefit associated with seismic events would more appropriately be based on a multiplier of 3.5 rather than 0.786. Provide a revised cost-benefit evaluation for these SAMAs using a multiplier of 3.5 or the more realistic multiplier developed in response to RAI 3f.

d. A key assumption in the analysis of SAMAs 27 and 28 was that the improvements would result in failure probabilities similar to that assumed for the borated water storage tank (BWST), which has a high confidence in low probability of failure (HCLPF) capacity of 0.3g. Provide additional justification for this assumption.

e. Based on the Fussell-Vesely values reported in Section E.5.1.6.2.2, offsite power insulator failure contributes about 12 percent of the seismic CDF. SAMA 2, which would allow the plant to operate without AC power for extended periods of time, is proposed as a potentially cost-effective means of addressing this issue. However,

the cost-benefit analysis for SAMA 2 does not account for additional benefits of this SAMA in seismic events. Provide a revised cost-benefit analysis for SAMA 2 that accounts for additional benefits in seismic events.

f. The baseline cost-benefit analysis and sensitivity analyses assume that manual refill of the BWST will prevent core damage in SGTR events, an assumption that AmerGen indicates has recently been called into question. The sensitivity analysis in Section E.7.2 shows that SAMA 10, automated BWST refill, is potentially cost-beneficial if it is assumed that manual BWST refill is not effective at preventing core damage. Identify any other SAMAs that may be cost-beneficial assuming manual BWST refill does not prevent core damage, for both the baseline and sensitivity analyses.

g. Provide additional detail on how SAMA 10 mitigates the fundamental issue that the BWST cannot be refilled at a rate that will completely make up the inventory lost through tube rupture (i.e., the SAMA may only delay, not prevent, core damage).

h. Describe AmerGen's plans for resolution of the technical concern that manual refill of the BWST does not prevent core damage, and plans for further evaluation or implementation of SAMA 10.

i. The estimated benefit of SAMA 10 only accounted for mitigating SGTR events. Provide an assessment of the potential additional benefit of mitigating interfacing system LOCA events in addition to SGTR events, and the impact on the net value of this SAMA.

j. SAMA 2 identifies the need for a portable 480V generator to support turbine-driven emergency feedwater operation during a station blackout (SBO) event based on the need for steam generator level instrumentation. Table A.4-3 of the B.5.b Phase 2 and 3 Mitigation Strategies identifies three potential steam generator level control options, including local steam generator level control. Discuss how the B.5.b enhancements relate to this SAMA, and impact the estimated cost and benefit for the SAMA.

k. Section E.4 provides the calculated results for each of the cost-risk elements used to develop the internal and external flooding events MACRs. Provide the revised results for each of these cost-risk elements that reflects the SECPOP2000 corrections.

l. The benefit analysis for SAMA 1 assumes that modifications to automate start of the SBO emergency diesel generator (EDG) only reduces the probability of failure to start the SBO EDG by a factor of 10 (from 2.66E-02 to 2.66E-03). The new probability of failure of 2.66E-03 seems high for a function that is automated (e.g., SAMAs 10 and 13 assume a reduction in human error probability of greater than a factor of 100 for automating BWST refill and reloading instrument air compressors). Provide justification for the use of the factor of 10 reduction. In addition, provide an assessment of the impact on results if the human error probability were reduced by a factor of 100.

7. AmerGen's cost-benefit analysis showed that eight of the SAMA candidates (SAMAs 8, 11, 12, 16, 19, 27, 32, and 33) were potentially cost-beneficial in the baseline analysis and that an additional seven SAMAs (SAMAs 2, 7, 15, 21, 23, 24, and 26) were potentially cost-beneficial based on the results of the sensitivity analysis. AmerGen stated that all 15 of these potentially cost-beneficial SAMAs will be considered for implementation through the established TMI-1 work management processes. In view of the significant number of potentially cost-beneficial SAMAs, it is likely that several of these SAMAs address the same risk contributors. As such, implementation of an optimal subset of these SAMAs could achieve a large portion of the total risk reduction at a fraction of the cost, and render the remaining SAMAs no longer cost-beneficial. (An assessment of this type was described in Section E.7.5 but was limited to consideration of only one SAMA.) In this regard: identify those SAMAs that AmerGen considers highest priority for implementation, provide a revised cost-benefit analysis assuming these high priority SAMAs are implemented, and identify those SAMAs that would no longer be cost-beneficial given implementation of the high-priority SAMAs. Also, provide any specific plans/commitments regarding implementation of the high priority SAMAs.

Three Mile Island Nuclear Station,
Unit 1

cc:

Site Vice President - Three Mile Island
Nuclear Station, Unit 1
AmerGen Energy Company, LLC
P.O. Box 480
Middletown, PA 17057

Senior Vice President - Operations,
Mid-Atlantic
AmerGen Energy Company, LLC
200 Exelon Way, KSA 3-N
Kennett Square, PA 19348

Vice President - Licensing and Regulatory
Affairs
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Regional Administrator
Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Chairman
Board of County Commissioners
of Dauphin County
Dauphin County Courthouse
Harrisburg, PA 17120

Chairman
Board of Supervisors
of Londonderry Township
R.D. #1, Geyers Church Road
Middletown, PA 17057

Senior Resident Inspector (TMI-1)
U.S. Nuclear Regulatory Commission
P.O. Box 219
Middletown, PA 17057

Director - Licensing and Regulatory Affairs
AmerGen Energy Company, LLC
Correspondence Control
P.O. Box 160
Kennett Square, PA 19348
Director
Bureau of Radiation Protection
Pennsylvania Department of
Environmental Protection
Rachel Carson State Office Building
P.O. Box 8469
Harrisburg, PA 17105-8469

Plant Manager - Three Mile Island Nuclear
Station, Unit 1
AmerGen Energy Company, LLC
P.O. Box 480
Middletown, PA 17057

Regulatory Assurance Manager - Three
Mile Island Nuclear Station, Unit 1
AmerGen Energy Company, LLC
P.O. Box 480
Middletown, PA 17057

Ronald Bellamy, Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

Ronnie Gardner, PMP
Manager, Site Operations and Corporate
Regulatory Affairs
AREVA NP Inc.
3315 Old Forest Road OF-16
Lynchburg, VA 24501

Dr. Judith Johnsrud
National Energy Committee
Sierra Club
433 Orlando Avenue
State College, PA 16803

Eric Epstein
TMI Alert
4100 Hillsdale Road
Harrisburg, PA 17112

cc:

I
Correspondence Control Desk
AmerGen Energy Company, LLC
200 Exelon Way, KSA 1-N-1
Kennett Square, PA 19348

Manager Licensing - Three Mile Island Nuclear Station, Unit 1
Exelon Generation Company, LLC
Correspondence Control
P.O. Box 160
Kennett Square, PA 19348

Christopher M. Crane
President and Chief Executive Officer
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Mr. Charles G. Pardee
Chief Nuclear Officer
AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

Associate General Counsel
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Chief Operating Officer (COO)
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Senior Vice President - Operations Support
AmerGen Energy Company, LLC
4300 Winfield Road
Warrenville, IL 60555

Frederick W. Polaski
Manager License Renewal
Exelon Nuclear
200 Exelon Way
Kennett Square, PA 19348

Albert A. Fulvio, Senior Project Manager
License Renewal
Exelon Nuclear
200 Exelon Way
Kennett Square, PA 19348

Rich Janati, Chief
Division of Nuclear Safety
Bureau of Radiation Protection
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
P.O. Box 8469
Harrisburg, PA 17105-8469

Michael Murphy
Bureau of Radiation Protection
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
P.O. Box 8469
Harrisburg, PA 17105-8469

Michael G. Brownell, Chief
Water Resources Management
Susquehanna River Basin Commission
1721 N. Front Street
Harrisburg, PA 17102

Rachel Diamond, Regional Director
Southcentral Regional Office
Pennsylvania Department of Environmental Protection
909 Elmerton Avenue
Harrisburg, PA 17110

cc:

Nancy Ranek
Environmental Lead, License Renewal
Exelon Nuclear
200 Exelon Way, KSA/2-E
Kennett Square, PA 19348

Christopher Wilson
KSQ License Renewal
Exelon Nuclear
200 Exelon Way, KSA/2-E
Kennett Square, PA 19348