## Appendix A

# NRC NEPA Issues for License Renewal of Nuclear Power Plants

*Oyster Creek Generating Station Environmental Report*

AmerGen has prepared this environmental report in accordance with the requirements of U.S. Nuclear Regulatory Commission (NRC) regulation 10 CFR 51.53. NRC included in the regulation a list of National Environmental Policy Act (NEPA) issues for license renewal of nuclear power plants.

Table A-1 lists these 92 issues and identifies the section in which AmerGen addressed each applicable issue in this environmental report. For organization and clarity, AmerGen has assigned a number to each issue and uses the issue numbers throughout the environmental report.

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**Table A-1. OCGS Environmental Report Discussion of License Renewal NEPA Issues[a]**

| Issue | | Category | Section of this Environmental Report | GEIS Cross Reference[b] (Section/Page) |
|---|---|---|---|---|
| | **Surface Water Quality, Hydrology, and Use (for all plants)** | | | |
| 1. | Impacts of refurbishment on surface water quality | 1 | NA | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 2. | Impacts of refurbishment on surface water use | 1 | NA | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 3. | Altered current patterns at intake and discharge structures | 1 | 4 Introduction | 4.2.1.2.1/4-5 |
| 4. | Altered salinity gradients | 1 | 4 Introduction | 4.2.1.2.2/4-4 |
| 5. | Altered thermal stratification of lakes | 1 | NA | Issue applies to a plant feature, discharge to a lake, that OCGS does not have. |
| 6. | Temperature effects on sediment transport capacity | 1 | 4 Introduction | 4.2.1.2.3/4-8 |
| 7. | Scouring caused by discharged cooling water | 1 | 4 Introduction | 4.2.1.2.3/4-6 |
| 8. | Eutrophication | 1 | 4 Introduction | 4.2.1.2.3/4-9 |
| 9. | Discharge of chlorine or other biocides | 1 | 4 Introduction | 4.2.1.2.4/4-10 |
| 10. | Discharge of sanitary wastes and minor chemical spills | 1 | 4 Introduction | 4.2.1.2.4/4-10 |
| 11. | Discharge of other metals in waste water | 1 | 4 Introduction | 4.2.1.2.4/4-10 |
| 12. | Water use conflicts (plants with once-through cooling systems) | 1 | 4 Introduction | 4.2.1.3/4-13 |
| 13. | Water use conflicts (plants with cooling ponds or cooling towers using make-up water from a small river with low flow) | 2 | NA, and discussed in Section 4.1 | Issue applies to a plant feature, cooling ponds or cooling towers, that OCGS does not have. |
| | **Aquatic Ecology (for all plants)** | | | |
| 14. | Refurbishment impacts to aquatic resources | 1 | NA | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 15. | Accumulation of contaminants in sediments or biota | 1 | 4 Introduction | 4.2.1.2.4/4-10 |
| 16. | Entrainment of phytoplankton and zooplankton | 1 | 4 Introduction | 4.2.2.1.1/4-15 |
| 17. | Cold shock | 1 | 4 Introduction | 4.2.2.1.5/4-18 |
| 18. | Thermal plume barrier to migrating fish | 1 | 4 Introduction | 4.2.2.1.6/4-19 |
| 19. | Distribution of aquatic organisms | 1 | 4 Introduction | 4.2.2.1.6/4-19 |

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Table A-1. OCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)

| Issue | Category | Section of this Environmental Report | GEIS Cross Reference[b] (Section/Page) |
|---|---|---|---|
| 20. Premature emergence of aquatic insects | 1 | 4 Introduction | 4.2.2.1.7/4-20 |
| 21. Gas supersaturation (gas bubble disease) | 1 | 4 Introduction | 4.2.2.1.8/4-21 |
| 22. Low dissolved oxygen in the discharge | 1 | 4 Introduction | 4.2.2.1.9/4-23 |
| 23. Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses | 1 | 4 Introduction | 4.2.2.1.10/4-24 |
| 24. Stimulation of nuisance organisms (e.g., shipworms) | 1 | 4 Introduction | 4.2.2.1.11/4-25 |
| **Aquatic Ecology (for plants with once-through and cooling pond heat dissipation systems)** | | | |
| 25. Entrainment of fish and shellfish in early life stages for plants with once-through and cooling pond heat dissipation systems | 2 | 4.2 | 4.2.2.1.2/4-16 |
| 26. Impingement of fish and shellfish for plants with once-through and cooling pond heat dissipation systems | 2 | 4.3 | 4.2.2.1.3/4-16 |
| 27. Heat shock for plants with once-through and cooling pond heat dissipation systems | 2 | 4.4 | 4.2.2.1.4/4-17 |
| **Aquatic Ecology (for plants with cooling-tower-based heat dissipation systems)** | | | |
| 28. Entrainment of fish and shellfish in early life stages for plants with cooling-tower-based heat dissipation systems | 1 | NA | Issue applies to a heat dissipation system, cooling towers, that OCGS does not have. |
| 29. Impingement of fish and shellfish for plants with cooling-tower-based heat dissipation systems | 1 | NA | Issue applies to a heat dissipation system, cooling towers, that OCGS does not have. |
| 30. Heat shock for plants with cooling-tower-based heat dissipation systems | 1 | NA | Issue applies to a heat dissipation system, cooling towers, that OCGS does not have. |
| **Groundwater Use and Quality** | | | |
| 31. Impacts of refurbishment on groundwater use and quality | 1 | NA | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 32. Groundwater use conflicts (potable and service water; plants that use < 100 gpm) | 1 | 4 Introduction | 4.8.1.1/4-116 and 4.8.2.1/4-119 |

**Table A-1. OCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)**

| Issue | Category | Section of this Environmental Report | GEIS Cross Reference[b] (Section/Page) |
|---|---|---|---|
| 33. Groundwater use conflicts (potable, service water, and dewatering; plants that use > 100 gpm) | 2 | NA, and discussed in Section 4.5 | Issue applies to an activity, using 100 gpm or more of groundwater, that OCGS does not do. |
| 34. Groundwater use conflicts (plants using cooling towers withdrawing make-up water from a small river) | 2 | NA, and discussed in Section 4.6 | Issue applies to a plant feature, cooling towers, that OCGS does not have. |
| 35. Groundwater use conflicts (Ranney wells) | 2 | NA, and discussed in Section 4.7 | Issue applies to a plant feature, Ranney wells, that OCGS does not have. |
| 36. Groundwater quality degradation (Ranney wells) | 1 | NA | Issue applies to a feature, Ranney wells, that OCGS does not have. |
| 37. Groundwater quality degradation (saltwater intrusion) | 1 | 4 Introduction | 4.8.2/4-118 |
| 38. Groundwater quality degradation (cooling ponds in salt marshes) | 1 | NA | Issue applies to a feature, cooling ponds, that OCGS does not have. |
| 39. Groundwater quality degradation (cooling ponds at inland sites) | 2 | NA, and discussed in Section 4.8 | Issue applies to a feature, cooling ponds, that OCGS does not have. |
| **Terrestrial Resources** | | | |
| 40. Refurbishment impacts to terrestrial resources | 2 | NA, and discussed in Section 4.9 | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 41. Cooling tower impacts on crops and ornamental vegetation | 1 | NA | Issue applies to a feature, cooling towers, that OCGS does not have. |
| 42. Cooling tower impacts on native plants | 1 | NA | Issue applies to a feature, cooling towers, that OCGS does not have. |
| 43. Bird collisions with cooling towers | 1 | NA | Issue applies to a feature, cooling towers, that OCGS does not have. |
| 44. Cooling pond impacts on terrestrial resources | 1 | NA | Issue applies to a feature, cooling ponds, that OCGS does not have. |
| 45. Power line right-of-way management (cutting and herbicide application) | 1 | 4 Introduction | 4.5.6.1/4-71 |
| 46. Bird collisions with power lines | 1 | 4 Introduction | 4.5.6.2/4-74 |

**Table A-1. OCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)**

| Issue | Category | Section of this Environmental Report | GEIS Cross Reference[b] (Section/Page) |
|---|---|---|---|
| 47. Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock) | 1 | 4 Introduction | 4.5.6.34-77 |
| 48. Floodplains and wetlands on power line right-of-way | 1 | 4 Introduction | 4.5.7.7/4-81 |
| **Threatened or Endangered Species (for all plants)** | | | |
| 49. Threatened or endangered species | 2 | 4.10 | 4.1/4-1 |
| **Air Quality** | | | |
| 50. Air quality during refurbishment (non-attainment and maintenance areas) | 2 | NA, and discussed in Section 4.11 | Issue applies to an activity, refurbishment, that OCGS does not plan to undertake. |
| 51. Air quality effects of transmission lines | 1 | 4 Introduction | 4.5.2/4-62 |
| **Land Use** | | | |
| 52. Onsite land use | 1 | 4 Introduction | 3.2/3-1 |
| 53. Power line right-of-way land use impacts | 1 | 4 Introduction | 4.5.3/4-62 |
| **Human Health** | | | |
| 54. Radiation exposures to the public during refurbishment | 1 | NA | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 55. Occupational radiation exposures during refurbishment | 1 | NA | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 56. Microbiological organisms (occupational health) | 1 | 4 Introduction | 4.3.6/4-48 |
| 57. Microbiological organisms (public health) (plants using lakes or canals, or cooling towers or cooling ponds that discharge to a small river) | 2 | NA, and discussed in Section 4.12 | Issue applies to plant features, cooling lakes, canals or towers, that OCGS does not have. |
| 58. Noise | 1 | 4 Introduction | 4.3.7/4-49 |
| 59. Electromagnetic fields, acute effects | 2 | 4.13 | 4.5.4.1/4-66 |
| 60. Electromagnetic fields, chronic effects | NA | 4 Introduction | |
| 61. Radiation exposures to public (license renewal term) | 1 | 4 Introduction | 4.6.2/4-87 |
| 62. Occupational radiation exposures (license renewal term) | 1 | 4 Introduction | 4.6.3/4-95 |

**Table A-1. OCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)**

| Issue | Category | Section of this Environmental Report | GEIS Cross Reference[b] (Section/Page) |
|---|---|---|---|
| | | **Socioeconomics** | |
| 63. Housing impacts | 2 | 4.14 | 3.7.2/3-10 (refurbishment - not applicable to OCGS) 4.7.1/4-101 (renewable term) |
| 64. Public services: public safety, social services, and tourism and recreation | 1 | 4 Introduction | Refurbishment (not applicable to OCGS because issue applies to an activity that OCGS does not plan to undertake)<br>Renewal Term<br>4.7.3/4-104 (public safety)<br>4.7.3.3/4-106 (safety)<br>4.7.3.44-107 (social)<br>4.7.3.6/4-107 (tour, rec) |
| 65. Public services: public utilities | 2 | 4.15 | 3.7.4.5/3-19 (refurbishment - not applicable to OCGS) 4.7.3.5/4-107 (renewable term) |
| 66. Public services: education (refurbishment) | 2 | NA, and discussed in Section 4.16 | Issue applies to an activity, refurbishment, that OCGS does not plan to undertake. |
| 67. Public services: education (license renewal term) | 1 | 4 Introduction | 4.7.3.1/4-106 |
| 68. Offsite land use (refurbishment) | 2 | NA, and discussed in Section 4.17.1 | Issue applies to an activity, refurbishment, that OCGS does not plan to undertake. |
| 69. Offsite land use (license renewal term) | 2 | 4.17.2 | 4.7.4/4-107 |
| 70. Public services: transportation | 2 | 4.18 | 3.7.4.2/3-17 (refurbishment - not applicable to OCGS) 4.7.3.2/4-106 (renewal term) |
| 71. Historic and archaeological resources | 2 | 4.19 | 3.7.7/3-23 (refurbishment - not applicable to OCGS) 4.7.7/4-114 (renewal term) |
| 72. Aesthetic impacts (refurbishment) | 1 | NA | Issue applies to an activity, refurbishment, that OCGS has no plans to undertake. |
| 73. Aesthetic impacts (license renewal term) | 1 | 4 Introduction | 4.7.6/4-111 |
| 74. Aesthetic impacts of transmission lines (license renewal term) | 1 | 4 Introduction | 4.5.8/4-83 |

**Table A-1. OCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)**

| Issue | Category | Section of this Environmental Report | GEIS Cross Reference[b] (Section/Page) |
|---|---|---|---|
| **Postulated Accidents** | | | |
| 75. Design basis accidents | 1 | 4 Introduction | 5.3.2/5-11 (design basis)<br>5.5.1/5-114 (summary) |
| 76. Severe accidents | 2 | 4.20 | 5.3.3/5-12 (probabilistic analysis)<br>5.3.3.2/5-19 (air dose)<br>5.3.3.3/5-49 (water)<br>5.3.3.4/5-65 (groundwater)<br>5.3.3.5/5-95 (economic)<br>5.4/5-106 (mitigation)<br>5.5.2/5-114 (summary) |
| **Uranium Fuel Cycle and Waste Management** | | | |
| 77. Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste) | 1 | 4 Introduction | 6.2/6-8 |
| 78. Offsite radiological impacts (collective effects) | 1 | 4 Introduction | Not in GEIS. |
| 79. Offsite radiological impacts (spent fuel and high-level waste disposal) | 1 | 4 Introduction | Not in GEIS. |
| 80. Nonradiological impacts of the uranium fuel cycle | 1 | 4 Introduction | 6.2.2.6/6-20 (land use)<br>6.2.2.7/6-20 (water use)<br>6.2.2.8/6-21 (fossil fuel)<br>6.2.2.9/6-21 (chemical) |
| 81. Low-level waste storage and disposal | 1 | 4 Introduction | 6.4.2/6-36 (low-level def)<br>6.4.3/6-37 (low-level volume)<br>6.4.4/6-48 (renewal effects) |
| 82. Mixed waste storage and disposal | 1 | 4 Introduction | 6.4.5/6-63 |
| 83. Onsite spent fuel | 1 | 4 Introduction | 6.4.6/6-70 |
| 84. Nonradiological waste | 1 | 4 Introduction | 6.5/6-86 |
| 85. Transportation | 1 | 4 Introduction | 6.3/6-31, as revised by Addendum 1, August 1999. |
| **Decommissioning** | | | |
| 86. Radiation doses (decommissioning) | 1 | 4 Introduction | 7.3.1/7-15 |
| 87. Waste management (decommissioning) | 1 | 4 Introduction | 7.3.2/7-19 (impacts)<br>7.4/7-25 (conclusions) |
| 88. Air quality (decommissioning) | 1 | 4 Introduction | 7.3.3/7-21 (air)<br>7.4/7-25 (conclusions) |

**Table A-1. OCGS Environmental Report Discussion of License Renewal NEPA Issues[a] (Continued)**

| Issue | Category | Section of this Environmental Report | GEIS Cross Reference[b] (Section/Page) |
|---|---|---|---|
| 89. Water quality (decommissioning) | 1 | 4 Introduction | 7.3.4/7-21 (water)<br>7.4/7-25 (conclusions) |
| 90. Ecological resources (decommissioning) | 1 | 4 Introduction | 7.3.5/7-21 (ecological)<br>7.4/7-25 (conclusions) |
| 91. Socioeconomic impacts (decommissioning) | 1 | 4 Introduction | 7.3.7/7-19 (socioeconomic)<br>7.4/7-24 (conclusions) |
| **Environmental Justice** | | | |
| 92. Environmental justice | NA | 2.6.2 | |

a. Source: 10 CFR 51, Subpart A, Appendix A, Table B-1. (Issue numbers added to facilitate discussion.)
b. Source: Generic Environmental Impact Statement for License Renewal of Nuclear Plants (NUREG-1437).

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# Appendix B

# NJPDES Permit



This Appendix contains selected pages of Oyster Creek Generating Station's New Jersey Pollutant Discharge Elimination System permit, including the cover page, which authorizes the Plant to discharge wastewater to Oyster Creek, a part of the Barnegat Bay Estuarine system, and pages pertinent to the Chapter 4 discussions of entrainment, impingement, and heat shock.

PERMIT NUMBER NJ0005550

| Permittee | Co-Permittee |
|---|---|
| GPU NUCLEAR CORPORATION<br>ONE UPPER POND ROAD<br>PARSIPPANY NJ 07054 | |

| Property Owner | Location of Activity |
|---|---|
| JCP&L<br>MADISON AVE @ PUNCH BOWL ROAD<br>MORRISTOWN NJ 07960 | OYSTER CREEK NUCLEAR<br>GENERATING STATION<br>ROUTE 9 SOUTH<br>FORKED RIVER NJ 08731 |

| Current Authorization Covered By This Approval And Previous Authorization | | Issuance Date | Effective Date | Expiration Date |
|---|---|---|---|---|
| B | IND/COMMERCIAL SURFACE WATER | 10/21/1994 | 12/01/1994 | 11/30/1999 |
| C | THERMAL SURFACE WATER DISCH | 10/21/1994 | 12/01/1994 | 11/30/1999 |
| 05 | GROUP I - STORMWATER RUNOFF | 10/21/1994 | 12/01/1994 | 11/30/1999 |

DISCHARGE TO: Oyster Creek (001, 004, 005, 008) CLASSIFICATION: SE-1
Forked River (002, 007, 009, 012)
South Branch of Forked River (013, 014)

By Authority of:
COMMISSIONER'S OFFICE

Narinder K. Ahuja
DEP AUTHORIZATION
NARINDER K. AHUJA
ASSISTANT DIRECTOR
DIVISION OF WATER QUALITY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER QUALITY

## STANDARD CONDITIONS FOR ALL NJPDES/DSW PERMITS

The permittee shall comply with all the conditions set forth in this permit **and** all the applicable requirements relevant to the permittee's discharge(s) that can be found in the Federal Clean Water Act and the New Jersey Water Pollution Control Act (the State Act as amended), N.J.S.A. 58:10A-1 et seq. The permittee may be subject to penalties for any violations thereof.

The following conditions that are applicable to all NJPDES/DSW permits are incorporated by reference. The permittee is required to comply with the regulations which were in effect as of the effective date of the final permit.

| Section A. GENERAL CONDITIONS | | N.J.A.C. |
|---|---|---|
| 1. | Penalties for Violations | 7:14-8.1 et seq. |
| 2. | Consolidation of Permit Process | 7:14A-1.4 |
| 3. | Incorporation by Reference | 7:14A-1.10 |
| 4. | Duty to Comply | 7:14A-2.5(a) |
| 5. | Duty to Reapply | 7:14A-2.1(g)5 |
| 6. | Continuation of Expired Permits | 7:14A-2.3 |
| 7. | Duty to Mitigate | 7:14A-2.1(f) |
| 8. | Permit Actions | 7:14A-2.5(a)8 |
| 9. | Duration of Permits | 7:14A-2.7 |
| 10. | Effect of Permit-other Laws | 7:14A-2.10(a)(b) & (c) |
| 11. | Inspection and Entry | 7:14A-2.5(a)11 |
| 12. | Severability | 7:14A-1.5 |
| 13. | Toxic Pollutants | 7:14A-2.5(a)3 |
| 14. | Reopener Clause | 7:14A-3.13(a)5 |
| 15. | Treatment Works Approval | 7:14A-22 |

| Section B. OPERATION AND MAINTENANCE | | |
|---|---|---|
| 1. | Proper Operation and Maintenance | 7:14A-2.5(a)7 |
| 2. | Need to Halt or Reduce not a defense | 7:14A-2.5(a)5 |
| 3. | Bypass of Treatment Facilities | 7:14A-3.10 |
| 4. | Upset | 7:14A-3.10 |
| 5. | Power Failure | 7:14A-2.5(a)5&7 |
| 6. | Emergency Plans | 7:14A-3.12(b) |
| 7. | Capacity Assurance Program | 7:14A-22.16 |

| Section C. MONITORING AND RECORDS | | |
|---|---|---|
| 1. | Representative Sampling | 7:14A-2.5(a)12.i |
| 2. | Monitoring Procedures | 7:14A-2.5(a)12.ii |
| 3. | Retention of Records | 7:14A-2.5(a)12.iii |
| 4. | Monitoring Records | 7:14A-2.5(a)12.iv |
| 5. | Additional Voluntary Monitoring | 7:14A-2.5(a)12.vi |
| 6. | Averaging of Measurements | 7:14A-2.5(a)12.vii |
| 7. | Required Additional Monitoring | 7:14A-2.5(a)12.xi |

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Operation Restrictions

The operation of a waste treatment or disposal facility shall at no time create: **(a) a direct discharge to the surface waters of the State, except as authorized by the Department and into the receiving water(s) at the specified location(s) as referenced in the Part III of this permit;** (b) a persistent standing or ponded condition for water or waste on the permittee's property except as specifically authorized by this or another permit; or (c) any standing or ponded condition for water or waste on adjacent properties unless these activities are specifically included within this or another permit.

**This permit does not authorize or approve any activities other than the discharge(s) as referenced above.**

Monitoring and Reporting

A. Monitoring results shall be summarized and reported on the appropriate Discharge Monitoring Reports (DMRs) following the completed reporting period. If a discharge does not occur during a particular reporting period, the permittee should write "NODI" across the face of the DMR. Unless otherwise specified or directed, signed copies of these DMRs shall be submitted postmarked no later than the 25th day of the calendar month following the completed reporting period to the following address:

NJDEP
Bureau of Permits Management
CN 029
Trenton, New Jersey 08625-0029
Attn. Monitoring Reports

B. In addition, a duplicate signed copy of all other monitoring reports required from the permittee including the DMRs shall be submitted to the DRBC **(only for dischargers to the Delaware River Basin)**, and the ISC **(only for dischargers to the Interstate Sanitation Commission district)**, at the following addresses:

Delaware River Basin Commission
P.O. Box 7360
West Trenton, New Jersey 08628
Attn: Executive Director

Interstate Sanitation Commission
311 West 43rd Street
New York, New York 10036
Attn: Director/Chief Engineer.

Sampling Points

All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water or substance. Monitoring points shall not be changed without notification to and the approval of the Department.

Stormwater Only Discharges

Stormwater shall be sampled during the first precipitation event of the monitoring period which causes a discharge at the site during working hours, unless otherwise directed in the permit. Stormwater monitoring should not necessarily be conducted at 30-day intervals. Therefore, it is incorrect for the permittee to choose a sampling date which remains the same every month, and report "NODI" on the DMR if it does not rain on that particular day.

D. "NPDES Compliance Sampling Manual", U.S. Environmental Protection Agency, Office of Water Enforcement, Publication MCD-51, 1977, 140 pp. (Available from the General Services Administration (8FFS), Centralized Mailing Lists Services, Building 41, Denver Federal Center, Denver CO 80225.)

Oil and Grease Effluent Limitations

Oil & Grease and/or Petroleum Hydrocarbons samples shall be collected and analyzed in accordance with N.J.A.C. 7:14A-14.1 et seq.

## Section G. ADDITIONAL DEFINITIONS

*"Aliquot"* means an individual sample of specified volume used to make up a total composite sample.

*"Annual monitoring"* means monitoring conducted at a minimum frequency of once every calendar year, beginning with the Effective Date of the Permit unless there is a different period specified in the permit.

*"Col/100 mL"* means the coliform colonies per 100 milliliters.

*"Composite Sample"* means a combination of individual (or continuously taken) samples (aliquots) of at least 100 milliliters, collected at periodic intervals over a specified time period. The composite can be either time proportional or flow proportional; either the time interval between each aliquot or the volume of each aliquot should be proportional to either the flow at the time of sampling or the total flow since the collection of the previous aliquot. Aliquots may be collected manually or automatically. For intermittent discharges of less than four (4) hours duration, aliquots shall be taken at intervals not to exceed 15-minutes. For intermittent discharges of four (4) hours or more duration, aliquots shall be taken at intervals not to exceed 30-minutes.

*"Daily Monitoring"* means monitoring conducted every day, including weekends and holidays.

*"EDP"* means Effective Date of the Permit.

*"EDPM"* means Effective Date of the Permit Modification

*"g/day"* means grams per day

*"kg/d or kg/day"* means kilograms per day.

*"Maximum Value"* means the highest value measured during the monitoring period.

*"mg/L"* means milligrams per liter.

*"Minimum Value"* means the lowest value measured during the monitoring period.

*"Monthly Monitoring"* means monitoring conducted at a minimum of once every calendar month, beginning with the EDP unless there is a different period specified in the permit.

*"Multiple Grab Composite"* means a combination of individual samples (aliquots) collected at a specified frequency over a specified time period. Each aliquot must be collected in a glass vial with a septum cap and iced until delivered for analysis. An air space should remain in the vial. Each aliquot shall be analyzed individually. The recorded value will be the flow proportioned average of the individual analyses for the specific time period.

*"Quarterly Monitoring"* means monitoring conducted at a minimum frequency of once every three calendar months, beginning with the EDP unless there is a different period specified in the permit.

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ADDITIONAL STANDARD CONDITIONS FOR
ALL NJPDES/DSW PERMITS FOR INDUSTRIAL DISCHARGES

1. Permit Conditions Relating to Treatment Works

A Treatment Works Approval (TWA) Permit is required prior to the construction, operation, or modification of a treatment works pursuant to N.J.A.C. 7:14A-22.1 et seq. and the amendments thereto. Applications for a TWA Permit shall be submitted to the following address:

New Jersey Department of Environmental Protection
Division of Water Quality
Bureau of Construction and Connection Permits
CN-029, Trenton, New Jersey 08625-0029
Attn: Chief

The operation of the treatment works shall be under the supervision of a licensed operator with the appropriate operator's classification in accordance with the "Rules Governing the Examination and Licensing of Operators", N.J.A.C. 7:10-13.1 et seq., which became effective July 2, 1984. The licensed operator shall meet the requirements of the TWA Permit pursuant to the provisions of N.J.S.A. 58:11-64 and the amendments thereto.

2. Permit Conditions Relating to Industrial Residuals Management

A. Collected grit and screenings, scums, sand bed sands, slurries, and sludges, and all other solids from the treatment process shall be managed in such a manner as to prevent such materials form entering the ground and/or surface waters of the State except in accordance with the NJPDES permit. If for any reason such materials are placed in the water or on the lands where they may cause pollutants to enter the ground and/or surface waters of the State or for any other noncompliance which may endanger public health or the environment, the following information shall be reported to the Water and Hazardous Waste Enforcement Element and to the Bureau of Pretreatment and Residuals pursuant to the requirements as outlined under N.J.A.C. 7:14A-2.5(a)(14):

(i) Dates of occurrence;
(ii) A description of the non-complying discharge (nature and volume);
(iii) Cause of noncompliance;
(iv) Steps taken to reduce and eliminate the non-complying discharge; and
(v) Steps taken to prevent recurrence of the condition of noncompliance.

B. The permittee shall not be permitted to store sludge on-site beyond the capacity of the structural treatment and storage components of the treatment works nor shall the permittee be permitted to store residual on-site in any manner which is not in accordance with Solid Waste Management Rules, N.J.A.C. 7:26.

C. The permittee shall comply with the Sludge Quality Assurance Regulations, N.J.A.C. 7:14-4. Where quality information is required by these regulations, analyses must reflect the quality of the final sludge product which the permittee must remove.

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1.A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge main condenser non-contact cooling water from outfall serial number: DSN 001.

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples taken in compliance with the specified monitoring requirements shall be taken at the outfall of DSN 001 for thermal parameters, and in the main condenser discharge tunnel just east of the chlorine monitor shed prior to the outfall or at the outfall of DSN 001 for all other parameters, and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY [6] | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | Continuous | Calculated |
| Temperature-Intake °C(°F) | N/A | N/A | NL | Continuous | Grab |
| Temperature-Effluent °C(°F) [1] | N/A | NL | 41.1(106) | Continuous | Grab |
| Temperature-Effluent °C(°F) [2,3] | N/A | NL | 43.3(110) | Continuous | Grab |
| Temperature-Diff. °C(°F) [1] | N/A | NL | 12.8(23) | Daily | Calculated |
| Temperature-Diff. °C(°F) [2,3] | N/A | NL | 18.3(33) | Daily | Calculated |
| Heat Addition MBTU/hr [1] | N/A | NL | 5420 | Daily | Calculated |
| Heat Addition MBTU/hr [2,3] | N/A | NL | 5700 | Daily | Calculated |
| Chlorine-Total Residual mg/l(kg/d) [4] | N/A | NL | 0.2(41.7) | Daily | Grab |
| TBCCW HX- Chlorine, Total Residual, mg/l [7] | N/A | NL | 0.2 | Daily | Grab |
| pH, Intake S.U. | NL | N/A | NL | 2/Week | Grab |
| pH, Effluent S.U. | 6.5 [5] | N/A | 8.5 [5] | 2/Week | Grab |
| Intake Velocity, fps | NL | NL | 2.2 | See Part IV-B/C | |
| Acute Toxicity, LC50 % effluent | NL | N/A | N/A | Annually | See Part IV-B/C |

See footnotes on next page

1.A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS continued

[1] Applies when four (4) circulating pumps are operating for condenser cooling.

[2] Applies during periods of condenser backwash or during intake component maintenance. The NJPDES Regulations require the permittee to maintain its plant in good working order and efficient operation. Preventive or corrective maintenance of any plant intake component (e.g. circulating water pumps and appurtenant equipment, traveling screens and appurtenant equipment, intake ports, etc.) may, therefore, be required. This maintenance could restrict velocity and/or which could have an effect on any one or a combination of the following: 1) maximum discharge temperature, 2) delta temperature or $\Delta T$, and 3) heat addition.

[3] Applies during an Emergency Need for Power which is defined as a situation in which the Pennsylvania-New Jersey-Maryland Interconnection has notified Jersey Central Power & Light Company (JCP&L) that it is unlikely to meet its load demand although the system has attempted to satisfy the load requirement by operating available generation. In the event of such a situation JCP&L System Operations would contact Oyster Creek Nuclear Generating Station to assist in meeting the load demand and only after the following measures have been initiated: 1) all maximum emergency generation has been ordered to run; 2) all controllable load management curtailment orders have been issued; 3) a voltage reduction of 5% has been ordered; and 4) voluntary customer load curtailment has been issued. Within eight (8) hours of an Emergency Need for Power being declared the permittee must notify the Department by telephone declaring that the Station has invoked the use of the alternate thermal limits of the Permit. The Station must follow-up the telephone notification within five (5) working days with a written report setting forth the following fact in support of the declaration of an Emergency Need for Power: the time and date of the telephone notification to the Department, the time and date the Station actually invoked relief under this permit condition, and the time and date it terminated such relief.

[4] Total Residual Chlorine may not be discharged from any single generating unit for more than two hours in one day. Note: There is only one unit.

[5] The pH shall not be less than 6.5 Standard Units (S.U.) nor greater than 8.5 S.U.; or, during periods when the pH of the intake water is less than 6.5, the pH of the effluent shall not be less than that of the intake; or, during periods when the pH of the intake water is greater than 8.5, the pH shall not be greater than that of the intake.

[6] Monitoring of these parameters is not required when there is no flow and/or heat load across the Station's main condensers.

[7] Daily grab sample shall be taken for Total Residual Chlorine during periods of chlorination of the Turbine Building Closed Cooling Water Heat Exchanger.

1.B. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge heat exchanger non-contact cooling water from outfall serial number: DSN 002.

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples taken in compliance with the specified monitoring requirements shall be taken from the common header located on the 23 foot elevation of the New Radwaste Heat Exchanger Room prior to the outfall of DSN 002, and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | 2/month | Calculated |
| Temperature-Intake °C(°F) | N/A | N/A | NL | 2/month | Grab |
| Temperature-Effluent °C(°F) | N/A | NL | 45(113) | 2/month | Grab |
| Temperature-Diff. °C(°F) | N/A | NL | 18.3(33) | 2/month | Calculated |
| Heat Addition MBTU/hr | N/A | NL | 790 | 2/month | Calculated |
| Chlorine-Total Residual mg/l | N/A | NL | 0.2 | 2/month | Grab |
| pH, Intake S.U. | NL | N/A | NL | 2/week | Grab |
| pH, Effluent S.U. | 6.5[1] | N/A | 8.5[1] | 2/week | Grab |
| Acute Toxicity, LC50 % effluent | NL | N/A | N/A | Quarterly | See Part IV-B/C |
| Chronic Toxicity, NOEC % effluent | NL | N/A | N/A | Quarterly | See Part IV-B/C |

[1] The pH shall not be less than 6.5 Standard Units (S.U.) nor greater than 8.5 S.U.; or, during periods when the pH of the intake water is less than 6.5, the pH of the effluent shall not be less than that of the intake; or, during periods when the pH of the intake water is greater than 8.5, the pH shall not be greater than that of the intake.

1.C. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge stormwater runoff, non-contact cooling water from reactor building and emergency service water heat exchangers, and discharge from the 1-5 sump from outfall serial number: DSN 004.

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples taken in compliance with the specified monitoring requirements shall be taken at the sample pipe located inside the fence near the terminus of the 30" header or at the outfall of DSN 004 (depending upon on-site conditions) and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY | SAMPLE TYPE |
| Effluent Flow, MGD | N/A | NL | NL | Monthly | Calculated |
| Heat Exchanger Flow, MGD | N/A | NL | NL | Monthly | Calculated |
| Net Flow, MGD [1] | N/A | NL | NL | Monthly | Calculated |
| Temperature-Effluent °C(°F) | N/A | NL | 37.2(99) | Monthly | Grab |
| Chlorine-Total Residual mg/l | N/A | NL | 0.2 | Monthly | Grab |
| Influent TSS, mg/l (kg/d) | N/A | NL(NL) | NL(NL) | Monthly | Grab |
| Effluent TSS, mg/l (kg/d) | N/A | NL(NL) | NL(NL) | Monthly | Grab |
| Net TSS, mg/l (kg/d) [1] | N/A | 30(NL) | 100(22.7) | Monthly | Calculated |
| Influent Petr. Hydrocarbons mg/l (kg/d) | N/A | NL(NL) | NL(NL) | Monthly | Grab |
| Effluent Petr. Hydrocarbons mg/l (kg/d) | N/A | NL(NL) | NL(NL) | Monthly | Grab |
| Net Petroleum Hydrocarbons mg/l (kg/d) [1] | N/A | 10(NL) | 15(4.54) | Monthly | Calculated |
| pH, Intake S.U. | NL | N/A | NL | Weekly | Grab |
| pH, Effluent S.U. | 6.0[2] | N/A | 9.0[2] | Weekly | Grab |
| TOC, mg/l | N/A | NL | 50 | Monthly | Grab |
| Acute Toxicity, LC50 % effluent | NL | N/A | N/A | Quarterly | See Part IV-B/C |
| Chronic Toxicity, NOEC % effluent | NL | N/A | N/A | Quarterly | See Part IV-B/C |

[1] Net Flow shall be used for the purposes of calculating ***loading values only***:
$Q_{net} = Q_{effluent} - Q_{heat\ exchanger}$
Concentration net values should be calculated as per the DMR Manual.

[2] The pH shall not be less than 6.0 Standard Units (S.U.) nor greater than 9.0 S.U.; or, during periods when the pH of the intake water is less than 6.0, the pH of the effluent shall not be less than that of the intake; or, during period when the pH of the intake water is greater than 9.0, the pH shall not be greater than that of the intake.

1.D. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge dilution pump discharge water from outfall serial number: DSN 005.

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples taken (calculated) in compliance with the specified monitoring requirements shall be reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | Continuous | Calculated |

The pH of the effluent shall not be less than 6.5 S.U. nor greater than 8.5 S.U.; or, during periods when the pH of the intake water is less than 6.5, the pH of the effluent shall not be less than that of the intake; or, during periods when the pH of the intake water is greater than 8.5, the pH shall not be greater than that of the intake. However, no monitoring or reporting is required.

1.E. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is not authorized to discharge from DSN 006.

This discharge has ceased. There shall be no discharge from this outfall.

All limitations and conditions for this outfall have been deleted.

1.F. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge dilution pump seal water from the oil/water separator from outfall serial number: DSN 007.

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples taken in compliance with the specified monitoring requirements shall be taken at the north side of the dilution pump structure at the outfall of DSN 007, and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY | SAMPLE TYPE |
| Flow, gpd | N/A | NL | NL | Monthly | Calculated |
| Petroleum Hydrocarbons, mg/l | N/A | 10 | 15 | Monthly | Grab |

The pH of the effluent shall not be less than 6.0 S.U. nor greater than 9.0 S.U.; or, during periods when the pH of the intake water is less than 6.0, the pH of the effluent shall not be less than that of the intake; or, during periods when the pH of the intake water is greater than 9.0, the pH shall not be greater than that of the intake. However, no monitoring or reporting is required.

1.G. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge screen and strainer washwater discharge from outfall serial number: DSN 008.

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples taken in compliance with the specified monitoring requirements shall be taken at the outfall of DSN 008 and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | Monthly | Calculated |

The pH of the effluent shall not be less than 6.5 S.U. nor greater than 8.5 S.U.; or, during periods when the pH of the intake water is less than 6.5, the pH of the effluent shall not be less than that of the intake; or, during periods when the pH of the intake water is greater than 8.5, the pH shall not be greater than that of the intake. However, no monitoring or reporting is required.

1.H. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge effluent from the fish sampling pool from outfall serial number: DSN 009.

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples taken in compliance with the specified monitoring requirements shall be taken at the outfall of DSN 009 and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | Monthly | Calculated |

The pH of the effluent shall not be less than 6.5 S.U. nor greater than 8.5 S.U.; or, during periods when the pH of the intake water is less than 6.5, the pH of the effluent shall not be less than that of the intake; or, during periods when the pH of the intake water is greater than 8.5, the pH shall not be greater than that of the intake. However, no monitoring or reporting is required.

1.I. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is not authorized to discharge from DSN 010.

This discharge has ceased. There shall be no discharge from this outfall.

All limitations and conditions for this outfall have been deleted.

1.J. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge stormwater from the oil/water separator associated with the Combustion Turbine Facility, demineralizer water system drains, and other treated stormwater from outfall serial number: DSN 012 (former Forked River DSN 012).

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples shall be taken during the first precipitation event of the month which causes a discharge during working hours unless otherwise noted.

Samples taken in compliance with the specified monitoring requirements shall be taken at the outfall of DSN 012 and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY [1] | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | Monthly | Calculated |
| pH, S.U. | 6.0 | N/A | 9.0 | Monthly | Grab |
| COD, mg/l | N/A | NL | 100 | Monthly | Grab |
| TSS, mg/l | N/A | NL | 50 | Monthly | Grab |
| Petroleum Hydrocarbons, mg/l | N/A | NL | 15 | Monthly | Grab |

[1] Samples shall be taken during the first precipitation event of the month which causes a discharge during working hours and which is preceded by a minimum dry period of 72 hours.

1.K. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge stormwater from outfall serial number: DSN 013 (former Forked River DSN 004).

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples shall be taken during the first precipitation event of the month which causes a discharge during working hours unless otherwise noted.

Samples taken in compliance with the specified monitoring requirements shall be taken at the outfall of DSN 013 and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY [1] | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | Monthly | Calculated |
| pH, S.U. | 6.0 | N/A | 9.0 | Monthly | Grab |
| COD, mg/l | N/A | NL | 100 | Monthly | Grab |
| TSS, mg/l | N/A | NL | 50 | Monthly | Grab |
| Petroleum Hydrocarbons, mg/l | N/A | NL | 15 | Monthly | Grab |

[1] Samples shall be taken during the first precipitation event of the month which causes a discharge during working hours and which is preceded by a minimum dry period of 72 hours.

1.L. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

During the period beginning EDP and lasting through EDP + five (5) years, the permittee is authorized to discharge stormwater from outfall serial number: DSN 014 (former Forked River DSN 007).

There shall be no discharge of floating solids or visible foam in other than trace amounts. There shall be no visible sheen. There shall be no discharge of Polychlorinated Biphenyl Compounds (PCBs).

The abbreviation "N/A" in the table below denotes "Not Applicable" while the abbreviation "NL" denotes "Not Limited" with both monitoring and reporting required.

Samples shall be taken during the first precipitation event of the month which causes a discharge during working hours unless otherwise noted.

Samples taken in compliance with the specified monitoring requirements shall be taken at the outfall of DSN 014 and reported monthly.

| PARAMETER | DISCHARGE LIMITATIONS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| | DAILY MIN | MONTHLY AVG | DAILY MAX | FREQUENCY[1] | SAMPLE TYPE |
| Flow, MGD | N/A | NL | NL | Monthly | Calculated |
| pH, S.U. | 6.0 | N/A | 9.0 | Monthly | Grab |
| COD, mg/l | N/A | NL | 100 | Monthly | Grab |
| TSS, mg/l | N/A | NL | 50 | Monthly | Grab |
| Petroleum Hydrocarbons, mg/l | N/A | NL | 15 | Monthly | Grab |

[1] Samples shall be taken during the first precipitation event of the month which causes a discharge during working hours and which is preceded by a minimum dry period of 72 hours.

2. TOXIC POLLUTANT REOPENER CLAUSE

Pursuant to N.J.A.C. 7:14A-3.13(a)(3)(iv), the Department may modify or revoke and reissue any permit to incorporate limitations or requirements to control the discharge of toxic pollutants, including whole effluent, chronic and acute toxicity requirements, chemical specific limitations or toxicity reduction requirements, as applicable.

3. USE OF BIOCIDES OR OTHER COOLING WATER ADDITIVES

The permittee uses the following corrosion inhibitors, biocides, or other cooling water additives in its cooling water at the time of permit issuance:

DSN 001: Sodium hypochlorite is used in the main condenser and the Turbine Building Closed Cooling Water Heat Exchanger to control macroinvertebrate fouling.

DSN 002: Chlorine gas is used in the treatment of cooling water for both the new radwaste system heat exchangers and augmented off-gas heat exchanger cooling water.

DSN 004: Sodium hypochlorite is used in the Reactor Building Closed Cooling Water Heat Exchanger and the Emergency Service Water Heat Exchanger cooling water.

If the permittee decides to begin using or change any of these agents in the future, the permittee must notify the Department at least 180 days prior to use so that the permit may be reopened to incorporate any additional limitations deemed necessary.

4. MODIFICATION OF MONITORING REQUIREMENTS

The permittee may request a modification of their permit to decrease monitoring frequencies for limited parameters if site specific conditions indicate applicability of such a modification. The Department will consider reducing the monitoring frequency of a limited parameter provided that:

1) ELGs applicable to the facility do not specify the required monitoring frequency;
2) the frequency reduction conditions are included in the public notice of the draft permit.
3) the permittee has shown consistent compliance with all permit conditions for the affected parameter(s) for:

a) a minimum period of one (1) year for a monitoring frequency of weekly;
b) a minimum period of two (2) years for a monitoring frequency of twice per month;
c) a minimum period of three (3) years for a monitoring frequency of monthly;
d) a minimum period of five (5) years for a monitoring frequency of quarterly; and
e) a minimum period of four tests for Whole Effluent Toxicity (WET) limitations;

4) A monitoring frequency can be reduced as follows:
a) from weekly to monthly;
b) from twice monthly to monthly;
c) from monthly to quarterly; or
d) from quarterly to semi-annually or annually.

5) For WET limitations, monitoring frequencies can be reduced as follows:
a) a minimum of twice per year for major dischargers; and
b) a minimum of annually for minor dischargers.

Reduction of monitoring frequency is not automatic; the Department shall determine whether or not a reduction is warranted. The Discharge Monitoring Reports (DMRs) shall be reviewed to verify consistent compliance with permit limitations and conditions for the affected parameter(s). If the Department agrees to grant the request, the Department will perform a conditional change to the permit to change the monitoring frequency of the affected parameters.

The monitoring frequency for the affected parameters cannot be reduced below annual frequency, in accordance with N.J.A.C. 7:14A-3.13.

ADDITIONAL REQUIREMENTS OF THIS PERMIT

1. TOXICITY TESTING REQUIREMENTS

The permittee shall conduct Acute and Chronic toxicity tests on its wastewater discharge DSN 001, DSN 002 and DSN 004 in accordance with the provisions in this section. Such testing will determine if appropriately selected effluent concentrations adversely affect the test species.

A. Acute Toxicity Testing Requirements

Acute toxicity tests shall be conducted using the Mysid (*Mysidopsis bahia*), 96 hr test. Any test that does not meet the specifications of N.J.A.C. 7:18-6, the laboratory certification regulations, must be repeated as soon as practicable within the monitoring period.

B. Chronic Toxicity Testing Requirements

1. Chronic toxicity testing shall consist of concurrent chronic toxicity tests, with two species on a split effluent sample. Chronic toxicity tests shall be conducted using the Sheepshead minnow (Cyprinodon variegatus), 7 day larval survival and growth test or Inland Silverside (Menidia beryllina), 7 day larval survival and growth test, and Mysid (Mysidopsis bahia) 7 day survival, growth and fecundity test. This chronic toxicity characterization study will be considered complete when four sets of acceptable concurrent tests, using split samples on the two species, have been completed and these data have been deemed sufficient to designate a more sensitive species for the discharge. If these data are deemed insufficient, testing shall continue with two species until such designation is possible. If any test does not meet the specifications contained in the Department's "Interim Chronic Toxicity Testing Methodologies For Use In The NJPDES Permit Program" document, that set of concurrent split sample tests must be repeated as soon as practicable within the monitoring period.

2. Test results shall be expressed as both the NOEC (No Observable Effect Concentration), the LOEC (Lowest Observable Effect Concentration), and the IC25 for each test endpoint. Where a chronic toxicity testing methodology yields NOECs/IC25s from more than one test endpoint, the most sensitive endpoint will be used to determine permit compliance.

C. The monitoring frequency for acute/chronic toxicity shall be one test every permit quarter. The first test shall be conducted no later than EDP + 3 months.

D. Reporting Requirements

1. The information specified below shall be submitted, to the address in paragraph D.1.b., within EDP + two months. This information must also be resubmitted within two months of a change of contract laboratory.

   a. A fully completed "Methodology Questionnaire for Acute Toxicity Tests," form and a completed "Methodology Questionnaire for Chronic Toxicity Tests," which includes an identification of the toxicity testing laboratory responsible for the testing. Copies of these forms are provided to certified laboratories, and may also be obtained by contacting the address below.

   b. Acute and Chronic toxicity test results shall be reported on the "NJPDES Biomonitoring Report Form - Acute Bioassays," and the "NJPDES Biomonitoring Report Form - Chronic Toxicity Tests", copies of which are provided to certified laboratories. Copies of these report forms may also be obtained by contacting the address below. TWO COPIES of each completed report form shall be submitted within 60 days of test completion to:

      Division of Water Quality, Bureau of Standard Permitting
      CN-029
      Trenton, New Jersey 08625
      Attention: Industrial Biomonitoring Program

   c. The test results shall also be reported on the permittee's Discharge Monitoring Report (DMR) for the monitoring period during which the test was conducted.

2. **EFFLUENT CHARACTERIZATION STUDY**

An Effluent Characterization Study is required for the monitoring locations and pollutants listed below as these pollutants have the potential to be present due to the nature of the facility and/or materials used. Based on all available information, there is insufficient data to substantiate whether or not certain pollutants are present in the discharge and at what levels. The results of the Effluent Characterization Study will be used to make a determination on whether to impose numerical limitations on these pollutants.

A. **Monitoring Locations, Pollutants, and Sample Types**

The permittee shall sample outfall DSNs 001, 002, 004, and the 1-5 Sump prior to combining with other wastewaters discharged through DSN 004.

DSN 001 shall be analyzed for the following parameters:

Total Organic Carbon (TOC)
Total Suspended Solids (TSS)
Petroleum Hydrocarbons
Beryllium
Cadmium
Chromium
Copper
Nickel
Silver
Zinc

DSN 002 shall be analyzed for the following parameters:

Total Organic Carbon (TOC)
Total Suspended Solids (TSS)
Petroleum Hydrocarbons
Beryllium
Cadmium
Chromium
Copper
Nickel
Silver
Zinc
Di-N-Butyl Phthalate

DSN 004 shall be analyzed for the following parameters:

Beryllium
Cadmium
Chromium
Copper
Nickel
Silver
Zinc
Di-N-Butyl Phthalate

The 1-5 Sump shall be analyzed for the following parameters:

Total Organic Carbon (TOC)
Total Suspended Solids (TSS)
Petroleum Hydrocarbons
pH
Appendix I Metals and Cyanide;

Appendix I Base/Neutral Compounds;
Appendix I Acid Compounds;
Appendix I Volatile Compounds;

All samples shall be grab samples.

Monitoring for each location is required in accordance with N.J.A.C. 7:14A-3.14. All data collected from the Study shall be in accordance with Part IV-B/C(2)(C), Recommended Quantitation Levels.

**B. Compliance Dates and Sampling Frequency**

The Effluent Characterization Study shall be performed between EDP and EDP + 4 years. A total of 12 samples for each of the parameters listed above shall be collected over the Study time period. Ideally, samples should be collected on a quarterly basis. However, due to facility discharge variables, samples may be taken more or less frequently than quarterly, as long as a total of 12 samples are collected and the time period between samples is no less than 1 month and no greater than 6 months.

The permittee shall submit to the Department an Effluent Characterization Study Report summarizing the data collected by outfall/sampling point for each parameter. The permittee shall submit copies of all laboratory data sheets attached to the summary report. The final report shall be submitted within 180 days prior to permit expiration.

**C. Recommended Quantitation Levels**

The Department, in order to ensure useful data to characterize the permittee's wastewaters, has developed the Recommended Quantitation Levels (RQLs) in Appendix I of this Part. The Department has determined that the quantitation levels listed therein can be reliably achieved by most State certified laboratories for the listed pollutants using the appropriate procedures specified in 40 CFR 136.

Effluent Characterization data are considered adequate where the detection levels achieved are at least as sensitive as the RQLs in Appendix I. The quantitation levels listed in Appendix I are to be used by the permittee and its contract laboratory as a guideline of the quantitation levels the Department will accept without additional explanation and/or review. Less sensitive levels may be acceptable, but will require a detailed explanation on the part of the permittee and/or contract laboratory and a more detailed review on the part of the Department. Where no RQL is furnished (N/A), the RQL shall be five times the value achieved by the laboratory.

If the permittee or laboratory believes or determines that the detection levels achieved for any pollutant or pollutants generally will not be as sensitive as those specified in Appendix I, a justification for a less sensitive detection level is required to be submitted to the Department. Pollutants that are detected but not quantified must be reported as such.

**D. Deletion of Parameters from the Study**

If a parameter is shown to be consistently less than the recommended quantitation level (<RQL and/or "not detectable" -see Part IV-B/C(2)(C)) utilizing an approved methodology and detection level, in a minimum of four consecutive analyses, the monitoring for that parameter may be discontinued from the Study. Additionally, for once-through cooling water only, a sample may count as non-detect towards discontinuance from the Effluent Characterization Study only if the parameter is detected in the influent and is either non-detect in the effluent or detected in the effluent at the same level as or less than the influent.

If a parameter is detected in one out of the first five sets of samples in the same order of magnitude as the RQL, and the permittee has reason to believe that the detection is "unwarranted" the permittee may submit a request in writing to the Department to request deletion of the parameter from the Study. However, this parameter should continue to be included in the Study until response is received from the Department.

For priority pollutant scans, if a single (or several) parameter(s) (except for pollutants of concern) is detected in one of the first four sets of samples of a particular scan, and the permittee has reason to believe that the detection(s) is "unwarranted", the scan should be continued as a part of the Study, and data for all parameters in the scan should continue to be submitted, even though other parameters were eligible for deletion from the Study. The permittee may submit a request for deletion of the entire scan from the Study, as above, but should continue to perform the scans until approval is received from the Department.

**E. Correspondence**

All submittals for the above studies shall be sent to:

Bureau of Standard Permitting
Division of Water Quality
CN-029
Trenton, NJ 08625-0029

3. DILUTION STUDY

A. To enable the Department to determine the need for Water Quality-Based Effluent Limitations in conjunction with the Chronic Toxicity Characterization Study, the permittee is required to perform a Dilution Study for outfall DSNs 001, 002, and 004.

B. The procedures for these studies must be in accordance with the Department's "Mixing Zone Implementation Policies for the Discharge of Toxic Substances Into Tidally Influenced Waters" (Part IV-B/C Appendix A).

A Dilution Study workplan shall be submitted within 180 days from the effective date of the permit EDP. The workplan must be approved by the Department prior to conducting the study.

C. The permittee shall commence field work during the first designated "critical period" which occurs at least ninety (90) days after approval by the Department of the Dilution Study Work Plan(s). If a critical period exists during the 90 days after approval from the Department, the permittee is not precluded from commencing the Study during that period. The "critical periods" shall be defined in the Dilution Study Work Plan and is that period which produces the minimal dilution.

D. The permittee shall submit to the Department a report of the results obtained from the Dilution Study within ninety (90) days of completion of the field work associated with the Dilution Study. The report shall be sent to the address in Section 2.E. above.

4. EFFLUENT TEMPERATURE EVALUATION STUDY

A. Except as provided in Part IV-B/C (4)(B) below, the permittee shall conduct an Effluent Temperature Evaluation Study (ETES) as described in Part IV-B/C(4)(C) below if any maximum daily temperature readings at the Route 9 Bridge monitoring location exceed the temperature monitoring action level of 97°F. The ETES is intended to determine what caused the exceedances and to identify mitigation measures for meeting the monitoring action level for effluent water temperature within Oyster Creek at the Route 9 Bridge.

B. When an exceedance occurs, the permittee shall:

(1) Evaluate whether the exceedance of the temperature monitoring action level at the Route 9 Bridge monitoring location occurred solely as a result of any, or a combination of the following factors:

(a) unusually high influent temperature, i.e., any influent temperature in excess of 85°F,

(b) Operation of the Dilution Pumps in accordance with Part IV-B/C(9),

(c) Dilution Pump operation during the Dilution Pump Optimization Studies, or

(d) Implementation of the alternate effluent limitations in accordance with Part III-B/C(1.A) of this permit

If the evaluation shows that any of the above factors caused the exceedance, the permittee need not conduct an ETES. However the permittee shall submit a report to the Department within ten (10) business days of the exceedance, which specifies the relationship of the exceedance to items(a) through (d) of Part IV-B/C(4)(B)(1) above. The report shall be submitted to the following address:

Bureau of Standard Permitting
Division of Water Quality
CN-029
Trenton, New Jersey 08625

C. When the temperature monitoring action level exceedance occurs and the cause cannot be attributed to the factors described in Part IV-B/C(4)(B)(1), then the permittee shall conduct an ETES in the following manner

(1) The permittee shall evaluate the relationship of the following factors to the exceedance of the temperature monitoring action level of 97°F: Circulating Water Pump operation, Dilution Pump operation, plant power levels, heat rejection, effluent temperature at DSN 001, temperature at the Route 9 Bridge monitoring location, and the temperature differential across the main condenser for the date of the exceedance of the temperature monitoring action level as well as relevant periods prior to and following the exceedance.

(2) A written report shall be prepared documenting the evaluation conducted in accordance with Part IV-B/C(4)(C)(1). The report shall include tabular and graphical presentation of daily maximum and average influent temperatures, effluent temperatures at DSN 001, Route 9 Bridge monitoring location temperatures, and the temperature differential across the main condenser. The report shall include an analysis and discussion of the cause of the exceedance and shall also include recommended mitigation measures.

(3) If mitigation measures are identified that can be implemented while maintaining compliance with all other permit conditions, then the permittee is not required to obtain Department approval prior to implementation. Otherwise, Department approval will be required prior to implementation of mitigation measures or modification of the permit.

(4) Two copies of all written submissions required above shall be sent to:

Bureau of Standard Permitting
Division of Water Quality
CN-029
Trenton, New Jersey 08625-0029

5. **DILUTION PUMP OPTIMIZATION STUDIES**

A. The permittee shall:

(1) not later than EDP + six (6) months submit a Plan of Study to the Department for approval to identify the optimum operating schedule for the Station's dilution water system and corresponding temporal (i.e., months or other defined times) or other definite, reportable conditions (such as intake, discharge, and/or other temperatures); optimization shall be defined as minimization of the total loss of aquatic organisms due to impingement and entrainment at the Station at times when the risk of heat shock and/or cold shock fish kills is minimal;

(2) not later than three (3) months after receipt of the Department's approval of the Plan of Study, implement the Plan of Study as approved by the Department and any conditions therein;

(3) not later than twenty-one (21) months after the date of receipt of the Department's approval of the Plan of Study submit a Dilution Pump Optimization Study Report to the Department.

B. **Reopener**

The Department may modify or revoke and reissue this permit to incorporate limitations or conditions based on results of the Dilution Pump Optimization Study.

All correspondence and reports, in duplicate, shall be sent to:

Bureau of Standard Permitting
Division of Water Quality
CN-029
Trenton, New Jersey 08625-0029

**6. TEMPERATURE MONITORING AT ROUTE 9 BRIDGE (former Part II, Condition H)**

The permittee shall continuously measure the temperature four (4) feet below the surface of Oyster Creek at the Route 9 Bridge.

**7. FLOATING SOLIDS OR VISIBLE FOAM (former Part II, Condition B)**

Except as specifically authorized in this permit, the permittee shall not discharge floating solids or visible foam, except such materials as are contained in the intake water. The causing of foam by agitation of the ambient water shall not be deemed a violation of this condition.

**8. PLANT SHUTDOWN(S) (former Part II, Condition C)**

A. The permittee shall not schedule routine shutdowns during the months of December, January, February, and/or March.

B. The permittee shall not schedule routine intake component (e.g. circulating water pumps and appurtenant equipment, traveling screens and appurtenant equipment, intake ports, etc.) maintenance which may cause violation of thermal limitations or intake velocity limitations during the months of June, July, August and/or September. The Department acknowledges that the NJPDES Regulations require the permittee to maintain its plant in good working order and efficient operation and, therefore, some intake component maintenance may be required.

**9. DILUTION PUMP OPERATIONS (former Part II Condition D)**

When the intake water temperature is at or above 60°F and the temperature as measured four (4) feet below the surface at the Route 9 Bridge over Oyster Creek is at or less than 87°F, no dilution pump operation is required.

A. When the temperature in Oyster Creek exceeds 87°F, as measured four (4) feet below the surface at the Route 9 Bridge over Oyster Creek, one dilution pump will be put into operation. If, after one dilution pump has been in operation for at least two hours, the temperature measured at such point continues to exceed 87°F, a second dilution pump will be put into operation.

B. When the intake water temperature is less than 60°F, two dilution pumps will be put into operation.

C. A third dilution pump shall be held in reserve at the Station and must be put into operation within 40 minutes after one of the other two dilution pumps becomes inoperable and the operation of two dilution pumps is required by Paragraphs A or B above.

D. During periods of dilution pump and/or dilution pump component maintenance, a sufficient number of dilution pumps may not be available to meet the requirements of Paragraphs A, B, and C above. In that event, the Station may be operated for a period not to exceed 14 (fourteen) days in order to make necessary repairs, provided at least one dilution pump is available for operation. As soon as a second dilution pump is available for operation, it shall be placed into service as required under Paragraphs A, B, and C. When the Station has operated under this Paragraph for 14 days and continues to lack sufficient pumps to comply with Paragraphs A, B, and C, the Station shall become subject to Paragraph E instead of this Paragraph.

E. If dilution pump operation is required under Paragraph A, B, and C and if one-pump operation under Paragraph D continues for 14 (fourteen) days, remedial action will be taken within 24 hours to bring the plant into compliance with Paragraphs A, B, and C. If remedial action taken involves reduction of Station power output, power will be reduced as necessary to achieve the same effect as operating the proper number of dilution pumps as required by Paragraphs A, B, and C.

F. Paragraphs 9.A. through 9.E. do not apply during Station shutdowns. Any dilution pump(s) will be operated, however, in a manner that will minimize the adverse impact of Station shutdown upon marine and estuarine life in Oyster Creek and Barnegat Bay.

G. Paragraphs 9.A. through 9.E. do not apply in the event of a hazardous substance spill into the intake or discharge canals. In such cases, the dilution pumps will be operated in a manner which will minimize the environmental impact of the spill, while taking into consideration the need to minimize the possibility of thermal shock mortality of organisms residing in the discharge canal.

10. **INTAKE VELOCITY (former Part II, Condition E)**

A. The intake velocity shall not exceed 2.2 fps averaged over one minute at any point at the midplane of each port and the average of the average readings taken at 5 foot intervals from the top to the bottom of the water column of the individual port shall not exceed 1 fps during 6 port-6 screen operation. In the event that any screen must be removed from service due to intake component maintenance, then the 1 fps limitation shall apply as an average over the effective intake face.

B. When one circulating water pump is in operation, or when one circulating water pump is in operation in each half of the intake structure, or when there is no flow through the main condenser, the permittee is not required to measure intake velocity.

The permittee shall report intake velocities monthly (on DMR for DSN 001) and any intake component maintenance actions taken during the month that requires a screen to be removed from service.

**11. RATE OF TEMPERATURE CHANGE (former Part II, Conditions F & G)**

The rate of temperature change shall not cause mortality of fish or shellfish.

**12. TERMINATION OF SECTION 316(a) VARIANCE/PENALTIES**

Notwithstanding any other provision of this permit, the Department specifically reserves the right to seek termination of the Section 316(a) variance granted in this permit or termination of this permit based on the permittee's noncompliance with any term or condition of this permit. Further, the Department specifically reserves the right to seek penalties pursuant to N.J.S.A. 58:10A-10 et seq. based on the permittee's noncompliance with any term or condition of this permit.

**13. RENEWAL OF SECTION 316(a) VARIANCE**

The Department proposes to grant a variance pursuant to Section 316(a). If the draft permit is finalized, the variance will automatically be terminated upon the expiration of the final NJPDES permit. Procedures for reissuance of a Section 316(a) variance are virtually unchanged from an initial Section 316(a) determination.

If upon renewal, the permittee wants the variance to be continued, the request for the variance along with a basis for its continuance must be submitted at the time of application for the renewal permit. In the event that the permittee wants the variance to be continued, the Department's Section 316(a) determination will include, but not be limited to a review of studies based on actual operating experience, a review of material submitted by the Permittee or others, to determine whether the nature of the aquatic population(s) associated with the Station have changed, whether the protection and propagation of the balanced, indigenous population has been continued to be assured, whether the best scientific methods to assess the effect of the permittee's cooling system have changed and whether the technical knowledge of stresses caused by cooling systems has changed.

**14. DEPARTMENT NOTIFICATION OF EMERGENCY NEED FOR POWER**

The permittee shall notify the Department within eight (8) hours after declaring an "Emergency Need for Power" which invokes the alternate limitations for heat, temperature and $\Delta T$ relief in the permit. Notification should be made to the Central Bureau of Water and Hazardous Waste

Enforcement during normal business hours and to the NJDEPE Hotline during non-business hours and weekends.

15. **THREATENED/ENDANGERED SPECIES**

The Permittee is required to comply with NRC Facility Operating License No. DPR-50-219, and all subsequent amendments that may be required by the National Marine Fisheries Service (NMFS) as approved by the NRC.

Alternative Best Technologies Considered Under Section 316(b)

Under Section 316(b), the Department must determine whether the location, design, construction, and capacity of the intake structure(s) at the Station reflect the best technology available (BTA) for minimizing adverse environmental impact.

Decisions under Section 316(b) are made on a case-by-case basis which includes, among other things, evaluation of economic considerations. Best Technology Available is intended to mean "the best technology available commercially at an economically practicable cost" (from remarks of Don H. Clausen (a member of the House-Senate Conference Committee) during House debate on the 1972 Amendments. Library of Congress (Congressional Research Service, Environmental Policy Division), A Legislative History of the Water Pollution Control Act Amendments of 1972, (Two Volumes), January 1973, Serial No. 93-1, U.S.G.P.O. Stock No. 5270-01759, Washington, D.C. Page 264). Further, Section 316 is interpreted as not "requiring use of technology whose cost is wholly disproportionate to the environmental benefit to be gained." Administrator's Decision, In Re Public Service Company of New Hampshire, Case No. 76-7 (June 10, 1977) ("Seabrook Administrator's Decision"), 10 ERC 1261; and In the Matter of Carolina Power and Light Company (Brunswick Steam Electric Plant), NPDES Permit No. NC0007064 (November 7, 1977) at 31-32). Section 316(b) requires that an intake structure reflect BTA in order to minimize adverse environmental impact but, further, the Department notes that minimization of adverse environmental impact does not necessarily require that all losses of organisms due to Station operation be eliminated. In the matter of Boston Edison Electric Company (Pilgrim Nuclear Station NPDES Permit Nos. MA0003557 and MA0025135).

The Department evaluated available information on various technologies, including their technical feasibility, biological effectiveness, and associated costs. Versar found that the major intake impact to be minimized was entrainment losses to early life stages of aquatic organisms, particularly hard clams and sand shrimp. Versar also noted that impingement losses and fish kills were of some concern. The alternative technologies identified by Versar to have the greatest potential for application to reduce impingement and entrainment at the Station were:

1. Replacing the existing 3/8" mesh traveling screens with fine mesh screen panels.
2. Traveling screens with conventional 3/8" mesh or fine mesh retrofitted in front of the dilution pumps and/or fine-mesh centerflow screens retrofitted in front of the dilution pumps.
3. Replacement of intakes with fine-mesh wedgewire screens.
4. Closed cycle cooling (cooling towers).
5. Optimization of dilution pump operations.

1989 Versar Report, pp. VII-6,7.

The first two alternatives would increase impingement loss while reducing entrainment. The net ecological benefit of these retrofits would depend on the degree to which the reduction in entrainment losses exceeds the gain in impingement losses. 1989 Versar Report, p. VII-6. Versar looked primarily at the first three (physical barrier) alternatives as they could be applied without complete replacement of the intake structure so as to avoid the high cost of an entirely new intake structure. 1989 Versar Report, p. VII-22. Versar was concerned with limited data on the engineering feasibility of some of these alternatives and was not able to recommend that the cost of these technologies could be appropriate in view of the limited benefits of these technologies. Versar found that none of the screening options reduces losses at the facility by even 50%. 1989 Versar Report, p. VII-22.

Versar dismissed the wedgewire screen alternative because its costs far exceeded its benefits. 1989 Versar Report, p. VII-6. Biofouling and detrital clogging would also be a concern in the application of wedgewire screens at the Station. The Department concurs with Versar's recommendations on the screening alternatives and determines that it is unable to demonstrate that they are available at a reasonable cost (not wholly disproportionate to environmental benefits).

Versar also considered the alternative of (recirculating) cooling towers which are a demonstrated, effective technology for reducing entrainment and impingement, as well as thermal discharge impacts. Cooling towers are the most expensive alternative but would reduce water withdrawal by more than 95 percent and provide the highest degree of protection of any single currently available technology as a reduction in impact would result from the withdrawal (flow) reduction. 1989 Versar Report, p. VII-7. GPUN's estimated cost to install a natural draft cooling tower(s) is approximately $70 million. (Mechanical draft cooling towers would be expected to have lower construction cost than natural draft cooling towers but a higher operating cost.) Cooling towers are expected to be more costly than the physical barrier alternatives and Versar did not recommend cooling towers be designated the best technology available due to concerns about economic cost. 1989 Versar Report, p. VII-7. Additionally, there are ecological costs associated with cooling towers including visual impacts if natural draft cooling towers were used [natural draft towers are typically several hundred feet high and add considerable visual impact], noise from tower fans [from mechanical draft towers], and potential for local salt drift, fogging and icing.) 1989 Versar Report, p. VII-7.

The Department concurs with Versar's recommendation and determines that it is not able, at this time, to demonstrate that (recirculating) cooling towers are available at a reasonable cost (not wholly disproportionate to environmental benefits), especially where, as here, the balanced indigenous population is protected by current operations. Versar concluded that "[c]ontinued operation of the Oyster Creek NGS at the estimated levels of losses to RIS populations, without modification to intake structures and/or operating practices, does not threaten the protection and propagation of balanced, indigenous populations." 1989 Versar Report, p. VIII-2. As stated above, the Department concurs with this conclusion. Pursuant to Section 316(b), any cooling water intake technology may be imposed by the Department despite a successful Section 316(a) demonstration, if the cost of the technology is not wholly disproportionate to the environmental benefit to be derived from the application of the technology. As discussed in the Decision of the General Counsel No. 63, July 29, 1977 at page 383, however, "[a]s a practical matter, it [is] more difficult for the [Department] to show, for example, that the imposition of a $25 million technology under Section 316(b) is not "wholly disproportionate" to the magnitude of the adverse environmental impact if the discharger has shown under Section 316(a) that the overall impact of a less stringent thermal effluent limitation does not interfere with the protection and propagation of the balanced indigenous population."

Versar also looked into optimization of dilution pump operations as an alternative for reducing total plant impingement-entrainment losses. Optimization studies would compare the benefits of an altered thermal mortality rate (from the cooling provided by dilution pump flows) with the environmental cost of exposure by entrainment of a greater number of organisms due to dilution pump flows. Versar found that the Section 316 Demonstration did not contain sufficient information to optimize dilution pump operations. Versar found that November through February (potential cold shock) and July and August (potential heat shock) are periods of high risk for fish kills, but that there was significant potential, based on the data in the 316 Demonstration, to reduce losses by reducing dilution pump flows.

Versar assumed that there would be no costs associated with reducing dilution pump flows. Operating costs to implement the Dilution Pump Optimization Studies are expected to be less than for the current operations. (Reduced flows will require less electricity for pump operations.)

Versar recommended that the Department require Dilution Pump Optimization Studies as the Best Technology Available for the Station to minimize the adverse impacts of the cooling water intake structure pursuant to Section 316(b). Such optimization studies were recommended to provide a sound, rational basis for operational schedule modifications which may reduce entrainment losses. Versar further recommended that prior to the collection of data for these optimization studies, operation of the dilution pumps should not be altered because of the risk of increasing total mortality associated with the facility. 1989 Versar Report, p. VII-23.

The Department affirms and adopts Versar's recommendation that Dilution Pump Optimization Studies should be required at the Station. Therefore, the Department is proposing to require Dilution Pump Optimization Studies (see the section entitled "Dilution Pump Optimization Studies" of the Fact Sheet/Basis, and Part IV-B/C(5)). The permit will be modified if the studies provide information that dilution pump operations should be changed to reduce entrainment losses.

Based on the standard articulated in In the Matter of Carolina Power and Light Company (Brunswick Steam Electric Plant) NPDES Permit No. NC0007064 (November 7, 1977) at 31-32, the Department is persuaded that BTA as used in Section 316(b) is distinguishable from the standard "best available technology (BAT)". The Department, however, provides the following analysis in the event that this is determined not to be the case.

Where USEPA has not promulgated an industry-wide technology-based standard, the Department must set BAT limitations on a case-by-case basis using its best professional judgment ("BPJ") consistent with the requirements of Section 304(b) of the CWA. Section 304(b) and the implementing regulations (40 CFR 125.3(c)(2)) require agencies including the Department to consider certain factors in making a BPJ BAT determination, including: the age of the equipment and facilities; the process employed; the engineering aspects of the application of various types of control techniques; process changes; the cost of achieving such effluent reductions; and non-water quality environmental impacts (including energy requirements).

Courts reviewing BAT limitations have found that effluent reduction benefits do not need to consider resultant ambient water quality improvements. Likewise, benefits do not need to be quantified in monetary terms. There is no structure as to how these must be considered and there is no specific weight to be given these factors in their consideration.

The administrative record provides detailed information on the age of equipment and facilities involved; the process employed; the engineering aspects of the application of various types of control techniques; process changes; the estimated cost of achieving such effluent reductions; and non-water quality environmental impacts (including energy requirements). Based on the analysis of this information, the Department is unable to demonstrate at this time that closed cycle cooling or physical barrier modification technologies are "available" for application at the Station to reduce impingement and entrainment at a reasonable cost (not wholly disproportionate to environmental benefits).

The existing cooling water system, in conjunction with Dilution Pump Optimization Studies (which the Department would be able to demonstrate to be available for application at the Station to reduce impingement and entrainment effects at a reasonable cost), would be designated as the BAT under Section 304(b) if that was found to be the standard applicable to a BTA determination under Section 316(b).

In sum, based on the above review of available technologies, the Department determines that the existing cooling water intake structure, in conjunction with Dilution Pump Optimization Studies, should be designated Best Technology Available under Section 316(b). Accordingly, pursuant to Section 316(b), the Department proposes to allow the Station to continue to operate with the present cooling water intake structures in conjunction with the conduct of the Dilution Pump Optimization Studies. A reopener clause has been included so that the permit can be revised upon review of the Dilution Pump Optimization Studies.

## Appendix C

# Special-Status Species Correspondence

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AmerGen
An Exelon Company

AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348
www.exeloncorp.com

October 20, 2004
2130-04-20249

John Staples, Supervisory Fish & Wildlife Biologist
U.S. Fish & Wildlife Service
New Jersey Field Office
927 N. Main Street
Heritage Square, Bldg. D
Pleasantville, NJ 08232

Subject: Request for Information on Listed Species and Critical Habitats for the Oyster Creek Generating Station License Renewal Application

Dear Mr. Staples:

AmerGen Energy Company, LLC (AmerGen) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for Oyster Creek Generating Station (OCGS), which expires in April 2009. Renewing the license would extend operation of the plant through April 2029. AmerGen operates the plant and is the licensee. AmerGen acquired the plant from General Public Utilities in August of 2000.

AmerGen intends to submit an application for license renewal in the summer of 2005. As part of the license renewal process, the NRC requires license applicants to "assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act" (10 CFR 51.53). As part of its review of the application, the NRC will consult with your office under Section 7 of the Endangered Species Act to determine if any listed species or critical habitat occurs in the project area. By contacting you in advance, we hope to identify any issues that need to be addressed or information required to expedite the NRC's consultation.

Oyster Creek Generating Station is in Ocean County, New Jersey, approximately 10 miles south of Toms River and approximately 35 miles north of Atlantic City (see Attachment 1, Figure 1). The plant lies approximately 2 miles inland from Barnegat Bay (see Attachment 1, Figure 1), which serves as its cooling water source and heat sink. One transmission line was constructed to connect OCGS to the regional transmission system. This transmission line (see Attachment 1, Figure 2) is now owned and maintained by FirstEnergy Corporation, which owns and operates a transmission system in Ohio, Pennsylvania, and New Jersey. Conectiv is planning to build a second transmission line from OCGS. However, because 10CFR51.53(c)(3)(ii)(H) requires an analysis of "lines that were constructed for the specific purpose of connecting the plant to the

U. S. Fish and Wildlife Service
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transmission system," this line is not part of the scope of the proposed action, which is license renewal of OCGS. In addition, it is our understanding that Conectiv has complied with the requirements of the Endangered Species Act with regard to this line. Therefore, we are not requesting your office's assistance in identifying sensitive species or habitats that might be affected by this line.

The OCGS property (see Attachment 1, Figure 3) consists of the OCGS site, which lies west of Highway 9, and the former Finninger Farm, which lies east of Highway 9. The parcel of land west of Highway 9 includes the powerblock area, support facilities, roads, parking lots, and some undeveloped buffer areas. It totals approximately 150 acres. The parcel of land east of Highway 9, the former Finninger Farm, is largely undeveloped and is maintained as a natural area. It is comprised of approximately 650 acres of old fields, abandoned orchards, forests, wetlands, and marshlands. The two parcels of land total approximately 800 acres.

In response to a request from Amergen, the Natural Heritage Program of the New Jersey Department of Environmental Protection (NJDEP) recently searched its database for occurrences of rare, threatened, and endangered species on the OCGS property and within one-quarter mile of the site boundary. Based on the NJDEP responses (see Attachment 2), seven state-listed animals and three state-listed plants may occur in the vicinity of the site; however, no federally listed species occur on site or within one-quarter mile. One of the plants that NJDEP believes "may be on site" is the bog asphodel (*Narthecium americanum*), which is a candidate for federal listing.

Jersey Central Power & Light Company, which operated OCGS for several decades, built the single 230-kilovolt transmission line to connect the plant to the regional transmission system (see Figure 2). This line originates at a sub-station west of the plant's powerblock area, runs northwest for approximately 1.5 miles, crossing the Garden State Parkway, then turns north to run approximately 9.5 miles to the Manitou Substation at Toms River. For most of its length, the line parallels the Garden State Parkway. Most of the land crossed by the line is pine forest, but the line also crosses a number of streams (three branches of Forked River, Huckleberry Branch, Deep Hollow Branch, Cedar Creek, Factory Branch, and Jakes Branch) and associated wetlands, bogs, ponds, and agricultural areas. For approximately 1 mile of its length, the transmission line crosses Double Trouble State Park.

Although AmerGen has not surveyed the transmission corridor for rare plants and animals, control of woody vegetation in this corridor could provide habitat for species that depend on open conditions (grassland and bog-type habitats) that are maintained by regular mowing and selective application of approved herbicides. The recent NJDEP review of the project indicated that more than a dozen state-listed species and several significant natural communities could occur in the vicinity of the transmission corridor. In addition, NJDEP reported that one federally listed plant (the threatened Knieskern's beaked rush, *Rhynchospora knieskernii*) and one plant that is a candidate for federal listing (the aforementioned bog asphodel) "may be" in the vicinity of the OCGS-to-Manitou transmission line.

AmerGen is committed to the conservation of significant natural habitats and protected species, and believes that operation of OCGS and its transmission line since 1969 has had no adverse impact on any threatened or endangered species. AmerGen has no plans to alter current operations over the license renewal period. Any maintenance activities necessary to support

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license renewal would be limited to previously disturbed areas. No expansion of existing facilities and no additional land disturbance is anticipated in support of license renewal. As a consequence, we believe that operation of the plant, including maintenance of the transmission line, over the license renewal period (an additional 20 years) would not adversely affect any threatened or endangered species.

We would appreciate your providing us with any information you may have about any state or Federally listed species or ecologically significant habitats that may occur on the 800-acre OCGS property or along the associated transmission corridor by December 1, 2004.

Please call Bill Maher at (610) 765-5939 if you have any questions or require any additional information.

Sincerely,

D. B. Helker /For

Michael P. Gallagher
Director, Licensing & Regulatory Affairs

Attachment 1: Figure 1: 50-Mile Vicinity Map
Figure 2: 6-Mile Vicinity Map
Figure 3: Oyster Creek Generating Station Site Boundary
Attachment 2: Letters from Herbert Lord (NJDEP) to William Mahler (AmerGen), "Oyster Creek Generating Station to Manitou Transmission Line" and "Oyster Creek Generating Station," both dated September 22, 2004.

cc: Karen Tucillo, NJ BNE
File No. 04007

United States Department of the Interior

FISH AND WILDLIFE SERVICE

New Jersey Field Office
Ecological Services
927 North Main Street, Building D
Pleasantville, New Jersey 08232
Tel: 609/646 9310
Fax: 609/646 0352
http://njfieldoffice.fws.gov

In Reply Refer to:

ES-04/618

JAN 25 2005
MICHAEL P. GALLAGHER
LICENSING SECTION

JAN 27 2005

REFER TO:

Michael P. Gallagher, Director
AmerGen Energy Company, LLC
Licensing and Regulatory Affairs
200 Exelon Way
Kennett Square, Pennsylvania 19348

Dear Mr. Gallagher:

This responds to your October 20, 2004 letter to the U.S. Fish and Wildlife Service (Service) requesting information on federally listed species in the vicinity of the Oyster Creek Generating Station located in Ocean County, New Jersey. The Service understands that you are preparing an application to the U.S. Nuclear Regulatory Commission to renew the operating license, which expires in April 2009, for the Oyster Creek Generating Station.

AUTHORITY

This response is provided pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*) (ESA) to ensure the protection of federally listed endangered and threatened species. These comments do not address all Service concerns for fish and wildlife resources and do not preclude separate review and comments by the Service pursuant to the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq.*) if project implementation requires a Department of the Army permit pursuant to Section 10 of the Rivers and Harbors Appropriation Act (30 Stat. 1151, as amended; 33 U.S.C. 403 *et seq.*) and/or Section 404 of the Clean Water Act (33 U.S.C. 1341), or pursuant to the December 22, 1993 Memorandum of Agreement (MOA) among the U.S. Environmental Protection Agency, New Jersey Department of Environmental Protection (NJDEP), and the Service, if project implementation requires a permit from the NJDEP pursuant to the New Jersey Freshwater Wetlands Protection Act (N.J.S.A. 13:9B *et seq.*). The following remarks do not preclude comments on any forthcoming environmental documents pursuant to the National Environmental Policy Act of 1969 as amended (83 Stat. 852; 42 U.S.C. 4321 *et seq.*).

FEDERALLY LISTED SPECIES

There is a known occurrence of the federally listed (threatened) plant Knieskern's beaked-rush (*Rhynchospora knieskernii*) within 1.5 miles of the project site. Knieskern's beaked-rush occurs in early successional wetland habitats, often on bog-iron substrate or mud deposits adjacent to slow-moving streams in the Pinelands region of New Jersey. This species is also found in man-disturbed wet areas including abandoned borrow pits, clay pits, ditches, rights-of-way, and unimproved roads. The species is intolerant of shade and competition, and is generally found on relatively bare substrate with sparse vegetation. Threats to Knieskern's beaked-rush include habitat loss from development, agriculture, hydrologic modification, and other wetland alterations; excessive disturbance from vehicle-use, trash dumping, and other activities; and natural vegetative succession of the open, sparsely-vegetated substrate preferred by this species. Additional information is enclosed regarding Knieskern's beaked-rush and its habitat.

There are two known occurrences of the federally listed (threatened) plant swamp pink (*Helonias bullata*) within 2.8 miles of the project site. Swamp pink is a perennial, shade-tolerant, obligate wetland plant found in forested freshwater wetlands, such as Atlantic white-cedar (*Chamaecyparis thyoides*) and red maple (*Acer rubrum*) swamps. The species usually occurs along small meandering streamlets, in headwater wetlands, or in spring seepage areas. Swamp pink habitat can have a variable canopy, and tends to have mucky substrates. Specific hydrologic requirements of swamp pink limit its occurrence to areas with lateral ground-water movement that are perennially saturated, but not inundated by floodwaters. The species also requires a water table at or near the surface, with only slight fluctuations in water levels throughout the year. Swamp pink often grows on hummocks formed by trees, shrubs, and sphagnum moss. The primary threats to swamp pink are the indirect effects of off-site activities and development, such as pollution and subtle changes in groundwater and surface water hydrology. Hydrologic changes include increased sedimentation from off-site construction; and increases in the frequency, duration, and volume of flooding, and subsequent erosion, caused by direct discharges to wetlands (such as stormwater outfalls) and by increased runoff from upstream development. Other threats to this species include direct destruction of habitat from wetland clearing, draining and filling; collection; and trampling. Additional information is enclosed regarding swamp pink and its habitat.

## CANDIDATE SPECIES

There is a known occurrence of the federal candidate plant species, bog asphodel (*Narthecium americanum*), located within the Oyster Creek Generating Station site boundary and several additional locations within 1.3 miles of the project site. Bog asphodel is a perennial herb found in open bogs, wet savannahs, lowland oxbow meanders, iron ore streamlet seeps, and sunny borders of Atlantic white-cedar (*Chamaecyparis thyoides*) swamps. The species often forms clumps in mucky soil along small channels of cold seepage water. Bog asphodel favors areas influenced by slow-moving groundwater, and cannot tolerate heavy shade or extended periods of flooding or dessication. Threats to bog asphodel include long-term hydrologic change, habitat loss, and natural vegetation succession.

## SERVICE COMMENTS AND RECOMMENDATIONS

Based upon a review of the information provided, the Service understands that there would be no expansion of the existing facilities, no additional land disturbance is anticipated in support of license renewal, and any maintenance activities necessary to support license renewal would be

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limited to previously disturbed areas. Therefore, the Service concurs with your determination that operation of the plant, including maintenance of the transmission line, over the license renewal period would not adversely affect federally listed threatened and endangered species. No further consultation pursuant to Section 7 of the ESA is required by the Service. If additional information on federally listed species becomes available, or if project plans change, this determination may be reconsidered.

A review of the Service's National Wetlands Inventory maps indicates that wetlands occur within the project site. Many areas of New Jersey, including the project site, have not been thoroughly surveyed for endangered and threatened plant and animal species. Therefore, occurrences of Knieskern's beaked-rush and swamp pink, as well as several State-listed plants and animals, could be located within wetlands on or adjacent to the project site. Although the Service understands that these wetlands will not be affected by the license renewal, it is recommended (not required) that a qualified botanist conduct a survey within the project site to determine the absence or presence of rare plants, particularly Knieskern's beaked-rush and swamp pink. Please forward the results of any survey, whether showing presence or absence, to this office. Please include the survey method used and the qualifications of the surveyor.

Candidate species are under consideration by the Service for possible inclusion on the List of Endangered and Threatened Wildlife and Plants. Although these species receive no substantive or procedural protection under the Endangered Species Act, the Service encourages federal agencies and other planners to consider candidate species in project planning. If field surveys are conducted for Knieskern's beaked rush or swamp pink, the Service recommends the survey also include bog asphodel.

The Service appreciates your efforts to address federally listed species concerns early in the planning process. Lisa Arroyo of my staff is available at (609) 646-9310, extension 49, to provide further assistance if you have any questions concerning the above information or require further assistance regarding federally listed endangered or threatened species.

Sincerely,

Clifford G. Day

Clifford G. Day
Supervisor

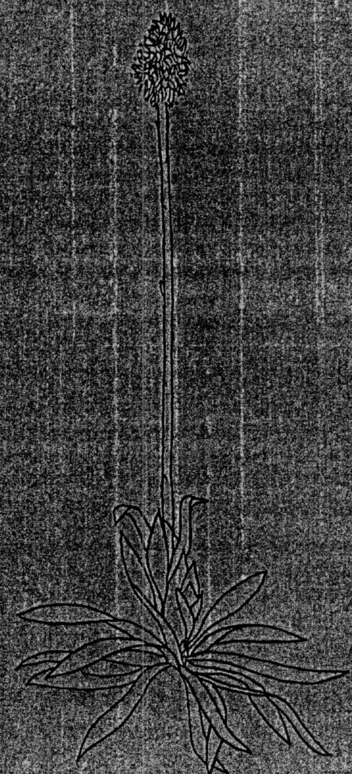
3

# Swamp pink

Swamp pink (*Helonias bullata*) was federally listed as a threatened plant species on September 9, 1988, pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*). New Jersey contains the majority of the remaining populations of the species; however, not all of the potential swamp pink habitats in New Jersey have been surveyed. The U.S. Fish and Wildlife Service (Service) requests that a qualified biologist conduct a comprehensive search for swamp pink in any potentially suitable wetland habitat, as described below, that may be impacted by project activities. The following information is provided to assist in identifying the species and its habitat and to describe recommended survey techniques.

**IDENTIFICATION:** Swamp pink is characterized by a bright pink flower cluster that blooms in early spring. The stocky, hollow flower stem grows from one to three feet tall and has sparse modified leaves along its length. In April or early May, the stem is topped by a cluster (approximately one to three inches long) of pink flowers dotted with pale blue anthers. However, only 10 to 15 percent of the plants in a population typically flower in any one season. When the plant is not flowering, swamp pink can be identified by its smooth, evergreen, lance-shaped leaves (approximately 3 to 10 inches long), which lie almost flat on the ground in a basal rosette. The leaves are shiny green when young and often attain a purplish tint in mature plants. In New Jersey, the plant is easiest to identify when in bloom or in the winter months when few other herbaceous plants are still green. Population sizes may vary from a few to several thousand plants.

**HABITAT:** Considered an obligate wetland species, swamp pink occurs in a variety of palustrine forested and scrub/shrub wetlands in New Jersey including: forested wetlands bordering meandering streamlets, headwater wetlands, sphagnous Atlantic white cedar swamps, and spring seepage areas. Specific hydrologic requirements of swamp pink limit its occurrence to wetlands that are perennially saturated, but not inundated by floodwater. The water table must be at or near the surface, fluctuating only slightly during spring and summer months.





G1

Swamp pink is a shade-tolerant plant that occurs in wetlands with varying canopy closure. Plant species associated with swamp pink include: Atlantic white cedar (*Chamaecyparis thyoides*), red maple (*Acer rubrum*), pitch pine (*Pinus rigida*), American larch (*Larix laricina*), black spruce (*Picea mariana*), red spruce (*Picea rubens*), sweet pepperbush (*Clethra alnifolia*), sweetbay magnolia (*Magnolia virginiana*), sphagnum mosses (*Sphagnum* spp.), cinnamon fern (*Osmunda cinnamomea*), skunk cabbage (*Symplocarpus foetidus*), and laurels (*Kalmia* spp.). Swamp pink often grows on hummocks formed by trees, shrubs, and sphagnum mosses, which indicates that these microtopographic conditions may be an important component of swamp pink habitat.

**RANGE:** Once found inhabiting wetland areas from New York to Georgia, swamp pink now occurs only along the coastal plain from New Jersey to Virginia and in small isolated bog areas in the Southern Appalachian Mountains. Containing more than 70 percent of the known sites, New Jersey represents the global stronghold for swamp pink. Plant colonies are found in Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Monmouth, Morris, Ocean, and Salem Counties.

**THREATS:** Threats to swamp pink include: loss or degradation of habitat due to illegal filling of wetlands; sedimentation from off-site construction activities; introduction of excess nutrients or toxic chemicals (e.g., herbicides) into the water; and, changes in groundwater and surface water hydrology due to excavation, water withdrawal, and increased runoff from upstream development (causing flooding and erosion). Additionally, direct discharge from stormwater outfalls can increase the frequency, duration, and volume of flooding in swamp pink wetlands and adversely affect the species.

**SURVEY REQUIREMENTS:** Although surveys can be conducted year round, the Service recommends conducting surveys from late fall to early spring when the foliage of other plant species is reduced, making the evergreen foliage of swamp pink easier to detect. Random transect surveys are inappropriate since the species may be present in small wet pockets, which may be overlooked during the random transect method. All available suitable habitat within the project impact area should be surveyed, concentrating on forested wetland areas as previously described, with suitable hydrology. The surveyor should census not only the wetlands on the subject property, but also upstream and downstream wetlands. Please **do not** collect specimens or send plants or parts of plants to the Service for identification. Report the survey method used, the qualifications of the surveyor, and the results of the survey (including size of area surveyed, hours searched, aerial and/or ground photographs with index map, and wetland delineations) to:

U.S. Fish and Wildlife Service
New Jersey Field Office
927 North Main Street, Building D-1
Pleasantville, New Jersey 08232
Telephone: (609) 646-9310
Facsimile: (609) 646-0352

**CONSERVATION AND PROTECTION:** The Service's Swamp Pink Recovery Plan identifies permanent protection of at least 80 large populations. If you own property containing swamp pink or know of other landowners who would be interested in permanently protecting this species, please notify the Service for additional information and assistance.

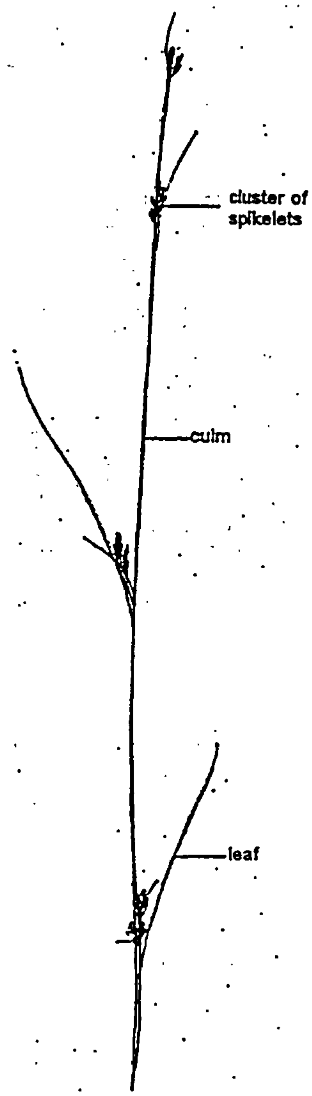


G2

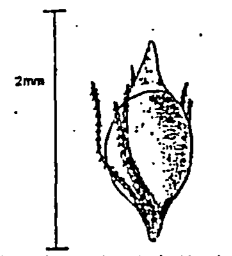
# Knieskern's beaked-rush

**DESCRIPTION:** Knieskern's beaked-rush (*Rhynchospora knieskernii*) was listed as a threatened species on July 18, 1991, pursuant to the Endangered Species Act of 1973 (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*). Knieskern's beaked-rush belongs to the sedge family and is endemic to the Pinelands region of New Jersey. This grass-like plant was generally considered to be an annual species; however, it is currently suspected to be a short-lived perennial in locations where habitat conditions are stable, allowing uninterrupted growth year after year. Knieskern's beaked-rush grows from 1.5 to 60 centimeters high (0.6 to 24 inches), has slender culms (stems) branching from the base, and short, narrowly linear leaves. Small spikelets (flower clusters) are numerous and occur at distant intervals along the entire length of the culm. The achene (fruit) is obovate, narrow at the base, 1.1 to 1.3 millimeters long (0.04 to 0.05 inches), and equal in length to the six downwardly-barbed or rarely, upwardly-barbed attached bristles. Fruiting typically occurs from July to September (U.S. Fish and Wildlife Service, 1993).

**HABITAT:** Knieskern's beaked-rush is an obligate hydrophyte (wetland plant) that occurs in groundwater-influenced, constantly fluctuating, successional habitats. An early successional species and colonizer, Knieskern's beaked-rush is intolerant of competition, especially from woody species. It is found on naturally occurring early successional habitats and disturbed areas such as burns, bog-iron deposits, gravel and clay pits, road cuts, mowed roadsides, utility and railroad rights-of-way, cleared home sites, eroded areas, cleared edges of Atlantic white-cedar swamps, wheel ruts, and muddy swales (Gordon, 1993; U.S. Fish and Wildlife Service, 1993; Radis, 1995). In the past, fire may have played an important role in creating and maintaining suitable habitat for Knieskern's beaked-rush. Occurrence records indicate that this plant is found in wet open areas within fire-dependent open pitch-pine forests. Periodic disturbance, either natural or human-induced, which maintains a damp-to-wet site in an early ecological successional stage, may be necessary for the successful colonization, establishment, recruitment, and maintenance of this species.



Flowering / fruiting culm (stem)



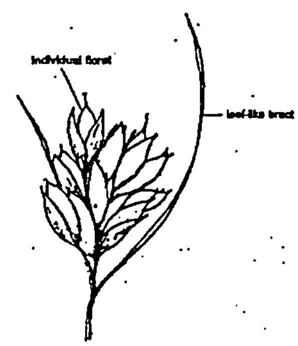
*Achene (fruit) with six barbed bristles*

Human-disturbed sites exhibit some of the same characteristics as bog-iron sites, including a high water table, temporary inundation, and open, early-successional habitat with relatively bare substrate. Plant species associated with Knieskern's beaked-rush include warty panic-grass (*Panicum verrucosum*), poverty-grass (*Aristida longispica*), and spatulate-leaved sundew (*Drosera intermedia*) (Gordon, 1993).

THREATS: Originally, the primary threat to the species was the loss of wetlands to urban and agricultural development. However, current State and federal wetland protection laws have reduced the loss of wetlands over time. Presently, vegetative succession is a major factor threatening Knieskern's beaked-rush. Human-induced threats to the species include alteration of wetland hydrology, off-road vehicle activity, trash dumping, and possibly roadside grading (U.S. Fish and Wildlife Service, 1993). Gordon (1993) found that fire can be both beneficial and detrimental to the species depending on the timing, duration, and intensity of the burn.

SURVEY REQUIREMENTS: The Service requests that a qualified biologist conduct a comprehensive search for Knieskern's beaked-rush in any potentially suitable early successional wetlands or disturbed wet areas that may be impacted by project activities. Surveys should be conducted from July to September. Random transect surveys are inappropriate since the species may be present in small wet pockets, which may be overlooked by this survey method. Please report in writing the survey method used, the qualifications of the surveyor, and the results of the survey to:

U.S. Fish and Wildlife Service
New Jersey Field Office
927 North Main Street, Building D-1
Pleasantville, New Jersey 08232
Telephone: 609/646-9310
Facsimile: 609/646-0352



*Cluster of spikelets*

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LITERATURE CITED

Gordon, T. 1993. Monitoring and Survey of *Rhynchospora knieskernii* in New Jersey - 1992. New Jersey Office of Natural Lands Management, Trenton, New Jersey. 9 pp.

Radis, R. 1995. Monitoring and survey research on *Rhynchospora knieskernii* Carey in New Jersey. 16 pp.

U.S. Fish and Wildlife Service. 1993. Knieskern's Beaked-Rush (*Rhynchospora knieskernii*) Recovery Plan. Hadley, Massachusetts. 40 pp.

AmerGen
An Exelon Company

AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348
www.exeloncorp.com

December 3, 2004

2130-04-20320

Mr. Larry Niles
Chief, Endangered and Non-Game Species Program
Division of Fish & Wildlife
New Jersey Dept. of Environmental Protection
501 East State Street, Floor 3
P.O. Box 400
Trenton, NJ 08625-0400

Dear Mr. Niles:

AmerGen Energy Company, LLC (AmerGen) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for Oyster Creek Generating Station (OCGS), which expires in April 2009. Renewing the license would extend operation of the facility through April 2029. AmerGen, a wholly-owned subsidiary of Exelon Corporation, operates the plant and is the licensee.

AmerGen intends to submit this application for license renewal in late-summer 2005. As part of the license renewal process, the NRC requires license applicants to "assess the impact of the proposed action on threatened or endangered species in accordance with the Endangered Species Act" (10 CFR 51.53). The NRC will consult with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act and may also seek your assistance in the identification of important species and habitats in the project area. By contacting you early in the application process, we hope to identify any issues that need to be addressed or information your office may need to expedite the NRC consultation.

In response to a request from AmerGen, the New Jersey Natural Heritage Program recently searched its database for occurrences of rare, threatened, and endangered species on the OCGS property and within one-quarter mile of the site boundary (see Attachment 1). Based on the Natural Heritage Program response (see Attachment 2), seven state-listed animals and three state-listed plants may occur in the vicinity of the site; however, no federally listed species occur on site or within one-quarter mile. One of the plants that the Heritage Program believes "may be on site" is the bog asphodel (*Narthecium americanum*), which is a candidate for federal listing.

Jersey Central Power & Light Company, which operated OCGS for several decades, built a single 230-kilovolt transmission line to connect the plant to the regional transmission system (see Attachment 1). This line originates at a sub-station west of the plant's powerblock area, runs northwest for approximately 1.5 mile, crossing the Garden State Parkway, then turns north

Endangered and Non-Game Species Program
December 3, 2004
Page 2

to run approximately 9.5 miles to the Manitou Substation at Toms River. The recent Heritage Program review of the project indicated that more than a dozen state-listed species and several significant natural communities could occur in the vicinity of the transmission corridor. In addition, the Heritage Program reported that one federally listed plant (the threatened Knieskern's beaked rush, *Rhynchospora knieskernii*) and one plant that is a candidate for federal listing (the aforementioned bog asphodel) "may be" in the vicinity of the OCGS-to-Manitou transmission line.

AmerGen is committed to the conservation of significant natural habitats and protected species, and believes that operation of OCGS and its transmission line since 1969 has had no adverse impact on any threatened or endangered species. AmerGen has no plans to alter current operations over the license renewal period. Any maintenance activities necessary to support license renewal would be limited to previously disturbed areas. No expansion of existing facilities is planned, and no additional land disturbance is anticipated in support of license renewal. As a consequence, we believe that operation of the plant, including operation and maintenance of the transmission line, over the license renewal period (an additional 20 years) would not adversely affect any threatened or endangered species.

We would appreciate your sending us a letter by January 7, 2005, detailing any additional information you have on state- or federally-listed species that may be affected by OCGS operations during the license renewal term or confirming AmerGen's conclusion that operation of OCGS over the license renewal term would have no adverse impact on any listed species. This will enable us to meet our application preparation schedule. AmerGen will include a copy of this letter and your response in the license renewal application that we submit to the NRC.

Please call Bill Maher at (610) 765-5939, if you have any questions or require any additional information to review the proposed action.

Sincerely,

G. A. Helker /FOR

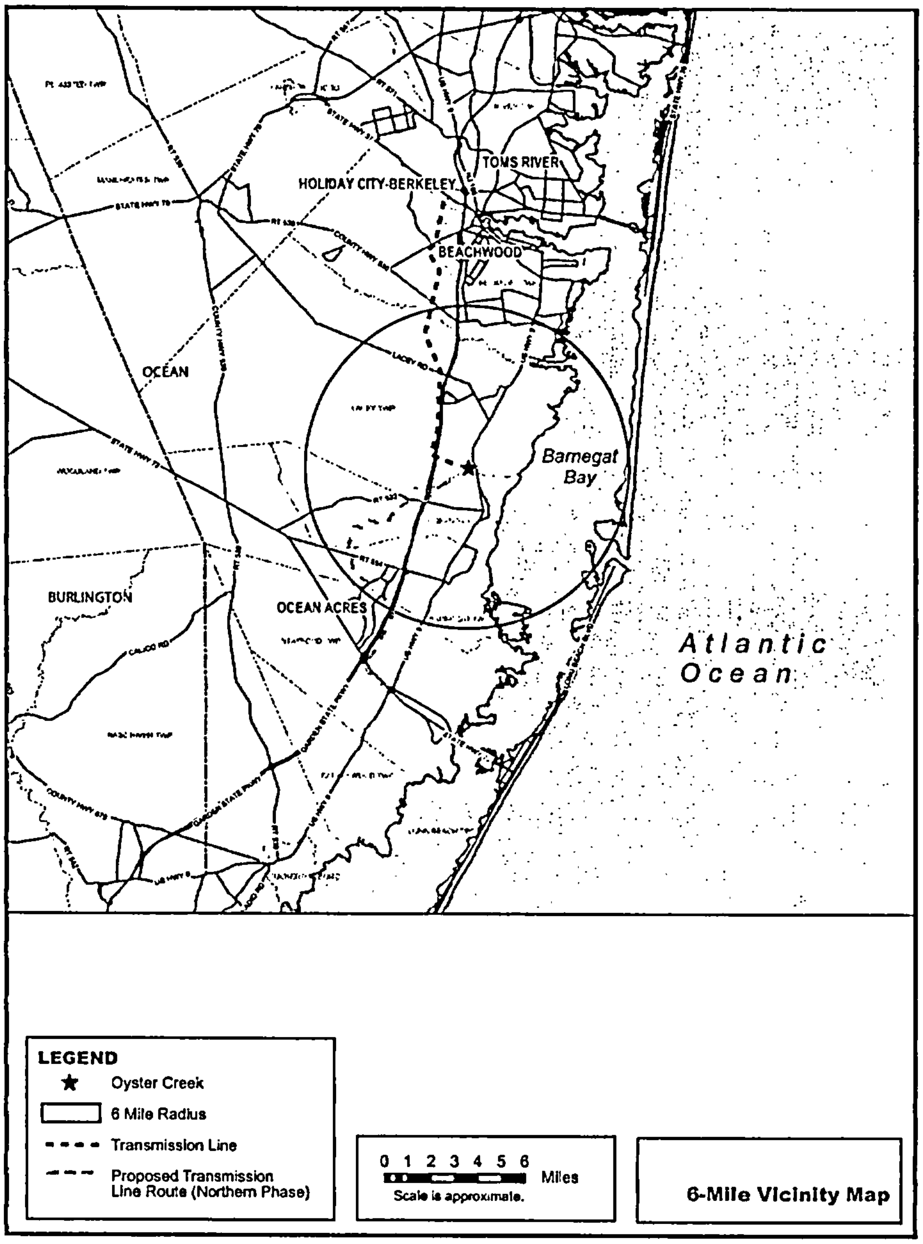
Michael P. Gallagher
Director, Licensing & Regulatory Affairs
AmerGen Energy Company, LLC

Attachments: 1) 6-Mile Vicinity Map
2) Letters from Herbert Lord (NJDEP) to William Mahler (AmerGen), "Oyster Creek Generating Station to Manitou Transmission Line" and "Oyster Creek Generating Station," both dated September 22, 2004

cc: Karen Tuccillo, NJ DEP BNE
Dave Golden, NJ DEP DFW
Dave Jenkins, NJ DEP DFW
File No. 04007

ATTACHMENT 1

6-Mile Vicinity Map


TOMS RIVER
HOLIDAY CITY-BERKELEY
BEACHWOOD
OCEAN
Barnegat Bay
BURLINGTON
OCEAN ACRES
Atlantic Ocean
LEGEND
Oyster Creek
6 Mile Radius
Transmission Line
Proposed Transmission Line Route (Northern Phase)
0 1 2 3 4 5 6 Miles
Scale is approximate.
6-Mile Vicinity Map

# ATTACHMENT 2

**Letters from Herbert Lord (NJDEP) to William Mahler (AmerGen)**

State of New Jersey

James E. McGreevey
*Governor*

Department of Environmental Protection
Division of Parks and Forestry
Office of Natural Lands Management
Natural Heritage Program
P.O. Box 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427

Bradley M. Campbell
Commissioner

September 22, 2004

William Mahler
Amergen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

Re: Oyster Creek Generating Station to Manitou Substation Transmission Line

Dear Mr. Mahler:

Thank you for your data request regarding rare species information for the above referenced project site in Berkeley Township, Lacey Township and South Toms River Borough, Ocean County.

Searches of the Natural Heritage Database and the Landscape Project (Version 2) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Request for Data into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

We have checked the Natural Heritage Database for occurrences of rare plant species or natural communities. The Natural Heritage Data Base has records for occurrences of *Juncus caesariensis* and *Calamovilfa brevipilis* that may be on the site and for pitch pine-shrub oak barrens (pb4/5), pine-oak-shrub oak woodland (pow), pitch pine lowlands (undifferentiated), *Rhynchospora knieskernii, Schizaea pusilla, Narthecium americanum* and *Muhlenbergia torreyana* that may be in the immediate vicinity of the site. The attached lists provide more information about these occurrences. **Because some species are sensitive to disturbance or sought by collectors, this information is provided to you on the condition that no specific locational data are released to the general public. This is not intended to preclude your submission of this information to regulatory agencies from which you are seeking permits.**

We have also checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat on the referenced site. Please see Table 1 for species list and conservation status.

Table 1 (on referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| American rubyspot | *Hetaerina americana* | | | G5 | S3 |
| barred owl | *Strix varia* | | T/T | G5 | S3B |
| bar-winged skimmer | *Libellula axilena* | | | G5 | S2BS3B,SZN |
| black skimmer foraging area | *Rynchops niger* | | E | G5 | S1B |
| black-crowned night-heron foraging habitat | *Nycticorax nycticorax* | | T/S | G5 | S3B,S4N |
| black-throated green warbler | *Dendroica virens* | | Special Concern | G5 | S3B |
| carpenter frog | *Rana virgatipes* | | Special Concern | G5 | S4 |
| cerulean warbler | *Dendroica cerulea* | | Special Concern | G4 | S3B |
| colonial waterbird foraging habitat | | | | | |
| Cooper's hawk | *Accipiter cooperii* | | T/T | G5 | S3B,S4N |
| corn snake | *Elaphe g. guttata* | | E | G5T5 | S1 |
| dotted skipper | *Hesperia attalus slossonae* | | Special Concern | G3G4T3 | S2S3 |
| eastern box turtle | *Terrapene carolina* | | Special Concern | G5 | S5B |
| eastern kingsnake | *Lampropeltis g. getula* | | U | G5T5 | S3 |
| Fowler's toad | *Bufo woodhousii fowleri* | | Special Concern | G5 | S4 |
| golden-winged skimmer | *Libellula auripennis* | | | G5 | S1S2 |
| Martha's pennant | *Celithemis martha* | | | G4 | S3S4 |
| northern parula | *Parula americana* | | Special Concern | G5 | S3B |
| northern pine snake | *Pituophis m. melanoleucus* | | T | G4T4 | S3 |
| pine barrens treefrog | *Hyla andersonii* | | T | G4 | S3 |
| red-headed woodpecker | *Melanerpes erythrocephalus* | | T/T | G5 | S2B,S2N |
| spotted turtle | *Clemmys guttata* | | Special Concern | G5 | S4 |
| tern species foraging habitat | | | | | |
| timber rattlesnake | *Crotalus h. horridus* | | E | G4T4 | S2 |
| veery | *Catharus fuscescens* | | Special Concern | G5 | S3B |
| wood turtle | *Clemmys insculpta* | | T | G4 | S3 |

We have also checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat within 1/4 mile of the referenced site. Please see Table 2 for species list and conservation status. This table excludes any species listed in Table 1.

Table 2 (additional species within 1/4 mile of referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| a satyr | *Neonympha areolata septentrionalis* | | | G4T3T4 | S3 |

Also attached is a list of rare species and natural communities that have been documented from Ocean County. If suitable habitat is present at the project site, these species have potential to be present.

Status and rank codes used in the tables and lists are defined in the attached EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State's best habitats for rare and endangered species and natural communities. Four of these sites are located within or near the areas you have outlined. Please refer to the enclosed Natural Heritage Priority Site Maps for the locations and boundaries of these sites. On the back of each Priority Site Map is a report describing the significance of the site. You may find the site biodiversity significance rating to be useful if you need to prioritize among the sites in your environmental assessment.

If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive I-Map-NJ website at the following URL, http://www.state.nj.us/dep/gis/imapnj/imapnj.htm or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Herbert A. Lord

Herbert A. Lord
Data Request Specialist

cc: Robert J. Cartica
Lawrence Niles
NHP File No. 04-3907472

1
21 SEP 2004

POSSIBLY ON PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| CALAMOVILFA BREVIPILIS | PINE BARREN REEDGRASS | | | LP | G4 | S4 | 1985-09-29 | Y | N. OF MIDDLE BRANCH FORKED RIVER, JUST W. OF GARDEN STATE PARKWAY. |
| JUNCUS CAESARIENSIS | NEW JERSEY RUSH | | E | LP | G2 | S2 | 1985-09-29 | Y | N. OF MIDDLE BRANCH FORKED RIVER, JUST W. OF GARDEN STATE PARKWAY. |

2 Records Processed

1
21 SEP 2004

IMMEDIATE VICINITY OF PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Ecosystems | | | | | | | | | |
| PINUS RIGIDA SATURATED WOODLAND ALLIANCE | PITCH PINE LOWLANDS (UNDIFFERENTIATED) | | | | G3 | S3 | 2003-01-25 | Y | SEVERAL PATCHES S OF JAKES BRANCH, N OF PINEWALD-KESWICK GROVE ROAD, EAST OF THE JCPL POWERLINE, AND W OF THE GARDEN STATE PARKWAY. |
| PINUS RIGIDA-(P. ECHINATA)-QUERCUS SPP./QUERCUS (MARILANDICA, ILICIFOLIA) WOODLAND | PINE-OAK-SHRUB OAK WOODLAND (POW) | | | | G3 | S3 | 2003-01-25 | Y | TWELVE SCATTERED PATCHES LOCATED SOUTH OF JAKES BRANCH, MOSTLY NORTH OF PINEWALD-KESWICK GROVE ROAD, MOSTLY EAST OF THE JCPL POWERLINE, AND WEST OF THE GARDEN STATE PARKWAY. |
| PINUS RIGIDA/QUERCUS (MARILANDICA, ILICIFOLIA)/PYXIDANTHERA BARBULATA WOODLAND | PITCH PINE-SHRUB OAK BARRENS (PB4/5) | | | | G2 | S2 | 2002-10-15 | Y | TWO MAIN PATCHES ARE LOCATED SOUTH OF JAKES BRANCH, NORTH OF PINEWALD-KESWICK GROVE ROAD, EAST OF JCPL POWERLINE, AND WEST OF THE GARDEN STATE PARKWAY. PATCHES ARE LOCATED 0.5 TO 2.3 MILES NORTH OF THE DOUBLE TROUBLE STATE PARK ENTRANCE, PARTLY WITHIN JAKES BRANCH COUNTY PARK IN BEACHWOOD BORO, AND PARTLY WITHIN DOUBLE TROUBLE STATE PARK AND PRIVATE LANDS IN BERKELEY TWP. |

2
21 SEP 2004

IMMEDIATE VICINITY OF PROJECT SITE
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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| MUHLENBERGIA TORREYANA | PINE BARREN SMOKE GRASS | | | LP | G3 | S3 | 1985-09-29 | Y | N. OF MIDDLE BRANCH FORKED RIVER, 0.25 MI. W. OF GARDEN STATE PARKWAY. |
| NARTHECIUM AMERICANUM | BOG ASPHODEL | C | E | LP | G2 | S2 | 1995-09-04 | Y | CA. 0.1 MILES EAST OF GARDEN STATE PARKWAY BETWEEN MIDDLE BRANCH AND SOUTH BRANCH OF FORKED RIVER, CA. 2 MILES SOUTHWEST OF THE INTERSECTION OF RT. 9 AND LACEY RD. |
| RHYNCHOSPORA KNIESKERNII | KNIESKERN'S BEAKED-RUSH | LT | E | LP | G2 | S2 | 1994-09-03 | Y | N. OF MIDDLE BRANCH FORKED RIVER, JUST W. OF GARDEN STATE PARKWAY. APPROXIMATELY 2.0 MILES SOUTH OF INTERCHANGE 74 OF GSP. |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 | 1907-07-25 | Y | LAKE INLET AT DOUBLE TROUBLE. |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 | 1915-07-10 | Y | CEDAR SWAMP ALONG SOUTH BRANCH OF FORKED RIVER SW OF FORKED RIVER. |

Records Processed

# Frequently Asked Questions About Natural Heritage Priority Sites

**What are Natural Heritage Priority Sites?**
Through its Natural Heritage Database, the Office of Natural Lands Management (ONLM) identifies critically important areas to conserve New Jersey's biological diversity. The database provides detailed, up-to-date information on rare species and natural communities to planners, developers, and conservation agencies for use in resource management, environmental impact assessment, and both public and private land protection efforts.

Using the database, ONLM has identified Natural Heritage Priority Sites that represent some of the best remaining habitat for rare species and exemplary natural communities in the state. These areas should be considered to be top priorities for the preservation of biological diversity in New Jersey. If these sites become degraded or destroyed, we may lose some of the unique components of our natural heritage.

ONLM has identified 410 priority sites over the course of more than 10 years. We have received assistance from many partner individuals and agencies over this time. The Nature Conservancy and the DEP Endangered and Nongame Species Program have provided key information or assisted with the delineation of a number of the sites.

**How are Natural Heritage Priority Site maps used in conservation of biological diversity?**
Natural Heritage Priority Site maps are used by individuals and agencies concerned with the protection and management of land. The maps have been used by municipalities preparing natural resource inventories; public and private conservation organizations preparing open space acquisition goals; land developers and consultants identifying environmentally sensitive lands; and public and private landowners developing land management plans.

Natural Heritage Priority Sites contain some of the best and most viable occurrences of endangered and threatened species and natural communities, but they do not cover all known habitat for endangered and threatened species in New Jersey. If information is needed on whether or not endangered or threatened species have been documented from a particular piece of land, a Natural Heritage Database search can be requested by contacting the Office of Natural Lands Management at the address below.

**What do the boundaries of the sites contain?**
The boundaries of each Natural Heritage Priority Site are drawn to encompass critical habitat for the rare species or natural communities. Often the boundaries extend to include additional buffer lands that should be managed to protect the habitat. A justification for the boundary is provided for each site. The term "primary bounds" is sometimes used to refer to boundaries enclosing critical habitat. The term "secondary bounds" is sometimes used to refer to boundaries enclosing additional buffer. In maps where both primary and secondary boundaries are described, only the outermost boundary is provided in the mapping.

**What is the background map that the sites are drawn upon?**
The sites are portrayed on background maps produced from a digital copy of the U.S. Geological Survey 7.5 minute topographic maps. The background maps contain topographic lines as well as streams, lakes, roads, towns and place names. These background maps do not always reflect recent changes in land development. Some may be more than 20 years old. Some sites appear to be shifted in position against this topo map. This shift is due to the fact that most sites have been digitized against a background of rectified aerial photography, and some of the digitized USGS topo maps do not align with this photography.

**What do "public lands" depict on the maps?**
The "public lands" shaded on these maps are state-owned open space lands that have been digitized as a GIS coverage by the state Green Acres Program. This information is provided to show patterns of State land ownership in the vicinity of the Priority Site. The public lands are areas such as State Parks and Forests, Wildlife Management Areas, and Natural Lands Trust preserves. They do not currently include lands owned by other state agencies, federal, county or municipal governments

or nonprofit conservation organizations. This GIS coverage is constantly being updated, and therefore future editions of the maps will likely contain additional public lands that are not currently mapped as such.

### What is the biodiversity significance rank and how is it used?

Each site is ranked according to its significance for biological diversity using a scale developed by The Nature Conservancy and the network of Natural Heritage Programs. The ranks can be used to distinguish between sites that are of global significance for conservation of biological diversity vs. those that are of state significance. The scale ranges from B1 to B5 with sites ranked B1-B3 generally being of global significance and sites ranked B4-B5 being of state significance. The specific definitions for each rank are as follows:

B1 - Outstanding significance, generally the "last of the least" in the world, such as the only known occurrence of any element (species or natural community), the best or an excellent occurrence of an element ranked critically imperiled globally, or a concentration (4+) of good or excellent occurrences of elements that are imperiled or critically imperiled globally. The site should be viable and defensible for the elements or ecological processes contained.

B2 - Very high significance, such as the most outstanding occurrence of any natural community. Also includes areas containing other occurrences of elements that are critically imperiled globally, a good or excellent occurrence of an element that is imperiled globally, an excellent occurrence of an element that is rare globally, or a concentration (4+) of good occurrences of globally rare elements or viable occurrences of globally imperiled elements.

B3 - High significance, such as any other viable occurrence of an element that is globally imperiled, a good occurrence of a globally rare element, an excellent occurrence of any natural community, or a concentration (4+) of good or excellent occurrences of elements that are critically imperiled in the State.

B4 - Moderate significance, such as a viable occurrence of a globally rare element, a good occurrence of any natural community, a good or excellent occurrence or only viable state occurrence of an element that is critically imperiled in the State, an excellent occurrence of an element that is imperiled in the State, or a concentration (4+) of good occurrences of elements that are imperiled in the State or excellent occurrences of elements that are rare in the State.

B5 - Of general biodiversity interest.

### How can I obtain Natural Heritage Priority Site maps for an area of interest to me?

Natural Heritage Priority Site hard copy maps can be obtained by submitting a written request accompanied by a check or money order made payable to the Office of Natural Lands Management at the following address:

Office of Natural Lands Management
P.O. Box 404
Trenton, NJ 08625-0404
Phone: 609-984-1339; Fax: 609-984-1427

Individual 8.5" X 11" maps are available at the following rate:

| | |
|---|---|
| 1 - 10 site maps & reports: | $1.50/site |
| 11 - 20 site maps & reports: | $1.00/site |
| > 20 sites: | $0.50/site |

*Digital GIS Coverage of Natural Heritage Priority Sites*

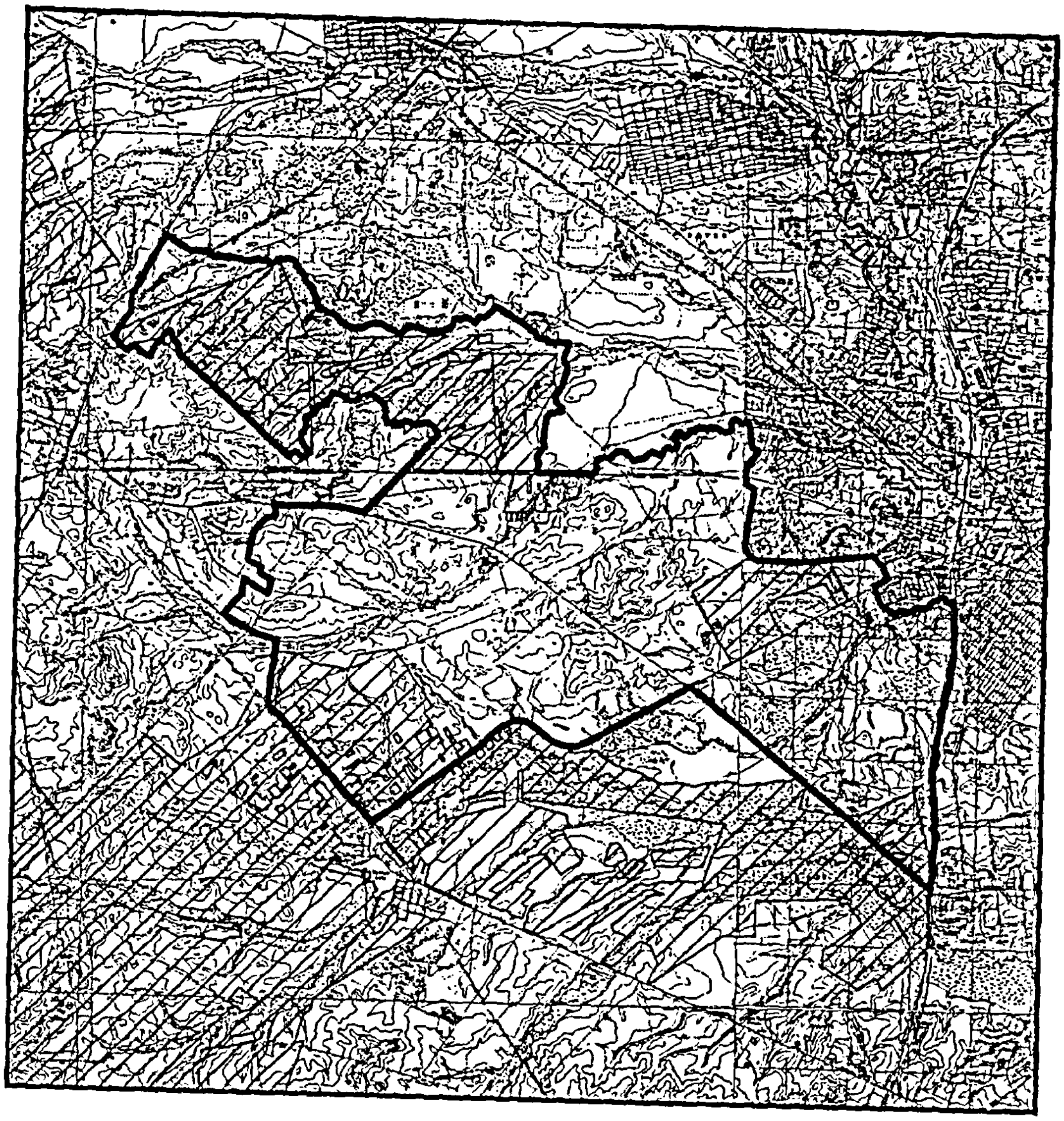
A digital version of the ArcView GIS file of Natural Heritage Priority Sites is also available. The zipped version of the file is approximately 1 MB in size. The 2001 version of Natural Heritage Priority Sites will be emailed upon request. The 1999 version of the digital files can be obtained on the internet at the following address: *http://www.state.nj.us/dep/gis/* -Click on "GIS Data Downloads" and then "Select a data layer" and then "Natural Heritage Priority Sites". There is no charge for emailing or downloading the GIS data.

### How often are the maps updated?

The Natural Heritage Priority Site information is constantly being updated in the Natural Heritage Database. A new edition of the maps will be made available after significant revisions or additions to the Database.

April 9, 2002

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management



Natural Heritage Priority Site

**Crossley RR Corridor Macrosite**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

1 0 1 Miles

Priority Site
Public Land

# Natural Heritage Priority Site
## Crossley RR Corridor Macrosite

*Locational Information*

Quad Name: Keswick Grove ; Toms River
County: Ocean
Municipality Berkeley Twp ; Manchester Twp ; Lacey Twp ; Beachwood Boro ; South Toms River Boro

*Description of Site*

A large patch of contiguous pine/oak woods with predominantly Lakehurst soils.

*Boundary Justification*

Bounds drawn to include large contiguous patch of pine/oak uplands that is habitat to endangered and threatened animal species.

*Biodiversity Rank* $\boxed{B4}$

Excellent site for State Endangered and Threatened animal species.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*60

Natural Heritage Priority Site

**Forked River Mountain Macrosite**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

1 0 1 Miles

Priority Site
Public Land

N W E S

# Natural Heritage Priority Site:
# Forked River Mountain Macrosite

***Locational Information***

| | |
|---|---|
| Quad Name: | Brookville ; Forked River ; Woodmansie ; Keswick Grove ; Whiting |
| County: | Ocean |
| Municipality | Lacey Twp ; Ocean Twp ; Manchester Twp ; Barnegat Twp |

***Description of Site***

A few small occurrences of dwarf pine plains (<150 acres) associated with up to 1000+ acres of transitional pine plains, and several small occurrences of hydric pine plains. Most of the plains are in the vicinity of Forked River Mountain, near the center of a large fireshed of over 30,000 acres. Within the fireshed are extensive occurrences of pitch pine-scrub oak barrens, other pine barrens and pine-oak forests, pitch pine lowlands, red maple-black gum palustrine forest, and atlantic white cedar palustrine forest.

***Boundary Justification***

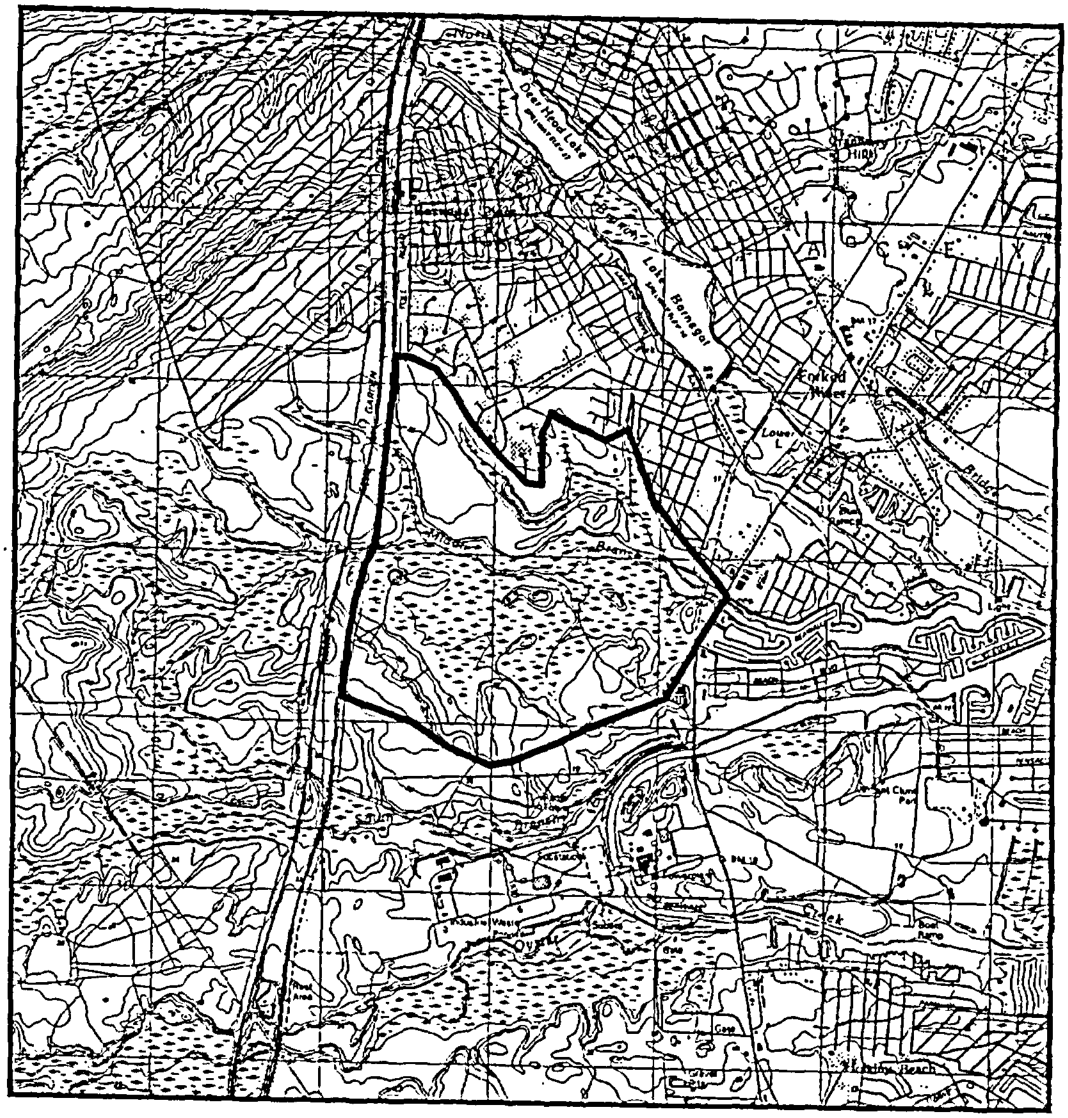
Fireshed limits where most plant community-maintaining wildfires would originate and be contained within, using convenient man-made and natural firebreaks and distribution of flammable pine barren plant communities for management purposes.

***Biodiversity Rank*** B2

The site contains a globally imperiled pine plains natural community.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*236




Natural Heritage Priority Site
**Middle Branch Forked River**
Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.4 0 0.4 Miles

Priority Site
Public Land

N W E S

# Natural Heritage Priority Site
# Middle Branch Forked River

*Locational Information*

Quad Name: Forked River
County: Ocean
Municipality Lacey Twp

*Description of Site*

Open wetlands adjacent to pine barren stream through Atantic white cedar swamp.

*Boundary Justification*

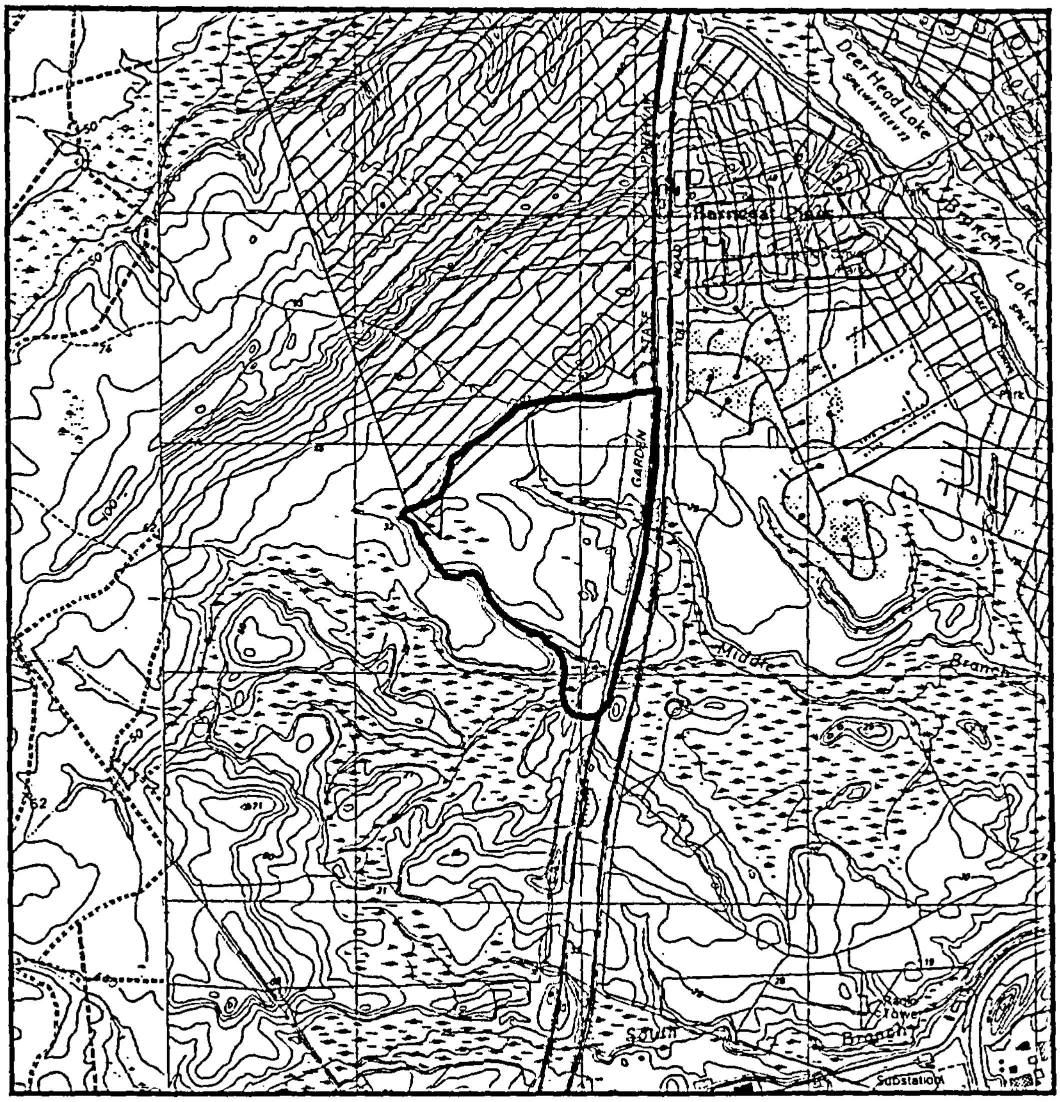
Boundaries include wetland habitat for rare plant species plus undeveloped uplands in the drainage basin east of the Garden State Parkway. With additional field work, bounds may be expanded upstream west of the Parkway.

*Biodiversity Rank* B2

Several globally rare and State listed plant species.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*365




Natural Heritage Priority Site

**Pits and Pond**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.3 0 0.3 Miles

Priority Site
Public Land

N W E S

# Natural Heritage Priority Site
## Pits and Pond

*Locational Information*

**Quad Name:** Forked River
**County:** Ocean
**Municipality** Lacey Twp

*Description of Site*

Two borrow pits (heavily used by ORV's) under and adjacent to mowed pipeline right-of-way through pitch pine lowland forest.

*Boundary Justification*

Uses existing sand roads to north, west, and south to enclose the adjacent wetlands and uplands draining towards the rare plants, with the Garden State Parkway forming the eastern boundary.

*Biodiversity Rank* B2

The site contains four globally rare plant species, two of which are state endangered, and one of which is also federally threatened.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*440

State of New Jersey
James E. McGreevey
*Governor*
Department of Environmental Protection
Division of Parks and Forestry
Office of Natural Lands Management
Natural Heritage Program
P.O. Box 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427
Bradley M. Campbell
Commissioner

September 22, 2004

William Mahler
Amergen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

Re: Oyster Creek Generating Station

Dear Mr. Mahler:

Thank you for your data request regarding rare species information for the above referenced project site in Lacey Township, Ocean County.

Searches of the Natural Heritage Database and the Landscape Project (Version 2) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Request for Data into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

We have checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat on the referenced site. Please see Table 1 for species list and conservation status.

Table 1 (on referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| barred owl | *Strix varia* | | T/T | G5 | S3B |
| black skimmer foraging area | *Rynchops niger* | | E | G5 | S1B |
| black-crowned night-heron foraging habitat | *Nycticorax nycticorax* | | T/S | G5 | S3B,S4N |
| colonial waterbird foraging habitat | | | | | |
| Cooper's hawk | *Accipiter cooperii* | | T/T | G5 | S3B,S4N |
| dotted skipper | *Hesperia attalus slossonae* | | Special Concern | G3G4T3 | S2S3 |
| eastern box turtle | *Terrapene carolina* | | Special Concern | G5 | S5B |
| Fowler's toad | *Bufo woodhousii fowleri* | | Special Concern | G5 | S4 |
| northern pine snake | *Pituophis m. melanoleucus* | | T | G4T4 | S3 |
| pine barrens treefrog | *Hyla andersonii* | | T | G4 | S3 |
| tern species foraging habitat | | | | | |
| wood turtle | *Clemmys insculpta* | | T | G4 | S3 |

We have also checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat within 1/4 mile of the referenced site. Please see Table 2 for species list and conservation status. This table excludes any species listed in Table 1.

Table 2 (additional species within 1/4 mile of referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| spotted turtle | *Clemmys guttata* | | Special Concern | G5 | S4 |

We have also checked the Natural Heritage Database for occurrences of rare plant species or natural communities. The Natural Heritage Data Base has records for occurrences of *Narthecium americanum* that may be on the site, and for *Pycnanthemum setosum* that may be on or in the immediate vicinity of the site, and for *Eupatorium resinosum*, *Pycnanthemum setosum*, *Juncus caesariensis* and *Schizaea pusilla* that may be in the immediate vicinity of the site. The

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*Recycled Paper*

attached lists provide more information about these occurrences. Because some species are sensitive to disturbance or sought by collectors, this information is provided to you on the condition that no specific locational data are released to the general public. This is not intended to preclude your submission of this information to regulatory agencies from which you are seeking permits.

Also attached is a list of rare species and natural communities that have been documented from Ocean County. If suitable habitat is present at the project site, these species have potential to be present.

Status and rank codes used in the tables and lists are defined in the attached EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State's best habitats for rare and endangered species and natural communities. One of these sites is located within or near the areas you have outlined. Please refer to the enclosed Natural Heritage Priority Site Map for the location and boundary of this site. On the back of each Priority Site Map is a report describing the significance of the site.

If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive I-Map-NJ website at the following URL, http://www.state.nj.us/dep/gis/imapnj/imapnj.htm or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Herbert A. Lord

Herbert A. Lord
Data Request Specialist

cc: Robert J. Cartica
Lawrence Niles
NHP File No. 04-3907472

# CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the database. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEP Land Use Regulation Program, P.O. Box 401, Trenton, NJ 08625-0401.

The Landscape Project was developed by the Division of Fish & Wildlife, Endangered and Nongame Species Program to map critical habitat for rare animal species. Some of the rare species data in the Landscape Project is in the Natural Heritage Database, while other records were obtained from other sources. Natural Heritage Database response letters will list all species (if any) found during a search of the Landscape Project. However, any reports that are included with the response letter will only reference specific records if they are in the Natural Heritage Database. This office cannot answer any inquiries about the Landscape Project. All questions should be directed to the DEP Division of Fish and Wildlife, Endangered and Nongame Species Program, P.O. Box 400, Trenton, NJ 08625-0400.

**This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.**

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

1
21 SEP 2004

POSSIBLY ON PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
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|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| NARTHECIUM AMERICANUM | BOG ASPHODEL | C | E | LP | G2 | S2 | 1991-05-22 | Y | CA. 1 MILE EAST-NORTHEAST OF OYSTER CREEK POWER PLANT AND SOUTH OF THE SOUTH BRANCH OF FORKED RIVER. APPROXIMATELY 1 1/2 MILES SOUTH OF THE INTERSECTION OF ROUTE 9 AND LACEY ROAD. |

1 Records Processed

1
21 SEP 2004

ON OR IN IMMEDIATE VICINITY OF PROJECT SITE
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|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN MINT | | | | G3? | S3 | 1993-??-?? | Y | SOUTH OF ORLANDO DRIVE AND NORTH OF OYSTER CREEK, LACEY TWP. |

1 Records Processed

1
21 SEP 2004

IMMEDIATE VICINITY OF PROJECT SITE
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|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| EUPATORIUM RESINOSUM | PINE BARREN BONESET | | E | LP | G3 | S2 | 1993-08-?? | Y | EAST SIDE OF ROUTE 9 JUST NORTH OF BAY PARKWAY. IN RECOVERING CRANBERRY BOG ON SOUTH BANK OF OYSTER CREEK. |
| JUNCUS CAESARIENSIS | NEW JERSEY RUSH | | E | LP | G2 | S2 | 1922-09-?? | Y | OYSTER CREEK ALONG TUCKERTON RR, NW (OF) WARETOWN. |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN MINT | | | | G3? | S3 | 1993-??-?? | Y | WEST OF CABLE ROAD AND EAST OF DOCK ROAD AND A SMALL EMBANKMENT OF OYSTER CREEK. |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 | 1993-??-?? | Y | SANDS HARBOR POINT, NORTHERNMOST TIP, NORTH OF BAY PARKWAY. |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 | 1993-??-?? | Y | EAST SIDE OF ROUTE 9, JUST NORTH OF BAY PARKWAY, SOUTH OF OYSTER CREEK. |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 | 1915-07-10 | Y | BY OYSTER CREEK NW ALONG TUCKERTON RR FROM WARETOWN. |

6 Records Processed

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The boundaries of each Natural Heritage Priority Site are drawn to encompass critical habitat for the rare species or natural communities. Often the boundaries extend to include additional buffer lands that should be managed to protect the habitat. A justification for the boundary is provided for each site.. The term "primary bounds" is sometimes used to refer to boundaries enclosing critical habitat. The term "secondary bounds" is sometimes used to refer to boundaries enclosing additional buffer. In maps where both primary and secondary boundaries are described, only the outermost boundary is provided in the mapping.

**What is the background map that the sites are drawn upon?**
The sites are portrayed on background maps produced from a digital copy of the U.S. Geological Survey 7.5 minute topographic maps. The background maps contain topographic lines as well as streams, lakes, roads, towns and place names. These background maps do not always reflect recent changes in land development. Some may be more than 20 years old. Some sites appear to be shifted in position against this topo map. This shift is due to the fact that most sites have been digitized against a background of rectified aerial photography, and some of the digitized USGS topo maps do not align with this photography.

**What do "public lands" depict on the maps?**
The "public lands" shaded on these maps are state-owned open space lands that have been digitized as a GIS coverage by the state Green Acres Program. This information is provided to show patterns of State land ownership in the vicinity of the Priority Site. The public lands are areas such as State Parks and Forests, Wildlife Management Areas, and Natural Lands Trust preserves. They do not currently include lands owned by other state agencies, federal, county or municipal governments

or nonprofit conservation organizations. This GIS coverage is constantly being updated, and therefore future editions of the maps will likely contain additional public lands that are not currently mapped as such.

### What is the biodiversity significance rank and how is it used?

Each site is ranked according to its significance for biological diversity using a scale developed by The Nature Conservancy and the network of Natural Heritage Programs. The ranks can be used to distinguish between sites that are of global significance for conservation of biological diversity vs. those that are of state significance. The scale ranges from B1 to B5 with sites ranked B1-B3 generally being of global significance and sites ranked B4-B5 being of state significance. The specific definitions for each rank are as follows:

B1 - Outstanding significance, generally the "last of the least" in the world, such as the only known occurrence of any element (species or natural community), the best or an excellent occurrence of an element ranked critically imperiled globally, or a concentration (4+) of good or excellent occurrences of elements that are imperiled or critically imperiled globally. The site should be viable and defensible for the elements or ecological processes contained.

B2 - Very high significance, such as the most outstanding occurrence of any natural community. Also includes areas containing other occurrences of elements that are critically imperiled globally, a good or excellent occurrence of an element that is imperiled globally, an excellent occurrence of an element that is rare globally, or a concentration (4+) of good occurrences of globally rare elements or viable occurrences of globally imperiled elements.

B3 - High significance, such as any other viable occurrence of an element that is globally imperiled, a good occurrence of a globally rare element, an excellent occurrence of any natural community, or a concentration (4+) of good or excellent occurrences of elements that are critically imperiled in the State.

B4 - Moderate significance, such as a viable occurrence of a globally rare element, a good occurrence of any natural community, a good or excellent occurrence or only viable state occurrence of an element that is critically imperiled in the State, an excellent occurrence of an element that is imperiled in the State, or a concentration (4+) of good occurrences of elements that are imperiled in the State or excellent occurrences of elements that are rare in the State.

B5 - Of general biodiversity interest.

### How can I obtain Natural Heritage Priority Site maps for an area of interest to me?

Natural Heritage Priority Site hard copy maps can be obtained by submitting a written request accompanied by a check or money order made payable to the Office of Natural Lands Management at the following address:

Office of Natural Lands Management
P.O. Box 404
Trenton, NJ 08625-0404
Phone: 609-984-1339; Fax: 609-984-1427

Individual 8.5" X 11" maps are available at the following rate:

| | |
|---|---|
| 1 - 10 site maps & reports: | $1.50/site |
| 11 - 20 site maps & reports: | $1.00/site |
| > 20 sites: | $0.50/site |

*Digital GIS Coverage of Natural Heritage Priority Sites*

A digital version of the ArcView GIS file of Natural Heritage Priority Sites is also available. The zipped version of the file is approximately 1 MB in size. The 2001 version of Natural Heritage Priority Sites will be emailed upon request. The 1999 version of the digital files can be obtained on the internet at the following address: *http://www.state.nj.us/dep/gis/* -Click on "GIS Data Downloads" and then "Select a data layer" and then "Natural Heritage Priority Sites". There is no charge for emailing or downloading the GIS data.

### How often are the maps updated?

The Natural Heritage Priority Site information is constantly being updated in the Natural Heritage Database. A new edition of the maps will be made available after significant revisions or additions to the Database.

April 9, 2002

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

Natural Heritage Priority Site

**Middle Branch Forked River**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.4 0 0.4 Miles

Priority Site
Public Land

# Natural Heritage Priority Site
# Middle Branch Forked River

*Locational Information*

**Quad Name:** Forked River
**County:** Ocean
**Municipality** Lacey Twp

*Description of Site*

Open wetlands adjacent to pine barren stream through Atantic white cedar swamp.

*Boundary Justification*

Boundaries include wetland habitat for rare plant species plus undeveloped uplands in the drainage basin east of the Garden State Parkway. With additional field work, bounds may be expanded upstream west of the Parkway.

*Biodiversity Rank* B2

Several globally rare and State listed plant species.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*365

EXPLANATIONS OF CODES USED IN NATURAL HERITAGE REPORTS

FEDERAL STATUS CODES

The following U.S. Fish and Wildlife Service categories and their definitions of endangered and threatened plants and animals have been modified from the U.S. Fish and Wildlife Service (F.R. Vol. 50 No. 188; Vol. 61, No. 40; F.R. 50 CFR Part 17). Federal Status codes reported for species follow the most recent listing.

| | |
|---|---|
| LE | Taxa formally listed as endangered. |
| LT | Taxa formally listed as threatened. |
| PE | Taxa already proposed to be formally listed as endangered. |
| PT | Taxa already proposed to be formally listed as threatened. |
| C | Taxa for which the Service currently has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species. |
| S/A | Similarity of appearance species. |

STATE STATUS CODES

Two animal lists provide state status codes after the Endangered and Nongame Species Conservation Act of 1973 (NSSA 23:2A-13 et. seq.): the list of endangered species (N.J.A.C. 7:25-4.13) and the list defining status of indigenous, nongame wildlife species of New Jersey (N.J.A.C. 7:25-4.17(a)). The status of animal species is determined by the Nongame and Endangered Species Program (ENSP). The state status codes and definitions provided reflect the most recent lists that were revised in the New Jersey Register, Monday, June 3, 1991.

| | |
|---|---|
| D | Declining species-a species which has exhibited a continued decline in population numbers over the years. |
| E | Endangered species-an endangered species is one whose prospects for survival within the state are in immediate danger due to one or many factors - a loss of habitat, over exploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow. |
| EX | Extirpated species-a species that formerly occurred in New Jersey, but is not now known to exist within the state. |
| I | Introduced species-a species not native to New Jersey that could not have established itself here without the assistance of man. |
| INC | Increasing species-a species whose population has exhibited a significant increase, beyond the normal range of its life cycle, over a long term period. |
| T | Threatened species-a species that may become endangered if conditions surrounding the species begin to or continue to deteriorate. |
| P | Peripheral species-a species whose occurrence in New Jersey is at the extreme edge of its present natural range. |
| S | Stable species-a species whose population is not undergoing any long-term increase/decrease within its natural cycle. |
| U | Undetermined species-a species about which there is not enough information available to determine the status. |

Status for animals separated by a slash(/) indicate a duel status. First status refers to the state breeding population, and the second status refers to the migratory or winter population.

Plant taxa listed as endangered are from New Jersey's official Endangered Plant Species List N.J.S.A. 131B-15.151 et seq.

E Native New Jersey plant species whose survival in the State or nation is in jeopardy.

REGIONAL STATUS CODES FOR PLANTS

LP Indicates taxa listed by the Pinelands Commission as endangered or threatened within their legal jurisdiction. Not all species currently tracked by the Pinelands Commission are tracked by the Natural Heritage Program. A complete list of endangered and threatened Pineland species is included in the New Jersey Pinelands Comprehensive Management Plan.

EXPLANATION OF GLOBAL AND STATE ELEMENT RANKS

The Nature Conservancy has developed a ranking system for use in identifying elements (rare species and natural communities) of natural diversity most endangered with extinction. Each element is ranked according to its global, national, and state (or subnational in other countries) rarity. These ranks are used to prioritize conservation work so that the most endangered elements receive attention first. Definitions for element ranks are after The Nature Conservancy (1982: Chapter 4, 4.1-1 through 4.4.1.3-3).

GLOBAL ELEMENT RANKS

G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout it's range; with the number of occurrences in the range of 21 to 100.

G4 Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.

GH Of historical occurrence throughout its range i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU Possibly in peril range-wide but status uncertain; more information needed.

GX Believed to be extinct throughout range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? Species has not yet been ranked.

STATE ELEMENT RANKS

S1 Critically imperiled in New Jersey because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.

S2 Imperiled in New Jersey because of rarity (6 to 20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences.

S3 Rare in state with 21 to 100 occurrences (plant species in this category have only 21 to 50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences.

S4 Apparently secure in state, with many occurrences.

S5 Demonstrably secure in state and essentially ineradicable under present conditions.

SA Accidental in state, including species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded; examples include European strays or western birds on the East Coast and vice-versa.

SE Elements that are clearly exotic in New Jersey including those taxa not native to North America (introduced taxa) or taxa deliberately or accidentally introduced into the State from other parts of North America (adventive taxa). Taxa ranked SE are not a conservation priority (viable introduced occurrences of G1 or G2 elements may be exceptions).

SH Elements of historical occurrence in New Jersey. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all of the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work.

SP Element has potential to occur in New Jersey, but no occurrences have been reported.

SR Elements reported from New Jersey, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. In some instances documentation may exist, but as of yet, its source or location has not been determined.

SRF Elements erroneously reported from New Jersey, but this error persists in the literature.

SU Elements believed to be in peril but the degree of rarity uncertain. Also included are rare taxa of uncertain taxonomical standing. More information is needed to resolve rank.

SX Elements that have been determined or are presumed to be extirpated from New Jersey. All historical occurrences have been searched and a reasonable search of potential habitat has been completed. Extirpated taxa are not a current conservation priority.

SXC Elements presumed extirpated from New Jersey, but native populations collected from the wild exist in cultivation.

SZ Not of practical conservation concern in New Jersey, because there are no definable occurrences, although the taxon is native and appears regularly in the state. An SZ rank will generally be used for long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations), transitory, and dispersed to be reliably identified, mapped and protected. In other words, the migrant regularly passes through the state, but enduring, mappable element occurrences cannot be defined.

Typically, the SZ rank applies to a non-breeding population (N) in the state – for example, birds on migration. An SZ rank may in a few instances also apply to a breeding population (B), for example certain lepidoptera which regularly die out every year with no significant return migration.

Although the SZ rank typically applies to migrants, it should not be used indiscriminately. Just because a species is on migration does not mean it receives an SZ rank. SZ will only apply when the migrants occur in an irregular, transitory and dispersed manner.

B Refers to the breeding population of the element in the state.

N Refers to the non-breeding population of the element in the state.

T Element ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species. For example *Stachys palustris* var. *homotricha* is ranked "G5T? SH" meaning the full species is globally secure but the global rarity of the var. *homotricha* has not been determined; in New Jersey the variety is ranked historic.

Q Elements containing a "Q" in the global portion of its rank indicates that the taxon is of questionable, or uncertain taxonomical standing, e.g., some authors regard it as a full species, while others treat it at the subspecific level.

.1 Elements documented from a single location.

Note: To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).

IDENTIFICATION CODES

These codes refer to whether the identification of the species or community has been checked by a reliable individual and is indicative of significant habitat.

Y Identification has been verified and is indicative of significant habitat.

BLANK Identification has not been verified but there is no reason to believe it is not indicative of significant habitat.

? Either it has not been determined if the record is indicative of significant habitat or the identification of the species or community may be confusing or disputed.

Revised September 1998

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OCEAN COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| *** Vertebrates | | | | | | |
| ACCIPITER COOPERII | COOPER'S HAWK | | T/T | | G5 | S3B,S4N |
| AMBYSTOMA TIGRINUM TIGRINUM | EASTERN TIGER SALAMANDER | | E | | G5T5 | S2 |
| AMMODRAMUS SAVANNARUM | GRASSHOPPER SPARROW | | T/S | | G5 | S2B |
| ARDEA HERODIAS | GREAT BLUE HERON | | S/S | | G5 | S2B,S4N |
| BARTRAMIA LONGICAUDA | UPLAND SANDPIPER | | E | | G5 | S1B |
| BOTAURUS LENTIGINOSUS | AMERICAN BITTERN | | E/S | | G4 | S2B |
| BUTEO LINEATUS | RED-SHOULDERED HAWK | | E/T | | G5 | S1B,S2N |
| CALIDRIS CANUTUS | RED KNOT | | T | | G5 | S3N |
| CHARADRIUS MELODUS | PIPING PLOVER | LT | E | | G3 | S1B |
| CIRCUS CYANEUS | NORTHERN HARRIER | | E/U | | G5 | S1B,S3N |
| CISTOTHORUS PLATENSIS | SEDGE WREN | | E | | G5 | S1B |
| CLEMMYS INSCULPTA | WOOD TURTLE | | T | | G4 | S3 |
| CLEMMYS MUHLENBERGII | BOG TURTLE | LT | E | | G3 | S2 |
| CROTALUS HORRIDUS HORRIDUS | TIMBER RATTLESNAKE | | E | | G4T4 | S2 |
| EGRETTA CAERULEA | LITTLE BLUE HERON | | S/S | | G5 | S2B |
| EGRETTA THULA | SNOWY EGRET | | S/S | | G5 | S3B,S4N |
| EGRETTA TRICOLOR | TRICOLORED HERON | | INC/S | | G5 | S3B |
| ELAPHE GUTTATA GUTTATA | CORN SNAKE | | E | | G5T5 | S1 |
| EUMECES FASCIATUS | FIVE-LINED SKINK | | U | | G5 | S3 |
| FALCO PEREGRINUS | PEREGRINE FALCON | | E | | G4 | S1B,S?N |
| HALIAEETUS LEUCOCEPHALUS | BALD EAGLE | LT | E | | G4 | S1B,S2N |
| HYLA ANDERSONII | PINE BARRENS TREEFROG | | E | | G4 | S3 |
| HYLA CHRYSOSCELIS | COPE'S GRAY TREEFROG | | E | | G5 | S2 |
| IXOBRYCHUS EXILIS | LEAST BITTERN | | D/S | | G5 | S3B |
| LAMPROPELTIS GETULA GETULA | EASTERN KING SNAKE | | SC | | G5T5 | S3 |
| LATERALLUS JAMAICENSIS | BLACK RAIL | | T/T | | G4 | S2B |
| LYNX RUFUS | BOBCAT | | E | | G5 | S3 |
| MELANERPES ERYTHROCEPHALUS | RED-HEADED WOODPECKER | | T/T | | G5 | S2B,S2N |
| NYCTANASSA VIOLACEA | YELLOW-CROWNED NIGHT-HERON | | T/T | | G5 | S2B |

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OCEAN COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| NYCTICORAX NYCTICORAX | BLACK-CROWNED NIGHT-HERON | | T/S | | G5 | S3B,S4N |
| PANDION HALIAETUS | OSPREY | | T/T | | G5 | S2B |
| PITUOPHIS MELANOLEUCUS MELANOLEUCUS | NORTHERN PINE SNAKE | | T | | G4T4 | S3 |
| PLEGADIS FALCINELLUS | GLOSSY IBIS | | D/S | | G5 | S3B,S4N |
| PODILYMBUS PODICEPS | PIED-BILLED GREBE | | E/S | | G5 | S1B,S3N |
| POOECETES GRAMINEUS | VESPER SPARROW | | E | | G5 | S1B,S2N |
| RYNCHOPS NIGER | BLACK SKIMMER | | E | | G5 | S1B |
| STERNA ANTILLARUM | LEAST TERN | | E | | G4 | S1B |
| STERNA DOUGALLII DOUGALLII | ROSEATE TERN | LE | E | | G4T3 | SHB |
| STERNA HIRUNDO | COMMON TERN | | D/S | | G5 | S3B |
| STERNA NILOTICA | GULL-BILLED TERN | | S | | G5 | S1B |
| STRIX VARIA | BARRED OWL | | T/T | | G5 | S3B |
| SYNAPTOMYS COOPERI | SOUTHERN BOG LEMMING | | U | | G5 | S2 |
| *** Ecosystems | | | | | | |
| COASTAL DUNE SHRUBLAND | COASTAL DUNE SHRUBLAND | | | | G4 | S2? |
| COASTAL DUNE WOODLAND | COASTAL DUNE WOODLAND | | | | G2G3 | S1 |
| MARINE INTERTIDAL GRAVEL/SAND | MARINE INTERTIDAL GRAVEL/SAND | | | | GU | SU |
| BEACH COMMUNITY | BEACH COMMUNITY | | | | | |
| PINE PLAINS | DWARF PITCH PINE-BLACKJACK OAK PINE PLAINS | | | | G1 | S1 |
| PINUS RIGIDA-CALAMOVILFA BREVIPILIS SAVANNA | PITCH PINE-PINELANDS REEDGRASS SAVANNA | | | | G1 | S1 |
| *** Invertebrates | | | | | | |
| ACRONICTA ALBARUFA | BARRENS DAGGERMOTH | | | | G3G4 | SU |
| AESHNA CLEPSYDRA | MOTTLED DARNER | | | | G4 | S2S3 |
| AGROTIS BUCHHOLZI | BUCHHOLZ'S DART | | | | G2 | S2 |
| AMBLYSCIRTES VIALIS | ROADSIDE SKIPPER | | | | G5 | S2S3 |

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OCEAN COUNTY
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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| APHARETRA DENTATA | A NOCTUID MOTH | | | | G4 | S2S3 |
| ATRYTONE AROGOS AROGOS | AROGOS SKIPPER | | E | | G3G4T1T2 | S1 |
| BOLORIA SELENE MYRINA | A SILVER-BORDERED FRITILLARY | | T | | G5T5 | S2 |
| CALLOPHRYS HENRICI | HENRY'S ELFIN | | | | G5 | S3S4 |
| CALLOPHRYS HESSELI | HESSEL'S HAIRSTREAK | | | | G3G4 | S3S4 |
| CALLOPHRYS IRUS | FROSTED ELFIN | | T | | G3 | S2S3 |
| CALLOPHRYS POLIOS | HOARY ELFIN | | | | G5 | S3 |
| CALLOPISTRIA GRANITOSA | GRANITOSA FERN MOTH | | | | G4G5 | S2S3 |
| CATOCALA HERODIAS GERHARDI | HERODIAS OR GERHARD'S UNDERWING | | | | G3T3 | S3 |
| CATOCALA JAIR SSP 2 | | | | | G4T4 | S3 |
| CELITHEMIS MARTHA | MARTHA'S PENNANT | | | | G4 | S3S4 |
| CICINDELA DORSALIS DORSALIS | NORTHEASTERN BEACH TIGER BEETLE | LT | E | | G4T2 | S1 |
| CICINDELA PATRUELA CONSENTANEA | A TIGER BEETLE | | | | G3T2T3 | S2S3 |
| CRAMBUS DAECKELLUS | DAECKE'S PYRALID MOTH | | | | G1G3 | S1S3 |
| DATANA RANAECEPS | A HAND-MAID MOTH | | | | G3G4 | S3S4 |
| ENALLAGMA PICTUM | SCARLET BLUET | | | | G3 | S3 |
| ENALLAGMA RECURVATUM | PINE BARRENS BLUET | | | | G3 | S3 |
| ERYNNIS PERSIUS PERSIUS | A PERSIUS DUSKY WING | | | | G5T2T3 | SH |
| EUPHYES BIMACULA | TWO-SPOTTED SKIPPER | | | | G4 | S3 |
| FARONTA RUBRIPENNIS | PINK STREAK | | | | G3G4 | S3 |
| GLENA PLUMOSARIA | | | | | G4 | SU |
| GRAMMIA PLACENTIA | PLACENTIA TIGER MOTH | | | | G4 | S1S3 |
| HESPERIA ATTALUS SLOSSONAE | DOTTED SKIPPER | | | | G3G4T3 | S2S3 |
| HETAERINA AMERICANA | AMERICAN RUBYSPOT | | | | G5 | S3 |
| HETEROCAMPA VARIA | A NOTODONTID MOTH | | | | G3G4 | S3 |
| HYPOMECIS BUCHHOLZARIA | BUCHHOLZ'S GRAY | | | | G3G4 | S3 |
| ITAME SP 1 | A SPANWORM | | | | G3 | S3 |

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OCEAN COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| LIBELLULA AURIPENNIS | GOLDEN-WINGED SKIMMER | | | | G5 | S1S2 |
| LIBELLULA AXILENA | BAR-WINGED SKIMMER | | | | G5 | S2BS3B,SZ N |
| LITHOPHANE LEMMERI | LEMMER'S PINION MOTH | | | | G3G4 | S2 |
| MACROCHILO SP 1 | A NOCTUID MOTH | | | | G3 | S3 |
| MEROLONCHE DOLLI | DOLL'S MEROLONCHE | | | | G3G4 | S1S3 |
| METARRANTHIS PILOSARIA | COASTAL BOG METARRANTHIS | | | | G3G4 | S3S4 |
| METARRANTHIS SP 1 | A GEOMETRID MOTH | | | | G3 | S2 |
| NEONYMPHA AREOLATA SEPTENTRIONALIS | A SATYR | | | | G4T3T4 | S3 |
| NICROPHORUS AMERICANUS | AMERICAN BURYING BEETLE | LE | E | | G2G3 | SH |
| PONTIA PROTODICE | CHECKERED WHITE | | T | | G4 | S1 |
| PTICHODIS BISTRIGATA | SOUTHERN PTICHODIS | | | | G3 | S1S3 |
| PYGARCTIA ABDOMINALIS | YELLOW EDGED PYGARCTIA | | | | G3G4 | SH |
| RICHIA SP 2 | | | | | G1Q | S1 |
| SEMIOTHISA EREMIATA | THREE-LINED ANGLE MOTH | | | | G4 | SU |
| SPARTINIPHAGA CARTERAE | CARTER'S NOCTUID MOTH | | | | G2G3 | S2 |
| ZALE SP 1 | PINE BARRENS ZALE | | | | G3G4 | S3 |
| ZANCLOGNATHA SP 1 | | | | | G3G4 | S3 |
| ZANCLOGNATHA THERALIS | | | | | G4 | SH |
| *** Other types | | | | | | |
| BALD EAGLE WINTERING SITE | BALD EAGLE WINTERING SITE | | | | G? | S? |
| COASTAL HERON ROOKERY | COASTAL HERON ROOKERY | | | | GU | S3 |
| MIGRATORY SHOREBIRD CONCENTRATION SITE | MIGRATORY SHOREBIRD CONCENTRATION SITE | | | | G? | S? |
| *** Vascular plants | | | | | | |
| ALOPECURUS AEQUALIS VAR AEQUALIS | SHORT-AWN MEADOW-FOXTAIL | | | | G5T? | S2 |

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OCEAN COUNTY
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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| AMARANTHUS PUMILUS | SEABEACH AMARANTH | LT | E | | G2 | S1 |
| AMIANTHIUM MUSCITOXICUM | FLY POISON | | | | G4G5 | S2 |
| ARETHUSA BULBOSA | DRAGON MOUTH | | | | G4 | S2 |
| ARISTIDA DICHOTOMA VAR CURTISSII | CURTISS' THREE-AWN GRASS | | | | G5T5 | S2 |
| ARISTOLOCHIA SERPENTARIA | VIRGINIA SNAKEROOT | | | | G4 | S3 |
| ARTEMISIA CAMPESTRIS SSP CAUDATA | BEACH WORMWOOD | | | | G5T5 | S2 |
| ASCLEPIAS LANCEOLATA | SMOOTH ORANGE MILKWEED | | | | G5 | S2 |
| ASCLEPIAS RUBRA | RED MILKWEED | | | LP | G4G5 | S2 |
| ASTER RADULA | LOW ROUGH ASTER | | E | | G5 | S1 |
| BUCHNERA AMERICANA | BLUEHEARTS | | | | G5? | SX |
| CACALIA ATRIPLICIFOLIA | PALE INDIAN PLANTAIN | | E | | G4G5 | S1 |
| CALAMOVILFA BREVIPILIS | PINE BARREN REEDGRASS | | | LP | G4 | S4 |
| CARDAMINE LONGII | LONG'S BITTERCRESS | | E | | G3 | SH |
| CAREX BARRATTII | BARRATT'S SEDGE | | | LP | G4 | S4 |
| CAREX MITCHELLIANA | MITCHELL'S SEDGE | | | | G3G4 | S2 |
| CAREX PALLESCENS | PALE SEDGE | | | | G5 | S2 |
| CAREX WILLDENOWII VAR WILLDENOWII | WILLDENOW'S SEDGE | | | | G5T5 | S2 |
| CIRSIUM VIRGINIANUM | VIRGINIA THISTLE | | E | | G3 | S1 |
| CLITORIA MARIANA | BUTTERFLY-PEA | | E | | G5 | S1 |
| COREMA CONRADII | BROOM CROWBERRY | | E | LP | G4 | S1 |
| COREOPSIS ROSEA | ROSE-COLOR COREOPSIS | | | LP | G3 | S2 |
| CROTON WILLDENOWII | ELLIPTICAL RUSHFOIL | | | LP | G5 | S2 |
| DESMODIUM PAUCIFLORUM | FEW-FLOWER TICK-TREFOIL | | E | | G5 | S1 |
| ELEOCHARIS HALOPHILA | SALT-MARSH SPIKE-RUSH | | | | G4 | S2 |
| ELEOCHARIS TORTILIS | TWISTED SPIKE-RUSH | | E | | G5 | S1 |
| ERIOCAULON PARKERI | PARKER'S PIPEWORT | | | | G3 | S2 |
| ERIOPHORUM TENELLUM | ROUGH COTTON-GRASS | | E | | G5 | S1 |

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27 JUN 2002

OCEAN COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| ERYNGIUM AQUATICUM VAR AQUATICUM | MARSH RATTLESNAKE-MASTER | | | | G4T4 | S3 |
| EUPATORIUM RESINOSUM | PINE BARREN BONESET | | E | LP | G3 | S2 |
| FIMBRISTYLIS CAROLINIANA | CAROLINA FIMBRY | | | | G4 | S2 |
| FRAXINUS PROFUNDA | PUMPKIN ASH | | E | | G4 | S1 |
| FUIRENA SQUARROSA | HAIRY UMBRELLA-SEDGE | | | | G4G5 | S3 |
| GALACTIA VOLUBILIS | DOWNY MILK-PEA | | E | | G5 | SH |
| GENTIANA AUTUMNALIS | PINE BARREN GENTIAN | | | LP | G3 | S3 |
| GLAUX MARITIMA | SEA-MILKWORT | | E | | G5 | SX.1 |
| GNAPHALIUM HELLERI | SMALL EVERLASTING | | E | | G4G5T3? | SH |
| HELONIAS BULLATA | SWAMP-PINK | LT | E | LP | G3 | S3 |
| HONCKENYA PEPLOIDES VAR ROBUSTA | SEABEACH SANDWORT | | | | G5T4 | S2 |
| HOTTONIA INFLATA | FEATHERFOIL | | E | | G4 | S1 |
| HOUSTONIA LONGIFOLIA | LONG-LEAF SUMMER BLUET | | | | G4G5 | SH |
| JEFFERSONIA DIPHYLLA | TWINLEAF | | E | | G5 | S1 |
| JUNCUS CAESARIENSIS | NEW JERSEY RUSH | | E | LP | G2 | S2 |
| JUNCUS GREENEI | GREENE'S RUSH | | | | G5 | S2 |
| JUNCUS TORREYI | TORREY'S RUSH | | E | | G5 | S1 |
| LIMOSELLA SUBULATA | AWL-LEAF MUDWORT | | E | | G4G5 | S1 |
| LINUM INTERCURSUM | SANDPLAIN FLAX | | E | | G4 | S1 |
| LISTERA AUSTRALIS | SOUTHERN TWAYBLADE | | | LP | G4 | S2 |
| LOBELIA CANBYI | CANBY'S LOBELIA | | | LP | G4 | S3 |
| LUDWIGIA BREVIPES | TUCKER'S ISLAND PRIMROSE-WILLOW | | | | G4G5 | SX.1 |
| LUZULA ACUMINATA | HAIRY WOOD-RUSH | | E | | G5T4T5 | S2 |
| MELANTHIUM VIRGINICUM | VIRGINIA BUNCHFLOWER | | E | | G5 | S1 |
| MUHLENBERGIA TORREYANA | PINE BARREN SMOKE GRASS | | | LP | G3 | S3 |
| MYRIOPHYLLUM TENELLUM | SLENDER WATER-MILFOIL | | E | | G5 | S1 |
| MYRIOPHYLLUM VERTICILLATUM | WHORLED WATER-MILFOIL | | E | | G5 | SH |

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27 JUN 2002

OCEAN COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| NARTHECIUM AMERICANUM | BOG ASPHODEL | C | E | LP | G2 | S2 |
| NYMPHOIDES CORDATA | FLOATINGHEART | | | LP | G5 | S3 |
| OENOTHERA HUMIFUSA | SEA-BEACH EVENING-PRIMROSE | | E | | G5 | S2 |
| ONOSMODIUM VIRGINIANUM | VIRGINIA FALSE-GROMWELL | | E | | G4 | S1 |
| PASPALUM DISSECTUM | MUDBANK CROWN GRASS | | | | G4? | S2 |
| PHORADENDRON LEUCARPUM | AMERICAN MISTLETOE | | | LP | G5 | S2 |
| PITYOPSIS FALCATA | SICKLE-LEAF GOLDEN-ASTER | | | LP | G3G4 | S3 |
| PLANTAGO MARITIMA VAR JUNCOIDES | SEASIDE PLANTAIN | | | | G5T5 | S2 |
| PLANTAGO PUSILLA | DWARF PLANTAIN | | E | | G5 | SH |
| POLYGONUM GLAUCUM | SEA-BEACH KNOTWEED | | E | | G3 | S1 |
| PRENANTHES AUTUMNALIS | PINE BARREN RATTLESNAKE-ROOT | | | LP | G4G5 | S2 |
| PRUNUS ANGUSTIFOLIA | CHICKASAW PLUM | | E | | G5T4T5 | S2 |
| PUCCINELLIA FASCICULATA | SALTMARSH ALKALI GRASS | | | | G3G5 | S2 |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 |
| RANUNCULUS CYMBALARIA | SEASIDE BUTTERCUP | | E | | G5 | SH |
| RHODODENDRON ATLANTICUM | DWARF AZALEA | | E | | G4G5 | S1 |
| RHYNCHOSPORA CEPHALANTHA | LARGE-HEAD BEAKED-RUSH | | | LP | G5 | S3 |
| RHYNCHOSPORA GLOBULARIS | COARSE GRASS-LIKE BEAKED-RUSH | | E | | G5? | S1 |
| RHYNCHOSPORA INUNDATA | SLENDER HORNED-RUSH | | | LP | G3G4 | S2 |
| RHYNCHOSPORA KNIESKERNII | KNIESKERN'S BEAKED-RUSH | LT | E | LP | G1 | S1 |
| RHYNCHOSPORA MICROCEPHALA | SMALL-HEAD BEAKED-RUSH | | E | | G5T5 | S1 |
| RHYNCHOSPORA NITENS | SHORT-BEAKED BALD-RUSH | | | | G4? | S2 |
| RHYNCHOSPORA PALLIDA | PALE BEAKED-RUSH | | | | G3 | S3 |
| RUBUS RECURVICAULIS | BLANCHARD'S DEWBERRY | | | | G4? | S1.1 |
| RUMEX HASTATULUS | ENGELMANN'S SORREL | | | | G5 | SH |
| SABATIA CAMPANULATA | SLENDER MARSH-PINK | | | | G5 | S3 |
| SABATIA DODECANDRA VAR DODECANDRA | LARGE MARSH-PINK | | | | G5?T4T5 | S2 |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 |

27 JUN 2002

OCEAN COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| SCHWALBEA AMERICANA | CHAFFSEED | LE | E | LP | G2 | S1 |
| SCIRPUS LONGII | LONG'S WOOLGRASS | | E | LP | G2 | S2 |
| SCIRPUS MARITIMUS | SALTMARSH BULRUSH | | E | | G5 | SH |
| SCLERIA MINOR | SLENDER NUT-RUSH | | | LP | G4 | S4 |
| SOLIDAGO STRICTA | WAND-LIKE GOLDENROD | | | LP | G5 | S3 |
| SOLIDAGO TARDA | LATE GOLDENROD | | | | G4?Q | S3 |
| SPIRANTHES LACINIATA | LACE-LIP LADIES'-TRESSES | | E | | G4G5 | S1 |
| SPIRANTHES ODORATA | FRAGRANT LADIES'-TRESSES | | | | G5 | S2 |
| STYLISMA PICKERINGII VAR PICKERINGII | PICKERING'S MORNING-GLORY | | E | LP | G4T2T3 | S1 |
| TIPULARIA DISCOLOR | CRANEFLY ORCHID | | | | G4G5 | S3 |
| TRIDENS FLAVUS VAR CHAPMANII | CHAPMAN'S REDTOP | | E | | G5T? | SH |
| TRIGLOCHIN MARITIMA | SEASIDE ARROW-GRASS | | E | | G5 | S1 |
| UTRICULARIA BIFLORA | TWO-FLOWER BLADDERWORT | | E | | G5 | S1 |
| UTRICULARIA MINOR | LESSER BLADDERWORT | | E | | G5 | S1 |
| UTRICULARIA PURPUREA | PURPLE BLADDERWORT | | | LP | G5 | S3 |
| UVULARIA PUBERULA VAR NITIDA | PINE BARREN BELLWORT | | E | | G5T3? | S2 |
| VERBENA SIMPLEX | NARROW-LEAF VERVAIN | | E | | G5 | S1 |
| XYRIS FIMBRIATA | FRINGED YELLOW-EYED-GRASS | | E | | G5 | S1 |
| ZIGADENUS LEIMANTHOIDES | DEATH-CAMUS | | E | | G4Q | S1 |

201 Records Processed

MICHAEL P. GALLAGHER
LICENSING SECTION

JAN 27 2005

REFER TO:

**State of New Jersey**

Richard J. Codey
*Acting Governor*

Department of Environmental Protection

Division of Fish, and Wildlife
Martin J. McHugh, Director
P.O. Box 400
Trenton, NJ 08625-0400
tel. 609-292-2965, fax 609-984-1414
Visit our Division Website: njfishandwildlife.com

Bradley M. Campbell
*Commissioner*

January 18, 2005

AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

Dear Mr Gallagher:

I am responding at Larry Nile's request to your letter of 12/3/2003 to Dr. Niles regarding renewal of AmerGen's operating license for the Oyster Creek Generating Station. Specifically your letter requested additional information regarding Threatened and Endangered species potentially affected by the operation of OCGS. You letter included a copy of response from the New Jersey Natural Heritage Program that provides a thorough accounting of Endangered and Threatened species found in the project area. At this time we have no additional information to add to that provided by NHP. Our agency is responsible for managing and monitoring of Endangered and Threatened wildlife species only, so I cannot comment with regard to any additional information that may exist pertaining to listed plant species. If you require any additional information with regard to Endangered and Threatened wildlife, please do no hesitate to contact me directly.

Sincerely,

C. David Jenkins, Jr.
Principal Zoologist
Endangered and Nongame Species Program

cc. Larry Niles, Chief, ENSP

State of New Jersey

James E. McGreevey
*Governor*

Department of Environmental Protection
Division of Parks and Forestry
Office of Natural Lands Management
Natural Heritage Program
P.O. Box 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427

Bradley M. Campbell
Commissioner

September 22, 2004

William Mahler
Amergen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

Re: Oyster Creek Generating Station to Manitou Substation Transmission Line

Dear Mr. Mahler:

Thank you for your data request regarding rare species information for the above referenced project site in Berkeley Township, Lacey Township and South Toms River Borough, Ocean County.

Searches of the Natural Heritage Database and the Landscape Project (Version 2) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Request for Data into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

We have checked the Natural Heritage Database for occurrences of rare plant species or natural communities. The Natural Heritage Data Base has records for occurrences of *Juncus caesariensis* and *Calamovilfa brevipilis* that may be on the site and for pitch pine-shrub oak barrens (pb4/5), pine-oak-shrub oak woodland (pow), pitch pine lowlands (undifferentiated), *Rhynchospora knieskernii, Schizaea pusilla, Narthecium americanum* and *Muhlenbergia torreyana* that may be in the immediate vicinity of the site. The attached lists provide more information about these occurrences. **Because some species are sensitive to disturbance or sought by collectors, this information is provided to you on the condition that no specific locational data are released to the general public. This is not intended to preclude your submission of this information to regulatory agencies from which you are seeking permits.**

We have also checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat on the referenced site. Please see Table 1 for species list and conservation status.

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*Recycled Paper*

Table 1 (on referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| American rubyspot | *Hetaerina americana* | | | G5 | S3 |
| barred owl | *Strix varia* | | T/T | G5 | S3B |
| bar-winged skimmer | *Libellula axilena* | | | G5 | S2BS3B,SZN |
| black skimmer foraging area | *Rynchops niger* | | E | G5 | S1B |
| black-crowned night-heron - foraging habitat | *Nycticorax nycticorax* | | T/S | G5 | S3B,S4N |
| black-throated green warbler | *Dendroica virens* | | Special Concern | G5 | S3B |
| carpenter frog | *Rana virgatipes* | | Special Concern | G5 | S4 |
| cerulean warbler | *Dendroica cerulea* | | Special Concern | G4 | S3B |
| colonial waterbird foraging habitat | | | | | |
| Cooper's hawk | *Accipiter cooperii* | | T/T | G5 | S3B,S4N |
| corn snake | *Elaphe g. guttata* | | E | G5T5 | S1 |
| dotted skipper | *Hesperia attalus slossonae* | | Special Concern | G3G4T3 | S2S3 |
| eastern box turtle | *Terrapene carolina* | | Special Concern | G5 | S5B |
| eastern kingsnake | *Lampropeltis g. getula* | | U | G5T5 | S3 |
| Fowler's toad | *Bufo woodhousii fowleri* | | Special Concern | G5 | S4 |
| golden-winged skimmer | *Libellula auripennis* | | | G5 | S1S2 |
| Martha's pennant | *Celithemis martha* | | | G4 | S3S4 |
| northern parula | *Parula americana* | | Special Concern | G5 | S3B |
| northern pine snake | *Pituophis m. melanoleucus* | | T | G4T4 | S3 |
| pine barrens treefrog | *Hyla andersonii* | | T | G4 | S3 |
| red-headed woodpecker | *Melanerpes erythrocephalus* | | T/T | G5 | S2B,S2N |
| spotted turtle | *Clemmys guttata* | | Special Concern | G5 | S4 |
| tern species foraging habitat | | | | | |
| timber rattlesnake | *Crotalus h. horridus* | | E | G4T4 | S2 |
| veery | *Catharus fuscescens* | | Special Concern | G5 | S3B |
| wood turtle | *Clemmys insculpta* | | T | G4 | S3 |

We have also checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat within 1/4 mile of the referenced site. Please see Table 2 for species list and conservation status. This table excludes any species listed in Table 1.

Table 2 (additional species within 1/4 mile of referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| a satyr | *Neonympha areolata septentrionalis* | | | G4T3T4 | S3 |

Also attached is a list of rare species and natural communities that have been documented from Ocean County. If suitable habitat is present at the project site, these species have potential to be present.

Status and rank codes used in the tables and lists are defined in the attached EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State's best habitats for rare and endangered species and natural communities. Four of these sites are located within or near the areas you have outlined. Please refer to the enclosed Natural Heritage Priority Site Maps for the locations and boundaries of these sites. On the back of each Priority Site Map is a report describing the significance of the site. You may find the site biodiversity significance rating to be useful if you need to prioritize among the sites in your environmental assessment.

If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive I-Map-NJ website at the following URL, http://www.state.nj.us/dep/gis/imapnj/imapnj.htm or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Herbert A. Lord

Herbert A. Lord
Data Request Specialist

cc: Robert J. Cartica
Lawrence Niles
NHP File No. 04-3907472

1
21 SEP 2004

POSSIBLY ON PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| CALAMOVILFA BREVIPILIS | PINE BARREN REEDGRASS | | | LP | G4 | S4 | 1985-09-29 | Y | N. OF MIDDLE BRANCH FORKED RIVER, JUST W. OF GARDEN STATE PARKWAY. |
| JUNCUS CAESARIENSIS | NEW JERSEY RUSH | | E | LP | G2 | S2 | 1985-09-29 | Y | N. OF MIDDLE BRANCH FORKED RIVER, JUST W. OF GARDEN STATE PARKWAY. |

2 Records Processed

1
21 SEP 2004

IMMEDIATE VICINITY OF PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Ecosystems | | | | | | | | | |
| PINUS RIGIDA SATURATED WOODLAND ALLIANCE | PITCH PINE LOWLANDS (UNDIFFERENTIATED) | | | | G3 | S3 | 2003-01-25 | Y | SEVERAL PATCHES S OF JAKES BRANCH, N OF PINEWALD-KESWICK GROVE ROAD, EAST OF THE JCPL POWERLINE, AND W OF THE GARDEN STATE PARKWAY. |
| PINUS RIGIDA-(P. ECHINATA)-QUERCUS SPP./QUERCUS (MARILANDICA, ILICIFOLIA) WOODLAND | PINE-OAK-SHRUB OAK WOODLAND (POW) | | | | G3 | S3 | 2003-01-25 | Y | TWELVE SCATTERED PATCHES LOCATED SOUTH OF JAKES BRANCH, MOSTLY NORTH OF PINEWALD-KESWICK GROVE ROAD, MOSTLY EAST OF THE JCPL POWERLINE, AND WEST OF THE GARDEN STATE PARKWAY. |
| PINUS RIGIDA/QUERCUS (MARILANDICA, ILICIFOLIA)/PYXIDANTHERA BARBULATA WOODLAND | PITCH PINE-SHRUB OAK BARRENS (PB4/5) | | | | G2 | S2 | 2002-10-15 | Y | TWO MAIN PATCHES ARE LOCATED SOUTH OF JAKES BRANCH, NORTH OF PINEWALD-KESWICK GROVE ROAD, EAST OF JCPL POWERLINE, AND WEST OF THE GARDEN STATE PARKWAY. PATCHES ARE LOCATED 0.5 TO 2.3 MILES NORTH OF THE DOUBLE TROUBLE STATE PARK ENTRANCE, PARTLY WITHIN JAKES BRANCH COUNTY PARK IN BEACHWOOD BORO, AND PARTLY WITHIN DOUBLE TROUBLE STATE PARK AND PRIVATE LANDS IN BERKELEY TWP. |

2

21 SEP 2004

IMMEDIATE VICINITY OF PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| MUHLENBERGIA TORREYANA | PINE BARREN SMOKE GRASS | | | LP | G3 | S3 | 1985-09-29 | Y | N. OF MIDDLE BRANCH FORKED RIVER, 0.25 MI. W. OF GARDEN STATE PARKWAY. |
| NARTHECIUM AMERICANUM | BOG ASPHODEL | C | E | LP | G2 | S2 | 1995-09-04 | Y | CA. 0.1 MILES EAST OF GARDEN STATE PARKWAY BETWEEN MIDDLE BRANCH AND SOUTH BRANCH OF FORKED RIVER, CA. 2 MILES SOUTHWEST OF THE INTERSECTION OF RT. 9 AND LACEY RD. |
| RHYNCHOSPORA KNIESKERNII | KNIESKERN'S BEAKED-RUSH | LT | E | LP | G2 | S2 | 1994-09-03 | Y | N. OF MIDDLE BRANCH FORKED RIVER, JUST W. OF GARDEN STATE PARKWAY. APPROXIMATELY 2.0 MILES SOUTH OF INTERCHANGE 74 OF GSP. |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 | 1907-07-25 | Y | LAKE INLET AT DOUBLE TROUBLE. |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 | 1915-07-10 | Y | CEDAR SWAMP ALONG SOUTH BRANCH OF FORKED RIVER SW OF FORKED RIVER. |

Records Processed

# Frequently Asked Questions About Natural Heritage Priority Sites

**What are Natural Heritage Priority Sites?**
Through its Natural Heritage Database, the Office of Natural Lands Management (ONLM) identifies critically important areas to conserve New Jersey's biological diversity. The database provides detailed, up-to-date information on rare species and natural communities to planners, developers, and conservation agencies for use in resource management, environmental impact assessment, and both public and private land protection efforts.

Using the database, ONLM has identified Natural Heritage Priority Sites that represent some of the best remaining habitat for rare species and exemplary natural communities in the state. These areas should be considered to be top priorities for the preservation of biological diversity in New Jersey. If these sites become degraded or destroyed, we may lose some of the unique components of our natural heritage.

ONLM has identified 410 priority sites over the course of more than 10 years. We have received assistance from many partner individuals and agencies over this time. The Nature Conservancy and the DEP Endangered and Nongame Species Program have provided key information or assisted with the delineation of a number of the sites.

**How are Natural Heritage Priority Site maps used in conservation of biological diversity?**
Natural Heritage Priority Site maps are used by individuals and agencies concerned with the protection and management of land. The maps have been used by municipalities preparing natural resource inventories; public and private conservation organizations preparing open space acquisition goals; land developers and consultants identifying environmentally sensitive lands; and public and private landowners developing land management plans.

Natural Heritage Priority Sites contain some of the best and most viable occurrences of endangered and threatened species and natural communities, but they do not cover all known habitat for endangered and threatened species in New Jersey. If information is needed on whether or not endangered or threatened species have been documented from a particular piece of land, a Natural Heritage Database search can be requested by contacting the Office of Natural Lands Management at the address below.

**What do the boundaries of the sites contain?**
The boundaries of each Natural Heritage Priority Site are drawn to encompass critical habitat for the rare species or natural communities. Often the boundaries extend to include additional buffer lands that should be managed to protect the habitat. A justification for the boundary is provided for each site. The term "primary bounds" is sometimes used to refer to boundaries enclosing critical habitat. The term "secondary bounds" is sometimes used to refer to boundaries enclosing additional buffer. In maps where both primary and secondary boundaries are described, only the outermost boundary is provided in the mapping.

**What is the background map that the sites are drawn upon?**
The sites are portrayed on background maps produced from a digital copy of the U.S. Geological Survey 7.5 minute topographic maps. The background maps contain topographic lines as well as streams, lakes, roads, towns and place names. These background maps do not always reflect recent changes in land development. Some may be more than 20 years old. Some sites appear to be shifted in position against this topo map. This shift is due to the fact that most sites have been digitized against a background of rectified aerial photography, and some of the digitized USGS topo maps do not align with this photography.

**What do "public lands" depict on the maps?**
The "public lands" shaded on these maps are state-owned open space lands that have been digitized as a GIS coverage by the state Green Acres Program. This information is provided to show patterns of State land ownership in the vicinity of the Priority Site. The public lands are areas such as State Parks and Forests, Wildlife Management Areas, and Natural Lands Trust preserves. They do not currently include lands owned by other state agencies, federal, county or municipal governments

or nonprofit conservation organizations. This GIS coverage is constantly being updated, and therefore future editions of the maps will likely contain additional public lands that are not currently mapped as such.

### What is the biodiversity significance rank and how is it used?

Each site is ranked according to its significance for biological diversity using a scale developed by The Nature Conservancy and the network of Natural Heritage Programs. The ranks can be used to distinguish between sites that are of global significance for conservation of biological diversity vs. those that are of state significance. The scale ranges from B1 to B5 with sites ranked B1-B3 generally being of global significance and sites ranked B4-B5 being of state significance. The specific definitions for each rank are as follows:

B1 - Outstanding significance, generally the "last of the least" in the world, such as the only known occurrence of any element (species or natural community), the best or an excellent occurrence of an element ranked critically imperiled globally, or a concentration (4+) of good or excellent occurrences of elements that are imperiled or critically imperiled globally. The site should be viable and defensible for the elements or ecological processes contained.

B2 - Very high significance, such as the most outstanding occurrence of any natural community. Also includes areas containing other occurrences of elements that are critically imperiled globally, a good or excellent occurrence of an element that is imperiled globally, an excellent occurrence of an element that is rare globally, or a concentration (4+) of good occurrences of globally rare elements or viable occurrences of globally imperiled elements.

B3 - High significance, such as any other viable occurrence of an element that is globally imperiled, a good occurrence of a globally rare element, an excellent occurrence of any natural community, or a concentration (4+) of good or excellent occurrences of elements that are critically imperiled in the State.

B4 - Moderate significance, such as a viable occurrence of a globally rare element, a good occurrence of any natural community, a good or excellent occurrence or only viable state occurrence of an element that is critically imperiled in the State, an excellent occurrence of an element that is imperiled in the State, or a concentration (4+) of good occurrences of elements that are imperiled in the State or excellent occurrences of elements that are rare in the State.

B5 - Of general biodiversity interest.

### How can I obtain Natural Heritage Priority Site maps for an area of interest to me?

Natural Heritage Priority Site hard copy maps can be obtained by submitting a written request accompanied by a check or money order made payable to the Office of Natural Lands Management at the following address:

Office of Natural Lands Management
P.O. Box 404
Trenton, NJ 08625-0404
Phone: 609-984-1339; Fax: 609-984-1427

Individual 8.5" X 11" maps are available at the following rate:

| | |
|---|---|
| 1 - 10 site maps & reports: | $1.50/site |
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*Digital GIS Coverage of Natural Heritage Priority Sites*

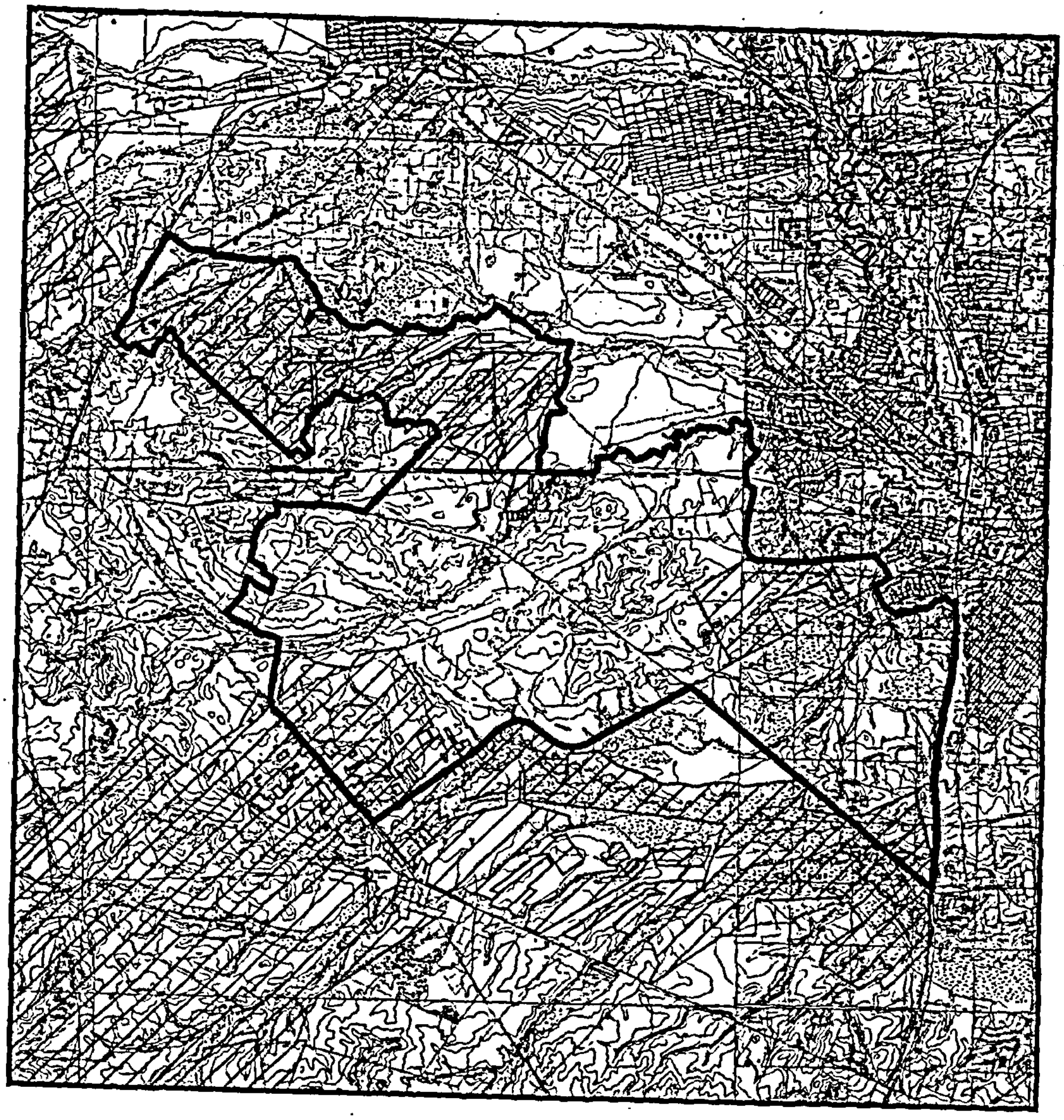
A digital version of the ArcView GIS file of Natural Heritage Priority Sites is also available. The zipped version of the file is approximately 1 MB in size. The 2001 version of Natural Heritage Priority Sites will be emailed upon request. The 1999 version of the digital files can be obtained on the internet at the following address: *http://www.state.nj.us/dep/gis/* -Click on "GIS Data Downloads" and then "Select a data layer" and then "Natural Heritage Priority Sites". There is no charge for emailing or downloading the GIS data.

### How often are the maps updated?

The Natural Heritage Priority Site information is constantly being updated in the Natural Heritage Database. A new edition of the maps will be made available after significant revisions or additions to the Database.

April 9, 2002

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management



Natural Heritage Priority Site

**Crossley RR Corridor Macrosite**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

1 0 1 Miles

Priority Site
Public Land

## Natural Heritage Priority Site
## Crossley RR Corridor Macrosite

***Locational Information***

**Quad Name:** Keswick Grove ; Toms River
**County:** Ocean
**Municipality** Berkeley Twp ; Manchester Twp ; Lacey Twp ; Beachwood Boro ; South Toms River Boro

***Description of Site***

A large patch of contiguous pine/oak woods with predominantly Lakehurst soils.

***Boundary Justification***

Bounds drawn to include large contiguous patch of pine/oak uplands that is habitat to endangered and threatened animal species.

***Biodiversity Rank*** B4

Excellent site for State Endangered and Threatened animal species.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*60

Natural Heritage Priority Site

**Forked River Mountain Macrosite**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

1 0 1 Miles

Priority Site
Public Land

# Natural Heritage Priority Site
# Forked River Mountain Macrosite

*Locational Information*

| | |
|---|---|
| **Quad Name:** | Brookville ; Forked River ; Woodmansie ; Keswick Grove ; Whiting |
| **County:** | Ocean |
| **Municipality** | Lacey Twp ; Ocean Twp ; Manchester Twp ; Barnegat Twp |

*Description of Site*

A few small occurrences of dwarf pine plains (<150 acres) associated with up to 1000+ acres of transitional pine plains, and several small occurrences of hydric pine plains. Most of the plains are in the vicinity of Forked River Mountain, near the center of a large fireshed of over 30,000 acres. Within the fireshed are extensive occurrences of pitch pine-scrub oak barrens, other pine barrens and pine-oak forests, pitch pine lowlands, red maple-black gum palustrine forest, and atlantic white cedar palustrine forest.

*Boundary Justification*

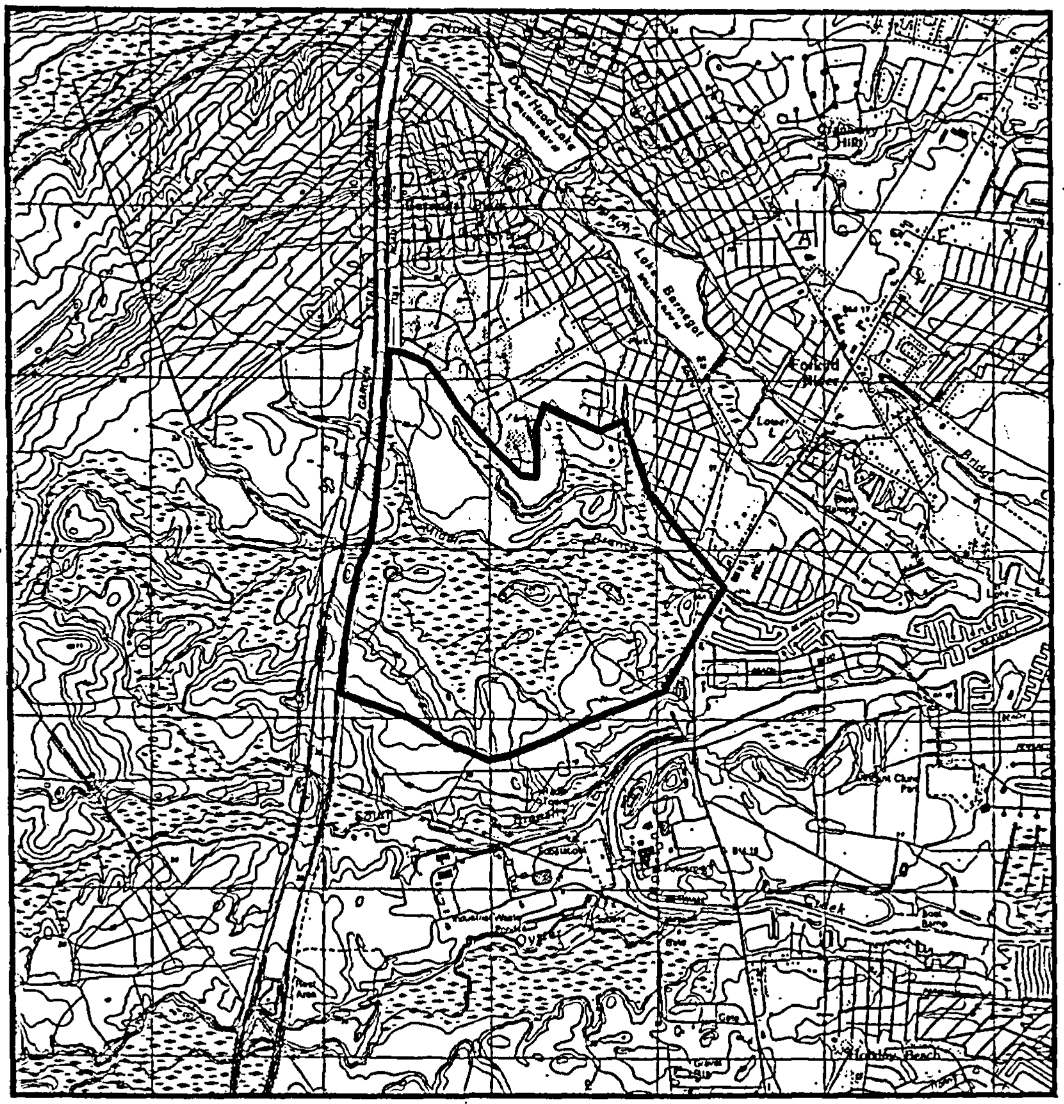
Fireshed limits where most plant community-maintaining wildfires would originate and be contained within, using convenient man-made and natural firebreaks and distribution of flammable pine barren plant communities for management purposes.

*Biodiversity Rank* B2

The site contains a globally imperiled pine plains natural community.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*236



Natural Heritage Priority Site

**Middle Branch Forked River**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.4 0 0.4 Miles

Priority Site
Public Land

# Natural Heritage Priority Site
# Middle Branch Forked River

*Locational Information*

Quad Name: Forked River
County: Ocean
Municipality Lacey Twp

*Description of Site*

Open wetlands adjacent to pine barren stream through Atantic white cedar swamp.

*Boundary Justification*

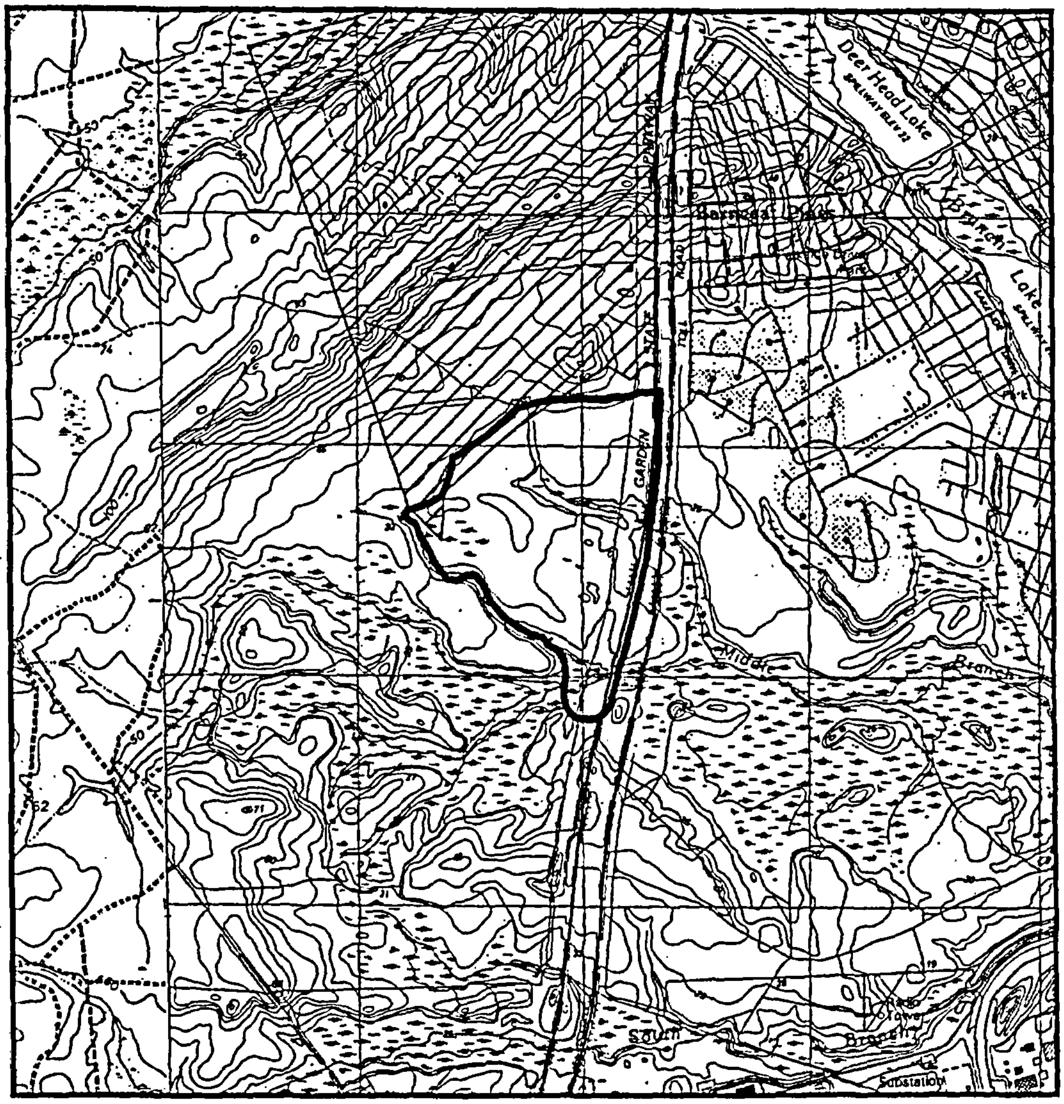
Boundaries include wetland habitat for rare plant species plus undeveloped uplands in the drainage basin east of the Garden State Parkway. With additional field work, bounds may be expanded upstream west of the Parkway.

*Biodiversity Rank* B2

Several globally rare and State listed plant species.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*365




Natural Heritage Priority Site
**Pits and Pond**
Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.3 0 0.3 Miles

Priority Site
Public Land

N W E S

# Natural Heritage Priority Site
# Pits and Pond

*Locational Information*

| | |
|---|---|
| Quad Name: | Forked River |
| County: | Ocean |
| Municipality | Lacey Twp |

*Description of Site*

Two borrow pits (heavily used by ORV's) under and adjacent to mowed pipeline right-of-way through pitch pine lowland forest.

*Boundary Justification*

Uses existing sand roads to north, west, and south to enclose the adjacent wetlands and uplands draining towards the rare plants, with the Garden State Parkway forming the eastern boundary.

*Biodiversity Rank* B2

The site contains four globally rare plant species, two of which are state endangered, and one of which is also federally threatened.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*440

State of New Jersey

James E. McGreevey
Governor

Department of Environmental Protection
Division of Parks and Forestry
Office of Natural Lands Management
Natural Heritage Program
P.O. Box 404
Trenton, NJ 08625-0404
Tel. #609-984-1339
Fax. #609-984-1427

Bradley M. Campbell
Commissioner

September 22, 2004

William Mahler
Amergen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

Re: Oyster Creek Generating Station

Dear Mr. Mahler:

Thank you for your data request regarding rare species information for the above referenced project site in Lacey Township, Ocean County.

Searches of the Natural Heritage Database and the Landscape Project (Version 2) are based on a representation of the boundaries of your project site in our Geographic Information System (GIS). We make every effort to accurately transfer your project bounds from the topographic map(s) submitted with the Request for Data into our Geographic Information System. We do not typically verify that your project bounds are accurate, or check them against other sources.

We have checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat on the referenced site. Please see Table 1 for species list and conservation status.

Table 1 (on referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| barred owl | *Strix varia* | | T/T | G5 | S3B |
| black skimmer foraging area | *Rynchops niger* | | E | G5 | S1B |
| black-crowned night-heron foraging habitat | *Nycticorax nycticorax* | | T/S | G5 | S3B,S4N |
| colonial waterbird foraging habitat | | | | | |
| Cooper's hawk | *Accipiter cooperii* | | T/T | G5 | S3B,S4N |
| dotted skipper | *Hesperia attalus slossonae* | | Special Concern | G3G4T3 | S2S3 |
| eastern box turtle | *Terrapene carolina* | | Special Concern | G5 | S5B |
| Fowler's toad | *Bufo woodhousii fowleri* | | Special Concern | G5 | S4 |
| northern pine snake | *Pituophis m. melanoleucus* | | T | G4T4 | S3 |
| pine barrens treefrog | *Hyla andersonii* | | T | G4 | S3 |
| tern species foraging habitat | | | | | |
| wood turtle | *Clemmys insculpta* | | T | G4 | S3 |

We have also checked the Natural Heritage Database and the Landscape Project habitat mapping for occurrences of any rare wildlife species or wildlife habitat within 1/4 mile of the referenced site. Please see Table 2 for species list and conservation status. This table excludes any species listed in Table 1.

Table 2 (additional species within 1/4 mile of referenced site).

| Common Name | Scientific Name | Federal Status | State Status | Grank | Srank |
|---|---|---|---|---|---|
| spotted turtle | *Clemmys guttata* | | Special Concern | G5 | S4 |

We have also checked the Natural Heritage Database for occurrences of rare plant species or natural communities. The Natural Heritage Data Base has records for occurrences of *Narthecium americanum* that may be on the site, and for *Pycnanthemum setosum* that may be on or in the immediate vicinity of the site, and for *Eupatorium resinosum*, *Pycnanthemum setosum*, *Juncus caesariensis* and *Schizaea pusilla* that may be in the immediate vicinity of the site. The

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*Recycled Paper*

attached lists provide more information about these occurrences. Because some species are sensitive to disturbance or sought by collectors, this information is provided to you on the condition that no specific locational data are released to the general public. This is not intended to preclude your submission of this information to regulatory agencies from which you are seeking permits.

Also attached is a list of rare species and natural communities that have been documented from Ocean County. If suitable habitat is present at the project site, these species have potential to be present.

Status and rank codes used in the tables and lists are defined in the attached EXPLANATION OF CODES USED IN NATURAL HERITAGE REPORTS.

The Natural Heritage Program reviews its data periodically to identify priority sites for natural diversity in the State. Included as priority sites are some of the State's best habitats for rare and endangered species and natural communities. One of these sites is located within or near the areas you have outlined. Please refer to the enclosed Natural Heritage Priority Site Map for the location and boundary of this site. On the back of each Priority Site Map is a report describing the significance of the site.

If you have questions concerning the wildlife records or wildlife species mentioned in this response, we recommend that you visit the interactive I-Map-NJ website at the following URL, http://www.state.nj.us/dep/gis/imapnj/imapnj.htm or contact the Division of Fish and Wildlife, Endangered and Nongame Species Program.

PLEASE SEE THE ATTACHED 'CAUTIONS AND RESTRICTIONS ON NHP DATA'.

Thank you for consulting the Natural Heritage Program. The attached invoice details the payment due for processing this data request. Feel free to contact us again regarding any future data requests.

Sincerely,

Herbert A. Lord

Herbert A. Lord
Data Request Specialist

cc: Robert J. Cartica
Lawrence Niles
NHP File No. 04-3907472

# CAUTIONS AND RESTRICTIONS ON NATURAL HERITAGE DATA

The quantity and quality of data collected by the Natural Heritage Program is dependent on the research and observations of many individuals and organizations. Not all of this information is the result of comprehensive or site-specific field surveys. Some natural areas in New Jersey have never been thoroughly surveyed. As a result, new locations for plant and animal species are continuously added to the database. Since data acquisition is a dynamic, ongoing process, the Natural Heritage Program cannot provide a definitive statement on the presence, absence, or condition of biological elements in any part of New Jersey. Information supplied by the Natural Heritage Program summarizes existing data known to the program at the time of the request regarding the biological elements or locations in question. They should never be regarded as final statements on the elements or areas being considered, nor should they be substituted for on-site surveys required for environmental assessments. The attached data is provided as one source of information to assist others in the preservation of natural diversity.

This office cannot provide a letter of interpretation or a statement addressing the classification of wetlands as defined by the Freshwater Wetlands Act. Requests for such determination should be sent to the DEP Land Use Regulation Program, P.O. Box 401, Trenton, NJ 08625-0401.

The Landscape Project was developed by the Division of Fish & Wildlife, Endangered and Nongame Species Program to map critical habitat for rare animal species. Some of the rare species data in the Landscape Project is in the Natural Heritage Database, while other records were obtained from other sources. Natural Heritage Database response letters will list all species (if any) found during a search of the Landscape Project. However, any reports that are included with the response letter will only reference specific records if they are in the Natural Heritage Database. This office cannot answer any inquiries about the Landscape Project. All questions should be directed to the DEP Division of Fish and Wildlife, Endangered and Nongame Species Program, P.O. Box 400, Trenton, NJ 08625-0400.

**This cautions and restrictions notice must be included whenever information provided by the Natural Heritage Database is published.**

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

1
21 SEP 2004

POSSIBLY ON PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| NARTHECIUM AMERICANUM | BOG ASPHODEL | C | E | LP | G2 | S2 | 1991-05-22 | Y | CA. 1 MILE EAST-NORTHEAST OF OYSTER CREEK POWER PLANT AND SOUTH OF THE SOUTH BRANCH OF FORKED RIVER. APPROXIMATELY 1 1/2 MILES SOUTH OF THE INTERSECTION OF ROUTE 9 AND LACEY ROAD. |

1 Records Processed

1
21 SEP 2001

ON OR IN IMMEDIATE VICINITY OF PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 | 1993-??-?? | Y | SOUTH OF ORLANDO DRIVE AND NORTH OF OYSTER CREEK, LACEY TWP. |

1 Records Processed

1
21 SEP 2004

IMMEDIATE VICINITY OF PROJECT SITE
BASED ON SEARCH OF NATURAL HERITAGE DATABASE
RARE PLANT SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK | DATE OBSERVED | IDENT. | LOCATION |
|---|---|---|---|---|---|---|---|---|---|
| *** Vascular plants | | | | | | | | | |
| EUPATORIUM RESINOSUM | PINE BARREN BONESET | | E | LP | G3 | S2 | 1993-08-?? | Y | EAST SIDE OF ROUTE 9 JUST NORTH OF BAY PARKWAY. IN RECOVERING CRANBERRY BOG ON SOUTH BANK OF OYSTER CREEK. |
| JUNCUS CAESARIENSIS | NEW JERSEY RUSH | | E | LP | G2 | S2 | 1922-09-?? | Y | OYSTER CREEK ALONG TUCKERTON RR, NW [OF] WARETOWN. |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 | 1993-??-?? | Y | WEST OF CABLE ROAD AND EAST OF DOCK ROAD AND A SMALL EMBANKMENT OF OYSTER CREEK. |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 | 1993-??-?? | Y | SANDS HARBOR POINT, NORTHERNMOST TIP, NORTH OF BAY PARKWAY. |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 | 1993-??-?? | Y | EAST SIDE OF ROUTE 9, JUST NORTH OF BAY PARKWAY, SOUTH OF OYSTER CREEK. |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 | 1915-07-10 | Y | BY OYSTER CREEK NW ALONG TUCKERTON RR FROM WARETOWN. |

6 Records Processed

# Frequently Asked Questions About Natural Heritage Priority Sites

**What are Natural Heritage Priority Sites?**
Through its Natural Heritage Database, the Office of Natural Lands Management (ONLM) identifies critically important areas to conserve New Jersey's biological diversity. The database provides detailed, up-to-date information on rare species and natural communities to planners, developers, and conservation agencies for use in resource management, environmental impact assessment, and both public and private land protection efforts.

Using the database, ONLM has identified Natural Heritage Priority Sites that represent some of the best remaining habitat for rare species and exemplary natural communities in the state. These areas should be considered to be top priorities for the preservation of biological diversity in New Jersey. If these sites become degraded or destroyed, we may lose some of the unique components of our natural heritage.

ONLM has identified 410 priority sites over the course of more than 10 years. We have received assistance from many partner individuals and agencies over this time. The Nature Conservancy and the DEP Endangered and Nongame Species Program have provided key information or assisted with the delineation of a number of the sites.

**How are Natural Heritage Priority Site maps used in conservation of biological diversity?**
Natural Heritage Priority Site maps are used by individuals and agencies concerned with the protection and management of land. The maps have been used by municipalities preparing natural resource inventories; public and private conservation organizations preparing open space acquisition goals; land developers and consultants identifying environmentally sensitive lands; and public and private landowners developing land management plans.

Natural Heritage Priority Sites contain some of the best and most viable occurrences of endangered and threatened species and natural communities, but they do not cover all known habitat for endangered and threatened species in New Jersey. If information is needed on whether or not endangered or threatened species have been documented from a particular piece of land, a Natural Heritage Database search can be requested by contacting the Office of Natural Lands Management at the address below.

**What do the boundaries of the sites contain?**
The boundaries of each Natural Heritage Priority Site are drawn to encompass critical habitat for the rare species or natural communities. Often the boundaries extend to include additional buffer lands that should be managed to protect the habitat. A justification for the boundary is provided for each site. The term "primary bounds" is sometimes used to refer to boundaries enclosing critical habitat. The term "secondary bounds" is sometimes used to refer to boundaries enclosing additional buffer. In maps where both primary and secondary boundaries are described, only the outermost boundary is provided in the mapping.

**What is the background map that the sites are drawn upon?**
The sites are portrayed on background maps produced from a digital copy of the U.S. Geological Survey 7.5 minute topographic maps. The background maps contain topographic lines as well as streams, lakes, roads, towns and place names. These background maps do not always reflect recent changes in land development. Some may be more than 20 years old. Some sites appear to be shifted in position against this topo map. This shift is due to the fact that most sites have been digitized against a background of rectified aerial photography, and some of the digitized USGS topo maps do not align with this photography.

**What do "public lands" depict on the maps?**
The "public lands" shaded on these maps are state-owned open space lands that have been digitized as a GIS coverage by the state Green Acres Program. This information is provided to show patterns of State land ownership in the vicinity of the Priority Site. The public lands are areas such as State Parks and Forests, Wildlife Management Areas, and Natural Lands Trust preserves. They do not currently include lands owned by other state agencies, federal, county or municipal governments

or nonprofit conservation organizations. This GIS coverage is constantly being updated, and therefore future editions of the maps will likely contain additional public lands that are not currently mapped as such.

### What is the biodiversity significance rank and how is it used?

Each site is ranked according to its significance for biological diversity using a scale developed by The Nature Conservancy and the network of Natural Heritage Programs. The ranks can be used to distinguish between sites that are of global significance for conservation of biological diversity vs. those that are of state significance. The scale ranges from B1 to B5 with sites ranked B1-B3 generally being of global significance and sites ranked B4-B5 being of state significance. The specific definitions for each rank are as follows:

B1 - Outstanding significance, generally the "last of the least" in the world, such as the only known occurrence of any element (species or natural community), the best or an excellent occurrence of an element ranked critically imperiled globally, or a concentration (4+) of good or excellent occurrences of elements that are imperiled or critically imperiled globally. The site should be viable and defensible for the elements or ecological processes contained.

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B3 - High significance, such as any other viable occurrence of an element that is globally imperiled, a good occurrence of a globally rare element, an excellent occurrence of any natural community, or a concentration (4+) of good or excellent occurrences of elements that are critically imperiled in the State.

B4 - Moderate significance, such as a viable occurrence of a globally rare element, a good occurrence of any natural community, a good or excellent occurrence or only viable state occurrence of an element that is critically imperiled in the State, an excellent occurrence of an element that is imperiled in the State, or a concentration (4+) of good occurrences of elements that are imperiled in the State or excellent occurrences of elements that are rare in the State.

B5 - Of general biodiversity interest.

### How can I obtain Natural Heritage Priority Site maps for an area of interest to me?

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Phone: 609-984-1339; Fax: 609-984-1427

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| | |
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### How often are the maps updated?

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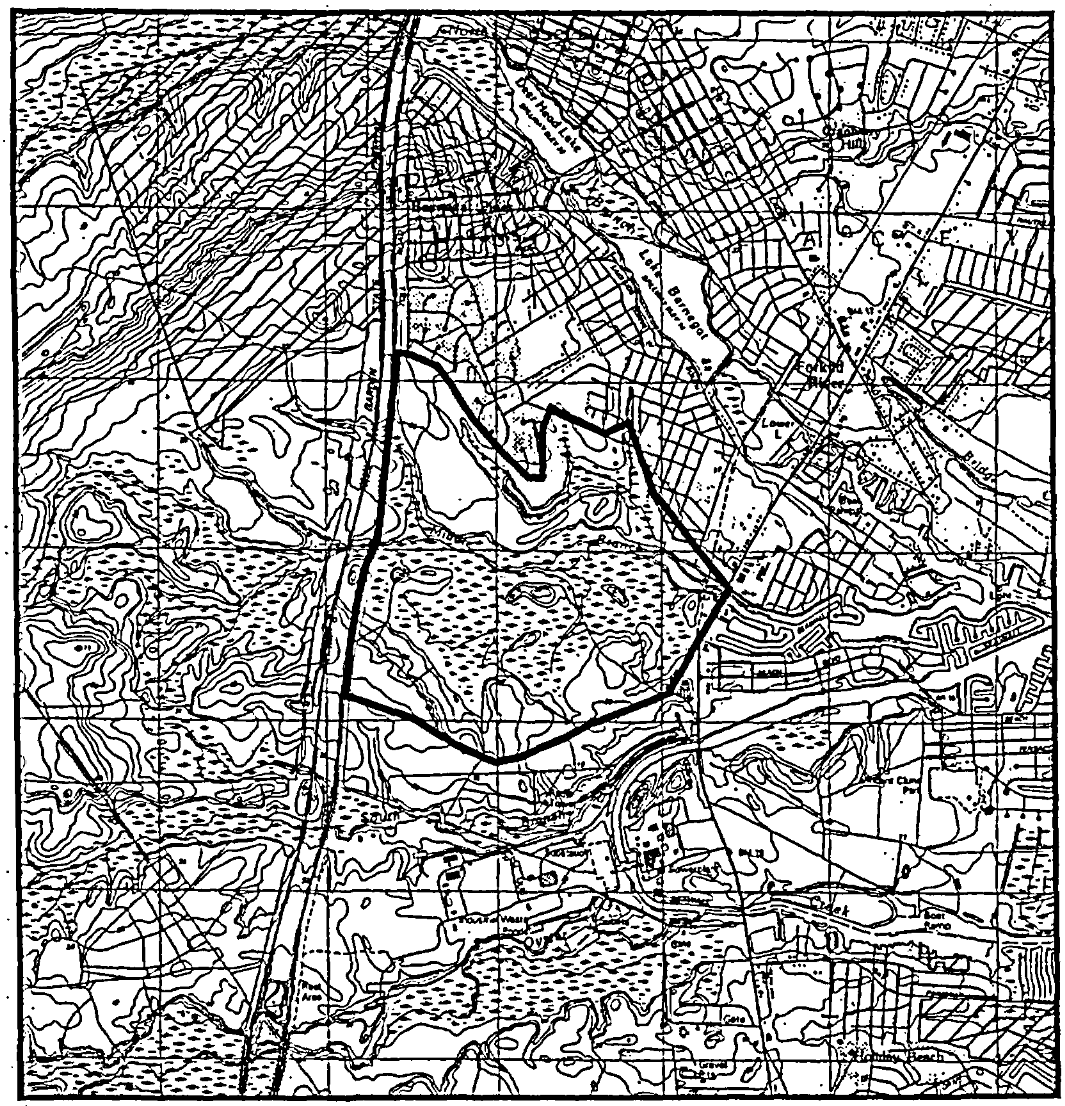
April 9, 2002

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management



Natural Heritage Priority Site

**Middle Branch Forked River**

Ocean County

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

0.4 0 0.4 Miles

Priority Site
Public Land

N
W E
S

## Natural Heritage Priority Site
## Middle Branch Forked River

***Locational Information***

**Quad Name:** Forked River
**County:** Ocean
**Municipality** Lacey Twp

***Description of Site***

Open wetlands adjacent to pine barren stream through Atantic white cedar swamp.

***Boundary Justification***

Boundaries include wetland habitat for rare plant species plus undeveloped uplands in the drainage basin east of the Garden State Parkway. With additional field work, bounds may be expanded upstream west of the Parkway.

***Biodiversity Rank*** B2

Several globally rare and State listed plant species.

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

July, 2001
*Site Code:* S.USNJHP1*365

EXPLANATIONS OF CODES USED IN NATURAL HERITAGE REPORTS

FEDERAL STATUS CODES

The following U.S. Fish and Wildlife Service categories and their definitions of endangered and threatened plants and animals have been modified from the U.S. Fish and Wildlife Service (F.R. Vol. 50 No. 188; Vol. 61, No. 40; F.R. 50 CFR Part 17). Federal Status codes reported for species follow the most recent listing.

| | |
|---|---|
| LE | Taxa formally listed as endangered. |
| LT | Taxa formally listed as threatened. |
| PE | Taxa already proposed to be formally listed as endangered. |
| PT | Taxa already proposed to be formally listed as threatened. |
| C | Taxa for which the Service currently has on file sufficient information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened species. |
| S/A | Similarity of appearance species. |

STATE STATUS CODES

Two animal lists provide state status codes after the Endangered and Nongame Species Conservation Act of 1973 (NSSA 23:2A-13 et. seq.): the list of endangered species (N.J.A.C. 7:25-4.13) and the list defining status of indigenous, nongame wildlife species of New Jersey (N.J.A.C. 7:25-4.17(a)). The status of animal species is determined by the Nongame and Endangered Species Program (ENSP). The state status codes and definitions provided reflect the most recent lists that were revised in the New Jersey Register, Monday, June 3, 1991.

| | |
|---|---|
| D | Declining species-a species which has exhibited a continued decline in population numbers over the years. |
| E | Endangered species-an endangered species is one whose prospects for survival within the state are in immediate danger due to one or many factors - a loss of habitat, over exploitation, predation, competition, disease. An endangered species requires immediate assistance or extinction will probably follow. |
| EX | Extirpated species-a species that formerly occurred in New Jersey, but is not now known to exist within the state. |
| I | Introduced species-a species not native to New Jersey that could not have established itself here without the assistance of man. |
| INC | Increasing species-a species whose population has exhibited a significant increase, beyond the normal range of its life cycle, over a long term period. |
| T | Threatened species-a species that may become endangered if conditions surrounding the species begin to or continue to deteriorate. |
| P | Peripheral species-a species whose occurrence in New Jersey is at the extreme edge of its present natural range. |
| S | Stable species-a species whose population is not undergoing any long-term increase/decrease within its natural cycle. |
| U | Undetermined species-a species about which there is not enough information available to determine the status. |

Status for animals separated by a slash(/) indicate a duel status. First status refers to the state breeding population, and the second status refers to the migratory or winter population.

Plant taxa listed as endangered are from New Jersey's official Endangered Plant Species List N.J.S.A. 1318-15.151 et seq.

E. Native New Jersey plant species whose survival in the State or nation is in jeopardy.

REGIONAL STATUS CODES FOR PLANTS

LP Indicates taxa listed by the Pinelands Commission as endangered or threatened within their legal jurisdiction. Not all species currently tracked by the Pinelands Commission are tracked by the Natural Heritage Program. A complete list of endangered and threatened Pineland species is included in the New Jersey Pinelands Comprehensive Management Plan.

EXPLANATION OF GLOBAL AND STATE ELEMENT RANKS

The Nature Conservancy has developed a ranking system for use in identifying elements (rare species and natural communities) of natural diversity most endangered with extinction. Each element is ranked according to its global, national, and state (or subnational in other countries) rarity. These ranks are used to prioritize conservation work so that the most endangered elements receive attention first. Definitions for element ranks are after The Nature Conservancy (1982: Chapter 4, 4.1-1 through 4.4.1.3-3).

GLOBAL ELEMENT RANKS

G1 Critically imperiled globally because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Imperiled globally because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout it's range; with the number of occurrences in the range of 21 to 100.

G4 Apparently secure globally; although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally; although it may be quite rare in parts of its range, especially at the periphery.

GH Of historical occurrence throughout its range i.e., formerly part of the established biota, with the expectation that it may be rediscovered.

GU Possibly in peril range-wide but status uncertain; more information needed.

GX Believed to be extinct throughout range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? Species has not yet been ranked.

STATE ELEMENT RANKS

S1 Critically imperiled in New Jersey because of extreme rarity (5 or fewer occurrences or very few remaining individuals or acres). Elements so ranked are often restricted to very specialized conditions or habitats and/or restricted to an extremely small geographical area of the state. Also included are elements which were formerly more abundant, but because of habitat destruction or some other critical factor of its biology, they have been demonstrably reduced in abundance. In essence, these are elements for which, even with intensive searching, sizable additional occurrences are unlikely to be discovered.

| | |
|---|---|
| S2 | Imperiled in New Jersey because of rarity (6 to 20 occurrences). Historically many of these elements may have been more frequent but are now known from very few extant occurrences, primarily because of habitat destruction. Diligent searching may yield additional occurrences. |
| S3 | Rare in state with 21 to 100 occurrences (plant species in this category have only 21 to 50 occurrences). Includes elements which are widely distributed in the state but with small populations/acreage or elements with restricted distribution, but locally abundant. Not yet imperiled in state but may soon be if current trends continue. Searching often yields additional occurrences. |
| S4 | Apparently secure in state, with many occurrences. |
| S5 | Demonstrably secure in state and essentially ineradicable under present conditions. |
| SA | Accidental in state, including species (usually birds or butterflies) recorded once or twice or only at very great intervals, hundreds or even thousands of miles outside their usual range; a few of these species may even have bred on the one or two occasions they were recorded; examples include European strays or western birds on the East Coast and vice-versa. |
| SE | Elements that are clearly exotic in New Jersey including those taxa not native to North America (introduced taxa) or taxa deliberately or accidentally introduced into the State from other parts of North America (adventive taxa). Taxa ranked SE are not a conservation priority (viable introduced occurrences of G1 or G2 elements may be exceptions). |
| SH | Elements of historical occurrence in New Jersey. Despite some searching of historical occurrences and/or potential habitat, no extant occurrences are known. Since not all of the historical occurrences have been field surveyed, and unsearched potential habitat remains, historically ranked taxa are considered possibly extant, and remain a conservation priority for continued field work. |
| SP | Element has potential to occur in New Jersey, but no occurrences have been reported. |
| SR | Elements reported from New Jersey, but without persuasive documentation which would provide a basis for either accepting or rejecting the report. In some instances documentation may exist, but as of yet, its source or location has not been determined. |
| SRF | Elements erroneously reported from New Jersey, but this error persists in the literature. |
| SU | Elements believed to be in peril but the degree of rarity uncertain. Also included are rare taxa of uncertain taxonomical standing. More information is needed to resolve rank. |
| SX | Elements that have been determined or are presumed to be extirpated from New Jersey. All historical occurrences have been searched and a reasonable search of potential habitat has been completed. Extirpated taxa are not a current conservation priority. |
| SXC | Elements presumed extirpated from New Jersey, but native populations collected from the wild exist in cultivation. |
| SZ | Not of practical conservation concern in New Jersey, because there are no definable occurrences, although the taxon is native and appears regularly in the state. An SZ rank will generally be used for long distance migrants whose occurrences during their migrations are too irregular (in terms of repeated visitation to the same locations), transitory, and dispersed to be reliably identified, mapped and protected. In other words, the migrant regularly passes through the state, but enduring, mappable element occurrences cannot be defined.<br><br>Typically, the SZ rank applies to a non-breeding population (N) in the state - for example, birds on migration. An SZ rank may in a few instances also apply to a breeding population (B), for example certain lepidoptera which regularly die out every year with no significant return migration. |

Although the SZ rank typically applies to migrants, it should not be used indiscriminately. Just because a species is on migration does not mean it receives an SZ rank. SZ will only apply when the migrants occur in an irregular, transitory and dispersed manner.

B Refers to the breeding population of the element in the state.

N Refers to the non-breeding population of the element in the state.

T Element ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species. For example *Stachys palustris* var. *homotricha* is ranked "G5T? SH" meaning the full species is globally secure but the global rarity of the var. *homotricha* has not been determined; in New Jersey the variety is ranked historic.

Q Elements containing a "Q" in the global portion of its rank indicates that the taxon is of questionable, or uncertain taxonomical standing, e.g., some authors regard it as a full species, while others treat it at the subspecific level.

.1 Elements documented from a single location.

Note: To express uncertainty, the most likely rank is assigned and a question mark added (e.g., G2?). A range is indicated by combining two ranks (e.g., G1G2, S1S3).

IDENTIFICATION CODES

These codes refer to whether the identification of the species or community has been checked by a reliable individual and is indicative of significant habitat.

Y Identification has been verified and is indicative of significant habitat.

BLANK Identification has not been verified but there is no reason to believe it is not indicative of significant habitat.

? Either it has not been determined if the record is indicative of significant habitat or the identification of the species or community may be confusing or disputed.

Revised September 1998

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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| *** Vertebrates | | | | | | |
| ACCIPITER COOPERII | COOPER'S HAWK | | T/T | | G5 | S3B,S4N |
| AMBYSTOMA TIGRINUM TIGRINUM | EASTERN TIGER SALAMANDER | | E | | G5T5 | S2 |
| AMMODRAMUS SAVANNARUM | GRASSHOPPER SPARROW | | T/S | | G5 | S2B |
| ARDEA HERODIAS | GREAT BLUE HERON | | S/S | | G5 | S2B,S4N |
| BARTRAMIA LONGICAUDA | UPLAND SANDPIPER | | E | | G5 | S1B |
| BOTAURUS LENTIGINOSUS | AMERICAN BITTERN | | E/S | | G4 | S2B |
| BUTEO LINEATUS | RED-SHOULDERED HAWK | | E/T | | G5 | S1B,S2N |
| CALIDRIS CANUTUS | RED KNOT | | T | | G5 | S3N |
| CHARADRIUS MELODUS | PIPING PLOVER | LT | E | | G3 | S1B |
| CIRCUS CYANEUS | NORTHERN HARRIER | | E/U | | G5 | S1B,S3N |
| CISTOTHORUS PLATENSIS | SEDGE WREN | | E | | G5 | S1B |
| CLEMMYS INSCULPTA | WOOD TURTLE | | T | | G4 | S3 |
| CLEMMYS MUHLENBERGII | BOG TURTLE | LT | E | | G3 | S2 |
| CROTALUS HORRIDUS HORRIDUS | TIMBER RATTLESNAKE | | E | | G4T4 | S2 |
| EGRETTA CAERULEA | LITTLE BLUE HERON | | S/S | | G5 | S2B |
| EGRETTA THULA | SNOWY EGRET | | S/S | | G5 | S3B,S4N |
| EGRETTA TRICOLOR | TRICOLORED HERON | | INC/S | | G5 | S3B |
| ELAPHE GUTTATA GUTTATA | CORN SNAKE | | E | | G5T5 | S1 |
| EUMECES FASCIATUS | FIVE-LINED SKINK | | U | | G5 | S3 |
| FALCO PEREGRINUS | PEREGRINE FALCON | | E | | G4 | S1B,S?N |
| HALIAEETUS LEUCOCEPHALUS | BALD EAGLE | LT | E | | G4 | S1B,S2N |
| HYLA ANDERSONII | PINE BARRENS TREEFROG | | E | | G4 | S3 |
| HYLA CHRYSOSCELIS | COPE'S GRAY TREEFROG | | E | | G5 | S2 |
| IXOBRYCHUS EXILIS | LEAST BITTERN | | D/S | | G5 | S3B |
| LAMPROPELTIS GETULA GETULA | EASTERN KING SNAKE | | SC | | G5T5 | S3 |
| LATERALLUS JAMAICENSIS | BLACK RAIL | | T/T | | G4 | S2B |
| LYNX RUFUS | BOBCAT | | E | | G5 | S3 |
| MELANERPES ERYTHROCEPHALUS | RED-HEADED WOODPECKER | | T/T | | G5 | S2B,S2N |
| NYCTANASSA VIOLACEA | YELLOW-CROWNED NIGHT-HERON | | T/T | | G5 | S2B |

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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| NYCTICORAX NYCTICORAX | BLACK-CROWNED NIGHT-HERON | | T/S | | G5 | S3B,S4N |
| PANDION HALIAETUS | OSPREY | | T/T | | G5 | S2B |
| PITUOPHIS MELANOLEUCUS MELANOLEUCUS | NORTHERN PINE SNAKE | | T | | G4T4 | S3 |
| PLEGADIS FALCINELLUS | GLOSSY IBIS | | D/S | | G5 | S3B,S4N |
| PODILYMBUS PODICEPS | PIED-BILLED GREBE | | E/S | | G5 | S1B,S3N |
| POOECETES GRAMINEUS | VESPER SPARROW | | E | | G5 | S1B,S2N |
| RYNCHOPS NIGER | BLACK SKIMMER | | E | | G5 | S1B |
| STERNA ANTILLARUM | LEAST TERN | | E | | G4 | S1B |
| STERNA DOUGALLII DOUGALLII | ROSEATE TERN | LE | E | | G4T3 | SHB |
| STERNA HIRUNDO | COMMON TERN | | D/S | | G5 | S3B |
| STERNA NILOTICA | GULL-BILLED TERN | | S | | G5 | S1B |
| STRIX VARIA | BARRED OWL | | T/T | | G5 | S3B |
| SYNAPTOMYS COOPERI | SOUTHERN BOG LEMMING | | U | | G5 | S2 |
| *** Ecosystems | | | | | | |
| COASTAL DUNE SHRUBLAND | COASTAL DUNE SHRUBLAND | | | | G4 | S2? |
| COASTAL DUNE WOODLAND | COASTAL DUNE WOODLAND | | | | G2G3 | S1 |
| MARINE INTERTIDAL GRAVEL/SAND | MARINE INTERTIDAL GRAVEL/SAND | | | | GU | SU |
| BEACH COMMUNITY | BEACH COMMUNITY | | | | | |
| PINE PLAINS | DWARF PITCH PINE-BLACKJACK OAK PINE PLAINS | | | | G1 | S1 |
| PINUS RIGIDA-CALAMOVILFA BREVIPILIS SAVANNA | PITCH PINE-PINELANDS REEDGRASS SAVANNA | | | | G1 | S1 |
| *** Invertebrates | | | | | | |
| ACRONICTA ALBARUFA | BARRENS DAGGERMOTH | | | | G3G4 | SU |
| AESHNA CLEPSYDRA | MOTTLED DARNER | | | | G4 | S2S3 |
| AGROTIS BUCHHOLZI | BUCHHOLZ'S DART | | | | G2 | S2 |
| AMBLYSCIRTES VIALIS | ROADSIDE SKIPPER | | | | G5 | S2S3 |

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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| APHARETRA DENTATA | A NOCTUID MOTH | | | | G4 | S2S3 |
| ATRYTONE AROGOS AROGOS | AROGOS SKIPPER | | E | | G1G4T1T2 | S1 |
| BOLORIA SELENE MYRINA | A SILVER-BORDERED FRITILLARY | | T | | G5T5 | S2 |
| CALLOPHRYS HENRICI | HENRY'S ELFIN | | | | G5 | S1S4 |
| CALLOPHRYS HESSELI | HESSEL'S HAIRSTREAK | | | | G3G4 | S3S4 |
| CALLOPHRYS IRUS | FROSTED ELFIN | | T | | G3 | S2S3 |
| CALLOPHRYS POLIOS | HOARY ELFIN | | | | G5 | S3 |
| CALLOPISTRIA GRANITOSA | GRANITOSA FERN MOTH | | | | G4G5 | S2S3 |
| CATOCALA HERODIAS GERHARDI | HERODIAS OR GERHARD'S UNDERWING | | | | G3T3 | S3 |
| CATOCALA JAIR SSP 2 | | | | | G4T4 | S3 |
| CELITHEMIS MARTHA | MARTHA'S PENNANT | | | | G4 | S3S4 |
| CICINDELA DORSALIS DORSALIS | NORTHEASTERN BEACH TIGER BEETLE | LT | E | | G4T2 | S1 |
| CICINDELA PATRUELA CONSENTANEA | A TIGER BEETLE | | | | G3T2T3 | S2S3 |
| CRAMBUS DAECKELLUS | DAECKE'S PYRALID MOTH | | | | G1G3 | S1S3 |
| DATANA RANAECEPS | A HAND-MAID MOTH | | | | G3G4 | S3S4 |
| ENALLAGMA PICTUM | SCARLET BLUET | | | | G3 | S3 |
| ENALLAGMA RECURVATUM | PINE BARRENS BLUET | | | | G3 | S3 |
| ERYNNIS PERSIUS PERSIUS | A PERSIUS DUSKY WING | | | | G5T2T3 | SH |
| EUPHYES BIMACULA | TWO-SPOTTED SKIPPER | | | | G4 | S3 |
| FARONTA RUBRIPENNIS | PINK STREAK | | | | G3G4 | S3 |
| GLENA PLUMOSARIA | | | | | G4 | SU |
| GRAMMIA PLACENTIA | PLACENTIA TIGER MOTH | | | | G4 | S1S3 |
| HESPERIA ATTALUS SLOSSONAE | DOTTED SKIPPER | | | | G3G4T3 | S2S3 |
| HETAERINA AMERICANA | AMERICAN RUBYSPOT | | | | G5 | S3 |
| HETEROCAMPA VARIA | A NOTODONTID MOTH | | | | G3G4 | S3 |
| HYPOMECIS BUCHHOLZARIA | BUCHHOLZ'S GRAY | | | | G3G4 | S3 |
| ITAME SP 1 | A SPANWORM | | | | G3 | S3 |

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|---|---|---|---|---|---|---|
| LIBELLULA AURIPENNIS | GOLDEN-WINGED SKIMMER | | | | G5 | S1S2 |
| LIBELLULA AXILENA | BAR-WINGED SKIMMER | | | | G5 | S2BS3B,SZN |
| LITHOPHANE LEMMERI | LEMMER'S PINION MOTH | | | | G3G4 | S2 |
| MACROCHILO SP 1 | A NOCTUID MOTH | | | | G3 | S3 |
| MEROLONCHE DOLLI | DOLL'S MEROLONCHE | | | | G3G4 | S1S3 |
| METARRANTHIS PILOSARIA | COASTAL BOG METARRANTHIS | | | | G3G4 | S3S4 |
| METARRANTHIS SP 1 | A GEOMETRID MOTH | | | | G3 | S2 |
| NEONYMPHA AREOLATA SEPTENTRIONALIS | A SATYR | | | | G4T3T4 | S3 |
| NICROPHORUS AMERICANUS | AMERICAN BURYING BEETLE | LE | E | | G2G3 | SH |
| PONTIA PROTODICE | CHECKERED WHITE | | T | | G4 | S1 |
| PTICHODIS BISTRIGATA | SOUTHERN PTICHODIS | | | | G3 | S1S3 |
| PYGARCTIA ABDOMINALIS | YELLOW EDGED PYGARCTIA | | | | G3G4 | SH |
| RICHIA SP 2 | | | | | G1Q | S1 |
| SEMIOTHISA EREMIATA | THREE-LINED ANGLE MOTH | | | | G4 | SU |
| SPARTINIPHAGA CARTERAE | CARTER'S NOCTUID MOTH | | | | G2G3 | S2 |
| ZALE SP 1 | PINE BARRENS ZALE | | | | G3G4 | S3 |
| ZANCLOGNATHA SP 1 | | | | | G3G4 | S3 |
| ZANCLOGNATHA THERALIS | | | | | G4 | SH |
| *** Other types | | | | | | |
| BALD EAGLE WINTERING SITE | BALD EAGLE WINTERING SITE | | | | G? | S? |
| COASTAL HERON ROOKERY | COASTAL HERON ROOKERY | | | | GU | S3 |
| MIGRATORY SHOREBIRD CONCENTRATION SITE | MIGRATORY SHOREBIRD CONCENTRATION SITE | | | | G? | S? |
| *** Vascular plants | | | | | | |
| ALOPECURUS AEQUALIS VAR AEQUALIS | SHORT-AWN MEADOW-FOXTAIL | | | | G5T? | S2 |

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| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| AMARANTHUS PUMILUS | SEABEACH AMARANTH | LT | E |  | G2 | S1 |
| AMIANTHIUM MUSCITOXICUM | FLY POISON |  |  |  | G4G5 | S2 |
| ARETHUSA BULBOSA | DRAGON MOUTH |  |  |  | G4 | S2 |
| ARISTIDA DICHOTOMA VAR CURTISSII | CURTISS' THREE-AWN GRASS |  |  |  | G5T5 | S2 |
| ARISTOLOCHIA SERPENTARIA | VIRGINIA SNAKEROOT |  |  |  | G4 | S3 |
| ARTEMISIA CAMPESTRIS SSP CAUDATA | BEACH WORMWOOD |  |  |  | G5T5 | S2 |
| ASCLEPIAS LANCEOLATA | SMOOTH ORANGE MILKWEED |  |  |  | G5 | S2 |
| ASCLEPIAS RUBRA | RED MILKWEED |  |  | LP | G4G5 | S2 |
| ASTER RADULA | LOW ROUGH ASTER |  | E |  | G5 | S1 |
| BUCHNERA AMERICANA | BLUEHEARTS |  |  |  | G5? | SX |
| CACALIA ATRIPLICIFOLIA | PALE INDIAN PLANTAIN |  | E |  | G4G5 | S1 |
| CALAMOVILFA BREVIPILIS | PINE BARREN REEDGRASS |  |  | LP | G4 | S4 |
| CARDAMINE LONGII | LONG'S BITTERCRESS |  | E |  | G3 | SH |
| CAREX BARRATTII | BARRATT'S SEDGE |  |  | LP | G4 | S4 |
| CAREX MITCHELLIANA | MITCHELL'S SEDGE |  |  |  | G3G4 | S2 |
| CAREX PALLESCENS | PALE SEDGE |  |  |  | G5 | S2 |
| CAREX WILLDENOWII VAR WILLDENOWII | WILLDENOW'S SEDGE |  |  |  | G5T5 | S2 |
| CIRSIUM VIRGINIANUM | VIRGINIA THISTLE |  | E |  | G3 | S1 |
| CLITORIA MARIANA | BUTTERFLY-PEA |  | E |  | G5 | S1 |
| COREMA CONRADII | BROOM CROWBERRY |  | E | LP | G4 | S1 |
| COREOPSIS ROSEA | ROSE-COLOR COREOPSIS |  |  | LP | G3 | S2 |
| CROTON WILLDENOWII | ELLIPTICAL RUSHFOIL |  |  | LP | G5 | S2 |
| DESMODIUM PAUCIFLORUM | FEW-FLOWER TICK-TREFOIL |  | E |  | G5 | S1 |
| ELEOCHARIS HALOPHILA | SALT-MARSH SPIKE-RUSH |  |  |  | G4 | S2 |
| ELEOCHARIS TORTILIS | TWISTED SPIKE-RUSH |  | E |  | G5 | S1 |
| ERIOCAULON PARKERI | PARKER'S PIPEWORT |  |  |  | G3 | S2 |
| ERIOPHORUM TENELLUM | ROUGH COTTON-GRASS |  | E |  | G5 | S1 |

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|---|---|---|---|---|---|---|
| ERYNGIUM AQUATICUM VAR AQUATICUM | MARSH RATTLESNAKE-MASTER | | | | G4T4 | S3 |
| EUPATORIUM RESINOSUM | PINE BARREN BONESET | | E | LP | G3 | S2 |
| FIMBRISTYLIS CAROLINIANA | CAROLINA FIMBRY | | | | G4 | S2 |
| FRAXINUS PROFUNDA | PUMPKIN ASH | | E | | G4 | S1 |
| FUIRENA SQUARROSA | HAIRY UMBRELLA-SEDGE | | | | G4G5 | S3 |
| GALACTIA VOLUBILIS | DOWNY MILK-PEA | | E | | G5 | SH |
| GENTIANA AUTUMNALIS | PINE BARREN GENTIAN | | | LP | G3 | S3 |
| GLAUX MARITIMA | SEA-MILKWORT | | E | | G5 | SX.1 |
| GNAPHALIUM HELLERI | SMALL EVERLASTING | | E | | G4G5T3? | SH |
| HELONIAS BULLATA | SWAMP-PINK | LT | E | LP | G3 | S3 |
| HONCKENYA PEPLOIDES VAR ROBUSTA | SEABEACH SANDWORT | | | | G5T4 | S2 |
| HOTTONIA INFLATA | FEATHERFOIL | | E | | G4 | S1 |
| HOUSTONIA LONGIFOLIA | LONG-LEAF SUMMER BLUET | | | | G4G5 | SH |
| JEFFERSONIA DIPHYLLA | TWINLEAF | | E | | G5 | S1 |
| JUNCUS CAESARIENSIS | NEW JERSEY RUSH | | E | LP | G2 | S2 |
| JUNCUS GREENEI | GREENE'S RUSH | | | | G5 | S2 |
| JUNCUS TORREYI | TORREY'S RUSH | | E | | G5 | S1 |
| LIMOSELLA SUBULATA | AWL-LEAF MUDWORT | | E | | G4G5 | S1 |
| LINUM INTERCURSUM | SANDPLAIN FLAX | | E | | G4 | S1 |
| LISTERA AUSTRALIS | SOUTHERN TWAYBLADE | | | LP | G4 | S2 |
| LOBELIA CANBYI | CANBY'S LOBELIA | | | LP | G4 | S3 |
| LUDWIGIA BREVIPES | TUCKER'S ISLAND PRIMROSE-WILLOW | | | | G4G5 | SX.1 |
| LUZULA ACUMINATA | HAIRY WOOD-RUSH | | E | | G5T4T5 | S2 |
| MELANTHIUM VIRGINICUM | VIRGINIA BUNCHFLOWER | | E | | G5 | S1 |
| MUHLENBERGIA TORREYANA | PINE BARREN SMOKE GRASS | | | LP | G3 | S3 |
| MYRIOPHYLLUM TENELLUM | SLENDER WATER-MILFOIL | | E | | G5 | S1 |
| MYRIOPHYLLUM VERTICILLATUM | WHORLED WATER-MILFOIL | | E | | G5 | SH |

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|---|---|---|---|---|---|---|
| NARTHECIUM AMERICANUM | BOG ASPHODEL | C | E | LP | G2 | S2 |
| NYMPHOIDES CORDATA | FLOATINGHEART | | | LP | G5 | S3 |
| OENOTHERA HUMIFUSA | SEA-BEACH EVENING-PRIMROSE | | E | | G5 | S2 |
| ONOSMODIUM VIRGINIANUM | VIRGINIA FALSE-GROMWELL | | E | | G4 | S1 |
| PASPALUM DISSECTUM | MUDBANK CROWN GRASS | | | | G4? | S2 |
| PHORADENDRON LEUCARPUM | AMERICAN MISTLETOE | | | LP | G5 | S2 |
| PITYOPSIS FALCATA | SICKLE-LEAF GOLDEN-ASTER | | | LP | G3G4 | S3 |
| PLANTAGO MARITIMA VAR JUNCOIDES | SEASIDE PLANTAIN | | | | G5T5 | S2 |
| PLANTAGO PUSILLA | DWARF PLANTAIN | | E | | G5 | SH |
| POLYGONUM GLAUCUM | SEA-BEACH KNOTWEED | | E | | G3 | S1 |
| PRENANTHES AUTUMNALIS | PINE BARREN RATTLESNAKE-ROOT | | | LP | G4G5 | S2 |
| PRUNUS ANGUSTIFOLIA | CHICKASAW PLUM | | E | | G5T4T5 | S2 |
| PUCCINELLIA FASCICULATA | SALTMARSH ALKALI GRASS | | | | G3G5 | S2 |
| PYCNANTHEMUM SETOSUM | AWNED MOUNTAIN-MINT | | | | G3? | S3 |
| RANUNCULUS CYMBALARIA | SEASIDE BUTTERCUP | | E | | G5 | SH |
| RHODODENDRON ATLANTICUM | DWARF AZALEA | | E | | G4G5 | S1 |
| RHYNCHOSPORA CEPHALANTHA | LARGE-HEAD BEAKED-RUSH | | | LP | G5 | S3 |
| RHYNCHOSPORA GLOBULARIS | COARSE GRASS-LIKE BEAKED-RUSH | | E | | G5? | S1 |
| RHYNCHOSPORA INUNDATA | SLENDER HORNED-RUSH | | | LP | G3G4 | S2 |
| RHYNCHOSPORA KNIESKERNII | KNIESKERN'S BEAKED-RUSH | LT | E | LP | G1 | S1 |
| RHYNCHOSPORA MICROCEPHALA | SMALL-HEAD BEAKED-RUSH | | E | | G5T5 | S1 |
| RHYNCHOSPORA NITENS | SHORT-BEAKED BALD-RUSH | | | | G4? | S2 |
| RHYNCHOSPORA PALLIDA | PALE BEAKED-RUSH | | | | G3 | S3 |
| RUBUS RECURVICAULIS | BLANCHARD'S DEWBERRY | | | | G4? | S1.1 |
| RUMEX HASTATULUS | ENGELMANN'S SORREL | | | | G5 | SH |
| SABATIA CAMPANULATA | SLENDER MARSH-PINK | | | | G5 | S3 |
| SABATIA DODECANDRA VAR DODECANDRA | LARGE MARSH-PINK | | | | G5?T4T5 | S2 |
| SCHIZAEA PUSILLA | CURLY GRASS FERN | | | LP | G3 | S3 |

8
27 JUN 2002

OCEAN COUNTY
RARE SPECIES AND NATURAL COMMUNITIES PRESENTLY RECORDED IN
THE NEW JERSEY NATURAL HERITAGE DATABASE

| NAME | COMMON NAME | FEDERAL STATUS | STATE STATUS | REGIONAL STATUS | GRANK | SRANK |
|---|---|---|---|---|---|---|
| SCHWALBEA AMERICANA | CHAFFSEED | LE | E | LP | G2 | S1 |
| SCIRPUS LONGII | LONG'S WOOLGRASS | | E | LP | G2 | S2 |
| SCIRPUS MARITIMUS | SALTMARSH BULRUSH | | E | | G5 | SH |
| SCLERIA MINOR | SLENDER NUT-RUSH | | | LP | G4 | S4 |
| SOLIDAGO STRICTA | WAND-LIKE GOLDENROD | | | LP | G5 | S3 |
| SOLIDAGO TARDA | LATE GOLDENROD | | | | G4?Q | S3 |
| SPIRANTHES LACINIATA | LACE-LIP LADIES'-TRESSES | | E | | G4G5 | S1 |
| SPIRANTHES ODORATA | FRAGRANT LADIES'-TRESSES | | | | G5 | S2 |
| STYLISMA PICKERINGII VAR PICKERINGII | PICKERING'S MORNING-GLORY | | E | LP | G4T2T3 | S1 |
| TIPULARIA DISCOLOR | CRANEFLY ORCHID | | | | G4G5 | S3 |
| TRIDENS FLAVUS VAR CHAPMANII | CHAPMAN'S REDTOP | | E | | G5T? | SH |
| TRIGLOCHIN MARITIMA | SEASIDE ARROW-GRASS | | E | | G5 | S1 |
| UTRICULARIA BIFLORA | TWO-FLOWER BLADDERWORT | | E | | G5 | S1 |
| UTRICULARIA MINOR | LESSER BLADDERWORT | | E | | G5 | S1 |
| UTRICULARIA PURPUREA | PURPLE BLADDERWORT | | | LP | G5 | S3 |
| UVULARIA PUBERULA VAR NITIDA | PINE BARREN BELLWORT | | E | | G5T3? | S2 |
| VERBENA SIMPLEX | NARROW-LEAF VERVAIN | | E | | G5 | S1 |
| XYRIS FIMBRIATA | FRINGED YELLOW-EYED-GRASS | | E | | G5 | S1 |
| ZIGADENUS LEIMANTHOIDES | DEATH-CAMUS | | E | | G4Q | S1 |

201 Records Processed

## Appendix D

# State Historic Preservation Officer Correspondence

# Table of Contents

AmerGen
An Exelon Company

AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348
www.exeloncorp.com

October 7, 2004
2130-04-20228

Dorothy Guzzo, State Historic Preservation Officer
Historic Preservation Office
P.O. Box 404
Trenton, NJ 08625-0404

Attn: Deborah Fimbel

Dear Ms. Guzzo:

AmerGen Energy Company, LLC (AmerGen) is preparing an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the operating license for Oyster Creek Generating Station (OCGS), which expires in April 2009. As part of the license renewal process, the NRC requires license applicants to "assess whether any historic or archaeological properties will be affected by the proposed project." The NRC may also request a consultation with your office at a later date under Section 106 of the National Historic Preservation Act of 1966, as amended (16 USC 470), and Federal Advisory Council on Historic Preservation regulations (36 CFR 800). By contacting you early in the application process, we hope to identify any issues that need to be addressed or any information your office may need to expedite the NRC consultation.

OCGS has operated since 1969. OCGS is located near the Atlantic Ocean within the State of New Jersey (see attached map). The site, approximately 800 acres, is in Lacey and Ocean Townships in Ocean County, New Jersey, about two miles inland from the shore of Barnegat Bay and about seven miles west-northwest of Barnegat Light. The site is approximately nine miles south of Toms River, New Jersey, about fifty miles east of Philadelphia, Pennsylvania, and about sixty miles south of Newark, New Jersey.

In the context of the National Historic Preservation Act, the Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission has determined that the Area of Potential Effect for a license renewal action is the area at the power plant site and its immediate environs which may be impacted by post-license renewal land disturbing activities or projected refurbishment activities, specifically related to license renewal, regardless of ownership or control of the land of interest.

AmerGen does not expect OCGS operation through the license renewal term (an additional 20 years) to adversely affect cultural or historic resources at the plant or its immediate environs because AmerGen has no plans to alter current operations for license renewal. No expansion of existing facilities is planned and no structural modifications have been identified for the purpose of supporting license renewal. Maintenance activities necessary to support license renewal would be restricted to previously disturbed areas. No additional land disturbance is anticipated in support of license renewal.

State Historic Preservation Officer
October 7, 2004
Page 2

Using the National Register Information System on-line database, we have compiled a list of sites on the National Register of Historic Places within a six-mile radius. The Barnegat Light Public School, Barnegat Lighthouse, Double Trouble Historic District, Falkinburg Farmstead, and Manahawkin Baptist Church all fall within a 6-mile radius of the OGCS. We will provide this information to the NRC to aid in its evaluation of the license application.

We would appreciate your sending us a letter by November 12, 2004, detailing any concerns you may have about historic or archaeological properties in the area of OCGS or confirming AmerGen's conclusion that operation of OCGS over the license renewal term would have no effect on any historic or archaeological properties in New Jersey. This will enable us to meet our application preparation schedule. AmerGen will include a copy of this letter and your response in the license renewal application that we submit to the NRC.

Please call Bill Maher at (610) 765-5939, if you have any questions or require any additional information to review the proposed action.

Sincerely,

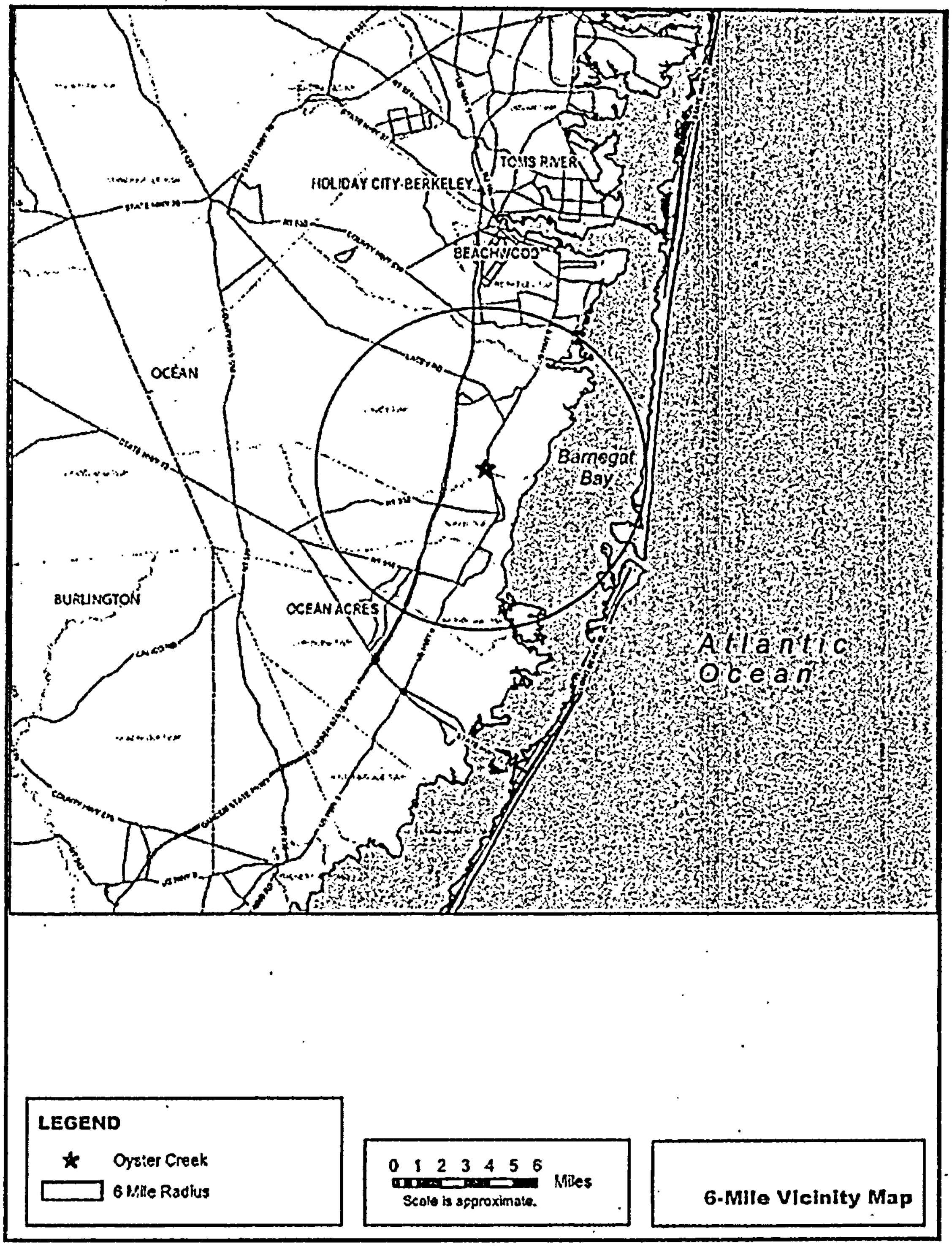
Michael P. Gallagher
Director, Licensing & Regulatory Affairs

Attachment: 6 mile Vicinity Map

cc: Karen Tuccillo, NJ BNE
File No. 04007

# ATTACHMENT

## 6-Mile Vicinity Map


TOMS RIVER
HOLIDAY CITY-BERKELEY
BEACHWOOD
OCEAN
Barnegat Bay
BURLINGTON
OCEAN ACRES
Atlantic Ocean
LEGEND
Oyster Creek
6 Mile Radius
0 1 2 3 4 5 6
Miles
Scale is approximate.
6-Mile Vicinity Map

AmerGen
An Exelon Company

AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348
www.exeloncorp.com

RECEIVED
OCT 1 3 2004
HISTORIC PRESERVATION OFFICE
HPO-J2004-102
04-2563-2-JF

October 7, 2004
2130-04-20228

Dorothy Guzzo, State Historic Preservation Officer
Historic Preservation Office
P.O. Box 404
Trenton, NJ 08625-0404

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State Historic Preservation Officer
October 7, 2004
Page 2

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Please call Bill Maher at (610) 765-5939, if you have any questions or require any additional information to review the proposed action.

Sincerely,

Michael P. Gallagher
Director, Licensing & Regulatory Affairs

Attachment: 6 mile Vicinity Map

cc: Karen Tuccillo, NJ BNE
File No. 04007

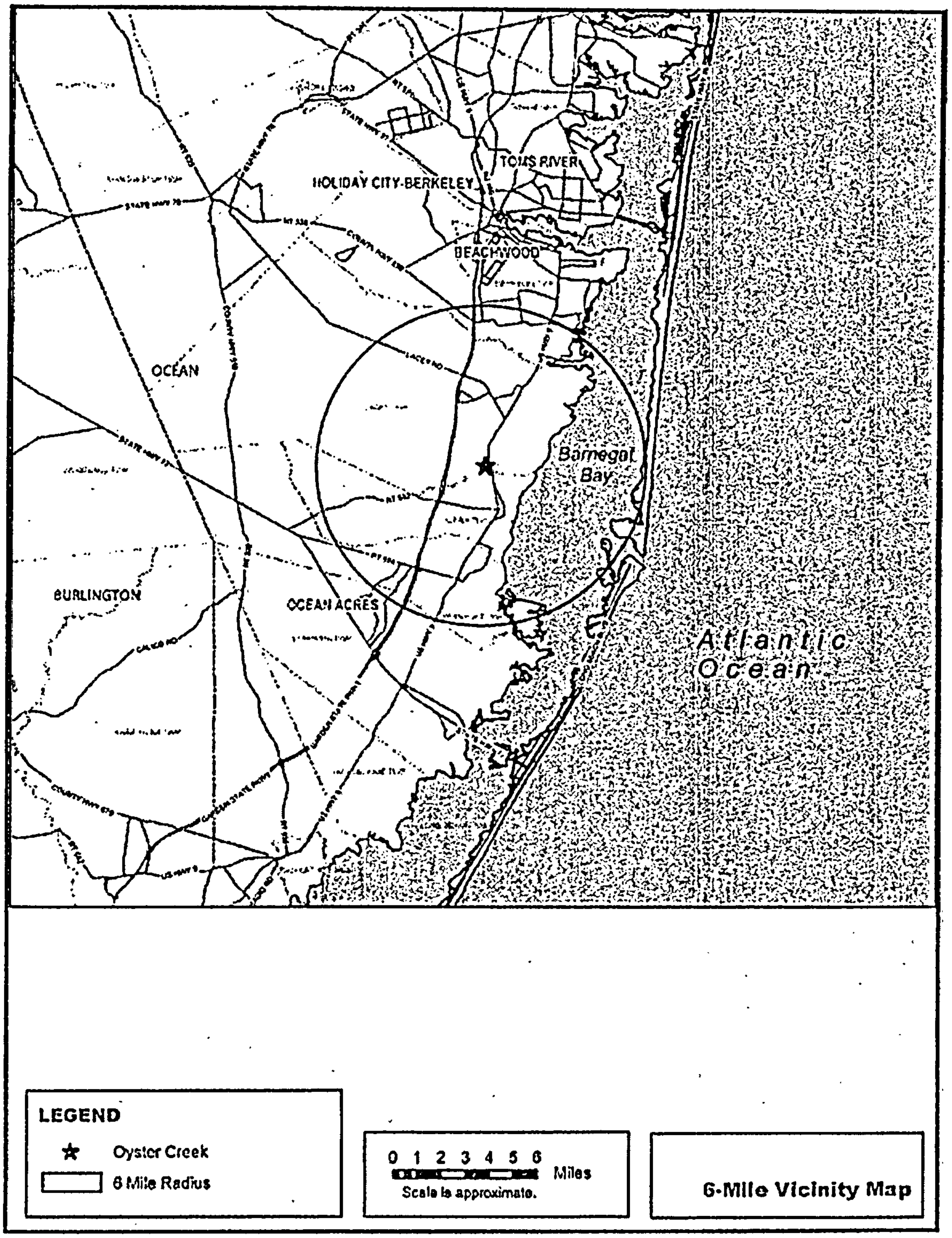
I concur with your finding that there are no historic properties affected within the project's area of potential effects. Consequently, pursuant to 36 CFR 800.4(d)(1), no further Section 106 consultation is required unless additional resources are discovered during project implementation pursuant to 36 CFR 800.13.

Dorothy P. Guzzo — 10/15/04
Deputy State Historic Preservation Officer — Date

NP

# ATTACHMENT

## 6-Mile Vicinity Map


TOMS RIVER
HOLIDAY CITY-BERKELEY
BEACHWOOD
OCEAN
Barnegat Bay
BURLINGTON
OCEAN ACRES
Atlantic Ocean
LEGEND
Oyster Creek
6 Mile Radius
0 1 2 3 4 5 6
Miles
Scale is approximate.
6-Mile Vicinity Map

## Appendix E

# Coastal Zone Consistency Certification

AmerGen.[SM]
An Exelon Company

AmerGen Energy Company, LLC
200 Exelon Way
Kennett Square, PA 19348

www.exeloncorp.com

January 20, 2005

Mr. Andy Heyl
Land Use Regulation Program
Bureau of Coastal Management
NJ Department of Environmental Protection
501 East State Street
Trenton, NJ 08625-0439

Subject: Federal Consistency Certification For Federal Permit And License Applicants
Oyster Creek Generating Station
License Renewal Application

Mr. Heyl:

AmerGen Energy Company, LLC (AmerGen) is requesting concurrence with the enclosed Federal Consistency Certification for Federal Permit and License Applicants. The certification presents AmerGen's position that continued operation of the Oyster Creek Generating Station (OCGS) in Lacey Township, NJ would be in compliance with the current New Jersey Coastal Management Program.

As part of the application process to the U. S. Nuclear Regulatory Commission (NRC) requesting renewal of the OCGS operating license, AmerGen performed a review for consistency with the New Jersey Coastal Management Program. In conjunction with the application submittal, AmerGen must certify to the NRC and the State of New Jersey that OCGS operations and activities are in compliance with the Coastal Zone Management Act.

Per NRC regulations for license renewal (10 CFR 54), AmerGen is in the process of preparing an environmental report as Appendix E of the license renewal application. The Environmental Report will include a description of the proposed action and the affected environment, and an analysis of environmental consequences of the proposed action and mitigating actions. Also to be included in the Environmental Report is a complete list of licenses, permits, and other approvals from Federal, State, and local authorities for current OCGS operations, and approvals and consultations that are required for the extended period of operations. A summary of this information is provided in the enclosed consistency certification.

Federal Consistency Certification
January 20, 2005
Page 2

After your office reviews the Consistency Certification, AmerGen requests a letter concurring with the enclosed Federal Consistency Certification for Federal Permit and License Applicants. AmerGen will include a copy of this letter and your response in the license renewal application that we submit to the NRC.

Please call Bill Maher at (610) 765-5939 if you have any questions or require any additional information to review the attached certification.

Sincerely,

Keith R. Jury

Keith R. Jury
Director – Licensing and Regulatory Affairs
AmerGen Energy Company, LLC

Enclosure 1: Federal Consistency Certification for Federal Permit and License Applicants

cc: Karen Tuccillo, NJ BNE
Peter Tam, Senior Project Manager, NRR
File No. XXXX

## FEDERAL CONSISTENCY CERTIFICATION FOR FEDERAL PERMIT AND LICENSE APPLICANTS[1]

This is the AmerGen Energy Company, LLC (AmerGen) certification to the U. S. Nuclear Regulatory Commission (NRC) and the State of New Jersey that renewal of the Oyster Creek Generating Station (OCGS) operating license would be consistent with enforceable policies of the federally approved state coastal zone management program. The certification describes background requirements, the proposed action (i.e., license renewal), anticipated environmental impacts, New Jersey enforceable coastal resource protection policies and OCGS's compliance status, and summary findings.

### CONSISTENCY CERTIFICATION

AmerGen will certify to the NRC that renewal of the OCGS operating license will be consistent with the federally approved New Jersey coastal management program. AmerGen expects OCGS operations during the license renewal term to be a continuation of current operations as described below, with no station structural or operational modifications related to license renewal that would change effects on New Jersey's coastal zone.

### NECESSARY DATA AND INFORMATION

#### Statutory Background

The federal Coastal Zone Management Act (16 USC 1451 et seq.) imposes requirements on the applicant for a federal license to conduct an activity that could affect a state's coastal zone. The Act requires an applicant to certify to the licensing agency that the proposed action would be consistent with the state's federally approved coastal zone management program. The Act also requires the applicant to provide to the state a copy of the certification statement and requires the state, at the earliest practicable time, to notify the federal agency and the applicant whether the state concurs with, or objects to, the consistency certification [16 USC 1456(c)(3)(A)].

The National Oceanic and Atmospheric Administration (NOAA) has promulgated implementing regulations that indicate that the certification requirement is applicable to renewal of federal licenses for activities not previously reviewed by the state [15 CFR 930.51(b)(1)]. NOAA approved the New Jersey coastal management program in 1980 (Ref. 2).

In New Jersey, the approved program is the Coastal Management Program. The Coastal Management Program comprises a network of offices within the New Jersey Department of Environmental Protection that serve distinct functions yet share responsibility for the coast of New Jersey. The Coastal Management program implements three major state laws: the Waterfront Development Law, the Wetlands Act of 1970, and the Coastal Area Facility Review Act (CAFRA). The Hackensack Meadowlands Reclamation and Development Act, and the Freshwater Wetlands Protection Act are additional authorities for Federal Consistency Review. Enforceable policies are contained in the Coastal Zone Management rules (New Jersey Administrative Code [NJAC] 7:7E), the Coastal Permit Program rules (NJAC 7:7) and the

1 This certification is patterned after the example certification included as Appendix E of the NRC Office of Nuclear Reactor Regulation's "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues" (LIC-203, 6-21-01).

Freshwater Wetlands Protection rules (NJAC 7:7A) (Ref. 3). The licensing of OCGS in 1969 by the NRC, pre-dated the state program approval.

**Proposed Action**

The NRC operating license for OCGS will expire in 2009. NRC regulations provide for license renewal, and AmerGen is applying for renewal of the license to 2029.

OCGS is an electric generating station located within the New Jersey coastal zone, in Lacey Township, Ocean County, between the South Branch of the Forked River and Oyster Creek, two miles inland of Barnegat Bay. The plant withdraws water from Barnegat Bay via the South Branch of the Forked River, and a manmade intake canal for non-contact cooling, and returns the heated discharge to Barnegat Bay via a discharge canal and Oyster Creek. Approximately 60 percent of the area within a 50-mile radius of OCGS is the water of the Atlantic Ocean. Attachments 2 and 3 of this enclosure are OCGS 50- and 6-mile vicinity maps, respectively.

OCGS is a boiling water reactor with an expected total output of 1,930 MW thermal and an expected electric output of 640 MW. The intake structure has four circulating water pumps within two bays. The four pumps provide a continuous supply (maximum of 460,000 gallons per minute [gpm]) of condenser cooling water. After moving through the condensers (and service water systems) water is discharged into a discharge canal and thence to Oyster Creek, which flows into Barnegat Bay. In addition to the four circulating water pumps (and four service water pumps with a total maximum pump capacity of 16,000 gpm) in the same intake structure, three dilution pumps pull water from the intake canal directly into the discharge canal to ameliorate the elevated temperatures in the discharge canal during part of the year. Maximum total capacity of the three dilution pumps is 780,000 gpm. Maximum flow with all circulation and dilution pumps working would be 1.25 million gpm; however, the NJPDES permit allows only two dilution pumps to operate simultaneously.

The OCGS workforce consists of approximately 470 AmerGen employees and 150 long-term contract employees. More than 80 percent reside in Ocean County. The OCGS reactor is on a 24-month refueling cycle. During refueling outages, site employment increases by approximately 1,300 workers for temporary (approximately 20 days) duty. AmerGen has no plans to add additional employees as a result of license renewal.

AmerGen has not identified any refurbishment activities necessary to allow operation for an additional 20 years, and have identified no significant environmental impacts from programs and activities for managing the effects of aging. As such, renewal would result in a continuation of environmental impacts currently regulated by the state. Table E-1 lists State and Federal licenses, permits, and other environmental authorization for current OCGS operations and Table E-2 identifies compliance activities associated specifically with NRC license renewal.

One transmission line was built to connect OCGS to the regional electric grid. The corridor runs approximately 11 miles, from OCGS to the Manitou substation near Toms River, and encompasses about 320 acres (Attachment 1). Conectiv is proposing to construct a new transmission line from the Oyster Creek substation south to Egg Harbor, but that proposal is not within the scope of this certification. The proposed action, renewing the license of OCGS for an additional 20 years, would not require additional transmission lines, nor is AmerGen anticipating that this action would change any corridor maintenance practices.

**Environmental Impacts**

NRC has prepared a generic environmental impact statement (GEIS; Ref. 4) on impacts that nuclear power plant operations could have on the environment and has codified its findings (10 CFR 51, Subpart A, Appendix B, Table B-1). The regulation identified 92 potential environmental issues, 69 of which the NRC identified as having small impacts and termed "Category 1 issues." NRC defines "small" as:

> Small – For the issue, environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purpose of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small as the term is used in this table (10 CFR 51, Subpart A, Appendix B, Table B-1)

The NRC regulation and the GEIS discuss the following types of Category 1 environmental issues:

- Surface water quality, hydrology, and use
- Aquatic ecology
- Groundwater use and quality
- Terrestrial resources
- Air quality
- Land use
- Human health
- Postulated accidents
- Socioeconomics
- Uranium fuel cycle and waste management
- Decommissioning

In its decision-making for plant-specific license renewal applications, absent new and significant information to the contrary, NRC relies on its codified findings, as amplified by supporting information in the GEIS, for assessment of environmental impacts from Category 1 issues [10 CFR 51.9(c)(4)]. For plants such as OCGS that are located in coastal areas, many of these issues involve impacts to the coastal zone. AmerGen will adopt by reference the NRC findings and GEIS analyses for all 58 applicable Category 1 issues. The remaining Category 1 issues do not apply to OCGS because either they are associated with design or operational features the OCGS does not have (e.g., cooling ponds), or to an activity (i.e., refurbishment) that OCGS does not intend to undertake.

The NRC regulation identified 21 issues as "Category 2," for which license renewal applicants must submit additional site-specific information.[2] Of these, 11 apply to OCGS, and, like the Category 1 issues, could involve impacts to the coastal zone. The applicable issues and AmerGen's impact conclusions are listed below.

- Entrainment of fish and shellfish in early life stages – This issue addresses mortality of organisms small enough to pass through the plant's circulating cooling water system. AmerGen monitored the fishery in Barnegat Bay from the early 1970s through the mid 1980s to identify impacts of OCGS on the fishery. Species collected included resident species, warm water migrants and cold water migrants. The patterns of species composition and relative abundance appeared stable. More recently, in response to the Barnegat Bay Study Act, other groups have studied the Bay, including its fish community. Results indicate that the water quality of the Bay, which had been in decline, is recovering and now supports a healthy fish population. One measure of the significance of environmental impacts is the degree to which they meet environmental protection legal standards. The New Jersey Department of Environmental Protection regulates OCGS entrainment and impingement, under its authority to issue the OGCS NJPDES discharge permit. To the best of Amergen's knowledge, OCGS is in compliance with its NJPDES permit. AmerGen concludes that the impacts of entrainment during current operations are small and it has no plans that would change this conclusion for the period of extended operation.

  Pursuant to Section 316(b) of the Clean Water ct, the U.S. Environmental Protection Agency has recently revised cooling water intake structure requirements for facilities such as OGCS. New Jersey will have to incorporate these revisions into its discharge permit program and the State and AmerGen will have to evaluate whether OCGS modifications would be necessary to comply with the new requirements. This evaluation could effectively re-define what would be an acceptable OGCS entrainment or impingement impact. If this happens, however, AmerGen observes that any modifications made to meet the new 316(b) requirements would only reduce, not increase, current OCGS impacts and that the post-modification result would still be small impacts.

- Impingement of fish and shellfish – This issue addresses mortality of organisms large enough to be caught by intake screens before passing through the plant's circulating cooling water system. OCGS has a fish return system consisting of Ristroph traveling screens at the intake pumps and a flume that delivers fish to the head of the discharge canal. This system reduces the number of fish impinged and impingement mortality. AmerGen concludes that impacts of impingement during current operations are small and it has no plans that would change this conclusion for the period of extended operation. See the paragraph above for discussion of 316(b).

- Heat shock – This issue addresses mortality of aquatic organisms by exposure to heated plant effluent. Cooling water flow rates and heat rejection rates are limited by provisions of NJPDES permit number NJ0005550. OCGS employs three dilution pumps to move water from the intake canal to the head of the discharge canal under certain temperature

[2] 10 CFR 51, Subpart A, Appendix B, Table B-1 also identifies 2 issues as "NA" for which NRC could not come to a conclusion regarding categorization. AmerGen believes that these issues, chronic effects of electromagnetic fields and environmental justice, do not affect the "coastal zone" as that phrase is defined by the Coastal Zone Management Act [16 USC 1453(1)].

conditions, as part of the NJPDES permit. AmerGen concludes that the impacts of heat shock during current operations are small and it has no plans that would change this conclusion for the license renewal term.

- Threatened or endangered species – This issue addresses effects that OCGS operations could have on species that are listed under federal law as threatened or endangered. In analyzing this issue, AmerGen has also considered species that are protected under New Jersey law (Table E-3).

Based on a review of the Natural Heritage Database and Landscape Project records, the following state-listed animal species occur in the vicinity of the OCGS site: barred owl (*Strix varia*), Cooper's hawk (*Accipter cooperii*), Northern pine snake (*Pituophis m. melanoleucus*), pine barrens treefrog (*Hyla andersoni*), and wood turtle (*Clemmys insculpta*). The Natural Heritage Database and Landscape Project also indicated that foraging habitat for the black skimmer (*Rhynchops niger*) and the black-crowned night heron (*Nycticorax nycticorax*) were within ¼ mile of the site. A survey of the undeveloped part of the site west of Rt. 9 done in support of security upgrades determined that none of the state-protected species were on site.

Although prior to 1992, no special-status marine species were observed or captured in the OCGS cooling canals, between June 1992 and July 1994, 9 sea turtles were impinged on the OCGS intake trash rack. An increase in the number of sea turtles observed in Barnegat Bay and in the number of sea turtles impinged at OCGS corresponded to the U.S. Army Corps of Engineers' deepening of Barnegat Inlet. It also followed the implementation in 1987 (full implementation in 1989) of federal regulations requiring U.S. shrimp trawlers to use Turtle Exclusion Devices that substantially reduced fishing-related mortality of sea turtles in south Atlantic and Gulf coastal waters.

In November 1993, the Nuclear Regulatory Commission (NRC) requested a formal consultation with the National Marine Fisheries Service (NMFS) regarding possible impacts of OCGS on listed sea turtles, and followed with a Biological Assessment in January 1995. In 2000 NRC submitted an updated Biological Assessment. In both instances, NMFS determined that OCGS may adversely affect three species of federally-protected sea turtle: endangered Kemp's ridley, endangered green, and threatened loggerhead. Each Biological Opinion further concluded that OCGS would not likely jeopardize the species' existences. Currently OCGS has an Incidental Take annual allowance of 5 loggerhead (no more than 2 lethal), 4 Kemp's Ridley (no more than 3 lethal), and 2 green (no more than one lethal) sea turtles. The Biological Opinion included Reasonable and Prudent Measures that must be implemented at OCGS to minimize impacts to sea turtles as well as a list of Terms and Conditions that implement the Reasonable and Prudent Measures. These non-discretionary Terms and Conditions include requirements for regular inspections of the intake trash racks in summer and fall; requirements for capturing, handling, resuscitating, and treating injured sea turtles; requirements for recording and reporting sightings and strandings; requirements for necropsies of dead turtles; and reporting requirements, including an annual report to NMFS on incidental takes. In 2004 OCGS exceeded its incidental take allowance for Kemp's ridley turtles.

As a result of this, NRC requested re-initiation of Endangered Species Act Section 7 consultation with NMFS. This consultation is on-going.

No other federally- or state-listed threatened or endangered species is known to occur, with the exception of the consultation noted above, at OCGS or along the OCGS-to-Manitou transmission corridor.

AmerGen is corresponding with cognizant federal and state agencies. With the exception of the consultation noted above, no federal or state agencies have identified any area of concern. AmerGen concludes that OCGS impacts to these protected species are small during current operations and has no plans that would change this conclusion for the license renewal term.

- Electromagnetic fields, acute effects (electric shock) – This issue addresses the potential for shock from induced currents, similar to static electricity effects, in the vicinity of transmission lines. Because this human-health issue does not directly or indirectly affect natural resources of concern within the Coastal Zone Management Act definition of "coastal zone" [16 USC 1453(1)], AmerGen concludes that the issue is not subject to the certification requirement.

- Housing – This issue addresses impacts that additional AmerGen employees required to support license renewal and the additional resulting indirect jobs could have on local housing availability. NRC concluded, and AmerGen concurs, that impacts would be small for plants located in high population areas that do not have growth control measures which limit housing development. Using the NRC definitions and categorization methodology, OCGS is located in a high population area without restrictive growth controls. AmerGen expects no additional employees would be required to support license renewal. AmerGen concludes that impacts during the OCGS license renewal term would be small.

- Public services; public utilities – This issue addresses impacts that adding license renewal workers could have on public utilities, particularly public water supply. AmerGen has analyzed the availability of public water supplies in the area and has found no limitations that would suggest that additional OCGS workers would cause impacts. AmerGen expects no additional employees to support license renewal. Therefore, AmerGen has concluded that impacts during the OCGS license renewal term would be small.

- Offsite land use – This issue addresses impacts that local government spending of plant property tax dollars can have on land use patterns. OCGS property taxes comprised 4 percent of Lacey Township's total tax revenues in 2003. AmerGen projects that OCGS taxes will remain relatively constant during the license renewal term. AmerGen concludes that impacts during the OCGS license renewal term would be small and not warrant mitigation.

- Public services; transportation – This issue addresses impacts that adding license renewal workers could have on local traffic patterns. AmerGen expects no additional employees would be required to support license renewal. Therefore, AmerGen has concluded that impacts during the OCGS license renewal term would be small.

- Historic and archaeological resources – This issue addresses impacts that license renewal activities could have on resources of historic or archaeological significance. Several archaeological or historic sites have been identified within 6 miles of OCGS; however, AmerGen is not aware of any adverse or detrimental impacts to these sites from current operations and AmerGen has no plans for license renewal activities that would disturb these resources. AmerGen correspondence with the State Historic Preservation Officer identified no issues of concern.

- Severe Accidents – This issue addresses the impact of severe accidents and the probability-weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts. The NRC has already determined the impacts from severe accidents to be of small significance for all plants.

**State Program**

The New Jersey Coastal Management Program is administered by the Land Use Regulation Program within the Department of Environment Protection. The Department maintains a website that describes the program in general terms (Ref. 3). The New Jersey Coastal Management Statutes (Ref. 5) contain guidelines for preservation and management of the coastal area that are set forth in policy statements, standards, and management objectives. Attachment 1 lists these objectives and discusses for each the applicability to OCGS.

Findings:

1. NRC has determined that the impacts of certain license renewal environmental issues (i.e., Category 1 issues) are small. AmerGen will adopt by reference NRC findings for these issues as they are applicable to OCGS.

2. For all other license renewal issues (i.e., Category 2 and "NA" issues), except endangered species, that are applicable to OCGS, AmerGen has determined that the environmental impacts are small.

3. NRC and NMFS are engaged in an Endangered Species Act Section 7 consultation regarding three protected sea turtle species. Outcome of this consultation will include recommendations, which will be reviewed by AmerGen.

4. To the best of AmerGen's knowledge, OCGS and its transmission corridor are in compliance with all New Jersey's licensing and permitting requirements and are in compliance with its state-issued licenses and permits.

5. AmerGen's license renewal and continued operation of OCGS would be consistent with the enforceable policies of the New Jersey coastal zone management program.

**STATE NOTIFICATION**

By this certification that OCGS license renewal is consistent with New Jersey's coastal zone management program, New Jersey is notified that it has six months from receipt of this letter and accompanying information in which to concur with or object to AmerGen's certification (15 CFR 930.51). However, pursuant to 15 CFR 930.51(b)(1), if New Jersey has not issued a decision within three months following the commencement of state agency review, it shall notify the contact listed below of the status of the matter and the basis for further delay. New Jersey's concurrence, objection, or notification of review status shall be sent to:

Andrew Kugler
Chief of Environmental Section
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
One White Flint
11555 Rockville Pike
Rockville, MD 20555
(301) 415-2828

Keith Jury
Director, Licensing and Regulatory Affairs
Exelon Corporation
200 Exelon Way
Kennett Square, PA 19348
(630) 657-2831

**REFERENCES**

1. NRR Office Instruction No. LIC-203, "Procedural Guidance for Preparing Environmental Assessments and Considering Environmental Issues." U. S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation. June 21, 2001.

2. State and Territory Coastal Management Program Summaries, New Jersey Coastal Management Program. National Oceanic and Atmospheric Administration. Available on line at http://www.ocrm.nos.noaa.gov/czm/czmsitelist.html. Accessed July 19, 2004.

3. New Jersey Department of Environmental Protection. 2004. Coastal Management Program. Available at http://www.nj.gov/dep/cmp. Accessed July 19, 2004.

4. Generic Environmental Impact statement for License Renewal of Nuclear Plants, U. S. Nuclear Regulatory Commission, NUREG-1437, May 1996. Available on line at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr1437. Accessed 12-23-03.

5. New Jersey Administrative Code, Title 7, Chapter 7E, Coastal Zone Management rules.

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**Figure E-1,** ***50-Mile Vicinity Map***

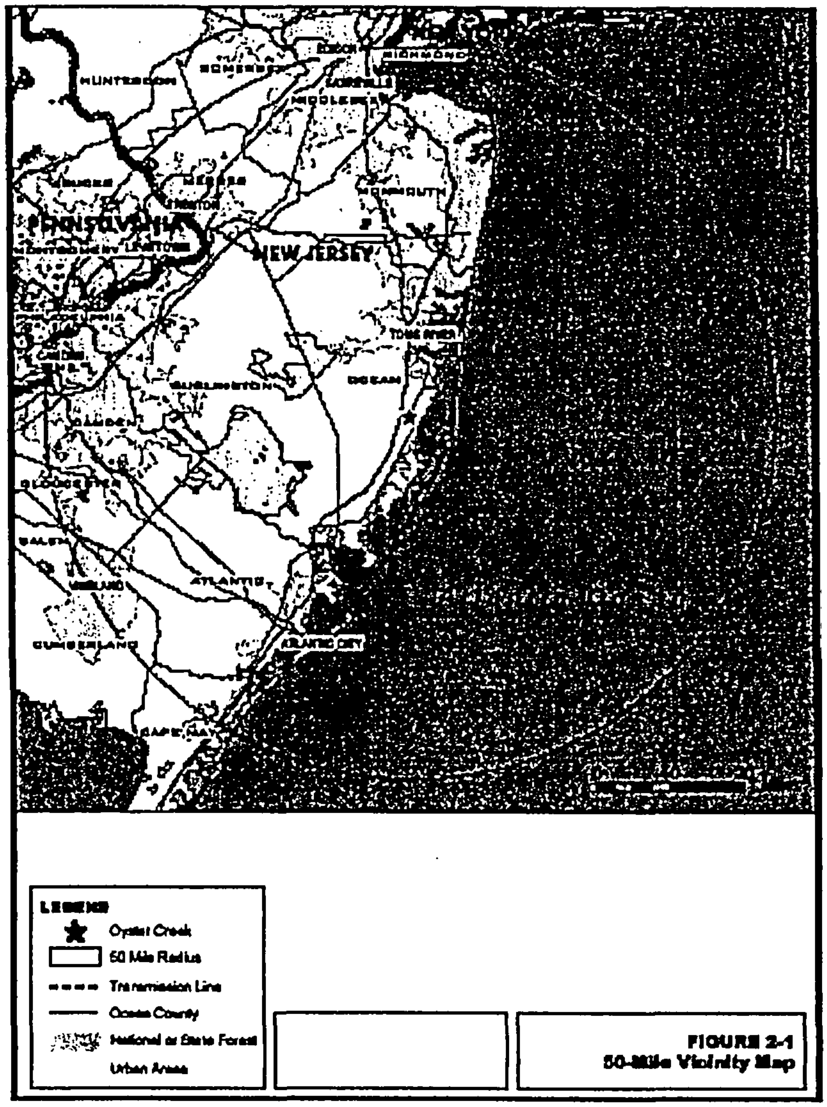

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Figure E-2, *6-Mile Vicinity* Map

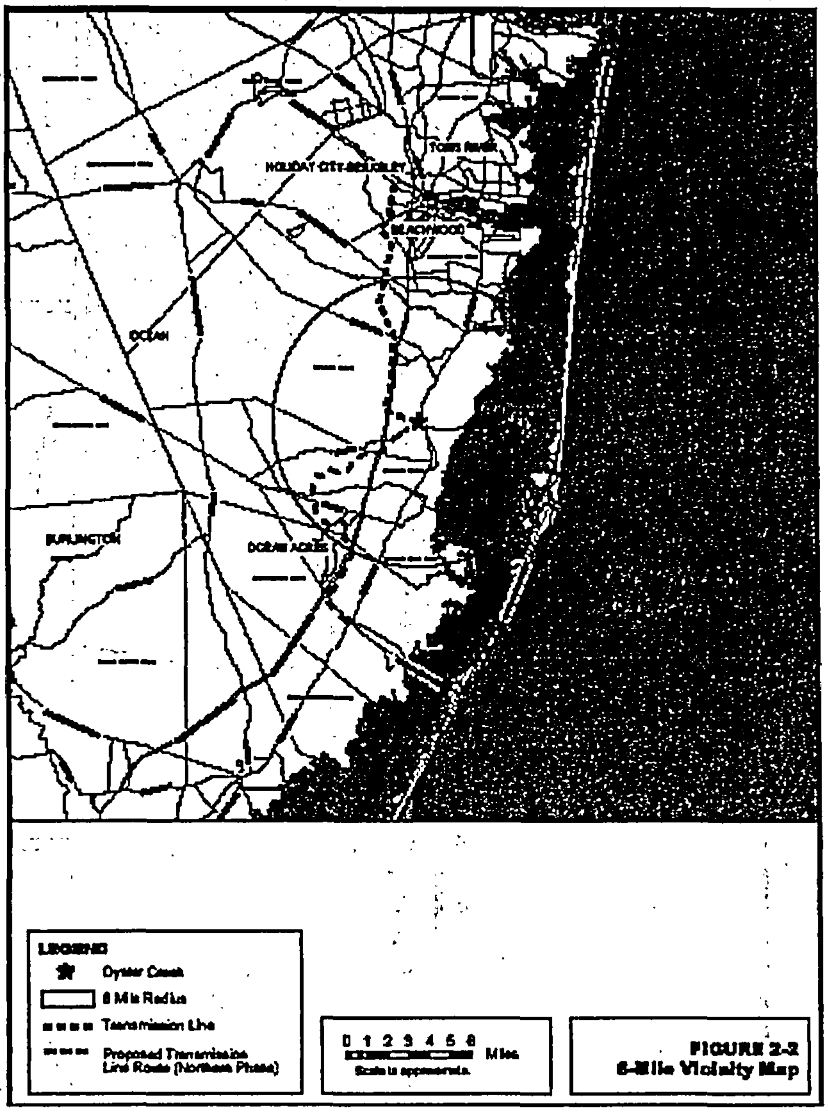

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**Figure E-3,** ***Site Boundary Map***

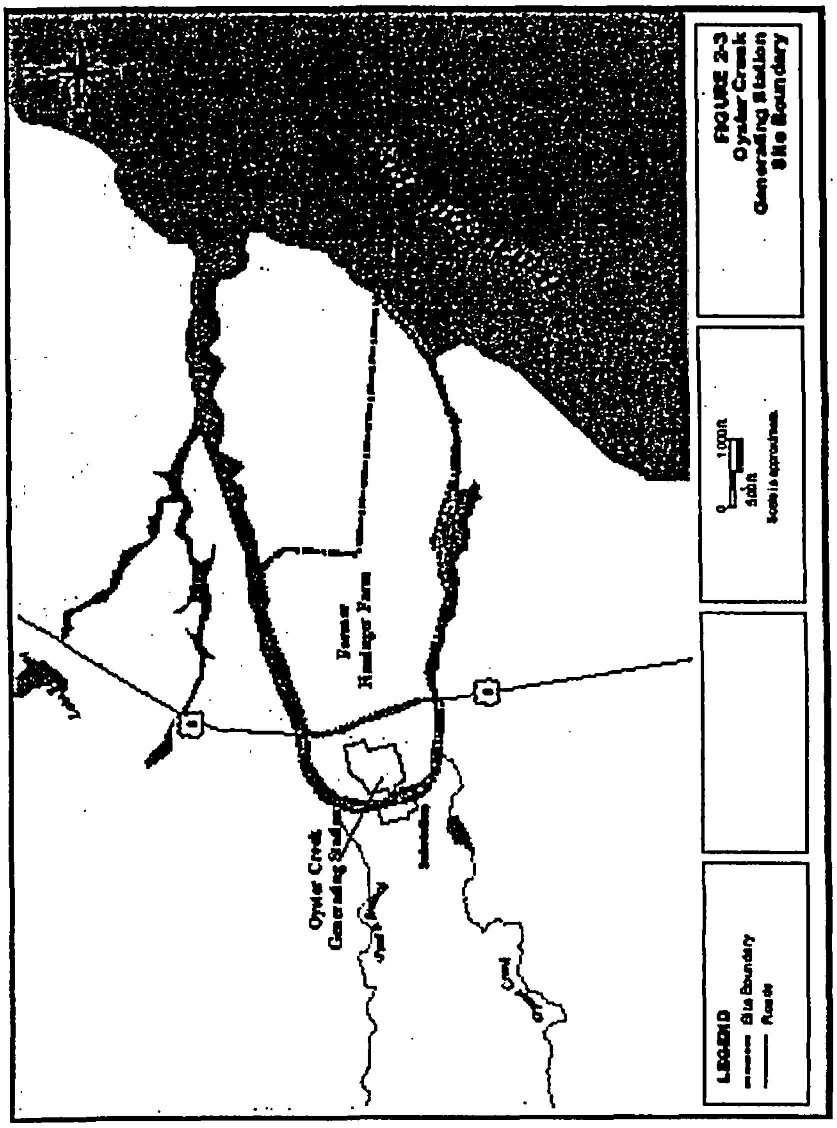

**Table E-1. Environmental Authorizations for Current OCGS Operations.**

| Agency | Authority | Requirement | Number | Issue or Expiration Date | Activity Covered |
|---|---|---|---|---|---|
| | | **Federal Requirements to License Renewal** | | | |
| U. S. Nuclear Regulatory Commission | Atomic Energy Act (42 USC 2011, et seq.), 10 CFR 50.10 | License to operate | DPR-16 | Issued: 4/9/1969 Expires: 4/9/2009 | Operation of OCGS |
| U.S. Department of Transportation | 49 USC 5108 | Registration | 052804700004MO | Issued: 5/28/04 Expires: 6/30/07 | Hazardous materials shipments |
| National Marine Fisheries Service | Endangered Species Act of 1973 (16 USC 1531-1544) | Incidental Take Permit - Sea Turtles | To be determined | | Possession and disposition of impinged or stranded sea turtles |
| New Jersey Department of Environment Protection | Clean Water Act (33 USC 1251 et seq.), NJ Statutes Annotated (N.J.S.A.) Water Pollution Control Act 58:10A et seq. and N. J. Administrative Code (N.J.A.C.)7:14A et seq. | New Jersey Pollutant Discharge Elimination System Permit – surface water | NJ0005550 | Issued: 10/21/94; Expires: 11/30/99 | Wastewater (industrial surface water, thermal surface water and stormwater runoff) discharges to Oyster Creek, Forked River, and South Branch of Forked River |
| New Jersey Department of Environment Protection | Clean Water Act (33 USC 1251 et seq.), N.J.S.A. 58:10A et seq. and N.J.A.C. 7:14A et seq. | New Jersey Pollutant Discharge Elimination System Permit – ground water | NJ0101966 | Issued: 2/20/04 Expires: 2/20/09 | Wastewater (percolation lagoon, underground injection, dredge spoils) to groundwater |

**Table E-1. Environmental Authorizations for Current OCGS Operations (Continued).**

| Agency | Authority | Requirement | Number | Issue or Expiration Date | Activity Covered |
|---|---|---|---|---|---|
| New Jersey Department of Environment Protection | Coastal Area Facility Review Act (N.J.S. A. 13:19-1 et seq.), Waterfront Development Act (N.J.S.A. 12:5-3), and Wetlands Act of 1970 (N.J.S.A. 13:9A-1 et seq.) | Certification | | | Compliance with Coastal Zone management rules, Freshwater Wetlands protection rules, and Coastal Permit Program rules |
| New Jersey Department of Environment Protection | Water Supply Management Act, N.J.S.A. 58: 1A et seq. | Water Use Registration | 11108W | Issued: 7/25/01 Expires: not applicable | Registers two wells with collective diversions of less than 100,000 gallons per day |
| New Jersey Department of Environmental Protection | N.J.A.C. 7:7A | Freshwater Wetlands Statewide General Permit | 1500-02-0004.1 | Issued: 6/4/02 Expires: 6/4/07 | Remove vegetation from fire pond |
| New Jersey Department of Environmental Protection | Chapter 251, Soil Erosion and Sediment Control Act, P.L. 195 | Certificate | SCD 1302 | Issued: 10/31/01 Expires: 4/3/05 | Soil Erosion Control and Sediment Control plan for upland dredge disposal site |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP970001 | Issued: 9/8/97 Expires: 9/8/07 | Air emission for DL-42 boiler and DL-68 boiler |

**Table E-1. Environmental Authorizations for Current OCGS Operations (Continued).**

| Agency | Authority | Requirement | Number | Issue or Expiration Date | Activity Covered |
|---|---|---|---|---|---|
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP970002 | Issued: 10/9/02<br>Expires: 10/9/07 | Emergency Fire Diesel 1-2 |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP970003 | Issued: 11/14/97<br>Expires: 11/14/07 | #1 boiler |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP970005 | Issued: 1/8/03<br>Expires: 1/8/08 | Forked River Emergency Fire Diesel |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP970006 | Issued: 10/31/02<br>Expires: 10/29/07 | Dirty Oil Lube Tank |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP960005 | Issued: 3/23/04<br>Expires: 3/23/09 | Main Fuel Tank |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP960006 | Issued: 7/10/04<br>Expires: 7/10/09 | Emergency Generator 1 |

**Table E-1. Environmental Authorizations for Current OCGS Operations (Continued).**

| Agency | Authority | Requirement | Number | Issue or Expiration Date | Activity Covered |
|---|---|---|---|---|---|
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP960007 | Issued: 7/10/04<br>Expires: 7/10/09 | Emergency Diesel Generator 2 |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP960008 | Issued: 6/26/96<br>Expires: 6/26/06 | Grit Blaster |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to operate | PCP020001 | Issued: 7/29/02<br>Expires: 7/28/07 | Emergency Fire Diesel 1-1 |
| New Jersey Department of Environmental Protection | N.J.A.C. 7:14B | Certificate to operate | GEN000001 | Issued: 7/19/00<br>Expires: 7/18/05 | Emergency Generator C2 |
| New Jersey Department of Environmental Protection | Clean Water Act (33 USC 1251 et seq.); Clean Air Act (42 USC 7401 et seq.); Resource Conservation and Recovery Act (42 USC 6901 et seq.); Water Pollution Control Act, N.J.S.A. 48:10A et seq.; Industrial Site Recovery Act, N.J.S.A. 26:2C-1 et seq. and N.J.A.C. 7:14B | Registration | UST 000002 | Issued: 8/24/04<br>Expires: 8/24/09 | Underground storage tank – emergency spill tank |

**Table E-1. Environmental Authorizations for Current OCGS Operations (Continued).**

| Agency | Authority | Requirement | Number | Issue or Expiration Date | Activity Covered |
|---|---|---|---|---|---|
| New Jersey Department of Environmental Protection | Industrial Site Recovery Act, N.J.S.A. 26:2C-1 et.seq. and N.J.A.C. 7:27-8 | Operating Certificate | CN 099746 | Issued: 10/16/00<br>Expires: 10/16/05 | Above-ground Gasoline Storage Tank |
| New Jersey Department of Environmental Protection | N.J.A.C. 7:18 et seq. | Laboratory Certification | 15304 | Issued: 6/30/04<br>Expires: 6/30/05 | State certified laboratory to perform listed analyses |
| New Jersey Department of Transportation | Fish and Game, Wild Birds and Animals | License | H-205 | Issued: 2/2004<br>Expires: 1/2005 | Oyster Creek Helistop |
| New Jersey Department of Environmental Protection | Clean Air Act (42 USC 7401 et seq); Air Pollution Control Act (1954), N.J.S.A. 26:2C-9.2 | Certificate to Operate | PCP960004 | Issued: 2/13/01<br>Expires: 2/13/06 | EDG Fuel Oil Storage Tank |
| South Carolina Department of Health and Environmental Control – Division of Waste Management | South Carolina Radioactive Waste Transportation and Disposal Act (Act No. 429) | South Carolina Radioactive Waste Transport Permit | 0043-29-05-X | 12/31/05 | Transportation of radioactive waste into the State of South Carolina |
| Commonwealth of Virginia Department of Environmental Protection | Virginia Department of Emergency Management<br>Title 44, Code of Virginia, Chapter 3.3, Section 44-146.3 | Virginia Registration to Transport Hazardous Radioactive Materials | AO-S-063006 | Issued: 5/27/2004<br>Expires: 6/30/2006 | Transport of hazardous radioactive materials |

**Table E-1. Environmental Authorizations for Current OCGS Operations (Continued).**

| Agency | Authority | Requirement | Number | Issue or Expiration Date | Activity Covered |
|---|---|---|---|---|---|
| State of Tennessee Department of Environment and Conservation Division of Radiological Health | Tennessee Department of Environment and Conservation Rule 1200-2-10.32 | Tennessee Radioactive Waste License-for-Delivery | T-NJ001-L05 | 12/31/05 | Transportation of radioactive waste into the State of Tennessee |
| New Jersey Department of Environmental Protection | 40 CFR 266 Subpart N N.J.A.C. 7:26G | Conditional Exemption | | | Storage and treatment of low-level mixed waste |
| Ocean County Utilities Authority | | Agreement | Not applicable | Not applicable | OCGS provides continuous radiation monitoring of discharges of OCGS wastewater to publicly-owned treatment facility |

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**Table E-2. Environmental Authorizations for OCGS License Renewal[a]**

| Agency | Authority | Requirement | Remarks |
|---|---|---|---|
| U.S. Nuclear Regulatory Commission | Atomic Energy Act (42 USC 2011 et seq.) | License renewal | Environmental Report submitted in support of license renewal application |
| U.S. Fish and Wildlife Service | Endangered Species Act Section 7 (16 USC 1536) | Consultation | Requires federal agency issuing a license to consult with the U.S. Fish and Wildlife Service |
| New Jersey Department of Environmental Protection | Clean Water Act Section 401 (33 USC 1341) | Certification | State issuance of NJPDES permit (Section 9.1.5) constitutes 401 certification |
| New Jersey Coastal Management Program | Coastal Zone Management Act (16 USC 1452 et seq.) | Certification | Requires applicant to prove certification to federal agency issuing the license that license renewal would be consistent with the federally approved State Coastal Zone Management program. Based on its review of the proposed activity, the State must concur with or object to the applicant's certification |
| New Jersey Office of Historic Preservation | National Historic Preservation Act Section 106 (16 USC 470f) | Certification | Requires federal agency issuing a license to consider cultural impacts and consult with State Historic Preservation Officer (SHPO). SHPO must concur that license renewal will not affect any sites listed or eligible for listing |

a. No renewal-related requirements identified for local or other agencies.

**Table E-3. Endangered and Threatened Species that Could Occur at or Near OCGS or Along Associated OCGS-Manitou Transmission Line.**

| Scientific Name | Common Name | Federal Status[a] | State Status[a] |
|---|---|---|---|
| **Mammals** | | | |
| *Lynx rufus* | Bobcat | - | E |
| **Birds** | | | |
| *Accipiter cooperii* | Cooper's hawk | - | T |
| *Ammodramus savannarum* | Grasshopper sparrow | - | T |
| *Bartramia longicauda* | Upland sandpiper | - | E |
| *Botaurus lentiginosus* | American bittern | - | E |
| *Calidris canutus* | Red knot | - | T |
| *Charadrius melodus* | Piping plover | T | E |
| *Circus cyaneus* | Northern harrier | - | E |
| *Cistothorus platensis* | Sedge wren | - | E |
| *Falco peregrinus* | Peregrine falcon | - | E |
| *Haliaeetus leucocephalus* | Bald eagle | T | E |
| *Laterallus jamaicensis* | Black rail | - | T |
| *Melanerpes erythrocephalus* | Red-headed woodpecker | - | T |
| *Nyctanassa violacea* | Yellow-crowned night-heron | - | T |
| *Nycticorax nycticorax* | Black-crowned night-heron | - | T |
| *Pandion haliaetus* | Osprey | - | T |
| *Podilymbus podiceps* | Pied-billed grebe | - | E |
| *Pooecetes gramineus* | Vesper sparrow | - | E |
| *Rynchops niger* | Black skimmer | - | E |
| *Sterna antillarum* | Least tern | - | E |
| *Sterna dougallii dougallii* | Roseate tern | E | E |
| *Strix varia* | Barred owl | - | T |
| **Reptiles** | | | |
| *Ambystoma tigrinum tigrinum* | Eastern tiger salamander | - | E |
| *Clemmys insculpta* | Wood turtle | - | T |
| *Clemmys muhlenbergii* | Bog turtle | T | T |
| *Crotalus horridus horridus* | Timber rattlesnake | | E |
| *Elaphe guttata guttata* | Corn snake | - | E |
| *Hyla andersoni* | Pine barrens treefrog | - | E |
| *Hyla chrysoscelis* | Cope's gray treefrog | - | E |
| *Pituophis melanoleucus* | Northern pine snake | - | T |
| **Invertebrates** | | | |
| *Cicindela dorsalis dorsalis* | Northeastern beach tiger beetle | T | E |
| *Nicrophorus americanus* | American burying beetle | E | E |

**Table E-3. Endangered and Threatened Species that Could Occur at or Near OCGS or Along Associated OCGS-Manitou Transmission Line (Continued).**

| Scientific Name | Common Name | Federal Status[a] | State Status[a] |
|---|---|---|---|
| **Plants** | | | |
| *Amaranthus pumilus* | Seabeach amaranth | T | E |
| *Aster radula* | Low rough aster | - | E |
| *Cacalia atriplicifolia* | Pale Indian plantain | - | E |
| *Cardamine longii* | Long's bittercress | - | E |
| *Cirsium virginianum* | Virginia thistle | - | E |
| *Clitoria mariana* | Butterfly-pea | - | E |
| *Corema conradii* | Broom crowberry | - | E |
| *Desmodium pauciflorum* | Few-flower tick-trefoil | - | E |
| *Eleocharis tortilis* | Twisted spike-rush | - | E |
| *Eriophorum tenellum* | Rough cotton-grass | - | E |
| *Eupatorium resinosum* | Pine Barren boneset | - | E |
| *Fraxinus profunda* | Pumpkin ash | - | E |
| *Galactia volubilis* | Downy milk-pea | - | E |
| *Glaux maritima* | Sea-milkwort | - | E |
| *Gnaphalium helleri* | Small everlasting | - | E |
| *Helonias bullata* | Swamp-pink | T | E |
| *Hottonia inflata* | Featherfoil | - | E |
| *Jeffersonia diphylla* | Twinleaf | - | E |
| *Juncus caesariensis* | New Jersey rush | - | E |
| *Juncus torreyi* | Torrey's rush | - | E |
| *Limosella subulata* | Awl-leaf mudwort | - | E |
| *Linum intercursum* | Sandplain flax | - | E |
| *Luzula acuminate* | Hairy wood-rush | - | E |
| *Melanthium virginicum* | Virginia bunchflower | - | E |
| *Myriophyllum tenellum* | Slender water-milfoil | - | E |
| *Myriophyllum verticillatum* | Whorled water-milfoil | - | E |
| *Narthecium americanum* | Bog asphodel | C | E |
| *Oenothera humifusa* | Sea-beach evening-primrose | - | E |
| *Onosmodium virginianum* | Virginia false-gromwell | - | E |
| *Plantago pusilla* | Dwarf plantain | - | E |
| *Polygonum glaucum* | Sea-beach knotweed | - | E |
| *Prunus angustifolia* | Chickasaw plum | - | E |
| *Ranunculus cymbalaria* | Seaside buttercup | - | E |
| *Rhododendron atlanticum* | Dwarf azalea | - | E |
| *Rhynchospora globularis* | Coarse grass-like beaked-rush | - | E |
| *Rhynchospora knieskernii* | Knieskern's beaked-rush | T | E |

**Table E-3. Endangered and Threatened Species that Could Occur at or Near OCGS or Along Associated OCGS-Manitou Transmission Line (Continued).**

| Scientific Name | Common Name | Federal Status[a] | State Status[a] |
|---|---|---|---|
| *Rhynchospora microcephala* | Small-head beaked-rush | - | E |
| *Schwalbea americana* | Chaffseed | E | E |
| *Scirpus longii* | Long's woolgrass | - | E |
| *Scirpus maritimus* | Saltmarsh bulrush | - | E |
| *Spiranthes laciniata* | Lace-lip ladies'-tresses | - | E |
| *Stylisma pickeringii var* | Pickering's morning glory | - | E |
| *Tridens flavus var chapmanii* | Chapman's redtop | - | E |
| *Triglochin maritima* | Seaside arrow-grass | - | E |
| *Utricularia biflora* | Two-flower bladderwort | - | E |
| *Utricularia minor* | Lesser bladderwort | - | E |
| *Uvularia puberula var nitida* | Pine Barren bellwort | - | E |
| *Verbena simplex* | Narrow-leaf vervain | - | E |
| *Xyris fimbriata* | Fringed yellow-eyed-grass | - | E |
| *Zigadenus leimanthides* | Death-camus | - | E |

a. E = Endangered; T = Threatened; C = Candidate; - = Not listed.
Source: NJDEP NHP 2001.

## ATTACHMENT 1

## NEW JERSEY COASTAL ZONE MANAGEMENT RULES

**APPLICABILITY**

The New Jersey Department of Environmental Protection (NJDEP) maintains a website that describes the state coastal management program (Ref. E-1) and provides a discussion of Federal consistency certification and links to the New Jersey's Federal Consistency Guidance Document and New Jersey's Approved Federal Consistency Listing (Ref. E-2). The consistency discussion and the guidance document indicate that the enforceable policies of the New Jersey coastal management program are contained in the following state rules:

- Coastal Zone Management Rules (NJAC[3] 7:7E)
- Coastal Permit Program Rules (NJAC 7:7)
- Freshwater Wetlands Protection Act Rules (NJAC 7:7A)

The Federal Consistency listing includes "[p]ermits and licenses required for the construction and operation of nuclear facilities under the Atomic Energy Act of 1954, Sections 6, 7, 8, and 10." While the listing does not expressly include license renewal, AmerGen has prepared this certification as if it did. The following paragraphs present AmerGen's conclusions with regard to the applicability of the New Jersey enforceable coastal management policies to U. S. Nuclear Regulatory Commission renewal of the Oyster Creek Generating Station (OCGS) operating license.

<u>Coastal Zone Management Rules (NJAC 7:7E, as amended 2/13/03)</u> – The New Jersey Land Use Regulation Program administers these rules under the authority of the state Coastal Area Facility Review Act (CAFRA) and other laws. The Program website (Ref. E-3) provides additional detail about its coastal programs and includes a link to a CAFRA zone map for a preliminary assessment of geographic coverage of the Act (Ref. E-4). The map indicates that the eastern one half of Ocean County is with the coastal area. OCGS is located within that portion of Ocean County, in Lacey Township. The rules at section 7:7E-1.2(a)1 indicates that the chapter (i.e., 7E) is applicable to consistency determinations. AmerGen has concluded that the location of the OCGS is within the CAFRA geographic coverage and that these rules, as they implement CAFRA, apply to the OCGS certification.

<u>Coastal Permit Program Rules (NJAC 7:7, as amended 2/13/03)</u> – These are the rules by which NJDEP implements its requirements for permits for construction within the coastal area; draining, dredging, excavation, or deposition of material, and erection of any structure in any coastal wetlands; and filling or dredging, or construction in certain upland areas adjacent to tidal waterways. Because AmerGen is not performing these activities as a result of license renewal, has no plans to perform such activities as a result of license renewal, and is not seeking a coastal permit for such activities, AmerGen has concluded that these rules are not applicable to its federal consistency certification.

3 NJAC = New Jersey Administrative Code

Freshwater Wetlands Protection Act Rules (NJAC 7:7A, effective 10/20/03) – These are the rules by which DEP regulates construction in, or other disturbance of, freshwater wetlands. AmerGen has concluded that these rules do not apply to the OCGS certification because AmerGen is not performing such a regulated activity and has no plans to perform such a regulated activity as a result of license renewal.

The following sections address specific provisions of the New Jersey Coastal Zone Management Rules and AmerGen's basis for its conclusions regarding applicability and consistency. Subchapter 1 of the rules deals with general information (e.g., purpose, jurisdiction, definitions) and Subchapter 2 is reserved, so the discussion begins with Subchapter 3.

**POLICY ANALYSIS**

**Subchapter 3 – Special Areas**

Rule Section 7:7E-3.1 groups Subchapter 3 requirements by the following categories of Special Areas:

- Special Water Areas, NJAC 7:7E-3.2 through 3.15
- Special Water's Edge Areas, NJAC 7:7E-3.16 through 3.32
- Special Land Areas, NJAC 7:7E-3.33 through 3.35
- Coastwide Special Areas, NJAC 7:7E-3.36 through 3.49

The following paragraphs address each category.

**Special Water Areas, NJAC 7:7E-3.2 through 3.15**

OCGS is located on approximately 800 acres in Lacey Township, Ocean County, New Jersey. The OCGS property lies between the South Branch of Forked River to the north, and Oyster Creek to the south. The plant withdraws and discharges water from Barnegat Bay via the South Branch of Forked River and Oyster Creek, respectively. OCGS operations have the potential to affect Special Water Areas of Barnegat Bay, the South Branch of Forked River, and Oyster Creek. The state regulates these effects through the OCGS New Jersey Environmental Pollutant Discharge Elimination System (NJPDES) permit. AmerGen is in compliance with its NJPDES permit and has no plans that would change these effects as a result of license renewal.

**7:7E-3.2 Shellfish habitat**

Hardshell clam (*Mercenaria mercenaria*) populations in Barnegat Bay declined in the 1960s and 1970s and do not appear to be recovering. However, because Barnegat Bay has a history of natural shellfish production, it is considered a shellfish habitat for the purposes of this document.

AmerGen will construct no docks, piers or mooring in Barnegat Bay. AmerGen will not dredge in Barnegat Bay, and if dredging the existing intake and discharge canals is necessary, the spoils will be disposed at a properly-permitted upland site. OCGS is in compliance with the rules protecting shellfish habitat.

**7:7E-3.3 Surf clam areas**

OCGS operations and license renewal involve no development in coastal waters; therefore, these requirements are not relevant.

**7:7E-3.4 Prime fishing areas**

Oyster Creek, from Route 9 to Barnegat Bay, is a popular recreational fishing area as is the Bay itself. AmerGen will not mine sand or gravel from the creek and is not proposing additional development; therefore, OCGS is in compliance with the rules protecting prime fishing areas.

**7:7E-3.5 Finfish migratory pathways**

Finfish seasonally migrate up and down Barnegat Bay. OCGS has no physical barriers that impede fish migrations in Barnegat Bay. The thermal plume entering the Bay from Oyster Creek has temperatures a few degrees Fahrenheit above the ambient temperature of the Bay, and does not interfere with any fish migrations. These conditions will remain throughout the license renewal term. No development that would decrease water quality in the creeks or Barnegat Bay will occur as a result of license renewal. OCGS is in compliance with the rules protecting finfish migrations.

**7:7E-3.6 Submerged vegetation habitat**

Barnegat Bay supports submerged vegetation. Prohibited activities are all related to development. As stated previously, AmerGen will not develop any part of the OCGS property as a result of license renewal. OCGS is in compliance with the rules protecting submerged vegetation habitat.

**7:7E-3.7 Navigation channels**

No OCGS operations affect any navigation channels; therefore, these requirements are not relevant.

**7:7E-3.8 Canals**

Canals are navigation channels for boat traffic through land areas. No navigation channels occur on AmerGen property, and the transmission line does not cross any canals; therefore, these requirements are not relevant.

**7:7E-3.9 Inlets**

AmerGen property is not contiguous to and does not include an inlet; therefore, these requirements are not relevant.

**7:7E-3.10 Marina Moorings**

AmerGen has no marina moorings; therefore, these requirements are not relevant.

**7:7E-3.11 Ports**

AmerGen has no ports; therefore, these requirements are not relevant.

**7:7E-3.12 Submerged infrastructure routes**

AmerGen has no submerged infrastructure, nor any property adjacent to submerged infrastructure routes; therefore, these requirements are not relevant.

**7:7E-3.13 Shipwreck and artificial reef habitats**

AmerGen has no shipwrecks or artificial reef habitats; therefore, these requirements are not relevant.

**7:7E-3.14 Wet borrow pits**

AmerGen has no wet borrow pits; therefore, these requirements are not relevant.

**7:7E-3.15 Intertidal and subtidal shallows**

AmerGen has no property with intertidal or subtidal shallows; therefore, these requirements are not relevant.

**Special Water's Edge Areas, NJAC 7:7E-3.16 through 3.32**

Rule Section 7:7E-3.1 divides Special Water's Edge Areas requirements into the following subcategories:

Oceanfront and Raritan and Delaware Bayfronts, NJAC 7:7E-3.16 through 3.19 - These requirements are not applicable to OCGS certification because OCGS is not located on, and does not affect, the oceanfront or Raritan and Delaware Bayfronts.

Barrier and Bay Islands, NJAC 7:7E-3.20 and 3.21 - These requirements are not applicable to OCGS certification because OCGS is not located on, and does not affect, barrier or bay islands.

Coastwide Special Water's Edge Areas, NJAC 7:7E-3.22 through 3.32 - OCGS operations have the potential to affect Coastwide Special Water's Edge Areas of Barnegat Bay, the South Branch of Forked River, and Oyster Creek. AmerGen has no plans that would change these effects as a result of license renewal.

**7:7E-3.22 Beaches**

Beaches are located at the eastern edge of Finninger Farms property. AmerGen has no plans that would affect these beaches as a result of license renewal.

**7:7E-3.23 Filled water's edge**

AmerGen has no filled water's edges; therefore, these requirements are not relevant.

**7:7E-3.24 Existing lagoon edges**

AmerGen has no existing lagoon edges; therefore, these requirements are not relevant.

**7:7E-3.25 Flood hazard areas**

Neither Oyster Creek nor the South Branch of the Forked River is identified as a flood hazard area in NJAC 7:13 Rules Governing Flood Hazard Areas; therefore, these requirements are not relevant.

**7:7E-3.26 Reserved**

**7:7E-3.27 Wetlands**

Vernal habitat mapping by Rutger's Center for Remote Sensing and Spatial Analysis indicates a small vernal pool between the Administration area's parking lot and Route 9. The pool has not been surveyed to determine if it meets NJDEP criteria for exceptional resource wetlands; however, AmerGen evaluated the rules for protection of wetlands.

As stated previously, AmerGen will not develop additional facilities at OCGS as a result of license renewal. AmerGen properly disposes of all solid and liquid wastes generated at the facility. OCGS is in compliance with wetland protection rules. The transmission line crosses several creeks and associated wetlands. FirstEnergy, which owns the transmission line, follows accepted procedures for the control of vegetation in wetlands.

**7:7E-3.28 Wetlands buffers**

The small vernal pool on AmerGen property has been surveyed for the presence / absence of protected species and a buffer was established. AmerGen will not develop any undeveloped land as a result of license renewal.

**7:7E-3.29 and 7:7E-3.30 Reserved**

**7:7E-3.31 Coastal bluffs**

AmerGen property has no coastal bluffs; therefore, these requirements are not relevant.

**7:7E-3.32 Intermittent stream corridors**

AmerGen property has no intermittent streams; therefore, these requirements are not relevant.

**Special Land Areas, NJAC 7:7E-3.33 through 3.35**

OCGS operations have the potential to affect Special Land Areas within the OCGS site boundary and within OCGS transmission line corridors. AmerGen has no plans that would change these effects as a result of license renewal.

**7:7E-3.33 Farmland conservation areas**

AmerGen property includes the 650-acre old Finninger Farm site, once an active beef cattle farm, east of Route 9. AmerGen maintains the undeveloped property as a buffer and has no plans to develop it as a result of license renewal. AmerGen is in compliance with the rules governing farmland conservation areas.

**7:7E-3.34 Steep slopes**

AmerGen property has no steep slopes; therefore, these requirements are not relevant.

**7:7E-3.35 Dry borrow pits**

AmerGen has no dry borrow pits; therefore, these requirements are not relevant.

**Coastwide Special Areas, NJAC 7:7E-3.36 through 3.49**

OCGS operations have the potential to affect Coastwide Special Areas within the OCGS site boundary and within OCGS transmission line corridors. AmerGen has no plans, as a result of license renewal activities, that would change any of these current effects.

**7:7E-3.36 Historic and archaeological resources**

Neither historic or pre-historic archaeological sites, nor any historic or archaeological resources have ever been identified on AmerGen property or the transmission line corridor; therefore, these requirements are not relevant.

**7:7E-3.37 Specimen trees**

AmerGen property has no specimen trees; therefore, these requirements are not relevant.

**7:7E-3.38 Endangered or threatened wildlife or plant species habitats**

AmerGen property has no endangered or threatened wildlife or plant species habitats; therefore, these requirements are not relevant.

**7:7E-3.39 Critical wildlife habitats**

AmerGen property has no critical wildlife habitats; therefore, these requirements are not relevant.

**7:7E-3.40 Public open space**

AmerGen property includes no public open space; therefore, these requirements are not relevant.

**7:7E-3.41 Special hazards area**

OCGS uses hazardous substances as defined by NJSA 58:10-23.11b-k, including substances that are corrosive, ignitable, flammable or radioactive. As such OCGS has an evacuation zone out to 10 miles from the OCGS. Therefore these rules are relevant.

Development within the special hazards area must include appropriate mitigating measures to protect public health and safety. OCGS maintains warning sirens, publishes and provides to the community information on what to do in the event of an emergency at the facility, trains first responders, and provides input to an evacuation plan updated with the most recent census and traffic data. For these reasons OCGS is in compliance with these rules.

**7:7E-3.42 Excluded Federal lands**

No excluded Federal lands are adjacent to the AmerGen property. These requirements are not relevant.

**7:7E-3.43 Special urban areas**

These requirements apply to development in special urban areas and hence, do not apply to OCGS.

**7:7E-3.44 Pinelands National Reserve and Pinelands Protection Area**

Lacey Township is partially in the Pinelands National Reserve Area. Rules in this subsection apply to development and the discharge of dredged materials into freshwater wetlands, neither of which OCGS will pursue during the license renewal term. The requirements are not relevant.

**7:7E-3.45 Hackensack Meadowlands District**

Ocean County is not part of the Hackensack Meadowlands district and therefore these rules are not relevant.

**7:7E-3.46 Wild and Scenic Rivers corridors**

OCGS is not part of the Great Egg Harbor River or the Maurice River watersheds (the only wild and scenic rivers in New Jersey) and thus, the requirements are not relevant.

**7:7E-3.47 Geodetic control reference marks**

No geodetic control reference mark is located on AmerGen property. Therefore, the requirements are not relevant.

**7:7E-3.48 Hudson River Waterfront Area**

Ocean County is not part of the Hudson River waterfront area; therefore, the requirements are not relevant.

**7:7E-3.49 Atlantic City**

OCGS is not located in Atlantic City; therefore, these requirements are not relevant.

**Subchapter 3A – Standards for Beach and Dune Activities**

Beaches are located at the eastern edge of Finninger Farms. AmerGen has no plans that would affect this resource as a result of license renewal.

**Subchapter 3B – Information required in tidal wetland and intertidal and subtidal shallows proposals**

Tidal wetlands are located in the eastern part of Finninger Farms property. AmerGen has no plans that would affect this resource as a result of license renewal.

**Subchapter 3C – Standards for conducting and reporting the results of an endangered or threatened wildlife or plant species habitat impact assessment and/or an endangered or threatened wildlife species habitat evaluation**

No endangered or threatened plant or animal species is known from the AmerGen property. The property does not abut habitats mapped as endangered or threatened wildlife habitats. Therefore, the requirements of this subsection are not relevant.

**Subchapter 4 – General Water Areas**

OCGS withdraws cooling water from Barnegat Bay via the South Branch of Forked River and discharges water to Barnegat Bay via Oyster Creek. Section 7:7E-4.1(b)iii 5 describes medium rivers, creeks and streams as having watersheds of less than 1,000 square miles. Section 7:7E-4.1(b)iii 7 describes semi-enclosed and back bays. Forked River and Oyster Creek are medium rivers, and Barnegat Bay is a back bay. Requirements for General Water Areas apply.

**7.7E-4.2 Aquaculture**

AmerGen does not practice aquaculture at OCGS. These requirements are not relevant.

**7.7E-4.3 Boat Ramps**

AmerGen maintains a private boat ramp on the north shore of Oyster Creek. It is constructed of metal plates and is used to launch boats for periodic biological and water quality sampling by AmerGen environmental staff. A garbage can is provided at the ramp. OCGS is in compliance with the rules governing boat ramps.

**7.7E-4.4 Docks and piers for cargo and commercial fisheries**

AmerGen does not maintain any docks or piers. These requirements are not applicable. AmerGen does maintain a metal bulkhead on the south shore of Oyster Creek, immediately downstream of the Rt. 9 bridge. This was used during construction to deliver large and heavy equipment from barges. Currently Ocean County uses the bulkhead to load artificial reef structures onto barges for transport offshore.

**7.7E-4.5 Recreational docks and piers**

AmerGen does not maintain any docks or piers. These requirements are not applicable.

**7.7E-4.6 Maintenance Dredging**

Three times since the plant began operations, the intake or discharge canals east of Rt. 9 have been dredged to remove accumulated sediments. It is likely that dredging will be required during the license renewal term. Before initiating any dredging, AmerGen would obtain the appropriate permits from the U.S. Army Corps of Engineers and the NJDEP. OCGS is in compliance with the rules governing maintenance dredging.

**7.7E-4.7 New Dredging**

AmerGen will not dredge a new channel/canal as a result of license renewal. These requirements are not relevant.

**7.7E-4.8 Dredged material disposal**

AmerGen has disposed of dredge spoils in a permitted dredge spoils basin on AmerGen property. AmerGen holds an NJPDES storm water discharge permit for the dredge spoils basin and an NJPDES permit to discharge groundwater from the dredge spoils. In addition the Ocean County Soil Conservation District has certified the AmerGen soil erosion and sediment control plan for the upland dredge site. OCGS is in compliance with the rules governing disposal of dredged material.

**7.7E-4.9 Solid waste or sludge dumping**

This activity is prohibited. AmerGen does not dispose of solid wastes or sludge in a water area.

**7.7E-4.10 Filling**

AmerGen will not fill any water area as a result of license renewal. These requirements are not relevant.

**7.7E-4.11 Mooring**

AmerGen will not construct any mooring for the purpose of anchoring a boat as a result of license renewal. These requirements are not relevant.

**7.7E-4.12 Sand and gravel mining**

AmerGen will not mine sand nor gravel as a result of license renewal. These requirements are not relevant.

**7.7E-4.13 Bridges**

AmerGen will not construct any bridges as a result of license renewal. These requirements are not relevant.

**7.7E-4.14 Submerged pipelines**

AmerGen will not construct any submerged pipelines as a result of license renewal. These requirements are not relevant.

**7.7E-4.15 Overhead transmission lines**

AmerGen will not construct any overhead transmission lines for the purpose of distributing power from the OCGS switchyard as a result of license renewal. These requirements are not relevant.

**7.7E-4.16 Dams and Impoundments**

AmerGen dammed Oyster Creek to create an emergency fire pond at the time of plant construction, and continues to maintain the fire pond and dam. Oyster Creek naturally is navigable above the pond only to canoes and kayaks, so the dam does not impede navigation. OCGS is in compliance with this requirement.

**7.7E-4.17 Outfalls and Intakes**

AmerGen has an intake and several outfalls. The uses associated with the intakes and outfalls meet applicable Coastal Zone management rules. OCGS is in compliance with this requirement.

**7.7E-4.18 Realignment of water areas**

The volume the circulating water pumps draw into the plant at the OCGS intake reversed the flow of the South Branch of Forked River. This environmental impact was identified in the conceptual design phase of the project and was approved by the regulatory agencies prior to construction. The operating parameters of OCGS will not change as a result of license renewal.

**7.7E-4.19 Breakwaters**

AmerGen has no breakwaters at the OCGS site and will not construct any as a result of license renewal. These requirements are not relevant.

**7.7E-4.20 Submerged cables**

AmerGen does not have and will not lay any submerged cables to support OCGS operations as a result of license renewal. These requirements are not relevant.

**7.7E-4.21 Artificial reefs**

AmerGen does not have and will not construct any artificial reefs as a result of license renewal. These requirements are not relevant.

**Subchapter 5 – Requirements for impervious cover and vegetative cover for general land areas and certain special areas**

This subchapter applies to development, which AmerGen will not undertake during the license renewal term. Therefore, the requirements are not relevant.

**Subchapter 6 – General location rules**

This subchapter applies to development, which AmerGen will not undertake during the license renewal term. Therefore, the requirements are not relevant.

**Subchapter 7 – Use rules**

This subchapter applies to development, which AmerGen will not undertake during the license renewal term. Therefore, the requirements are not relevant.

**Subchapter 8 – Resource rules**

This subchapter applies to development, which AmerGen will not undertake during the license renewal term. Therefore, the requirements are not relevant.

**References**

E.1 New Jersey Department of Environmental Protection. 2004. Coastal Management Program. Available at http://ww.nj.gov/dep/cmp. Accessed July 19, 2004.

E.2 New Jersey Department of Environmental Protection. 2004. Coastal Management Program; Federal Consistency Available at http://ww.nj.gov/dep/cmp/czm_federal.html. Accessed July 19, 2004.

E.3 New Jersey Department of Environmental Protection. 2004. Land Use Regulation Program. Available at http://ww.nj.gov/dep/landuse/coast.html. Accessed July 19, 2004.

E.4 New Jersey Department of Environmental Protection. 2004. CAFRA Boundary Line. Available at http://www.state.nj.us/dep/landuse/coast/coast.html.

State of New Jersey
Department of Environmental Protection
Land Use Regulation Program
P.O. Box 439, Trenton, New Jersey 08625-0439
Telephone # (609) 292-0060
Fax # (609) 292-8115 or (609) 777-3656
www.state.nj.us/dep/landuse

Richard J. Codey
*Acting Governor*

Bradley M. Campbe
Commissioner

March 31, 2005

LICENSING DEPARTMENT
APR 7 2005
REFER TO:

Keith R. Jury, Director
Licensing and Regulatory Affairs
AmerGen Energy Company LLC
200 Exelon Way
Kennett Square, PA 19348

RE: Request for Necessary Data and Information for a Federal Consistency Determination
File No. 1500-02-0004.4 CDT050001
Applicant: AmerGen Energy Company LLC
Project: Oyster Creek Nuclear Generating Station
Location: Lacey Township, Ocean County

Dear Mr. Jury:

Please be advised the Program received the above referenced request on January 21, 2005. As the Program did not issue a deficiency letter within 30 days of the date of receipt, the Program under 15 CFR 930.60(A)(1)(ii) is advising the applicant that the State agency's review has begun, and that the certification or information deficiencies must be cured by the applicant during the State's review period. A decision on this request is due on or before July 21, 2005.

Request for Necessary Data and Information.

The Program requests the following three (3) items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1i, 1viii, 6.2, and 8.2.

1. Submit the data and information and an analysis of that data and information to support the statement on page 4 under the section identified as "Entrainment of fish and shellfish in early life stages" that "Results indicate that the water quality of the Bay, which had been in decline, is recovering and now supports a healthy fish population."

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Keith R. Jury
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2. Submit the data and information and an analysis of that data and information to support the statement on page 4 under the section identified as "Entrainment of fish and shellfish in early life stages" that "... the impacts of entrainment during current operations are small...". Please quantify the term "small" in the previous sentence using the data and information to be submitted.

3. Submit the data and information and an analysis of that data and information to support the statement on page 4 under the section identified as "Impingement of fish and shellfish" that "... impacts of impingement during current operations are small...". Please quantify the term "small" in the previous sentence using the data and information to be submitted.

4. Submit the data and information and an analysis of that data and information to support the statements on page 4 under the section identified as "Impingement of fish and shellfish" that the Ristroph traveling screens currently being used reduces the number of fish impinged and impingement mortality.

5. Submit the data and information and an analysis of that data and information to support the statement on page 5 under the section identified as "Heat shock" that "...impacts of heat shock during current operations are small...". Please quantify the term "small" in the previous sentence using the data and information to be submitted.

The Program requests the following item under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1i, 3.38, and 6.2.

6. Please submit a copy of the results of the NRC's requested re-initiation of Endangered Species Act Section 7 consultation with the National Marine Fisheries Service (NMFS) discussed on page 5 and 7.

The Program requests the following items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1iv, 1viii, 3.41, and 6.2.

7. Submit the data and information and an analysis of that date and information to support the statements on page 6 under the section identified as "Electromagnetic fields", acute effects (electric shock).

Keith R. Jury
File No. 1500-02-0004.4 CDT050001



8. On page 28, the submittal advises "OCGS uses hazardous substances as defined by N.J.S.A. 58:10-23.11b-k, including substances that are corrosive, ignitable, flammable or radioactive." Please submit a listing of those substances and any available data showing the extent and concentrations of their dispersal in to the environment. If any of the substances are being released in amounts lethal to organisms, please list those substances and the organisms potentially impacted and any data or information on the generating station's impact on those organisms.

The Program requests the following items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1i, 3.5, and 6.2.

9. Submit the data and information, including but not limited to the species and numbers of fish killed during cold weather shut downs, and an analysis of that date and information to support the statements on page 25 under the section identified as "Prime Fishing Areas" that supports the statement that "The thermal plume entering the Bay from Oyster Creek has temperatures a few degrees Fahrenheit above the ambient temperature of the Bay and does not interfere with any fish migrations." In addition, please include the date of and ambient bay temperature and plume temperatures at the time of each shut down event.

10. Submit data and information and an analysis of that data and information to support the statement on page 25 under the section identified as "Prime Fishing Areas" with regard to the impingement of alewife or river herring (Alosa pseudoharengus), blueback herring (Alosa aestivalis), American shad (Alosa sapidissima), striped bass (Monrone saxatilis), Atlantic sturgeon (Acipenser oxyrhynchus), Shortnose sturgeon (Acipenser brevirostrum) and American eel (Anguilla rostrata) that "OCGS is in compliance with the rules protecting finfish migrations".

The Program requests the following items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1v and 7:7E-8.11.

11. The submittal does not discuss public access to the waterfront. Please identify any public access to the waterfront provided on property owned by AmerGen. If no public access to the waterfront is available, can public access be provided to Oyster Creek, Forked River or Barnegat Bay through the Finninger Farm? If AmerGen's response is negative, please detail why public access to the waterfront can not be provided.

Keith R. Jury
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With regard to the data and information requested above, the Program has knowledge that data and information were gathered by Ichthyological Associates (IA) and Environmental Associates (EA) in the 1970s and 1980s. The Program assumes that you will utilize those studies and all other subsequent 316B studies to respond to the above requests.

Should you have any questions or wish to discuss this matter further, please do not hesitate to contact me at the above address or at 609-984-0288.

Sincerely,

Andrew Heyl, Section Chief
Bureau of Coastal Regulation

c. Andrew Kugler, Chief of Environmental Section, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Agency, One White Flint, 11555 Rockville Pike, Rockville, Maryland 20555

AmerGen
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June 15, 2005
2130-05-20112

Mr. Andy Heyl
Land Use Regulation Program
Bureau of Coastal Management
NJ Department of Environmental Protection
501 East State Street
Trenton, NJ 08625-0439

Subject: Reponse to Request for Necessary Data and Information for a
Federal Consistency Determination
File No. 1500-02-0004.4 CDT050001
Project: Oyster Creek Generating Station

Dear Mr. Heyl:

On January 20, 2005, AmerGen Energy Company, LLC (AmerGen) submitted the Federal Coastal Zone Management Act consistency certification in support of the Oyster Creek Generating Station (OCGS) license renewal application to the New Jersey Department of Environmental Protection (NJDEP) Land Use Regulation Program for review. On March 31, 2005, NJDEP Land Use Regulation Program requested necessary data and information to support statements made by AmerGen in the consistency determination. The attached discussions address each of the requests for necessary data.

After your office reviews the attached information, AmerGen requests a letter concurring with the previously transmitted Federal Consistency Certification for Federal Permit and License Applicants. AmerGen will include a copy of this letter and your response in the license renewal application that we submit to the Nuclear Regulatory Commission.

If you have any questions or require any additional information, please contact Bill Maher at (610) 765-5939.

Sincerely,

Pamela B. Cowan
Director - Licensing & Regulatory Affairs
AmerGen Energy Company, LLC

NJ DEP, Land Use Regulation Program
June 15, 2005
Page 2

Enclosure: Response to Request for Necessary Data and Information for a Federal Consistency Determination

cc: Karen Tuccillo, NJ BNE
P. S. Tam, USNRC, Senior Project Manager, NRR
File No. 05100

**Enclosure**

**Response to Request for Necessary Data and Information for a Federal Consistency Determination**

**The program requests the following three (3) items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1i, 1viii, 6.2 and 8.2.**

1. **Submit the data and information and an analysis of that data and information to support the statement on page 4 under the section identified as "Entrainment of fish and shellfish in early life stages" that "Results indicate that the water quality of the Bay, which had been in decline, is recovering and now supports a healthy fish population."**

*The Barnegat Bay Estuary Program Characterization Report* (BBEP 2001) indicated that the priority problems in the estuary were: (1) water supply and water quality, including the issues of contaminated stormwater and runoff, nutrient loading, pathogen contamination, groundwater contaminations, and future water supply deficits; (2) habitat loss and alteration; (3) fisheries decline; and (4) human activities and competing uses. The Barnegat Bay *Final Comprehensive Conservation and Management Plan* (CCMP), completed in May 2002, laid out an approach for restoring the Barnegat Bay ecosystem that was keyed to these priorities (BBEP 2002). It contains numerous "action plans" for improving water quality, slowing habitat loss, restoring ecological communities, and balancing the needs of competing users. It also contains a Monitoring Program Plan and a framework for tracking progress of the various program initiatives.

The Barnegat Bay Estuary Program and its cooperating agencies have already had a number of successes with regard to water quality. The CCMP singled out degraded storm water management (retention or detention) basins as sources of non-point source pollution and made "retrofit of stormwater basins to increase infiltration and recharge of rainfall runoff" an Action Item. (BBEP 2002, Chapter 5, Table 5-1, Action Item 5.2). Cooperating county, state, and federal agencies led by the Ocean County Planning Board identified three stormwater basins in the County that were no longer functioning as designed and restored them, amending soils as necessary to lower pH, adding compost to encourage growth of soil organisms, seeding the basins with drought-tolerant native grasses, and planting native shrubs and trees (EPA 2003a). This pilot project demonstrated that stormwater basins could be quickly and cost-effectively restored to create living systems that effectively treat stormwater while creating aesthetically pleasing areas that provide wildlife habitat. As more and more stormwater basins are retrofitted, the volume of polluted stormwater entering the Bay will decrease.

Another goal of the BBEP has been the reduction of bacterial contamination in Barnegat Bay. Studies in the 1980s documented only 4 sewage pump-out facilties in all of coastal New Jersey (EPA 2003b). Since that time, long-term collaborative efforts by BBEP partners have resulted in the installation of more than 70 marine sewage pump-out facilities in Barnegat Bay and its tributaries. Funding for the pump-out facilities was provided by the New Jersey Clean Vessel Program, which in turn is funded by the U.S. Fish & Wildlife Service (Wallop-Breaux monies) and the NJDEP. The Clean Vessel Program and other initiatives have reduced the amount of bacteria entering the Bay and improve water quality in many Ocean County swimming areas.

One of the specific goals of the CCMP was the establishment of a "No Discharge Zone" to make the discharge of raw sewage from boats illegal. Section 312 of the Clean Water Act provides for these zones. New Jersey DEP petitioned the EPA in March 2002 to make Barnegat Bay a No Discharge Zone. The EPA determined that the Bay's 66 stationary pump-out facilities (many at marinas) and three pump-out vessels were adequate to accommodate the 28,000 recreational vessels using the Bay. On June 12, 2003 the EPA announced that Barnegat Bay had adequate facilities for the safe and sanitary removal and treatment of sewage from all vessels and that the Bay had been officially designated a No Discharge Zone (Federal Register, Volume 68, No. 113, June 12, 2003, pg 35214-35215. Available online at http://access.gpo.gove/su_docs/federal/a030612c.html. Accessed 4/22/05).

Another indication of improving water quality in Barnegat Bay is the opening of shellfish beds over the last 4 to 5 years. In late 2000, 5,132 acres in Barnegat Bay previously closed to shellfishing were opened to shellfish harvesting. At that time, State Environmental Protection Commissioner Bob Shinn declared that, "The continued expansion of our shellfish harvesting waters is a clear and reliable yardstick of our progress in improving water quality" (NJDEP News Release dated 11-20-2000). In 2004, another 161 acres of shellfish beds in Barnegat Bay were upgraded, while 85 acres were downgraded, a net increase of 76 acres open to shellfishermen (NJDEP News Release dated 2-20-2004).

The available evidence suggests that Barnegat Bay, once in a state of decline, is beginning to recover. Water quality appears to be improving, benefiting from a number of county, state, and federal initiatives, as well as the work of countless volunteers and several non-profit organizations.

Anecdotal information suggests that many finfish populations are healthy and sport fishing for several species (e.g., striped bass, weakfish, bluefish) in the Bay is excellent (Flyfishing Connection 1999; Fishing and Hunting News 2004; Haughey 2004). One important forage species that is not faring well in Barnegat Bay, the Atlantic menhaden, is in a state of decline up and down the mid-Atlantic and south Atlantic coast. Landings of menhaden in New Jersey increased in the late 1980s and early 1990s, peaking in 1994 at 17,386 metric tons, but have declined steadily since that time, falling to 9,276 metric tons in 2003 (NMFS 2005). The reduction in Atlantic coast menhaden stocks has been attributed to poor recruitment, which may be the result of water quality degradation along the rapidly developing Eastern Seaboard, and to periodic disease outbreaks and mass die-offs in adults, which may also be exacerbated by water quality problems (AMTC 2001; CBEF 2004).

The National Marine Fisheries Service (NMFS) maintains records on recreational landings of important species, including many of the species sought by anglers in Barnegat Bay. These data are organized by region (e.g., north Atlantic, mid-Atlantic, south-Atlantic) and by state, but are not available by watershed or waterbody. Most of the species in question range up and down the mid-Atlantic coast and use Barnegat Bay seasonally; therefore, data for the state of New Jersey are assumed to reflect the state of Barnegat Bay populations.

The NMFS data indicate that striped bass landings in New Jersey reached an all time low in the 1980s, but have exceeded 1,000,000 fish in every year since 1999 (NMFS 2005). In 2004, an estimated 1,760,506 striped bass weighing more than 4.6 million pounds were landed in New Jersey. These data, along with widely circulated stories of anglers and outdoor writers, indicate that striped bass fishing along the New Jersey shore and in Barnegat Bay is as good today as it was in the 1960s and 1970s, if not better.

Other species sought by anglers in Barnegat Bay include bluefish, weakfish, and summer flounder. Based on New Jersey recreational landings, bluefish numbers in recent years have been consistently high, more than 3,000,000 fish per year over the 2000 through 2004 period (NMFS 2005). In 2004 an estimated 4,151,920 bluefish weighing 3.3 million pounds were landed by N.J. fishermen. In the 1990s, bluefish landings ranged from 1,217,527 (1993) to 3,557,337 (1991) fish per year. These high bluefish landings are consistent with angler and outdoor writer reports of excellent fishing in Barnegat Bay. Based on anecdotal information, fishing for weakfish is excellent in Barnegat Bay. Data on weakfish landings in New Jersey, however, suggest that weakfish numbers peaked over the 1995-1996 period and have generally declined over the 1997-2004 period (NMFS 2005). Summer flounder landings have been high since 1990, ranging from 3 million to 13 million fish per year (NMFS 2005). No clearcut trend in landings are apparent. In 2004, an estimated 8.8 million summer flounder were landed by recreational fishermen (NMFS 2004).

**2. Submit the data and information and an analysis of that data and information to support the statement on page 4 under the section identified as "Entrainment of fish and shellfish in early life stages" that "...the impacts of entrainment during current operations are small..." Please quantify the term "small" in the previous sentence using the data and information to be submitted.**

The following material is from the 1984 monograph *Ecology of Barnegat Bay, New Jersey,* which was an attempt by a diverse group of utility biologists, academics, and resource agency scientists to assemble and synthesize several decades of research on Barnegat Bay's water quality and aquatic communities.

> "Numerous investigations have been performed in Forked River, Oyster Creek, and Barnegat Bay to assess the effects of thermal discharges, impingement, and entrainment of the Oyster Creek Nuclear Generating Station on aquatic communities. Rutgers University scientists studied the bay and adjacent tributaries from 1965 through 1980, and this work produced 9 annual reports, 12 masters theses, and 5 doctoral dissertations. In 1975, Ichthyological Associates, a consultant for the Jersey Central Power and Light Company, initiated investigations of plankton and fish populations and impacts of station operation on these populations. Some of these investigations were continued to 1984..." (page 327, *Ecology of Barnegat Bay, New Jersey*)
>
> "A five-volume 316(a) and (b) Demonstration report prepared by the Jersey Central Power & Light Company for the New Jersey Department of Environmental Protection...summarized the information and conclusions drawn by these investigations...Conclusions of the report indicate that, **while impacts on aquatic communities have occurred because of the cooling system of the station, these impacts generally are localized to Oyster Creek.**" (emphasis added) (page 327, *Ecology of Barnegat Bay, New Jersey*)
>
> "...some fishes and macroinvertebrates are affected by impingement on intake screens of the station....Population surveys of fishes and macroinvertebrates indicate that the standing crop lost through impingement was less than 10 percent for species in central Barnegat Bay. **No evidence exists that losses of organisms through impingement on intake screens have had a discernible effect on invertebrate and fish communities in Barnegat Bay.**" (emphasis added) (page 331, *Ecology of Barnegat Bay, New Jersey*)
>
> "To mitigate future impingement effects, the conventional traveling screens (0.95 cm mesh) on the intake structure of the station were replaced starting in 1979 through 1983 with Ristroph screens composed of a continuously rotating traveling design modified with a low pressure spray wash and fish recovery and return system. The Ristroph screens contain water-tight fish buckets which collect impinged organisms washed from the screens and return them to the discharge canal via a sluiceway. Experimental testing...indicated that the total fish mortality was reduced from 48% to 24%." (page 331, *Ecology of Barnegat Bay, New Jersey*)

"Effects of operation of the Oyster Creek Nuclear Station on aquatic communities appear to be restricted to the discharge canal and Oyster Creek. The species composition, abundance, and distribution of phytoplankton, zooplankton, benthic invertebrates, and fishes in these two regions (areas) are substantially different than Barnegat Bay. **Fluctuations within Bay communities appear to be due to the natural population dynamics of constituent populations and not due to operation of the station. Aquatic communities in Barnegat Bay parallel those of other mid-Atlantic estuaries which are unaffected by operations of electric generating stations."** (emphasis added) (page 331, *Ecology of Barnegat Bay, New Jersey*)

As noted above, extensive data on impingement and entrainment were submitted to NJDEP as part of a Section 316 Demonstration. These data were evaluated by NJDEP and its contractor, Versar. Versar (1988) used three independent population models to assess the impact of impingement and entrainment losses at OCGS: the Equivalent Adult Model, the Production Foregone Model, and the Spawning/Nursery Area of Consequences Model. In each case, Versar/NJDEP concluded that impacts, although non-trivial, were not sufficient to de-stabilize populations. Having evaluated the data as submitted by Jersey Central Power & Light/General Public Utilities Nuclear (GPUN) and having conducted its own analysis employing different assumptions and analytical methods, NJDEP concluded that:

"...the Department has determined that the avoidance of heated areas, impingement and entrainment impacts of the Station do not present an unacceptable, substantial long-term population and/or ecosystem impacts and, in conjunction with limitations generally reflecting current operations, will assure the protection and propagation of a balanced indigenous population." (OCGS NJPDES Fact Sheet, June 30, 1994, page 71)

The Barnegat Bay Estuary Program, a non-profit environmental organization, reviewed impingement and entrainment studies conducted at OCGS in the 1970s and 1980s in its (2001) *Barnegat Bay Characterization Report*. The author(s) of the BBEP report note that;

"despite the large numbers of eggs, larvae, and small life forms of Barnegat Bay organisms lost via in-plant passage at the OCNGS, these losses have not resulted in detectable impacts on biotic communities in Barnegat Bay. Effects of operation of the OCNGS on aquatic communities appear to be restricted to the discharge canal and Oyster Creek."

For its certification to the U. S. Nuclear Regulatory Commission (NRC), AmerGen will use the NRC definition of "small" in characterizing environmental impacts of OCGS license renewal 10 CFR 51 Subpart A, appendix B, Table B-1, Footnote 3). Page 3 of the certification provides the NRC definition of "small," which states in part the following:

Small – For the issue, environmental effects are not detectable or are so small that they will neither destabilize nor noticeably alter any important attribute of the resource.

The NRC definition is qualitative, and AmerGen has not quantified the term "small." It is AmerGen's understanding, however, that regardless of whether the impact is small, at issue is whether the impact is consistent with enforceable provisions of the state's federally approved coastal zone management program. As AmerGen indicated in the certification text, New Jersey regulates OCGS entrainment impacts through its New Jersey Pollutant Discharge Elimination System (NJPDES) program.

To the best of AmerGen's knowledge, OCGS is in compliance with its NJPDES permit. Regulatory and permitting requirements regarding environmental impact control may change during the remainder of the OCGS current NRC license term or during the license renewal term. However, AmerGen is committed to complying with changes to enforceable provisions of the state's federally approved coastal zone management program, and the state has the authority to enforce compliance. These factors form the basis for the AmerGen consistency certification.

**3. Submit the data and information and an analysis of that data and information to support the statement on page 4 under the section identified as "Impingement of fish and shellfish" that "...the impacts of impingement during current operations are small..." Please quantify the term "small" in the previous sentence using the data and information to be submitted.**

As noted in the response to Question 2, studies of impingement and entrainment conducted by Jersey Central Power & Light and GPUN and subjected to considerable scrutiny (including re-analysis by NJDEP's third party reviewer, Versar) indicate that impingement and entrainment losses, which are, for some species, relatively high, do not "present unacceptable, substantial, long-term population or ecosystem impacts." Versar scientists determined that the impact of impingement at OCGS was so small that "the losses due to impingement at the Oyster Creek Generating Station were of no consequence to the [Section 316(b) compliance determination" (Summers et al. 1989, pg. VI-6). Species with relatively high losses (e.g., opossum shrimp, sand shrimp, bay anchovy) are common forage species whose abundance tends to fluctuate widely between years depending on environmental conditions and intensity of predation. As noted in the Fact Sheet for the 1994 OCGS NJDPDES permit (page 70), "the effects of these losses on the Barnegat Bay food web are small."

As discussed earlier, the Barnegat Bay Estuary Program, a non-profit environmental organization, reviewed impingement and entrainment studies conducted at OCGS in the 1970s and 1980s in its (2001) *Barnegat Bay Characterization Report*. The BBEP author(s) conclude that:

> ..."no evidence exists that losses of organisms through impingement on the intake screens have had a discernible effect on invertebrate and fish communities in the bay."

Most organisms impinged in these studies were either invertebrates (e.g., blue crab, sand shrimp, grass shrimp) or small, schooling (forage) fish (e.g., bay anchovy, Atlantic menhaden, Atlantic silverside).

See the response to Question 2 for a discussion of the NRC definition of "small" and AmerGen's use of the term. To the best of AmerGen's knowledge, OCGS is in compliance with its NJPDES permit. Regulatory and permitting requirements regarding environmental impact control may change during the remainder of the OCGS current NRC license term or during the license renewal term. However, AmerGen is committed to complying with changes to enforceable provisions of the state's federally approved coastal zone management program, and the state has the authority to enforce compliance. These factors form the basis for the AmerGen consistency certification.

**4. Submit the data and information and an analysis of that data and information to support the statement on page 4 under the section identified as "Impingement of fish and shellfish" that the Ristroph traveling screens currently being used reduces the number of fish impinged and impingement mortality.**

Ristroph traveling screens, which employ water-filled buckets to collect impinged fish, have been installed at power plants from coast to coast. The impinged fish are spilled into a trough or holding tank and then returned to the source waterbody by way of a pipe or sluiceway. In its *Technical Development Document for the Final 316(b) Phase I new Facilities Rule* (EPA 821-R-01-036, November 1, 2001. Available on line at http://www.epa.gov/waterscience/316b/technical/technicaldd.html/. Accessed 4/22/05), the EPA describes Ristroph-type screens as a "proven technology" that has been shown to have "good potential for alleviating impingement mortality" (CWIS Technology Fact Sheets, pages A-6 and A-7).

Facilities that have tested or employed Ristroph-type screens in the east include Surry Power Station (Virginia), Indian Point Nuclear Generating Station (New York), Kintigh (aka Somerset) Generating Station in New Jersey, Bowline Point Generating Station (New York), Roseton Generating Station (New York), Danskammer Generating Station (New York), Salem Generating Station (New Jersey), and Calvert Cliffs Nuclear Power Plant (Maryland). In its *Technical Development Document for the Final 316(b) Phase II Existing Facilities Rule* (EPA 821-R-04-007, February 12, 2004. Available on line at http://www.epa.gov/ost/316b/devdoc/final.htm. Accessed 4/22/05 ), the EPA discusses the relative effectiveness of modified traveling screens of the Ristroph type at 10 U.S. power plants and concludes (p. 4-9) that:

> "Studies conducted at steam electric power generating facilities over the last three decades have built a sizable record demonstrating the performance potential for modified traveling screens that include some form of fish return. Comprehensive studies...have shown that modified screens can achieve an increase in the post-impingement survival of aquatic organisms that come under the influence of cooling water intake structures. Hardier species, as might be expected, have exhibited survival rates as high as 100 percent. More fragile species, which are typically smaller and more numerous in the source waterbody, understandably have lower survival rates."

In this context, "hardier species" would include many of the recreationally-important fish and shellfish impinged at OCGS: blue crab, striped bass, white perch, bluefish, croaker, spot, and flounder. More fragile species would include the various small, schooling species that serve as forage for sport fish in Barnegat Bay, with bay anchovy, and Atlantic menhaden being the most important.

Both of the previously-mentioned EPA reports present data that demonstrate the effectiveness of Ristroph screens in reducing impingement mortality.

As noted previously in Response 2, experimental testing in the mid-1980s indicated that total fish mortality at the OCGS cooling water intake structure was reduced from 48% to

24% after Ristroph screens were installed (page 331, *Ecology of Barnegat Bay, New Jersey*). In the case of some species, however, impingement survival was improved dramatically. Studies by EA Engineering, Science, and Technology (1986; page 4-11) showed that the installation of Ristroph traveling screens at OCGS produced a three-fold increase in the total survival of impinged bay anchovy when compared to previous studies of impingement on the conventional traveling screens.

5. **Submit the data and information and an analysis of that data and information to support the statement on page 5 under the section identified as "Heat shock" that "...impacts of heat shock during current operations are small..." Please quantify the term "small" in the previous sentence using the data and information to be submitted.**

NJDEP hired Versar, Inc. in 1987 to review the Oyster Creek 316 Demonstration (composed of 1974, 1978, and 1986 submittals), evaluate potential impacts of OCGS operation on aquatic communities, and recommend appropriate limitations on cooling water withdrawals and discharge temperatures to meet the intent of Section 316 of the Clean Water Act. With regard to thermal impacts, the 1989 Versar report noted that OCGS effluents were not in compliance with state surface water quality standards (N.J.A.C. 7:9B-1.1 et seq.) but "the potential adverse effects of the thermal discharges on the Barnegat Bay ecosystem were determined and they were localized and had little or no regional significance" (Summer et al. 1989, pg IV-65).

Based on the 316 Demonstration and the Versar study, NJDEP determined that thermal discharges (specifically the avoidance of heated areas) from OCGS did not jeopardize aquatic populations and that water quality-based effluent limitations would be more stringent than necessary to assure the protection and propagation of the balanced indigenous population (community):

> "The Department is therefore, granting GPUN's request for a variance pursuant to Section 316(a) and is proposing thermal limitations which will allow the continued operation of the existing once-through cooling system." [OCGS NJPDES Fact Sheet, June 30, 1994, page 71]

These included limitations on effluent temperature (daily maximum of 106°F with 4 circulating water pumps operating), temperature rise across the condenser (daily maximum of 23°F with 4 pumps operating), and heat addition (daily maximum of 5,420 MBTU/hr with 4 pumps operating) (OCGS 1994 NJPDES permit, Outfall Number DSN 001).

Oyster Creek uses dilution pumps to moderate water temperatures in its discharge; in accordance with NPDES permit requirements. Procedures are in place to ensure that a dilution pump is activated when the temperature in Oyster Creek reaches 87°F, as measured four feet below the surface at the Route 9 bridge. If, two hours later, the temperature still exceeds 87°F, a second dilution pump is put into operation. So long as the plant is operated according to plant operating procedures, there is little chance of heat shock in the plant's discharge canal and even less chance of heat shock further downstream, east of the Route 9 bridge. There have been some infrequent instances of fish kills in the plant's discharge canal caused by high temperatures which occurred because dilution pumps were deactivated when temperatures in the discharge reached the (87°F) setpoint established by NJDEP. In addition to paying a substantial fine as a result of a 2002 heat-shock fish kill, AmerGen committed to improved training and increased vigilance where operation of the dilution pumps was concerned. After a lengthy discussion of potential impacts (OCGS NJPDES Fact Sheet, June 30, 1994, page 71), the permit writers conclude that:

> "...the Department has determined that the avoidance of heated areas, impingement and entrainment impacts of the Station do not present an unacceptable, substantial long-term population and/or ecosystem impacts and, in conjunction with limitations generally reflecting current operations, will assure the protection and propagation of a balanced indigenous population."

This language, crafted by NJDEP, is consistent with AmerGen's assertion that impacts of heat shock are small, using the criteria employed by the NRC at 10 CFR 51, Appendix B, Table B-1. These criteria state that "environmental effects are so minor that they will neither de-stabilize or noticeably alter any important attribute of the resource."

See the response to Question 2 for a discussion of the NRC definition of "small" and AmerGen's use of the term. To the best of AmerGen's knowledge, OCGS is in compliance with its NJPDES permit. Regulatory and permitting requirements regarding environmental impact control may change during the remainder of the OCGS current NRC license term or during the license renewal term. However, AmerGen is committed to complying with changes to enforceable provisions of the state's federally approved coastal zone management program, and the state has the authority to enforce compliance. These factors form the basis for the AmerGen consistency certification.

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**The Program requests the following items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1iv, 1viii, 3.41 and 6.2**

**6. Please submit a copy of the results of the NRC's requested re-initiation of Endangered Species Act Section 7 consultation with the National Marine Fisheries Service (NMFS) discussed on page 5 and 7.**

As of this date, NMFS has not completed its Biological Opinion, therefore, results are not available. The NRC sent its Biological Assessment (BA) to NMFS on March 29, 2005. A copy of the BA was sent to Mr. Kent Tosch, Chief, New Jersey Department of Environmental Protection, Bureau of Nuclear Engineering. The NRC ADAMS document accession number is ML050900162.

NMFS has, however, recommended that, until the Biological Opinion gets issued, the NRC continue to implement the requirements identified in the July 21, 2001 Opinion and the August 29, 2001 amended ITS. Attachment 6-1 is a copy of this recommendation.

NJ DEP, Land Use Regulation Program
June 15, 2005
Enclosure



**The Program requests the following items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1iv, 1viii, 3.41 and 6.2**

**7. Submit the data and information and analysis of that data and information to support the statements on page 6 under the section identified as "Electromagnetic fields", acute effects (electric shock).**

Attachment 7-1 to this document is the calculation package for the electric shock analysis that was prepared as part of the license renewal application. It includes input data, methodology, and copies of the results of the ACDC analysis, the computer model used to calculate the shock potential.

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8. **On page 28, the submittal advises "OCGS uses hazardous substances as defined by N.J.S.A.58:10-23.11b-k, including substances that are corrosive, ignitable, flammable or radioactive." Please submit a listing of those substances and any available data showing the extent and concentrations of their dispersal in to the environment. If any of the substances are being released in amounts lethal to organisms, please list those substances and the organisms potentially impacted and any data or information on the generating station's impact on those organisms.**

In accordance with the Superfund Amendments and Reauthorization Act, AmerGen reports OCGS hazardous chemical information to the NJDEP, Office of Pollution Prevention and Right to Know. The report for 2004 lists bromotrifluoromethan (fire extinguishing compound), diesel fuel, sodium hypochlorite (water treatment additive), propane, nitrogen liquid, gasoline, lead and sulfuric acid (in batteries), dichlorofluoroethane (air conditioning system fluid), and motor oil. Attachment 8-1 to this document is a copy of the cover letter for the 2004 report. OCGS toxic releases are below the SARA Title III thresholds that would trigger release inventory reporting requirements.

OCGS is a small-quantity generator of hazardous waste and reports waste types and quantities to the NJDEP. OCGS is also subject to NJDEP inspection. Attachment 8-2 of this document is a copy of the cover letter for the recent report that identifies the following as OCGS hazardous waste types: ignitable, corrosive, reactive, various heavy metals, tetrachloroethylene, spent halogenated and non-halogenated solvents, and other discarded commercial chemical products.

The 1994 NJPDES permit required an effluent characterization study. AmerGen (then GPUN) completed the study in 1998 and submitted the results to NJDEP on June 3, 1999. The measure of effluent toxicity that NJDEP and AmerGen rely on for current OCGS discharges is the annual effluent acute toxicity testing required by the NJPDES permit (Attachment 8-3). Results of these tests support the conclusion that releases of chemicals at OCGS do not pose a problem to aquatic organisms. In 2004, the survival of the test organisms met or exceeded that of the control organisms.

The U. S. Nuclear Regulatory Commission (NRC) regulates OCGS use of radioactive materials. AmerGen annually reports OCGS radioactive releases (Annual Radioactive Effluent Release Report) and measurements of radioactivity in the OCGS environment (Annual Radiological Environmental Operating Report). Attachments 8-4 and 8-5 are copies of the cover letters for recent reports. Concurrent with transmittal to NRC, AmerGen provides copies to Kent Tosch, Chief, Bureau of Nuclear Engineering, NJDEP.

The Barnegat Bay Estuary Program, a non-profit environmental organization, evaluated the impacts of the operation of OCGS on the Barnegat Bay Estuary (BBEP 2001). According to the report, the concentration of radionuclides released from OCGS "...is too low to be hazardous to aquatic organisms or humans who consume contaminated seafood from the bay."

OCGS use of corrosive, ignitable, flammable, and other hazardous substances is regulated by the NJDEP. The NRC regulates radioactive substances. To the best of AmerGen's knowledge, OCGS releases no substances in amounts lethal to organisms.

**The Program requests the following items under the enforceable Coastal Zone Management Rules (Rules) at N.J.A.C. 7:7E-1.5(a)1I, 3.5 and 6.2.**

**9. Submit the data and information, including but not limited to the species and number of fish killed during cold weather shutdowns, and an analysis of that data and information to support the statements on page 25 under the section identified as "Prime Fishing Areas" [sic] that supports the statement that "The thermal plume entering the Bay from Oyster Creek has temperatures a few degrees Fahrenheit above the ambient temperature of the Bay and does not interfere with any fish migrations." In addition, please include the date of and ambient bay temperature and plume temperatures at the time of each shutdown event.**

The BBEP Characterization Report (2002) discusses OCGS's circulating water system and heated discharge. It also discusses the station's dilution pumps, which are designed to temper discharge temperatures and reduce impacts to aquatic biota in the receiving waters. The Report notes that the station's thermal plume is confined to roughly a 1.6-kilometer (one mile) radius about the mouth of Oyster Creek. On calm days, the plume "fans out" from the mouth of the creek; strong winds from the north or south cause the plume to be compressed against the shoreline. At times of peak operation, water temperatures are 3 to 5°C above ambient at the mouth of Oyster Creek (Chizmadia et al. 1984; BBEP 2002).

The Fact Sheet to the 1994 NJPDES permit contains excerpts of a 1989 Versar review of the OCGS 316(a) studies and quotes the Versar report's findings relative to the thermal plume and avoidance studies conducted by GPUN. Quoting the Fact Sheet:

> "Although Versar found that best methods reasonably available to assess "avoidance effects" were not used because avoidance studies were not conducted with opossum shrimp and sand shrimp, Versar concluded that 'avoidance effects' were not a serious problem. Specifically, Versar stated that:
>
> the overall exclusionary effect of the thermal plume was localized and small. The exclusion of fish was primarily confined to the Discharge Canal which comprised about 2-4% of the total volume of Barnegat Bay. The avoidance temperatures used in the 316 Demonstration were the lowest of several available estimates and should be protective of the resource. Finally, the entire thermal plume in August is small relative to the total area of Barnegat Bay (6-10%)."

Table 1 lists fish kills at OCGS that were believed to be related to cold shock or cold-weather shutdowns of the station. The last of these fish kills was in November 2001.

# Frequently Asked Questions About Natural Heritage Priority Sites

**What are Natural Heritage Priority Sites?**
Through its Natural Heritage Database, the Office of Natural Lands Management (ONLM) identifies critically important areas to conserve New Jersey's biological diversity. The database provides detailed, up-to-date information on rare species and natural communities to planners, developers, and conservation agencies for use in resource management, environmental impact assessment, and both public and private land protection efforts.

Using the database, ONLM has identified Natural Heritage Priority Sites that represent some of the best remaining habitat for rare species and exemplary natural communities in the state. These areas should be considered to be top priorities for the preservation of biological diversity in New Jersey. If these sites become degraded or destroyed, we may lose some of the unique components of our natural heritage.

ONLM has identified 410 priority sites over the course of more than 10 years. We have received assistance from many partner individuals and agencies over this time. The Nature Conservancy and the DEP Endangered and Nongame Species Program have provided key information or assisted with the delineation of a number of the sites.

**How are Natural Heritage Priority Site maps used in conservation of biological diversity?**
Natural Heritage Priority Site maps are used by individuals and agencies concerned with the protection and management of land. The maps have been used by municipalities preparing natural resource inventories; public and private conservation organizations preparing open space acquisition goals; land developers and consultants identifying environmentally sensitive lands; and public and private landowners developing land management plans.

Natural Heritage Priority Sites contain some of the best and most viable occurrences of endangered and threatened species and natural communities, but they do not cover all known habitat for endangered and threatened species in New Jersey. If information is needed on whether or not endangered or threatened species have been documented from a particular piece of land, a Natural Heritage Database search can be requested by contacting the Office of Natural Lands Management at the address below.

**What do the boundaries of the sites contain?**
The boundaries of each Natural Heritage Priority Site are drawn to encompass critical habitat for the rare species or natural communities. Often the boundaries extend to include additional buffer lands that should be managed to protect the habitat. A justification for the boundary is provided for each site. The term "primary bounds" is sometimes used to refer to boundaries enclosing critical habitat. The term "secondary bounds" is sometimes used to refer to boundaries enclosing additional buffer. In maps where both primary and secondary boundaries are described, only the outermost boundary is provided in the mapping.

**What is the background map that the sites are drawn upon?**
The sites are portrayed on background maps produced from a digital copy of the U.S. Geological Survey 7.5 minute topographic maps. The background maps contain topographic lines as well as streams, lakes, roads, towns and place names. These background maps do not always reflect recent changes in land development. Some may be more than 20 years old. Some sites appear to be shifted in position against this topo map. This shift is due to the fact that most sites have been digitized against a background of rectified aerial photography, and some of the digitized USGS topo maps do not align with this photography.

**What do "public lands" depict on the maps?**
The "public lands" shaded on these maps are state-owned open space lands that have been digitized as a GIS coverage by the state Green Acres Program. This information is provided to show patterns of State land ownership in the vicinity of the Priority Site. The public lands are areas such as State Parks and Forests, Wildlife Management Areas, and Natural Lands Trust preserves. They do not currently include lands owned by other state agencies, federal, county or municipal governments

or nonprofit conservation organizations. This GIS coverage is constantly being updated, and therefore future editions of the maps will likely contain additional public lands that are not currently mapped as such.

### What is the biodiversity significance rank and how is it used?

Each site is ranked according to its significance for biological diversity using a scale developed by The Nature Conservancy and the network of Natural Heritage Programs. The ranks can be used to distinguish between sites that are of global significance for conservation of biological diversity vs. those that are of state significance. The scale ranges from B1 to B5 with sites ranked B1-B3 generally being of global significance and sites ranked B4-B5 being of state significance. The specific definitions for each rank are as follows:

B1 - Outstanding significance, generally the "last of the least" in the world, such as the only known occurrence of any element (species or natural community), the best or an excellent occurrence of an element ranked critically imperiled globally, or a concentration (4+) of good or excellent occurrences of elements that are imperiled or critically imperiled globally. The site should be viable and defensible for the elements or ecological processes contained.

B2 - Very high significance, such as the most outstanding occurrence of any natural community. Also includes areas containing other occurrences of elements that are critically imperiled globally, a good or excellent occurrence of an element that is imperiled globally, an excellent occurrence of an element that is rare globally, or a concentration (4+) of good occurrences of globally rare elements or viable occurrences of globally imperiled elements.

B3 - High significance, such as any other viable occurrence of an element that is globally imperiled, a good occurrence of a globally rare element, an excellent occurrence of any natural community, or a concentration (4+) of good or excellent occurrences of elements that are critically imperiled in the State.

B4 - Moderate significance, such as a viable occurrence of a globally rare element, a good occurrence of any natural community, a good or excellent occurrence or only viable state occurrence of an element that is critically imperiled in the State, an excellent occurrence of an element that is imperiled in the State, or a concentration (4+) of good occurrences of elements that are imperiled in the State or excellent occurrences of elements that are rare in the State.

B5 - Of general biodiversity interest.

### How can I obtain Natural Heritage Priority Site maps for an area of interest to me?

Natural Heritage Priority Site hard copy maps can be obtained by submitting a written request accompanied by a check or money order made payable to the Office of Natural Lands Management at the following address:

Office of Natural Lands Management
P.O. Box 404
Trenton, NJ 08625-0404
Phone: 609-984-1339; Fax: 609-984-1427

Individual 8.5" X 11" maps are available at the following rate:

| | |
|---|---|
| 1 - 10 site maps & reports: | $1.50/site |
| 11 - 20 site maps & reports: | $1.00/site |
| > 20 sites: | $0.50/site |

*Digital GIS Coverage of Natural Heritage Priority Sites*

A digital version of the ArcView GIS file of Natural Heritage Priority Sites is also available. The zipped version of the file is approximately 1 MB in size. The 2001 version of Natural Heritage Priority Sites will be emailed upon request. The 1999 version of the digital files can be obtained on the internet at the following address: *http://www.state.nj.us/dep/gis/* -Click on "GIS Data Downloads" and then "Select a data layer" and then "Natural Heritage Priority Sites". There is no charge for emailing or downloading the GIS data.

### How often are the maps updated?

The Natural Heritage Priority Site information is constantly being updated in the Natural Heritage Database. A new edition of the maps will be made available after significant revisions or additions to the Database.

April 9, 2002

NJ Department of Environmental Protection
Division of Parks and Forestry
Natural Lands Management

**Table 1. Known fish kills at OCGS associated with cold-weather shutdowns.**

| DATE | NUMBER | SPECIES | SIZE RANGE (mm) | PROBABLE CAUSE | INTAKE TEMPERATURE °C (°F) |
|---|---|---|---|---|---|
| | 3 | ladyfish | 292.7* | | |
| | 2 | Northern kingfish | | | |
| | 1 | gray snapper | 118.0 | | |
| | 1 | American eel | | | |
| | 1 | mojarra | 221.0 | | |
| 12/10/81 | 13 | bluefish | — | Thermal Shock | 3.6 (38.5) |
| | 12 | Atlantic menhaden | | | |
| | 5 | spot | | | |
| | 3 | butterfish | | | |
| | 2 | scup | | | |
| | 2 | jack | | | |
| | 1 | striped mullet | | | |
| 12/10/82 | 5,000 (estimate) | bluefish | 274-476 | Thermal Shock | 8.9 (48.0) |
| | 2,655 (estimate) | crevalle jack | 110-204 | | |
| | 80 | blue runner | 171-218 | | |
| | 28 | Atlantic neddlefish | 250-661 | | |

**Table 1. Known fish kills at OCGS associated with cold-weather shutdowns.**

| DATE | NUMBER | SPECIES | SIZE RANGE (mm) | PROBABLE CAUSE | INTAKE TEMPERATURE °C (°F) |
|---|---|---|---|---|---|
| | 9 | scup | 205-247 | | |
| | 1 | ladyfish | 410 | | |
| | 1 | Northern kingfish | 185 | | |
| 2/2/85 | 16 | Atlantic menhaden | 150-275 | Thermal Shock | 2.2 (36.0) |
| | 1 | blueback herring | — | | |
| 12/15/85 | 52 | weakfish | — | Thermal Shock | 4.3 (39.7) |
| | 1 | black sea bass | | | |
| | 1 | spot | | | |
| | 1 | white perch | | | |
| 12/8/89 | 2,641 | Atlantic menhaden | 152-305 | Thermal Shock | 1.1 (34) |
| | 166 | bluefish | 216-521 | | |
| | 5 | weakfish | 495-533 | | |
| | 3 | spotted seatrout | 464-597 | | |
| | 7 | northern kingfish | 203-356 | | |
| | 1 | spot | 165 | | |
| | 500-1,000 | crevalle jack | | | |
| | 4 | red drum | | | |
| | 2 | American eel | | | |

**Table 1. Known fish kills at OCGS associated with cold-weather shutdowns.**

| DATE | NUMBER | SPECIES | SIZE RANGE (mm) | PROBABLE CAUSE | INTAKE TEMPERATURE °C (°F) |
|---|---|---|---|---|---|
| | 1 | spiny dogfish | | | |
| 2/15 -2/16/91 | 1,114 | bluefish | 220-910 | Thermal Shock | 2.4-5.8 (36.4-42.4) |
| | 20 | spot | 120-140 | | |
| | 11 | spotted seatrout | 480-525 | | |
| | 3 | smooth dogfish | 250-300 | | |
| | 1 | northern kingfish | 300 | | |
| | 1 | weakfish | | | |
| | 1 | Atlantic herring | | | |
| 12/18/95 | 6 | bluefish | 308-457 | Thermal Shock | 1.7 (35) |
| | 5 | black drum | 210-290 | | |
| | 3 | spotted sea trout | 435-560 | | |
| | 3 | smooth dogfish | 600-668 | | |
| | 1 | weakfish | 430 | | |
| | 1 | scup | 210 | | |

**Table 1.** **Known fish kills at OCGS associated with cold-weather shutdowns.**

| DATE | NUMBER | SPECIES | SIZE RANGE (mm) | PROBABLE CAUSE | INTAKE TEMPERATURE °C (°F) |
|---|---|---|---|---|---|
| 12/27-12/28/95 | 620 | striped bass | 296-758 | Thermal Shock | -1.2 (29.9) |
| | 229 | white perch | 228-361 | | |
| | 5 | American eel | 640-714 | | |
| | 1 | gizzard shad | 365 | | |
| 03/20/98 | 30 | bluefish | 575-756 | Thermal Shock | 6.1-7.4 (43-45.5) |
| 01/21/00 – 02/01/00 | 2981 | Striped bass | 338-860 | Thermal Shock | -1.5 – 0.5 (29.22-32.94) |
| | 305 | White perch | 285-299 | | |
| | 117 | Black drum | 185-525 | | |
| | 34 | Bluefish | 360-648 | | |
| | 9 | Striped mullet | 285-524 | | |
| | 8 | Gizzard shad | 280-305 | | |
| | 7 | American eel | 510-660 | | |
| | 5 | Mummichog | 35-52 | | |
| | 4 | Tautog | 225-342 | | |
| | 2 | Atlantic herring | 252-258 | | |
| | 2 | Spotted seatrout | 433-502 | | |

**Table 1. Known fish kills at OCGS associated with cold-weather shutdowns.**

| DATE | NUMBER | SPECIES | SIZE RANGE (mm) | PROBABLE CAUSE | INTAKE TEMPERATURE °C (°F) |
|---|---|---|---|---|---|
| | 2 | Weakfish | 560-608 | | |
| | 2 | Winter flounder | 232-295 | | |
| | 1 | Cunner | 60 | | |
| | 1 | Red drum | 446 | | |
| | 1 | Smooth dogfish | 580 | | |
| | 66 | Unidentified | Unknown | | |
| 11/11/01-11/14/01 | 1306 | Crevalle jack / Blue runner | 128-214 | Thermal Shock | 8.99 - 13.09 (48.19-55.56) |
| | 78 | Lookdown | 117-155 | | |
| | 11 | Bluefish | 328-384 | | |
| | 7 | Bluespotted cornetfish | 340 | | |
| | 2 | Greater amberjack | 470-495 | | |
| | 1 | Southern stingray | 310 | | |
| | 1 | Spanish mackerel | 324 | | |
| | 1 | Spotfin butterflyfish | 83 | | |

**10. Submit data and information and an analysis of that data and information to support the statement on page 25 under the section identified as "Prime Fishing Areas" [sic] with regard to the impingement of alewife or river herring (*Alosa pseudoharengus*), blueback herring (*A. aestivalis*), American shad (*A. sapidissima*), striped bass (*Morone saxatilis*), Atlantic sturgeon (*Acipenser oxyrhynchus*), shortnose sturgeon (*A. brevirostrum*), and American eel (*Anguilla rostrata*) that "OCGS is in compliance with the rules protecting finfish migrations."**

AmerGen has not conducted any recent studies on the impingement of fish at OCGS. However, the 316(b) determination and the issuance of an NJPDES permit by the state of New Jersey are implicit concurrence by the state that the operation of OCGS is in compliance with the rules protecting finfish migrations. See Question 2 for a more complete discussion of the impingement of organisms at OCGS.

AmerGen also notes that the NRC, in performing its generic review of impacts of nuclear plant operation and license renewal, characterized plant impact on finfish migrations as small (NRC 1996).

**11. The submittal does not discuss public access to the waterfront. Please identify any public access to the waterfront provided on property owned by AmerGen. If no public access to the waterfront is available, can public access be provided to Oyster Creek, Forked River, or Barnegat Bay through the Finninger Farm? If AmerGen's response is negative, please detail why public access to the waterfront can not be provided.**

AmerGen recognizes that the CZMA generally contemplates consideration be given to a wide range of uses of the coastal zone - but it does not mandate that every approved use of the coastal zone allow for multipurpose uses and widespread access at every location. Sometimes multipurpose uses can coexist, but in other circumstances, only one activity may be conducted in a particular location. When dealing with a major pre-existing project, other uses of that portion of the coastal zone are limited, especially for the very special situation of a pre-existing nuclear power plant. Finninger Farm is currently the state-approved location for placement of dredged spoils for the plant's intake structure, and intake and discharge canals. The New Jersey Bureau of Nuclear Engineering (NJBNE) maintains a radiation monitor on the Finninger Farm. NJBNE should be consulted about what additional uses could be made at this location.

As stated in AmerGen's Federal Consistency Certification For Federal Permit And License Applicants, dated January 20, 2005, Enclosure page 2, AmerGen has not identified any refurbishment activities necessary to allow operation for an additional 20 years, and have identified no significant environmental impacts from programs and activities for managing the effects of aging.

Further, in AmerGen's certification, Enclosure page 23, in consideration of Coastal Permit Program Rules (NJAC 7:7), AmerGen states that they are not performing any activities (construction within the coastal area, dredging, excavation, or deposition of material, and erection of any structure in any coastal wetlands; and filling or dredging, or construction in certain upland areas adjacent to tidal wetlands) as a result of license renewal, has no plans to perform such activities as a result of license renewal, and is not seeking a coastal permit for such activities.

Finally, in AmerGen's certification, Enclosure page 32, under Subchapter 8 – Resource Rules, AmerGen states that, since this subchapter applies to development, which AmerGen will not undertake during the license renewal term, the requirements are not relevant. The rationale for AmerGen's statement come from NJAC 7:7E8-1(a), where it states, Purpose and scope, in addition to satisfying the location and use rules, a proposed development must satisfy the requirements of this subchapter. This subchapter contains the standards the Department utilizes to analyze the proposed development in terms of its effects on various resources of the built and natural environment of the coastal zone, both at the proposed site as well as in its surrounding region (emphasis added).

**REFERENCES**

Atlantic Menhaden Technical Committee (AMTC). 2001. 2001 Status of Atlantic Menhaden Stock and Fishery. Atlantic Menhaden Technical Committee of Atlantic States Marine Fisheries Commission (ASMFC). July 1.

Barnegat Bay Estuary Program (BBEP). 2001. The Barnegat Bay Estuary Program Characterization Report. Prepared by the Barnegat Bay National Estuary Program's Scientific and Technical Advisory Committee. January. Available on line at www.bbep.org.

Barnegat Bay Estuary Program (BBEP). 2002. Final Comprehensive Conservation and Management Plan. Available on line at www.bbep.org.

Chesapeake Bay Ecological Foundation (CBEF). 2004. Atlantic menhaden (*Brevoortia tyrannus*). Available on line at http://www.chesbay.org.

Chizmadia, P. A.; M. J. Kennish, and V. C. Ohori. 1984. "Physical description of Barnegat Bay" *in Ecology of Barnegat Bay* (M. J. Kennish and R. A. Lutz, eds), Springer – Verlag, New York.

EA Engineering, Science and Technology, Inc. (EA). 1986. Entrainment and impingement studies at Oyster Creek Nuclear Generating Station, 1984-1985. Prepared for GPU Nuclear Corporation, Parsippany, New Jersey. EA Report GPU 44G.

Environmental Protection Agency (EPA). 2003a. "A 'ground-breaking' partnership for the Barnegat Bay Estuary Program." National Estuary Program website. Available on line at http://www.epa.gov/nep/coastlines/nov03/barbay.html.

Environmental Protection Agency (EPA). 2003b. "Controlling Bacterial Contamination in Barnegat Bay, New Jersey." National Estuary Program website. Available on line at http://www.epa.gov/nep/coastlines/apr03/controlling.html.

Environmental Protection Agency (EPA). 2004a. "National Estuary Program." Available on line at http://www.epa.gov/nep/.

Environmental Protection Agency (EPA). 2004b. "Comprehensive Conservation and Management Plans." National Estuary Program website. Available on line at http://www.epa.gov/owow/estuaries/ccmp/.

Fishing and Hunting News. 2004. "Beachcombers aren't only summer migrants." Orig. published in Fishing and Hunting News. Available on line at http://espn.go.com/outdoors/fishing/s/f_map_NJ_Barnegat_bay.html.

Flyfishing Connection. 1999. "Saltwater Fly Fishing New Jersey's Barnegat Bay." Available on line at http://www.flyfishingconnection.com/barnegatbay.html.

Haughey, John. 2004. "Time to make way for Oyster Creek Stripers.{" Orig. published in Fishing and Hunting News. Available on line at http://espn.go.com/outdoors/fishing/s/f_map_NJ_Barnegat_bay.html.

NMFS (National Marine Fisheries Service). 2003. Annual Commercial Landing Statistics for Atlantic menhaden. Fisheries Statistics & Economics Division — NOAA Fisheries. Available on line at http://www.st.nmfs.gov/st1/commercial/index.html.

NMFS (National Marine Fisheries Service). 2004. Marine Recreational Fisheries Statistics Fisheries Statistics & Economics Division — NOAA Fisheries. Available on line at http://www.st.nmfs.gov/st1/recreational/data.html.

NRC (Nuclear Regulatory Commission). 1996. Generic Environmental Impact Statement for License Renewal of Nuclear Plants. NUREG-1437. Office of Nuclear Regulatory Research. Washington DC. May.

Summers, J. K., A. F. Holland, S. B. Weisberg, L. C. Wendling, C. F. Stroup, R. L. Dwyer, M. A. Turner, and W. Burton. 1989. Technical review and evaluation of thermal effects studies and cooling water intake structure demonstration of impact for the Oyster Creek Nuclear Generating Station, Revised Final Report, Volume I – Text. Prepared by Versar, Inc. for New Jersey Department of Environmental Protection Division of Water Resources. Trenton, NJ.

Versar (Versar, Inc.) 1988. Technical review and evaluation of thermal effects studies and cooling water intake structure demonstration of impact for the Oyster Creek Nuclear Generating Station. Final Report. Volume I – Text. Prepared for the New Jersey Department of Environmental Protection, Division of Water Resources, Trenton, NJ. March.

**Attachment 6-1**

**Oyster Creek Nuclear Generating Station, Formal Section 7 Consultation Initiation**

Rec'd 6-10 05 MB

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930-2298

JUN - 3 2005

Pao-Tsin Kuo, Program Director
License Renewal and Environmental Impacts Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Re: Oyster Creek Nuclear Generating Station, Formal Section 7 Consultation Initiation

Dear Mr. Kuo:

This correspondence acknowledges the receipt of your March 29, 2005 letter regarding the reinitiation of formal consultation pursuant to section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, for continued operation of the Oyster Creek Nuclear Generating Station (OCNGS). Previous section 7 consultation was completed with the issuance of a biological opinion (Opinion) on July 18, 2001. The 2001 Opinion along with the revised incidental take statement (ITS) issued on August 29, 2001 authorized the annual take of five loggerhead, four Kemp's ridley, and two green sea turtles during the annual operation of OCNGS. During 2004, eight Kemp's ridley sea turtles occurred at OCNGS, exceeding the authorized ITS. Due to the number of Kemp's ridley sea turtle takes, the Nuclear Regulatory Commission (NRC) has requested reinitiation of formal consultation.

The Biological Assessment dated March 2005, enclosed with your letter, has provided information for this consultation. Upon review of the submitted information, it is NOAA's National Marine Fisheries Services' (NMFS) determination that all of the information required to initiate formal consultation has been received.

NMFS will prepare an Opinion analyzing whether or not the continued use of the OCNGS is likely to jeopardize listed sea turtles. Your March 29, 2005 letter was received by NMFS Northeast Region, Protected Resources Division on April 28, 2005, which will serve as the commencement date of the formal consultation process. The ESA and the section 7 regulations require that formal consultation be concluded within 90 calendar days of initiation, and the biological opinion be delivered to the action agency within 45 days after the conclusion of formal consultation. As such, we expect to provide you with our biological opinion no later than September 10, 2005. As a reminder, the NRC must not make any irreversible or irretrievable commitments of resources that would prevent NMFS from proposing or implementing any reasonable and prudent alternatives to avoid jeopardizing sea turtles.

Until the final biological opinion is completed and signed, NMFS recommends that the Nuclear Regulatory Commission continue to implement the requirements identified in the July 21, 2001 Opinion and the August 29, 2001 amended ITS.

If you have any questions concerning these comments or the section 7 consultation requirements, please contact Sara McNulty of my staff at (978) 281-9300 x6520.

Sincerely,

Mary Colligan

Mary Colligan
Assistant Regional Administrator
for Protected Resources

cc: Malcolm Browne, AmerGen
Collins, GCNE
Williams, GCNE
Riportella, F/NER-SII
Scida, F/NER
Nash, NRC

File code: NRC Oyster Creek, reinitiation letter, 2005

NJ DEP, Land Use Regulation Program
June 15, 2005
Attachment

**Attachment 7-1**

**Calculation Package for Oyster Creek Transmission Line Induced Current Analysis**

**Calculation Package for Oyster Creek Transmission Line Induced Current Analysis**

**July 8, 2004**

**Prepared for:**

**Exelon Nuclear**
**Lacey Township, New Jersey**

**Prepared by:**

**Steven J. Connor**
**Tetra Tech NUS**
**Aiken, South Carolina**

## I. Problem Statement

These calculations were performed in support of *Applicant's Environmental Report, Operating License Renewal Stage, Oyster Creek Nuclear Generating Station*, specifically section 4.13 on induced current. NRC regulations and guidance for preparing license renewal environmental reports requires that licensees demonstrate that their transmission lines comply with the induced shock provisions of the National Electrical Safety Code (NESC) in Part 2, Rules 232C1c and 232D3c. NESC requires that vertical clearances for transmission lines exceeding 98-kilovolts be sufficient to ensure that the induced current due to electrostatic effects is not greater than 5 milliamperes for the largest anticipated truck, vehicle, or equipment parked beneath the lines.

The Oyster Creek transmission lines consist of two 230 kV lines that are hung on double-circuit towers in a vertical configuration. The lines run 11.1 miles from the Oyster Creek 230 kV substation to the Manitou Substation.

## II. Model Input Data

The computer code ACDCLINE by the Electric Power Research Institute was used for the calculations. The inputs necessary for running ACDCLINE were obtained from the following drawings provided by First Energy (2004).

- Plan and Profile drawings D-48825, Manitou-Oyster Creek 230 kV Transmission Line, sheets 1 - 12.
- Standard 230 kV Transmission Line Sag & Tension Charts A-35801 through A-35805 and A-35928 through A-35932.
- 230 kV Double Circuit Transmission Line Suspension Tower Type KR, Drawing T-11070

In general, the plan and profile drawings for each line were used to identify two types of locations: (1) at all paved roads (2) any location with clearance lower than the least road clearance, regardless of terrain or structures beneath. The candidate locations are cataloged in Table 1 along with the data used for selecting locations to analyze.

Table 1. Candidate analysis locations

| Location | Description | Clearance (ft) |
|---|---|---|
| 27+68 | Proposed 3rd Avenue | 48 |
| 30+07 | Proposed 2nd Avenue | 48 |
| 32+48 | Proposed 1st Avenue | 60 |
| 51+05 | Intersection of Hill Street and proposed 5th Avenue | 35 |
| 54+33 | Proposed Mill Street | 52 |
| 57+26 | Proposed Shepherd Street | 73 |
| 61+10 | Intersection of Proposed 6th Avenue and Emanuel | 39 |
| 64+55 | Proposed Johnson Street | 52 |
| 68+00 | Proposed Ingard Street | 72 |
| 71+40 | Proposed Factory Street | 49 |
| 74+78 | Dover Road | 51 |
| 122+69 | Proposed Milton Avenue | 47 |
| 193+63 | Pinewald-Keswick Road | 51 |
| 350+14 | Proposed Alpine Street | 54 |
| 352+63 | Proposed Chesler Street | 58 |
| 355+13 | Proposed Clifton Street | 54 |
| 357+63 | Proposed Elwood Street | 54 |
| 360+13 | Proposed Center Street | 59 |
| 362+63 | Proposed Hoyt Street | 52 |
| 365+13 | Proposed Devon Street | 40 |
| 367+86 | Proposed River Street | 49 |
| 431+17 | Proposed Clearview Street | 61 |
| 433+91 | Proposed Fairview Street | 39 |
| 436+63 | Proposed Ocean Street | 40 |
| 439+34 | Proposed State Street | 64 |
| 442+50 | Proposed Cedar Avenue | 46 |
| 444+77 | Proposed Grove Street | 37 |
| 518+38 | Estimated parking position on Garden State Parkway - southbound | 42 |
| 523+67 | Estimated parking position on Garden State Parkway - northbound | 50 |
| 102+00 | Edge of swamp land – no road | 32 |
| 177+00 | Medium woods – no road | 29 |
| 187+00 | Medium woods – no road | 29 |

Examination of the data in Table 1 resulted in selection of the locations identified in Table 2 for analysis. These locations should yield the bounding case among those identified in Table 1. Additional location-specific data needed for analysis are also provided.

Table 2. Data for locations selected for analysis.

| Location | Description | Clearance (ft) | Span (ft) | Sag[1] (ft) | Angle[2] | Conductor Height[3] (ft) | Tower Type |
|---|---|---|---|---|---|---|---|
| 51+05 | Intersection of Hill Street and proposed 5th Avenue | 35 | 1100 | @167° 44<br>@120° 41 | 45° | 79' | KR-KR |
| 444+77 | Proposed Grove Street | 37 | 1050 | @167° 42<br>@120° 38 | 30° | 78'. | KR-KR |
| 177+00 | Medium woods – no road | 29 | 1000 | @167° 36<br>@120° 34 | NA | 67 | KR-KR |

1. Plan and Profile drawings indicate 167°F sag. Sag at 120°F determined from sag charts.
2. Angle of transmission line to road. Due to an error in ACDCLINE, the value entered into the code is the complementary angle.
3. Weighted average height of lowest conductor attachment to towers, above road or location of interest. See Attachment A for calculation of these values.

The Type KR towers were the only ones used at the locations of interest. Data on these towers are provided in Table 3. The conductors are arranged in a vertical configuration with one circuit occupying each side of the tower phased A-B-C, top-to-bottom on both sides.

Table 3. Type KR Tower Dimensions

| Phase | Horizontal Distance from Centerline (ft) | Connection Height Above Lowest Conductor (ft) |
|---|---|---|
| Left static | -10.5 | 63 |
| Left A | -18 | 42 |
| Left B | -20.5 | 21 |
| Left C | -18 | 0 |
| Right static | +10.5 | 63 |
| Right A | +18 | 42 |
| Right B | +20.5 | 21 |
| Right C | +18 | 0 |

As identified on the Plan and Profile drawings, the conductors are 1590 MCM 45/7 ACSR Lapwing. The static wires are 7#6 AW. ACDCLINE selected the parameters for these conductors and static wires from its library.

## III. Methods

In most cases the elevation of the two towers of a span of interest were different, and the elevation of the location of interest was different than the nearest tower base. Because AC/DCLINE does not accommodate non-level geometries, a surrogate geometry was constructed that uses weighted average height for conductor attachments above the location of interest. The surrogate geometry had the two towers at the same elevation. This surrogate geometry would not have identical impact with that of the actual geometry, but it should be close. Calculations of weighted average heights for the surrogate geometry are found in Attachment A.

The code was first run to give electric field with no coupled objects to find the transverse location with the highest electric field strength. The code was then rerun with a long box coupled object with dimensions of the largest tractor-trailer truck that is expected to be on the roads, 12 by 8 by 65 feet. The 12-foot height is a weighted average of the cab and the trailer. At the non-road location, a combine of dimensions 11.5 by 7.5 by 30 feet was used. The truck or combine was placed at the longitudinal location of interest and at the transverse location with the highest electric field strength.

**IV. Results**

Analytical results for each analysis is provided in the table below to three significant digits, as provided in the ACDCLINE printouts in Attachment B. All values are in compliance with the NESC limit, which is presented as one significant digit, 5 milliamperes.

| Survey Location | Description | Induced Current (millamps) |
|---|---|---|
| 51+05 | Intersection of Hill Street and proposed 5th Avenue | 2.76 |
| 444+77 | Proposed Grove Street | 2.75 |
| 177+00 | Medium woods – no road | 2.10 |

**References**

First Energy, 2004. Letter from Barry Sensenig, First Energy to William D. Maher, Exelon, with attachments, First Energy, Reading, Pennsylvania, June 1.

# Attachment A
# Calculation of Weighted Average Heights

Oyster Creek Induced Current Analysis
Weighted Average Conductor Heights

| Location 51+05 | | Location 444+77 | | Location 175+00 | |
|---|---|---|---|---|---|
| Tower 93 | feet | Tower 134 | feet | Tower 106 | feet |
| conductor elevation | 138 | conductor elevation | 114 | conductor elevation | 132 |
| distance to road | 555 | distance to road | 477 | distance to road | 500 |
| Tower 94 | | Tower 135 | | Tower 107 | |
| conductor elevation | 140 | conductor elevation | 122 | conductor elevation | 130 |
| distance to road | 545 | distance to road | 573 | distance to road | 500 |
| road elevation | 60 | road elevation | 40 | road elevation | 64 |
| Span | 1100 | Span | 1050 | Span | 1000 |
| Weighted average elevation | 139 | Weighted average elevation | 118 | Weighted average elevation | 131 |
| Weighted average height above road - lowest conductor | 79 | Weighted average height above road | 78 | Weighted average height above road | 67 |
| Weighted average height above road - middle conductor | 100 | Weighted average height above road - middle conductor | 99 | Weighted average height above road - middle conductor | 88 |
| Weighted average height above road - highest conductor | 121 | Weighted average height above road - highest conductor | 120 | Weighted average height above road - highest conductor | 109 |
| Weighted average height above road - static wire | 142 | Weighted average height above road - static wire | 141 | Weighted average height above road - static wire | 130 |

**Attachment B**
**ACDCLINE Printouts**

Results of AC/DCLINE program EFION (EPRI/HVTRC 7-93) for:

ELECTRIC FIELD & IONS WITHOUT SHIELDING OBJECTS

Configuration file name: C:\TLW30\ACDCLINE\DATA\ACT93
Date: 7/ 8/2004 Time: 15:33

T93 Intersection of Hill Street and 5th Avenue at 51+05

BUNDLE INFORMATION

| BNDL # | CIRC # | VOLTAGE VOLTAGE (kV) | VOLTAGE ANGLE (DEG) | CURRENT LOAD (A) | CURRENT ANGLE (DEG) | # OF COND | BUNDLE COORDINATES X (feet) | BUNDLE COORDINATES Y (feet) | BUNDLE COORDINATES SAG (feet) | PH |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 230.0 | 0. | 500. | 0. | 1 | -18.0 | 121.0 | 41.0 | A |
| 2 | 1 | 230.0 | 240. | 500. | 240. | 1 | -20.5 | 100.0 | 41.0 | B |
| 3 | 1 | 230.0 | 120. | 500. | 120. | 1 | -18.0 | 79.0 | 41.0 | C |
| 6 | 2 | 230.0 | 0. | 500. | 0. | 1 | 18.0 | 121.0 | 41.0 | A |
| 7 | 3 | 230.0 | 240. | 500. | 0. | 1 | 20.5 | 100.0 | 41.0 | B |
| 8 | 4 | 230.0 | 120. | 1000. | 120. | 1 | 18.0 | 79.0 | 41.0 | C |
| 4 | 1 | .0 | 0. | 0. | 0. | 1 | -10.5 | 142.0 | 35.0 | GND |
| 5 | 2 | .0 | 0. | 0. | 0. | 1 | 10.5 | 142.0 | 35.0 | GND |

MINIMUM GROUND CLEARANCE = 38.00 feet
POWER SYSTEM FREQUENCY = 60. Hz
SOIL RESISTIVITY = 100. ohm meter

SUBCONDUCTOR INFORMATION - REGULAR BUNDLES

| BNDL # | CONDUCTOR NAME | DIAMETER (inch) | SPACING (inch) | DC RESIST (ohm/mile) | AC RESIST (ohm/mile) | AC REACT (ohm/mile) |
|---|---|---|---|---|---|---|
| 1 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 2 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 3 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 6 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 7 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 8 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 4 | 7#6AW | .490 | 18.000 | 1.5070 | 1.5360 | .7210 |
| 5 | 7#6AW | .490 | 18.000 | 1.5070 | 1.5360 | .7210 |

```
*************************************
*                                   *
*     AC  ELECTRIC FIELD PROFILE    *
*    at   3.28 feet above ground    *
*                                   *
* longitudinal  distance: 545.00 feet *
*                                   *
*************************************
```

| LATERAL DISTANCE (feet) | (meters) | MAXIMUM FIELD (kV/m) | MINOR/MAJOR ELLIPSE AXES (ratio) | VERTICAL (kV/m) | HORIZONTAL (kV/m) | SPACE POTENTIAL (kV) |
|---|---|---|---|---|---|---|
| -50.0 | -15.24 | .861 | .035 | .848 | .155 | .853 |
| -45.0 | -13.72 | 1.115 | .030 | 1.100 | .182 | 1.105 |
| -40.0 | -12.19 | 1.407 | .025 | 1.392 | .204 | 1.396 |
| -35.0 | -10.67 | 1.725 | .020 | 1.712 | .215 | 1.712 |
| -30.0 | -9.14 | 2.049 | .016 | 2.038 | .209 | 2.034 |
| -25.0 | -7.62 | 2.346 | .011 | 2.339 | .181 | 2.331 |
| -20.0 | -6.10 | 2.588 | .006 | 2.584 | .137 | 2.573 |
| -15.0 | -4.57 | 2.755 | .002 | 2.754 | .087 | 2.743 |
| -10.0 | -3.05 | 2.850 | .000 | 2.850 | .045 | 2.841 |
| -5.0 | -1.52 | 2.892 | .000 | 2.892 | .017 | 2.887 |
| .0 | .00 | 2.903 | .000 | 2.903 | .000 | 2.899 |
| 5.0 | 1.52 | 2.892 | .000 | 2.892 | .017 | 2.887 |
| 10.0 | 3.05 | 2.850 | .000 | 2.850 | .045 | 2.841 |
| 15.0 | 4.57 | 2.755 | .002 | 2.754 | .087 | 2.743 |
| 20.0 | 6.10 | 2.588 | .006 | 2.584 | .137 | 2.573 |
| 25.0 | 7.62 | 2.346 | .011 | 2.339 | .181 | 2.331 |
| 30.0 | 9.14 | 2.049 | .016 | 2.038 | .209 | 2.034 |
| 35.0 | 10.67 | 1.725 | .020 | 1.712 | .215 | 1.712 |
| 40.0 | 12.19 | 1.407 | .025 | 1.392 | .204 | 1.396 |
| 45.0 | 13.72 | 1.115 | .030 | 1.100 | .182 | 1.105 |
| 50.0 | 15.24 | .861 | .035 | .848 | .155 | .853 |
| 100.0 | 30.48 | .090 | .102 | .090 | .013 | .089 |
| 150.0 | 45.72 | .118 | .009 | .118 | .002 | .118 |
| 100.0 | 30.48 | .090 | .102 | .090 | .013 | .089 |
| 150.0 | 45.72 | .118 | .009 | .118 | .002 | .118 |

```
---------------------------------------------------------------
 Results of AC/DCLINE program COUPLE (EPRI/HVTRC  7-93) for:
---------------------------------------------------------------
      COUPLING to OBJECTS & SHIELDING by OBJECTS

Configuration file name: C:\TLW30\ACDCLINE\DATA\ACT93
Date:  7/ 8/2004   Time: 15:33
```

```
DATE:  7/ 8/2004 TIME: 15:33
**************************************************
*                                                *
*            ELECTRICAL COUPLING TO OBJECTS      *
*      INCLUDING EFFECTS OF  6 SHIELDING OBJECTS *
*                                                *
*                 OBJECT TYPE =  2               *
*             LONG  BOX (LONG VEHICLE)           *
*                                                *
**************************************************

EQUIVALENT COUPLED OBJECT AREA =    3255.98 ft**2
CALCULATED CAPACITANCE TO GROUND =      2500. pF
CALCULATED RESISTANCE  TO GROUND =       .72 kohms
(1% RESISTANCE VALUE MEASURED FOR VEHICLES WITH THE SAME CAPACITANCE,
IN DIFFERENT WEATHER CONDITIONS AND ON DIFFERENT PAVEMENTS - NORTHEAST USA)

LATERAL AND LONGITUDINAL DISTANCE TO OBJECT CENTER =     .00   545.00 feet


AC SHORT CIRCUIT CURRENT =      2.76 mA

THEORETICAL MAXIMUM AC VOLTAGE TO GROUND =     2925. V
                1%  AC VOLTAGE TO GROUND =     1644. V
                50% AC VOLTAGE TO GROUND =      243. V
```

Results of AC/DCLINE program EFION (EPRI/HVTRC 7-93) for:

ELECTRIC FIELD & IONS WITHOUT SHIELDING OBJECTS

Configuration file name: C:\TLW30\ACDCLINE\DATA\ACT134
Date: 7/ 8/2004 Time: 15:37

T134 Grove Street at 444+77

BUNDLE INFORMATION

| BNDL # | CIRC # | VOLTAGE VOLTAGE (kV) | VOLTAGE ANGLE (DEG) | CURRENT LOAD (A) | CURRENT ANGLE (DEG) | # OF COND | BUNDLE COORDINATES X (feet) | BUNDLE COORDINATES Y (feet) | SAG (feet) | PH |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 230.0 | 0. | 500. | 0. | 1 | -18.0 | 120.0 | 38.0 | A |
| 2 | 1 | 230.0 | 240. | 500. | 240. | 1 | -20.5 | 99.0 | 38.0 | B |
| 3 | 1 | 230.0 | 120. | 500. | 120. | 1 | -18.0 | 78.0 | 38.0 | C |
| 6 | 2 | 230.0 | 0. | 500. | 0. | 1 | 18.0 | 120.0 | 38.0 | A |
| 7 | 3 | 230.0 | 240. | 500. | 0. | 1 | 20.5 | 99.0 | 38.0 | B |
| 8 | 4 | 230.0 | 120. | 1000. | 120. | 1 | 18.0 | 78.0 | 38.0 | C |
| 4 | 1 | .0 | 0. | 0. | 0. | 1 | -10.5 | 141.0 | 32.0 | GND |
| 5 | 2 | .0 | 0. | 0. | 0. | 1 | 10.5 | 141.0 | 32.0 | GND |

MINIMUM GROUND CLEARANCE = 40.00 feet
POWER SYSTEM FREQUENCY = 60. Hz
SOIL RESISTIVITY = 100. ohm meter

SUBCONDUCTOR INFORMATION - REGULAR BUNDLES

| BNDL # | CONDUCTOR NAME | DIAMETER (inch) | SPACING (inch) | DC RESIST (ohm/mile) | AC RESIST (ohm/mile) | AC REACT (ohm/mile) |
|---|---|---|---|---|---|---|
| 1 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 2 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 3 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 6 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 7 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 8 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 4 | 7#6AW | .490 | 18.000 | 1.5070 | 1.5360 | .7210 |
| 5 | 7#6AW | .490 | 18.000 | 1.5070 | 1.5360 | .7210 |

```
**************************************
*                                    *
*    AC  ELECTRIC FIELD PROFILE      *
*   at   3.28 feet above ground      *
*                                    *
* longitudinal  distance: 477.00 feet *
*                                    *
**************************************
```

| LATERAL DISTANCE (feet) | (meters) | MAXIMUM FIELD (kV/m) | MINOR/MAJOR ELLIPSE AXES (ratio) | VERTICAL (kV/m) | HORIZONTAL (kV/m) | SPACE POTENTIAL (kV) |
|---|---|---|---|---|---|---|
| -50.0 | -15.24 | .866 | .030 | .855 | .144 | .859 |
| -45.0 | -13.72 | 1.101 | .026 | 1.089 | .166 | 1.093 |
| -40.0 | -12.19 | 1.366 | .022 | 1.354 | .184 | 1.356 |
| -35.0 | -10.67 | 1.651 | .018 | 1.640 | .191 | 1.640 |
| -30.0 | -9.14 | 1.937 | .014 | 1.928 | .184 | 1.925 |
| -25.0 | -7.62 | 2.200 | .010 | 2.194 | .161 | 2.187 |
| -20.0 | -6.10 | 2.416 | .006 | 2.413 | .125 | 2.404 |
| -15.0 | -4.57 | 2.572 | .003 | 2.571 | .084 | 2.561 |
| -10.0 | -3.05 | 2.668 | .001 | 2.667 | .047 | 2.660 |
| -5.0 | -1.52 | 2.715 | .000 | 2.715 | .020 | 2.710 |
| .0 | .00 | 2.729 | .000 | 2.729 | .000 | 2.724 |
| 5.0 | 1.52 | 2.715 | .000 | 2.715 | .020 | 2.710 |
| 10.0 | 3.05 | 2.668 | .001 | 2.667 | .047 | 2.660 |
| 15.0 | 4.57 | 2.572 | .003 | 2.571 | .084 | 2.561 |
| 20.0 | 6.10 | 2.416 | .006 | 2.413 | .125 | 2.404 |
| 25.0 | 7.62 | 2.200 | .010 | 2.194 | .161 | 2.187 |
| 30.0 | 9.14 | 1.937 | .014 | 1.928 | .184 | 1.925 |
| 35.0 | 10.67 | 1.651 | .018 | 1.640 | .191 | 1.640 |
| 40.0 | 12.19 | 1.366 | .022 | 1.354 | .184 | 1.356 |
| 45.0 | 13.72 | 1.101 | .026 | 1.089 | .166 | 1.093 |
| 50.0 | 15.24 | .866 | .030 | .855 | .144 | .859 |
| 100.0 | 30.48 | .071 | .145 | .070 | .014 | .069 |
| 150.0 | 45.72 | .110 | .010 | .110 | .002 | .110 |
| 100.0 | 30.48 | .071 | .145 | .070 | .014 | .069 |
| 150.0 | 45.72 | .110 | .010 | .110 | .002 | .110 |

```
-------------------------------------------------------------
 Results of AC/DCLINE program COUPLE (EPRI/HVTRC  7-93) for:
-------------------------------------------------------------
     COUPLING to OBJECTS & SHIELDING by OBJECTS

Configuration file name: C:\TLW30\ACDCLINE\DATA\ACT134
Date:  7/ 8/2004   Time: 15:37
```

```
DATE:  7/ 8/2004 TIME: 15:37
***************************************************
*                                                 *
*          ELECTRICAL COUPLING TO OBJECTS         *
*     INCLUDING EFFECTS OF  6 SHIELDING OBJECTS   *
*                                                 *
*                OBJECT TYPE =  2                 *
*            LONG  BOX (LONG VEHICLE)             *
*                                                 *
***************************************************

EQUIVALENT COUPLED OBJECT AREA =   3255.98 ft**2
CALCULATED CAPACITANCE TO GROUND =     2500. pF
CALCULATED RESISTANCE  TO GROUND =        .72 kohms
(1% RESISTANCE VALUE MEASURED FOR VEHICLES WITH THE SAME CAPACITANCE,
IN DIFFERENT WEATHER CONDITIONS AND ON DIFFERENT PAVEMENTS - NORTHEAST USA)

LATERAL AND LONGITUDINAL DISTANCE TO OBJECT CENTER =      .00   477.00 feet

AC SHORT CIRCUIT CURRENT =      2.75 mA

THEORETICAL MAXIMUM AC VOLTAGE TO GROUND =    2915. V
                1%  AC VOLTAGE TO GROUND =    1638. V
               50%  AC VOLTAGE TO GROUND =     242. V
```

Results of AC/DCLINE program EFION (EPRI/HVTRC 7-93) for:

ELECTRIC FIELD & IONS WITHOUT SHIELDING OBJECTS

Configuration file name: C:\TLW30\ACDCLINE\DATA\ACT106
Date: 7/ 8/2004 Time: 15:42

T106 least clearance, no road - 175+00

BUNDLE INFORMATION

| BNDL # | CIRC # | VOLTAGE VOLTAGE (kV) | VOLTAGE ANGLE (DEG) | CURRENT LOAD (A) | CURRENT ANGLE (DEG) | # OF COND | BUNDLE COORDINATES X (feet) | BUNDLE COORDINATES Y (feet) | BUNDLE COORDINATES SAG (feet) | PH |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 230.0 | 0. | 500. | 0. | 1 | -18.0 | 109.0 | 36.0 | A |
| 2 | 1 | 230.0 | 240. | 500. | 240. | 1 | -20.5 | 88.0 | 36.0 | B |
| 3 | 1 | 230.0 | 120. | 500. | 120. | 1 | -18.0 | 67.0 | 36.0 | C |
| 6 | 2 | 230.0 | 0. | 500. | 0. | 1 | 18.0 | 109.0 | 36.0 | A |
| 7 | 3 | 230.0 | 240. | 500. | 0. | 1 | 20.5 | 88.0 | 36.0 | B |
| 8 | 4 | 230.0 | 120. | 1000. | 120. | 1 | 18.0 | 67.0 | 36.0 | C |
| 4 | 1 | .0 | 0. | 0. | 0. | 1 | -10.5 | 130.0 | 29.0 | GND |
| 5 | 2 | .0 | 0. | 0. | 0. | 1 | 10.5 | 130.0 | 29.0 | GND |

MINIMUM GROUND CLEARANCE = 31.00 feet
POWER SYSTEM FREQUENCY = 60. Hz.
SOIL RESISTIVITY = 100. ohm meter

SUBCONDUCTOR INFORMATION - REGULAR BUNDLES

| BNDL # | CONDUCTOR NAME | DIAMETER (inch) | SPACING (inch) | DC RESIST (ohm/mile) | AC RESIST (ohm/mile) | AC REACT (ohm/mile) |
|---|---|---|---|---|---|---|
| 1 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 2 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 3 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 6 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 7 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 8 | LAPWING | 1.500 | 18.000 | .0580 | .0620 | .3640 |
| 4 | 7#6AW | .490 | 18.000 | 1.5070 | 1.5360 | .7210 |
| 5 | 7#6AW | .490 | 18.000 | 1.5070 | 1.5360 | .7210 |

```
*************************************
*                                   *
*    AC  ELECTRIC FIELD PROFILE     *
*   at   3.28 feet above ground     *
*                                   *
* longitudinal  distance: 500.00 feet *
*                                   *
*************************************
```

| LATERAL DISTANCE (feet) | (meters) | MAXIMUM FIELD (kV/m) | MINOR/MAJOR ELLIPSE AXES (ratio) | VERTICAL (kV/m) | HORIZONTAL (kV/m) | SPACE POTENTIAL (kV) |
|---|---|---|---|---|---|---|
| -50.0 | -15.24 | .807 | .060 | .786 | .188 | .795 |
| -45.0 | -13.72 | 1.122 | .048 | 1.099 | .237 | 1.108 |
| -40.0 | -12.19 | 1.514 | .039 | 1.488 | .285 | 1.496 |
| -35.0 | -10.67 | 1.972 | .031 | 1.947 | .320 | 1.950 |
| -30.0 | -9.14 | 2.462 | .023 | 2.441 | .322 | 2.436 |
| -25.0 | -7.62 | 2.921 | .014 | 2.908 | .277 | 2.893 |
| -20.0 | -6.10 | 3.274 | .007 | 3.269 | .186 | 3.246 |
| -15.0 | -4.57 | 3.470 | .000 | 3.469 | .083 | 3.448 |
| -10.0 | -3.05 | 3.525 | .003 | 3.525 | .015 | 3.513 |
| -5.0 | -1.52 | 3.507 | .003 | 3.507 | .017 | 3.505 |
| .0 | .00 | 3.490 | .000 | 3.490 | .000 | 3.493 |
| 5.0 | 1.52 | 3.507 | .003 | 3.507 | .017 | 3.505 |
| 10.0 | 3.05 | 3.525 | .003 | 3.525 | .015 | 3.513 |
| 15.0 | 4.57 | 3.470 | .000 | 3.469 | .083 | 3.448 |
| 20.0 | 6.10 | 3.274 | .007 | 3.269 | .186 | 3.246 |
| 25.0 | 7.62 | 2.921 | .014 | 2.908 | .277 | 2.893 |
| 30.0 | 9.14 | 2.462 | .023 | 2.441 | .322 | 2.436 |
| 35.0 | 10.67 | 1.972 | .031 | 1.947 | .320 | 1.950 |
| 40.0 | 12.19 | 1.514 | .039 | 1.488 | .285 | 1.496 |
| 45.0 | 13.72 | 1.122 | .048 | 1.099 | .237 | 1.108 |
| 50.0 | 15.24 | .807 | .060 | .786 | .188 | .795 |
| 100.0 | 30.48 | .158 | .050 | .158 | .009 | .157 |
| 150.0 | 45.72 | .140 | .008 | .139 | .003 | .139 |
| 100.0 | 30.48 | .158 | .050 | .158 | .009 | .157 |
| 150.0 | 45.72 | .140 | .008 | .139 | .003 | .139 |

```
------------------------------------------------------------
 Results of AC/DCLINE program COUPLE (EPRI/HVTRC  7-93) for:
------------------------------------------------------------
     COUPLING to OBJECTS & SHIELDING by OBJECTS

Configuration file name: C:\TLW30\ACDCLINE\DATA\ACT106
Date:  7/ 8/2004   Time: 15:42
```

```
DATE:  7/ 8/2004 TIME: 15:42
*****************************************************
*                                                   *
*           ELECTRICAL COUPLING TO OBJECTS          *
*      INCLUDING EFFECTS OF  6 SHIELDING OBJECTS    *
*                                                   *
*                 OBJECT TYPE =  2                  *
*             LONG  BOX (LONG VEHICLE)              *
*                                                   *
*****************************************************

EQUIVALENT COUPLED OBJECT AREA =   1864.91 ft**2
CALCULATED CAPACITANCE TO GROUND =     1000. pF
CALCULATED RESISTANCE  TO GROUND =      1.80 kohms
(1% RESISTANCE VALUE MEASURED FOR VEHICLES WITH THE SAME CAPACITANCE,
IN DIFFERENT WEATHER CONDITIONS AND ON DIFFERENT PAVEMENTS - NORTHEAST USA)

LATERAL AND LONGITUDINAL DISTANCE TO OBJECT CENTER =    10.00   500.00 feet

AC SHORT CIRCUIT CURRENT =       2.10 mA

THEORETICAL MAXIMUM AC VOLTAGE TO GROUND =      5582. V
             1%  AC VOLTAGE TO GROUND =      3137. V
             50% AC VOLTAGE TO GROUND =       463. V
```

**Attachment 8-1**

**SARA Right to Know 2004 Survey Cover Letter**

**AmerGen.**
An Exelon Company

AmerGen Energy Company, LLC
Oyster Creek
115 Route 9 South, P.O. Box 388
Forked River, NJ 08731-0388
www.exeloncorp.com

February 28, 2005
2120-052-2889

New Jersey Department of Environmental Protection
Office of Pollution Prevention and Right to Know
P.O. Box 405
Trenton, NJ 08625-0405

Dear Sir or Madam:

Subject: OYSTER CREEK GENERATING STATION (OCGS)
2004 SARA TITLE III, SECTION 312 REPORT

In accordance with the reporting requirements of SARA Title III, Section 312, attached is the following information for hazardous chemicals used by AmerGen at the OCGS.

Section 312 - Community Right-to-Know Survey for 2004

If there are any questions regarding this submittal, please contact me at (609) 971-4029.

Sincerely,

Douglas R Weigle
Environmental Specialist
Chemistry/Radwaste

Attachment

cc: Chief William A. Nally
Lacey Township Office of Emergency Management
P.O. Box 184
Forked River, NJ 08731

February 28, 2005
2120-052-2889
New Jersey Department of Environmental Protection
Page 2

cc: Ocean County Health Department
Community Right-to-Know Coordinator
P.O. Box 2191
Toms River, NJ 08754

Chief, Forked River Fire Department
P.O. Box 32
Forked River, NJ 08731

Lacey Police Department
108 West Lacey Road
Forked River, NJ 08731

NJ DEP, Land Use Regulation Program
June 15, 2005
Attachment

**Attachment 8-2**

**Small Quantity Hazardous Waste Generator Annual Report Cover Letter**

AmerGen
An Exelon Company

AmerGen Energy Company, LLC
Oyster Creek
US Route 9 South, P.O. Box 388
Forked River, NJ 08731-0388
www.exeloncorp.com

File # 05009
2130-05-20076

April 12, 2005

2120-052-2896

State of New Jersey
Department of Environmental Protection
Division of County Environmental and Waste Enforcement Programs
Bureau of Hazardous Waste Compliance and Enforcement
300 Horizon Center
P.O. Box 407
Trenton, NJ 08625-0407

Attention: Ms. Aneeta Sakheja

Dear Ms Sakheja:

Attached is completed USEPA Form 8700-13 for the year 2003, pertaining to the Oyster Creek Generating Station in Lacey Township, Ocean County, NJ. This form is being forwarded to you in response to the request made during the conference call that occurred on March 22, between yourself and Theresa Pagodin of the DEP and the following members of the station environmental staff – Lynn Newton, Douglas Weigle and Zigmund Karpa. We appreciate your time and attention to resolving the matter regarding the station status as a Small Quantity Generator (SQG) of hazardous waste.

During the conference call it was agreed that upon receipt of this USEPA Form 8700-13, that the station would receive a written confirmation that the Notice of Violation, dated January 21, 2005, would be rescinded. Please send this correspondence to Mr. Douglas R Weigle of our Chemistry Department. If you have any further questions, please do not hesitate to contact Mr. Weigle at (609) 971-4029.

Thank you for your assistance.

Very truly yours,

James J. Randich

Mr. James J. Randich
Plant Manager - Oyster Creek

cc. Theresa Pagodin
Kim Moyer

NJ DEP, Land Use Regulation Program
June 15, 2005
Attachment

**Attachment 8-3**

**Effluent Toxicity Annual Test Cover Letter.**

SENT BY: TLD OFFICE OC A08; 6099714468; APR-29-05 11:01; PAGE 2

GPU NUCLEAR

GPU Nuclear, Inc.
U.S. Route 9 South
Post Office Box 388
Forked River, NJ 08731-0388
Tel 609-971-4000

6530-992-2373
JUN 0 1 1999

Mr. Jeffrey Thein
New Jersey Department of Environmental Protection
Bureau of Point Source Permitting Region I
PO Box 029
401 East State Street, 2nd Floor East Wing
Trenton, NJ 08625-0029

Dear Mr. Thein:

Subject: GPU Nuclear Inc. (GPUN)
Oyster Creek Nuclear Generating Station (OCNGS)
NJPDES DSW Permit No. NJ0005550
Effluent Characterization Study Final Report

GPU Nuclear, Inc. hereby submits the Effluent Characterization Study Final Report in fulfillment of Additional Requirement 2 of Part IV-B/C of the subject permit. This report summarizes the data collected during the Effluent Characterization Study by each outfall/sampling point for each parameter analyzed. We will be happy to meet with the NJDEP, at your convenience, if you would care to discuss any aspect of the report.

If you have any questions, please contact Malcolm Browne (609) 971-4124, or Jay Vouglitois (609) 971-4021 of our Environmental Affairs Department.

Very truly yours,

Michael B Roche

Michael B. Roche
Vice President & Director, OC

MBR/MEB/ew

SENT BY: TLD OFFICE OC AOB; 6099714468; APR-29-05 11:01; PAGE 3

AmerGen Energy Company, LLC
Oyster Creek
US Route 9 South, P.O. Box 388
Forked River, NJ 08731-0388

www.exeloncorp.com

AmerGen
An Exelon Company

2120-042-2866

DEC 10 2004

NJ Department of Environmental Protection
Division of Water Quality
Bureau of Standard Permitting
P.O. Box 029
Trenton, NJ 08625-0029
Attn: Industrial Biomonitoring Program

Dear Sir or Madam:

Subject: AMERGEN ENERGY COMPANY, LLC
OYSTER CREEK GENERATING STATION
NJPDES DSW PERMIT NO. NJ 0005550
BIOMONITORING REPORT- 2004

In accordance with Part IV-B/C of the above subject permit, please find enclosed two copies of the following forms for discharge points DSN001, DSN002, and DSN004 for 2004:

- NJPDES Biomonitoring Report Form - Acute Bioassays (Annual)

If you have any questions concerning this report, please do not hesitate to contact Mr. Malcolm Browne of our Chemistry/Radwaste Department at (609) 971-4124.

Very truly yours,

Michael J. Massaro

Michael J. Massaro
Plant Manager
Oyster Creek

MJM/MEB/dm
Attachment

cc: Geoffrey Pritchard
NJ Dept. of Environmental Protection
Central Bureau of Water Compliance & Enforcement
P.O. Box 407
Trenton, NJ 08625-0407

**Attachment 8-4**

**2003 Annual Radioactive Effluent Release Report Cover Letter**

AmerGen.
An Exelon Company

AmerGen Energy Company, LLC
Oyster Creek
US Route 9 South, P.O. Box 388
Forked River, NJ 08731-0388

www.exeloncorp.com

Technical Specification 6.9.1.e

April 29, 2004
2130-04-20096
2120-042-2823

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Oyster Creek Generating Station
Facility Operating License No. DPR-16
NRC Docket No. 50-219

Subject: Annual Radiological Environmental Operating Report - 2003

Enclosed is a copy of the Annual Radiological Environmental Operating Report for calendar year 2003, for the Oyster Creek Generating Station. This submittal is made in accordance with Oyster Creek Generating Station Technical Specification 6.9.1.e.

If any further information or assistance is needed, please contact David Fawcett at 609-971-4284.

Sincerely,

C. N. Swenson
Vice President, Oyster Creek Generating Station

CNS/DW/DIF
Enclosure

cc: H. J. Miller, Administrator, USNRC Region I
P. S. Tam, USNRC Senior Project Manager, Oyster Creek
R. J. Summers, USNRC Senior Resident Inspector, Oyster Creek
File No. 04004

IE25

NJ DEP, Land Use Regulation Program
June 15, 2005
Attachment

**Attachment 8-5**

**2004 Annual Radiological Environmental Operating Report Cover Letter**

**AmerGen**
An Exelon Company

AmerGen Energy Company, LLC
Oyster Creek
US Route 9 South, P.O. Box 388
Forked River, NJ 08731-0388
www.exeloncorp.com

Technical Specification 6.9.1.e

April 29, 2005
2130-05-20082
2120-052-2904

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

Oyster Creek Generating Station
Facility Operating License No. DPR-16
NRC Docket No. 50-219

Subject: Annual Radiological Environmental Operating Report - 2004

Enclosed is a copy of the Annual Radiological Environmental Operating Report for calendar year 2004, for the Oyster Creek Generating Station. This submittal is made in accordance with Oyster Creek Generating Station Technical Specification 6.9.1.e.

If any further information or assistance is needed, please contact David Fawcett at 609-971-4284.

Sincerely,

C. N. Swenson
Vice President, Oyster Creek Generating Station

CNS/DRW/DJF
Enclosure

cc: S. J. Colllins, Administrator, USNRC Region I
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*APPENDIX F*

# Severe Accident Mitigation Alternatives

*Oyster Creek Nuclear Generating Station*

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# Appendix F
# Severe Accident Mitigation Alternatives

This appendix outlines the general methodology for completing the Severe Accident Mitigation Alternatives (SAMA) evaluation in support of License Renewal and its implementation for Oyster Creek. The basis for the methodology comes from past SAMA submittals along with substantial input provided by NRC Requests for Additional Information (RAI).

The requirements for a SAMA evaluation are derived from the 1969 National Environmental Protection Act (NEPA) and the following Code of Federal Regulations (CFR):

- The environmental report must contain a consideration of alternatives to mitigate severe accidents "...if the staff has not previously considered severe accident mitigation alternatives for the applicant's plant in an environmental impact statement or related supplement or in an environmental assessment..." 10 CFR 51.53(c)(3)(ii)(L)
- "...The probability weighted consequences of atmospheric releases, fallout onto open bodies of water, releases to ground water, and societal and economic impacts from severe accidents are small for all plants. However, alternatives to mitigate severe accidents must be considered for all plants that have not considered such alternatives..." 10 CFR 51, Subpart A, Appendix B, Table B-1, Issue 76

The severe accident mitigation alternatives (SAMA) analysis discussed in 4.20 is presented below.

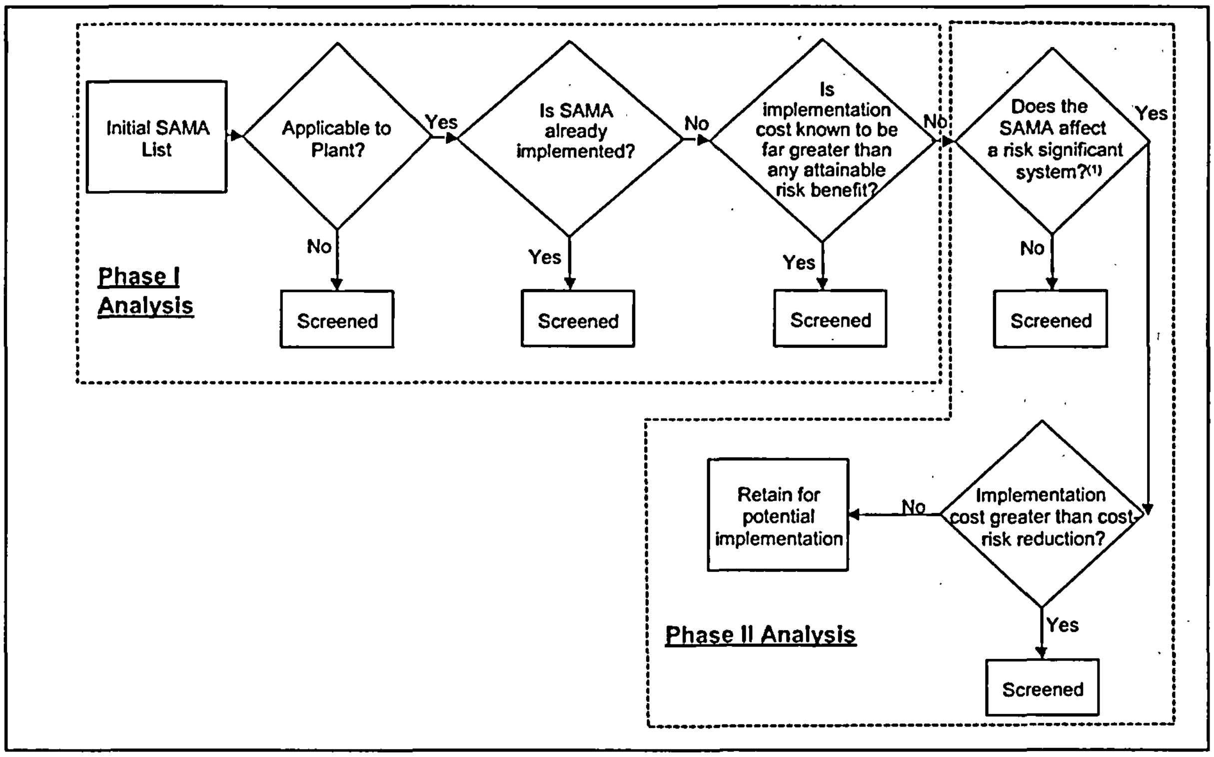
# F.1 Methodology

The methodology selected for this analysis involves identifying SAMA candidates that have the potential for reducing core damage frequency and person-rem and determining whether or not the implementation of those mitigation candidates is beneficial on a cost-risk reduction basis compared with implementation costs. This process consists of the following steps:

- **Oyster Creek Probabilistic Risk Assessment (PRA) Model** – Use the Oyster Creek Internal Events PRA model as the basis for the analysis. Incorporate External Events contributions using IPEEE Submittal [F-22] (Section F.2).
- **Level 3 PRA Analysis** – Use Oyster Creek Level 1 and 2 Internal Events PRA output and site-specific meteorology, demographic, land use, and emergency response data as input in performing a Level 3 probabilistic safety assessment (PRA) using the MELCOR Accident Consequences Code System Version 2 (MACCS2) (Section F.3).
- **Baseline Risk Monetization** – Use NRC regulatory analysis techniques, calculate the monetary value of the unmitigated Oyster Creek severe accident risk. This becomes the maximum averted cost-risk that is possible (Section F.4).
- **Phase I SAMA Analysis** – Identify potential SAMA candidates based on the Oyster Creek PRA, IPEEE, plant specific aging issues, and documentation from the industry and the NRC. Screen out Phase I SAMA candidates that are not applicable to the Oyster Creek design or are of low benefit in boiling water reactors (BWRs) such as Oyster Creek, candidates that have already been implemented at Oyster Creek or whose benefits have been achieved at Oyster Creek using other means, and candidates whose estimated cost exceeds the maximum possible averted cost-risk (Section F.5).
- **Phase II SAMA Analysis** – Calculate the risk reduction attributable to each remaining SAMA candidate and compare to a more detailed cost analysis to identify any net cost benefit. Probabilistic risk assessment (PRA) insights are also used to screen SAMA candidates in this phase (Section F.6).
- **Sensitivity Analysis** – Evaluate how changes in the SAMA analysis assumptions might affect the cost/benefit evaluation (Section F.7).
- **Conclusions** – Summarize results and identify conclusions. In addition, list plant modifications and procedural changes (if any) that have or will be implemented to reduce the severe accident dose consequence risk (Section F.8).

The steps outlined above are described in more detail in the subsections of this appendix. Figure F-1 provides a graphical representation of the SAMA process.

**Figure F-1. SAMA Screening Process**




(1) Risk significant system in this analysis is any system, structure, or component with a risk reduction worth (RRW) greater than 1.01.

## F.1.1 OYSTER CREEK SPECIFIC SAMA

One of the initial steps in the SAMA process is to identify practical physical plant modifications and plant procedural and administrative changes that can reduce severe accident dose consequence risk. For each modification or change, estimate the approximate reduction in risk.

The initial list of SAMA candidates for Oyster Creek was developed from a combination of resources. These include the following:

- Oyster Creek PRA results [F-25]
- Industry Phase II SAMAs [F-6, F-7, F-8, F-11, F-13]
- Oyster Creek IPEEE [F-22]
- NUREG-1742 [F-45]
- Aging Issues[1]

These resources are judged to provide a list of potential plant changes that are most applicable and most likely to yield potential candidates that reduce risk in a cost-effective manner for Oyster Creek.

The emphasis in the SAMA evaluation process has been on ensuring that Oyster Creek specific plant features are assessed using the available Oyster Creek PRA tools. This is judged to be the most appropriate source of potential SAMA items. Generic lists of SAMAs are also reviewed to ensure that proper attention is given to useful SAMAs identified at similar BWRs. The details of the SAMA identification process are provided in Section F.5.1.

(1) The License Renewal process includes an extensive process for assessing the aging effects on the plant and providing adequate methods for addressing them.

## F.1.2 QUANTITATIVE STRATEGY FOR EXTERNAL EVENT ASSESSMENT

External events have been identified by the nuclear industry as small, but non-negligible contributors to plant risk. (See Addendum FA.) The following summary is excerpted from NUREG-1437 (as noted in Addendum FA):

> *"..., the commission concludes that the risk from sabotage and beyond design basis earthquakes at existing nuclear power plants is small and additionally, that the risks from other external events, are adequately addressed by a generic consideration of internally initiated severe accidents."*

While the focus of nuclear PRA applications has typically been on internal events models, efforts have been made to expand the types of PRA insights used in the SAMA analysis to include external events issues.

The Oyster Creek Individual Plant External Events Examination (IPEEE) [F-22] has not been maintained as a "living" analysis. The documentation and results are limited to what was produced during the performance of the Individual Plant External Events Examination (IPEEE). As a result, any qualitative insights or quantitative estimates related to external events used in the SAMA analysis is usually extrapolated from outdated information.

Another disadvantage of not maintaining a living external events model is that the latest PRA techniques and plant changes are not incorporated into the available results. On a larger scale, given that the industry has generally not pursued external events modeling at a level consistent with internal events models, the technology for external events analysis is not as robust or refined. The result is that the core damage frequencies calculated for the internal and external events models are not necessarily comparable. External events models are considered to be useful tools for identifying important accident sequences and mitigative equipment, but the quantitative results should not be directly compared with those from the internal events models. In this analysis, External Events contributions are estimated for the reasons described above.

Recognizing the need: (1) to include SAMAs specifically addressing external events; and, (2) to address the impacts of all SAMAs on the external event risk profile, a multi-prong approach is implemented for Oyster Creek. This multi-prong approach consists of the following:

- Step 1: Make use of the up-to-date and operational PRA logic models that encompass internal events and internal floods and which have been constructed using the ASME PRA Standard Supporting Requirements.

- Step 2: Recognize that external events contribute additional risk to plant operation that must be accounted for.

- Step 3: Approximate the quantitative measure of the external event risk, even if it has a conservative bias.

- Step 4: Ensure that the conservatively biased external event risk does not unduly bias the value impact assessment of any SAMAs.

- Step 5: Derive plant specific SAMAs to address external event risk directly from the IPEEE submittal, the NRC SER on IPEEE, and NUREG-1742.

- Step 6: Evaluate the external event SAMA risk reduction with the most appropriate risk tool available.

Implementation of this strategy has taken the following form:

Step 1: The available PRA logic model is used in the SAMA evaluations to reflect the current PRA plant configuration, procedures, data, and operating philosophy. See Section F.2.

Steps 2 & 3: The external events risk has been conservatively quantified in the IPEEE submittal as revised through interactions with the NRC and documented in RAI responses and the NRC SER. This quantification of approximately ten years ago is as follows:

| Contributor | Frequency (per/yr) |
|---|---|
| Fire | 1.9E-5 |
| Seismic | 4.7E-6 |
| Total | 2.4E-5 |

This ten year old estimate is judged to be conservatively biased because of older fire initiating event data, the EPRI FIVE methodology, and the lack of credit for effective fire suppression.

Steps 4: The conservative CDF for external events is a factor of 2.3 times the internal events CDF. Considering that this is a conservative characterization of the CDF and that any SAMA impact derived for internal events will, in general, have a smaller relative impact on the external event risk profile. It is judged that a doubling of the internal events CDF is a realistic method of providing a surrogate risk measure that can be used in cost benefit analysis[(1)] for those SAMAs aimed primarily at internal event risk contributors.[(2)]

Step 5: The SAMAs that influence the external event risk profile are identified from the IPEEE, NUREG-1742, and the NRC SER on the IPEEE. These SAMAs are added to the list of SAMAs. See Section F.2.3.

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(1) A SAMA derived to address the internal events risk profile will, in general, have a less profound impact on the external event risk profile. By assuming a one-to-one correspondence, the benefit to be obtained from the SAMA will be overestimated. This could falsely indicate a net value where it is only a reflection of the "conservative" bias. To avoid this trap, a multiplier of two on the internal events CDF is used to characterize the portion of the external event risk spectrum that could reasonably be affected by internal events related SAMAs.

(2) While a SAMA may be derived based on internal event risk contributors, it is recognized that it may also be at least partially beneficial in external event accident mitigation. Therefore, the use of a surrogate risk measure is desired.

Step 6: All SAMAs are evaluated for their risk reduction using the best available risk model. For most SAMAs, the internal events logic model (including internal floods) is used with the averted cost risk doubled to account for potential impacts on the external event risk profile.[2]

For external event SAMAs, the CDF and radionuclide releases are explicitly quantified using the best available characterization of the CDF and radionuclide release impact. The existing IPEEE results are used to estimate the external event risk contribution that could be eliminated if the SAMA is implemented. This evaluation process is supplemented by available insights as a result of Oyster Creek's continuing risk management program which includes initial efforts to update the fire PRA.[1]

In summary, in order to account for the external events contributions in the SAMA analysis, a two stage process has been implemented to provide estimates of the averted cost-risk based on external events accidents.

The first stage is used in the Phase I analysis and is based on the assumption that the risk posed by external and internal events is approximately equivalent. Given that the risk is assumed to be equal, the maximum averted cost-risk calculated for the internal events model has been doubled to account for external events contributions. This total is referred to as the "modified maximum averted cost-risk" or MMACR. The MMACR is used in the Phase I screening process to identify and screen SAMAs that could not be cost beneficial even if all risk related to power operations was eliminated. These are the SAMAs with costs of implementation that are greater than the MMACR.

The second stage of the strategy is used in the Phase II analysis and uses the assumption that the external events component of the averted cost-risk for a given SAMA is equivalent to the averted cost-risk based on internal events. This requires that any averted cost-risk calculated for a SAMA be multiplied by two to approximate the corresponding external event averted cost-risk. For some specific cases where only external events are affected, the averted cost-risk is explicitly calculated rather than using the factor of two assumption.

(1) Analysis in Section F.6 of SAMAs 124 and 125 are examples of the external event SAMA evaluation process using available logic models and the latest information.

# F.2 Oyster Creek PRA Model

The 2004B Oyster Creek Level 1 and Level 2 Probabilistic Risk Assessment (PRA) is used as the basis for the SAMA analysis. In this version of the PRA, the base Core Damage Frequency (CDF) is $1.05 \times 10^{-5}$ events per year and the Large Early Release Frequency (LERF) is $5.80 \times 10^{-7}$ events per year [F-25]. As a result of the Oyster Creek PRA maintenance process, the model has evolved since the submittal of the IPE. This section provides an overview of the model changes since the IPE, the current risk profiles, and the model review history.

The following subsections are provided to address these topics:

- PRA Model changes since the IPE Submittal (Section F.2.1)
- Current Level 1 Oyster Creek PRA model (Section F.2.2)
- External Events Modeling (Section F.2.3)
- Current Level 2 Oyster Creek PRA model (Section F.2.4)
- PRA model review summary (Section F.2.5)

## F.2.1 PRA MODEL CHANGES SINCE IPE SUBMITTAL

The internal events PRA used for the SAMA evaluation is based on an updated version of the PRA used for the IPE (1992). The PRA model was updated in 1998 (partial update), 2001, and 2004.

The 2004B update to the Oyster Creek PRA is the most recent evaluation of the risk profile at Oyster Creek for internal event challenges. It is a regular scheduled update, in accordance with AmerGen internal guidance, ER-AA-600-1015, "FPIE PRA Model Update." There have been a series of probabilistic evaluations beginning with the Individual Plant Examination (IPE) issued in 1992 as requested by the NRC in Generic Letter 88-20. These probabilistic evaluations and their associated risk metrics can be summarized as follows:

| Model | Date | CDF (Per Yr) | LERF (Per Yr) |
|---|---|---|---|
| • IPE | 8/92 | 3.69E-06 | 5.8E-07[1] |
| • Revision 2001A | 1/02 | 6.27E-06 | 1.2E-06[2] |
| • Revision 2004B | 3/05 | 1.05E-05 | 5.8E-07 |

The major differences in the PRA model between the original IPE and the PRA updates through the current update are the following:

- 2001 PRA update included:
    - Resolution of Oyster Creek PRA Peer Review comments
    - Update and inclusion of Internal Flooding in Base PRA internal events model
    - Data update
    - Level 2 re-assessment with a simplified LERF model
- 2004 PRA update included:
    - Conversion of the software platform from RISKMAN to CAFTA
    - Revised component failure data including extensive use of plant-specific component failure data gathered from the Oyster Creek Maintenance Rule program
    - Revised initiating events data utilizing the latest Oyster Creek operating experience (Includes the addition of AC and DC bus failure initiating events)
    - Addition of AC and DC initiating events
    - Added alternate configuration logic for all systems with alternate / standby trains
    - Extensive HRA re-assessment based on operating crew interviews using the latest EOPs and support procedures

(1) P. 8-4 of IPE, large early is 15.8% of CDF.
(2) March 2003 for simplified LERF model which conservatively included releases in the High/Early (LERF) category.

- Incorporation of dependent HEP evaluation
- Addition of Pre-Initiating Human Error Events into the model
- Use of MAAP 4.0.5 deterministic calculations to support the success criteria and HRA calculations
- Maintenance unavailability data based on the most recent plant operating experience
- Bayesian updated initiating event frequencies utilizing Oyster Creek most recent operating experience
- Individual component random failure probabilities Bayesian updated (as applicable) based upon the most recent plant specific data
- Addition of more detailed modeling of extreme weather and its impact on offsite AC power, the Combustion Turbine Building, and the Diesel Fire Pump Building.
- Common cause failure (CCF) calculations revised to incorporate the updated individual random basic event probabilities and the most up to date Alpha parameters from NUREG/CR-5497 and NUREG/CR-5485
- Revised LOOP analysis for initiating event frequencies and non-recovery probabilities including the 2003 Northeast Blackout
- Revised mechanical and electrical ATWS probabilities, based on information in NUREG/CR-5500
- Self-Assessment against the ASME PRA Standard
- Addition of recirculation pump seal leakage scenarios
- More detailed ATWS analysis
- Development of a time phase SBO model
- The LERF model was upgraded to a full Level 2 model with a spectrum of possible radionuclide releases to support license extension calculations for SAMA and eliminate conservative bias

## F.2.2 CURRENT LEVEL 1 INTERNAL EVENTS PRA MODEL

The results reported for the 2004B PRA model [F-25] indicate that the CDF is $1.05 \times 10^{-5}$ per year. The remainder of this section provides a summary of the 2004B model results.

<u>Results Summary:</u>

The functional accident classes (Level 1 end states) and the contribution of each to CDF are summarized in Table F-1 for the average maintenance model.

The 2004B PRA average maintenance model includes 57 initiating events (truncated at 1E-11 per year). Figure F-2 summarizes this information, which identifies the initiating event and its percent contribution to the CDF.

Figure F-3a summarizes the ten most risk significant systems, based on the increase in core damage frequency if each system were unavailable to perform its function. This measure of risk significance is the risk achievement worth (RAW). It is the ratio of CDF with the system failed to the nominal CDF value. For example, if a system has a risk achievement worth of 3, then the CDF increases by a factor of 3 when the system is unavailable.

Figure F-3b summarizes the ten most risk significant systems, based on the Fussell-Vesely (FV) importance measure. The FV importance measure represents the frequency of cutsets with the system failed divided by the frequency of all cutsets for the CDF risk metric.

Level 2 PRA results for the 2004B model are also provided here as key inputs to the Level 3 consequence calculations as follows:

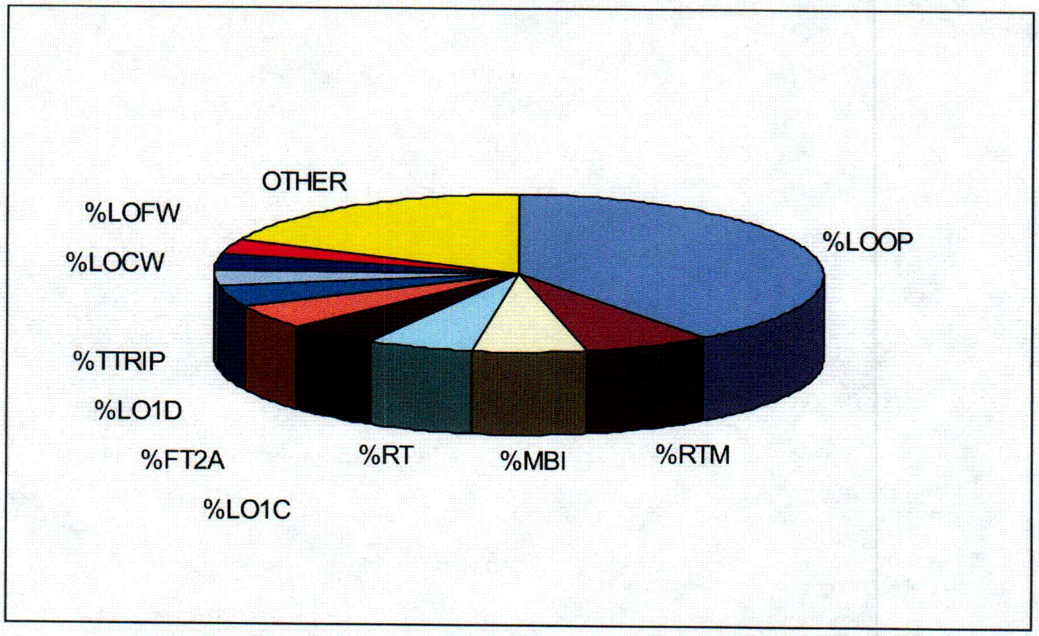
- Section F.2.4.3 provides the Level 2 PRA radionuclide release categories and their frequencies.
- Section F.2.4.4 provides the radionuclide source terms for impact to the consequence code, MACCS.

**Table F-1 Accident Class Distribution Table (2004B PRA Model)**

| Class | Description | Frequency (per year) | Percent of Total |
|---|---|---|---|
| IA (Early) | Transient leading to core damage with reactor at high pressure (early) | 1.51E-06 | 14.4% |
| IA (Late) | Transient leading to core damage with reactor at high pressure (late) | 1.06E-6 | 10.1% |
| IBE | SBO leading to early core damage (less than 4 hours) | 3.86E-06 | 36.8% |
| IBL | SBO leading to late core damage (4 hours or longer) | 6.15E-07 | 5.9% |
| IC | ATWS leading to core damage in an intact containment (Included in IA-Early) | -- | -- |
| ID | Transient leading to core damage with reactor at low pressure | 1.66E-07 | 1.6% |
| II | Loss of containment heat removal and core damage induced post containment failure (transient/small LOCA model) | 1.65E-06 | 15.7% |
| IIIB | LOCA leading to core damage with the reactor at high pressure | 9.19E-07 | 8.8% |
| IIIC | LOCA leading to core damage with the reactor at low pressure | 4.81E-07 | 4.6% |
| IIID | LOCA with vapor suppression failure | 2.08E-08 | 0.2% |
| IV | Reactor power control failure in the transient model challenges containment and induces core damage post containment failure. | 1.81E-07 | 1.7% |
| V | LOCA bypassing containment leading to core damage | 3.23E-08 | 0.3% |
| | Total | 1.05E-05 | |

**Figure F-2 Oyster Creek Contribution to CDF by Initiator (2004B Model)**

| Event Name | Description | % of CDF |
|---|---|---|
| %LOOP | LOSS OF OFFSITE POWER INITIATING EVENT | 39.8% |
| %RTM | MANUAL SHUTDOWNS | 6.5% |
| %MBI | MEDIUM LOCA - BELOW CORE INSIDE DRYWELL | 6.2% |
| %RT | REACTOR TRIP | 5.5% |
| %LO1C | LOSS OF 4160 VAC BUS 1C | 5.0% |
| %FT2A | COND BAY AREA FEEDWATER FLOOD | 4.7% |
| %LO1D | LOSS OF 4160 VAC BUS 1D | 4.3% |
| %TTRIP | TURBINE TRIP | 3.3% |
| %LOCW | LOSS OF CIRCULATING WATER | 3.3% |
| %LOFW | LOSS OF FEEDWATER | 3.2% |
| OTHER | REMAINING INITIATING EVENTS | 18.2% |




Notes:

(1) % of CDF is the Fussell-Vesely (FV) importance value for each initiator.

(2) The total contribution to CDF from %LOOP initiator and the conditional LOOP given a LOCA or transient is 42%.



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**Figure F-3a System RAW Ranking (CDF) (Model 2004B)**

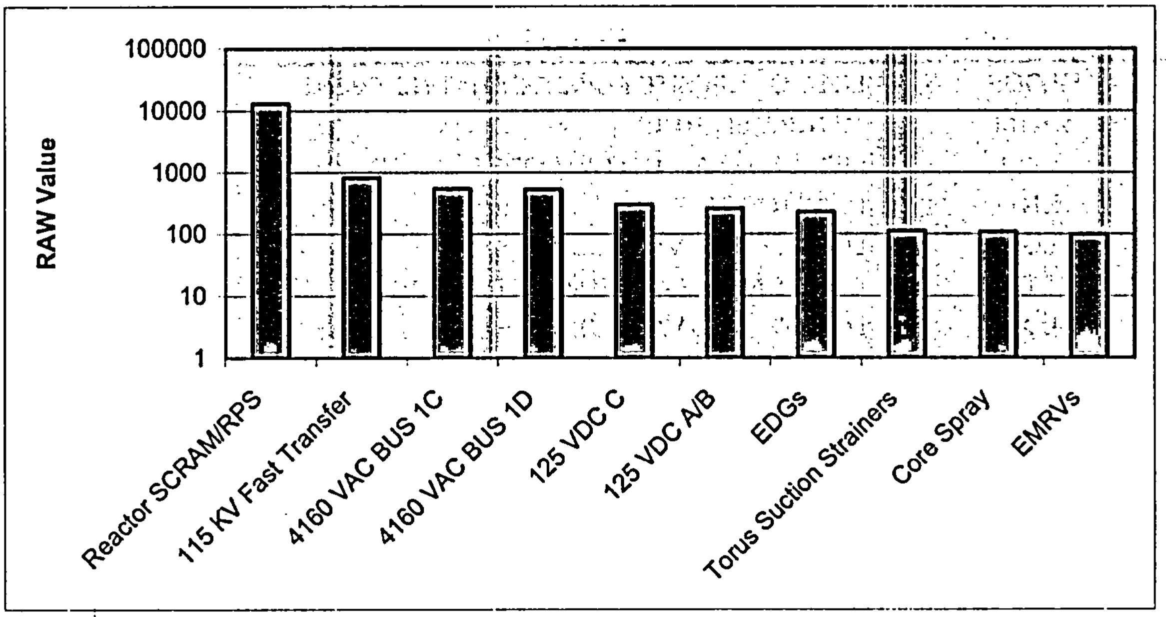
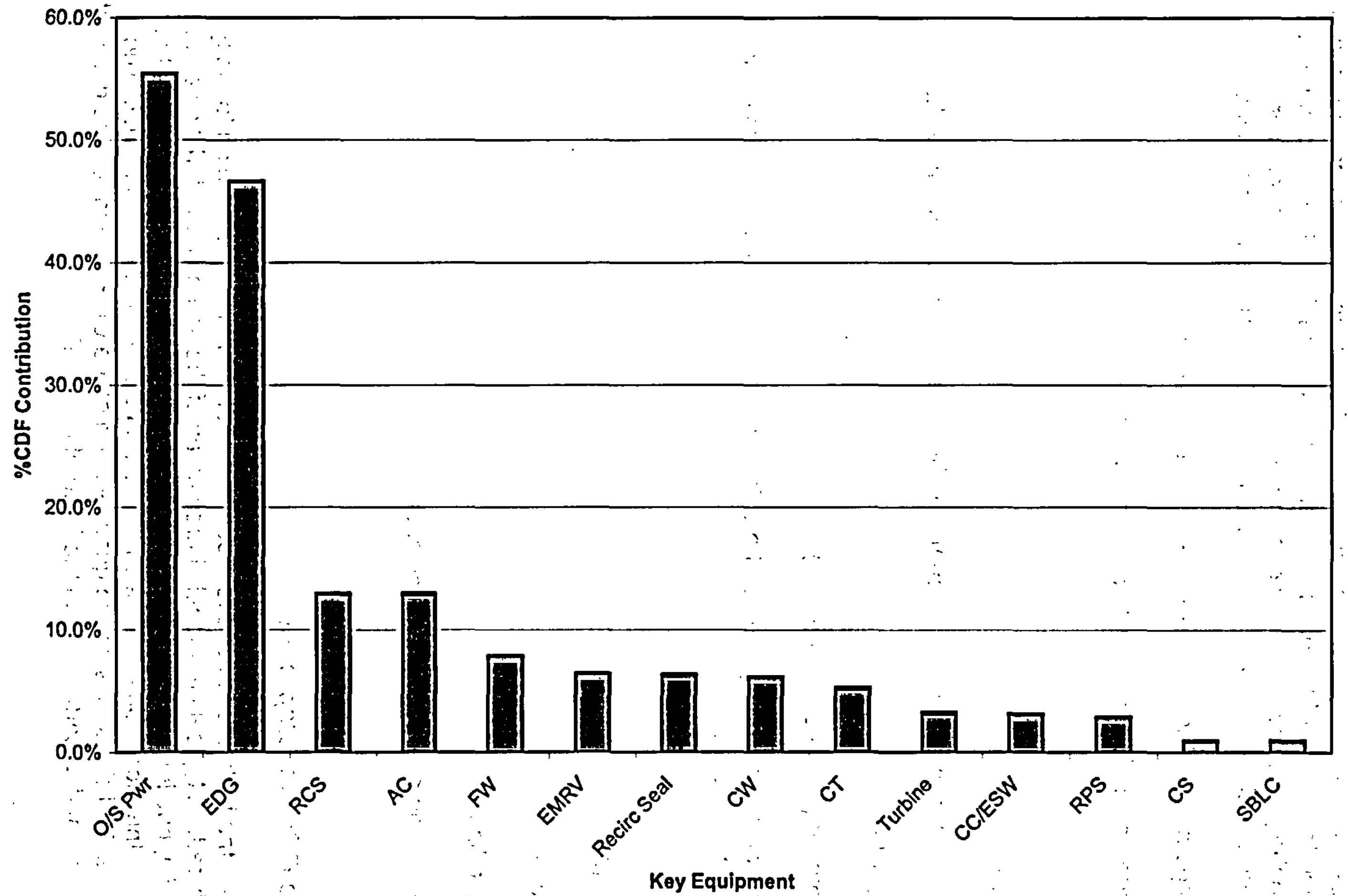


**Figure F-3b. System Fussell-Vesely Ranking (Model 2004B)**



## F.2.3 EXTERNAL EVENTS MODELING

The IPEEE was used in the Oyster Creek SAMA analysis primarily to identify the highest risk accident sequences and the potential means of reducing the risk posed by those sequences. The IPEEE identified that some of the external events that were reviewed were screened based on inapplicability to the plant, low frequency of occurrence, or because the events or consequences of the events are already addressed by the PRA. These events include:

- Severe temperature transients (extreme heat, extreme cold)
- Severe storm (ice, hail, snow, dust, and sand storms)
- Lightning
- External Fires
- Extraterrestrial Activity (meteors, man-made objects entering earth's atmosphere)
- Volcanic activity
- Earth movement (avalanche, landslide)

After the elimination of the preceding events, the external events requiring further investigation at Oyster Creek were limited to:

- Internal Fires
- Seismic events
- High wind events
- External Flooding
- Transportation and nearby facility accidents

### F.2.3.1 Fires

*Overview of Fire PRA Development*

As discussed above, the techniques used to model external events vary according to the type of initiator being analyzed. A typical fire model shares many of the same characteristics as the internal events model, but limitations on the state of technology may produce results that are significantly biased in the more conservative direction than the internal events model. The following summarizes fire PRA topics where quantification of the CDF may introduce different levels of modeling bias and uncertainty than the internal events PRA.

General Fire Model Limitations

Fire PRAs are useful tools to identify design or procedural items that could be clear areas of focus for improving the safety of the plant. Fire PRAs use a structure and quantification technique similar to that used in the internal events PRA.

Since less industry resources and standards development have historically been accorded to fire PRAs, conservative modeling is common in a number of areas of the fire analysis to provide a "bounding" methodology for fires. This concept is contrary to the base internal events PRA which has had more analytical development and is judged to be closer to a realistic assessment (i.e., best estimate) of the plant.

There are a number of fire PRA topics involving technical inputs, data, and modeling that prevent the effective comparison of the calculated core damage frequency figure of merit between the internal events PRA and the fire PRA. These areas are identified as follows:

| | |
|---|---|
| Initiating Events: | The frequency of fires and their severity are generally conservatively overestimated. A revised NRC fire events database indicates the trend toward lower frequency and less severe fires. This trend reflects the improved housekeeping, reduction in transient fire hazards, and other improved fire protection steps at utilities. |
| System Response: | Fire protection measures such as sprinklers, $CO_2$ and fire brigades may be given minimal (conservative) credit in their ability to limit the spread of a fire.<br><br>Cable routings are typically characterized conservatively because of the lack of data regarding the routing of cables or the lack of the analytic modeling to represent the different routings. This leads to limited credit for balance of plant systems that are extremely important in CDF mitigation. |
| Sequences: | Sequences may subsume a number of fire scenarios to reduce the analytic burden. The subsuming of initiators and sequences is done to envelope those sequences included. This results in additional conservatism. |
| Fire Modeling: | Fire damage and fire spread are conservatively characterized. Fire modeling presents bounding approaches regarding the immediate effects of a fire (e.g., all cables in a tray are always failed for a cable tray fire) and fire propagation. |
| HRA: | There is little industry experience with crew actions under conditions of the types of fires modeled in fire PRAs. This has led to conservative characterization of crew actions in fire PRAs. Because the CDF is strongly correlated with crew actions, this conservatism has a profound effect on the calculated fire PRA results. |
| Level of Detail: | The fire PRAs may have reduced level of detail in the mitigation of the initiating event and consequential system damage. |

| | |
|---|---|
| Quality of Model: | The peer review process for fire PRAs is less well developed than for internal events PRAs. For example, no industry standard, such as NEI-00-02, exists for the structured peer review of a fire PRA. This may lead to less assurance of the realism of the model. |

### *Overview of Oyster Creek Fire PRA Development*

A Modified EPRI Fire Induced Vulnerability Evaluation (FIVE) assessment was developed for the IPEEE. A probabilistic process, based on the FIVE Methodology, was employed to evaluate plant fire areas. Fire areas were reviewed in progressive detail and once an area was shown to contribute less than 1E-6/yr to total core damage frequency, it was screened from further analysis. In addition, areas that were retained included significant conservatisms. Due to this approach, the IPEEE cannot be used to estimate a total fire CDF comparable to that used in the internal events portion of the PRA. Noting that probabilistic values in the Fire IPEEE are considered upper bound values due to conservatism and level of detail in the analysis, the IPEEE reports a core damage frequency of 7.7E-6/yr. The NRC notes that this value was revised to 1.9E-5/yr in their SER [F-36].

Areas that required detailed analysis are presumed to be those with the greatest risk significance. The detailed fire analysis included a probabilistic treatment of fire severity, fire detection and suppression, growth and propagation as well as equipment impacts. Seven fire areas required detailed analysis. These areas were:

- Reactor Building 51' Elevation (RB-FZ-1D)
- Reactor Building Main Floor – 23' Elevation (RB-FZ-1E)
- Cable Spreading Room – 36' Elevation (OB-FZ-1E)
- Control Room – 46'6" Elevation (OB-FZ-5)
- "A" 480 VAC Switchgear Room (OB-FZ-6A)
- A and B Battery Room, Tunnel and Electric Tray Room – 35' Elevation (OB-FZ-8C)
- Turbine Building Basement (TB-FZ-11D)
- Battery Room South of 4160 VAC Switchgear (TB-FA-26)

Of these areas, two could not be screened within the IPEEE analysis:

- Cable Spreading Room – 36' Elevation (OB-FZ-1E)
- "A" 480 VAC Switchgear Room (OB-FZ-6A)

The IPEEE report notes that these unscreened areas contribute 62.6% of fire CDF. Relative to potential SAMA, the IPEEE does not provide information regarding specific improvements to reduce risk related to these areas. However, AmerGen has reviewed these results for the purpose of the SAMA evaluation. Based on this review of the Oyster Creek fire IPEEE results, the following SAMAs have been identified for inclusion on the SAMA list:

- SAMA 116 – Transient Combustible housekeeping
- SAMA 122 – Consider training operations and fire brigade to cope with fire scenarios
- SAMA 125 – Reduce fire impact in dominant fire areas

#### F.2.3.2 Seismic

A seismic PRA (SPRA) was performed for the Oyster Creek IPEEE. The overall approach in performing a seismic PRA consists of a seven step process:

Step 1: Determination of site specific seismicity characteristics. This step involves the development of the frequencies of occurrence and magnitude of seismic events for the site. Site structure analysis, including block wall evaluation, and soil liquefaction assessments have also been performed. The resulting frequencies and magnitudes of seismic events are the initiating events for the SPRA. EPRI Seismic Hazard Curves [F-24] are used to establish the initiating event frequency. Site structure responses are input into step 5 where the capacity of components which impact risk are calculated.

Step 2: Identification of those components important to plant safety, including equipment, structures and procedures. The original Level 1 PRA developed for Oyster Creek was utilized to determine those components which impact risk. Other studies such as the A-46 Safe Shutdown Equipment List (SSEL) as well as a qualitative review of systems, structures and components which may impact the probability of core damage due to seismic initiators were also used to ensure that the list of components which impact risk is comprehensive.

Step 3: An initial plant walkdown of the identified systems and components has been performed, and any plant seismic system interactions and unique plant features which may impact risk were identified.

Step 4: Develop plant logic models. The plant logic models were developed using the Level 1 Oyster Creek PRA with the addition of the failure rates of components due to seismically initiated events. The Level 1 model was modified to ensure that the independent as well as seismic failures are accounted for in the logic model.

Step 5: A second plant walkdown was performed to verify plant models and to collect data to determine component capacities. Fragility curves which plot the peak ground acceleration at which the component is expected to fail have been developed primarily from analysis and engineering judgment, supported by limited test data. This evaluation included the assessment of essential relays.

Step 6: Analyze the plant models to determine seismic initiated accident sequences and their frequency. This step involved the assembly and quantification of the plant logic models as well as the reporting and analyzing of the results.

Step 7: Identify plant seismic vulnerabilities. This step defined any site specific vulnerabilities which are discovered as a result of the performance of the study.

Results from the SPRA show a seismic CDF of 4.7E-6/yr. Since the IPEEE model was modified significantly as part of the NRC review process, the model outlined in the NRC SER [F-36] is described here.

The top ten seismic scenarios are summarized below where the seismic initiating events have been binned into four categories of increasing seismic magnitude (SEISI to 4):

- Sequence 1 is defined by the seismic failure of the turbine building following a SEIS2 initiating event. This sequence contributes 19%. (See also sequence number 22.)

- Sequence 2 is defined by the seismic failure of the turbine building following a SEIS4 initiating event. This sequence contributes 14%. (See also sequence number 4.)

- Sequence 3 is defined by the seismic failure of the turbine building following a SEIS3 initiating event. This sequence contributes 13%. (See also sequence number 10.)

- Sequence 4 is defined by the seismic failure of the turbine building following a SEIS4 initiating event and the failure of the recirculation pump supports. This sequence is non-minimal since the failure of the turbine building is assumed to result in core damage. This sequence contributes 7%. (See also sequence number 2.)

- Sequence 5 is defined by the seismic failure of the turbine building following a SEIS2 initiating event. This sequence contributes 6%.

- Sequence 6 is defined by the seismic failure of the turbine building following a SEIS1 initiating event. This sequence contributes 3%.

- Sequence 7 is defined by the seismic failure of the turbine building following a SEIS3 initiating event. This sequence contributes 6%. (See also sequence number 21.)

- Sequence 8 is defined by the seismic failure of the turbine building following a SEIS4 initiating event. This sequence contributes 6%. (See also sequence number 14.)

- Sequence 9 is defined by the independent failure of the EMRVs to reclose following initial post trip pressure relief followed by the independent failure of the core spray system following a SEIS1 initiating event. This sequence is the first independent failure scenario. Since main feedwater is assumed failed in seismic events and fire protection is not modeled as providing vessel inventory in seismic events, core damage results. This sequence contributes 1.6% to the seismic core damage frequency.

- Sequence 10 is defined by the seismic failure of the turbine building and the recirculation pump supports following a SEIS3 initiating event. This sequence is non-minimal since core damage is assumed following the failure of the turbine building. This sequence contributes 1.5% to the seismic core damage frequency. (See also sequence number 3.)

Table F-2 shows the contribution from the top seismic related failures and Table F-3 shows the top fragilities within the seismic sequences.

**Table F-2 Contribution of the Top Ten Seismic Model Failures**

| No. | Top Event | Fussell-Vesely | Risk Achievement Worth | Risk Reduction | Top Event Description |
|---|---|---|---|---|---|
| 1 | TZ | 3.54E-01 | 1.57E+03 | 6.46E-01 | Seismic Turbine Building Failure |
| 2 | RZ | 9.69E-02 | 1.57E+03 | 9.03E-01 | Seismic Reactor Building Failure |
| 3 | EW | 8.61E-02 | 1.63E+00 | 9.14E-01 | Seismic 4160 VAC 1C Failure |
| 4 | MU | 6.56E-02 | 1.63E+00 | 9.34E-01 | Independent Iso Cond Makeup Failure |
| 5 | SX | 5.48E-02 | 1.34E+00 | 9.45E-01 | Seismic Condensate Tank Failure |
| 6 | XX | 5.34E-02 | 1.05E+00 | 9.47E-01 | Seismic Long Term 125 VDC B Failure |
| 7 | IY | 5.12E-02 | 4.48E+00 | 9.49E-01 | Seismic Failure of Offsite Pwr Recovery |
| 8 | VR | 4.40E-02 | 1.66E+00 | 9.56E-01 | Indep Failure of EMRVs to Reclose |
| 9 | FX | 3.55E-02 | 1.89E+00 | 9.65E-01 | Seismic Fire Protection Failure |
| 10 | OX | 3.42E-02 | 1.32E+00 | 9.66E-01 | Seismic Offsite Power Failure |

**Table F-3 Contribution of Top Fragilities in Seismic Scenarios**

| Fragility ID | Top Event | Fussell-Vesely | Risk Achievement Worth | Risk Reduction | 10% Median Acceleration Decrease | Top Event Description |
|---|---|---|---|---|---|---|
| FRAG39 | TZ | 2.97E-01 | 1.57E+03 | 7.03E-01 | 1.14E+00 | Turbine Building – column |
| FRAG37 | RZ | 9.64E-02 | 1.57E+03 | 9.04E-01 | 1.05E+00 | Reactor Building - column |
| FRAG05 | EW | 8.61E-02 | 1.63E+00 | 9.14E-01 | 1.02E+00 | Switchgear room fan |
| FRAG10 | SX | 5.48E-02 | 1.34E+00 | 9.45E-01 | 1.01E+00 | Condensate storage tank |
| FRAG04 | XX | 5.34E-02 | 1.05E+00 | 9.47E-01 | 1.01E+00 | Battery room fans |
| FRAG18 | IY | 5.12E-02 | 4.48E+00 | 9.49E-01 | 1.02E+00 | Isolation condenser |
| FRAG38 | TZ | 4.11E-02 | 1.57E+03 | 9.59E-01 | 1.04E+00 | Turbine building – shear |
| FRAG00 | FX | 3.55E-02 | 1.89E+00 | 9.65E-01 | 1.01E+00 | Generic fragility for others |
| FRAG01 | OX | 3.42E-02 | 1.32E+00 | 9.66E-01 | 1.00E+00 | Offsite power |
| FRAG00 | RX | 3.27E-02 | 2.80E+00 | 9.67E-01 | 1.01E+00 | Generic fragility for others |

Based on a review of the IPEEE seismic results and NUREG-1742, the following SAMAs have been identified for inclusion on the SAMA list:

- SAMA 21 – Increase seismic ruggedness of plant components (the specific components to be investigated are listed under the individual SAMAs listed below)
- SAMA 67 – Safety related condensate storage tank
- SAMA 114 – Check bolt tightness on CT Fin-Fan Coolers
- SAMA 115 – Consider battery spacers for CT battery compartments
- SAMA 117 – Consider upgrading high pressure CO2 cylinders in turbine building; potential missiles

- SAMA 118 – Consider additional support for oil filter on turbine generator hydrogen seal oil unit
- SAMA 119 – Review anchorage for Arrowhead demineralizer trailer. Walkdown issue apparently related to seismic housekeeping
- SAMA 120 – Consider upgrading high pressure CO2 rack in turbine building; potential missiles
- SAMA 121 – Consider replacing fire protection deluge valves that can be spuriously actuated in a seismic event
- SAMA 123 – Consider replacing relays that had chatter <0.3g
- SAMA 124 – Consider reinforcement for Block Wall 53

### F.2.3.3 Other External Events

For the high winds, floods, transportation, and nearby facility accidents, hereafter referred to as "other hazards", portion of the Oyster Creek IPEEE, the methodology outlined in NUREG-1407 [F-26] was used. This methodology is best described as a progressive screening approach. In this approach, each issue is evaluated in greater detail for each subsequent step of the analysis until it can be shown to be either low risk or a vulnerability. For each type of potential hazard, the evaluation requires, at a minimum, a review of the plant relative to the hazard, a review of changes since the issuance of the plant's operating license (OL), and a review of the plant against the 1975 Standard Review Plant (SRP) [F-27]. Per NUREG-1407, the scope of the analysis includes high winds, external flooding, and transportation and nearby facility accidents. These events are discussed in the following sections.

Overall, the analysis breaks down into eight tasks, the first three of which were summarized in the above paragraph. Task 1 requires the analyst to review available information regarding the plant design and licensing basis relative to the hazard under evaluation. Task 2 requires the analyst to extend the set of information above by considering changes since the issuance of the plant's OL. Specifically, the review should evaluate changes with respect to military and industrial facilities within 5 miles (~8 km) of the plant, onsite storage or other activities involving hazardous materials, transportation, and development that could affect the original design conditions. In addition, a plant walk-down is performed to identify any additional relevant information. In Task 3, the analyst reviews the information obtained above relative to 1975 SRP criteria. If the plant conforms to the 1975 SRP criteria and no potential vulnerabilities are identified in Task 2, the hazard is screened and is considered to pose a negligible risk.

If the hazard is not screened based on SRP criteria, then three types of detailed analysis are considered. If the hazard can be screened by any of the three detailed analysis approaches, then it is considered a negligible risk.

The three detailed analyses are: Task 4 - hazard frequency analysis, Task 5 - bounding analysis, and Task 6 - probabilistic risk assessment (PRA). In the hazard frequency analysis, the analysis considers the probability of the hazard occurring. If the event frequency can be shown to be less than 1E-5 per year with conditional core damage probability of 1E-1 per event, then the hazard can be screened. This amounts to showing that the hazard related core damage frequency is less than 1E-6 per year. If the hazard under review does not screen, then one of the other two detailed analysis approaches is used.

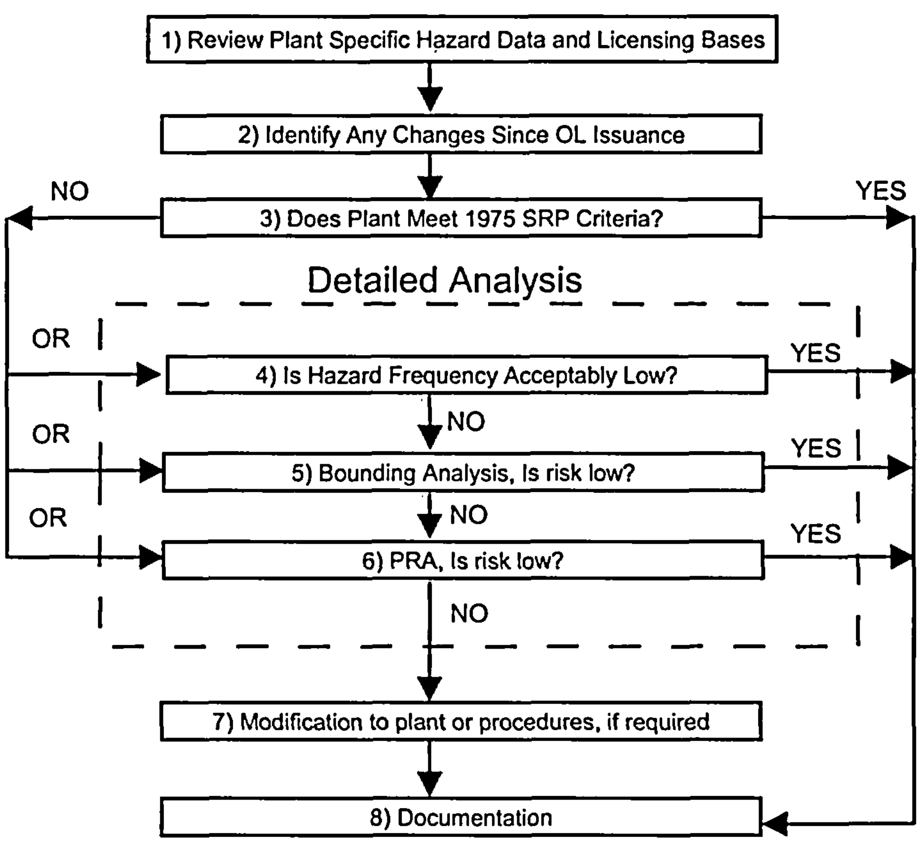
The second type of detailed analysis is called bounding analysis and it considers the consequence of the hazard. If it can be shown that the hazard could not result in core damage, then it can be screened as a negligible risk. If it cannot be screened, then PRA is considered.

In the PRA, detailed fault trees and/or event trees are developed to model the frequency of the event and the probability that the plant equipment and operators respond to mitigate the event prior to core damage.

Figure F-4 shows a simplified representation of the approach for the other External Hazards analysis. This figure was taken from NUREG-1407 and modified slightly. As shown in the figure, Tasks 4 through 6 are optional tasks. One of the optional tasks, at a minimum, is used, at the discretion of the analyst, for any hazard that does not screen based on the SRP review. Two or three of the optional tasks may be used if the hazard is not screened. If the hazard cannot be screened by the SRP review or any of the detailed analyses, then modification to the plant and/or procedures is considered in Task 7.

The final task is documentation of the analysis. The remainder of this section describes the analysis and provides summary documentation of the analysis and results.

**Figure F-4. Approach for Other External Hazards**



## *High Winds*

Since tornados were not considered as part of the Oyster Creek design basis, a probabilistic assessment was performed for high winds as part of the IPEEE. The probabilistic assessment included wind-induced missiles and resulted in a CDF of approximately 4.9E-7/yr. High winds were screened from further consideration as part of the IPEEE based on contributing less than 1E-6/yr to overall CDF.

However, it is noted that severe weather has been included in the internal events PRA because of the impact on offsite AC power, the Diesel Fire Pump Building, and the Combustion Turbine Building. This 2004 PRA update item is considered to be part of the treatment of the LOOP initiator consistent with recent INEL data work. [F-44].

External Flooding and Probable Maximum Precipitation

Oyster Creek meets the intent of the SRP in terms of external flooding [F-28]. With regard to revised Probable Maximum Precipitation (PMP) estimates, which include higher rainfall intensities over short time intervals, potential flooding has been considered. Based on walk-downs, it was concluded that overland runoff will not enter buildings housing equipment that could lead to core damage. Also, roof ponding was determined to be a negligible hazard.

Global warming and glacier melting impacts on the site were considered negligible.

Transportation and Nearby Facility Accidents

The hazards due to natural gas pipelines, airfields, and transportation near the site are addressed below.

## *Natural Gas Pipelines*

There are four natural gas pipelines in the vicinity of Oyster Creek. They are located along US Route 9 approximately 0.25 miles from the plant. There are one six inch pipeline, one eight inch pipeline, and two sixteen inch pipelines. One of the sixteen inch pipelines runs adjacent to the intake canal and supplies the combustion turbines.

An analysis performed for the Tennessee Valley Authority (TVA), NUREG-0014 [F-29] was compared to Oyster Creek. Based on the distance from the plant and size of the pipeline, it was concluded that the pipelines posed a minimal hazard.

## *Hydrogen Water Chemistry Storage Facility*

A hydrogen water chemistry system was installed to mitigate potential cracking in the nuclear steam supply system. The main storage area is more than 620 feet away from the nearest safety related structure. The system was evaluated against EPRI guidelines [F-30] for water chemistry installations and found to be adequate. Based on the assessment, the system was screened as a minimal hazard.

## *Aircraft Hazard Evaluation*

There are no missile sites within a 10-mile radius of the Oyster Creek site. Nine airfields are located within 20 miles of the plant. Two of the airfields are military installations: (1) McGuire Air Force Base, also used by the U.S. Air Force, U.S. Air National Guard, and the Military Air Transport Service, 25 miles to the northwest of the site and (2) Lakehurst Naval Air Station, 20 miles north-northwest of the site. Other airports listed by the Federal Aviation Administration (FAA) are Breton Woods, 17 miles north; Eagle's Nest, 12 miles south-southwest; Coyle Tower, 10 miles west: Ocean City, 9 miles north-northwest; Manahawkin, 9 miles south-southwest; and Beechwood, 8 miles north-northwest. In addition, there is a sod strip 2 miles northeast of Forked River.

Aircraft strike probabilities have been estimated for three size categories including small general aviation. Medium sized commercial, and large (heavy) commercial or military aircraft. The nearest airports of significance are at Lakehurst, 16 miles north-northwest and McGuire Air force Base about 24 miles northwest. At these distances there is no significant hazard due to landing and takeoff activities. Low-level military training routes in the area must be kept more than five miles from the plant by agreement between the military and the NRC. There is little traffic along these routes, and at this distance they represent an extremely low hazard to the plant (UFSAR).

Based on evaluation of the available information on air traffic conditions at the site, it was concluded that the only significant hazard is from the traffic along the "Victor Air Lane 312" airway and general aviation in the area. Probabilities for a strike on the plant were developed for three sizes of aircraft based on available traffic information for each size. The largest mean frequency was from general aviation at $4.0 \times 10^{-7}$ (UFSAR).

The "Victor Air Lane 312," which is aligned east-west and passes over the site, has been screened based on Reference F-28, which states that because the aircraft strike probabilities are extremely low, aircraft traffic does not pose a significant threat to the Oyster Creek plant.

The FAA lists three restricted areas in the vicinity of the plant. Two of these areas, R5001A and R5001B, are contiguous to Fort Dix, which is 15 miles to the north-northwest of the site. These restricted areas are used mainly as firing ranges for small arms, artillery, and mortars. The third area, R5002, at Warren Grove is a low-level aerial target range, used by the U.S. Air National Guard. Its closest boundary to the plant is 7.5 miles. Bombs, rockets, and 20-millimeter guns are used in the target range. The bombs are dummies that give off a flash, but no explosive charge. The rockets do not have explosive charges, only a propellant to deliver the rocket on target, and shells used in the 20-millimeter guns have solid heads without explosives. The likelihood of any of these hazards having any impact on Oyster Creek is judged to be extremely low.

## *Transportation Hazard Evaluation*

The nearest transportation route to the station is U.S. Route 9, which is located approximately 0.25 miles east of the reactor building. There were no industries in close proximity to the plant site that were expected to use or store large amounts of explosive or hazardous material. Additionally, Route 9 is a local road with many traffic lights and low speed limits, especially where it passes through towns. Through traffic generally uses the Garden State Parkway, a limited access toll road that runs parallel to Route 9. The parkway is about 1.25 miles west of the plant.

The staff stated in an SER dated April 6, 1993, [F-34] that "In view of the above [GPU analysis on transportation accidents], and the licensee's Procedure 2000-ABN-3200.33, "Toxic Material/Flammable Gas Release – No Radiation Involved," the staff finds that the risk due to hazardous truck shipments near the OCNGS is acceptably low and the staff considers this issue resolved."

NUREG-0737, "Clarification of TMI Action Plan Requirements," Task Action Plan Item III.D3.4, "Control Room Habitability," requires that the operators in the control room be adequately protected against the effects of accidental releases of toxic and radioactive gases.

In a Technical Specification change request dated, October 18, 1989, as supplemented on February 21, 1990, GPUN addressed items related to control room habitability. In this submittal GPUN also described modifications that had been made to the Oyster Creek control room HVAC system. With the issuance of POL Amendment 139 dated May 29, 1990 and its accompanying SER, the staff found the licensee's provisions acceptable to resolve this NUREG-0737 item [F-32].

## F.2.4 CURRENT LEVEL 2 OYSTER CREEK PRA MODEL

The core damage frequency (CDF) model provides a tool for estimating the likelihood or frequency of core damage. Because consequences of a core damage event can range from minimal (as in the case of the Three Mile Island event in 1979) to more severe (as in the case of the Chernobyl event in 1986), this is not enough information to assess risk. Therefore, the PRA model is designed to identify underlying causes of containment failure for severe accidents and the associated release pathways and their frequencies.

The Oyster Creek containment event trees allow core damage scenarios defined in the CDF model to be further developed into consequence bins. Separating scenarios this way allows results of plant risk calculations to be presented in simple, meaningful terms. Consequence bins are based on the severity of the source term and the timing of the release relative to the time a general emergency is declared, as described in the Oyster Creek Level 2 Notebook. The characteristics of these bins are then used as input for the Level 3 model. The following subsections summarize the breakdown of the bins and the Level 2 results.

The IPE employed what some would call a simplistic Level 2 methodology based on a small number of MAAP cases. Many accident progression phenomena or failure modes are eliminated from consideration.

To support License Renewal which requires Level 3 calculations, Exelon developed a full Level 2 PRA model for Dresden that meets standard industry practices. The full Level 2 model is used for the License Renewal analyses, and that model also has now been incorporated in the 2004B Oyster Creek PRA model. It is also the basis for LERF calculations for risk assessment.

A brief summary of the current Level 2 model compared to the 2001 Level 2 model follows:

- Dependencies on Level 1 scenarios are explicitly treated
- The end states are expanded to cover the spectrum of radionuclide release end states
- Significant increase in discrimination of mitigating actions are included
- The ASME PRA Standard self assessment process endorsed by RG 1.200 is implemented

### F.2.4.1 <u>Consequence Bins: Source Term Severity</u>

The radionuclide release categories are defined based on two parameters: timing and severity. Timing of the release for each sequence is based on MAAP calculations of the sequence chronology. The classification of release magnitude is also based on MAAP 4.0.5 calculations.

The inputs for determining the plant specific characteristics of the radionuclide release bins are the following:

- The plant model
- The MAAP 4.0.5 plant specific calculations
- The Oyster Creek Emergency Plan, e.g., the Emergency Action Levels (EALs)

- The magnitude of releases that can contribute to public health effects
- The evacuation timing

The magnitude of the radionuclide releases for purposes of binning sequences is characterized in terms of the radionuclide release fraction for CsI. This is a dominant contributor to both prompt and latent health effects. The CsI release fraction also correlates well with other contributors to offsite effects. For consequence calculations, additional radionuclides are included as inputs to the release. (See Section F.3.5.) The bins used to define the release magnitude spectrum are as follows:

| Characterization | Designator | CsI Release Fraction |
|---|---|---|
| High | H | > 10% |
| Medium | M | > 1% and ≤ 10% |
| Low | L | > .1% and ≤ 1% |
| Low-Low | LL | ≤ .1% |

The resulting definitions of the radionuclide release end states are summarized in Table F-4.

Using these results and the Level 2 containment event trees, the radionuclide release categories are assigned to each CET sequence end state.

The determination of end state consequences is performed using the MAAP computer code for most of the end state assessments. Therefore, the Modular Accident Analysis Program (MAAP) is used to estimate the radionuclide release consequences of accident scenarios, and results are documented in the Level 2 Thermal Hydraulic Analysis Notebook. For phenomena which are not well modeled by MAAP (e.g., steam explosions), conservative MAAP evaluations are used to characterize the release. This is confirmed by comparison with surrogate plant analysis. Each Level 2 accident sequence from the radioactive release event trees is characterized by a MAAP case.

#### F.2.4.2 Consequence Bins: Timing of Release

Each sequence that leads to a radioactive release from containment is classified as "early", "intermediate", or "late". This designation is intended to reflect mitigation of consequences by evacuating people from the area, as appropriate. It is assumed for the purpose of the risk analysis that 6 hours are required from the time a general emergency is declared to the time radioactive material is released from containment to effectively reduce consequences by evacuation. Based on this assumption, radioactive releases within 6 hours of general emergency declaration are considered "early", and releases after 6 hours are categorized as intermediate. Long term releases at greater than 24 hours after the declaration of a GE are considered "late". Release timing is summarized in Table F-4.

#### F.2.4.3 Oyster Creek Level 2 PRA Radionuclide Release Categories

Classifications of radionuclide releases need to be adequate to distinguish the severe accident scenarios that can result in potentially high public consequence versus those that have public consequences below measurable values. Therefore, the Oyster Creek PRA model has been expanded to be a full Level 2 model with a spectrum of radionuclide release categories. This knowledge of consequences, coupled with the quantification of the accident sequence frequencies, results in the ability to characterize the public risk and the potential for cost-beneficial modifications.

As mentioned previously, the quantification of the source terms associated with each of these release severity categories is accomplished through the use of Oyster Creek specific calculations. A review of existing consequence analyses performed in previous IDCOR studies, PRAs, and NRC studies containing detailed consequence modeling was also performed to confirm the reasonableness of the radionuclide releases.

A broad spectrum of accident sequences have been postulated that could lead to core damage and potentially challenge containment. The Oyster Creek Level 1 PSA has calculated the frequency of those accident sequences that contribute to the core damage frequency for Oyster Creek using system oriented (systemic) event trees. Each of these sequences may result in different challenges to containment. However, many of these challenges to containment have similarities in their functional failure characteristics. This has been confirmed in individual BWR PRAs including NUREG-1150. The result is that these studies have categorized these containment challenges into a finite, discrete group of accident sequence bins, which have similar functional failures. While the Level 1 sequences are binned into accident classes, this represents only a convenience for summarizing Level 1 results. The transfer of information from Level 1 to Level 2 is on a cutset by cutset basis to ensure dependencies are accurately treated between Level 1 and Level 2.

As pointed out in past BWR PRAs, different portions of the spectrum of postulated core damage accidents represent substantially different challenges to the containment depending upon the system failures and phenomena that have contributed to the sequence. Therefore, the containment event tree response must be capable of reflecting the entire spectrum of challenges to ensure that the following are explicitly incorporated:

- System failures in the Level 1 evaluation (including support systems)
- Phenomenological interaction due to the type of core melt progression
- RPV conditions
  - Pressures
  - Decay heat level
- Containment conditions
- Timing of the sequence of events (i.e., core damage and containment failure (if applicable)).

### *Core Damage Functional Classes*

An event sequence classification into thirteen accident sequence functional classes (including containment intact) can be performed using the functional events as a basis for selection of end states. The description of functional classes is presented in Table F-1 discussed in Section F.2.2. The basic types of challenges to containment evaluated based on the Level 1 output (Table F-1) are the same accident classes referenced in Table F-6, Column 1.

Each CET end state can then be associated with a radionuclide source term bin, which covers a spectrum of similar potential scenarios and timing. Theoretically, it would be desirable in determining the point estimates of risk to evaluate the source terms for each sequence of each accident plant damage state. However, for purposes of risk presentation, the CET end states can also be characterized in such a manner as to combine similar "consequence impact" sequences within a single CET end state.

The discrete nature of the radionuclide release categories means that the severe accident spectrum is divided up into bins, which then represent a group of severe accidents that have similar characteristics. These characteristics result in similar public health consequences. It has been found in the past that the public health consequences are affected by a large number of governing features. The following portrays the radionuclide release category characterization used for Oyster Creek.

### Radionuclide Release Categories (CET End States)

The spectrum of possible radionuclide release scenarios is represented by a discrete set of categories or bins. The end states of the containment and phenomenological event sequences may be characterized according to certain key quantitative attributes that affect offsite consequences. These attributes include two important factors:

- Timing (e.g., early or late releases); and,
- Total quantity of fission products released.

Therefore, the containment event tree end states represent the source term magnitude and relative timing of the radionuclide release. The number of categories used for Oyster Creek (i.e., 13) in the source term characterization offers a level of discrimination similar to that included in numerous published PRAs.

### Timing Bins

Three timing categories are used, as follows:

- Early (E)   Less than time when evacuation is effective
- Intermediate (I)   Greater than or equal to Early, but less than 24 hrs
- Late (L)   Greater than or equal to 24 hours.

The definition of the categories is based upon past experience concerning offsite accident response:

- Early is conservatively assumed to include cases in which minimal offsite protective measures have been observed to be performed in non-nuclear accidents.
- Intermediate is a time frame in which much of the offsite nuclear plant protective measures can be assured to be accomplished.
- Late (>24 hours) are times at which the offsite measures can be assumed to be fully effective.

### *Radionuclide Release Magnitude Bins*

The assessment of plant response under postulated severe accident scenarios is a complex integrated evaluation. The primary and secondary containment building responses are sensitive to pressures, temperatures, flows, and event timings. These parameters also affect the operator action timings, the radionuclide release timings, and the mitigating system performance assessments. Therefore, the proper plant specific characterization of the severe accident progression is important to the realistic representation of the plant and highly desirable for the Level 2 assessment. These deterministic calculations provide the following information:

- The pressures and temperatures for various accident scenarios in the RPV, the drywell, the wetwell, and the reactor building;
- The time to reach these pressures and temperatures which is key to the assessment of recovery; (The time windows available for recovery actions must be estimated.)
- The source term magnitude and timing.

Five severity classifications associated with volatile or particulate releases are defined as follows:

- High (H) - A radionuclide release of sufficient magnitude to have the potential to cause prompt fatalities.
- Medium or Moderate (M) - A radionuclide release of sufficient magnitude to cause near-term health effects.
- Low (L) - A radionuclide release with the potential for latent health effects.
- Low-Low (LL) - A radionuclide release with undetectable or minor health effects.
- Negligible (OK) - A radionuclide release that is less than or equal to the containment design base leakage.

A relationship was then developed with the five release severity categories. The results of this partitioning are shown in Table F-4.

The frequency of radionuclide release is characterized by the quantification of the Level 1 and Level 2 PRA models. The Level 2 radioactive release frequency event tree end states are delineated by the magnitude and timing bins of the calculated radionuclide release, as described above. Therefore, the containment event tree end states are characterized using a two-term matrix (severity, time) as shown in Table F-5.

Given this characterization strategy, the Level 2 quantification can be summarized in complementary tables (F-4, F-5 and F-6). Tables F-4 and F-5 provide the nomenclature used in the definition of radionuclide release categories. Table F-6 provides a quantitative summary of the radioactive release frequency event tree results. For each of the release categories from Table F-5, the corresponding frequency is provided. Table F-6 provides quantitative information that is useful in the interpretation of the current containment capability given the spectrum of core damage sequences calculated in the Level 1 PRA.

The quantification provides a yardstick with which to measure the best estimate of containment performance given that severe accidents could progress to beyond core damage. The quantification may include some conservatisms to account for the inability of current models and experiments to predict certain severe accident related phenomena.

A fraction (approximately 26 percent) of the core damage accidents transferred from Level 1 PRA are effectively mitigated such that releases are essentially contained within an intact containment (i.e., negligible release bin). In addition, approximately 94 percent of the postulated accidents do not have "large" releases occurring before protective action can be taken (i.e., approximately 94 percent of the accidents do not result in LERF).

Figure F-5 summarizes in graphical form a histogram comparing the total core damage frequency (i.e., the results of the Level 1 PRA) with the frequencies for each of the radionuclide release categories from Level 2. A substantial fraction of the core damage end states (approximately 60 percent) lead to "small" (low or low-low) or negligible releases categories from Level 2.

MACCS2 calculations are performed to provide the ex-plant consequences. The resulting ex-plant consequence bins have been derived and are reduced from the fourteen Level 2 end states to ten consequence bins. The ten consequence bins used for ex-plant consequence evaluation are described in Table F-6A. The source terms used as input to the MACCS computer code for these ten consequence bins are provided in Section F.2.4.4.

**Table F-4 Release Severity And Timing Classification Scheme[1]**

| Release Severity | | Release Timing | |
|---|---|---|---|
| **Classification Category** | **Cs Iodide % in Release** | **Classification Category** | **Time of Initial Release[2] Relative to Time for General Emergency Declaration** |
| High (H) | Greater than 10 | Late (L) | Greater than 24 hours |
| Medium or Moderate (M) | 1 to 10 | Intermediate (I) | 6 to 24 hours |
| Low (L) | 0.1 to 1 | Early (E) | Less than 6 hours |
| Low-low (LL) | Less than 0.1 | | |
| Intact (OK) | Leakage | | |

(1) The combinations of severity and timing classifications results in one OK release category and 12 other release categories of varying times and magnitudes.

(2) The accident initiation is used as the surrogate for the time when EALs are exceeded.

**Table F-5 Release Severity And Timing Classification Matrix**

| Time of Release | Magnitude of Release | | | |
|---|---|---|---|---|
| | H | M | L | LL |
| E | H/E | M/E | L/E | LL/E |
| I | H/I | M/I | L/I | LL/I |
| L | H/L | M/L | L/L | LL/L |

## Table F-6. Summary Of Oyster Creek Level 2 Release Categories (/Yr)(1), (2)

| Class | Base CDF | Intact | LL/E | LL/I | LL/L | L/E | L/I | L/L | M/E | M/I | M/L | H/E | H/I | H/L | Total Release |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IA (Early) | 1.51E-06 | 1.14E-06 | N/A | 2.06E-07 | 5.87E-08 | 2.03E-08 | 1.61E-08 | N/A | 5.13E-08 | N/A | N/A | 2.01E-08 | 1.66E-09 | N/A | 3.74E-07 |
| IA (Late) | 1.06E-06 | 2.09E-08 | N/A | 0.00E+00 | 1.34E-07 | N/A | 6.95E-07 | 1.90E-10 | N/A | 3.20E-08 | N/A | N/A | 1.77E-07 | N/A | 1.04E-06 |
| IBE | 3.86E-06 | 7.05E-07 | N/A | 1.24E-07 | 1.37E-09 | 1.10E-06 | 7.88E-07 | N/A | 6.70E-07 | N/A | N/A | 3.07E-07 | 1.58E-07 | N/A | 3.15E-06 |
| IBL | 6.15E-07 | 9.82E-08 | N/A | 2.05E-08 | 0.00E+00 | N/A | 3.80E-07 | N/A | N/A | 3.53E-08 | N/A | N/A | 8.10E-08 | N/A | 5.17E-07 |
| ID | 1.66E-07 | 1.01E-07 | N/A | 3.26E-09 | 7.07E-10 | 1.16E-09 | 1.27E-09 | N/A | 5.56E-08 | N/A | N/A | 2.83E-09 | 0.00E+00 | N/A | 6.48E-08 |
| II | 1.65E-06 | 0.00E+00 | N/A | N/A | N/A | N/A | 1.36E-08 | N/A | N/A | 1.55E-06 | N/A | N/A | 1.09E-07 | N/A | 1.67E-06 |
| IIIB(3) | 9.19E-07 | 6.35E-07 | N/A | N/A | 0.00E+00 | 4.42E-09 | N/A | 3.33E-10 | 3.36E-08 | 2.23E-08 | 6.87E-10 | 4.88E-08 | 8.50E-08 | 8.84E-08 | 2.84E-07 |
| IIIC | 4.81E-07 | 8.69E-09 | N/A | N/A | 0.00E+00 | 8.01E-10 | N/A | 3.04E-11 | 1.42E-08 | 1.80E-08 | 9.85E-10 | 1.43E-07 | 1.74E-07 | 1.22E-07 | 4.73E-07 |
| IIID | 2.08E-08 | 0.00E+00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 2.08E-08 | N/A | N/A | 2.08E-08 |
| IV | 1.81E-07 | 0.00E+00 | N/A | N/A | N/A | 1.11E-09 | 0.00E+00 | N/A | 1.74E-07 | N/A | N/A | 5.50E-09 | N/A | N/A | 1.81E-07 |
| V | 3.23E-08 | 0.00E+00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | 3.23E-08 | N/A | N/A | 3.23E-08 |
| Total | 1.05E-05 | 2.71E-06 | 0.00E+00 | 3.54E-07 | 1.95E-07 | 1.13E-06 | 1.89E-06 | 5.53E-10 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.80E-07 | 7.86E-07 | 2.10E-07 | 7.81E-06 |

(1) Based on results of PRAQuant file OC-L2-SEQ.QNT. Level 2 quantified at a truncation value of 1E-11/yr.
(2) N/A indicates that the accident class did not contribute to release of that specific category.
(3) Non-minimal cutsets eliminated from Class IIIB results compared to Class IIIC results (due to event OH-IC-SBO).

## TABLE F-6A. Accident Sequence Timings as a Function of Consequence Category (2004B Oyster Creek PRA)

| Consequence Category | Dominant Release Category | MAAP Case | Time to TAF | Time to Core Damage | Time of Initial Release | Time of Gen. Emg. Declaration | Time of End of Release | EAL Basis Provided in Notes | Frequency (per yr) |
|---|---|---|---|---|---|---|---|---|---|
| L2-1 | H/E(LERF) (52%)[(1)] | OC0500 IA-L2-1A-NSPR | 23 min | 1.3 hr | 6.5 hr | ~ 1.0 hr | 38 hr | (2) | 5.48E-7[(4)] |
| L2-2 | H/I (26%) | OC0525 IB-L2-SBO-2B | 8.8 hr | 9.9 hr | 21 hr | 36 min | 72 hr | (2) | 7.86E-7 |
| L2-3 | H/L (49%) | OC0513 IIA-L2-9B-DW | 7 sec | 31.4 hr | 32.0 hr | 8.0 hr | 72 hr | (3) | 2.10E-7 |
| L2-4 | M/E (5.07%) | OC0523 IVA-L2-14X2-A | 2 min | 1.7 hr | 2.0 hr | ~ 1.5 hr | 38 hr | (2) or (3) | 9.99E-7 |
| L2-5 | M/I (3.2%) | OC0509 IA-L2-7B-NSPR-IC | 1.4 hr | 3.7 hr | 12.0 hr | 36.0 min | 40 hr | (2) | 1.66E-6 |
| L2-6 | M/L (5.9%) | OC0510 IIA-L2-9A-WWA | 23 min | 38.8 hr | 39.0 hr | 8.0 hr | 72 hr | (3) | 1.67E-9 |
| L2-7 | L/E, LL/E, L/I or LL/I (0.72%) | OC0505 ID-L2-7B-NSPR | 23 min | 52 min | 7.0 hr | ~ 1.0 hr | 38 hr | (2) | 3.37E-6 |
| L2-8 | L/L or LL/L (0.03%) | OC0501a IA-L2-2A-SPRY-A | 23 min | 1.3 hr | 28.7 hr | ~ 1.0 hr | 38 hr | (2) | 1.96E-7 |
| L2-9 | Class V (LERF) (92%) | OC0521b V-L2-17 | 36 sec | 12 min | 0.5 hr | 20 min | 38 hr | (2) | 3.23E-8[(4)] |
| L2-10 | Intact (0.01%) | OC0522 IB-L2-22 | 10 min | 31 min | 1.0 hr | ~ 1.0 hr | 38 hr | (2) or (3) | 2.71E-6 |

NOTES TO TABLE F-6A:

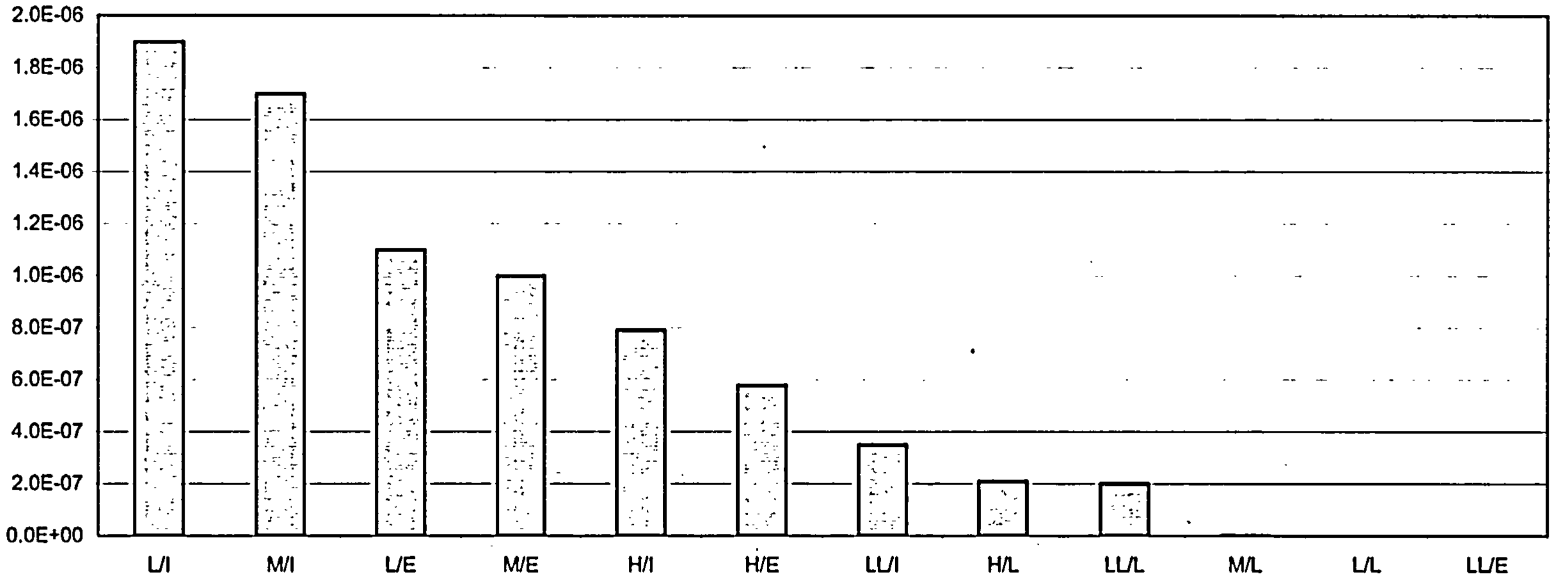
(1) Cumulative Percent CsI released at end of release.

(2) RPV Level ≤ 30" TAF for 2 minutes or longer. NOTE: This condition is indicative of a "loss of 2 out of 3 fission product barriers with a potential loss of the third". An EAL update after the freeze date of the PRA changed this criterion to –20". Therefore these characterizations of Release Timing are slightly conservative.

(3) Shutdown occurs, but all decay heat removal capability is lost. Significant cladding failure or fuel melt could occur in 10 hours with subsequent containment failure.

(4) The total LERF is the sum of two consequence categories, Category L2-1 and L2-9

**Figure F-5. Summary of Release Magnitudes**
**Summary of Oyster Creek Level 2 Release Categories (/yr)**



### F.2.4.4 Oyster Creek Level 2 PRA Source Terms

The input to the Level 3 Oyster Creek model provided by the Level 2 model is a combination of radionuclide release fractions, the timing of the radionuclide releases relative to the declaration of a general emergency, and the frequencies at which the releases occur. This combination of information is used in conjunction with other Oyster Creek site characteristics in the Level 3 model to evaluate the consequences of a core damage event.

The Level 1 functional accident sequences leading to core damage are summarized in Table F-1. These functional accident sequences contain many individual sequences that are transferred directly to the Level 2 evaluation to ensure dependencies are correctly treated. The functional accident sequences are then displayed in Table F-6 as to their contribution to each of the radionuclide release categories.

Source terms are developed for the ten release categories identified in Table F-6A and shown in Table F-7. Table F-7 provides a summary of the Level 2 results that are used as Level 3 input for the Oyster Creek SAMA analysis. This table includes the following information:

- Radionuclide Release frequency (per year)
- Oyster Creek Modular Accident Analysis Program (MAAP) case identifier (for reference)
- Airborne release for each of the fission product groups provided by MAAP
- Start time of the airborne release (measured from the time of accident initiation)
- End time of the airborne release (measured from the time of accident initiation)

The consequences corresponding to each of these source terms are provided in section F.3.

The energy of release and height of release are described in Section F.3.5.

It is noted that the warning time and treatment of evacuation are discussed in Section F.3.6.

Then, Section F.4 calculates the impacts of these severe accident consequences in economic terms.

## Table F-7. Oyster Creek Source Term Summary

| | Release Category[1, 2, 3] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | L2-1 H/E | L2-2 H/I | L2-3 H/L | L2-4 M/E | L2-5 M/I | L2-6 M/L | L2-7 L/E, LL/E, LI or LL/I | L2-8 L/L or LL/L | L2-9 V (H/E) | L2-10 Intact |
| Bin Frequency | 5.48E-7 | 7.86E-7 | 2.10E-7 | 9.99E-7 | 1.66E-6 | 1.67E-9 | 3.38E-6 | 1.96E-7 | 3.23E-8 | 2.71E-6 |
| MAAP Run | 500 | 525 | 513 | 523 | 509 | 510 | 505 | 501a | 521b | 522 |
| Time after Scram when General Emergency is declared | ~1.0 hr | 36 min. | 8.0 hr | 1.5 hr | 36 min. | 8.0 hr | ~1.0 hr | ~1.0 hr | 20 min. | ~1.0 hr |
| **Fission Product Group:** | | | | | | | | | | |
| 1) Noble | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 78 | 72 | 100 | 100 | 72 | 100 | 43 | 100 | 100 | 0.42 |
| Start of Release (hr) | 6.5 | 21.0 | 32.0 | 2.0 | 12.0 | 39. | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 7.5 | 22.0 | 40.0 | 5.0 | 13.0 | 50. | 8.0 | 29.7 | 3.0 | 17.0 |
| 2) CsI | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 52 | 26 | 49 | 5.0 | 3.2 | 5.9 | 0.72 | 3.2E-2 | 92 | 0.01 |
| Start of Release (hr) | 6.5 | 21.0 | 32.0 | 2.0 | 12.0 | 39. | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 16.5 | 50.0 | 65.0 | 28.5 | 32.0 | 50. | 22.0 | 38.0 | 3.0 | 3.0 |
| 3) TeO2 | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 24 | 1.7 | 29 | 4.0 | 1.2 | 2.8 | 0.90 | 1.7E-3 | 75 | 6.8E-3 |
| Start of Release (hr) | 6.5 | 21.0 | 32.0 | 2.0 | 12.0 | 39.0 | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 9.5 | 50.0 | 65.0 | 18.5 | 32.0 | 50.0 | 22.0 | 29.7 | 3.0 | 7.0 |
| 4) SrO | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 2.2 | 0.5 | 0.69 | 3.2 | 1.0 | 1.3 | 2.5 | 1.6E-7 | 2.5 | 3.8E-5 |
| Start of Release (hr) | 6.5 | 32.5 | 32.0 | 8.5 | 12.0 | 57. | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 9.5 | 40.0 | 65.0 | 18.5 | 32.0 | 67. | 12.0 | 29.7 | 10.0 | 7.0 |
| 5) MoO2 | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 5.5E-3 | 0.4E-2 | 0.67 | 6.2E-2 | 1.7E-3 | 0.13 | 1.5E-4 | 6.6E-7 | 4.5 | 1.4E-4 |
| Start of Release (hr) | 6.5 | 21.0 | 32.0 | 2.0 | 12.0 | 39.0 | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 7.5 | 22.0 | 40.0 | 5.0 | 12.0 | 50.0 | 7.0 | 29.7 | 3.0 | 7.0 |
| 6) CsOH | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 36 | 5.1 | 36 | 6.4 | 5.4 | 2.9 | 3.6 | 5.1E-2 | 69 | 5.9E-3 |
| Start of Release (hr) | 6.5 | 21.0 | 32.0 | 2 hr | 12.0 | 39.0 | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 16.5 | 50.0 | 65.0 | 28.5 | 32.0 | 67.0 | 22.0 | 38.0 | 3.0 | 7.0 |

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## Table F-7. Oyster Creek Source Term Summary

| | Release Category[1, 2, 3] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | L2-1 H/E | L2-2 H/I | L2-3 H/L | L2-4 M/E | L2-5 M/I | L2-6 M/L | L2-7 L/E, LL/E, LI or LL/I | L2-8 L/L or LL/L | L2-9 V (H/E) | L2-10 Intact |
| Bin Frequency | 5.48E-7 | 7.86E-7 | 2.10E-7 | 9.99E-7 | 1.66E-6 | 1.67E-9 | 3.38E-6 | 1.96E-7 | 3.23E-8 | 2.71E-6 |
| MAAP Run | 500 | 525 | 513 | 523 | 509 | 510 | 505 | 501a | 521b | 522 |
| Time after Scram when General Emergency is declared | ~1.0 hr | 36 min. | 8.0 hr | 1.5 hr | 36 min. | 8.0 hr | ~1.0 hr | ~1.0 hr | 20 min. | ~1.0 hr |
| **Fission Product Group:** | | | | | | | | | | |
| 7) BaO | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 0.96 | 0.22 | 1.3 | 1.5 | 0.46 | 0.71 | 1.1 | 8.4E-7 | 5.6 | 2.4E-4 |
| Start of Release (hr) | 6.5 | 32.5 | 32.0 | 8.5 | 12.0 | 39.0 | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 9.5 | 40.0 | 65.0 | 18.5 | 22.0 | 67.0 | 12.0 | 29.7 | 10.0 | 7.0 |
| 8) La2O3 | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 6.7E-2 | 2.3E-3 | 9.7E-3 | 0.13 | 6.1E-3 | 2.4E-2 | 4.1E-2 | 3.5E-8 | 0.10 | 4.4E-6 |
| Start of Release (hr) | 6.5 | 32.5 | 32.0 | 8.5 | 12.0 | 45.0 | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 9.5 | 40.0 | 65.0 | 18.5 | 22.0 | 67.0 | 12.0 | 29.7 | 10.0 | 7.0 |
| 9) CeO2 | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 1.3 | 0.12 | 0.16 | 1.6 | 0.27 | 0.54 | 0.77 | 2.0E-7 | 0.7 | 6.2E-6 |
| Start of Release (hr) | 6.5 | 32.5 | 32.0 | 8.5 | 12.0 | 57.0 | 7.0 | 28.7 | 7.0 | 1.0 |
| End of Release (hr) | 9.5 | 40.0 | 65.0 | 18.5 | 22.0 | 67.0 | 22.0 | 29.7 | 10.0 | 7.0 |
| 10) Sb | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 30 | 28 | 54 | 19 | 27 | 12 | 11 | 6.7E-5 | 74 | 1.2E-4 |
| Start of Release (hr) | 6.5 | 21.0 | 32.0 | 2.0 | 12.0 | 39.0 | 7.0 | 28.7 | 0.5 | 1.0 |
| End of Release (hr) | 9.5 | 40.0 | 65.0 | 28.5 | 32.0 | 67.0 | 22.0 | 29.7 | 20.0 | 7.0 |
| 11) Te2 | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 1.9 | 4.8E-3 | 2.8E-2 | 1.3 | 1.2 | 0.66 | 1.2 | 3.2E-6 | 1.0 | 9.1E-7 |
| Start of Release (hr) | 6.5 | 32.5 | 4.0 | 8.5 | 12.0 | 57.0 | 7.0 | 28.7 | 7.0 | 7.0 |
| End of Release (hr) | 9.5 | 40.0 | 65.0 | 18.5 | 22.0 | 67.0 | 12.0 | 29.7 | 20.0 | 17.0 |
| 12) UO2 | | | | | | | | | | |
| Total Release % at 36 Hours after core damage | 4.6E-3 | 2.0E-4 | 2.2E-4 | 7.9E-3 | 4.8E-4 | 1.6E-3 | 2.6E-3 | 6.0E-13 | 2.6E-3 | 4.8E-10 |
| Start of Release (hr) | 6.9 | 32.5 | 55.0 | 8.5 | 12.0 | 57.0 | 7.0 | 28.7 | 7.0 | 7.0 |
| End of Release (hr) | 9.5 | 40.0 | 65.0 | 18.5 | 22.0 | 67.0 | 12.0 | 29.7 | 10.0 | 17.0 |

(1) See Section F.3.5 for additional discussion of the radionuclide release characterization.
(2) Evacuees are assigned to begin evacuating 30 minutes after General Emergency declaration. See Section F.3.6 for additional discussion of population evacuation.
(3) The airborne releases are those cumulative fission product releases to the environment calculated for times of 36 hours past core damage.





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### F.2.5 PRA MODEL REVIEW SUMMARY

This section summarizes the reviews of the Oyster Creek PRA model and the results of the reviews.

#### *NRC IPE Review*

The NRC review of the Oyster Creek Individual Plant Examination (IPE) was issued on August 2, 1994 [F-35]. The Staff Evaluation Report (SER) concluded the following regarding the Oyster Creek IPE:

- The Oyster Creek IPE meets the intent of Generic Letter 88-20 and associated Supplement 1.
- The submittal is deficient because the treatment of pre-initiating event human errors is lacking.
- GPUN plans to evaluate connection of the fire protection system to drywell spray as part of accident management.
- Recirculation pump seal LOCA should be modeled.
- The following "low-cost" improvement initiatives were noted by the NRC:
    - Develop an emergency procedure for Loss of Offsite Power
    - Develop an emergency procedure for Loss of DC Power
    - Increase training on the importance of the core spray system
    - Change maintenance scheduling for the core spray system
    - Institute programs to reduce blockage and fouling of the isolation condensers
    - Modify the Reactor Overfill Protection System
    - Consider the development of specific guidance, training, and procedures for reactor overfill transients
    - Increase emphasis in training on key operator actions as defined by the IPE
    - Consider alternate containment heat removal capability to maintain minimal NPSH as part of accident management
    - Consider alternate water supply for drywell sprays (Accident Management)
    - Consider Internal Flooding Procedure Enhancements
    - Consider Portable DC Charger

Many of the initiatives and improvements noted by the NRC have been completed as discussed below:

- <u>Pre-Initiating Events</u> – These have been formally added to the PRA model.
- <u>Fire Protection System connection to Drywell Spray</u> – Not implemented but added as SAMA item (See SAMA Item 111).
- <u>Recirc Pump Seal LOCA</u> - This has been formally added to the PRA model.

- Loss of Offsite Power Procedure Development – Completed (Abnormal Operating Procedure ABN-36, Also ABN-37 for SBO).
- Loss of DC Power Procedure Development – Completed (Abnormal Operating Procedures ABN-53, 54, 55).
- Core Spray Importance Training – SAMA 127
- Core Spray Maintenance Scheduling – This item is addressed by on-line maintenance planning associated with the a(4) portion of the maintenance rule program.
- Isolation Condenser Blockage and Fouling program – SAMA 128
- Reactor Overfill Modification – An RPV Level setdown modification has been installed.
- Reactor Overfill Protection Procedures – The Reactor SCRAM abnormal operating procedure (ABN-1) has been modified to address RPV overfill. For example, step 3.10 includes direction to trip feedwater pumps.
- Key Operator Action Training – SAMA 127
- Alternate Containment Heat Removal - Not implemented but added as SAMA items (See SAMA Items 18, 111).
- Alternate water supply for drywell sprays - Not implemented but added as SAMA item (See SAMA Item 111).
- Internal Flooding Procedure Enhancements – SAMA 129
- Portable DC Charger - Not implemented but added as SAMA item (See SAMA Item 109).

### *NRC IPEEE Review*

The NRC review of the Oyster Creek Individual Plant Examination for External Events (IPEEE) was issued on February 8, 2001 [F-36]. The Staff Evaluation Report (SER) concluded the following regarding the Oyster Creek IPEEE:

- The OC IPEEE meets the intent of Generic Letter 88-20 Supplement 4
- In Response to NRC Requests for Additional Information (RAI), Reactor and Turbine Building failures were considered and were determined to dominate results
- In Response to NRC RAI, Fire analysis was reconsidered and dominant contributors to risk due to fire initiating events became:

- Cable Spreading room (CDF = 8.6E-6/yr)
- 480 VAC Switchgear Room (CDF = 5.1E-6/yr)
- Turbine Building Basement (CDF = 1.9E-6/yr)

- NUREG-1407 based screening of "other" external hazards was appropriately implemented

- The following potential improvements to cope with IPEEE "findings" were noted by the NRC:

  - Review Combustion Turbine Fin-Fan bolts
  - Consider additional battery spacers for Combustion Turbine battery compartment
  - Upgrade anchorage for CO2 system
  - Upgrade anchorage for CO2 racks in turbine building
  - Add supports for turbine-generator seal oil unit
  - Replace drop-weight actuated deluge valves
  - Modification of the anchorage for the Arrowhead demineralizer trailer
  - Provide operator training on IPEEE results.

All of the improvements noted by the NRC have been completed or an analysis performed to support the existing configuration as discussed below. (Closeout of these items is listed in the Oyster Creek Licensing Action Request (LAR) database):

- Review Combustion Turbine Fin-Fan bolts – Complete (LAR 88242.19)

- Consider additional battery spacers for Combustion Turbine battery compartment – Re-evaluated and determined not necessary (LAR 88242.20)

- Upgrade anchorage for CO2 system – Re-evaluated and determined not necessary (LAR 88242.22)

- Upgrade anchorage for CO2 racks in turbine building - Complete (LAR 88242.25)

- Add supports for turbine-generator seal oil unit - Re-evaluated and determined not necessary (LAR 88242.23)

- Replace drop-weight actuated deluge valves - Complete (LAR 88242.26)

- Modification of the anchorage for the Arrowhead demineralizer trailer - Complete (LAR 88242.24)

- Provide operator training on IPEEE results - Complete (LAR 88242.27)

### *BWROG PRA Peer Review*

In September 1997, a BWROG PRA Peer Certification Review was performed on the Oyster Creek PRA model. The overall conclusion was positive and stated that the Oyster Creek PRA can be effectively used to support applications involving relative risk significance.

The "Facts and Observations" for Oyster Creek have been evaluated and addressed by the Oyster Creek PRA Program as part of the last two PRA updates. There were three "A" and nineteen "B" Facts and Observations. All twenty-two Facts and Observations have been resolved by model changes. No outstanding model issues exist outside of the normal PRA maintenance program and none are known to have the potential to impact the SAMA conclusions.

### *PRA Self-Assessment Analysis Review*

Following the issuance of the ASME PRA Standard [F-9] and its endorsement by the NRC in RG 1.200, AmerGen undertook a detailed review of the Oyster Creek PRA model and documentation. This review was performed using the NEI recommended self-assessment process as endorsed by the NRC in RG 1.200.

The objective of the Oyster Creek self-assessment is to achieve a Capability Category II for all Supporting Requirements.

The 2004 review against the ASME PRA Standard [F-9] produced a number of items for update. Most of the items have been addressed as part of the most recent PRA update and none of the remaining resource intensive items are judged to affect the SAMA evaluation.

### *Conclusion*

The BWROG PRA Peer Review and the self assessment analysis resolutions were incorporated into the 2004B PRA update used for the SAMA evaluation.

# F.3 Level 3 PSA Analysis

This section addresses the critical input parameters and analysis of the Level 3 portion of the probabilistic risk assessment. In addition, Section F.3.8 summarizes the base case results and a series of sensitivity evaluations to potentially critical parameters.

## F.3.1 ANALYSIS

The MACCS2 code [F-37] was used to perform the Level 3 probabilistic risk assessment (PRA) for the Oyster Creek Nuclear Station. Oyster Creek specific parameters are used for population distribution and economic parameters. Other input parameters given with the MACCS2 "Sample Problem A", formed the basis for the present analysis. Plant-specific release data included the time-dependent nuclide distribution of releases and release frequencies. The behavior of the population during a release (evacuation parameters) was based on plant and site-specific set points. These data were used in combination with site-specific meteorology to simulate the probability distribution of impact risks (both exposures and economic effects) to the surrounding 50-mile radius population as a result of the release accident sequences at Oyster Creek.

## F.3.2 POPULATION

The population surrounding the Oyster Creek site was estimated for the year 2029.

Population projections within 50 miles of Oyster Creek were determined using SECPOP2000 [F-38], utilizing a geographic information system (GIS), U.S Census block-group level population data allocated to each sector based on the area fraction of the census block-groups in each sector, and population growth rate estimates. U.S. Census data from 1990 and 2000 were used to determine an annual average population growth estimate for each of the 50-mile radius rings. The annual population growth estimate for each ring was applied uniformly to all sectors in the ring to calculate the year 2029 population distribution.

The distribution is given in terms of population at distances to 1, 2, 3, 4, 5, 10, 20, 30, 40 and 50 miles from the plant and in the direction of each of the 16 compass points (i.e., N, NNE, NE......NNW).

The total year 2029 population for the 160 sectors (10 distances × 16 directions) in the region is estimated as 5,411,150. The population multiplier (in parenthesis) and distribution of the population is given for the 10-mile radius from Oyster Creek and for the 50-mile radius from Oyster Creek in Tables F-8A and F-8B, respectively.

### F.3.3 ECONOMY

MACCS2 requires the spatial distribution of certain economic data (fraction of land devoted to farming, annual farm sales, fraction of farm sales resulting from dairy production, and property value of farm and non-farm land) in the same manner as the population. This was done by using the SECPOP2000 code [F-38] for each of the counties surrounding the plant to a distance of 50 miles. SECPOP2000 utilizes economic data from the U.S. Department of Agriculture, "1997 Census of Agriculture" [F-39] and from other 1998 and 1999 data sources. Economic values for up to 97 economic zones were calculated and allocated to each of the 160 sectors.

In addition, generic economic data that are applied to the region as a whole were revised from the MACCS2 sample problem input when better information was available. These revised parameters include per diem living expenses (applied to owners of interdicted properties and relocated populations), relocation costs (for owners of interdicted properties), and value of farm and non-farm wealth. These values were updated to the year 2000 value using the Consumer Price Index ratio.

## F.3.4 FOOD AND AGRICULTURE

Food ingestion was modeled using the COMIDA2 methodology consistent with Sample Problem A. The COMIDA2 model utilizes national based food production parameters derived from the annual food consumption of an average individual such that site specific food production values are not utilized. The fraction of population dose due to food ingestion is typically small compared to other population dose sources. For Oyster Creek, approximately 4% of the total population dose is due to food ingestion. A sensitivity case was performed to determine the impact of using site specific food production data. The results are discussed in Section F.3.8.

### F.3.5 NUCLIDE RELEASE

The core inventory at the time of the accident is based on a plant specific ORIGEN 2.1 calculation. The core inventory corresponds to the best estimate, end-of-cycle values (i.e., 24 month fuel cycle) for the Oyster Creek core.

Oyster Creek nuclide release categories are related to the MACCS categories as shown in Table F-9. All releases are modeled as occurring at 0.0 meters. The thermal content of each of the releases are assumed to be the same as ambient; i.e., buoyant plume rise is not modeled.

A MACCS2 release height sensitivity case was run using a release height of 44.8m (top of reactor building) for high containment failure cases (i.e., drywell head failure) and 0.0m for low containment failure cases (i.e., wetwell or shell melt through failures). The results are discussed in Section F.3.8.

## F.3.6 EVACUATION

Reactor scram signal begins each evaluated accident sequence. A General Emergency is declared when plant conditions degrade to the point where it is judged that there is a credible risk to the public. Therefore, the timing of the General Emergency declaration is sequence specific and ranges from 20 minutes to 8 hours for the release sequences evaluated.

The MACCS2 User's Guide input parameters of 95 percent of the population within 10 miles of the plant (Emergency Planning Zone) evacuating and 5 percent not evacuating were employed. These values have been used in similar studies (e.g., Hatch, Calvert Cliffs, References F-5 and F-3) and are conservative relative to the NUREG-1150 study, which assumed evacuation of 99.5 percent of the population within the emergency planning zone. The evacuees are assumed to begin evacuating 30 minutes after a General Emergency has been declared and are evacuated at an average radial speed of 1.3 miles per hour (0.57 m/sec). This speed is the time weighted value accounting for season, day of the week, time of day, weather conditions, and special events. The evacuation time weighted average of 501 minutes is for the full 0-10 mile EPZ, an assumed 15 minute notification time, and 15 minutes for evacuation preparation [F-42].

Two evacuation sensitivity cases were also performed to determine the impact of evacuation assumptions. One sensitivity case reduced the evacuation speed by a factor of two (0.29 m/sec). The second sensitivity case assumed a 90 minute delay (in lieu of 30 minute delay) prior to the start of physical evacuation movement. The results are discussed in Section F.3.8

**Table F-8A. Estimated Population Distribution Within a 10-Mile Radius of Oyster Creek, Year 2029**

| Sector | 0-1 mile (1.378)[1] | 1-2 miles (1.33) | 2-3 miles (1.495) | 3-4 miles (1.916) | 4-5 miles (1.481) | 5-10 miles (1.563) | 10-mile total |
|---|---|---|---|---|---|---|---|
| N | 0 | 1917 | 4741 | 2826 | 855 | 38079 | 48418 |
| NNE | 478 | 1446 | 3437 | 4503 | 2304 | 35127 | 47295 |
| NE | 187 | 1104 | 1897 | 3757 | 3443 | 3893 | 14281 |
| ENE | 0 | 1677 | 601 | 904 | 0 | 0 | 3182 |
| E | 0 | 842 | 387 | 0 | 0 | 5 | 1234 |
| ESE | 120 | 1112 | 0 | 0 | 0 | 42 | 1274 |
| SE | 496 | 1226 | 202 | 0 | 0 | 1771 | 3695 |
| SSE | 0 | 789 | 1437 | 270 | 0 | 902 | 3398 |
| S | 0 | 281 | 1443 | 4192 | 1678 | 2362 | 9956 |
| SSW | 152 | 40 | 423 | 4209 | 3406 | 20893 | 29123 |
| SW | 0 | 0 | 0 | 2018 | 1687 | 14845 | 18550 |
| WSW | 0 | 13 | 21 | 11 | 6 | 1790 | 1841 |
| W | 0 | 0 | 0 | 0 | 0 | 28 | 28 |
| WNW | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| NW | 0 | 0 | 0 | 0 | 0 | 569 | 569 |
| NNW | 0 | 379 | 2262 | 0 | 44 | 4384 | 7069 |
| Total | 1433 | 10826 | 16851 | 22690 | 13423 | 124690 | 189913 |

[1] Radial population multiplier applied to year 2000 census data to develop year 2029 estimate.

**Table F-8B. Estimated Population Distribution Within a 50-Mile Radius of Oyster Creek, Year 2029**

| Sector | 0-10 miles | 10-20 miles (1.422)[1] | 20-30 miles (1.346) | 30-40 miles (1.374) | 40-50 miles (1.172) | 50-mile total |
|---|---|---|---|---|---|---|
| N | 48418 | 162020 | 135089 | 212027 | 393492 | 951046 |
| NNE | 47295 | 149321 | 170467 | 183999 | 19442 | 570524 |
| NE | 14281 | 11461 | 0 | 0 | 0 | 25742 |
| ENE | 3182 | 0 | 0 | 0 | 0 | 3182 |
| E | 1234 | 0 | 0 | 0 | 0 | 1234 |
| ESE | 1274 | 0 | 0 | 0 | 0 | 1274 |
| SE | 3695 | 0 | 0 | 0 | 0 | 3695 |
| SSE | 3398 | 920 | 0 | 0 | 0 | 4318 |
| S | 9956 | 12725 | 3 | 0 | 0 | 22684 |
| SSW | 29123 | 28375 | 23559 | 170768 | 33216 | 285041 |
| SW | 18550 | 1864 | 25994 | 69876 | 11983 | 128267 |
| WSW | 1841 | 479 | 3108 | 40610 | 114051 | 160089 |
| W | 28 | 1089 | 18411 | 176684 | 598898 | 795110 |
| WNW | 0 | 3949 | 53627 | 224109 | 923745 | 1205430 |
| NW | 569 | 22469 | 32655 | 245559 | 327893 | 629145 |
| NNW | 7069 | 52842 | 34704 | 135208 | 394546 | 624369 |
| Total | 189913 | 447514 | 497617 | 1458840 | 2817266 | 5411150 |

(1) Radial population multiplier applied to year 2000 census data to develop year 2029 estimate.

**Table F-9. MACCS2 Release Categories vs. Oyster Creek Release Catgegories**

| MACCS Release Categories | Oyster Creek Release Categories |
|---|---|
| 1-Xe/Kr | noble gases |
| 2-I | CsI |
| 3-Cs | CsOH |
| 4-Te | Sb (TeO2 & Te2 fractions are included) |
| 5-Sr | SrO |
| 6-Ru | MoO2 (Mo is in Ru MACCS category) |
| 7-La | La2O3 |
| 8-Ce | CeO2 (included UO2 in this category) |
| 9-Ba | BaO |

## F.3.7 METEOROLOGY

Annual Oyster Creek meteorology data from year 2003 was used in MACCS2 for the base case results. Year 2003 was the most complete and contained Oyster Creek site specific precipitation data as well as mid tower data.(1) The 2003 Oyster Creek meteorological data set contained eleven gaps of missing dates (179 total hours, representing 2.04% of the hourly readings). Five of the gaps contained more than six consecutive hours of missing data and were filled by substituting data from previous hours or days. Six of the gaps contained six or fewer consecutive hours of missing dates and were filled by interpolation. The year 2003 meteorological data set was utilized for the Oyster Creek base case MACCS2 analysis based on the fact that the year 2003 provided the highest population dose risk and offsite economic cost risk and is judged to be the most conservative.

The year 2003 meteorological data set consisted of 11 gaps of missing data (179 hours, 2.04%). Traditionally, up to 10% of missing data is considered acceptable. Of the missing gaps, six gaps consisted of 6 hours or fewer and interpolation was used to fill in the missing meteorological data. Four gaps consisted of 7 to 18 hours of missing data. One gap consisted of 100 hours of missing data. Missing meteorological data gaps of more than 6 hours were filled based on substituting data from the same time of day from the period just before or after the missing data in order to account for seasonal variations and the onset of severe weather. It is noted that MACCS results used in the SAMA analysis are the statistical mean of 369 weather sequences (each sequence contains 120 hours of data) chosen at random from pre-sorted weather bins. Due to the large number of samples analyzed, the adjustment of any particular weather sequence has negligible impact on the mean results.

Oyster Creek MACCS2 analysis evaluated three meteorological data sets (Calendar years 2000, 2001, and 2003) to ensure that the meteorological data set used in the analysis is adequate. The use of the most conservative data set (year 2003) accounts for any weather sequences that may have been misrepresented by substitute data. Based on the multiple years analyzed, minimum data gaps in the year 2003 meteorological data, and the sampling methodology used, the reported mean results are judged acceptable and appropriate for use in averted cost risk calculations.

Meteorological data was prepared for MACCS2 input as follows:

1. Wind speed and direction from the 10-meter sensor of the site tower were combined with precipitation (hourly cumulative). If the lower wind direction was unavailable, mid and/or upper directions were used to estimate the lower wind direction. Precipitation from the Atlantic City International Airport was used to supplement the Oyster Creek precipitation data for any unavailable hours.
2. If a brief period (i.e., few hours) of missing data existed for all tower sensors, interpolation was used between hours.
3. For larger data voids (i.e., days), tower data from the previous or following week was utilized to fill data gaps (for the same time of day).
4. Atmospheric stability was calculated according to the vertical temperature gradient of the tower temperature data.

(1) Based on the meteorological sensitivity cases, year 2003 MET data was found to result in the highest population cost and highest dose and was therefore chosen for the Base Case.

5. Atmospheric mixing heights were specified for morning and afternoon hours. These values were taken from Reference F-46 for New York, New York (approximately 50 miles from Oyster Creek).

   This source defined morning as being the four-hour period from 0200 to 0600 Local Standard Time and afternoon as being the four-hour period from 1200 to 1600 Local Standard Time.

   The Code Manual for MACCS2: Volume 1 (from Appendix A, pages A-1 and A-2) states the following:

   > The first of these two values corresponds to the morning mixing height and the second to the afternoon height. In the current implementation, the larger of these two values and the value of the boundary weather mixing height is used by the code.
   >
   > In its present form, that atmospheric model implemented in MACCS2 does not allow a change in the mixing layer to occur during transport of the plume. Mixing layer height is assumed to be constant and therefore only a single value is used by the code.

   For the Oyster Creek MACCS2 analyses, these conditions mean that, generally, only the afternoon mixing height is used since it is normally larger that the morning mixing height. Note that the boundary weather mixing height, wind speed and stability category are only used when there is no meteorological data. These fixed boundary weather values are ignored by the code when an hourly meteorological data file is supplied by the user, as was the case in the MACCS2 runs for Oyster Creek.

As noted above, site meteorological data for years 2000 and 2001 are also evaluated as sensitivity cases to ensure year 2003 data is an appropriate data set. For years 2000 and 2001 no site specific precipitation data is available, therefore, data from nearby Atlantic City International Airport is utilized. The results are discussed in Section F.3.8.

## F.3.8 MACCS2 RESULTS

### F.3.8.1 Base Case

Table F-10 shows the mean off-site doses and economic impacts to the region within 50 miles of Oyster Creek for each of ten release categories calculated using MACCS2. These impacts are multiplied by the annual frequency for each release category and then summed to obtain the frequency-weighted mean doses and economic costs.

Table F-11 provides a summary of the Oyster Creek Level 2 PRA results which provide the base case radionuclide release frequencies and timing as the input to the offiste dose and economic impact calculations.

These inputs are supplied to support the calculation of:

- The offsite Exposure Cost (uses offsite dose input)
- The offsite Economic Cost Risk (uses offsite economic impacts)

### F.3.8.2 Sensitivity Cases

Table F-12 provides summary results of the MACCS2 sensitivity cases evaluated. The sensitivity cases include the following types of sensitivities:

- Meteorological (MET2000; MET20001)
- Population (30INC)
- Evacuation (Slow Evac; 90Delay)
- Radionuclide release height (OCATM6)
- Food Production (OCCROP)
- Recovery, decontamination, resettlement (Intermediate Phase) (CHR1, CHR3)

Two risk metrics are provided in Table F-12:

- The Population Dose Risk used to quantify the costs associated with dose to the public
- The offsite clean-up cost-risk which quantifies the costs associated with offsite economic impacts

The costs associated with these two risk metrics are additive along with the other smaller cost contributors discussed in Section F.4 which remain the same for these sensitivity cases.

The meteorological sensitivity cases demonstrate minimal impact on population and dose results (± 3%), as expected for mean results.

The population sensitivity case (30INC) demonstrates the expected significant dependency because population dose and offsite costs are primarily driven by the regional population.

The evacuation sensitivity cases (SlowEvac and 90Delay) demonstrate minor population dose impacts associated with evacuation assumptions due to the relatively slow base case Oyster Creek evacuation. Evacuation assumptions do not impact MACCS2 offsite economic cost-risk estimates because MACCS2 calculated cost-risks are based on land contamination levels which remain unaffected by evacuation assumptions and the number of people evacuating. The dose received by individuals is accounted for in the population dose (person-rem) total calculated by MACCS2.

The release height sensitivity case (OCATM6) shows a 0% change in the dose risk and an increase of 0.67% in the economic cost risk. The sensitivity case modeled a release height of 44.8m (top of reactor building) for high containment failure release categories (H/L and L-LL/L) and the intact case. The remaining containment failure release categories utilized a zero release height in the sensitivity case based on the projected containment failure phenomena of the representative MAAP case (e.g., shell melt through, wetwell failure).

The food production sensitivity case (OCCROP) shows a negligible change in dose risk (< -0.1%) and economic cost risk (0.0%). The sensitivity case utilized food production data developed for the Oyster Creek surrounding counties (i.e., 50 mile radius) in lieu of the national averages used in the COMIDA base case modeling. The negligible change is expected because the impacts of food ingestion on the population dose and economic costs are generally observed to be small (e.g., approximately 4% of the total population dose is due to food ingestion).

The Intermediate Phase, as modeled by MACCS2, is the time period beginning after the early phase (one week emergency phase) and extends to the time when recovery actions such as decontamination and resettlement are started (long term phase). MACCS2 allows the habitation of land during the intermediate phase unless the projected dose criterion is exceeded. If the projected dose criterion is exceeded during the intermediate phase, the individual is relocated. MACCS2 allows an intermediate phase ranging from no intermediate phase to one (1) year. The Intermediate Phase related sensitivity cases (CHR1 and CHR3) show significant dependence in relation to economic impact, and are therefore further discussed:

- The No Intermediate Phase case (CHR1) was developed based on the NUREG-1150 modeling approach. However, it is judged too optimistic in that the land decontamination efforts are modeled as starting one week after the accident (i.e., after the early phase ends and the long term phase begins) such that a significant portion of population relocation costs are omitted (e.g., costs associated with temporary housing while decontamination strategies are developed and decontamination teams are contracted). It is believed that NUREG-1150 studies omitted the intermediate phase because the MACCS intermediate phase coding was not validated at that time. The population dose increases because people are allowed to re-occupy the land sooner.

- The 1 Year Intermediate Phase case (CHR3) was developed based on the maximum length of time allowed by MACCS2 for the intermediate phase. A long intermediate phase can be unrealistic in that re-occupation of the contaminated land is not performed during this phase even if contamination levels decrease (by natural radioactive decay) to levels which would allow it (i.e., resettlement is evaluated as part of the long term phase, not the intermediate phase). Therefore, population relocation costs may be over estimated using a long (i.e., one year) intermediate phase, but population dose values would be lower.

- The six month intermediate phase (base case) is judged to be a best estimate approach in that it provides a reasonable time for both decontamination efforts and resettlement to begin. The sensitivity cases demonstrate that this six month modeling approach is mid-range of the modeling choices available.

**Table F-10. MACCS2 Base Case Mean Results**

| MAAP Case | Release Category | Dose (P-Sv) | Costs($) | Frequency (per year) | Wtd. Dose Risk (p-rem/yr) | Wtd. Cost Risk ($/yr) |
|---|---|---|---|---|---|---|
| OC0500 | H/E | 7.93E+04 | 3.77E+10 | 5.48E-07 | 4.35E+00 | 2.07E+04 |
| OC0525 | H/I | 4.19E+04 | 1.09E+10 | 7.86E-07 | 3.29E+00 | 8.57E+03 |
| OC0513 | H/L | 7.50E+04 | 3.76E+10 | 2.10E-07 | 1.58E+00 | 7.90E+03 |
| OC0523 | M/E | 5.79E+04 | 1.91E+10 | 9.99E-07 | 5.78E+00 | 1.91E+04 |
| OC0509 | M/I | 4.20E+04 | 1.27E+10 | 1.66E-06 | 6.97E+00 | 2.11E+04 |
| OC0510 | M/L | 3.53E+04 | 9.63E+09 | 1.67E-09 | 5.90E-03 | 1.61E+01 |
| OC0505 | L-LL/E | 4.02E+04 | 1.18E+10 | 3.37E-06 | 1.35E+01 | 3.98E+04 |
| OC0501A | L-LL/L | 1.48E+03 | 1.21E+08 | 1.96E-07 | 2.90E-02 | 2.37E+01 |
| OC0521B | CLASS V | 1.24E+05 | 3.62E+10 | 3.23E-08 | 4.01E-01 | 1.17E+03 |
| OC0522 | INTACT | 2.50E+02 | 9.91E+06 | 2.71E-06 | 6.78E-02 | 2.69E+01 |
| **Frequency Weighted Totals** | | | | 1.05E-05 | 3.60E+01 | 1.18E+05 |

## Table F-11. Accident Sequence Timings As A Function Of Consequence Category – Base Case

| Consequence Category | OC MAAP CASE | Dominant Release Category | Time of Gen. Emergency Declaration[1] | Time of Initial Release[1] | Plume Duration | Release Frequency (Per Rx Yr) |
|---|---|---|---|---|---|---|
| L2-1 | OC0500 | H/E | ~1.0 hr | 6.5 hr | 1.0, 3.0, and 10 hr | 5.48E-07 |
| L2-2 | OC0525 | H/I | 36 min | 21 hr | 1.0, 7.5, and 10 hr | 7.86E-07 |
| L2-3 | OC0513 | H/L | 8.0 hr. | 32 hr | 3.0, 5.0, and 10 hr | 2.10E-07 |
| L2-4 | OC0523 | M/E | ~1.5 hr | 2.0 hr | 3.0, 10, and 10 hr | 9.99E-07 |
| L2-5 | OC0509 | M/I | 36 min | 12 hr | 1.0, 10, and 10 hr | 1.66E-06 |
| L2-6 | OC0510 | M/L | 8.0 hr | 39 hr | 6.0, 5.0, and 10 hr | 1.67E-09 |
| L2-7 | OC0505 | L-LL/E | ~1.0 hr | 7.0 hr | 1.0, 5.0, and 10 hr | 3.37E-06 |
| L2-8 | OC0501A | L-LL/L | ~1.0 hr | 28.7 hr | 1.0, 9.3, and 9.3 hr | 1.96E-07 |
| L2-9 | OC0521B | CLASS V | 20 min | 30 min | 2.5, 3.0, and 10 hr | 3.23E-08 |
| L2-10 | OC0522 | INTACT | ~1.0 hr | 1.0 hr | 1.0, 4.0, and 10 hr | 2.71E-06 |

(1) Warning Time is the time of initial release minus the time of General Emergency declaration.

**Table F-12. MACCS2 Sensitivity Cases Results**

| Case | Description | Pop. Dose Risk (Per-rem/yr) | Δ Base | Offsite Economic Cost Risk ($/yr) | Δ Base |
|---|---|---|---|---|---|
| Base Case (2004B) | Base Case (Year 2003 MET data) | 36.0 | -- | 1.18E+05 | -- |
| MET2000 | Year 2000 MET data | 35.8 | -0.56% | 1.15E+05 | -2.54% |
| MET2001 | Year 2001 MET data | 35.1 | -2.5% | 1.14E+05 | -3.39% |
| 30INC | Year 2029 population values increased uniformly 30% over base case. | 46.3 | 28.6% | 1.46E+05 | 23.7% |
| SlowEvac | Evacuation speed decreased 50% to 0.63 mph, 0.28 m/sec (Base Case is 1.25 mph). | 39.0 | 8.33% | 1.18E+05 | 0% |
| 90Delay | Evacuation begins 90 minutes after declaration of General Emergency (Base Case is 30 minutes). | 36.5 | 1.39% | 1.18E+05 | 0% |
| CHR1 | No Intermediate Phase; Long Term Phase starts immediately after the Early Phase is over | 41.3 | 14.7% | 7.38E+04 | -37.5% |
| CHR3 | 1 Year Intermediate Phase following the Early Phase | 32.2 | -10.6% | 1.60E+05 | 35.6% |
| OCATM6 | Release height of 44.8m (top of reactor building) for high containment failure cases (H/L, L-LL/L) and intact case | 36.1 | 0.28% | 1.19E+05 | 0.85% |
| OCCROP | Site specific food production data (Base case uses national food production data) | 36.0 | < -0.1% | 1.18E+05 | 0% |

# F.4 Baseline Risk Monetization

This section explains how the monetized value of the status quo (i.e., accident consequences without SAMA implementation) is calculated. This analysis is also used to establish the maximum benefit that a SAMA could achieve if the SAMA eliminated all Oyster Creek risk.

### F.4.1 OFF-SITE EXPOSURE COST

The baseline annual off-site exposure risk was converted to dollars using the NRC's conversion factor of $2,000 per person-rem [F-2], and discounting to present value using the NRC standard formula [F-2]:

$$W_{pha} = C \times Z_{pha}$$

Where:

$W_{pha}$ = monetary value of public health risk after discounting

$C$ = $[1-\exp(-rt_f)]/r$

$t_f$ = years remaining until end of facility life = 20 years

$r$ = real discount rate (as fraction) = 0.07/year

$Z_{pha}$ = monetary value of public health (accident) risk per year before discounting ($/year)

The Level 3 analysis showed an annual off-site population dose risk of 36.0 person-rem. The calculated value for C using 20 years and a 7 percent discount rate is approximately 10.76. Therefore, calculating the discounted monetary equivalent of accident risk involves multiplying the dose (person-rem per year) by $2,000 and by the C value (10.76). The calculated present value of the off-site exposure cost is $774,929.

## F.4.2 OFF-SITE ECONOMIC COST RISK (OECR)

The Level 3 analysis showed an annual off-site economic risk of $118,000. Calculated values for off-site economic costs caused by severe accidents must be discounted to present value as well. This is performed in the same manner as for public health risks and uses the same C value. The resulting value is $1,270,022.

### F.4.3 ON-SITE EXPOSURE COST RISK

Occupational health was evaluated using the NRC methodology in Reference F-2, which involves separately evaluating "immediate" and long-term doses.

Immediate Dose - For the case where the plant is in operation, the equation that NRC recommends using [F-2] is:

Equation 1:

$$W_{IO} = R\{(FD_{IO})_S - (FD_{IO})_A\}\{[1 - \exp(-rt_f)]/r\}$$

Where:

$W_{IO}$ = monetary value of accident risk avoided due to immediate doses, after discounting

R = monetary equivalent of unit dose ($/person-rem)

F = accident frequency (events/yr)

$D_{IO}$ = immediate occupational dose (person-rem/event)

S = subscript denoting status quo (current conditions)

A = subscript denoting after implementation of proposed action

r = real discount rate

$t_f$ = years remaining until end of facility life.

The values used in the Oyster Creek analysis are:

R = $2,000/person-rem

r = 0.07

$D_{IO}$ = 3,300 person-rem/accident (best estimate, as documented in Reference F-2)

$t_f$ = 20 years (license extension period)

F = $1.05\times10^{-5}$ (total core damage frequency)

For the basis discount rate, assuming $F_A$ is zero, the best estimate of the immediate dose cost is:

$$W_{IO} = R\,(FD_{IO})_S\{[1 - \exp(-rt_f)]/r\}$$

$$= 2{,}000*1.05\times10^{-5}*3{,}300*\{[1 - \exp(-0.07*20)]/0.07\}$$

$$= \$746$$

Long-Term Dose - For the case where the plant is in operation, the NRC equation [F-2] is:

Equation 2:

$W_{LTO}$ = $R\{(FD_{LTO})_S - (FD_{LTO})_A\}\{[1 - \exp(-rt_f)]/r\}\{[1 - \exp(-rm)]/rm\}$

Where:

$W_{IO}$ = monetary value of accident risk avoided long-term doses, after discounting, $

m = years over which long-term doses accrue

The values used in the Oyster Creek analysis are:

R = $2,000/person-rem

r = 0.07

$D_{LTO}$ = 20,000 person-rem/accident (best estimate, as documented in Reference F-2)

m = "as long as 10 years"

$t_f$ = 20 years (license extension period)

F = $1.05 \times 10^{-5}$ (total core damage frequency)

For the basis discount rate, assuming $F_A$ is zero, the best estimate of the long-term dose is:

$W_{LTO}$ = $R\,(FD_{LTO})_S\{[1 - \exp(-rt_f)]/r\}\{[1 - \exp(-rm)]/rm\}$

= $2{,}000 * 1.05 \times 10^{-5} * 20{,}000 * \{[1 - \exp(-0.07*20)]/0.07\}\{[1 - \exp(-0.07*10)]/0.07*10\}$

= $3,251

Total Occupational Exposure - Combining Equations 1 and 2 above and using the above numerical values, the total accident related on-site (occupational) exposure avoided ($W_O$) is:

$W_O$ = $W_{IO} + W_{LTO}$ = ($746+ $3,251) = $3,997

## F.4.4 ON-SITE CLEANUP AND DECONTAMINATION COST - RISK

The net present value that NRC provides for cleanup and decontamination for a single event is \$1.1 billion, discounted over a 10-year cleanup period [F-2]. NRC uses the following equation to integrate the net present value over the average number of remaining service years:

$U_{CD} = [PV_{CD}/r][1-\exp(-rt_f)]$

Where:

$PV_{CD}$ = net present value of a single event

$r$ = real discount rate

$t_f$ = years remaining until end of facility life.

The values used in the Oyster Creek analysis are:

$PV_{CD} = \$1.1\times10^9$

$r = 0.07$

$t_f = 20$

The resulting net present value of cleanup integrated over the license renewal term, $\$1.18\times10^{10}$, must be multiplied by the total core damage frequency of $1.05\times10^{-5}$ to determine the expected value of cleanup and decontamination costs. The resulting monetary equivalent is \$124,312.

### F.4.5 REPLACEMENT POWER COST - RISK

Long-term replacement power costs was determined following the NRC methodology in Reference F-2. The net present value of replacement power for a single event, $PV_{RP}$, was determined using the following equation:

$$PV_{RP} = [\$1.2\times10^8/r] * [1 - \exp(-rt_f)]^2$$

Where:

$PV_{RP}$ = net present value of replacement power for a single event, ($)

$r$ = 0.07

$t_f$ = 20 years (license renewal period)

To attain a summation of the single-event costs over the entire license renewal period, the following equation is used:

$$U_{RP} = [PV_{RP} / r] * [1 - \exp(-rt_f)]^2$$

Where:

$U_{RP}$ = net present value of replacement power over life of facility ($-year)

After applying a correction factor to account for Oyster Creek's size relative to the "generic" reactor described in NUREG/BR-0184 [F-2] (i.e., 630 MWe/910 MWe), the replacement power costs are determined to be $5.46\times10^9$ ($-year). Multiplying this value by the CDF ($1.05\times10^{-5}$) results in a replacement power cost of $57,357.

## F.4.6 TOTAL COST - RISK

The sum of the baseline costs is as follows:

| | | |
|---|---|---|
| Off-site exposure cost | = | $774,929 |
| Off-site economic cost | = | $1,270,022 |
| On-site exposure cost | = | $3,997 |
| On-site cleanup cost | = | $124,312 |
| Replacement Power cost | = | $57,357 |
| Total cost | = | $2,230,616 |

This is the Maximum Averted Cost-Risk (MACR) based on internal events contributions. This is rounded to next highest thousand ($2,231,000) for SAMA calculations.

As described in section F.1.2, the internal events MACR is doubled to account for external events contributions. The resulting modified MACR (MMACR) is $4,462,000 and was used in the Phase I screening process to eliminate SAMAs that are not economically feasible. If the estimated cost of implementing a SAMA exceeded $4,462,000, it was excluded from further analysis.

Exceeding this threshold would mean that a SAMA would not have a positive net value even if it could eliminate all severe accident costs. On the other hand, if the cost of implementation is less than this value, then a more detailed examination of the potential fractional risk benefit that can be attributed to the SAMA is performed.

# F.5 Phase I SAMA Analysis

The SAMA evaluation process was discussed in Appendix F.1. It includes two "phases". This subsection discusses the Phase I evaluation process of the SAMA evaluation. This includes the following tasks:

- Identify an initial list of candidate SAMAs (Section F.5.1)
- Determine the approximate implementation costs (Section F.5.2)
- Disposition the SAMAs (Section F.5.3) by determining one of the following:
    - Applicability to Oyster Creek
    - Status at Oyster Creek of implementation
    - Cost of implementation in relation to cost-risk averted

### F.5.1 SAMA IDENTIFICATION

The SAMA identification process is described in this subsection. It includes the following sources:

- The Oyster Creek 2004B Level 1 PRA update using the CDF importance list (Section F.5.1.1)
- The Oyster Creek 2004B Level 2 PRA Update using the LERF importance list (Section F.5.1.2)
- Industry Phase II SAMA evaluations (Section F.5.1.3)
- The original Oyster Creek IPE insights (Section F.5.1.4)
- The original Oyster Creek IPEEE insights (Section F.5.1.5)
- NUREG-1742 (Section F.5.1.5)
- Oyster Creek System Managers input (Section F.5.1.6)

The SAMA identification process for Oyster Creek is primarily based on the PRA importance listings and potential improvements identified in the Oyster Creek updated PRA (2004B), the IPE, and IPEEE submittals. In addition to these plant specific sources, selected industry SAMA analyses were reviewed to identify any Phase II SAMAs from other plants that were determined to be cost beneficial. Also, a general review of the PRA model, focusing on aspects that affect results, was undertaken to identify potential improvements .The following subsections provide a more detailed description of the SAMA candidate identification process.

The SAMA identification process examines generic sources of information that address the spectrum of potential radionuclide releases. In addition, the plant specific PRA provides a method to examine the spectrum of releases using the two risk metrics: (1) CDF (See subsection F.5.1.1), and (2) LERF (See subsection F.5.1.2). The CDF changes or impacts result in changes affecting the following:

- Offsite population dose (primarily latent health effects)
- Offsite economic costs (including clean up)
- On-site clean up costs
- On-site dose effects

The LERF risk metrics result in identifying changes that impact offsite population dose (the early health effects costs).

There are also potential impacts of mitigation systems or phenomena associated with core melt progression that could influence the same averted cost risk parameters as the CDF risk metric mentioned above. These effects have been evaluated by scrutinizing the detailed Level 2 and the resulting contributors to the dominant averted cost release categories to assess whether additional SAMAs beyond those identified by CDF and LERF should be identified. Those identified for consideration are the following:

- DW sprays (enhancements for external sources or passive features)
- Inerted containment
- Filtered containment vent

These SAMAs have been previously identified and are either generically dispositioned or are explicitly addressed in the SAMA list.

#### F.5.1.1 Level 1 Oyster Creek Importance List Review

The Oyster Creek PRA update (2004) was used to generate a list of events sorted according to their Risk Reduction Worth (RRW). The top events in this list are those events that would most reduce the Oyster Creek CDF if the failure probability were set to 0.0. The events were reviewed down to the RRW of 1.01 level (FV of 0.01), which approximately corresponds to a 1 percent change in the CDF given 100 percent reliability of the event. If the dose-risk and offsite economic cost-risk were also assumed to be reduced by 1 percent, the corresponding averted cost-risk would be approximately $45,000. This includes a doubling factor to estimate the potential impact of External Events (refer to Section F.1.2). Systems, structures, or components (SSCs) with RRW less than 1.01 are not considered to be likely candidates for cost effective implementation because the implementation cost is judged to exceed this $45,000 potential maximum cost-risk. No further review of the importance listing was performed below the 1.01 level. Table F-13 documents the disposition of each event in the Level 1 Oyster Creek RRW list.

#### F.5.1.2 Level 2 Oyster Creek Importance List Review

A similar review was performed on the importance listings from the LERF results. The LERF contributors were reviewed to identify other potential SAMA.

The LERF RRW values were also reviewed down to the RRW of 1.01. As described for the Level 1 RRW list, events below the 1.01 cutoff value are estimated to yield an averted cost-risk less than $45,000 and are not considered to be likely candidates for identifying cost effective SAMAs. As such, the events with RRW values below 1.01 were not reviewed. Table F-14 documents the disposition of each event in the Level 2 Oyster Creek RRW list.

Table F-13. Level 1 Importance List Review

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| %LOOP | 4.62E-02 | 1.662 | LOSS OF OFFSITE POWER INITIATING EVENT | Switchyard work and other potential plant-centered initiators are included in the On-line maintenance review process performed for the a(4) portion of the maintenance rule program. The following SAMAs affecting %LOOP or its mitigation are identified:<br>• Bury offsite power lines (SAMA 57)<br>• Transformer protection (SAMAs 100 and 138)<br>• Make CTs more responsive (SAMAs 56, 100, 130, and 132)<br>• Cross tie of Div. 1 and 2 (SAMAs 33 and 91)<br>• Grid stability (SAMA 131)<br>No other means of reducing the LOOP frequency have been identified. |
| LOOP-IE-XW | 4.00E-02 | 1.491 | PROBABILITY OF LOOP DUE TO EXTREME WEATHER EVENT | This is a phenomenological factor for which operators have no control. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| OSPR3HR-XW | 7.43E-01 | 1.378 | FAILURE TO RECOVER OSP WITHIN 2.5 HOURS (EXTREME WEATHER LOOP EVENT) | Included as OC SAMA 130. |
| OH-IC-SBO | 9.00E-01 | 1.208 | OPERATORS FAIL TO LOCALLY OPERATE IC (LOSS OF LONG TERM DC) | Included as OC SAMAs 81 and 99. |
| C-CATF-INP | 4.40E-01 | 1.181 | CONT. CATASTOPHIC FAILURE MODE | This event relates to the ultimate capability of primary containment. Improvements to decrease failure rate are judged to involve dramatic design improvements to primary containment such that the cost far exceeds any potential benefit. |

Table F-13. Level 1 Importance List Review

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| ACP-OSP-LOCA-IND | 2.40E-02 | 1.144 | CONDITIONAL PROBABILITY OF LOOP (LOCA EVENT) | Included as OC SAMA 131. |
| DGEDG0001S | 1.40E-02 | 1.142 | DIESEL GEN. EDG-1 FAILS TO START | The EDGs are subject to an extensive testing and preventative maintenance process that is directed at maximizing system reliability. The PRA team could not identify other meaningful improvements regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 33, 56, 81, 91, 100, 109, 130, 132, 134. |
| DGEDG0002S | 1.40E-02 | 1.138 | DIESEL GENERATOR EDG-2 FAILS TO START | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| DGEDG0001R | 1.04E-02 | 1.102 | DIESEL GEN. EDG-1 FAILS TO RUN | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| DGEDG0002R | 1.04E-02 | 1.098 | DIESEL GENERTOR EDG-2 FAILS TO RUN | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |

Table F-13. Level 1 Importance List Review

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| CCFDG1DG2R | 3.86E-04 | 1.096 | CCF OF DIESEL GENERATORS TO RUN | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| CCFDG1DG2S | 3.74E-04 | 1.093 | CCF OF DIESEL GENERATORS TO START | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| OH-DEP-ICMU-DHR4 | 5.00E-07 | 1.085 | DEPENDENT HEP - FAILURE OF DHR, IC SHELL MAKEUP, AND USE OF MODE SWITCH | Addressed by SAMA 127. |
| ICWATERHMR | 5.00E-01 | 1.085 | ICs FAILED BY WATER HAMMER GIVEN HIGH RPV LEVEL | This is a phenomenological factor for which operators have no control other than to limit overfill. Plant modification and procedural improvement related to RPV level setdown has been implemented. These actions reduce the potential for an overfill event. Further, additional crew actions to address overfill prevention and mitigation are encompassed by SAMA 127. Oyster Creek could be modified to make the ICs more rugged but refitting of ICs and/or connected piping is judged to exceed the maximum benefit. |
| %RTM | 1.73E+00 | 1.07 | MANUAL SHUTDOWNS | Considered addressed by normal plant management processes. |
| SLSEALLOCA | 5.00E-02 | 1.068 | SEAL LOCA OCCURS DURING SBO | OC has installed improved recirc pump seals. The PRA team is not aware of any more reliable seals or seal configuration that could be implemented as a SAMA. Also, SAMA 106 addresses loss of component cooling contribution to seal unreliability. |
| EDEDG2--------MM | 9.96E-03 | 1.067 | DIESEL GENERATOR EDG-2 IN MAINTENANCE | Considered addressed by the maintenance rule. |

**Table F-13. Level 1 Importance List Review**

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| %MBI | 2.36E-04 | 1.066 | MEDIUM LOCA - BELOW CORE INSIDE DRYWELL | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7, and 127. |
| OH-DEP-S1 | 1.10E-01 | 1.064 | MANUAL RPV DEPRESSURIZATION (MEDIUM LOCA BELOW TAF) | Addressed by SAMAs 3 and 127. |
| RVNR108-SORV | 1.50E-01 | 1.063 | FAILURE OF EMRV TO RECLOSE ON REDUCED PRESSURE | The only options identified involved EMRV replacement with a more reliable design or addition of block valves to allow closure of the lines, as necessary. No significantly more reliable design was identified and addition of block valves is expensive and introduces competing risks. For example, block valves can increase the probability of line rupture by isolating the relief lines and can also decrease the reliability of blowdown by introducing block valve failed closed failure modes. |
| DGRECOV | 5.00E-01 | 1.062 | DIESEL GENERATOR RECOVERY WITHIN 4 HOURS | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| %RT | 1.01E+00 | 1.058 | REACTOR TRIP | Considered addressed by normal plant management processes. |
| OHECD1 | 2.90E-01 | 1.056 | OP FAILS TO OPEN CRD MANUAL BYPASS VALVE V-15-30 (BLOCK_B) | Addressed by SAMAs 92 and 127. |
| OH-DEP-SORV | 3.80E-03 | 1.056 | MANUAL RPV DEPRESSURIZATION (IORV/MLOCA ABOVE TAF) | Addressed by SAMAs 3 and 127. |
| ECEDG1--------MM | 8.07E-03 | 1.053 | DIESEL GENERATOR EDG-1 IN MAINTENANCE | Considered addressed by the maintenance rule. |

**Table F-13. Level 1 Importance List Review**

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| %LO1C | 5.53E-03 | 1.053 | LOSS OF 4160 VAC BUS 1C | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These sequences involve operation of the ICs with no support equipment. These SAMAs relate to this event indirectly. See SAMAs 81, 109. |
| %FT2A | 1.24E-02 | 1.05 | COND BAY AREA FEEDWATER FLOOD | SAMA 129 addresses internal flooding. Also, other SAMAs have been identified to reduce the impact on flood sequences of other failures, such as failure to manually depressurize, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3 and 127. |
| LOOP-IE-PC | 5.60E-01 | 1.049 | COND. PROBABILITY LOOP DUE TO PLANT CENTERED EVENT | Included as SAMA 131. |
| RVNR108-SORVNISO | 1.60E-02 | 1.045 | SORV GIVEN NON-ISOLATION EVENT OR SUCCESS OF IC | The only options identified involved EMRV replacement with a more reliable design or addition of block valves to allow closure of the lines, as necessary. No significantly more reliable design was identified and addition of block valves is expensive and introduces competing risks. For example, block valves can increase the probability of line rupture by isolating the relief lines and can also decrease the reliability of blowdown by creating block valve failed closed failure modes. |
| %LO1D | 5.53E-03 | 1.045 | LOSS OF 4160 VAC BUS 1D | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These sequences involve operation of the ICs with no support equipment. These SAMAs relate to this event indirectly. See SAMAs 81, 109. |
| OH-DEP-FW-DHR | 5.00E-07 | 1.044 | DEP. HEP - FAILURE TO CONTROL LVL, INITIATE TORUS COOLING, AND VENT CONT. | Addressed by SAMAs 3 and 127. |

**Table F-13. Level 1 Importance List Review**

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| OH-DEP-X-ICMU | 9.90E-06 | 1.04 | DEPENDENT HEP - FAILURE TO DEPRESS. RPV AND INITIATE IC MAKEUP | Addressed by SAMAs 3 and 127. |
| LOOP-IE-SW | 2.00E-01 | 1.035 | COND. PROBABILITY LOOP DUE TO SEVERE WEATHER EVENT | This is a phenomenological factor for which operators have no control. |
| GRID30MIN | 6.07E-01 | 1.035 | FAILURE TO RECOVER GRID WITHIN 30 MINUTES | Included as SAMA 132. |
| %TTRIP | 6.09E-01 | 1.035 | TURBINE TRIP | Considered addressed by normal plant management processes. |
| %LOCW | 1.93E-02 | 1.034 | LOSS OF CIRCULATING WATER | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 104, 112, and 127. |
| %LOFW | 4.39E-02 | 1.033 | LOSS OF FEEDWATER | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7, and 127. |
| ACP-OSP-TRANS | 2.40E-03 | 1.032 | CONDITIONAL PROBABILITY OF LOOP (TRANSIENT EVENT) | Included as SAMA 131. |
| QMSCRAMFAIL | 2.10E-06 | 1.03 | MECHANICAL SCRAM FAILURE (Qm) | Reactor SCRAM reliability has been the subject of extensive industry review. The PRA team is not aware of any outstanding alternatives for increasing mechanical SCRAM reliability. The PRA team could not identify a meaningful improvement regarding this failure mode. |
| OSPR30MIN-PC | 5.68E-01 | 1.03 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (PLANT CENTERED LOOP EVENT) | Included as SAMA 132. |

**Table F-13. Level 1 Importance List Review**

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| %MAIMS | 1.63E-03 | 1.025 | MEDIUM LOCA - ABOVE CORE INSIDE DRYWELL | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize and/or provide alternate injection, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7, and 127. |
| OH-DEP-X-ICMU2 | 1.20E-05 | 1.024 | DEP. HEP - FAILURE TO DEPRESS. RPV AND ALIGN FPS FOR IC MU | Addressed by SAMAs 3, 94, and 127. |
| LOOP-IE-GR | 2.00E-01 | 1.023 | COND. PROBABILITY LOOP DUE TO GRID RELATED EVENT | This is a phenomenological factor for which operators have no control. |
| CT-OP-1AND2 | 5.80E-02 | 1.023 | BOTH CTS INITIALLY OPERATING | Included as SAMA 132. |
| %SBI | 5.43E-03 | 1.023 | SMALL LOCA - BELOW CORE INSIDE DRYWELL | This is a relatively small contributor and is unlikely to have a cost beneficial method of removing this failure mode. In addition, the PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3 and 127. |
| OSPR30MIN-XW | 8.51E-01 | 1.022 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (EXTREME WEATHER LOOP EVENT) | Included as SAMA 130. |
| CT52G001R | 9.02E-02 | 1.022 | Combustion turbine NO 1 fails | This is a relatively small contributor and is unlikely to have a cost beneficial method of removing this failure mode. In addition, the PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109. |

Table F-13. Level 1 Importance List Review

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| %LOFC | 1.69E-01 | 1.02 | LOSS OF FEEDWATER CONTROL (HIGH LEVEL) | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7, and 127. |
| CV0390001D | 7.60E-05 | 1.017 | CHECK VALVE V-39-1 FAILS TO OPEN ON DEMAND | Related to fuel oil for EDGs. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109. |
| CCG02MCA------MM | 1.40E-02 | 1.016 | CONTAINMENT SPRAY SYSTEM 2 IN MAINTENANCE | Considered addressed by the maintenance rule. |
| RVNR108-SORVISO | 5.40E-02 | 1.015 | SORV GIVEN ISOLATION EVENT AND FAILURE OF IC | This is a relatively small contributor and is unlikely to have a cost beneficial method of removing this failure mode. In addition, the only options identified involved EMRV replacement with a more reliable design or addition of block valves to allow closure of the lines, as necessary. No significantly more reliable design was identified and addition of block valves is expensive and introduces competing risks. For example, block valves can increase the probability of line rupture by isolating the relief lines and can also decrease the reliability of blowdown by creating block valve failed closed failure modes. |
| OSPR8HR-XW | 6.30E-01 | 1.015 | FAILURE TO RECOVER OSP WITHIN 8 HOURS (EXTREME WEATHER LOOP EVENT) | Included as OC SAMA 130. |
| OSPR8HR-SW | 2.59E-01 | 1.015 | FAILURE TO RECOVER OSP WITHIN 8 HOURS (SEVERE WEATHER LOOP EVENT) | Included as OC SAMA 130. |

**Table F-13. Level 1 Importance List Review**

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| OH-DEP-CS | 2.70E-04 | 1.015 | DEPENDENT HEP - FAILURE TO CONTROL MIN. FLOW VIA CS A AND B | Addressed by SAMA 127. |
| FNEFSF10021RCC | 4.73E-04 | 1.015 | Exhaust fan FN56-21 & supply fan FN-56-21 fail to run due to CCF | Switchgear room cooling failure. ARP T-6-a provides annunciator response for high room temperature. Procedure 328 provides system level direction to open doors to promote natural circulation and to use portable fans as necessary. PRA team could identify no additional meaningful procedure or plant modifications to directly relate to this failure mode. (See SAMA 77.) However, manual IC operation appears in the same cutset and is addressed by SAMA 81. |
| CT52G002R | 9.02E-02 | 1.015 | Combustion turbine NO 2 fails | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109. |
| OH-DEP-X-FW | 1.10E-05 | 1.014 | DEPENDENT HEP - FAILURE TO DEPRESS. RPV AND IMPLEMENT RPV LEVEL CONTROL | Addressed by SAMAs 3 and 127. |
| LPCOMBTURB2---MM | 1.25E-01 | 1.014 | COMBUSTION TURBINE 2 UNAVAILABLE DUE TO MAINTENANCE | Considered addressed by the maintenance rule. |
| OSPR30MIN-SW | 7.46E-01 | 1.013 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (SEVERE WEATHER LOOP EVENT) | Included as OC SAMA 130. |
| OHEOF1 | 7.20E-01 | 1.013 | OPERATOR FAILS TO RECOVER FROM FEED REG VALVE LOCKUP | Addressed by SAMA 127. |
| OH-DEP-ICMU-DHRD | 5.00E-07 | 1.013 | DEP. HEP - FAILURE TO INITIATE IC MU AND INITIATE TORUS COOL, AND VENT CONT. | Addressed by SAMA 127. |

Table F-13. Level 1 Importance List Review

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| EBXR34500SBR--MM | 8.97E-04 | 1.013 | START UP TRANSFORMER SB FAILS DURING OPERATION IN MAINTENANCE | Considered addressed by the maintenance rule. |
| OSPR30MIN-GR | 7.04E-01 | 1.012 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (GRID RELATED LOOP EVENT) | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| CCCB01A1BO | 1.47E-05 | 1.012 | CCF OF BREAKERS 1A AND 1B TO OPEN ON DEMAND | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, 134. |
| %SAI | 3.23E-03 | 1.012 | SMALL LOCA - ABOVE CORE INSIDE DRYWELL | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize and/or provide alternate injection, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7, and 127. |
| %FT2BL | 3.11E-03 | 1.012 | COND BAY AREA LARGE CW FLOOD | SAMA 129 addresses internal flooding. Also, other SAMAs have been identified to reduce the impact on flood sequences of other failures, such as failure to manually depressurize, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3 and 127. |
| %FT2B | 3.06E-03 | 1.012 | COND BAY AREA VERY LARGE CW FLOOD | SAMA 129 addresses internal flood. Also, other SAMAs have been identified to reduce the impact on flood sequences of other failures, such as failure to manually depressurize, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3 and 127. |

Table F-13. Level 1 Importance List Review

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| EAXR34500SAR--MM | 7.46E-04 | 1.011 | START UP TRANSFORMER SA FAILS DURING OPERATION IN MAINTENANCE | Considered addressed by the maintenance rule. |
| CB4KV001DT | 1.99E-05 | 1.011 | BREAKER 1D TRANSFERS OPEN | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios and operation of ICs without support. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, and 130. |
| CB4KV001CT | 1.99E-05 | 1.011 | BREAKER 1C TRANSFERS OPEN | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios and operation of ICs without support. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, and 130. |
| OSPR8HR-PC | 6.40E-02 | 1.01 | FAILURE TO RECOVER OSP WITHIN 8 HOURS (PLANT CENTERED LOOP EVENT) | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 99, and 109. |
| OSPR25HR-XW | 4.90E-01 | 1.01 | FAILURE TO RECOVER OSP WITHIN 25 HOURS (EXTREME WEATHER LOOP EVENT) | The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, 109, 130, 132, and 134. |
| OH-DEP-TR | 1.95E-04 | 1.01 | MANUAL RPV DEPRESSURIZATION (TRANSIENT) | Addressed by SAMAs 3 and 127. |

**Table F-13. Level 1 Importance List Review**

| Event Name | Probability | RRW | Description | SAMA Discussion |
|---|---|---|---|---|
| %LBI | 1.83E-04 | 1.01 | LARGE LOCA - BELOW CORE INSIDE DRYWELL | This is a relatively small contributor and is unlikely to have a cost beneficial method of removing this failure mode. In addition, the PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 7 and 127. |
| OH-DEP-AT | 1.10E-01 | 1.009 | MANUAL RPV DEPRESSURIZATION (ATWS) | Addressed by SAMAs 3 and 127. |
| %PLOFW | 1.71E-01 | 1.009 | LOSS OF RPV LEVEL CONTROL (LOW) | Addressed by SAMAs 3 and 127. |
| %LOIS | 5.12E-03 | 1.009 | LOSS OF INTAKE FLOW DUE TO GRASSING | Addressed by SAMA 112. |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| %LOOP | 4.62E-02 | 2.071 | LOSS OF OFFSITE POWER INITIATING EVENT | No SAMA for reducing loss of offsite power frequency have been identified. However, SAMA 132 addresses improved recovery likelihood. |
| GVSY-GVFAIL-F-- | 1.00E+00 | 2.03 | FAILURE OF GV (CLASSES IBE, IBL) | SAMA 84 |
| LOOP-IE-XW | 4.00E-02 | 1.854 | PROBABILITY LOOP DUE TO EXTREME WEATHER EVENT | No SAMA for making offsite power more rugged have been identified. However, modifying CT structure has been considered, SAMA 130. |
| AC-L2-OP-SL | 7.40E-01 | 1.804 | OP FAILS TO RESTORE AC POWER DURING BOIL-OFF (EARLY) - SEAL LOCA OR DC FAILS | SAMAs 127 and 132. |
| OSPR3HR-XW | 7.43E-01 | 1.738 | FAILURE TO RECOVER OSP WITHIN 2.5 HOURS (EXTREME WEATHER LOOP EVENT) | SAMAs 127, 130, and 132. |
| OH-DEP-ALTD | 1.00E+00 | 1.731 | ALTERNATE DEPRESS. METHODS NOT CREDITED | SAMA 3 |
| OPPH-PRESBK-F-- | 9.90E-01 | 1.731 | NO PRESSURE INDUCED FAILURE OF PRIMARY SYSTEM | This is a success term included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| OPPH-SORV---F-- | 4.10E-01 | 1.731 | INDUCED SORV | No means for cost-effective improvement of EMRV ruggedness have been identified. The only options identified involved EMRV replacement with a more reliable design or addition of block valves to allow closure of the lines, as necessary. No significantly more reliable design was identified and addition of block valves is expensive and introduces competing risks. For example, block valves can increase the probability of line rupture by isolating the relief lines and can also decrease the reliability of blowdown by introducing block valve failed closed failure modes. |
| OPPH-TEMPBK-F-- | 5.00E-01 | 1.731 | NO HIGH TEMP. INDUCED FAILURE OF PRIMARY SYS | This is a success term included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |
| OP-SEAL | 9.00E-01 | 1.731 | RECIRC PUMP SEAL DOES NOT FAIL | This is a success term included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |
| AC-L2-SI-SL | 4.40E-01 | 1.558 | COND. PROB. OF NO AC RECOVERY FOR SI TIME FRAME (EARLY) - SEAL LOCA OR DC FAILS | SAMAs 127 and 132. |
| L2GVINERT | 9.85E-01 | 1.553 | CONTAINMENT INERTED; VENTING NOT REQUIRED | This is a success term included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |
| ACP-OSP-LOCA-IND | 1.00E+00 | 1.479 | CONDITIONAL PROBABILITY OF LOOP (LOCA EVENT) | SAMA 131 |
| OPPH-OP3-NOTFSU | 2.40E-02 | 1.479 | SUCCESSFUL RPV DEPRESSURIZATION (CLASS III) | This is a success term included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |
| SIHU-RCVR---H-- | 9.00E-01 | 1.422 | FAILURE TO RECOVER A WATER SYSTEM | SAMAs 2, 7, 111, and 127 |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| SIPH-SUMPOV-F-- | 1.00E+00 | 1.422 | MELT OVERFLOWS SUMP | OC Sump cannot contain a complete core melt. No means for cost-effective improvement of sump have been identified. |
| SI-SHELL-SAFE | 6.30E-01 | 1.422 | SHELL FAILS: NO WATER | No means for cost-effective improvement of shell have been identified. Benefit of water is addressed for basic event SIHU-RCVR---H--, above. |
| SIPHBARRIS-F-- | 7.50E-01 | 1.411 | DW BARRIERS FAIL TO PREVENT DEBRIS FROM CONTACTING SHELL | Cost-effective improvement of internal drywell barriers have not been identified. Benefit of water is addressed for basic event SIHU-RCVR---H--, above. |
| GRID30MIN | 6.07E-01 | 1.267 | FAILURE TO RECOVER GRID WITHIN 30 MINUTES | SAMA 132 |
| DGEDG0001S | 1.40E-02 | 1.251 | DIESEL GEN. EDG-1 FAILS TO START | The diesel generator reliability is considered very good. Further improvements in the reliability are not considered feasible. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |
| DGEDG0002S | 1.40E-02 | 1.235 | DIESEL GENERATOR EDG-2 FAILS TO START | The diesel generator reliability is considered very good. Further improvements in the reliability are not considered feasible. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |

**Table F-14. Level 2 Importance List Review (Based on LERF RRW)**

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| CCFDG1DG2R | 3.86E-04 | 1.187 | CCF OF DIESEL GENERATORS TO RUN | The common cause failure of the diesels is a relatively small probability. Further reduction in the CCF probability are not considered cost effective. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |
| CCFDG1DG2S | 3.74E-04 | 1.18 | CCF OF DIESEL GENERATORS TO START | The common cause failure of the diesels is a relatively small probability. Further reduction in the CCF probability are not considered cost effective. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |
| DGEDG0001R | 1.04E-02 | 1.173 | DIESEL GEN. EDG-1 FAILS TO RUN | The diesel generator reliability is considered very good. Further improvements in the reliability are not considered feasible. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOOP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| DGEDG0002R | 1.04E-02 | 1.162 | DIESEL GENERTOR EDG-2 FAILS TO RUN | The diesel generator reliability is considered very good. Further improvements in the reliability are not considered feasible. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |
| %SBI | 5.43E-03 | 1.153 | SMALL LOCA - BELOW CORE INSIDE DRYWELL | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize and/or provide alternate injection, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 2, 3, 7, and 127. |
| EDEDG2--------MM | 9.96E-03 | 1.114 | DIESEL GENERATOR EDG-2 IN MAINTENANCE | Addressed by maintenance rule. |
| OPPH-OPE-NOTFSU | 8.60E-01 | 1.112 | SUCCESSFUL RPV DEPRESSURIZATION (CLASS IBE) | SAMA 3. |
| LERF-COND-PROB | 1.00E+00 | 1.101 | CONDITIONAL PROBABILITY FOR HIGH/EARLY RELEASE (CLASS V) | No SAMA for allowing containment bypass sequences to be re-binned have been identified. |
| RXRX-FRECINJH-- | 9.00E-01 | 1.091 | OPERATOR FAILS TO RECOVER INJECTION BEFORE RPV MELT | SAMA 127 |
| ECEDG1--------MM | 8.07E-03 | 1.089 | DIESEL GENERATOR EDG-1 IN MAINTENANCE | Addressed by maintenance rule. |

**Table F-14. Level 2 Importance List Review (Based on LERF RRW)**

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| %SAI | 3.23E-03 | 1.085 | SMALL LOCA - ABOVE CORE INSIDE DRYWELL | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize and/or provide alternate injection, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 2, 3, 7, and 127. |
| CZPH-VBRKFCAF-- | 1.40E-02 | 1.085 | ONE VACUUM BREAKER FAILS TO CLOSE DURING ACCIDENT | SAMA 68 |
| CZPH-DEIN-O2F-- | 1.50E-02 | 1.082 | OPERATION DEINERTED OR O2 INTRODUCED | An inerted containment provides an effective method to prevent containment failure due to combustible gas deflagration. The plant minimizes the time deinerted. Increasing the time deinerted results in a direct increase in LERF because early large releases are likely if combustible gases are not effectively controlled. No feasible SAMA for changing the technical specification allowed operation De-inerted during start-up and shutdown have been identified. No feasible SAMA to reduce potential for O2 introduction have been identified. |
| CZPH-H2-DEFGF-- | 1.00E+00 | 1.082 | HYDROGEN DEFLAGATION OCCURS GLOBALLY | SAMA 6 |
| CZPH-STMINRTF-- | 5.00E-01 | 1.082 | CONTAINMENT NOT STEAM INERTED | No feasible SAMA for increasing the likelihood of this phenomenological factor have been identified. |
| F-CMBUST-GAS-VNT | 1.00E+00 | 1.082 | COMBUSTIBLE GAS VENTING FAILS | SAMA 84 |
| SLSEALLOCA | 5.00E-02 | 1.079 | SEAL LOCA OCCURS DURING SBO | OC has installed improved recirc pump seals and PRA team is not aware of any more reliable seals or seal configuration. |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| %MAIMS | 1.63E-03 | 1.068 | MEDIUM LOCA - ABOVE CORE INSIDE DRYWELL | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize and/or provide alternate injection, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7, and 127. |
| LOOP-IE-PC | 5.60E-01 | 1.042 | COND. PROBABILITY LOOP DUE TO PLANT CENTERED EVENT | SAMA 131 |
| QMSCRAMFAIL | 2.10E-06 | 1.037 | MECHANICAL SCRAM FAILURE (Qm) | The PRA team could not identify a meaningful improvement regarding this failure mode. |
| OSPR30MIN-PC | 5.68E-01 | 1.034 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (PLANT CENTERED LOOP EVENT) | SAMAs 127 and 132. |
| CT-OP-1AND2 | 5.80E-02 | 1.03 | BOTH CTS INITIALLY OPERATING | SAMA 132. |
| CV0390001D | 7.60E-05 | 1.03 | CHECK VALVE V-39-1 FAILS TO OPEN ON DEMAND | Related to fuel oil for EDGs. The PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |
| OSPR30MIN-XW | 8.51E-01 | 1.03 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (EXTREME WEATHER LOOP EVENT) | SAMAs 127, 130, and 132. |

**Table F-14. Level 2 Importance List Review (Based on LERF RRW)**

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| %MBI | 2.36E-04 | 1.029 | MEDIUM LOCA - BELOW CORE INSIDE DRYWELL | The PRA team could not identify a meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize and/or provide alternate injection, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7, and 127. |
| PI-CONTF | 2.70E-03 | 1.027 | Pre-Existing Containment Boundary Failure | Existing methods of inspection and testing of the containment boundary ensure that containment isolation remains a very small contributor to the risk profile. No feasible SAMA for increasing the likelihood of this phenomenological factor have been identified. |
| %LBI | 1.83E-04 | 1.025 | LARGE LOCA - BELOW CORE INSIDE DRYWELL | LOCAs contribute to the small residual risk at Oyster Creek. This fact reinforces the need for continued vigilance in the in-service inspection (ISI) program. Oyster Creek has an effective ISI program. The PRA team could not identify additional meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 7 and 127. |
| %LAIMS | 3.02E-04 | 1.024 | STEAM OR FEEDWATER LINE BREAK IN DRYWELL | LOCAs contribute to the small residual risk at Oyster Creek. This fact reinforces the need for continued vigilance in the in-service inspection (ISI) program. Oyster Creek has an effective ISI program. The PRA team could not identify additional meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 7 and 127. |

**Table F-14. Level 2 Importance List Review (Based on LERF RRW)**

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| %SAOIC | 5.91E-03 | 1.024 | SMALL ABOVE CORE BREAK (IC TUBE) | LOCAs contribute to the small residual risk at Oyster Creek. This fact reinforces the need for continued vigilance in the in-service inspection (ISI) program. Oyster Creek has an effective ISI program. The PRA team could not identify additional meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures, such as failure to manually depressurize and/or provide alternate injection, in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 2, 3, 7, and 127. |
| AC-L2-OPL | 8.30E-01 | 1.024 | OPERATOR FAILS TO RESTORE AC POWER DURING BOIL-OFF (LATE) | SAMAs 127 and 132. |
| AC-L2-SIL | 7.10E-01 | 1.024 | CONDITIONAL PROB. OF NO AC RECOVERY FOR SI TIME FRAME (LATE) | SAMAs 127 and 132. |
| RVNR108-SORV | 1.50E-01 | 1.024 | FAILURE OF EMRV TO RECLOSE ON REDUCED PRESSURE | The only options identified involved EMRV replacement with a more reliable design or addition of block valves to allow closure of the lines, as necessary. No significantly more reliable design was identified and addition of block valves is expensive and introduces competing risks. For example, block valves can increase the probability of line rupture by isolating the relief lines and can also decrease the reliability of blowdown by creating block valve failed closed failure modes. |

**Table F-14. Level 2 Importance List Review (Based on LERF RRW)**

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| %LAOIC | 1.44E-04 | 1.022 | IC STEAMLINE BREAK IN REACTOR BUILDING | LOCAs contribute to the small residual risk at Oyster Creek. This fact reinforces the need for continued vigilance in the in-service inspection (ISI) program. Oyster Creek has an effective ISI program. The PRA team could not identify additional meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 7 and 127. |
| OH-DEP-S1 | 1.10E-01 | 1.021 | MANUAL RPV DEPRESSURIZATION (MEDIUM LOCA BELOW TAF) | SAMA 3. |
| OH-L2-FPS | 5.40E-01 | 1.02 | OP FAILS TO ALIGN ALT. INJ. SOURCES IN LEVEL 2 | SAMA 127. |
| LOOP-IE-SW | 2.00E-01 | 1.017 | COND. PROBABILITY LOOP DUE TO SEVERE WEATHER EVENT | No SAMA for making offsite power more rugged have been identified. However, modifying CT structure has been considered, SAMA 130. |
| OPPH-OP1-NOTFSU | 8.40E-01 | 1.016 | SUCCESSFUL RPV DEPRESSURIZATION (CLASS IA, IE) | SAMA 3. |
| SSECCSSUCTIONLOC | 1.00E-04 | 1.016 | ECCS SUCTION STRAINER FAILURE (LOCA EVENTS) | Oyster Creek has implemented a redesigned ECCS suction strainer to dramatically decrease the probability of clogging of the suction strainer. In addition, the cleanliness of the torus water has been significantly improved. No feasible SAMA for further improving ECCS suction strainer reliability have been identified but providing additional injection not dependent on the suction strainers is included as SAMA 7. |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| ICWATERHMR | 5.00E-01 | 1.015 | ICs FAILED BY WATER HAMMER GIVEN HIGH RPV LEVEL | This is a phenomenological factor for which operators have no control other than to limit overfill. Limiting overfill operator action is Addressed by SAMA 127. Plant could be modified to make the ICs more rugged but refitting of ICs and/or connected piping is judged to exceed the maximum benefit. |
| LOOP-IE-GR | 2.00E-01 | 1.015 | COND. PROBABILITY LOOP DUE TO GRID RELATED EVENT | SAMA 131. |
| OHECD1 | 2.90E-01 | 1.015 | OP FAILS TO OPEN CRD MANUAL BYPASS VALVE V-15-30 (BLOCK_B) | SAMA 127. |
| OH-DEP-SORV | 3.80E-03 | 1.014 | MANUAL RPV DEPRESSURIZATION (IORV/MLOCA ABOVE TAF) | SAMAs 3 and 127. |
| %LAICS | 1.64E-04 | 1.013 | CORE SPRAY LINE BREAK INSIDE DRYWELL | LOCAs contribute to the small residual risk at Oyster Creek. This fact reinforces the need for continued vigilance in the in-service inspection (ISI) program. Oyster Creek has an effective ISI program. The PRA team could not identify additional meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 7 and 127. |
| OH-IC-SBO | 9.00E-01 | 1.013 | OPERATORS FAIL TO LOCALLY OPERATE IC (LOSS OF LONG TERM DC) | SAMA 99. |
| OSPR30MIN-GR | 7.04E-01 | 1.013 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (GRID RELATED LOOP EVENT) | SAMAs 127 and 132. |
| OSPR30MIN-SW | 7.46E-01 | 1.013 | FAILURE TO RECOVER OSP WITHIN 30 MINUTES (SEVERE WEATHER LOOP EVENT) | SAMAs 127, 130, and 132. |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| %FT2A | 1.24E-02 | 1.012 | COND BAY AREA FEEDWATER FLOOD | SAMA 129 addresses internal flooding. Also, other SAMAs have been identified to reduce the impact on flood sequences of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 3, 7 and 127. |
| MISLBB | 5.00E-01 | 1.012 | IC BREAK AFFECTS ISOLATION CONDENSER B | LOCAs contribute to the small residual risk at Oyster Creek. This fact reinforces the need for continued vigilance in the in-service inspection (ISI) program. Oyster Creek has an effective ISI program. The PRA team could not identify additional meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 7 and 127. |
| RVNR108-SORVISO | 1.60E-02 | 1.012 | SORV GIVEN ISOLATION EVENT AND FAILURE OF IC | The only options identified involved EMRV replacement with a more reliable design or addition of block valves to allow closure of the lines, as necessary. No significantly more reliable design was identified and addition of block valves is expensive and introduces competing risks. For example, block valves can increase the probability of line rupture by isolating the relief lines and can also decrease the reliability of blowdown by creating block valve failed closed failure modes. |
| RVNR108-SORVNISO | 5.40E-02 | 1.012 | SORV GIVEN NON-ISOLATION EVENT OR SUCCESS OF IC | The only options identified involved EMRV replacement with a more reliable design or addition of block valves to allow closure of the lines, as necessary. No significantly more reliable design was identified and addition of block valves is expensive and introduces competing risks. For example, block valves can increase the probability of line rupture by isolating the relief lines and can also decrease the reliability of blowdown by creating block valve failed closed failure modes. |

Table F-14. Level 2 Importance List Review (Based on LERF RRW)

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| ACP-OSP-TRANS | 2.40E-03 | 1.011 | CONDITIONAL PROBABILITY OF LOOP (TRANSIENT EVENT) | SAMA 131. |
| CFE-TNK-VF-HITMP | 1.00E-05 | 1.011 | SUPPRESSION POOL WATER UNAVAILABLE DUE TO HIGH WATER TEMP | SAMAs 7, 18, and 111. |
| CFE-TNK-VF-LOLVL | 1.00E-05 | 1.011 | SUPPRESION POOL WATER LEVEL BELOW DOWNCOMERS | SAMAs 7, 18, and 111. |
| MISLBA | 5.00E-01 | 1.011 | IC BREAK AFFECTS ISOLATION CONDENSER A | LOCAs contribute to the small residual risk at Oyster Creek. This fact reinforces the need for continued vigilance in the in-service inspection (ISI) program. Oyster Creek has an effective ISI program. The PRA team could not identify additional meaningful improvement regarding this failure mode. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 7 and 127. |
| OH-DEP-X-ICMU | 9.90E-06 | 1.011 | DEPENDENT HEP - FAILURE TO DEPRESS. RPV AND INITIATE IC MAKEUP | SAMA 127 |
| 1DIDW-CONTFL-F-- | 1.00E+00 | 1.01 | DW NOT INTACT DUE TO LOSS OF VSS OR ATWS (CLASS IIID, IV) | This is a flag marker type basic event included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |
| 1NCPH-L1CNTFLF-- | 1.00E+00 | 1.01 | LG CONT. FAILURE GIVEN CONT. FAILED IN LEVEL 1 (CLASS II, IIID, IV) | This is a flag marker type basic event included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |

**Table F-14. Level 2 Importance List Review (Based on LERF RRW)**

| Event Name | Probability | RRW | Description | Potential SAMAs |
|---|---|---|---|---|
| CT52G001R | 9.02E-02 | 1.01 | Combustion turbine NO 1 fails | This is a relatively small contributor and is unlikely to have a cost beneficial method of removing this failure mode. In addition, the PRA team could not identify a meaningful improvement regarding this failure mode which relates to mitigation of LOSP/SBO scenarios. However, other SAMAs have been identified to reduce the impact of other failures in sequences where this basic event appears. These SAMAs relate to this event indirectly. See SAMAs 81, 91, and 109. |
| RXSY-RXFAIL-F-- | 1.00E+00 | 1.01 | FAILURE OF RX (CLASSES II, IIID, IV) | This is a flag marker type basic event included in the model to allow for appropriate endstate binning. No specific failure applies for SAMA consideration. |
| CZPH-VBRKFRCF-- | 2.00E-03 | 1.009 | ONE VACUUM BREAKER FAILS TO REMAIN CLOSED | SAMA 68. |
| OH-CSS-VSS-S1 | 4.10E-02 | 1.009 | DW SPRAY INITIATION MEDIUM LOCA WITH VSS FAIL | SAMA 111 |
| OH-CT-30M | 2.10E-02 | 1.009 | OPS FAIL TO START AND ALIGN CTS WITHIN 30 MIN. | SAMA 127. |

### F.5.1.3 Industry Phase II SAMAs

Phase II SAMAs are those plant changes that require more detailed analysis than what is performed in the Phase I screening process for proper disposition. While many of these SAMAs are shown not to be cost-beneficial, some are close contenders and a small number have been shown to be cost-beneficial at other plants. Use of the Oyster Creek importance ranking should identify the types of changes that would most likely be cost beneficial for Oyster Creek, but review of selected industry Phase II SAMAs may capture potentially important changes not identified for Oyster Creek due to PRA modeling differences. Given this potential, it was considered prudent to include a review of selected industry Phase II SAMAs in the Oyster Creek SAMA identification process.

The Phase II SAMAs from the following U.S. nuclear sites have also been reviewed:

- Monticello [F-13]
- Dresden [F-7]
- Quad Cities [F-8]
- Peach Bottom [F-6]
- Nine Mile Point Unit 1 [F-11]

The above selection of five BWR sites is chosen from similar BWRs with available documentation to serve as one of the Phase I SAMA sources for Oyster Creek. Two of these sites use Isolation Condensers. Not all of the Phase II SAMAs from these sources need to be included in the initial SAMA list. For example, many of the industry Phase II SAMAs are already represented by other SAMAs in the plant specific list, or if the industry Phase II SAMA indicated it to be a large non-cost beneficial change it can be judged that they would not be close contenders for Oyster Creek.

### F.5.1.4 Oyster Creek IPE

Performance of the Oyster Creek IPE generated a list of risk-based insights and potential plant improvements. Typically, changes identified in the IPE process are implemented and closed; however, there are some items that are not completed due to high projected costs or other criteria. As the criteria for implementation of a SAMA may be different than what was used in the post IPE decision-making process, these SAMAs are re-examined in this analysis. Eight improvements were not verified complete and were added to the SAMA list. These SAMAs include:

- Connection of the fire protection system to drywell spray (SAMA 111)
- Increased training on the importance of the core spray system (SAMA 127)
- Programs instituted to reduce blockage and fouling of the isolation condensers (SAMA 128)

- Increased emphasis in training on key operator actions as defined by the IPE (SAMA 127)
- Consideration of alternate containment heat removal capability to maintain minimal NPSH as part of accident management (SAMA 18)
- Alternate water supply for drywell sprays (SAMA 111)
- Internal Flooding Procedure Enhancements (SAMA 129)
- Addition of a Portable DC Charger (SAMA 109)

### F.5.1.5 Oyster Creek IPEEE

Similar to the IPE, the Oyster Creek IPEEE generated a list of risk-based insights and potential plant improvements. As the criteria for implementation of a SAMA may be different than what was used in the post IPEEE decision-making process, these SAMAs are re-examined in this analysis. Thirteen improvements were added to the Phase I SAMA list. These SAMAs include:

- Ensure all bolts on the Forked River combustion turbine fin-fan coolers are installed and torqued properly. (SAMA 114)
- Consider the addition of battery spacers in the CT battery compartments. (SAMA 115)
- Review current housekeeping policy/procedures and walk-down plant to review housekeeping and controls for transient combustibles. (SAMA 116)
- Consider upgrading the high pressure CO2 system in the turbine building. These cylinders could potentially become missiles. (SAMA 117)
- Consider additional support of a small oil filter on the Turbine generator hydrogen seal oil unit. The unit is supported by a vertical stanchion but has no lateral support. (SAMA 118)
- Review the basis for the Arrowhead demineralizer trailer. During the IPEEE walkdowns the anchorage chain was not attached to the embedded eyehook. (SAMA 119)
- Consider anchoring the high pressure generator purge CO2 rack outside the turbine building. This rack can become a missile. (SAMA 120)
- Consider replacement of fire protection drop-weight actuated deluge valves. Following a seismic event these valves could spuriously actuate and cause flow diversion of fire water and/or spurious spray of critical equipment. (SAMA 121)
- Consider training fire brigade and operators on dominant fire scenarios. (SAMA 122)
- The following relays had chatter HCLPF <0.3 g and should be considered for replacement: PNL-ER18A-2HFA51A, PNL-ER8A-2HFA51A, PNL-ER8B-2HFA51A. (SAMA 123)

- Block wall 53 has a HCLPF of 0.27g and should be considered for reinforcement. This block wall can impact 125 VDC. (SAMA 124)
- A fire in the cable spreading room can have a number of impacts. Rerouting cable or installing fire barriers can reduce the impacts of the fire. (SAMA 125)
- A fire in the 480 VAC "A" Switchgear room can have a number of impacts. Rerouting cable or installing fire barriers can reduce the impacts of the fire. (SAMA 125)

### F.5.1.6 Oyster Creek System Manager Inputs

The Oyster Creek system managers provided input into both the PRA and the SAMA process in two ways:

1. The system managers were interviewed as part of the PRA update process. This interview process yielded both information regarding the Oyster Creek system models and also served to identify issues related to the systems that could be enhanced via a procedure or plant modification.
2. The system managers reviewed the SAMA list of the DRAFT Appendix F and provided revised cost estimates and additional SAMAs to factor into the evaluation.

Therefore, the system managers helped identify SAMAs through participation in each of the two separate process elements.

### F.5.2 APPROXIMATE IMPLEMENTATION COSTS

The implementation costs associated with the identified SAMAs are developed from a variety of sources:

- Generic estimates
- Other similar plant estimates
- Plant specific estimates (e.g., system managers' input)
- Engineering judgment

### F.5.3 PHASE I ANALYSIS

The initial list of SAMA candidates is presented in Table F-15 for consideration in a Phase I cost benefit screening evaluation. This list was developed as described in Section F.5.1 and is used as the starting point for the Oyster Creek SAMA review. The screening process used in this analysis is summarized in Figure F-1.

The purpose of the Phase I analysis is to use high level knowledge of the plant and SAMAs to preclude the need to perform detailed cost-benefit analyses for each candidate SAMA. The following criteria are used in the Phase I analysis to eliminate SAMAs from further consideration:

- Applicability to the Plant (N/A): If a proposed SAMA does not apply to the Oyster Creek design, it is not retained. For example, inclusion of an improved ESW method for D/G cooling would not require further analysis for a plant like Oyster Creek that has air cooled diesel generators.

- Cost (C): If a SAMA requires extensive changes that are known to exceed any possible benefit, they are screened without developing an estimated cost of implementation. For example, the cost of installing an additional, buried offsite power source over a path of fifty miles is known to exceed any potential benefit and would be immediately disqualified. A present value screening averted cost risk of $4,462,000 is used when compared to the cost of an improvement (See section F.4).

- Already Implemented at Oyster Creek (D): If an improvement has already been implemented at Oyster Creek, it is screened from further consideration.

- Cost Exceeds Benefit (F): If the cost obviously exceeds the benefit or if the benefit is negligible, the SAMA is screened from further consideration.

- Addressed by a Similar Item (I): If a SAMA is included within another SAMA, it is screened if the other item completely subsumes it.

Those retained (R) for further evaluation are identified with a "Yes" in the last column.

While Table F-15 provides the initial screening (Phase I), the sensitivity cases described in Section F-7 provide variations in the inputs to Table F-15 that require reassessment. Therefore, in addition, to the baseline review of Table F-15, there are two additional reviews of the disposition of these SAMAs based on:

- Change in real discount rate

- Use of upper CDF uncertainty bound (95% bound)

Table F-15 provides a description of how each SAMA is dispositioned in Phase I. Those SAMAs that are not screened out and require a more detailed assessment are transferred to Phase II and are evaluated in Section F.6.

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 1 | Enhanced DC Power Availability | DC power availability is important for several reasons at another BWR, including 1) maintaining high pressure injection, 2) maintaining low pressure injection (SRVs as well as control power), and 3) supporting containment venting. These functions are important for several accident scenarios and improving DC availability could reduce the risk resulting from failure of each of them. Several options are available to improve DC availability, including:<br>a) Provide an independent battery for SRVs and Hard Pipe Vent (HPV)<br>b) Provide a portable generator to support SRVs and HPV<br>c) Proceduralize use of car batteries for SRVs and bypass HPV DC dependency with manual vent control<br>d) Practice and test separate DC generator backfeed to the battery chargers<br>e) Provide a direct connection from DG-13 to required loads | Monticello Application for License Renewal [F-13] | I – Included in Oyster Creek specific SAMA Item 109. Oyster Creek already has multiple batteries in the A-B division. Also, batteries and chargers are of diverse design, minimizing potential for CCF.<br><br>Note item b) noted in the Monticello SAMA is selected as the feasible SAMA and is evaluated in SAMA item 109.<br><br>Item a): The cost associated with additional batteries, the routing of the associated cable, the procedure impact, the required surveillance testing and preventive maintenance, and the need to find a location for the batteries is judged to make the addition of two batteries prohibitive. Therefore, item b) is selected as the candidate SAMA.<br><br>Item c): The use of car batteries (from outside the security fence) and the procedure to implement this is considered feasible, but the success probability is much less than Item b). This relates to the limited capability and the need for significant movement (i.e., accessibility) within the plant. If Item b) proves not cost beneficial, then Item c) could be reassessed. | No (See SAMA 109) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 1 (cont'd) | | | | Also, such a use does not address instrumentation without additional separate batteries. This process is judged unduly cumbersome compared to Item b).<br><br>Item d) requires a method of power generation judged better met by Item b).<br><br>Item e) is plant-specific to Montecello and is not applicable to Oyster Creek. | |
| 2 | Additional HP Injection System | An additional high pressure injection system would increase high pressure injection diversity and reduce the probability of requiring RPV depressurization early in an accident. An additional HP injection system would also impact the contribution of liner melt-through sequences in the Level 2 evaluation by reducing the frequency of high pressure core melt accident class. The benefit of this SAMA would be increased if the pump was 1) diesel powered, 2) could provide power to operate its own injection valves, and 3) be located in a flood safe zone. | Monticello Application for License Renewal [F-13] | F, I –Installation of another high pressure injection system is costly and is not offset by benefits. Benefits associated with an additional high pressure injection source are minimized by the Oyster Creek features of IC and CRD. IC is a passive high pressure inventory control method and the Oyster Creek CRD includes a dedicated bypass line that allows significant flow. SAMA improvement related to CRD is included in Item 92. Improving CRD flow would provide an additional high pressure injection system for scenarios wherein CRD is not currently credited.<br><br>Cost of a self-powered, high pressure injection system, located in a separate fire and flood zone is expected to cost $10,000,000. This is in excess of the maximum averted cost. | No (See SAMA 92) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 3 | Enhance Depressurization and Injection Cues | RPV depressurization, while a reliable action, is an important contributor to plant risk. The cognitive portion of this action is specifically identified as an important contributor for another BWR. Potential means of improving the probability of identifying the need for depressurization include: adding a unique audible alarm and/or a highly visible alarm light to denote the need for depressurization. Installation of a large, graphical core display for water level is an additional enhancement. | Monticello Application for License Renewal [F-13] | F – Monticello estimated the cost of this modification to be about $700,000. This is the result of combining the costs of performing the training/procedural changes and the required hardware changes. Procedural changes are generally on the order of $50,000 to $100,000 [F-20] and the hardware costs are estimated based on the $600,000 cost of installing computer aided instrumentation in the main control room. This will not significantly reduce operator error rate as annunicators are currently in place and improvement potential is minimal. | No |
| 4 | Additional Fan and Louver pair for EDG HVAC | Providing an additional HVAC train for the EDG building would improve cooling reliability. Low cost, alternate means of cooling that require local operator actions, such as the use of portable fans, have been excluded as the sprinkler system would start and damage the EDGs before the actions could be completed. | Monticello Application for License Renewal [F-13] | N/A – Oyster Creek EDG room cooling requires only operation of fans. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 5 | Improved EDG-ESW Pumping Capability | Common cause failure of the EDG-ESW pumps is a large contributor to the system failure, which results in the loss of the EDGs. Installing a diverse, engine driven EDG-ESW pump would address CCF issues. Alternatively, a cross-tie to the SW system or Fire Service Water system could be implemented to back-up EDG-ESW. Given the relatively rapid heatup of the EDGs' cooling water without an active heat sink, the existing connection to SW is not credited. The SW pumps are shed on loss of power and the EDGs would fail before the pumps could be re-started and aligned to the EDGs through the cross-tie. A potential means of crediting the SW cross-tie would be to install a high temperature trip on the EDGs to prevent damage while the SW system was re-started and aligned. This would result in a temporary loss of AC power, which is undesirable. Finally, the FSW system could be modified to backup the cooling function. No load shed problems would exist, but new piping would have to be installed. Locating cross-tie controls in the main control room would allow for rapid alignment. | Monticello Application for License Renewal [F-13] | N/A – Oyster Creek EDGs are air-cooled. | No |
| 6 | Drywell Igniters or Passive Hydrogen Ignition System | This SAMA would provide a means to reduce the chance of hydrogen detonation. | Monticello Application for License Renewal [F-13] | F - Benefit is negligible because Oyster Creek containment operates with an inerted environment. Therefore, for inerted containments, such as the Oyster Creek Mark I containment, the NRC has previously concluded that igniters are not safety significant. The Calvert Cliffs application for license renewal [F-3] estimates the cost of a passive hydrogen ignition system to be $760,000. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 7 | Enhance Alternate Injection Reliability | The capability exists at another BWR to provide flow from the RHRSW and Fire Protection systems to the RHR system; however, the reliability of the cross-tie could potentially be improved by including the cross-tie valves in the maintenance program so that the operability of the valves is monitored and tested. | Monticello Application for License Renewal [F-13] | R – OC has a hard pipe cross tie from the Fire Protection System to support RPV injection through the Core Spray system. An additional cross-tie capability from SW or ESW would provide further alternate injection capability. Development of cross-tie to SW or ESW may be feasible. | Yes |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 8 | Additional DFP for Fire Service Water System | An additional diesel fire pump would provide another source of water for RPV injection and containment spray. This could be achieved through the implementation of a procedure to direct the pressurization of the Fire Protection system using a fire truck. | Monticello Application for License Renewal [F-13] | D – Oyster Creek currently has 1 electric and 2 diesel fire pumps. The electric pump is powered from normal AC power and uses a tank with limited volume. The two-diesel fire pumps are located outside the protected area in a standard metal sided building with concrete foundation.<br><br>F – Addition of a third diesel fire pump is judged to have exceedingly small incremental benefit for RPV injection. This is because:<br>• OC has numerous injection sources<br>• Common-cause failure among the fire pumps dominates regardless if there are 2 or 3 pumps.<br><br>The containment spray enhancement is treated under SAMA 111. | No (See SAMA 111) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 9 | Enhance, Test and Train on Alternate Boron Injection | Another BWR has the capability to use the RWCU and CRD systems to inject boron into the RPV; however, these alignments are not practiced. The RWCU alignment is not credited in the PRA model due to the length of time required for alignment. Changes to make these connections permanent and capable of being aligned from the MCR would improve their reliability. Additional training and practice of the alignments in the simulator and with mock-up test rigs would also improve alternate boron injection reliability. | Monticello Application for License Renewal [F-13] | I – Oyster Creek has a reliable SLC system and the proceduralized capability for two alternate injection pathways.<br><br>F - The cost of making the available options directly operable from the control room is expected to cost $4,000,000. This includes making the proceduralized hose connections of the alternate systems into hard pipe connections. The benefit is minimal because the RPS is reliable and the existing SLC system provides an adequately reliable backup. | No |
| 10 | Passive Overpressure Relief | This SAMA would reduce the risk of catastrophic failure of the containment. The current Torus Hard Pipe Vent includes a rupture disk beyond an isolation valve; however, an alternate path to the Torus Hard Pipe Vent could be made in the wetwell using a rupture disk that would fail at about 60 psid. Alternatively, the containment vent valves could be changed so that they "fail open" on loss of support. Given this change, the vent path would be open on loss of support with the exception of the rupture disk. To prevent premature opening of the vent path during scenarios with loss of vent valve support, the strength of the rupture disk could be increased so that it is closer to the EOP vent pressure. | Monticello Application for License Renewal [F-13] | R – while expected to be costly and of limited benefit, this item can not be declared obviously non-cost-beneficial at this point and is retained.<br>Oyster Creek is designed with no rupture disk in the hard pipe vent path. | Yes |

**Table F-15. Phase I SAMA Evaluation**

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 11 | Refill CST | Develop a procedure for the replenishment of the water in the CSTs (in emergency conditions). This would provide a cool suction source in LOCA or extended SBO conditions when the suppression pool becomes saturated, or for ISLOCAs, additional inventory. The benefit of this SAMA is likely limited due to the fact that 1) for SBO, the 200,000 gallon CST volume is adequate for about 3 days of boiloff makeup flow, and 2) for a LOCA, the containment level limits would be surpassed early in an accident if volume were added from outside containment. | Monticello Application for License Renewal [F-13] | D – Oyster Creek has the ability to makeup to the CST from the fire protection system, i.e., the feature already exists at Oyster Creek. | No |
| 12 | Include a High Water Level Interlock to Open the Door from the TB931E Area to the Cold Machine Shop | Given a flood in the TB931E area, water level will rise and flood rooms critical to DC and AC power distribution. Floor failure is also possible from ponding effects. Installation of an interlock to open the door to the Cold Machine Shop on high water level and changing its swing direction will prevent these flooding consequences by diverting water to a "safe" area. | Monticello Application for License Renewal [F-13] | N/A – Monticello plant specific item which is not applicable to Oyster Creek. | No |
| 13 | Modify RCIC so that it is Capable of Operating Without Electrical Support | The important flooding scenarios at Monticello result in loss of DC and, in some cases, also AC power. This fails motor driven injection and eventually SRV operation. While RCIC is capable of injecting to the RPV when it is at high pressure (given loss of SRVs), it is currently dependent on DC power. If the electrical dependency could be removed so that the system could be operated with local, manual control, injection could be maintained for a longer period of time. | Monticello Application for License Renewal [F-13] | I – While RCIC is not a part of the Oyster Creek design, Oyster Creek has an Isolation Condenser (IC) that provides RPV inventory control following a forced shutdown. The Oyster Creek IC can be operated under loss of support conditions using local operator actions.<br><br>Also, note that local shell level indication improvement is addressed in SAMA 81 and 100. | No (See SAMA 81 and 100) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 14 | Post an Operator at the ASDS Panel Full Time | In the event that a fire in the Main Control Room requires evacuation to the ASDS panel, having a full time operator at the panel would allow for a more rapid transition to alternate reactor control. This is important for loss of injection cases where there is currently not enough time for the operators to evacuate the main control room and assume control at the ASDS panel (Class 1A). | Monticello Application for License Renewal [F-13] | C - The cost of implementation for this SAMA is based on an estimated base salary and the cost of benefits for 5 additional licensed operators. Five operators are justified considering that personnel are required to cover all shifts, 7 days a week and that 20 percent of operator time is spent in training. Assuming that an operator's salary and benefits cost $100,000 per year and that the panel will be manned for the 20 year license renewal period, the cost of implementation would be $10 million, not including raises. This cost is above the maximum averted cost for Oyster Creek. | No |
| 15 | Enhance the ASDS Panel to Include Additional System Controls | Fire scenarios that result in control room evacuation require reactor control from the ASDS panel. Given that only one division of controls is available at the panel, a single additional system failure would result in the loss of a safety function and core damage would ensue. If controls for the opposite division were added, single division failures would be eliminated as a failure mode. This is important for loss of injection cases in which the operators have time to initially take control of the plant from the ASDS panel and depressurize the RPV (Class 1D). | Monticello Application for License Renewal [F-13] | D – In addition to the remote shutdown panel (RSP), Oyster Creek IC can be operated locally as well. This limits the benefit of additional controls at the RSP. Also, note that local shell level indication improvement is addressed in SAMA 99. Since Oyster Creek has redundant success paths (IC RSP, IC local) for control room fire mitigation, this SAMA is considered implemented at Oyster Creek. Development of additional success paths is costly and not considered beneficial. | No |

**Table F-15. Phase I SAMA Evaluation**

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 16 | Add an Emergency Level Control System to the Hotwell | This system would actuate on low level in the main condenser (well outside of the normal operating range) and automatically provide makeup so that the FW/Condensate system will have a long term suction source. This would relegate the operator action that is currently required to align the CST to the main condenser to a backup action and improve the reliability of main condenser makeup. This is important for accident class II cases in which the FW/Condensate is initially established but fails in the long term due to lack of hotwell inventory. | Monticello Application for License Renewal [F-13] | I – Included under SAMA 133. Oyster Creek has the capability for hotwell makeup via both gravity drain (vacuum drag) and pumped system. | No (See SAMA 133) |
| 17 | Enhance loss of component cooling procedure | Enhance loss of component cooling procedure to present desirability of cooling down reactor coolant system (RCS) prior to seal LOCA. | Dresden Application for License Renewal [F-7] | I – Included as Item 106 | No (See SAMA 106) |
| 18 | Improved ability to cool the residual heat removal heat exchangers. | This SAMA would reduce the probability of a loss of decay heat removal by implementing procedure and hardware modifications to allow manual alignment of the fire protection system or by installing a component cooling water cross-tie.<br><br>A portable diesel-driven pump is under consideration to provide cooling water to a LPCI heat exchanger. This was discussed in the EPU correspondence as the tentative plan for dealing with the seismic outlier of Dresden Island Lock & Dam, i.e., loss of UHS, by Fall 2003. | Dresden Application for License Renewal [F-7] | R – Cross-tie of fire water to containment spray heat exchangers can not be declared non-cost-beneficial at this point. | Yes |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 19 | Develop an enhanced drywell spray system. | This SAMA would provide a redundant source of water to the containment to control containment pressure, when used in conjunction with containment heat removal. A potential enhancement would be to proceduralize the cross-tie between the containment spray path of one unit to the LPCI system of the opposite unit. Another alternative is the addition of a connection between containment spray and the plant's fire protection system. | Dresden Application for License Renewal [F-7] | I – See Item 111. | No (See SAMA 111) |
| 20 | Re-open MSIVs | SAMA would allow regaining the main condenser as a heat sink by re-opening the MSIVs. There are two important aspects of the MSIV closure response:<br><br>For non-ATWS conditions, the ability to rapidly respond to MSIV closure and restore the main condenser as a heat sink is not explicitly directed.<br><br>For ATWS conditions, Dresden EOPs direct MSIV low level closure bypass in order to retain the main condenser as a heat sink; however, this assumes the MSIVs have not yet closed.<br><br>For both cases, explicit procedural direction to re-open the MSIVs could be included. | Dresden Application for License Renewal [F-7] | R – Potentially cost-beneficial. | Yes |
| 21 | Increase seismic ruggedness of plant components. | Increase the seismic capacity of components on the safe shutdown paths with capacities less than 0.3g. | Dresden Application for License Renewal [F-7] | I – See Oyster Creek specific Items 123, 124, and item 67. | No (See SAMAs 67, 123, and 124) |

**Table F-15. Phase I SAMA Evaluation**

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 22 | Passive Overpressure Relief | This SAMA will prevent catastrophic failure of the containment. Controlled relief through a selected vent path has a greater potential for reducing the release of radioactive material than through a random break. | Dresden Application for License Renewal [F-7] | D, I – For benefits of passive venting, see SAMA Item 10. Oyster Creek has already implemented a hard pipe containment vent. | No (See SAMA 10) |
| 23 | Diversify the explosive valve operation | An alternate means of opening a pathway to the RPV for SBLC injection would improve the success probability for reactor shutdown. | Dresden Application for License Renewal [F-7] | R – This cannot be declared non-cost-beneficial at this point. | Yes |
| 24 | Enrich Boron | The increased boron concentration will reduce the time required to achieve the shutdown concentration. This will provide increased margin in the accident timeline for successful operator activation of SBLC. | Dresden Application for License Renewal [F-7] | D – Oyster Creek already has highly enriched Boron. Further enrichment is not expected to significantly impact the PRA. | No |
| 25 | Bypass Low Pressure Permissive | LPCI and CS injection valves require a permissive signal from the same 2 pressure sensors in order to open. The instruments are currently specified as diverse. However, because this is a "pinch point" for all CS and LPCI injection, it is judged prudent to consider a plant modification to allow a bypass switch (1/division) to insert the permissive if the sensors fail to perform their function. A few other BWRs currently have this capability (e.g., Perry). | Dresden Application for License Renewal [F-7] | R – This cannot be declared non-cost-beneficial at this point. | Yes |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 26 | Supplemental Air Supply for the Containment Vent | The containment vent function is among the last resort methods currently specified in BWRs to remove heat from containment and control containment pressure under extremely adverse circumstances. The Dresden air compressors are required to support the containment vent function. The air compressors in turn require cooling, normally from TBCCW/SW. An alternative method to supply air to the vent valves for opening would be desirable if SW were to become inadequate. | Dresden Application for License Renewal [F-7] | D – Oyster Creek has dedicated air accumulators for containment venting AOVs in the hard pipe vent path.<br><br>F – Oyster Creek does have secondary vent pathways that would be used to vent and purge combustible gases from containment. However, because Oyster Creek operates with an interted containment atmosphere the NRC has previously determined that Mark I combustible gas venting is not risk significant. This is supported by the Oyster Creek PRA. Therefore, this plant modification would not be cost beneficial. | No |
| 27 | Supplemental Air Supply for Containment Vent Under SBO Conditions | The containment vent function is among the last resort methods currently specified in BWRs to remove heat from containment and control containment pressure under extremely adverse circumstances. Many plants require a long term source of air or nitrogen and a DC power source to allow venting in an SBO. | Dresden Application for License Renewal [F-7] | I – Oyster Creek has dedicated air accumulators for containment venting AOVs. Venting in an SBO is not a significant contributor because of the dominance by shorter term failures. SAMA 84 addresses handwheels for containment vent valves which would allow system operation in SBO. | No (See SAMA 84) |
| 28 | Demonstrate RCIC Operability Following Depressurization | This SAMA would increase the operators' options for injection with the vessel at low pressure. Given Monticello's ability to power the battery chargers with the 480v AC generator, the limiting factor for RCIC injection appears to be depressurization at HCTL. If it could be shown that a limited depressurization to about 100 psid could be performed and allow continued injection with RCIC, injection could be maintained for a longer period during an SBO. | Quad Cities Application for License Renewal [F-8] | N/A – Not applicable to Oyster Creek design.<br>No RCIC at Oyster Creek. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 29 | Control Containment Venting Within a Narrow Band of Pressure | This SAMA would establish a narrow pressure control band that would thereby prevent rapid containment depressurization when venting is implemented. Venting in this manner would avoid adverse impacts on the low pressure ECCS injection systems taking suction from the torus. | Quad Cities Application for License Renewal [F-8] | I – see Item 88. | No |
| 30 | Provide means for alternate SSMP room cooling | The SSMP requires room cooling at extended times. This SAMA would allow SSMP operation late in accidents when normal room cooling has failed. Evaluate the benefit of providing alternate SSMP room cooling. These options may include:<br><br>- Controls in the Main Control Room for remote alignment of SW or FPS to SSMP room cooling<br>- Procedures for opening SSMP room doors and using portable fans for SSMP room cooling | Quad Cities Application for License Renewal [F-8] | N/A – Quad Cities plant specific item not applicable to Oyster Creek.<br><br>It is noted that ECCS pumps at Oyster Creek can survive without room cooling for the PRA mission time of 24 hours. | No |
| 31 | Develop an enhanced drywell spray system. | SAMA would provide a redundant source of water to the containment to control containment pressure, when used in conjunction with containment heat removal. The Fire Protection system can already provide water to the RHR system at Quad Cities; however, no procedures have been developed to use it as a containment spray source. The containment spray function could be further enhanced at Quad Cities. | Quad Cities Application for License Renewal [F-8] | I – See Item 111. | No<br>(See SAMA 111) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 32 | Use fuel cells instead of lead-acid batteries. | SAMA would extend DC power availability in an SBO. | Quad Cities Application for License Renewal [F-8] | I, F – Oyster Creek has diverse battery design presently. The system is already reliable. Evaluation of a portable DC charger is viewed as more beneficial. See Item 109. Also, note that the fuel cell option is new technology, never used in such a manner. It is judged expensive. A small, engine driven charger is considered a more cost-efficient and proven approach. | No (See SAMA 109) |
| 33 | Improve 4.16-kV bus cross-tie ability. | Enhance procedures to direct 4kV bus cross-tie. If this procedural step already exists, investigate installation of hardware that would perform an automatic cross-tie to the opposite 4kV bus given failure of the dedicated diesel. | Quad Cities Application for License Renewal [F-8] | I – See Item 91.<br><br>Procedure step does not currently exist and automatic cross-tie is not pursued in favor of manual actuation. Auto-closure is more expensive and, in this case, may increase the potential to auto-close into a fault. The PRA team's assessment is that the preferred course of action is for the operators to manually diagnose and control the evolution based on actual plant conditions. | No (See SAMA 91) |
| 34 | Create a backup source for diesel cooling. (Not from existing system) | This SAMA would provide a redundant and diverse source of cooling for the diesel generators, which would contribute to enhanced diesel reliability. | Quad Cities Application for License Renewal [F-8] | N/A – Oyster Creek EDGs are air cooled. | No |
| 35 | Provide procedures for (a) bypassing major DC buses; (b) locally starting equipment | This SAMA would allow for powering specific loads given a DC bus failure and/or the ability to start equipment locally that normally requires DC power for a control room start. | Quad Cities Application for License Renewal [F-8] | D – Oyster Creek has procedures for Operating breakers manually (See ABN-53). | No |
| 36 | Delete High DW Pressure Signal from SDC isolation | This SAMA would allow the initiation of SDC when the drywell is at elevated pressures. | Quad Cities Application for License Renewal [F-8] | I – See Item 90 for disposition. | No (See SAMA 90) |

**Table F-15. Phase I SAMA Evaluation**

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 37 | Develop procedures to control Feedwater flow without 125 VDC power to prevent tripping Feedwater on High/Low level | This SAMA increases the functionality of Feedwater in loss of DC scenarios and increases the probability of successful level control. | Quad Cities Application for License Renewal [F-8] | D – Oyster Creek has a procedure for local manual control of feedwater. | No |
| 38 | Remove Loop Select Logic | In the event that there is no break in the recirc loops and there is a Loop "B" injection path failure, the Loop "A" injection path is precluded from use. Removal of the LPCI Loop Select Logic or installation of a bypass switch would allow use of the "A" loop for injection in the event of a "B" injection path failure. | Quad Cities Application for License Renewal [F-8] | N/A – Not applicable to Oyster Creek design. | No |
| 39 | Diversify the explosive valve operation | An alternate means of opening a pathway to the RPV for SBLC injection would improve the success probability for reactor shutdown. | Quad Cities Application for License Renewal [F-8] | I – See Item 23 for disposition. | No (See SAMA 23) |
| 40 | Enrich Boron | The increased boron concentration will reduce the time required to achieve the shutdown concentration. This will provide increased margin in the accident timeline for successful operator activation of SBLC. | Quad Cities Application for License Renewal [F-8] | I – See Item 24 for disposition. | No (See SAMA 24) |
| 41 | Passive Overpressure Relief | This SAMA will prevent catastrophic failure of the containment. Controlled relief through a selected vent path has a greater potential for reducing the release of radioactive material than through a random break. | Quad Cities Application for License Renewal [F-8] | I – See Item 10 for disposition. | No (See SAMA 10) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 42 | Enhance Procedural Guidance for Use of Cross-tied Service Water Pumps | Enhancement of procedures directing the use of the Service Water system as a back up for 1) ESW and 2) EDG/ESW. Updated procedures and training on their use may improve the reliability of the cross-ties. | PBAPS Application for License Renewal [F-6] | D – Oyster Creek has procedures for swapping Circulating Water system cooling of TBCCW to SW and for use of fire water to cool air compressors. No cooling water cross-tie procedural weaknesses have been noted.<br><br>• F – Section F.6.3 included a number of sensitivity assessments regarding service water and emergency service water cross-tie. These sensitivities show that these cross-ties produce minimal benefit and are not cost-beneficial.<br><br>N/A - OC DGs do not require cooling water. | No |
| 43 | Improved ability to cool the residual heat removal heat exchangers. | This SAMA would reduce the probability of a loss of decay heat removal by implementing procedure and hardware modifications to allow manual alignment of the fire protection system or by installing a component cooling water cross-tie. | PBAPS Application for License Renewal [F-6] | I – See Item 18 for disposition. | No (See SAMA 18) |
| 44 | Install an independent method of suppression pool cooling. | This SAMA would decrease the probability of loss of containment heat removal. | PBAPS Application for License Renewal [F-6] | F – IC provides an alternate method of DHR that eliminates heat discharge to the torus for non-LOCA scenarios. Development of another means beyond containment spray is viewed as limited benefit compared to a high cost for such a modification. An independent system is judged to cost $5,000,000. This is in excess of the maximum averted cost. | No |

**Table F-15. Phase I SAMA Evaluation**

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 45 | Install a filtered containment vent to remove decay heat. | This SAMA would provide an alternate decay heat removal method for non-ATWS events, with the released fission products being scrubbed.<br>Option 1: Gravel Bed Filter<br>Option 2: Multiple Venturi Scrubber | PBAPS Application for License Renewal [F-6] | F – Cost is high at > $4M as assessed for Shoreham. The benefits in dose reduction are limited because of the Mark I shell failure mode and ATWS challenges that would fail containment.<br><br>SAMA would not address core damage and does not address Noble gas release. This was not found cost-beneficial for Peach Bottom. Estimated to cost in excess of the maximum averted cost. | No |
| 46 | Install a containment vent large enough to remove ATWS decay heat. | Assuming that injection is available, this SAMA would provide alternate decay heat removal in an ATWS event. | PBAPS Application for License Renewal [F-6] | F – Cost is high and benefits, in terms of dose reduction, are limited because of the small ATWS contribution to the risk profile. Containment vent size is sufficient to prevent containment failure as long as reactivity management tasks are completed as modeled in the PRA (i.e., RPV level control and SLC initiation). ATWS power levels without reactivity control would be in the range of 10% to 40% of full power. This requires a substantially larger containment vent than the current hard pipe vent. To achieve an operational "ATWS Vent" of hard pipe configuration and adequate size is estimated to cost in excess of $2M. This is above the benefit to be achieved for elimination of the small ATWS contribution to risk at Oyster Creek. | No |
| 47 | Use the fire protection system as a backup source for the containment spray system. | This SAMA would provide redundant containment spray function without the cost of installing a new system. | PBAPS Application for License Renewal [F-6] | I - See Item 111 for disposition. | No (See SAMA 111) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 48 | Install a passive containment spray system. | This SAMA would provide redundant containment spray method without high cost. | PBAPS Application for License Renewal [F-6] | F – High cost modification. Gravity feed system would provide limited benefit beyond that considered in Item 111 and would likely increase internal flooding risk. | No (See SAMA 111) |
| 49 | Construct a building to be connected to primary/secondary containment that is maintained at a vacuum. | This SAMA would provide a method to depressurize containment and reduce fission product release. | PBAPS Application for License Renewal [F-6] | C – This item is viewed as having a very large cost (> $10 Million) and is well beyond the maximum averted cost for Oyster Creek. | No |
| 50 | Proceduralize alignment of spare diesel to shutdown board after loss of offsite power and failure of the diesel normally supplying it. | This SAMA would reduce the SBO frequency. | PBAPS Application for License Renewal [F-6] | D - Oyster Creek has previously installed Combustion Turbines (CTs) as an alternate AC power source to supplement the emergency diesel generators. The CTs are credited in the OC Station Blackout (SBO) analysis. The alignment of the alternate AC sources are proceduralized and allow connection to one of the in-plant AC buses (1B) in response to LOOP or SBO. SAMA 91 addresses the cross tie of these AC sources (CTs) to both in-plant AC divisions. | No (See SAMA 91 and 140) |
| 51 | Provide an additional diesel generator. | This SAMA would increase the reliability and availability of onsite emergency AC power sources. | PBAPS Application for License Renewal [F-6] | C – Cost of an additional building and diesel is estimated at more than $5M. This is greater than the maximum cost averted benefit. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 52 | Provide additional DC battery capacity. | This SAMA would ensure longer battery capability during an SBO, reducing the frequency of long-term SBO sequences. | PBAPS Application for License Renewal [F-6] | I –Oyster Creek already has multiple batteries in the A-B division. Also, batteries and chargers are of diverse installation. Additional batteries are costly, require a location for installation, and must be inter-connected with the current system. Also, as with the currently installed batteries, they eventually become exhausted in long-term SBO scenarios. Evaluation of a portable battery charger is viewed as more beneficial for Oyster Creek. Included in Item 109 for disposition. | No (See SAMA 109) |
| 53 | Use fuel cells instead of lead-acid batteries. | This SAMA would extend DC power availability in an SBO. | PBAPS Application for License Renewal [F-6] | I, - See SAMA 32 | No (See SAMA 32) |
| 54 | Increase/improve DC bus load shedding. | This SAMA would extend battery life in an SBO event. | PBAPS Application for License Renewal [F-6] | D – Oyster Creek already has multiple batteries in the A-B division. DC load shedding is part of LOOP and SBO proceduralized responses. DC load shedding has been reviewed by the PRA Team as part of crew interviews to support the Human Reliability Analysis (HRA) and no additional enhancements or improvements in the procedure were noted. The potential benefit from enhancements is considered to be a relatively small increase in time available with DC power (e.g., approximately 1 to 2 hours). Such small changes in time available for AC recovery has a very small impact on the risk profile. Therefore, this SAMA is not considered cost beneficial. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 55 | Develop procedures to repair or replace failed 4-kV breakers. | This SAMA would offer a recovery path from a failure of the breakers that perform transfer of 4.16-kV non-emergency busses from unit station service transformers, leading to loss of emergency AC power. | PBAPS Application for License Renewal [F-6] | D – Viewed as within electrical maintenance capability for repairable equipment failures. | No |
| 56 | Install gas turbine generator. | This SAMA would improve onsite AC power reliability by providing a redundant and diverse emergency power system. | PBAPS Application for License Renewal [F-6] | D - Oyster Creek has previously installed Combustion Turbines (CTs) as an alternate AC power source to supplement the emergency diesel generators. The CTs are credited in the OC Station Blackout (SBO) analysis. | No |
| 57 | Bury offsite power lines. | This SAMA could improve offsite power reliability, particularly during severe weather. | PBAPS Application for License Renewal [F-6] | D – The Power line supply from the CTs is already underground.<br><br>Obviously, the offsite power grid and its connection to the on-site transformers is above ground. It is considered that the intent of the SAMA includes addressing only the alternate AC power source (e.g., the Conowingo Dam at Peach Bottom). | No |
| 58 | Proceduralize intermittent operation of HPCI. | This SAMA would allow for extended duration of HPCI availability. | PBAPS Application for License Renewal [F-6] | N/A – Not applicable to Oyster Creek; No HPCI at Oyster Creek. | No |
| 59 | Install motor-driven feedwater pump. | This SAMA would increase the availability of injection subsequent to MSIV closure. | PBAPS Application for License Renewal [F-6] | D – Oyster Creek condensate and feedwater pumps are all motor driven. Because already implemented, no significant incremental benefit from additional feedwater pumps. | No |
| 60 | Enhance procedure to instruct operators to trip unneeded RHR/CS pumps on loss of room ventilation. | This SAMA increases availability of required RHR/CS pumps. Reduction in room heat load allows continued operation of required RHR/CS pumps, when room cooling is lost. | PBAPS Application for License Renewal [F-6] | D – It is noted that ECCS pumps at Oyster Creek can survive for the PRA mission time of 24 hours without room cooling. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 61 | Increase the safety relief valve (SRV) reseat reliability. | This SAMA addresses the risk associated with dilution of boron caused by the failure of the SRVs to reseat after standby liquid control (SLC) injection.<br><br>The SAMA benefit extends to non-ATWS conditions where the IC is a critical inventory control method. The SORV would adversely impact IC availability. | PBAPS Application for License Renewal [F-6] | D – EMRV reseat failure is a significant risk contributor to Oyster Creek.<br><br>Oyster Creek has staggered the EMRV and safety valve pressure setpoints to minimize the number of challenges to EMRVs. In addition, operators have clear procedural direction to reduce RPV pressure to minimize the number of EMRV challenges reducing the need for a low-low set modification. In addition, Oyster Creek IC operation limits the number of EMRV challenges. The only other means for significant reduction for this failure mode would be a complete replacement of EMRV design. No other designs have been noted to be significantly more reliable so benefit is judged negligible at this time. The normal maintenance process takes into account vendor recommended maintenance.<br><br>No additional modifications or procedural enhancements are known. | No |
| 62 | Modify Reactor Water Cleanup (RWCU) for use as a decay heat removal system and proceduralize use. | This SAMA would provide an additional source of decay heat removal. | PBAPS Application for License Renewal [F-6] | C – The RWCU system is currently proceduralized and used "as is" to provide decay heat removal over a portion of the spectrum of shutdowns. However, the RWCU system has very small heat removal capability and therefore, does not have the capability to provide a significant benefit.<br><br>No options for significant capacity improvement have been identified that would cost less than $4M. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 63 | Increase seismic ruggedness of plant components. | This SAMA would increase the availability of necessary plant equipment during and after seismic events. | PBAPS Application for License Renewal [F-6] | I – See Items 114, 117, 118, 120, 121, 123, 124.<br><br>The seismic analysis submitted as part of the IPEEE was reviewed to assess whether any plant specific SAMAs should be added to the evaluation. The results of the review included the identification of additional SAMAs. | No<br>(See SAMAs 114, 11, 118, 120, 121, 123 and 124) |
| 64 | Passive High Pressure System | This SAMA will improve prevention of core melt sequences by providing additional high pressure capability to remove decay heat through an isolation condenser type system | PBAPS Application for License Renewal [F-6] | D – Oyster Creek already has isolation condensers installed. These represent a form of passive decay heat removal. | No |
| 65 | Suppression Pool Jockey Pump | This SAMA will improve prevention of core melt sequences by providing a small makeup pump to provide low pressure decay heat removal from the RPV using the suppression pool as a source of water. | PBAPS Application for License Renewal [F-6] | F – Not viewed as a significant benefit. The small pump with suction from the suppression pool could provide water to the RPV. The flow rate may be adequate to supply MRDIR flow dictated in the SAMGs but is not considered sufficient for the prevention of core damage. Support systems for the pump will govern its availability to fulfill this role. No measurable risk decrease is judged achievable. | No |
| 66 | Additional Active High Pressure System | This SAMA will improve reliability of high pressure decay heat removal by adding an additional system. | PBAPS Application for License Renewal [F-6] | I – See Item 2 for disposition. | No<br>(See SAMA 2) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 67 | Safety Related Condensate Storage Tank | This SAMA will improve availability of CST following a Seismic event | PBAPS Application for License Renewal [F-6] | R – Oyster Creek does not use CST for RCIC/HPCI/HPCS as is common for other BWRs. However, Oyster Creek uses CST for condensate/feedwater, CRD, and IC makeup. OC also has an option to align the CST to the suction of core spray. *Condensate and feedwater* are likely to be failed in seismic event because of low fragility for offsite power and CTs. IC could be failed because of seismic acceleration amplification (Large tank-type configuration located high in building). Also, fire pump makeup is possible if the fire system and IC survive but CST does not.<br><br>The CS alignment to the CST can also be used to cope with failure of the torus, ECCS suction strainer plugging, and to supplement containment flooding. These issues are considered to be of low probability and represent marginal additional benefits.<br><br>Therefore, it would appear that benefit is driven by CRD significance primarily. HCLPF for CST is 0.09 and strengthening cannot be ruled out as cost beneficial. | Yes |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 68 | Improved Vacuum Breakers (redundant valves in each line) | This SAMA reduces the probability of a stuck open vacuum breaker. | PBAPS Application for License Renewal [F-6] | F - Oyster Creek has 14 single torus to drywell vacuum breakers arranged in 7 parallel lines, which can impact vapor suppression. Adding valves in series is highly expensive and reduces the success probability for the open on demand function. Benefit impacts only low frequency accident sequences. Added redundancy has only minor impact on the risk profile. Cost estimated by system manager to be $2,000,000. | No |
| 69 | Improved MSIV Design | Replace MSIVs with improved design. | PBAPS Application for License Renewal [F-6] | C – Replacing MSIVs is estimated by system manager to cost $10 million which is beyond the maximum averted cost. | No |
| 70 | Steam Driven Turbine Generator | This SAMA would provide a steam driven turbine generator which uses reactor steam and exhausts to the suppression pool. If large enough, it could provide power to additional equipment. | PBAPS Application for License Renewal [F-6] | C – Adding such a system is judged to require a new building and therefore, involves a cost greater than $10 million which is beyond the maximum averted cost. | No |
| 71 | Improved Uninterruptible Power Supplies | This SAMA would provide increased reliability of power supplies supporting front-line equipment, thus reducing core damage and release frequencies. | PBAPS Application for License Renewal [F-6] | D – Oyster Creek has automatic transfer switches that allow 120V AC and 125V DC to be powered from multiple sources for many vital components. Oyster Creek on DC power as a primary backup for vital instrumentation. Oyster Creek 125 VDC is diverse based on battery installation and charger design (static chargers and MG Sets). Any marginal improvement is judged to rely primarily on the portable charger included as Item 109. | No (See also SAMA 109) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 72 | Dedicated RHR (bunkered) Power Supply | Install new electric distribution subsystem. | PBAPS Application for License Renewal [F-6] | C – There may be some benefit for security or seismic related challenges but the cost of implementation far exceeds the maximum averted cost. A bunkered power supply is judged to require a new building and involve a cost greater than $5 million.<br><br>While the IC is a decay heat removal system in addition to an inventory control system, it is not an RHR system. The IC can operate independent of all electric support. A portable battery charger would allow operators to utilize the ICs during a long-term loss of all AC electrical subsystems with higher reliability. Therefore, one alternative is judged to reside with the portable charger included as Item 109. | No<br>(See SAMA 109) |
| 73 | Dedicated DC Power Supply | This SAMA addresses the use of a diverse DC power system such as an additional battery or fuel cell for the purpose of providing motive power to certain components (e.g., RCIC). | PBAPS Application for License Renewal [F-6] | I – See Items 1, 32, 52 for disposition. | No<br>(See SAMAs 1, 32, and 52) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 74 | DC Cross-ties | This SAMA would improve DC power reliability. | PBAPS Application for License Renewal [F-6] | D – OC currently has cross-ties for Divisions A and B for selected components. Some SSCs are not provided with this cross tie capability.<br><br>Cross tie to Division C is judged to introduce unacceptable competing risks. Therefore, this SAMA is not pursued.<br><br>Adding a portable charger, capable of supporting either division is judged the most cost-beneficial means of improving DC reliability rather than additional cross ties. | No (See SAMA 109) |
| 75 | Additional training on the loss of component cooling. | This SAMA would potentially improve the success rate of operator actions after a loss of component cooling (to restore RCP seal damage). | Nine Mile Point 1 Application for License Renewal [F-11] | I – See Item 106 for disposition. | No (See SAMA 106) |
| 76 | Improved ability to cool the residual heat removal heat exchangers | This SAMA would reduce the probability of a loss of decay heat removal by implementing procedure and hardware modifications to allow manual alignment of the fire protection system or by installing a component cooling water cross-tie. | Nine Mile Point 1 Application for License Renewal [F-11] | I – See Item 18 | No (See SAMA 18) |
| 77 | Procedures for actions on loss of HVAC. | This SAMA would provide for improved credit to be taken for loss of HVAC sequences (improved affected electrical equipment reliability upon a loss of Control Building HVAC). | Nine Mile Point 1 Application for License Renewal [F-11] | D, F – Oyster Creek has procedures for opening doors and installing portable fans as appropriate. No additional improvements have been identified.(1) | No |
| 78 | Modify RWCU for use as a decay heat removal system and proceduralize use. | This SAMA would provide an additional source of decay heat removal. | Nine Mile Point 1 Application for License Renewal [F-11] | I – See Item 62. | No (See SAMA 62) |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 79 | Use of CRD for alternate boron injection. | This SAMA provides an additional system to address ATWS with SLC failure or unavailability. | Nine Mile Point 1 Application for License Renewal [F-11] | F – Alternate methods of boron injection already exist for Oyster Creek. Additional alternate systems would not provide a cost-beneficial option.<br><br>D – Oyster Creek has a reliable SLC system and the proceduralized capability for two alternate injection pathways.<br><br>C - The cost of making the available options directly operable from the control room is expected to cost $4,000,000. This includes making the proceduralized hose connections of the alternate systems hard pipe connections. The benefit is minimal because the RPS is reliable and the existing SLC system provides adequately reliable as a backup. | No |
| 80 | Improved drywell head bolts | Replace drywell head bolts with stronger material. | Nine Mile Point 1 Application for License Renewal [F-11] | F - The Oyster Creek Drywell Head bolt failure mode is an insignificant contributor to containment failure at low temperatures (200 °F), but its contribution increases and becomes more significant as a function of temperature up to 800 °F. However, other important failure modes such as Mark I shell failure, penetrations, hatches, the pedestal, and RPV skirt at these temperatures are also via the Drywell. The presence of these other failure modes limits the benefit of the improved head bolts such that the benefit is judged to be outweighed by the cost of $250K. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 81 | Improve training on Alternate Instruments | NMP1 alternate instruments in East and West instrument rooms are significant assets in PRA, augmented training for IC operation could be valuable. | Nine Mile Point 1 Application for License Renewal [F-11] | I – Included as SAMA 99. | No (See SAMA 99) |
| 82 | Reduce fire risk | Reduction in sources, relatively simple cable re-routing, and/or additional use of thermography could reduce CDF. | Nine Mile Point 1 Application for License Renewal [F-11] | I – See Items 125, 126 for disposition. | No (See SAMAs 125 and 126) |
| 83 | Reduce Offsite power recovery dependency on Div 11 DC | Add DC source or justify manual manipulation for offsite AC power recovery | Nine Mile Point 1 Application for License Renewal [F-11] | N/A – Plant specific item for NMP1. | No |
| 84 | Manually operate containment vent valves | Provide capability to vent primary containment without support systems with procedure/training | Nine Mile Point 1 Application for License Renewal [F-11] | R – Oyster Creek has dedicated air accumulators for Containment hard pipe vent valves as well as redundant (AC and DC) power supply for the related solenoid valves. While this is a highly reliable configuration which leads to a low risk impact, the use of handwheels could potentially be cost-beneficial and is retained for further analysis. | Yes |
| 85 | Provide an alternate DC charger | Portable unit for temp alignment to divisional batteries with procedure/training | Nine Mile Point 1 Application for License Renewal [F-11] | I – See Item 109 for disposition. | No (See SAMA 109) |
| 86 | Improve AC power load management | Provide training on potential impact of PB16A &16B crosstie (17A &17B) | Nine Mile Point 1 Application for License Renewal [F-11] | I – Plant specific issue for NMP1, transformer loading limitation. Note that an Oyster Creek specific AC cross-tie is included as SAMA 91. | No (See SAMA 91) |
| 87 | Improve procedures/training for loss of air | Improve reliability of operator action to ensure that feedwater is available as RPV makeup source on loss of air | Nine Mile Point 1 Application for License Renewal [F-11] | D – Oyster Creek has a procedure for local manual control of feedwater. The CST to hotwell valves fail open (fail safe for FW operation) given a loss of air.(1) | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| | | **OYSTER CREEK SPECIFIC SAMA ITEMS IDENTIFIED VIA PRA, IPE, OR IPEEE** | | | |
| 88 | Containment vent | The primary alternative identified is that the vent be opened and closed to control containment pressure approximately 10 psig below EOP Figure J. The vent procedure could be modified to explicitly include this restriction, plus add to the operating crew training cycle specific techniques to be used to maintain a vent control band.<br><br>Another alternative is to include mechanical stops on the large vent valves to reduce the flow area from the vent, thus minimizing the discharge of steam flow rate for containment venting. | Oyster Creek PRA Review (Section F.5) | R – Improvement for containment vent control is likely to be cost-beneficial. | Yes |
| 89 | Improve procedure for aligning SDC with high DW pressure | Perform a Safety Evaluation that allows Operating Procedure 305 to be implemented "as-is" with the elimination of the requirement for operators to invoke 50.54(x). | Oyster Creek PRA Review (Section F.5) | R – Improvement for containment vent control or explicit direction in the SDC AOP may be cost-beneficial. See also Item 110 for disposition. | Yes |
| 90 | Not Used | – | – | – | – |
| 91 | Allow 4160 VAC bus IC and ID crosstie | Perform a Safety Evaluation that allows procedure 337 to be modified to allow operators to cross-tie buses 1C and 1D under emergency conditions which require operation of critical equipment. | Oyster Creek PRA Review (Section F.5) | R - Improvement for 4160 VAC cross-tie may be cost-beneficial provided plant modification is not required and there are not appreciable competing risks. | Yes |
| 92 | Allow operators to maximize CRD flow | Modify EOP 1, Support Procedure 3 to eliminate the 150 gpm flow limitation and replace with a caution to monitor the system for pump runout when system flow is greater than 150 gpm. | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial. | Yes |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 93 | EAL modification | *The prerequisite for a General Emergency action statement could consider the following:*<br>• Containment pressure approaching PCPL and containment venting will be required. (Declare GE 6 hours before vent action is anticipated.)<br>• The main condenser and Containment Spray System systems are unavailable and not recoverable before PCPL will be exceeded. (Declare GE 6 hours before PCPL to be exceeded.)<br>• Declare General Emergency when HCTL is exceeded.<br>• A combination of the above | Oyster Creek PRA Review (Section F.5) | D – Already implemented in Oyster Creek EAL. | No |
| 94 | Increase success probability for fire protection alignment | Modify EOPs 1a and 1b to provide a cue or note to operators that fire protection system alignment takes longer to establish than other potential sources of RPV injection. | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial. | Yes |
| 95 | Add procedural clarification related to 5 psid CSS alarm | Modify the 5 psid CSS alarm response procedure (B-5-A, B-5-B) and procedure 310 to include a caution that CSS should not be secured if being utilized for accident mitigation. | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial. | Yes |
| 96 | Improve direction for cooldown in LOOP | Revise ABN-36 step 3.1.7 to require a <10°F/hr cooldown only when high pressure makeup is not available and decouple the <10°F/hr cooldown from IC shell makeup criteria. | Oyster Creek PRA Review (Section F.5) | D – Procedure change completed by Oyster Creek. | No |
| 97 | Guideline modification to SAGs for drywell sprays priority | The purpose of this insight is to list drywell spray initiation as among the priority actions that should be taken if allowed by the SAG-2 and other restrictions in Legs 3 and 4 of SAG-1. | Oyster Creek PRA Review (Section F.5) | D – Already implemented by Oyster Creek in SAG-2 in 3 legs based on temperature, pressure, and radiation. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 98 | CRD flow enhancement | Ensure sufficient flow to the RPV such that CRD alone is adequate to support RPV injection for all non-LOCA events. | Oyster Creek PRA Review (Section F.5) | I – See Item 92 for disposition. | No (See SAMA 92) |
| 99 | Provide an alternate method for IC shell level determination | The IC shells could be modified to include a permanent, passive local shell level indication such as available at Dresden. This, combined with adequate procedures and training, would allow IC operation should AC and DC power be unavailable | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial | Yes |
| 100 | Connect SBO transformer to both AC divisions. | Currently the SBO transformer, which is powered from the combustion turbines, is connected only to the "B" switchgear. Connecting the transformer to the "A" bus will add redundancy. | OC System Manager Review | R – Potentially cost-beneficial | Yes |
| 101 | Provide a procedure for determining RPV level using fuel zone level indicators A/C with SLC operating | Additional guidance should be evaluated for operators to consider temporarily securing SLC pumps, as necessary, to record RPV level. This approach must balance SLC pump start frequency requirements as well as RPV level trends against the downsides of RPV flooding. | Oyster Creek PRA Review (Section F.5) | R – Applies to very low frequency sequences but may be cost-beneficial. | Yes |
| 102 | Revise ATWS EOP to provide RPV level correction based on power | Revise EOP 1b "RPV Control – ATWS" to include an RPV Fuel Zone Level correction factor to account for reactor power level. (See also Item 103) | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial. This has been implemented at other plants. | Yes |
| 103 | Modify fuel zone logic to provide RPV level correction based on power | Modify instrumentation to account for reactor power (See also Item 102) | Oyster Creek PRA Review (Section F.5) | F – More costly than Item 102 with similar benefit. See Item 102 for disposition.<br><br>(Note 102 found not to be cost beneficial.) | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 104 | Improve loss of circulating water response | Develop a loss of circulating water abnormal operating procedure or revise the loss of condenser vacuum procedure to include guidance to allow condensate and feedwater to be adequately protected by swapping necessary cooling of TBCCW to SW. This includes more rapid swapping to service water.<br><br>(See also Item 105) | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial. | Yes |
| 105 | Improve loss of circulating water response | The plant could be modified to provide an auto-swap from circulating water to service water.<br><br>(See also Item 104) | Oyster Creek PRA Review (Section F.5) | F – More costly than Item 104 with similar benefit. See Item 104 for disposition. | No (See SAMA 104) |
| 106 | Improve direction for cooldown in Loss of RBCCW | Revise ABN-19 to include guidance to implement a <90°F/hr cooldown as soon as possible following a loss of RBCCW. | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial. | Yes |
| 107 | Reduce potential for loss of CST following loss of instrument air | Modify the spill valve air supply to be fitted with air accumulators. | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial | Yes |
| 108 | Reduce fuel zone level instrument error band | Relocate reference leg instrument penetration closer to TAF and recalibrate. | Oyster Creek PRA Review (Section F.5) | R – Unlikely to be cost-beneficial but retained for further analysis. | Yes |
| 109 | Portable DC battery charger to preserve IC and EMRV operability along with adequate instrumentation | Provide small, engine-driven battery chargers capable of supplying 125V DC buses | Oyster Creek PRA Review (Section F.5) | R – Potentially cost-beneficial as the system would provide a success path for long term SBOs independent of currently installed AC power. | Yes |
| 110 | Delete high drywell pressure signal from SDC isolation | The purpose of this insight is to identify the desirability of removing the SDC interlock on high drywell pressure to increase the flexibility of SDC system use. | Oyster Creek PRA Review (Section F.5) | R – This has been implemented at other plants. See also Item 89. | Yes |

**Table F-15. Phase I SAMA Evaluation**

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 111 | Provide alternate drywell spray injection source | The possible alternatives may include:<br>• ESW cross tie<br>• SW cross tie<br>• Diesel Fire pump cross tie | Oyster Creek PRA Review (Section F.5) | R – Unlikely to be cost-beneficial but retained for further analysis. | Yes |
| 112 | Intake structure | The purpose of this insight is to identify that there are potential safety beneficial effects associated with a pro-active plan to ensure high reliability of the cooling water intake structure and its supply to support raw water systems into the plant. | Oyster Creek PRA Review (Section F.5) | R – Unlikely to be cost-beneficial but retained for further analysis. | Yes |
| 113 | Use of drywell sprays in SAMs | The primary alternative is to provide an evaluation that establishes a radiation level that can assure drywell spray initiation prior to RPV breach. | Oyster Creek PRA Review (Section F.5) | D – Already implemented at OC.<br><br>This direction is already included in the SAMG's. Operators are directed to initiate Drywell Sprays at 20,000 R in containment. This equates to the 20% full damage. Individual fuel pins may be failing, but there is very little of any fuel melt. So this is long before RPV breach. | No |
| 114 | CT fan cooler bolts | Ensure all bolts on the Forked River combustion turbine fin-fan coolers are installed and torqued properly. | Oyster Creek IPEEE [F-22] | D – These fans were evaluated and extra bolts have been added. (LAR 88242.20) | No |
| 115 | CT Battery Spacers | Consider the addition of battery spacers in the CT battery compartments. | Oyster Creek IPEEE [F-22] | F – CT Battery was reviewed in more detail and additional battery spacers were determined to represent a negligible benefit (RAI-2 7/26/2000) (LAR 88242.20) | No |
| 116 | Improve Housekeeping | Review current housekeeping policy/procedures and walk-down plant to review housekeeping and controls for transient combustibles | Oyster Creek IPEEE [F-22] | D – Page 7-1 of IPEEE [F-22] indicates good housekeeping was confirmed. | No |
| 117 | CO2 system anchorage | Consider upgrading the high pressure CO2 system in the turbine building. These cylinders could potentially become missiles. | Oyster Creek IPEEE [F-22] | D – Previously re-evaluated by Oyster Creek and determined not necessary (LAR 88242.22) | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 118 | Turbine generator hydrogen seal oil support | Consider additional support of a small oil filter on the Turbine generator hydrogen seal oil unit. The unit is supported by a vertical stanchion but has no lateral support. | Oyster Creek IPEEE [F-22] | D – Previously re-evaluated by Oyster Creek and determined not necessary (LAR 88242.23) | No |
| 119 | Demin trailer anchorage | Review the basis for the Arrowhead demineralizer trailer. During the IPEEE walkdowns, anchorage chain was not attached to the embedded eyehook. | Oyster Creek IPEEE [F-22] | D – Procedure 320, Rev 29, Figure 320-3 provides a checklist for the GSS to verify when the Arrowhead Demin trailers are reinstalled after the trailer anchorage chain has been removed, that the trailer holddown chains are reinstalled, due to IPEEE recommendation to prevent potential missile hazard. (LAR 88242.24) | No |
| 120 | High pressure generator purge CO2 rack anchorage | Consider anchoring the high pressure generator purge CO2 rack outside the turbine building. This rack can become a missile. | Oyster Creek IPEEE [F-22] | D – CO2 bottle rack at the south side of the turbine building designed to seismic anti-falldown criteria, installation of anchor bolts and bonding of rackbase to concrete pad performed to minimize seismic risk, as identified in the OC IPEEE recommendations. (LAR 88242.25.) | No |
| 121 | Replacement of fire protection drop-weight actuated deluge valves | Consider replacement of fire protection drop-weight actuated deluge valves. Following a seismic event these valves could spuriously actuate and cause flow diversion of fire water and/or spurious spray of critical equipment. | Oyster Creek IPEEE [F-22] | D – Completed per Job Order 502857, LAR 88242.26. | No |
| 122 | Fire brigade and operator training | Consider training fire brigade and operators on dominant fire scenarios. | Oyster Creek IPEEE [F-22] | D – Completed by assignment of ETTS 34893 (LAR 88242.27). | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 123 | Replace CS and CSS relays | The following relays had chatter HCLPF <0.3 g and should be considered for replacement: PNL-ER18A-2HFA51A, PNL-ER8A-2HFA51A, PNL-ER8B-2HFA51A. | Oyster Creek IPEEE [F-22] | D - Already addressed.<br><br>All Core Spray GE HFA relays are 12HFA151A and Seismic Qualification of GE 12HFA121A relay exceeds the requirement of IPEEE. These are qualified to 1.27g. As such, OC does not require any replacement of GE HFA relays in Core Spray System.<br><br>Containment spray is no longer an automatic system. It will be manually started at some point into the event (10 min. or so). Therefore, it only has to be operable "after" the event and relay chatter is not a concern after an event. | No |
| 124 | Block wall 53 Reinforcement | Block wall 53 has a HCLPF of 0.27g and should be considered for reinforcement. This block wall can impact 125 VDC. | Oyster Creek IPEEE [F-22] | R – Potentially cost-beneficial. | Yes |
| 125 | Reduce fire impact in dominant fire areas | A fire in the cable spreading room and 480 VAC "A" Switchgear room may have a number of adverse impacts. Modifying circuits or installing fire barriers can reduce the impacts of postulated fires. | Oyster Creek IPEEE [F-22] | R –Potentially cost-beneficial. | Yes |
| 126 | Not Used | | | | |
| 127 | Operator training | Increased training on the systems and operator actions assessed as important in the PRA. | Oyster Creek IPE [F-15] | R – Potentially cost-beneficial. | Yes |
| 128 | IC Fouling | Programs instituted to reduce blockage and fouling of the isolation condensers | Oyster Creek IPE [F-15] | R – Potentially cost-beneficial. | Yes |
| 129 | Internal Flooding Procedure Enhancements | Improve procedures for responding to internal flooding events | Oyster Creek IPE [F-15] | R – Potentially cost-beneficial. | Yes |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 130 | Protect Combustion Turbines | Increase CT building integrity to withstand high winds. Consider specifications similar to safety related requirements. | PRA Model Importance Review (Section F.5.1) | R – Potentially cost-beneficial. | Yes |
| 131 | Decrease Grid Impact | Perform periodic evaluations of grid stability assuming a spurious OC trip. Intent is to minimize a loss of offsite power event following a spurious OC trip. This requires coordination with grid managers. | PRA Model Importance Review (Section F.5.1) | D – Per PJM Nuclear Communications Protocol[2], First Contingency analysis is performed automatically approximately once per minute. Cases where operating security limits are exceeded are corrected within 30 minutes. | No |
| 132 | Reduce probability of Multi-CT Operation | When both CTs are in operation, alignment for Oyster Creek LOOP response takes additional time due to need for CTs to coast down prior to switching. This SAMA would eliminate procedural guidance to shutdown CTs, if initially running, | PRA Model Importance Review (Section F.5.1) | R – Potentially cost-beneficial. | Yes |
| 133 | Enhance Hotwell makeup | Enhance hotwell makeup from CST to match CST makeup from fire water. | OC System Manager Review | R – Potentially cost-beneficial. | Yes |
| 134 | Upgrade Fire Pump House structural integrity | Upgrade fire pump house building integrity so that fire system would be capable of withstanding a severe weather event. | OC System Manager Review | R – Potentially cost-beneficial. | Yes |
| 135 | Increase structural integrity of IC makeup piping | The water supply to makeup to the Iso Condensers is neither safety related nor seismic. Upgrade of the Condensate Transfer System supply to the ICs would possibly increase their long term availability. | OC System Manager Review | C – The Oyster Creek IPEEE analysis included IC performance during seismic events. Using the EPRI hazard curves, the IC contributed 4.97% to the overall CDF of 3.6E-6/yr. If the IC could be made perfect, it would reduce contribution by a value of 1.79E-7/yr (3.6E-6*4.87%). Considering such a modification is expected to cost at least $5,000,000, this option is considered not cost-beneficial. | No |

Table F-15. Phase I SAMA Evaluation

| NO. | SAMA TITLE | SAMA DESCRIPTION | SOURCE | PHASE I DISPOSITION | RETAINED FOR PHASE II ANALYSIS? |
|---|---|---|---|---|---|
| 136 | Provide alternate power to condensate transfer pumps | Presently, both Condensate Transfer Pumps are powered from USS 1B2 via MCC 1B32. Also both are tripped and not loaded onto the EDG on LOOP. Operator must go to intake to reset UV device to allow use of pumps. Redundant power to the pumps would increase the availability of the system, and auto load onto the EDGs would make them available quickly and with no operator action during LOOP. | OC System Manager Review | R – Potentially cost-beneficial. | Yes |
| 137 | Create a crib house | Currently, some equipment related to the intake structure is exposed to the elements. Creating an expanded crib house may improve equipment reliability. | OC System Manager Review | F – No specific reliability problems associated with environmental exposure of OC equipment have been identified. Such a structure is expected to cost $500,000. Since no quantifiable benefit exists, this item is not considered cost-beneficial. | No |
| 138 | Protect transformers | The main and startup transformers are located approximately 15' apart. There is a concern that a failure of one could impact the other. | OC System Manager Review | R – Potentially cost-beneficial. | Yes |

Notes to Table F-15:

Legend

- Applicability to the Plant (N/A): If a proposed SAMA does not apply to the Oyster Creek design, it is not retained. For example, inclusion of an automatic alternate refill system for an Isolation Condenser System would not require further analysis for a plant that does not have an Isolation Condenser System.
- Cost (C): If a SAMA requires extensive changes that are known to exceed any possible benefit, they are screened without developing an estimated cost of implementation. For example, the cost of installing an additional, buried offsite power source over a path of fifty miles is known to exceed any potential benefit and would be immediately disqualified. A screening value of $4,462,000 is used when compared to a judged improvement cost (See section F.4).
- Already Implemented at Oyster Creek (D): If an improvement has already been implemented at Oyster Creek, it is screened from further consideration.
- Cost Exceed Benefit (F): If the cost obviously exceeds the benefit or if the benefit is negligible, the SAMA is screened from further consideration.
- Addressed by a Similar Item (I): If a SAMA is included within another SAMA, it is screened if the other item completely subsumes it.

Those retained (R) for further evaluation, are identified with a "Yes" in the last column.

Notes:

(1) The Oyster Creek procedures were evaluated as part of the HRA and the crew interviews. During this process it was concluded that the procedures and training were consistent with requirements and goals established by INPO. No significant general discrepancies or issues were identified related to the procedures. If specific issues or discrepancies with a specific procedure was identified, then it is discussed along with the appropriate SAMA. Otherwise, general procedure review and enhancement is not considered necessary.

(2) "PJM Control Center Requirements, Attachment B, Nuclear Plant Communications Protocol," Revision 08, 1/1/2005.

# F.6 Phase II SAMA Analysis

The Phase I SAMA screening process of 136[1] candidate plant changes, modifications, or procedure/training changes in Table F-15 has resulted in a reduced list of 37 SAMA candidates. This reduced SAMA list is provided in the Phase II summary disposition table, Table F-16. Table F-16 includes the basis for the dispositioning of each of the 37 SAMA candidates in Phase II using a more detailed analysis that is documented in the subsections of F.6. Seven SAMAs result in a positive net value based on detailed, realistic cost benefit analysis.

Some SAMA candidates are determined to have a negligible impact on the CDF (i.e., <1E-9/yr, which represents approximately 0.01% of the baseline CDF). The averted cost risk associated with such small CDF changes is less than $1,000. For such candidates, detailed implemented cost estimates are not judged warranted.

For each of the remaining SAMA candidates that survived from Phase I that could not be eliminated based on screening cost, PRA/application insights, or negligible PRA impacts, a more detailed conceptual design is prepared along with a more detailed estimated cost. This information is then used to evaluate the effect of the candidates' changes upon the plant safety model.

The risks associated with the continued operation of the Oyster Creek plant are calculated and then converted into a present value dollar ($) cost. This is referred to in the analysis as a cost-risk.

These cost-risks are then compared with the cost of implementing a plant modification, procedure change, or training related change. The estimated cost of every Phase II SAMA was not obtained from plant staff so the PRA staff has estimated the approximate cost in these cases. These estimates where noted are considered a "best-estimate" and are considered to be an "order-of-magnitude" estimate only. Comparison of costs from other available SAMA analyses is made as available.

The cost-risk based evaluation method used to determine the desirability of implementing the SAMA is defined by the following equation:

*Net Value = (baseline cost-risk of site operation (MMACR) – cost-risk of site operation with SAMA implemented) – cost of implementation*

If the net value of the SAMA is negative, the cost of implementation is larger than the benefit associated with the SAMA and the SAMA is not considered beneficial. The baseline cost-risk of plant operation is derived using the methodology presented in Section F.4. The cost-risk of plant operation with the SAMA implemented is determined in the same manner with the exception that the PRA results reflect the application of the SAMA to the plant (the baseline input is replaced by the results of a PRA sensitivity with the SAMA change in effect).

Table F-16 and subsections of F.6 below describe the analysis that is used to determine how the unscreened SAMA candidates in Table F-15 are assessed.

Each of the subsections of F.6 provide the following information:

[1] There is no SAMA 90 or 126.

- A description of the proposed SAMA
- The method for modeling the SAMA in the PRA
- Two tables summarizing the results
  - The first table in each subsection of F.6 (see blank table below) summarizes the results for the PRA baseline and the PRA case with the individual SAMA implemented. The calculational results shown in the table are as follows:

    (1) The PRA frequencies of each radionuclide release category plus the "total" release frequency (which is also equal to the CDF). (Rows 1 and 2)

    (2) The MACCS2 results for these radionuclide release frequencies for the plant configuration with the SAMA implemented. These results are provided in terms of Dose Risk (Person Rem per year) in Row 3 and the Offsite Economic Cost Risk (OECR) ($ per year) in Row 4.

**Example Blank Table**
**SAMA XX PRA and MACCS Results By Release Category**

| Row | Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| 1 | Baseline Freq. (per yr.) | | | | | | | | | | | |
| 2 | SAMA Freq. (per yr.) | | | | | | | | | | | |
| 3 | SAMA Dose-Risk (Person Rem/yr.) | | | | | | | | | | | |
| 4 | SAMA OECR ($/yr.) | | | | | | | | | | | |

  - The second table (see blank table below) uses the present value total base cost-risk[(1)] (Column 1) and the calculated total present value cost-risk[(1)] associated with the plant if the SAMA is implemented (Column 2). The difference of these two values is the "Averted Cost-Risk". Using this "Averted Cost-Risk" (Column 3) minus the "Cost of Implementation" (Column 4) yields the "Net Value" (Column 5) which reflects whether the SAMA is cost beneficial, i.e., if the dollar value is positive.

[(1)] Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Example Blank Table
SAMA Number XX Net Value

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk[1] for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| | | | | |

[1] Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

**Table F-16. Phase II SAMA Disposition Summary**

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION[5] |
|---|---|---|---|---|---|---|
| 7 | Enhance Alternate Injection Reliability | The capability exists at some BWRs to provide flow from the RHRSW and Fire Protection systems to the RHR system; however, the reliability of the cross-tie could potentially be improved by including the cross-tie valves in the maintenance program so that the operability of the valves is monitored and tested. | Monticello Application for License Renewal [F-13] | Modification: $500,000 estimated by System Manager. This estimate is used for Oyster Creek.<br><br>Averted cost-risk: $174,000 | For Oyster Creek, this represents a potential modification to enable alignment of service water or ESW to Core Spray or Feedwater. The competing risk is that the raw water could clog the FW or CS spargers or the associated valves. | Determined to be not cost beneficial |
| 10 | Passive Overpressure Relief | This SAMA would reduce the risk of catastrophic failure of the containment. The current Torus Hard Pipe Vent includes a rupture disk beyond an isolation valve; however, an alternate path to the Torus Hard Pipe Vent could be made in the wetwell using a rupture disk that would fail at about 60 psid. Alternatively, the containment vent valves could be changed so that they "fail open" on loss of support. Given this change, the vent path would be open on loss of support with the exception of the rupture disk. To prevent premature opening of the vent path during scenarios with loss of vent valve support, the strength of the rupture disk could be increased so that it is closer to the EOP vent pressure. | Monticello Application for License Renewal [F-13] | Modification: $1,000,000 estimated for Oyster Creek.[3]<br><br>Averted cost-risk: $788,000 | For Oyster Creek, this represents a potential modification to install a passive containment vent arrangement in the existing hard pipe vent. Competing risks exist for containment isolation failure and loss of ECCS torus suction. | Determined to be not cost beneficial |

**Table F-16. Phase II SAMA Disposition Summary**

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION[5] |
|---|---|---|---|---|---|---|
| 18 | Improved Ability To Cool The Residual Heat Removal Heat Exchangers. | This SAMA would reduce the probability of a loss of decay heat removal by implementing procedure and hardware modifications to allow manual alignment of the fire protection system or by installing a component cooling water cross-tie.<br><br>A portable diesel-driven pump is under consideration to provide cooling water to a LPCI heat exchanger. This was discussed in the EPU correspondence as the tentative plan for dealing with the seismic outlier of Dresden Island Lock & Dam, i.e., loss of UHS, by Fall 2003. | Dresden Application for License Renewal [F-7] | Modification: $265,000 estimated for Dresden. This estimate is used for Oyster Creek.<br><br>Averted cost-risk: $8,000 | For Oyster Creek, this represents a potential modification to enable alignment of service water or fire protection to containment spray heat exchanger shells. | Determined to be not cost beneficial |

Table F-16. Phase II SAMA Disposition Summary

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION[5] |
|---|---|---|---|---|---|---|
| 20 | Re-open MSIVs | SAMA would allow regaining the main condenser as a heat sink by re-opening the MSIVs. There are two important aspects of the MSIV closure response:<br><br>For non-ATWS conditions, the ability to rapidly respond to MSIV closure and restore the main condenser as a heat sink is not explicitly directed.<br><br>For ATWS conditions, Dresden EOPs direct MSIV low level closure bypass in order to retain the main condenser as a heat sink; however, this assumes the MSIVs have not yet closed.<br><br>For both cases, explicit procedural direction to re-open the MSIVs could be included. | Dresden Application for License Renewal [F-7] | Modification: $400,000 estimated by System manager<br><br>Averted cost-risk: $4,000 | For Oyster Creek, this represents modification of the steam lines drains to allow improved MSIV operation. | Determined to be not cost beneficial |
| 23 | Diversify The Explosive Valve Operation | An alternate means of opening a pathway to the RPV for SBLC injection would improve the success probability for reactor shutdown. | Dresden Application for License Renewal [F-7] | Modification: Not estimated for Dresden.<br><br>$150,000 estimated for Oyster Creek.[3]<br><br>Averted cost-risk: $42,000 | For Oyster Creek, this represents a potential modification to enable manual bypass of explosive valves (explosive valve in a bypass line). | Determined to be not cost beneficial |

Table F-16. Phase II SAMA Disposition Summary

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION[5] |
|---|---|---|---|---|---|---|
| 25 | Bypass Low Pressure Permissive | LPCI and CS injection valves require a permissive signal from the same 2 pressure sensors in order to open. The instruments are currently specified as diverse. However, because this is a "pinch point" for all CS and LPCI injection, it is judged prudent to consider a plant modification to allow a bypass switch (1/division) to insert the permissive if the sensors fail to perform their function. A few other BWRs currently have this capability (e.g., Perry). | Dresden Application for License Renewal [F-7] | Modification: Not estimated for Dresden.<br><br>$50,000 estimated for Oyster Creek.[3]<br><br>Averted cost-risk: $4,000 | For Oyster Creek, this represents a potential modification or procedure to enable quick bypassing of low pressure permissive for core spray. | Determined to be not cost beneficial |
| 67 | Safety Related Condensate Storage Tank | This SAMA will improve availability of CST following a Seismic event. | PBAPS Application for License Renewal [F-6] | Modification: $1,000,000 per CST for Peach Bottom. This estimate is used for the one Oyster Creek CST tank.<br><br>Averted cost-risk: $65,000 | For Oyster Creek, this represents a potential modification to enable CST to survive a greater spectrum of earthquake challenges. | Determined to be not cost beneficial |
| 84 | Manually Operate Containment Vent Valves | Provide capability to vent primary containment without support systems with procedure/training | Nine Mile Point 1 Application for License Renewal [F-11] | Modification: Not estimated for Nine Mile 1.<br><br>$150,000 estimated for Oyster Creek.[3]<br><br>Averted cost-risk: $80,000 | For Oyster Creek, this represents a potential modification to enable manual operation of all containment vent valves. This would require local controls for the AOV vent valves. | Determined to be not cost beneficial |

Table F-16. Phase II SAMA Disposition Summary

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION(5) |
|---|---|---|---|---|---|---|
| 88 | Containment Vent | • The primary alternative identified is that the vent be opened and closed to control containment pressure approximately 10 psig below EOP Figure J. The vent procedure could be modified to explicitly include this restriction, plus add to the operating crew training cycle specific techniques to be used to maintain a vent control band.<br>• Another alternative is to include mechanical stops on the large vent valves to reduce the flow area from the vent, thus minimizing the discharge of steam flow rate for containment venting. | Oyster Creek PRA Review (Section F.5) | Procedure: $50,000‡<br><br>Averted cost-risk: $0 | This represents a potential procedure change to specify a control band for containment venting. Alternately, containment vent valves could be modified.<br><br>Vent valves are already restricted in movement to $30^0$ maximum opening. | Determined to be not cost beneficial |
| 89 | Improve Procedure For Aligning SDC With High DW Pressure | Perform a Safety Evaluation that allows Operating Procedure 305 to be implemented "as-is" with the elimination of the requirement for operators to invoke 50.54(x). | Oyster Creek PRA Review (Section F.5) | Procedure: $50,000‡<br><br>Averted cost-risk: Negligible (not calculated) | For Oyster Creek, this represents a procedure change to allow operators to bypass the SDC isolational signal and provide additional time to align SDC (i.e., improves crew response and is reflected in the PRA by a reduced Human Error Probability (HEP). | Determined to be not cost beneficial |
| 91 | Allow 4160 VAC Bus IC And ID Crosstie | Perform a Safety Evaluation that allows procedure 337 to be modified to allow operators to cross-tie buses 1C and 1D under emergency conditions which require operation of critical equipment. | Oyster Creek PRA Review (Section F.5) | Procedure and Hardware: $90,000<br><br>Averted cost-risk: $118,000 | Competing risks such as human errors associated with the new cross-tie were not included. | Candidate for implementation based on assessment as cost beneficial |

**Table F-16. Phase II SAMA Disposition Summary**

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION(5) |
|---|---|---|---|---|---|---|
| 92 | Allow Operators To Maximize CRD Flow | Modify EOP 1, Support Procedure 3 to eliminate the 150 gpm flow limitation and replace with a caution to monitor the system for pump runout when system flow is greater than 150 gpm. | Oyster Creek PRA Review (Section F.5) | Procedure, Test, Analysis: $100,000‡<br><br>Averted cost-risk: $36,000 | For Oyster Creek, this represents the potential for CRD flow to mitigate transients and a larger spectrum of LOCA sizes. | Determined to be not cost beneficial |
| 94 | Increase Success Probability For Fire Protection Alignment | Modify EOPs 1a and 1b to provide a cue or note to operators that fire protection system alignment takes longer to establish than other potential sources of RPV injection. | Oyster Creek PRA Review (Section F.5) | Procedure: $50,000‡<br><br>Averted cost-risk: $0 | For Oyster Creek, this represents an earlier to cue to operators to align fire protection such that the HEP is decreased. | Determined to be not cost beneficial |
| 95 | Add Procedural Clarification Related To 5 Psid CSS Alarm | Modify the 5 psid CSS alarm response procedure (B-5-A, B-5-B) and procedure 310 to include a caution that CSS should not be secured if being utilized for accident mitigation. | Oyster Creek System Manager Review | Procedure: $50,000‡<br><br>Averted cost-risk: Negligible (not calculated) | Operators indicated they would not secure a containment spray train based solely on the differential pressure alarm, and therefore, no penalty can be realistically assigned. Therefore no penalty is currently applied in the PRA. | Determined to be not cost beneficial |
| 99 | Provide an alternate method for IC shell level determination | The IC shells could be modified to include a permanent, passive local shell level indication such as available at Dresden. This, combined with adequate procedures and training, would allow IC operation should AC and DC power be unavailable | Oyster Creek PRA Review (Section F.5) | Procedure and Hardware: $150,000<br><br>Averted cost-risk: $674,000 | This involves development of a means for local indication of IC level as well as training on control of IC with no AC or DC power available. | Candidate for implementation based on assessment as cost beneficial |
| 100 | Connect SBO transformer to both AC divisions. | Currently the SBO transformer, which is powered from the combustion turbines, is connected only to the "B" switchgear. Connecting the transformer to the "A" bus will add redundancy. | Oyster Creek System Manager Review | Procedure and Hardware: $500,000<br><br>Averted cost-risk: $146,000 | Modification of the circuit to allow the combustion turbines to also supply the "A" bus directly would be beneficial. This would provide a benefit similar to SAMA 91 except that equipment such as feedwater pumps that are power from Bus A would also be potentially available. | Determined to be not cost beneficial |

Table F-16. Phase II SAMA Disposition Summary

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION[5] |
|---|---|---|---|---|---|---|
| 101 | Provide A Procedure For Determining RPV Level Using Fuel Zone Level Indicators A/C With SLC Operating | Additional guidance should be evaluated for operators to consider temporarily securing SLC pumps, as necessary, to record RPV level. This approach must balance SLC pump start frequency requirements as well as RPV level trends against the downsides of RPV flooding. | Oyster Creek System Manager Review | Procedure: $50,000‡<br><br>Averted cost-risk: $0 | No significant benefit calculated with the PRA model. | Determined to be not cost beneficial |
| 102 | Revise ATWS EOP To Provide RPV Level Correction Based On Power | Revise EOP 1b "RPV Control – ATWS" to include an RPV Fuel Zone Level correction factor to account for reactor power level. | Oyster Creek System Manager Review | Procedure: $50,000‡<br><br>Averted cost-risk: $0 | No significant benefit calculated with the PRA model. | Determined to be not cost beneficial |
| 104 | Improve Loss Of Circulating Water Response | Develop a loss of circulating water abnormal operating procedure or revise the loss of condenser vacuum procedure to include guidance to allow condensate and feedwater to be adequately protected by swapping necessary cooling of TBCCW to SW. This includes more rapid swapping to service water. | Oyster Creek PRA Review (Section F.5) | Modification: $250,000 includes both procedural changes and hardware modifications to allow the timely transition to SW.<br><br>Averted cost-risk: $44,000 | None. | Determined to be not cost beneficial |
| 106 | Improve Direction For Cooldown In Loss Of RBCCW | Revise ABN-19 to include guidance to implement a <90°F/hr cooldown as soon as possible following a loss of RBCCW to supplement protection of recirc seals by reducing RPV pressure. | Oyster Creek System Manager Review | Procedure: $50,000‡<br><br>Averted cost-risk: $34,000 | Vendor test data was reviewed to assess the probability that recirculation pump seals may leak. | Determined to be not cost beneficial |
| 107 | Reduce potential for loss of CST inventory following loss of instrument air | Modify the spill valves so that they fail close on loss of instrument air.<br><br>Modify the spill valve air supply to be fitted with air accumulators. | Oyster Creek PRA Review (Section F.5) | Modification: $150,000[3]<br><br>Averted cost-risk: $0 | Negligible CDF benefit calculated. | Determined to be not cost beneficial |

Table F-16. Phase II SAMA Disposition Summary

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION(5) |
|---|---|---|---|---|---|---|
| 108 | Reduce Fuel Zone Level Instrument Error Band | Relocate reference leg instrument penetration closer to TAF and recalibrate. | Oyster Creek System Manager Review | Modification: $500,000(3)<br><br>Averted cost-risk: Not calculated | Negligible CDF benefit calculated. | Determined to be not cost beneficial |
| 109 | Portable DC Battery Charger To Preserve IC And EMRV Operability Along With Adequate Instrumentation | Provide portable battery chargers capable of supplying 125V DC buses | Oyster Creek PRA Review (Section F.5) | Modification: $75,000 estimated in Monticello SAMA evaluation.<br><br>Averted cost-risk: $674,000 | For Oyster Creek, DC power is critical to the operation of the isolation condenser and other mitigation systems. It therefore represents a benefit in station blackout related sequences and other similar sequences. | Candidate for implementation based on assessment as cost beneficial |
| 110 | Delete High Drywell Pressure Signal From SDC Isolation | The purpose of this insight is to identify the desirability of removing the SDC interlock on high drywell pressure to increase the flexibility of SDC system use. | Oyster Creek System Manager Review | Modification: $75,000(3)<br><br>Averted cost-risk: Negligible | See item 89, similar benefit as a proposed procedural change. | Determined to be not cost beneficial |
| 111 | Provide Alternate Drywell Spray Injection Source | The possible alternatives may include:<br>• ESW cross tie<br>• SW cross tie<br>• Diesel Fire pump cross tie | Oyster Creek PRA Review (Section F.5) | Modification: $500,000<br><br>Averted cost-risk: Negligible | A potential competing risk is that the raw water might clog the containment spray nozzles. | Determined to be not cost beneficial |
| 112 | Intake Structure | The purpose of this insight is to identify that there are potential safety beneficial effects associated with a pro-active plan to ensure high reliability of the cooling water intake structure and its supply to support raw water systems into the plant. | Oyster Creek PRA Review (Section F.5) | Modification: $1,000,000(2)<br><br>Averted cost-risk: $8,000 | Minimal benefit. | Determined to be not cost beneficial |
| 124 | Block Wall 53 Reinforcement | Block wall 53 has a HCLPF of 0.27g and should be considered for reinforcement. This block wall can impact 125 VDC. | Oyster Creek IPEEE [F-22] | Modification: $150,000(3)<br><br>Averted cost-risk: $84,000 | Mentioned in IPEEE submittal to NRC. | Determined to be not cost beneficial |

**Table F-16. Phase II SAMA Disposition Summary**

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION[5] |
|---|---|---|---|---|---|---|
| 125 | Reduce fire impact in dominant fire areas | A fire in the cable spreading room and 480 VAC "A" Switchgear room may have a number of adverse impacts. Modifying circuits or installing fire barriers may reduce the impacts of postulated fires. | Oyster Creek IPEEE [F-22] | Modification: $100,000[3]<br><br>Averted cost-risk: $333,000 | Mentioned in IPEEE submittal to NRC. Mentioned as a significant contributor on page 1–6 of IPEEE submittal to NRC. | Candidate for implementation based on assessment as cost beneficial |
| 127 | Operator Training | Increased training on the PRA systems and operator actions determined as important in the PRA. | Oyster Creek IPE [F-15] | Training: $50,000‡<br><br>Averted cost-risk: Not calculated | Mentioned by NRC in IPE SER. | Candidate for implementation based on assessment as cost beneficial |
| 128 | IC Fouling | Programs instituted to reduce blockage and fouling of the isolation condensers. | Oyster Creek IPE [F-15] | Program: $200,000[3]<br><br>Averted cost-risk: Negligible | Mentioned by NRC in IPEEE SER. | Determined to be not cost beneficial |
| 129 | Internal Flooding Procedure Enhancements | Improve procedures for responding to internal flooding events. | Oyster Creek IPE [F-15] | Procedure: $100,000[4]<br><br>Averted cost-risk: $56,000 | Mentioned by NRC in IPE SER. | Determined to be not cost beneficial |
| 130 | Protect Combustion Turbines | Increase CT building integrity to withstand high winds. Consider specifications similar to safety related requirements. | PRA Model Importance Review (Section F.5.1) | Modification: $600,000[3]<br><br>Averted cost-risk: $747,000 | For Oyster Creek, this represents expanding the severe weather design requirements for the Combustion Turbines (CTs) and the SBO transformers to accommodate higher wind levels. This change allows the CTs to be available as an AC power source for a larger spectrum of events. | Candidate for implementation based on assessment as cost beneficial |

**Table F-16. Phase II SAMA Disposition Summary**

| SAMA ID NUMBER | SAMA TITLE | SAMA DESCRIPTION | SOURCE | ESTIMATED COST & AVERTED COST-RISK | COMMENT | PHASE II DISPOSITION(5) |
|---|---|---|---|---|---|---|
| 132 | Reduce Probability of Multi-CT Operation | When both CTs are in operation, alignment for Oyster Creek LOOP response takes additional time due to need for CTs to coast down prior to switching. This SAMA would eliminate procedural guidance to shutdown CTs, if initially running, | PRA Model Importance Review (Section F.5.1) | Procedure: $50,000‡<br><br>Averted cost-risk: $46,000 | An alternative SAMA to provide this capability by obtaining First Energy (operator of the CTs) agreement to always maintain one CT in standby status is considered cost prohibitive and is considered adequately represented by the procedure change. | Determined to be not cost beneficial |
| 133 | Increase Hotwell Makeup Capability | Increase hotwell makeup flowrate to allow condensate/feedwater to be beneficial over a wide spectrum of LOCA conditions | System Manager Comment | Modification: $250,000<br><br>Averted cost-risk: $72,000 | | Determined to be not cost beneficial |
| 134 | Upgrade Fire Pump House structural integrity | Upgrade fire pump house building integrity so that fire system would be capable of withstanding a severe weather event. | OC System Manager Review | Modification: $150,000<br><br>Averted cost-risk: $438,000 | | Candidate for implementation based on assessment as cost beneficial |
| 136 | Provide alternate power to condensate transfer pumps | Presently, both Condensate Transfer Pumps are powered from USS 1B2 via MCC 1B32. Also both are tripped and not loaded onto the EDG on LOOP. Operator must go to intake to reset UV device to allow use of pumps. Redundant power to the pumps would increase the availability of the system, and auto load onto the EDGs would make them available quickly and with no operator action during LOOP. | OC System Manager Review | Modification: $100,000<br><br>Averted cost-risk: $0 | | Determined to be not cost beneficial |
| 138 | Protect transformers | The main and startup transformers are located approximately 15' apart. There is a concern that a failure of one could impact the other. | OC System Manager Review | Modification: $780,000<br><br>Averted cost-risk: $446,000 | | Determined to be not cost beneficial |

Notes to Table F-16:

‡ Cost of procedure change is estimated to be $50,000 and includes:

- Procedure Change
- Training
- Verification
- Roll-Out
- Minor Calculations, If Needed

(1) Assumes all fire risk could be eliminated by this SAMA.

(2) Based on continuing more aggressive program over 20 years for treatment to prevent intake structure problems of:

- Clogging by floating vegetation
- Mussels and Asiatic clams
- Silting

(3) Engineering judgment by the PRA team.

(4) Internal flood improvements in procedure, training, and possible control room indication hardware is anticipated to cost in excess of $100,000.

(5) The Phase II determination of cost benefit is documented in the subsections of F.6.

### F.6.1 SAMA 7: ENHANCE ALTERNATE INJECTION RELIABILITY

Currently, Oyster Creek has only one alternate source of RPV injection credited in the PRA model, Fire Protection Injection via core spray. Implementation of another alternate supply would provide a benefit in terms of additional redundancy for RPV water level control. Some other plants have the ability to align service water or emergency service water to the RPV for injection. At Oyster Creek, both service water and emergency service water piping currently exist in the reactor building. Providing a hard-piped cross-connection between emergency service water and core spray would provide a second alternate low pressure injection source[1].

In order to determine the potential benefit of such a plant modification, the PRA model was modified assuming a cross-tie between ESW and core spray was available. A failure probability of 1E-2 was assumed to represent operator action and additional equipment operation that could prevent the modification from functioning.

The OC-LEV2.caf fault tree model was saved as OC-SAMA7.caf and edited. The CS (Core Spray) node was modified by placing ESW gate logic under gates CS1FP and CS2FP. This allows the core spray function to be operable if core spray, fire water, or ESW is available, provided the core spray injection pathway operates. The ESW gates (CCG01MDD, CCG02MED) were "ORed" with a new basic event (1E-2) to represent the failure probability of the equipment and operator action associated with the new modification. In order to reduce the suction strainer failures that impact core spray, the ESW logic was "ANDed" into the suction strainer failure gate so that suction strainer AND ESW failure would be required to guarantee failure of the core spray injection function. The same process was not used for internal floods that impact core spray because it was assumed that the internal floods would fail the ESW alignment equipment and/or operator action.

The baseline CDF is 1.05E-5 per year and the model re-quantified with the proposed modification is 1.02E-5 per year. This is a reduction of 3.1E-7 per year. This is judged to be a conservative estimate of the improvement because both SW and ESW are "dirty" water systems from a salt water source. There are potential significant clogging issues associated with the Core Spray spargers that could compromise the benefit to be achieved from such cross ties. Development of cross-tie to SW or ESW may be feasible.

The results from this case indicate a 2.9 percent reduction in CDF ($CDF_{new}$=1.02E-5 per year). A further breakdown of this information is provided below according to release category.

(1) Likewise, some other plants have the ability to align service water directly to the condenser hotwell. This has the potential to eliminate the impact of the limited CST inventory in LOCA scenarios. However, this modification would be completely reliant on the present condensate and feedwater system for RPV injection which in turn is completely reliant on the offsite AC power. In addition, the potential for clogging of the FW injection path due to the debris from the ESW and SW may compromise this pathway. Therefore, this additional option was not pursued.

**SAMA 7 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category: Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.02E-05 | 2.63E-06 | 3.34E-06 | 1.95E-07 | 9.55E-07 | 1.65E-06 | 1.39E-09 | 5.03E-07 | 7.30E-07 | 1.75E-07 | 3.14E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.47E+01 | 6.56E-02 | 1.34E+01 | 2.89E-02 | 5.53E+00 | 6.92E+00 | 4.90E-03 | 3.99E+00 | 3.06E+00 | 1.31E+00 | 3.89E-01 |
| SAMA OECR ($/yr.) | 1.13E+05 | 2.60E+01 | 3.94E+04 | 2.36E+01 | 1.82E+04 | 2.09E+04 | 1.34E+01 | 1.90E+04 | 7.96E+03 | 6.59E+03 | 1.14E+03 |

The System Manager's estimate of the cost for this modification is $500,000.

This information was used as input to the present value cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 7 Net Value**

| Base Case: Cost-Risk for Oyster Creek (site)[(1), (2)] | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,288,000 | $174,000 | $500,000 | -$326,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

(2) Includes a factor of two increase to account for external events.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.2 SAMA 10: PASSIVE OVERPRESSURE RELIEF

Containment venting requires instrument air and CIP-3 supplied control power as well as local operator action outside the Control Room and in the yard. The instrument air valves are fitted with air accumulators and CIP-3 receives power from diverse AC and DC sources. Therefore, loss of support is a low probability situation. However, operator action is required and reduction in the contribution could be achieved if a passive primary containment overpressure protection device is installed. Such a device, i.e., rupture disk, would eliminate the operator action. In order for this device to be useful, the vent pathway valves would have to be initially open, fail open, and remain open upon a high drywell pressure signal. It should be noted that this represents a substantial change to the design basis of this system. Associated with this significant design basis change, the rupture disk could also increase the potential for containment isolation failure, i.e., a competing risk. Also, the device would not be useful for low pressure, combustible gas venting scenarios.

The maximum benefit associated with the plant modification is assessed here by neglecting the competing risks. The OC-LEV2.caf fault tree model was saved as OC-SAMA10.caf and edited. This potential modification was modeled by deleting the following logic from the containment venting portion of the model (OV Node):

- OHEOV1 – Operator Action
- OH-TORUSCLG – Operator Action
- OHEOV1-COND – Operator Action
- VENT-SUPPORT – Gate with AC and DC support nodes

The baseline CDF is 1.05x10-5 per year and the model re-quantified with the proposed modification is 8.87x10-6 per yr. This is a reduction of 1.6x10-6 per yr. As noted, this is the maximum benefit associated with the change determined by neglecting the competing risks.

However, the plant modification could cause at least two competing risks or adverse consequences. One competing risk is the increase in the probability of a containment isolation failure. A normally open set of valves would be required to isolate the containment as necessary. This would likely require operator action. As such, the original operator action to open the vent would be replaced by an operator action to close the primary containment as necessary for containment isolation.

The second competing risk is that the use of rupture disks would result in a rapid containment blowdown which would likely compromise ECCS suction from the torus due to low NPSH. This adverse impact has also not been explicitly accounted for in the modeling of this SAMA but is considered qualitatively in assessing the benefit.

The results from this case indicate a 15.5 percent reduction in CDF (CDFnew=8.87E-6 per year). A further breakdown of this information is provided below according to release category.

**SAMA 10 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category: Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 8.87E-06 | 2.71E-06 | 3.37E-06 | 1.96E-07 | 9.99E-07 | 1.32E-07 | 1.67E-09 | 5.48E-07 | 6.78E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 2.92E+01 | 6.76E-02 | 1.35E+01 | 2.90E-02 | 5.79E+00 | 5.54E-01 | 5.90E-03 | 4.34E+00 | 2.84E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 9.77E+04 | 2.68E+01 | 3.98E+04 | 2.37E+01 | 1.91E+04 | 1.68E+03 | 1.61E+01 | 2.06E+04 | 7.39E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be $1,000,000 based on the need for considerable analysis relating to primary containment integrity (i.e., rupture disks would become an extension of containment) as well as extensive modification of the primary containment vent pathway. Continued maintenance and training is also significant. This is assumed to include equipment procurement, training, and procedure updates. Licensing costs are also likely to be significant and are included in the estimate.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 10 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $3,674,000 | $788,000 | $1,000,000 | -$212,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

In addition, the adverse impacts on RPV makeup due to NPSH issues and failure of containment isolation combine to make a strong case for not including this as a viable modification. Therefore, while the competing risks are not explicitly quantified they support the above determination that the modification should not be performed.

## F.6.3 SAMA 18: IMPROVED ABILITY TO COOL THE CONTAINMENT SPRAY SYSTEM HEAT EXCHANGERS

SAMA 18 represents a potential modification to enable alignment of service water or fire protection to containment spray heat exchanger shells.

The OC-LEV2.caf fault tree model was saved as OC-SAMA18.caf and edited. To model this proposed modification, nodes FP (Fire Protection) and SW (Service Water) were added under the AND gates for emergency service water (Gates CCG01MDD, CCG02MBD). This logic would now require failure of service water and fire water in addition to emergency service water pumps, for failure of the containment spray heat exchanger heat sink.

The results from this case indicate a 0.5 percent reduction in CDF ($CDF_{new}$= 1.04E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 18 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category: Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.04E-05 | 2.70E-06 | 3.35E-06 | 1.96E-07 | 9.96E-07 | 1.65E-06 | 1.67E-09 | 5.46E-07 | 7.82E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.59E+01 | 6.75E-02 | 1.35E+01 | 2.90E-02 | 5.77E+00 | 6.92E+00 | 5.90E-03 | 4.33E+00 | 3.28E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.67E+01 | 3.96E+04 | 2.37E+01 | 1.90E+04 | 2.09E+04 | 1.61E+01 | 2.06E+04 | 8.52E+03 | 7.91E+03 | 1.17E+03 |

Dresden [F-7] estimated the cost of a similar modification to be $265,000. This cost value is judged a reasonable estimate for this OC SAMA.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 18 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,454,000 | $8,000 | $265,000 | -$257,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

A sensitivity analysis is also performed, similar to that above, except that only the service water cross-tie is credited. The difference is a change in CDF of less than 1E-8/yr and demonstrates a very small benefit.

As an additional sensitivity, the model used for SAMA 18 was further edited to include fire water and service water as direct heat sinks for the SDC heat exchangers. The revision involved "ANDing" gates FP (Fire Protection) and SW (Service Water) along with RB (RBCCW) under the SD (SDC) gate. This model was saved as OC-SAMA18A.caf. When this model was requantified the resulting delta CDF was 1E-9/yr when compared to the 1.040E-5/yr value for the original SAMA 18 calculation, the difference is found to be insignificant. This shows that the primary benefit would be related to expanding the heat sinks for containment spray. This occurs because containment spray as a heat sink is useful in most scenarios, including all wherein SDC would also be beneficial. By contrast, SDC is not effective in high pressure scenarios or scenarios involving LOCAs.

## F.6.4 SAMA 20: RE-OPEN MSIVS TO RESTORE THE MAIN CONDENSER AS A HEAT SINK

The main condenser represents one of the ultimate heat sink available to remove heat from the RPV and containment for non-LOCA conditions. There is currently no EOP direction to reopen the MSIVs and restore the main condenser as a heat sink for non-ATWS conditions. There are non-accident procedures (system procedures) that provide the required guidance and the crews are trained on how to perform the line up (reopen the MSIVs).

The enhancement that could be considered is to provide clear direction on reopening the MSIVs for cases when the event can be clearly identified as a spurious MSIV closure and the main condenser is otherwise available. Operators have indicated to the PRA team that current EOPs are interpreted to provide guidance to use the main heat sink wherever possible. However, at Oyster Creek, reestablishing the main heat sink can be difficult because the main steam lines can not easily be vented to equalize pressure across the MSIVs. This would likely lead to significant pressure perturbation when the MSIVs are opened. The pressure spikes would then likely cause reclosure. Providing a configuration which allows for easy steam line venting would require a modification to replace steam line drains and thus eliminate the need for the currently installed spectacle flanges.

In order to quantify the benefit of this improvement, the OC-LEV2.caf fault tree model was saved as OC-SAMA20.caf and edited. To model this proposed modification, a basic event was ANDed with the MSIV closure (%CMSIV) initiator. This basic event was set equal to 0.1 and represents the reopening of a spuriously closed steam line to allow the main heat sink to function. Based on the above information, the benefit from an enhanced procedure is modeled with a human error probability (HEP) of 0.1. Using a lower HEP (e.g., 0.01) is judged to potentially overestimate the benefit of the SAMA.

The results from this case indicate a 0.4 percent reduction in CDF ($CDF_{new}$= 1.05E-5 per year). The delta CDF is 3.8E-8/yr. A further breakdown of this information is provided below according to release category.

**SAMA 20 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.70E-06 | 3.37E-06 | 1.95E-07 | 9.94E-07 | 1.64E-06 | 1.67E-09 | 5.47E-07 | 7.84E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.59E+01 | 6.76E-02 | 1.36E+01 | 2.89E-02 | 5.75E+00 | 6.87E+00 | 5.90E-03 | 4.34E+00 | 3.28E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.68E+01 | 3.98E+04 | 2.36E+01 | 1.90E+04 | 2.08E+04 | 1.61E+01 | 2.06E+04 | 8.54E+03 | 7.91E+03 | 1.17E+03 |

System managers estimate the cost of this modification to be $400,000. Steam line drains inside the primary containment must be refitted with leak-tight isolation valves capable of remote operation.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 20 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,458,000 | $4,000 | $400,000 | -$396,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.5 SAMA 23: DIVERSIFY THE EXPLOSIVE VALVE OPERATION

SAMA 23 represents a potential modification to enable manual bypass of explosive valves (manually operated valve in a bypass line).

The OC-LEV2.caf fault tree model was saved as OC-SAMA23.caf and edited. To model this proposed modification, a basic event, SAMA23BE, was added under the AND gate for the squib valves, BIG02MHC. This basic event was set to 1E-2 to reflect estimated operator reliability under such a configuration.

The results from this case indicate a 0.7 percent reduction in CDF ($CDF_{new}$= 1.04E-5 per year), A further breakdown of this information is provided below according to release category.

**SAMA 23 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.04E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.32E-07 | 1.66E-06 | 1.67E-09 | 5.45E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.56E+01 | 6.76E-02 | 1.36E+01 | 2.90E-02 | 5.40E+00 | 6.95E+00 | 5.90E-03 | 4.33E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.17E+05 | 2.68E+01 | 3.99E+04 | 2.37E+01 | 1.78E+04 | 2.10E+04 | 1.61E+01 | 2.06E+04 | 8.57E+03 | 7.91E+03 | 1.17E+03 |

This SAMA is expected to involve installation of an explosive valve bypass line. This is a significant plant modification expected to cost at least $150,000. System manager estimates it would cost $150,000 for an additional manual valve ($500,000 for MOV w/CR controls). None of these items would be considered cost beneficial.

Because the valving must be highly leak-tight to avoid unintentionally introducing boron to the RPV, a $150,000 estimate is considered very optimistic.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 23 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| **$4,462,000** | **$4,420,000** | **$42,000** | **$150,000** | **-$108,000** |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.6 SAMA 25: BYPASS LOW PRESSURE PERMISSIVE

SAMA 25 represents a potential modification or procedure to enable quick bypassing of low pressure permissive for core spray.

The OC-LEV2.caf fault tree model was saved as OC-SAMA25.caf and edited. To model this proposed procedure change, an AND gate was added under the gates for core spray injection valves (CSG00MEF, CSG00MEK). Under the new AND gate is logic for the permissive as well as a new basic event that represents operator action to bypass the permissive. The new basic event, SAMA25BE, was set to 1E-2.

The results from this case indicate a 0.3 percent reduction in CDF ($CDF_{new}$= 1.05E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 25 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.69E-06 | 3.38E-06 | 1.96E-07 | 9.93E-07 | 1.65E-06 | 1.65E-09 | 5.44E-07 | 7.82E-07 | 2.08E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.59E+01 | 6.74E-02 | 1.36E+01 | 2.90E-02 | 5.75E+00 | 6.95E+00 | 5.82E-03 | 4.31E+00 | 3.27E+00 | 1.56E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.67E+01 | 3.98E+04 | 2.37E+01 | 1.90E+04 | 2.10E+04 | 1.59E+01 | 2.05E+04 | 8.52E+03 | 7.80E+03 | 1.17E+03 |

The cost of implementation for this SAMA was estimated to be $50,000.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 25 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| **$4,462,000** | **$4,458,000** | **$4,000** | **$50,000** | **-$46,000** |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

### F.6.7 SAMA 67: SAFETY RELATED CONDENSATE STORAGE TANK

SAMA 67 represents a potential modification to enable the CST to survive a larger portion of the seismic spectrum. The modification to strengthen the seismic capability of the CST is judged only to impact the seismic risk contribution. Therefore, the fire and internal events risk contributions are assumed to remain unchanged.

The current Oyster Creek PRA model does not include seismic initiating events. However, the IPEEE evaluation [F-22] built a seismic model that can be used to estimate the potential benefit of this proposed modification. Seismic CDF is 3.63E-6/yr and no containment event tree was developed for use with seismic events.

In the IPEEE, the seismic induced failure of the condensate storage tank was modeled using top event SX. The following table shows the failure rate under various conditions modeled in the seismic PRA.

| Model Identifier | Condition | Failure Rate (EPRI NP-6395-D Hazard Curve) | Failure Rate of Containment Spray Components (Safety Related) For Comparison |
|---|---|---|---|
| SX1 | CST Failure given earthquake between 0.007g and 0.26g | 4.91E-3 | 4.74E-5 |
| SX2 | CST Failure given earthquake between 0.26g and 0.46g | 0.522 | 4.43E-2 |
| SX3 | CST Failure given earthquake between 0.46g and 0.62g | 0.833 | 0.296 |
| SX4 | CST Failure given earthquake between 0.62g and 0.82g | 0.935 | 0.648 |

The Fussell-Vesely (FV) importance measure for the SX Top event is 0.31 which means that the seismic induced failure of the CSTs occurs in approximately 31% of seismic core damage sequences. Given the fairly high seismic failure rate for CSTs, it is judged reasonable to assume that designing the CSTs to standards equal to safety related components would reduce CST failure sequences by a factor of 5. Such a change would reduce seismic CDF from 3.63E-6/yr to 2.73E-6/yr (3.63E-6*((1-0.31)+(0.31/5))). The results from this case indicate a 24.8 percent reduction in seismic CDF ($CDF_{new}$= 2.73E-6 per year).

The IPEEE indicates that most seismic CST failure sequences involve high RPV pressure conditions. As such, these sequences are assumed to apply only to Class1A and that the relative contribution to Level 2 endstates is proportional to those derived using the baseline Level 1 model. Applying this relationship yields the following results regarding the impact of the proposed modification.

**SAMA 67 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category: Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 3.63E-06 | 2.73E-06 | 5.83E-07 | 1.41E-07 | 1.23E-07 | 0.00E+00 | 0.00E+00 | 4.84E-08 | 3.99E-09 | 0.00E+00 | 0.00E+00 |
| SAMA Freq. (per yr.) | 2.73E-06 | 2.06E-06 | 4.39E-07 | 1.06E-07 | 9.28E-08 | 0.00E+00 | 0.00E+00 | 3.64E-08 | 3.00E-09 | 0.00E+00 | 0.00E+00 |
| SAMA Dose-Risk (Person Rem/yr.) | 2.67E+00 | 5.14E-02 | 1.76E+00 | 1.57E-02 | 5.37E-01 | 0.00E+00 | 0.00E+00 | 2.88E-01 | 1.26E-02 | 0.00E+00E | 0.00E+00 |
| SAMA OECR ($/yr.) | 8.39E+03 | 2.04E+01 | 5.18E+03 | 1.29E+01 | 1.77E+03 | 0.00E+00 | 0.00E+00 | 1.37E+03 | 3.27E+01 | 0.00E+00 | 0.00E+00 |

The cost of this SAMA was estimated in the Peach Bottom SAMA evaluation [F-6] and was estimated to be $1,000,000 per tank. Because Oyster Creek has one CST, the cost of implementation for this SAMA is $1,000,000.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 67 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site)(2) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $262,000 | $197,000 | $65,000 | $1,000,000 | -$935,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

(2) This includes only the seismic contribution to risk as that is the only portion of risk considered impacted by this SAMA.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.8 SAMA 84: MANUALLY OPERATE CONTAINMENT VENT VALVES

SAMA 84 represents a potential modification to enable manual operation of all containment vent valves. This would require local controls for vent valves.

The manual operation of the containment isolation AOVs requires local access within the Reactor Building. Adverse environmental conditions within the Reactor Building due to high radiation, high temperatures, or scenario dependent issues such as flooding or fire could compromise the benefit associated with the SAMA.

For the cost benefit evaluation the following assumptions are made:

- Only venting prior to core damage is credited as feasible. (No Level 2 credit is assumed.)
- Adverse Reactor Building environments due to high temperature, flooding or fire is not included. This overestimates the benefit for this SAMA.

The OC-LEV2.caf fault tree model was saved as OC-SAMA84.caf and edited. To model this proposed modification, a new gate, SAMA84, was added directly under the OV, Primary Containment venting, gate. The new gate was constructed as an AND gate and a new basic event was added to represent operators manually operating containment venting locally. This basic event was named OH-OV-SAMA84 and set equal to 1E-2 per demand. All containment venting basic events related to support system interaction were then moved under the SAMA84 gate to be "ANDed" with the new basic event. This logic makes the current equipment redundant to a new means to open the containment venting pathway.

The results from this case indicate a 1.7 percent reduction in CDF ($CDF_{new}$= 1.03E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 84 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.03E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.49E-06 | 1.67E-09 | 5.48E-07 | 7.74E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.53E+01 | 6.76E-02 | 1.36E+01 | 2.90E-02 | 5.79E+00 | 6.26E+00 | 5.90E-03 | 4.34E+00 | 3.25E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.16E+05 | 2.68E+01 | 3.99E+04 | 2.37E+01 | 1.91E+04 | 1.89E+04 | 1.61E+01 | 2.06E+04 | 8.44E+03 | 7.91E+03 | 1.17E+03 |

The cost to install handwheels or other local devices on the two torus air operated containment isolation valves is estimated to be $100,000, plus $50,000 for required procedure changes.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 84 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,382,000 | $80,000 | $150,000 | -$70,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.9 SAMA 88: CONTAINMENT VENT

SAMA 88 represents a potential procedure change to specify a control band for containment venting. Alternatively, containment vent valves could be modified. Vent valves are already restricted in movement to $30^0$ maximum opening. Further modification is not judged warranted.

Adding more specific direction to EOPs to provide operators with a defined pressure control band is judged to provide a reduction in operator error rate. Specifically, the failure probability for uncontrolled venting leading to loss of ECCS suction can be reduced by a factor of 10, if a specific control band is established. The OC-LEV2.caf fault tree model was saved as OC-SAMA88.caf and edited. This proposed procedure change was modeled by reducing basic event OHEOV3, "Operator Fails To Control Venting Evolution," from 3.8E-2 per demand to 3.8E-3 per demand.

The results from this case indicate a 0.1 percent reduction in CDF ($CDF_{new}$= 1.05E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 88 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.64E-06 | 1.67E-09 | 5.48E-07 | 7.85E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.60E+01 | 6.76E-02 | 1.36E+01 | 2.90E-02 | 5.79E+00 | 6.90E+00 | 5.90E-03 | 4.34E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.68E+01 | 3.99E+04 | 2.37E+01 | 1.91E+04 | 2.09E+04 | 1.61E+01 | 2.06E+04 | 8.56E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be $50,000 because it involves procedure changes only.

This information was used as input to the cost benefit calculation. As can be seen, there are negligible changes in the CDF and the release category frequencies. This leads to a negligible change in averted cost risk. The results of this calculation are provided in the following table:

**SAMA Number 88 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,462,000 | $0 | $50,000 | -$50,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

### F.6.10 SAMA 89: IMPROVE PROCEDURE FOR ALIGNING SDC GIVEN HIGH DW PRESSURE

SAMA 89 represents the performance of a Safety Evaluation that would allow Operating Procedure 305 to be implemented "as-is" with the elimination of the requirement for operators to invoke 50.54(x).

The OC-LEV2.caf fault tree model was saved as OC-SAMA89.caf and edited. This action is currently quantified with 3 hours available for the action. This time is driven by the time to reach the high drywell pressure limit. If operators are allowed to bypass this SDC isolation signal, the alignment of SDC would be required prior to the primary containment pressure limit (PCPL). This is reached at approximately 19 hours. Requantifying the HEP for SDC with 19 hours instead of 3 hours available would reduce the failure probability from 1.6E-3 per demand to 4.1E-4 per demand. Thus, to model this proposed procedure change or modification, the value for basic event OHESD1, "Operator Fails To Align SDC System," was reduced from 1.6E-3 per demand to 4.1E-4 per demand.

The results from this case indicate a very small reduction in CDF (<1E-10/yr). This is due to the dominance of dependent operator error in the failure of all decay heat modes, which would not be addressed by this proposed improvement. Specifically, operator action OH-TORUSCLG, "Operator fails to align for Torus Cooling" would still apply as a common dependent diagnosis failure mode of both torus cooling and SDC. Therefore, the resulting change in CDF is negligible.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.11 SAMA 91: ALLOW 4160 VAC BUS IC AND ID CROSSTIE

This SAMA represents procedure/training changes and the performance of a Safety Evaluation that would allow System Procedure 337 to be modified to allow operators to cross-tie emergency AC buses 1C and 1D under emergency conditions which require operation of critical equipment.[1]

The OC-LEV2.caf fault tree model was saved as OC-SAMA91.caf and edited. The current model includes one division of core spray and containment spray under the ECCS-HDWR-SBO gate. This gate represents the equipment powered from the combustion turbine following its alignment. Currently, the CT can be aligned to only one AC division via the SBO transformer. Since no cross-tie capability exists, only equipment from one division is credited in the PRA. In order to credit an improvement that would allow bus cross-tie alignment, the ECCS-HDWR-SBO gate was modified. Core spray and containment spray gates were added for the divisions that would be potentially available should the proposed cross-tie be implemented. Opposite divisions were ANDed with the equipment available directly from the SBO transformer (i.e., equipment credited in the base model). A new basic event, SAMA91-OP-ACTION, was added to represent operator actions necessary to align the proposed cross-tie. This basic event is ORed with the alternate core spray and containment spray trains and is set to 0.1. Because of the reluctance to cross tie emergency divisions, the HEP of 0.1 is considered appropriately realistic.

For non-LOOP cases, the improvement would also allow for a benefit. For these cases the EC and ED node logic was modified to allow the cross-tie to be aligned when the respective non-safety related bus supply is unavailable (i.e., Bus 1A, Bus 1B). This was done by adding a new OR gate (SAMA91-EC) under gate ECG00MDB for the EC (Bus 1C Node). Bus 1D basic events were then added under this new OR gate, along with the SAMA91-OP-ACTION basic event, to require availability of bus 1D to support bus 1C, as necessary. Similar changes were made under the ED (Bus 1D) node.

Note that no competing risks have been included. Any issues that would present operational difficulties are expected to be identified as part of plant staff input and will be captured as costs.

The results from this case indicate a 2.6 percent reduction in CDF ($CDF_{new}$= 1.02E-5 per year. A further breakdown of this information is provided below according to release category.

[1] There is an existing procedure to allow the cross-tie but it is only allowed for planned shutdown conditions.

**SAMA 91 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.02E-05 | 2.66E-06 | 3.22E-06 | 1.95E-07 | 9.74E-07 | 1.64E-06 | 1.67E-09 | 5.36E-07 | 7.64E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.50E+01 | 6.65E-02 | 1.30E+01 | 2.89E-02 | 5.64E+00 | 6.88E+00 | 5.90E-03 | 4.25E+00 | 3.20E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.15E+05 | 2.64E+01 | 3.80E+04 | 2.36E+01 | 1.86E+04 | 2.08E+04 | 1.61E+01 | 2.02E+04 | 8.32E+03 | 7.91E+03 | 1.17E+03 |

The Safety Evaluation is estimated to cost approximately $40,000. The procedure change is expected to cost an additional $50,000 for a total of $90,000.

The competing risk associated with this proposed SAMA relates to the connection of a faulted bus to the only AC power supply, i.e., the combustion turbine. Based on input from the system manager, adequate circuit protection exists to prevent propagation of potential faults and therefore for operators to perform the cross-tie action under emergency conditions. Therefore, it is judged that no modifications would be required although a more formal review by electrical design is required as part of the safety evaluation process. It is possible that modifications could be required

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 91 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,344,000 | $118,000 | $90,000 | $28,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is less than the averted cost-risk for this SAMA, the net value is positive and this enhancement is cost beneficial based on the SAMA methodology.

## F.6.12 SAMA 92: ALLOW OPERATORS TO MAXIMIZE CRD FLOW

SAMA 92 involves a procedure change to modify EOP 1, Support Procedure 3 to eliminate the 150 gpm flow limitation and replace with a caution to monitor the system for pump runout when system flow is greater than 150 gpm.

Oyster Creek remains one of the few BWRs that has retained the CRD bypass pathway as an injection method directly to the RPV. This flowpath has the potential to pass increased flow. This could be a benefit for Oyster Creek in the assessment of the risk profile if the action to align the pathway is taken early in an event and the flow is allowed to increase above currently specified levels.

The OC-LEV2.caf fault tree model was saved as OC-SAMA92.caf and edited. The current model does not take credit for CRD providing adequate high pressure makeup, primarily due to operator guidance that limits CRD flow to protect the system. However, if CRD is allowed to supply additional flow under emergency conditions, there is some likelihood that CRD alone could provide enough flow to prevent core damage. This potential capability is modeled by changing the FWT gate in the feedwater node to an AND gate. The CRD node (CD) was then added to this gate to allow CRD to be redundant to feedwater in terms of high pressure injection. LOCA events were also "ORed" in this logic so that CRD would not be allowed to be successful under LOCA conditions.

To confirm the likelihood of CRD successfully providing the level of benefit quantified, a deterministic thermal hydraulic analysis was performed to characterize the performance. MAAP run OC58a modeled a loss of feedwater, coupled with MSIV closure event. CRD injection to the vessel was assumed to be 60 gpm for the first 5 minutes and 220 gpm thereafter. This assumption may be optimistic in assessing the potential benefit associated with the change. The core was uncovered but the hottest core node remained below approximately 1200°F and core damage did not occur. Also, the PRA quantification did not credit the benefit of additional CRD injection during small LOCA events including seal LOCAs. Additional CRD injection would allow a greater spectrum of break sizes to be mitigated. This conservatism is judged to offset the potential to overestimate the value of CRD in providing redundant high pressure injection capability associated with an operator action assumed at 5 min.

The results from this case indicate an 2 percent reduction in CDF ($CDF_{new}$= 1.03E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 92 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.03E-05 | 2.56E-06 | 3.35E-06 | 1.88E-07 | 9.76E-07 | 1.66E-06 | 1.67E-09 | 5.45E-07 | 7.85E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.58E+01 | 6.41E-02 | 1.35E+01 | 2.79E-02 | 5.65E+00 | 6.96E+00 | 5.90E-03 | 4.32E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.17E+05 | 2.54E+01 | 3.95E+04 | 2.28E+01 | 1.86E+04 | 2.11E+04 | 1.61E+01 | 2.05E+04 | 8.56E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be as follows:

- $50,000 for procedure changes
- Test to ensure that the two pumps could provide greater than 220 gpm without low pressure suction trip or failures. (Estimated $50,000)

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 92 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,426,000 | $36,000 | $100,000 | -$64,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is more than the averted cost-risk for this SAMA, the net value is -$64,000 and this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.13 SAMA 94: INCREASE SUCCESS PROBABILITY FOR FIRE PROTECTION ALIGNMENT

The fire protection system at Oyster Creek provides an alternate RPV injection source that can be aligned by the crew through local manual actions given sufficient time and access to equipment. SAMA 94 is a procedure and training change to modify EOPs 1a and 1b to provide a cue for crew action to align fire protection for RPV injection with sufficient time available. This could also be a note to operators that fire protection system alignment takes longer to establish than other potential sources of RPV injection.

The HRA includes this action as a number of basic events based on plant conditions. This SAMA would provide operators with an earlier cue for fire water alignment and would reduce error rate accordingly. The base basic event values are shown in the table below. The HRA calculation was reviewed and revised basic event values were determined by evaluating the impact if the action cue were to occur 5 minutes earlier. The last column of the table below shows these values. These values were modified in the OC-SAMA94.caf fault tree, which was copied directly from the OC-LEV2.caf fault tree model

| Cases | Designator | Description | Base Failure Probability | Failure Probability 5 minutes Added to Cognitive Time-Window |
|---|---|---|---|---|
| A | OH-FPS-FW-IC | FPS injection for non-ATWS cases without FW or IC | 7.3E-2 | 6.0E-2 |
| B | OH-L2-DFPALIGN | FPS injection for non-ATWS cases without FW or IC M/U | 7.3E-2 | 6.0E-2 |
| C | OH-FPS-SORV | FPS injection for non-ATWS cases with SORV | 1.0 | 0.08 |
| D | OH-FPS-SBO | FPS injection for non-ATWS cases with SBO | 0.15 | 0.1 |

The results from this case indicate a 0.2 percent reduction in CDF ($CDF_{new}$= 1.05E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 94 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.70E-06 | 3.38E-06 | 1.96E-07 | 9.95E-07 | 1.65E-06 | 1.67E-09 | 5.47E-07 | 7.86E-07 | 2.10E-07 | 3.05E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.60E+01 | 6.74E-02 | 1.36E+01 | 2.90E-02 | 5.76E+00 | 6.95E+00 | 5.90E-03 | 4.34E+00 | 3.29E+00 | 1.58E+00 | 3.79E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.67E+01 | 3.99E+04 | 2.37E+01 | 1.90E+04 | 2.10E+04 | 1.61E+01 | 2.06E+04 | 8.57E+03 | 7.91E+03 | 1.11E+03 |

The cost of implementation for this SAMA is estimated to be $50,000 since it is limited to procedure changes.

This information was used as input to the cost benefit calculation. As can be seen, there are negligible changes in the CDF and the release category frequencies. This leads to a negligible change in averted cost risk. The results of this calculation are provided in the following table:

**SAMA Number 94 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,462,000 | $0 | $50,000 | -$50,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.14 SAMA 95: ADD PROCEDURAL CLARIFICATION RELATED TO 5 PSID CSS ALARM

SAMA 95 is a procedure and training change to modify the 5 psid CSS alarm response procedure (B-5-A, B-5-B) and procedure 310 to include a caution that CSS should not be secured if being utilized for accident mitigation.

The Containment Spray tube to shell differential pressure alarm response could potentially cause operators to inadvertently secure an operating containment spray train based on the concern that there is a problem with tube integrity. However, based on operator interviews, this alarm can initiate due to normal system fouling and other operational conditions. Operators indicated that they were aware of the conditions and indicated that they would not secure a containment spray train based solely on the differential pressure alarm, no penalty was applied in the PRA model.

Based on the operating crew interviews and their current training, no penalty in the PRA for the associated error of commission is included. Therefore no change in CDF is calculated for this SAMA.

The cost of the change is relatively small (i.e., $50,000 for a procedure change) but no material benefit is calculated. Therefore, this change is considered not cost beneficial.

## F.6.15 SAMA 99: PROVIDE AN ALTERNATE METHOD FOR IC SHELL WATER LEVEL DETERMINATION

SAMA 99 represents a potential addition to the procedures and operator training program to provide a specific Job Performance Measure (JPM) for operation of the Isolation Condensers (ICs) with no support systems available (e.g., during a long-term SBO when DC power is exhausted). This also includes staging of materials for the local reading of the IC shell level.

Currently, IC shell level cannot be directly determined without support systems. Correctly determining IC shell level is important in accurately controlling the system. With IC shell level available locally, and RPV level available at the Yarway instruments, operators can maintain adequate control of the RPV for long-term SBO scenarios Operators and System Managers have indicated that IC shell level can be locally measured with some fairly simple improvements.

The OC-LEV2.caf fault tree model was saved as OC-SAMA99.caf and edited. To model this proposed procedure change and training enhancements, the failure rate for basic event OH-IC-SBO was reduced by a factor of 0.1. This basic event models the operators successfully operating the ICs locally when DC power is unavailable. It is believed that improved training on this scenario could improve operator reliability. A factor of ten (10) is judged slightly optimistic and may not be achievable.

The results from this case indicate an 15.6 percent reduction in CDF ($CDF_{new}$=8.85E-6 per year) if the assumed improvement in crew response could be achieved. A further breakdown of this information is provided below according to release category.

**SAMA 99 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 8.85E-06 | 2.60E-06 | 2.41E-06 | 7.40E-08 | 9.86E-07 | 1.46E-06 | 1.67E-09 | 5.42E-07 | 5.53E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.02E+01 | 6.50E-02 | 9.70E+00 | 1.10E-02 | 5.71E+00 | 6.15E+00 | 5.90E-03 | 4.29E+00 | 2.32E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.01E+05 | 2.57E+01 | 2.85E+04 | 8.96E+00 | 1.88E+04 | 1.86E+04 | 1.61E+01 | 2.04E+04 | 6.03E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be $150,000. The cost of implementation includes procedure changes, training, and modification to install local level instrumentation that can function without support systems.

Note that operators have indicated that a Tygon tube based apparatus could potentially be pre-staged to allow IC shell level detection. It is unclear if this is a viable method but it could potentially represent a less costly option.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 99 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $3,788,000 | $674,000 | $150,000 | $524,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is less than the averted cost-risk for this SAMA, the net value is $524,000. This enhancement is cost beneficial based on the SAMA methodology.

## F.6.16 SAMA 100: CONNECT SBO TRANSFORMER TO BOTH AC DIVISIONS.

Presently, the combustion turbine supplies only the "B" bus directly via the SBO transformer. Modification of the circuit to allow the combustion turbines to also supply the "A" bus directly would be beneficial. This would provide a benefit similar to SAMA 91 except that equipment such as feedwater pumps that are powered from Bus A would also be potentially available.

This modeling change to address this option was accomplished by making the same changes as noted in SAMA 91 as well as adding new basic events to represent the condensate/feedwater system as well as additional decay heat removal paths. Specifically, under gate ECCS-HDWR-SBO 2 basic events were added: SAMA139-FW-INJ (1E-2) to represent additional feedwater system availability and SAMA139-DHR-COND (0.1) to represent realignment of additional heat removal paths such as the main condenser and containment venting. This is judged optimistic toward supporting this SAMA because the base model takes little credit for these success paths even though Bus B is currently available from the CTs.

The results from this case indicate a 3.7 percent reduction in CDF ($CDF_{new}$=1.01E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 100 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.01E-05 | 2.64E-06 | 3.16E-06 | 1.95E-07 | 9.63E-07 | 1.64E-06 | 1.67E-09 | 5.63E-07 | 7.54E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.46E+01 | 6.60E-02 | 1.27E+01 | 2.89E-02 | 5.58E+00 | 6.87E+00 | 5.90E-03 | 4.21E+00 | 3.16E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.14E+05 | 2.62E+01 | 3.73E+04 | 2.36E+01 | 1.84E+04 | 2.08E+04 | 1.61E+01 | 2.00E+04 | 8.22E+03 | 7.91E+03 | 1.17E+03 |

System managers have estimated the cost of the modification to be $500,000.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 100 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site)(2) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,316,000 | $146,000 | $500,000 | -$354,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

(2) Damage due to high winds is an external event. External event contributions attributable to other sources may be omitted. External event contributions from seismic and fire are removed from consideration, such that the cost risk multiplier used is 1.0 rather than 2.0.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology. However, note that a significant portion of this benefit can also be achieved by implementation of SAMA 91, the 4160 VAC cross-tie option.

## F.6.17 SAMA 101: PROVIDE A PROCEDURE FOR DETERMINING RPV LEVEL USING FUEL ZONE LEVEL INDICATORS A AND C WITH SLC OPERATING

Additional guidance should be evaluated for operators to consider temporarily securing SLC pumps, as necessary, to record RPV level. This approach must balance SLC pump start frequency requirements as well as RPV level trends against the downsides of RPV flooding.

Two trains of Oyster Creek fuel zone level instruments utilize SLC system piping for the variable leg tap. This causes a situation where these trains are inaccurate when the SLC system is running. In ATWS scenarios, and all SAMG conditions where SLC is expected to be running, level indication evaluation provides an additional challenge for operators. Improved procedures, such as potentially securing SLC flow or providing a correction curve could reduce the operator error rate for the ATWS task involving lowering RPV level to control power. It is judged that a factor of three reduction in error rate is an attainable goal.

| Case | Designator | Description | Base Failure Probability | Failure Probability with improved instrumentation procedure |
|---|---|---|---|---|
| A | OH-LVL-ERLY | RPV level control MSIVs closed, Early Initiation of Level Control (6 min.) | 0.12 | 0.04 |
| B | OH-LVL-LATE | RPV level control MSIVs closed, Late Initiation of Level Control (20 min.) | 4.8E-02(1) | 4.8E-2(2) |
| C | OH-LVL-TT | RPV level control Main condenser available, Initiation of Level Control (40 min.) | 9.0E-04 | 3.0E-4 |

(1) Conditional Failure probability.
(2) Conditional Failure probability is not adjusted for SAMA since benefit captured in OH-LVL-ERLY

The probability of these basic events was modified in model OC_SAMA101.caf, which was developed directly from OC-LEV2.caf.

The results from this case indicate a 0.2 percent reduction in CDF ($CDF_{new}$=1.05E-5 per year). A further breakdown of this information is provided below according to release category.

There is also a benefit to be gained by allowing a more suitable SAG branch to be selected given level can be determined versus the SAG leg that is defaulted to if level is not available. This additional benefit has not been quantified.

**SAMA 101 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.70E-06 | 3.38E-06 | 1.95E-07 | 9.87E-07 | 1.66E-06 | 1.67E-09 | 5.47E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.60E+01 | 6.75E-02 | 1.36E+01 | 2.89E-02 | 5.72E+00 | 6.95E+00 | 5.90E-03 | 4.34E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.67E+01 | 3.99E+04 | 2.37E+01 | 1.89E+04 | 2.10E+04 | 1.61E+01 | 2.06E+04 | 8.57E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be $50,000 since it is limited to procedure changes.

This information was used as input to the cost benefit calculation. As can be seen, there are negligible changes in the CDF and the release category frequencies. This leads to a negligible change in averted cost risk. The results of this calculation are provided in the following table:

**SAMA Number 101 Net Value**

| Base Case: Cost-Risk[(1)] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,462,000 | $0 | $50,000 | -$50,000 |

[(1)] Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, and this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.18 SAMA 102: REVISE ATWS EOP TO PROVIDE RPV LEVEL CORRECTION BASED ON POWER

Revise EOP 1b "RPV Control – ATWS" to include an RPV Fuel Zone Level correction factor to account for reactor power level. Oyster Creek currently does not correct fuel zone level according to power. This type of correction has been implemented at other plants such as Nine Mile Point Unit 1, to account for RPV level being indicated lower than actual in ATWS events. This could cause operators to not lower water level low enough to adequately reduce power.

This is judged to have the same level of impact as SAMA 101, above.

The results from this case indicate a 0.2 percent reduction in CDF ($CDF_{new}$= 1.05E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 102 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.70E-06 | 3.38E-06 | 1.95E-07 | 9.87E-07 | 1.66E-06 | 1.67E-09 | 5.47E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.60E+01 | 6.75E-02 | 1.36E+01 | 2.89E-02 | 5.72E+00 | 6.95E+00 | 5.90E-03 | 4.34E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.67E+01 | 3.99E+04 | 2.37E+01 | 1.89E+04 | 2.10E+04 | 1.61E+01 | 2.06E+04 | 8.57E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be $50,000 associated with procedure changes. There would also be significant analysis/modeling and training costs of approximately $50,000.

This information was used as input to the cost benefit calculation. As can be seen, there are negligible changes in the CDF and the release category frequencies. This leads to a negligible change in averted cost risk. The results of this calculation are provided in the following table:

**SAMA Number 102 Net Value**

| Base Case: Cost-Risk[(1)] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| **$4,462,000** | **$4,462,000** | **$0** | **$100,000** | **-$100,000** |

[(1)] Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.19 SAMA 104: IMPROVE LOSS OF CIRCULATING WATER RESPONSE

SAMA 104 is to develop a loss of circulating water abnormal operating procedure or revise the loss of condenser vacuum procedure to include guidance to allow condensate and feedwater to be adequately protected. This could include more rapid swapping to service water and/or the direction to temporarily secure condensate and feedwater while the swap occurs.

Currently, circulating water (CW) provides the normal heat sink for the TBCCW system. In turn, TBCCW provides cooling to the condensate and feedwater pumps. Without cooling, condensate pumps may fail within a matter of a few minutes. Oyster Creek has the capability to align the service water system as a backup to the circulating water system for TBCCW cooling. However, this alignment takes enough time that the PRA group judged it would be difficult to credit with regard to feedwater availability. As such, in the base PRA model, feedwater is completely dependent on circulating water. This SAMA involves creating a procedure that allows for a reliable means of implementing the TBCCW heat sink swap from circulating water to service water.

To model this potential improvement, the SW gate was added under the CP-COOLING gate in the CP fault tree. The logic was established so that SW was "ANDed" with CW. No operator actions were included which is slightly optimistic in supporting the proposed change. The OC_SAMA101.caf fault tree, which was developed directly from OC-LEV2.caf was used to model this SAMA.

The results from this case indicate a 3.1 percent reduction in CDF ($CDF_{new}$= 1.02E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 104 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category<br>Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.02E-05 | 2.47E-06 | 3.33E-06 | 1.84E-07 | 9.77E-07 | 1.66E-06 | 1.67E-09 | 5.43E-07 | 7.85E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.57E+01 | 6.17E-02 | 1.34E+01 | 2.72E-02 | 5.66E+00 | 6.95E+00 | 5.90E-03 | 4.31E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.17E+05 | 2.45E+01 | 3.93E+04 | 2.23E+01 | 1.87E+04 | 2.10E+04 | 1.61E+01 | 2.05E+04 | 8.56E+03 | 7.91E+03 | 1.17E+03 |

The swapping action currently requires a number of operations to be implemented outside the control room. This includes:

1. Close V-3-58 in the Turbine Bldg. basement.
2. Open V-3-59 in the Turbine Bldg. basement.
3. Close V-3-76 and V-3-77 in the Turbine Bldg. basement.
4. Throttle V-3-76 to a position not fully closed in the Turbine Bldg. basement.
5. Open V-3-74 in the Turbine Bldg. basement.

In order to assure the actions are completed in sufficient time to protect the feedwater system, it is currently judged that hardware modifications will be needed in addition to procedural changes. These hardware changes would most likely involve conversion of local manual valves to remotely operated valves with controls in the control room. Therefore, the cost of implementation for this SAMA is estimated to be $250,000 (hardware and procedure costs).

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 104 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,418,000 | $44,000 | $250,000 | -$206,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.20 SAMA 106: IMPROVE DIRECTION FOR COOLDOWN IN LOSS OF RBCCW

SAMA 106 is to revise ABN-19 to include guidance to implement a <90°F/hr cooldown as soon as possible following a loss of RBCCW to supplement protection of recirculation pump seals by reducing RPV pressure.

RBCCW provides cooling to the recirculation pump seals and its unavailability presents a challenge to the recirculation pump seal integrity. This challenge can be reduced by lowering RPV pressure. The strategy would be to depressurize to 500 to 700 psi immediately and then subsequently reduce pressure further as inventory makeup and cooldown requirements allow. Guidance to implement this strategy upon loss of RBCCW, including SBO cases, will reduce the probability of a seal LOCA. Based on a review of vendor test data which shows a lower failure rate at lower RPV pressures, a seal failure probability reduction of 10% is used as the best estimate achievable.

The OC_SAMA106.caf fault tree, which was developed directly from OC-LEV2.caf, was used to model this SAMA. The SLSEALLOCA basic event was lowered 10% from 5.0E-2 to 4.5E-2 per demand. The basic event was also added under gate SL1 to allow the improvement in non-SBO cases.

The results from this case indicate a 0.7 percent reduction in CDF ($CDF_{new}$= 1.04E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 106 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.04E-05 | 2.69E-06 | 3.34E-06 | 1.96E-07 | 9.88E-07 | 1.66E-06 | 1.67E-09 | 5.42E-07 | 7.83E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.58E+01 | 6.73E-02 | 1.34E+01 | 2.90E-02 | 5.72E+00 | 6.95E+00 | 5.90E-03 | 4.30E+00 | 3.28E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.17E+05 | 2.67E+01 | 3.95E+04 | 2.37E+01 | 1.89E+04 | 2.10E+04 | 1.61E+01 | 2.04E+04 | 8.54E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be $50,000 because it is limited to procedure changes.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

SAMA Number 106 Net Value

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,428,000 | $34,000 | $50,000 | -$16,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, the net value is negative and this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.21 SAMA 107: REDUCE POTENTIAL FOR LOSS OF CST INVENTORY FOLLOWING LOSS OF INSTRUMENT AIR

SAMA 107 is to modify the spill valve air supply to be fitted with air accumulators. Currently, the hotwell makeup valves fail open given loss of instrument air. In order to preserve CST inventory, operators must manually close the spill valves. Addition of an air accumulator for this function would improve reliability.

The OC_SAMA107.caf fault tree, which was developed directly from OC-LEV2.caf, was used to model this SAMA. The OH-DRAINCST basic event was lowered from 1.0E-1 to 1.0E-3 per demand. This conservatively captures the reliability of the new accumulators as well as the operator action that would still be necessary for longer term loss of instrument air scenarios.

The results from this case indicate a 0.1 percent reduction in CDF ($CDF_{new}$= 1.05E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 107 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.70E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.64E-06 | 1.67E-09 | 5.48E-07 | 7.85E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.60E+01 | 6.76E-02 | 1.36E+01 | 2.90E-02 | 5.79E+00 | 6.91E+00 | 5.90E-03 | 4.34E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.68E+01 | 3.99E+04 | 2.37E+01 | 1.91E+04 | 2.09E+04 | 1.61E+01 | 2.06E+04 | 8.56E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is estimated to be $150,000 for installation of air accumulators.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 107 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,462,000 | $0 | $150,000 | -$150,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, the net value is negative and this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.22 SAMA 108: REDUCE FUEL ZONE LEVEL INSTRUMENT ERROR BAND

SAMA 108 is to relocate reference leg instrument penetration closer to TAF and recalibrate. Channels A and B have a range of –144" to 180" and Channels C and D have a range of –150" to 180". Channels A and B have an error band of +20" to –40" and Channels C and D have a no error band specified in the available documents. This error band (i.e., ~5 feet) can increase the likelihood that operators lower water level too low during ATWS mitigation.

The potential for operators to lower water level too low in an ATWS is modeled in the basic events shown in the table, below. The HEPs for these actions were reviewed and the table, below, also shows the values applicable if the SAMA is implemented. For this evaluation, the cause based cognitive error and the execution error were assumed zero, should the proposal be implemented. This is optimistic with respect to supporting the modification.

| Case | Designator | Description | Base Failure Probability | Failure Probability if Fuel Zone Error Band is Reduced |
|---|---|---|---|---|
| A | OH-AT-LVL-COND | Operator controls level with condensate to avoid inadequate core cooling. | 2.1E-2 | 1.3E-2 |
| B | OH-AT-LVL-FPS | Operator controls level with FPS or CS to avoid inadequate core cooling. | 0.15 | 0.14 |

The fuel zone water level instruments also play a role in other operator actions. These primarily include blowdown and transition to SAGs. For blowdown, the main impact on the PRA model relates to allowing low pressure injection success. Once RPV level drops below 61", EOPs include direction to lower RPV pressure as necessary to allow low pressure systems to inject. Further guidance is provided to blowdown at 0" (TAF) if any alternate system is running. If no systems are available, blowdown is directed at –20". A large error band can impact the actual RPV level wherein these actions occur however, because operators are directed to lower RPV pressure starting at 61", there is little significance for cases with low pressure injection systems available and no additional model changes were made.

With no systems capable of injection, the blowdown will not play a significant role in core protection since no makeup water is available. Also, since water level would, even with a large error band, be significantly above BAF, there is little impact on high pressure core melt type scenarios. No model changes were required for this scenario.

The transition to SAGs occurs when water level drops below –20". A large error band could delay this transition but the SAGs do not provide additional mitigation actions except containment flooding. Containment flooding is not credited to prevent core damage and would be primarily aimed at mitigating releases. Since the direction would occur well above BAF, even with a large instrument error, severe accident mitigation alternatives are not impacted and no model changes are necessary.

The results from this case indicate a very small benefit, which is on the order of 1.3E-9/per year.

The cost of implementation for this SAMA is expected to be on the order of $500,000 as significant modification of instrument piping and instrumentation would be necessary.

Considering costs and benefits, this item is not considered cost-beneficial.

## F.6.23 SAMA 109: PORTABLE DC BATTERY CHARGER TO PRESERVE IC AND EMRV OPERABILITY ALONG WITH ADEQUATE INSTRUMENTATION

SAMA 109 is to provide portable battery chargers capable of supplying 125V DC buses. This would provide a significant benefit in station blackout and similar sequences where battery capacity determines the time window for operator response. The longer the time window for AC power recovery, the higher the success probability.

Loss of offsite power (LOOP) and station blackout (SBO) scenarios are significant contributors to most nuclear plant PRAs, including Oyster Creek. One of the most significant determining factors to risk in such scenarios is the amount of time available for AC power recovery. Onsite batteries provide DC power for approximately 3 to 8 hours of useful capacity, depending on the electrical division relied upon. Extending this time is a significant contributor to risk reduction, particularly for LOOP events caused by severe weather. A means of providing battery charging, independent of installed capability, provides extended DC capability and allows for mitigation of a much wider spectrum of LOOP/SBO events. The alignment of a relatively small, self contained, engine-driven charging system would provide this benefit.

Several plants, including Monticello, Dresden, Susquehanna, and Nine Mile Point Unit 1, have previously identified the potential benefit of a small engine-driven charger that could be aligned to support the DC system, if necessary. The system would be a small, fairly off-the-shelf generator that operates on diesel or gasoline fuel. Development of a location suitable for operation and a means of connecting to the safety related batteries, via clamps or other terminations, would be the issues relating to currently installed equipment.

For the types of reasons discussed above, a number of industry SAMAs relate to DC power. The industry SAMAs tend to relate to more reliable or more capable DC systems. It was noted that the portable charger would, more feasibly, provide a similar benefit to many of the industry SAMAs such as providing additional batteries or alternative power sources such as fuel cells. Other industry SAMAs involved additional diesel generators or other sources of AC Power. Such systems would address LOOP/SBO risk but considering the cost of such systems, the currently installed combustion turbines, and the lower cost of mitigating LOOP/SBO risk using a portable engine-driven charger, these were not considered further.

A number of industry SAMAs have benefits which are judged to be offset or subsumed by implementation of an effective portable DC battery charger. Recognizing the feasibility of a small, simple engine-powered charger, these SAMAs were subsumed into the engine-driven charger SAMA, SAMA 109.

The OC-SAMA109.caf fault tree, which was developed directly from OC-EV2.caf, was used to model this SAMA.

The station blackout model includes an operator action, OH-IC-SBO that involves operators using plant equipment after DC batteries were depleted. Logic wherein this basic event applies requires a situation where one Division of the ICs can be effective in the long term (i.e., no seal LOCA, no stuck open EMRVs, etc.). The loss of the IC heat removal capability is judged significant and this pathway is not credited for this proposed SAMA.

The portable charger can also assist in the additional mitigation of SBO-LOCA situations (i.e., maintain EMRVs and instrumentation for fire protection water injection to RPV as a success path). The proposed SAMA can provide extended DC support to mitigate non-LOCA loss of AC cases. In such cases, the IC is capable of removing decay heat over the long term. Thus, a basic event has been created to model the portable charger. This basic event is linked in the model so that it is ANDed with basic event OH-IC-SBO. It is assumed to benefit only non-LOCA loss of AC scenarios. The new basic event, CHGR-SAMA109 was set equal to 0.1 and represents the portable charger equipment as well as the operator actions necessary to align it.

The results from this case indicate a 15.6 percent reduction in CDF ($CDF_{new}$= 8.85E-6 per year). A further breakdown of this information is provided below according to release category.

**SAMA 109 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 8.85E-06 | 2.60E-06 | 2.41E-06 | 7.40E-08 | 9.86E-07 | 1.46E-06 | 1.67E-09 | 5.42E-07 | 5.53E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.02E+01 | 6.50E-02 | 9.70E+00 | 1.10E-02 | 5.71E+00 | 6.15E+00 | 5.90E-03 | 4.29E+00 | 2.32E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.01E+05 | 2.57E+01 | 2.85E+04 | 8.96E+00 | 1.88E+04 | 1.86E+04 | 1.61E+01 | 2.04E+04 | 6.03E+03 | 7.91E+03 | 1.17E+03 |

The cost of this SAMA was estimated in the Monticello SAMA evaluation [F-13] to be $75,000. This estimate, which is assumed to include necessary procedure changes, may be unrealistically low but is judged reasonable for Oyster Creek for initial consideration of the SAMA for further investigation.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 109 Net Value**

| Base Case: Cost-Risk[(1)] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $3,788,000 | $674,000 | $75,000 | $599,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is less than the averted cost-risk for this SAMA, the net value is $599,000 and this enhancement is cost beneficial based on the SAMA methodology.

### F.6.24 SAMA 110: DELETE HIGH DRYWELL PRESSURE SIGNAL FROM SDC ISOLATION

The purpose of this insight is to identify the desirability of removing the SDC interlock on high drywell pressure to increase the flexibility of SDC system use.

The model used for SAMA 89 is considered applicable for this proposal.

The cost of implementation for this SAMA is estimated to be $75,000.

The results from this case indicate a very small reduction in CDF (<1E-10/yr) such that cost-benefit considerations do not support the modification.

## F.6.25 SAMA 111: PROVIDE ALTERNATE DRYWELL SPRAY INJECTION SOURCE

SAMA 111 considers possible alternatives for alternate sources of drywell spray supply, which may include:

- ESW cross tie
- SW cross tie
- Diesel Fire pump cross tie

The competing risk is that the raw water might clog the containment spray nozzles or a radionuclide release pathway to the environment may be opened.

The OC_SAMA111.caf fault tree, which was developed directly from OC-LEV2.caf was used to model this SAMA. To model this proposal, the fire protection node, FP, was "ANDed" under the gates for each set of containment spray pumps (Gates CCG01MAG and CCG02MED). This allows fire protection water to be redundant to the containment spray pumps.

The system manager has estimated that the cost for this improvement is $500,000.

Drywell sprays have a minimal impact on the CDF risk metric. This impact is manifested in mitigating vapor suppression failures.

The Level 2 is significantly impacted by drywell sprays if available because it provides an effective containment boundary protection and release mitigator. However, failures of containment spray are dominated by injection valve power failures that are not compensated for by the SAMA.

The results from this case indicate a very small reduction in CDF (3.6E-10/yr). This is due partially to dominance by operator action associated with EOP directed actions and the drywell spray initiation curve. When compared to four (4) containment spray pump reliability or four (4) containment spray pumps plus an additional pump, operator reliability is limiting. Therefore, this SAMA is not considered cost-beneficial.

Therefore, based on the competing risk and the lack of a cost beneficial assessment. This change is not considered further.

## F.6.26 SAMA 112: INTAKE STRUCTURE

SAMA 112 addresses the insight that there are potential safety beneficial effects associated with a pro-active plan to ensure high reliability of the cooling water intake structure and its supply to support raw water systems into the plant.

This proposal was modeled by reducing the loss of intake structure initiating event (LOIS) from 5.12E-3/yr to 1E-3/yr, a factor of approximately five (5).

The results from this case indicate a 0.8 percent reduction in CDF ($CDF_{new}$=1.04E-5 per year. A further breakdown of this information is provided below according to release category.

**SAMA 112 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.04E-05 | 2.65E-06 | 3.37E-06 | 1.93E-07 | 9.94E-07 | 1.65E-06 | 1.67E-09 | 5.47E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.59E+01 | 6.63E-02 | 1.35E+01 | 2.86E-02 | 5.76E+00 | 6.94E+00 | 5.90E-03 | 4.33E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.63E+01 | 3.97E+04 | 2.34E+01 | 1.90E+04 | 2.10E+04 | 1.61E+01 | 2.06E+04 | 8.56E+03 | 7.91E+03 | 1.17E+03 |

The cost of initiating and administering this SAMA is judged to be $1,000,000. This estimate includes program initiatives such as intake canal surveillance, active programs to combat mussel intrusion, "grassing", and other debris effects as well as trending of data by a system manager.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 112 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,454,000 | $8,000 | $1,000,000 | -$992,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.27 SAMA 124: REINFORCEMENT BLOCK WALL 53

Block Wall 53 has a HCLPF estimated in the Oyster Creek IPEEE of 0.27g. Failure of this block wall can cause loss of 125 VDC. This alternative considers reinforcement of Block Wall 53. The following risk assessment for this SAMA item conservatively assumes for the purpose of this analysis that the reinforced wall after SAMA implementation is not susceptible to seismic-induced failure (i.e., the probability of seismic-induced failure of the reinforced wall is 0.0 for all seismic events).

### F.6.27.1 Two Approaches

The updated seismic PRA referenced in the NRC SER on IPEEE [F-36] has a risk profile dominated by large seismic induced failures of the Turbine Building. This failure mode was added after submittal of the original IPEEE in 1993.

Because of the large uncertainty associated with the seismic analysis and because of potential "masking" effects related to assuming the entire Turbine Building fails in the updated seismic PRA referenced in the SER, two approaches are used here to assess the potential averted cost risk and net value of reinforcing the block wall. These two approaches are:

> Approach 1: Use the latest seismic PRA results submitted as part of IPEEE RAIs and referenced in the NRC SER.
>
> Approach 2: Use insights from the original IPEEE and the estimated impacts of the block wall on CDF to provide an additional perspective on the net value.

### F.6.27.2 Approach 1

In the original IPEEE assessment, Block Wall 53 was a significant contributor (i.e., it was included in the third highest seismic accident sequence). However, in the revised model it is much less significant and does not appear in the Top 10 sequences. As can be seen in Table F-2 and F-3, the block wall does not show up in the Top 10 Seismic contributors and has a Fussell-Vesely of less than 0.034. A conservative estimate of the maximum benefit possible for block wall improvement would be significantly less than 1.6E-7/yr [4.7E-6*0.034)]. This represents a small residual risk and this SAMA is not evaluated further.

More significant seismic failures include Turbine Building failure, Reactor Building failure, and switchgear room cooling fan failure. Significantly improving the seismic capability of the Turbine Building and Reactor Building is judged to require expenditure beyond the maximum averted cost. Recovery of the switchgear room cooling fans is not credited in the seismic model. Mitigation by opening doors and using portable fans is currently proceduralized and no further improvement has been identified.

### F.6.27.3 Approach 2

Base Seismic CDF and Release Risk Profile

The current Oyster Creek PRA model does not include seismic initiating events. However, the Oyster Creek IPEEE evaluation [F-22] includes a Level 1 seismic model that can be used to estimate the potential benefit of this proposed modification. The base seismic CDF calculated by the Oyster Creek seismic IPEEE analysis is 3.63E-6/yr. In the interaction with the NRC on the IPEEE submittal, changes to the seismic analysis added catastrophic failure modes associated with the Reactor Building and Turbine Building failures which added approximately 2E-6/yr to the seismic CDF. A total revised seismic CDF of 4.7E-6/yr was quoted in the RAI responses and the NRC SER. The block wall impact on this incremental change is considered negligible. Therefore, for the Approach #2 SAMA evaluation, the original seismic CDF of 3.6E-6/yr is used as the "base" case for the sole purpose of calculating the change in risk when the block wall is reinforced. Based on review of the top 20 dominant seismic sequences (representing approximately 50% of the seismic CDF), as documented in the Oyster Creek IPEEE submittal report, the breakdown of the base seismic CDF as a function of core damage accident type is as follows:

- Class IA(Late): 15%
- Class IB(Early): 80%
- Class IIIB: 5%

This has removed the seismic induced catastrophic failure of the Turbine Building and Reactor Building. This is considered appropriate for the delta risk assessment of the block wall.

The Oyster Creek seismic IPEEE analysis does not include a Level 2 analysis; however, a reasonable approximation of release frequency distribution can be made, as follows:

- Use the above seismic CDF accident class distributions for the entire seismic CDF.
- Apply the release category probabilities as a function of accident class obtained from the Oyster Creek internal events PRA, except for one modification. Seismic IB scenarios involve switchyard structural failures that are assumed not recoverable within the PRA mission time. As the internal events Class IBE (Station Blackout) credits AC power recovery (which is inappropriate for Class IB seismic scenarios), the internal events Class ID release distribution is applied to the seismic Class IBE scenarios. The internal events Class ID scenarios reasonably simulate seismic Class IBE scenarios in that recovery of injection in the internal events Level 2 for Class ID scenarios is negligible.
- Adjust release category timings to reflect potential inability to evacuate by making the category times shorter by one category for each release state (i.e., H/I is added to H/E, H/L becomes new H/I, etc.). This accounts for the negative impacts on offsite mitigation efforts (e.g., evacuation) caused by seismic effects on the surrounding infrastructures (e.g., roads, bridges).

Using this approach, the release frequency as a function of accident class for the Oyster Creek base seismic risk profile is as follows:

Oyster Creek Seismic Base Release Profile Frequencies (/yr)

| Accident Class | CDF | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IA (Late) | 5.45E-7 | 1.07E-08 | 3.57E-07 | 6.91E-08 | 0.00E+00 | 1.64E-08 | 0.00E+00 | 0.00E+00 | 9.10E-08 | 0.00E+00 | 0.00E+00 |
| ID | 2.90E-6 | 1.77E-06 | 9.95E-08 | 1.24E-08 | 9.73E-07 | 0.00E+00 | 0.00E+00 | 4.95E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| IIIB | 1.82E-7 | 1.26E-07 | 8.75E-10 | 6.59E-11 | 6.65E-09 | 4.42E-09 | 1.36E-10 | 9.67E-09 | 1.68E-08 | 1.75E-08 | 0.00E+00 |
| Totals: | 3.63E-6 | 1.90E-06 | 4.57E-07 | 8.16E-08 | 9.79E-07 | 2.09E-08 | 1.36E-10 | 5.92E-08 | 1.08E-07 | 1.75E-08 | 0.00E+00 |

Seismic CDF and Release Risk Profile for SAMA #124

Based on review of the Oyster Creek seismic IPEEE results, sequences with seismic-induced failure of Block Wall 53 represent approximately 15% of the base seismic CDF. Therefore, reinforcement of Block Wall 53 will result in reducing the base seismic CDF by approximately 15% to 3.09E-6/yr (e.g., approximately 5.4E-7/yr). This reduction is apportioned to each of the three seismic accident classes using the same ratios as the base seismic results (i.e., 15%, 80% and 15%). The resulting release frequency as a function of accident class for this SAMA item is as follows:

Release Profile Frequencies (/yr) for SAMA #124

| Accident Class | CDF | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IA (Late) | 4.63E-7 | 9.11E-09 | 3.03E-07 | 5.87E-08 | 0.00E+00 | 1.40E-08 | 0.00E+00 | 0.00E+00 | 7.73E-08 | 0.00E+00 | 0.00E+00 |
| ID | 2.47E-6 | 1.50E-06 | 8.47E-08 | 1.05E-08 | 8.29E-07 | 0.00E+00 | 0.00E+00 | 4.21E-08 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| IIIB | 1.54E-7 | 1.06E-07 | 7.40E-10 | 5.58E-11 | 5.62E-09 | 3.74E-09 | 1.15E-10 | 8.18E-09 | 1.42E-08 | 1.48E-08 | 0.00E+00 |
| Totals: | 3.09E-6 | 1.62E-06 | 3.89E-07 | 6.93E-08 | 8.34E-07 | 1.77E-08 | 1.15E-10 | 5.03E-08 | 9.15E-08 | 1.48E-08 | 0.00E+00 |

Cost-Benefit Calculation for SAMA #124

Using the above seismic risk profiles, and the dose and economic information presented earlier in this report, the economic cost risk for the base seismic risk profile and the SAMA #124 risk profiles are summarized below:

Oyster Creek Seismic Base OECR Results

| Risk Metric | CDF | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (/yr) | 3.63E-6 | 1.90E-06 | 4.57E-07 | 8.16E-08 | 9.79E-07 | 2.09E-08 | 1.36E-10 | 5.92E-08 | 1.08E-07 | 1.75E-08 | 0.00E+00 |
| Dose-Risk (person rem/yr) | 8.71E+00 | 4.76E-02 | 1.84E+00 | 1.21E-02 | 5.67E+00 | 8.76E-02 | 4.80E-04 | 4.69E-01 | 4.52E-01 | 1.31E-01 | 0.00E+00 |
| OECR ($/yr) | 2.85E+04 | 1.89E+01 | 5.40E+03 | 9.87E+00 | 1.87E+04 | 2.65E+02 | 1.31E+00 | 2.23E+03 | 1.17E+03 | 6.58E+02 | 0.00E+00 |

SAMA #124 OECR Results

| Risk Metric | CDF | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Freq. (/yr) | 3.09E-6 | 1.62E-06 | 3.89E-07 | 6.93E-08 | 8.34E-07 | 1.77E-08 | 1.15E-10 | 5.03E-08 | 9.15E-08 | 1.48E-08 | 0.00E+00 |
| Dose-Risk (person rem/yr) | 7.41E+00 | 4.05E-02 | 1.56E+00 | 1.03E-02 | 4.83E+00 | 7.44E-02 | 4.06E-04 | 3.99E-01 | 3.83E-01 | 1.11E-01 | 0.00E+00 |
| OECR ($/yr) | 2.42E+04 | 1.61E+01 | 4.59E+03 | 8.39E+00 | 1.59E+04 | 2.25E+02 | 1.11E+00 | 1.90E+03 | 9.98E+02 | 5.57E+02 | 0.00E+00 |

The cost of implementation for this SAMA is estimated to be $150,000.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA #124 Net Value**

| Base Case: Cost-Risk[(1)] for Oyster Creek (site)[(2)] | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $559,000 | $475,000 | $84,000 | $150,000 | -$66,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the *other contributors to cost-risk described in Section F.3.*

(2) This includes only the seismic contribution to risk as that is the only portion of risk considered impacted by this SAMA.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

### F.6.27.4 Summary

Both approaches outlined above demonstrate that the Block Wall 53 reinforcement reduces seismic risk, but the net value is determined to be not cost beneficial. The remainder of the SAMA analysis retains Approach 2 estimates of the net value for use in comparison tables and sensitivity analysis.

### F.6.28 SAMA 125: REDUCE FIRE IMPACT IN HIGHER RISK FIRE AREAS

Based upon the IPEEE results for Oyster Creek, two fire areas are identified as potentially dominant contributors to the fire induced risk profile. These two areas are:

- The cable spreading room
- The 480V AC "A" switchgear compartment

The following information is noted pertaining to the cable spreading room:

- The cable spreading room contains the two RPS M/G sets. Both M/G sets have grease-lubricated bearings and have a 'radiant' energy shield above them. As such, they do not represent a significant fire threat.
- There are a number of electrical cabinets within the CSR.
- The remainder of the CSR is judged relatively benign with respect to fires. The cable trays are provided with an 'in-tray' suppression system. Therefore, if any one tray is the starting point for a fire, there is an opportunity for it to be suppressed before another tray is damaged.
- There are a few specific conduits that are provided with radiant energy shield boards.

The following information is noted pertaining to the 480V AC "A" switchgear room:

- Two important Vital 480 VAC MCCs or their cable are in this room.
- There are liquid filled transformers in this room which create a potential fire hazard.

The current Oyster Creek internal events PRA does not include fire initiating events. The IPEEE evaluation, while conservative, can be used to provide some understanding of the potential for risk reduction. In order to quantify this potential, the fire impacts for the two areas (cited as dominant in the IPEEE) are incorporated into the updated internal events PRA for the purposes of SAMA evaluation only. The additional modeling was augmented by insights developed from preliminary analysis performed as part of preparation for a formal Fire PRA Update. The IPEEE information as well as the additional insights are discussed below.

The following initiating events and their associated initiating event frequencies are added to the SAMA PRA model:

- %FIRE41 – Fire in Cable Spreading Area, General Area (2.22E-5/yr)
- %FIRE42 – Fire in Cable Spreading Area, Panel DC-E Area (8.0E-4/yr)
- %FIRE43 – Fire in Cable Spreading Area, Suppressed (1.03E-2/yr)
- %FIRE6A1 – Fire in 480 VAC "A" Area, General Area (7.72E-5/yr)

- %FIRE6A2 – Fire in 480 VAC "A" Area, USS 1A2 (1.47E-3/yr)
- %FIRE6A3 – Fire in 480 VAC "A" Area, Hallway, Suppressed (2.19E-3/yr)
- %FIRE6A3B – Fire in 480 VAC "A" Relay Cabinet, Suppressed (4.4E-4/yr)

These initiators for both dominant areas are added to the updated internal events model to provide an integrated picture of overall plant risk. Also, it should be noted that these initiating event frequencies are modified from the values reported in the IPEEE. The modifications resulted from the incorporation of updated generic fire frequency values from EPRI 1003111. Partitioning of the updated frequency values resulted in the altering of the fire frequency assigned to each electrical cabinet in the 'A' Switchgear Room. In addition, a recent walkdown associated with the Fire PRA Update effort determined that some fixed fire sources cannot physically result in fires which spread beyond their immediate location. The following list shows the fire initiating events whose frequencies are modified along with the corresponding values used in the IPEEE:

- %FIRE41 – Fire in Cable Spreading Area, General Area (IPEEE: 1.23E-4/yr) – the IPEEE value was revised to the 2.22E-05/yr value noted above based on an updated walkdown and analysis using EPRI 1003111.
- %FIRE6A1 – Fire in 480 VAC "A" Area, General Area (IPEEE: 2.09E-4/yr) - the IPEEE value was based the on assumption that any fire originating in the switchgear room was capable of causing area-wide damage if the suppression system failed. The modified treatment for this case included only the Load Center and its associated transformer. The modified fire frequency multiplied by failure probability of the automatic fire suppression system resulted in the 7.72E-05/yr value noted above.
- %FIRE6A2 – Fire in 480 VAC "A" Area, USS 1A2 (IPEEE: 1.34E-3/yr) – the IPEEE value was based on an assumed partition factor of 1/3. The updated treatment applies a more rigorous development and resulted in a minor change in fire frequency.
- %FIRE6A3 – Fire in 480 VAC "A" Area, Hallway, Suppressed (IPEEE: 2.63E-3/yr) – the IPEEE value was based on an assumed partition factor of 2/3. Fire case 6A3 was broken into two sub-cases due to the insight that the relay cabinets are distinct fire locations. The updated treatment and the split of this case into two sub-cases (i.e., %FIRE6A3, %FIRE6A3B) resulted in a reduction in the fire frequency.

All fire initiators are added to the following gates in order to invoke initiating event logic in the PRA logic model:

- TRAN-MULT-EMRV – "TRANSIENT MULTI-ERV INITIATORS"
- TRAN-NON-RT – "TRANS INITS OTHER THAN RTM OR RT"
- GTR-NONISO – "NON-ISOLATION TRANSIENT EVENT"

- IE-GEN-TRANS – "RPV TRANSIENT INITIATORS"

Table F-17 shows the systemic impact of each initiating event.

After quantifying the model modified to incorporate fires, the baseline Offsite Economic Cost Risk (OECR) is as follows:

**PRA Results Incorporating Dominant Fire Contributors By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) (Fire Incl.) | 3.16E-05 | 5.77E-06 | 1.51E-05 | 2.49E-06 | 1.17E-06 | 2.59E-06 | 1.68E-09 | 5.98E-07 | 3.66E-06 | 2.11E-07 | 3.31E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 1.01E+02 | 1.44E-01 | 6.07E+01 | 3.69E-01 | 6.77E+00 | 1.09E+01 | 5.93E-03 | 4.74E+00 | 1.53E+01 | 1.58E+00 | 4.10E-01 |
| SAMA OECR ($/yr.) | 3.05E+05 | 5.72E+01 | 1.78E+05 | 3.01E+02 | 2.23E+04 | 3.29E+04 | 1.62E+01 | 2.25E+04 | 3.99E+04 | 7.93E+03 | 1.20E+03 |

These results for the modified base PRA reflect incorporation of the dominant fire risk contributors and show that the total release frequency increases by a factor of 3.0. The Dose Risk (person rem/yr) increases by a factor of 2.8. The MACCS2 calculated OECR increases by a factor of 2.6.

A difference in this probabilistic assessment from the IPEEE analysis is due to a newly quantified failure mode wherein a fire in 480VAC "A" switchgear room not only fails bus 1A2 but also 1B2 because the bus cross-tie breaker is in the "A" area and likely would not prevent a short from propagating to bus 1B2. The results are also impacted by the event sequence, system model, and data updates discussed in Section F.2.1.

After reviewing the cutsets from the revised model, it is apparent that a number of cutsets could be mitigated by other SAMAs. In particular, a number of cutsets are related to AC and DC power. SAMA 109 deals with AC and DC power issues, and is cost-beneficial independent of fire scenarios. Therefore, the fire modified model was further modified to incorporate SAMA 109. The results of this quantification are shown in the table noted SAMA 125A, below.

**SAMA 125A PRA and MACCS Results By Release Category (SAMA 109 Implemented)**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 3.16E-05 | 5.77E-06 | 1.51E-05 | 2.49E-06 | 1.17E-06 | 2.59E-06 | 1.68E-09 | 5.98E-07 | 3.66E-06 | 2.11E-07 | 3.31E-08 |
| SAMA Freq. (per yr.) | 1.47E-05 | 5.36E-06 | 4.11E-06 | 4.29E-07 | 1.16E-06 | 1.92E-06 | 1.67E-09 | 5.91E-07 | 8.71E-07 | 2.10E-07 | 3.31E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 4.18E+01 | 1.34E-01 | 1.65E+01 | 6.35E-02 | 6.72E+00 | 8.06E+00 | 5.90E-03 | 4.69E+00 | 3.65E+00 | 1.58E+00 | 4.10E-01 |
| SAMA OECR ($/yr.) | 1.36E+05 | 5.31E+01 | 4.85E+04 | 5.19E+01 | 2.22E+04 | 2.44E+04 | 1.61E+01 | 2.23E+04 | 9.49E+03 | 7.90E+03 | 1.20E+03 |

The cost of initiating and administering SAMA 109 has been determined to be cost-beneficial based on analysis with the internal events only in Section F.6.23, non-fire risk reduction. Further risk reduction would require consideration of additional options. The most obvious additional option would be to add a circuit breaker to bus 1B2 to protect the bus from cross-tie cable shorts initiated by fires in the 480 VAC "A" switchgear room. This plant modification would reduce basic event "FIRE-SHORT" from 0.2 to approximately 3E-4 (circuit breaker fails to open on demand). The model developed for case SAMA 125A was modified to incorporate the new cross-tie breaker on Bus 1B2. The SAMA 125B case, below, includes the benefit of such an improvement.

**SAMA 125B PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Freq. After SAMA 125A[1] is Implemented (per yr.) (Fire, C/B SAMA Incl.)[2] | 1.47E-05 | 5.36E-06 | 4.11E-06 | 4.29E-07 | 1.16E-06 | 1.92E-06 | 1.67E-09 | 5.91E-07 | 8.71E-07 | 2.10E-07 | 3.31E-08 |
| SAMA 125B Freq. (per yr.) | 1.24E-05 | 4.68E-06 | 3.06E-06 | 2.19E-07 | 1.13E-06 | 1.88E-06 | 1.67E-09 | 5.80E-07 | 6.38E-07 | 2.10E-07 | 3.31E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.62E+01 | 1.17E-01 | 1.23E+01 | 3.24E-02 | 6.54E+00 | 7.90E+00 | 5.90E-03 | 4.60E+00 | 2.67E+00 | 1.58E+00 | 4.10E-01 |
| SAMA OECR ($/yr.) | 1.20E+05 | 4.64E+01 | 3.61E+04 | 2.65E+01 | 2.16E+04 | 2.39E+04 | 1.61E+01 | 2.19E+04 | 6.95E+03 | 7.90E+03 | 1.20E+03 |

(1) Same as SAMA 109 is implemented.
(2) Circuit breaker added to the 480V AC switchgear to preclude propagation of shorts induced by fire.

The cost of SAMA 125B is estimated to be $100,000. The result of the net value calculation for this option is provided in the following table:

**SAMA Number 125B Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (125A) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $2,624,000 | $2,291,000 | $333,000 | $100,000 | $233,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Cutsets resulting from this quantification were reviewed and it was found that loss of IC cutsets dominate the residual fire risk reflected in the Case 125B results. These cutsets occur from random IC failures as well as seal LOCAs and stuck open relief valves. A potential plant modification is possible to allow credit for depressurization and Core Spray as a backup to the Isolation Condenser. Such a modification would require the relocation of the EMRV related cables, circuitry, and components (relays) in this room to a different plant location. In addition, other modifications would be required to ensure that at least one train of Core Spray remains unaffected by the postulated fire event. The extensive changes that would be needed would represent a significant plant modification. In addition, the potential adverse impact to adjoining areas may require fire wrapping as a means of risk mitigation and to maintain compliance with the existing NRC Regulations related to Fire Protection. A detailed scoping and estimate for such a modification was not prepared, but based on the number of components affected, an estimated cost in excess of $600,000 is anticipated. Also, even if RPV injection could be provided, containment heat removal must also be addressed. This would mean protecting containment spray cabling or providing the manual containment venting capability outlined in SAMA 84 ($150,000). A conservative estimate for the cost of further risk reduction is therefore $750,000 ($600,000 + $150,000). In order to explore the potential for risk-reduction in this area, the model developed for the SAMA 125B case was further modified to essentially eliminate fire risk due to these dominant contributors. SAMA 125C represents the case where SAMA 109 and SAMA 125B are implemented and an additional means of eliminating all fire risk due to these dominant fire risk contributors is implemented.

**SAMA 125C PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) (Fire, C/B SAMA, SAMA 109 Incl.) | 1.24E-05 | 4.68E-06 | 3.06E-06 | 2.19E-07 | 1.13E-06 | 1.88E-06 | 1.67E-09 | 5.80E-07 | 6.38E-07 | 2.10E-07 | 3.31E-08 |
| SAMA Freq. (per yr.) | 8.85E-06 | 2.60E-06 | 2.41E-06 | 7.40E-08 | 9.86E-07 | 1.46E-06 | 1.67E-09 | 5.42E-07 | 5.53E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.02E+01 | 6.50E-02 | 9.69E+00 | 1.10E-02 | 5.71E+00 | 6.13E+00 | 5.90E-03 | 4.30E+00 | 2.32E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.01E+05 | 2.58E+01 | 2.84E+04 | 8.95E+00 | 1.88E+04 | 1.85E+04 | 1.61E+01 | 2.04E+04 | 6.03E+03 | 7.90E+03 | 1.17E+03 |

The results of this calculation show the maximum benefit that can be achieved if risk from these fires is completely eliminated. This is summarized in the following table:

**SAMA Number 125C Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (125B) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $2,291,000 | $1,894,000 | $397,000 | $750,000 | -$353,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Therefore, it has been determined that implementation of SAMA 109 along with installation of a circuit breaker on the 480 VAC Bus 1B2 cross-tie supply are the cost-beneficial approaches to fire risk reduction. As such, the additional circuit breaker for Bus 1B2 is assigned as SAMA 125B. Its net value is defined by case 125B, above.

Table F-17. Summary of Fire Impacts Added to Base Model

| Fire Initiator(s) | Fire Impact | Compartment | Model Changes |
|---|---|---|---|
| %FIRE41 | 125 VDC Division B | CSR | Initiator added directly under "DB" gate |
| | Service Water | CSR | Initiator added directly under "SW" gate |
| | Circulating Water | CSR | Initiator added directly under "CW" gate |
| | RPS Actuation-Drywell Pressure | CSR | Initiator added directly under "DP" gate |
| | RPS Actuation-Reactor Pressure | CSR | Initiator added directly under "PR" gate. Recirc pump trip logic related to Isolation Condenser modified slightly so that fire induced loss of reactor pressure actuation of recirc pump trip does not directly fail ICs without opportunity for manual trip. |
| | RPS Actuation-Reactor Level | CSR | Initiator added directly under "RL" gate |
| | MSIV Isolation | CSR | Initiator added directly under "MEG01MEC" gate (Failure Of Automatic Actuation). |
| | Condensate Pumps | CSR | Initiator added directly under "CP" gate |
| | Operator ATWS Actions | CSR | Initiator added directly "ORed" with OH-LVL-ERLY, OH-LVL-LATE, OH-LVL-TT basic events. |
| | Control Rod Drive (RPV Injection) | CSR | Initiator added directly under "CP" gate |
| | Containment Spray | CSR | Initiator added directly under "CC" gate |
| | Core Spray | CSR | Initiator added directly under "CS" gate |
| | Containment Venting | CSR | Initiator added directly under "OV" gate |
| | Automatic IC Initiation | CSR | Initiator added directly under "RPAL-FIRE" gate (Auto IC Actuation) |
| | Isolation Condenser "A" | CSR | Initiator added directly under "ICG01MDA" gate (Isolation Condenser Train A Failed) |
| | Isolation Condenser "B" | CSR | Fire fails main CR IC control circuit. Operators using RSP modeled by adding basic event "OP-FIRE41" (=0.1) and logic under "ICG075" gate (Long Term DC Failure Affects IC B) |
| | Offsite Power | CSR | Initiator added directly under "EAB", "EBB" gates |
| | EDG A | CSR | Initiator added directly under "EC" gate |

**Table F-17. Summary of Fire Impacts Added to Base Model**

| Fire Initiator(s) | Fire Impact | Compartment | Model Changes |
|---|---|---|---|
| %FIRE41 (cont'd) | ADS | CSR | Initiator added directly under "ADG022" gate (ADS Support System Failure) |
| %FIRE42 | 125 VDC Division B | CSR | Initiator added directly under "DB" gate |
| %FIRE43 | RPS Actuation-Reactor Pressure | CSR | Initiator added directly under "PR" gate. Recirc pump trip logic related to Isolation Condenser modified slightly so that fire induced loss of reactor pressure actuation of recirc pump trip does not directly fail ICs without opportunity for manual trip. |
| | RPS Actuation-Reactor Level | CSR | Initiator added directly under "RL" gate |
| | Control Rod Drive (RPV Injection) | CSR | Initiator added directly under "CP" gate |
| | 125 VDC Division B (Charging Only) | 480V AC "A" | Initiator added directly under "XBGCHA" gate (Supply From Battery Charger A M-G Set Fails) and "XBGCHB" gate (Supply From Battery Charger B M-G Set Fails. |
| | Service Water | 480V AC "A" | Initiator added directly under "SW" gate |
| | Circulating Water | 480V AC "A" | Initiator added directly under "CW" gate |
| %FIRE6A1 | RPS Actuation-Drywell Pressure | 480V AC "A" | Initiator added directly under "DP" gate |
| | RPS Actuation-Reactor Level | 480V AC "A" | Initiator added directly under "RL" gate |
| | Control Rod Drive (RPV Injection) | 480V AC "A" | Initiator added directly under "CP" gate |
| | Containment Spray | 480V AC "A" | Initiator added directly under "CC" gate |
| | Core Spray | 480V AC "A" | Initiator added directly under "CS" gate |
| | Containment Vent | 480V AC "A" | Initiator added directly under "OV" gate |
| | Isolation Condenser "A" | 480V AC "A" | Initiator added directly under "ICG01MDA" gate (Isolation Condenser Train A Failed) |
| | Isolation Condenser "B" | 480V AC "A" | Fire fails main IC control circuit. Operators using 480 VAC control modeled by adding basic event "FIRE-IC-BE" and logic under "ICG075" gate (Long Term DC Failure Affects IC B) |

**Table F-17. Summary of Fire Impacts Added to Base Model**

| Fire Initiator(s) | Fire Impact | Compartment | Model Changes |
|---|---|---|---|
| %FIRE6A1 | Shutdown Cooling | 480V AC "A" | Initiator added directly under "SD" gate |
| (cont'd) | Onsite AC Power Distribution | 480V AC "A" | Initiator added directly under "EH" gate (480 VAC Bus 1A2 Fails). Initiators are also added under "EK" gate (480 VAC Bus 1B2 Fails) and are ANDed with new basic event "FIRE-SHORT" (Recoverable Fire Induced Short). FIRE-SHORT is a newly identified failure mode wherein the cable for the bus cross-tie is located in fire area and can propagate a short to the alternate division. This short is recoverable via operating procedures. A value of 0.2 is used for the new basic event which represents operator action. Operator action requires operators to cut the cross-tie cable, re-insulate the cable, and re-close the supply breaker. |
| | ADS | 480V AC "A" | Initiator added directly under "ADG022" gate (ADS Support System Failure) |
| | Circulating Water | 480V AC "A" | Initiator added directly under "DP" gate |
| | RPS Actuation-Drywell Pressure | 480V AC "A" | Initiator added directly under "RL" gate |
| %FIRE6A2 | RPS Actuation-Reactor Level | 480V AC "A" | Initiator added directly under "RL" gate |
| | Control Rod Drive (RPV Injection) | 480V AC "A" | Initiator added directly under "CP" gate |
| | Containment Vent | 480V AC "A" | Initiator added directly under "OV" gate |
| | Isolation Condenser "B" | 480V AC "A" | Fire fails main IC control circuit. Operators using 480 VAC control modeled by adding basic event "FIRE-IC-BE" and logic under "ICG075" gate (Long Term DC Failure Affects IC B) |
| | Shutdown Cooling | 480V AC "A" | Initiator added directly under "SD" gate |

Table F-17. Summary of Fire Impacts Added to Base Model

| Fire Initiator(s) | Fire Impact | Compartment | Model Changes |
|---|---|---|---|
| %FIRE6A2 (cont'd) | Onsite AC Power Distribution | 480V AC "A" | Initiator added directly under "EH" gate (480 VAC Bus 1A2 Fails). Initiators are also added under "EK" gate (480 VAC Bus 1B2 Fails) and are ANDed with new basic event "FIRE-SHORT" (Recoverable Fire Induced Short). FIRE-SHORT is a newly identified failure mode wherein the cable for the bus cross-tie is located in fire area and can propagate a short to the alternate division. This short is recoverable via operating procedures. A value of 0.2 is used for the new basic event which represents operator action. Operator action requires operators to cut the cross-tie cable, re-insulate the cable, and re-close the supply breaker. |
| | Circulating Water | 480V AC "A" | Initiator added directly under "DP" gate |
| | RPS Actuation-Drywell Pressure | 480V AC "A" | Initiator added directly under "RL" gate |
| | RPS Actuation-Reactor Level | 480V AC "A" | Initiator added directly under "RL" gate |
| %FIRE6A3 | Control Rod Drive (RPV Injection) | 480V AC "A" | Initiator added directly under "CP" gate |
| | Containment Spray (1 Division) | 480V AC "A" | Initiator added directly under "CCG02MCA" gate (Containment Spray And ESW System Loop 1 Failed) |
| | Containment Vent | 480V AC "A" | Initiator added directly under "OV" gate |
| | Isolation Condenser "A" | 480V AC "A" | Initiator added directly under "ICG01MDA" gate (Isolation Condenser Train A Failed) |
| | Shutdown Cooling | 480V AC "A" | Initiator added directly under "SD" gate |
| | ADS | 480V AC "A" | Initiator added directly under "ADG022" gate (ADS Support System Failure) |
| %FIRE6A13B | Core Spray | 480V AC "A" | Initiator added directly under "CS" gate |

### F.6.29 NOT USED

## F.6.30 SAMA 127: OPERATOR TRAINING

On-going training on the PRA importance of systems and operator actions is judged to provide an "across-the-board" reduction in operator error probability. Also, training is important to maintain current PRA assessed operator reliability values.

Based on a review of model importance values, providing operators with training on PRA results, including external event insights, is deemed obviously cost-beneficial. It is also clearly cost-beneficial to continue to use PRA importance ranking to assist in prioritizing operator training activities such as simulator exercises.

### F.6.31 SAMA 128: IC FOULING

Programs instituted to reduce blockage and fouling of the shell side of the isolation condensers were identified as potentially beneficial in the original IPE analysis.

The PRA model includes two basic events for IC fouling. Basic event HX014NE1AP represents plugging or fouling of IC A and basic event HX014NE1BP represents plugging or fouling of IC B. Model OC-SAMA128.caf, created from OC-LEV2.caf, was adjusted by reducing the IC plugging fouling basic events by an order of magnitude to reflect a significant improvement in reliability. The results from this case indicate a negligible reduction in CDF (i.e., 1E-10/yr). The negligible reduction in CDF results in a negligible cost-risk benefit (i.e., less than $14,000 using Section F.6.34 for a guide value).

Administering a program such as this is expected to cost at least $20,000 per year or in excess of $200,000 present value based on standard amortization tables.

This proposal is clearly not cost beneficial.

## F.6.32 SAMA 129: INTERNAL FLOODING PROCEDURE ENHANCEMENTS

SAMA 129 is to improve procedures for responding to internal flooding events.

Improved procedures and training could potentially reduce internal flood related risk; primarily by increasing the likelihood of isolating ruptures before risk significant equipment is affected. To simulate a potential benefit of rapid recovery because of procedures and training, internal flood initiating events were reduced by a factor of two. All initiators, except "Fire Protection Spray of Buses 1A, 1B," were reduced by a factor of two. The fire protection spray initiator was not reduced because it was assumed that damage could occur too quickly for isolation to be effective. A factor of two represents a significant improvement in operator capability that is likely to be achieved only after a considerable commitment to improved training and procedures. Also, it is noted that there is some potential for competing risk in that operator time and attention focused on internal flooding will, by definition, result in diverting operator training from other, potentially higher safety significant activities.

The results from this case indicate a 3.9 percent reduction in CDF ($CDF_{new}$=1.01E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 129 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.01E-05 | 2.42E-06 | 3.32E-06 | 1.82E-07 | 9.69E-07 | 1.64E-06 | 1.67E-09 | 5.42E-07 | 7.84E-07 | 2.10E-07 | 3.21E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.55E+01 | 6.05E-02 | 1.33E+01 | 2.70E-02 | 5.61E+00 | 6.90E+00 | 5.90E-03 | 4.30E+00 | 3.28E+00 | 1.58E+00 | 3.99E-01 |
| SAMA OECR ($/yr.) | 1.17E+05 | 2.40E+01 | 3.91E+04 | 2.20E+01 | 1.85E+04 | 2.09E+04 | 1.61E+01 | 2.04E+04 | 8.54E+03 | 7.91E+03 | 1.16E+03 |

The cost of implementation for this SAMA is estimated to be $100,000 since a review of flooding rates, impacts, and operator intervention options is required in addition to procedure changes and training.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 129 Net Value**

| Base Case: Cost-Risk[(1)] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,406,000 | $56,000 | $100,000 | -$44,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, the net value is negative and this enhancement is not cost beneficial based on the SAMA methodology. Note also that competing risks associated with diluting the training curricula have not yet been quantified.

### F.6.33 SAMA 130: PROTECT COMBUSTION TURBINES

SAMA 130 increases CT building integrity to withstand high winds. This considers specifications similar to safety related requirements.

The PRA model includes the probability that the CTs are damaged by high winds. This is treated as a value which is conditional on LOOP (4.62E-2/yr). Based on a review of the LOOP data in the Initiating Events Notebook, LOOP events were classified into four (4) categories:

- Plant Centered (56%)
- Grid Related (20%)
- Severe Weather (20%)
- Extreme Weather (4%)

The extreme weather case did not credit the CTs because the building design (i.e., 85 mph) limited the likelihood of survival. Figure 7, Page 5.1-5, of the OC IPEEE provides Tornado and Straight Wind Hazard Probability for the OC site. Based on the site specific wind hazard, if the CT building and SBO transformer structure were designed for a higher wind level, in the range of 115 mph, the conditional failure probability of being in the Extreme Weather "bin" could be reduced as follows:

- Plant Centered (56%)
- Grid Related (20%)
- Severe Weather (23.8%)
- Extreme Weather (0.2%)

This re-binning of LOOP initiating events basically expands the severe weather definition up to higher wind levels and allows the CTs to be available for a wider spectrum of events. This modeling change was accomplished by changing basic event LOOP-IE-SW probability from 0.2 to 0.238 per demand and basic event LOOP-IE-XW probability from 0.04 to 2E-3 per demand. This adjustment is made to all impacted gates except those under the FP (Fire Protection) gate. The fire pump house is also impacted by high winds but improvement is not applied in this particular SAMA.

The results from this case indicate a 30.1 percent reduction in CDF ($CDF_{new}$=7.33E-6 per year). A further breakdown of this information is provided below according to release category.

**SAMA 130 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 7.33E-06 | 2.13E-06 | 1.70E-06 | 1.95E-07 | 4.88E-07 | 1.64E-06 | 1.67E-09 | 3.13E-07 | 6.37E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 2.38E+01 | 5.33E-02 | 6.84E+00 | 2.88E-02 | 2.82E+00 | 6.90E+00 | 5.90E-03 | 2.49E+00 | 2.67E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 7.82E+04 | 2.11E+01 | 2.01E+04 | 2.36E+01 | 9.31E+03 | 2.09E+04 | 1.61E+01 | 1.18E+04 | 6.95E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is judged to be $600,000 since fairly extensive CT Building and SBO transformer structural improvements will be necessary.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 130 Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site)(2) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $2,231,000 | $1,484,000 | $747,000 | $600,000 | $147,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

(2) Damage due to high winds is an external event. External event contributions attributable to other sources may be omitted. External event contributions from seismic and fire are removed from consideration, such that the cost risk multiplier used is 1.0 rather than 2.0.

Given that the cost of implementation is less than the averted cost-risk for this SAMA, this enhancement is cost beneficial based on the SAMA methodology.

## F.6.34 SAMA 132: REDUCE PROBABILITY OF MULTI-CT OPERATION

When the Combustion Turbines (CTs) are in operation, alignment for Oyster Creek LOOP response takes additional time due to the need for CTs to be stopped and to coast down first. This is due to uncertain procedural guidance in Procedure ABN-36 which directs operators to secure the CTs, if they were initially running.

Gates CT1 and CT2 in the OSP node model the likelihood that CT coast down is required. For 30 minute success criteria LOOP sequences, coast down causes CT failure because procedurally CTs require 40 minutes for alignment if they are initially operating. Because the CTs may spuriously trip due to overspeed caused by loss of load, this SAMA is modeled by "ANDing" an new basic event "SAMA132-BE" with the CT1 and CT2 gates. A value of 0.5 is used to represent the potential for spurious trip. If a spurious trip occurs, coastdown would be required before operators could restart. Otherwise, the current configuration would allow operators to immediately transfer loads.

The results from this case indicate a 1.24 percent reduction in CDF ($CDF_{new}$=1.04E-5 per year). A further breakdown of this information is provided below according to release category.

**SAMA 132 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.04E-05 | 2.68E-06 | 3.31E-06 | 1.96E-07 | 9.77E-07 | 1.66E-06 | 1.67E-09 | 5.38E-07 | 7.81E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.55E+01 | 6.71E-02 | 1.33E+01 | 2.90E-02 | 5.66E+00 | 6.95E+00 | 5.90E-03 | 4.26E+00 | 3.27E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.17E+05 | 2.66E+01 | 3.91E+04 | 2.37E+01 | 1.87E+04 | 2.10E+04 | 1.61E+01 | 2.03E+04 | 8.51E+03 | 7.91E+03 | 1.17E+03 |

Two methods of achieving the reduction in probability that the CTs are in operation are as follows:

Method A: Revise operating procedures to allow switching of the CTs to Oyster Creek while running.

Method B: Achieve agreement with First Energy (operation of the CTs) to require at least 1 CT to be available in standby at all times.

<u>Method A</u>

The cost of implementation for this SAMA is judged to be $50,000 to implement the procedure changes.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

SAMA Number 132 Net Value

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,416,000 | $46,000 | $50,000 | -$4,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation of Method A is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

Method B

An alternative SAMA to provide a similar capability to Method "A" by obtaining First Energy (operator of the CTs) agreement to always maintain one CT in standby status is considered cost prohibitive and is considered adequately represented by the procedural modification in Method A.

## F.6.35 SAMA 133: INCREASE HOTWELL MAKEUP CAPABILITY

The supply from the CST to the hotwell is currently via 10" or 4" pipe pathways. Two transfer pumps are available to augment the gravity feed and can supply 250 gpm each. The Fire Protection system can makeup to the CST at a rate of approximately 2000 gpm. A proposed SAMA would increase the hotwell makeup capacity so that it would transfer at least 2000 gpm from the CST to the hotwell. This additional flow from the CST to the hotwell, via the proposed SAMA, could allow feedwater to provide successful inventory control over a wider spectrum of LOCAs. Currently, the PRA does not credit feedwater for mitigation of below core LOCAs. The model can be adjusted to assume feedwater is able to mitigate any LOCA. This would be conservative toward supporting the proposed SAMA because, even with the additional flow, it is uncertain whether feedwater could mitigate large, below core LOCAs. This uncertainty arises because much of the inventory supplied by feedwater would flow out the break and not provide core cooling. In any event, for this sensitivity, it is assumed that the flow would be adequate to mitigate all LOCAs.

To model this sensitivity the gate "CP-LOCA-BTAF" is removed from the model. This gate is used to list those conditions (i.e., initiators) wherein feedwater is assumed to be insufficient, largely due to hotwell makeup concerns. The revised model was saved as OC-SAMA133.CAF and requantified. CDF reduced 1%, from 1.05E-5/yr to 1.04E-5/yr.

**SAMA 133 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.04E-05 | 2.69E-06 | 3.38E-06 | 1.96E-07 | 9.91E-07 | 1.65E-06 | 1.50E-09 | 5.22E-07 | 7.55E-07 | 1.89E-07 | 3.14E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.54E+01 | 6.73E-02 | 1.36E+01 | 2.90E-02 | 5.74E+00 | 6.92E+00 | 5.28E-03 | 4.14E+00 | 3.16E+00 | 1.42E+00 | 3.89E-01 |
| SAMA OECR ($/yr.) | 1.16E+05 | 2.67E+01 | 3.99E+04 | 2.37E+01 | 1.89E+04 | 2.09E+04 | 1.44E+01 | 1.97E+04 | 8.23E+03 | 7.09E+03 | 1.14E+03 |

This modification is estimated to cost $250,000 (3/8/2005 email from Pupek to Burns).

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

SAMA Number 133 Net Value

| Base Case: Cost-Risk for Oyster Creek[2] | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,390,000 | $72,000 | $250,000 | -$178,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

(2) Includes a factor of two increase to account for external events.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.36 SAMA 134: UPGRADE FIRE PUMP HOUSE STRUCTURAL INTEGRITY

SAMA 134 increases fire pump building integrity to withstand high winds. This considers specifications similar to safety related requirements.

The PRA model includes the probability that the fire pumps are damaged by high winds. This is treated as a value which is conditional on LOOP (4.62E-2/yr). Based on a review of the LOOP data in the Initiating Events Notebook, LOOP events were classified into four (4) categories:

- Plant Centered (56%)
- Grid Related (20%)
- Severe Weather (20%)
- Extreme Weather (4%)

The extreme weather case did not credit the fire pumps as the building design (i.e., 85 mph) limited the likelihood of survival. Figure 7, Page 5.1-5, of the OC IPEEE provides Tornado and Straight Wind Hazard Probability for the Oyster Creek site. Based on the site specific wind hazard, if the fire pump building were designed for a higher wind level, in the range of 115 mph, the extreme weather conditional failure probability could be reduced as follows:

- Plant Centered (56%)
- Grid Related (20%)
- Severe Weather (23.8%)
- Extreme Weather (0.2%)

This basically expands the severe weather definition up to higher wind levels and allows the fire pumps to be available for a wider spectrum of events. This modeling change was accomplished by changing basic event LOOP-IE-SW probability from 0.2 to 0.238 per demand and basic event LOOP-IE-XW probability from 0.04 to 2E-3 per demand. This adjustment is applied only under the FP (Fire protection) gate as this SAMA relates only to the fire pump house.

The results from this case indicate a 15.7 percent reduction in CDF ($CDF_{new}$=8.84E-6 per year). A further breakdown of this information is provided below according to release category.

**SAMA 134 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 8.84E-06 | 2.38E-06 | 2.65E-06 | 1.95E-07 | 5.29E-07 | 1.72E-06 | 1.67E-09 | 3.33E-07 | 8.15E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 2.91E+01 | 5.95E-02 | 1.07E+01 | 2.88E-02 | 3.06E+00 | 7.21E+00 | 5.90E-03 | 2.64E+00 | 3.41E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 9.38E+04 | 2.36E+01 | 3.13E+04 | 2.36E+01 | 1.01E+04 | 2.18E+04 | 1.61E+01 | 1.25E+04 | 8.88E+03 | 7.91E+03 | 1.17E+03 |

System managers estimate that this modification would cost $150,000.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 134 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek[2] | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $2,231,000 | $1,793,000 | $438,000 | $150,000 | $288,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

(2) Damage due to high winds is an external event. External event contributions attributable to other sources may be omitted. External event contributions from seismic and fire are removed from consideration, such that the cost risk multiplier used is 1.0 rather than 2.0.

Given that the cost of implementation is not greater than the averted cost-risk for this SAMA, this enhancement is cost beneficial based on the SAMA methodology.

Note that Oyster Creek has the capability and procedural guidance to align a fire pump truck to provide additional fire pump redundancy. The truck is under the control of the Forked River Fire Department. Due to uncertainty regarding its availability, particularly in high wind events, its benefit has not been explicitly quantified in the PRA.

## F.6.37 SAMA 136: PROVIDE ALTERNATE POWER TO CONDENSATE TRANSFER PUMPS

Presently, both Condensate Transfer Pumps are powered from USS 1B2 via MCC 1B32. Also, both pumps are tripped and not loaded onto the EDG following a LOOP. The operator must go to the intake to reset UV device to allow use of pumps. Redundant power to the pumps would increase the availability of the system, and auto load onto the EDGs would make them available quickly and with no operator action during LOOP.

This modeling change to address this option was accomplished by adding the AC power supplies (Gates EL and EI) under the individual pump gates in the condensate transfer tree (Gates CTG00MDC and CTG00MEC). The failure of Gate EL was removed as a single point failure under gate CTG010.

The results from this case indicate a 0.2 percent reduction in CDF ($CDF_{new}$=1.05x$10^{-5}$ per year). A further breakdown of this information is provided below according to release category.

**SAMA 136 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.05E-05 | 2.70E-06 | 3.37E-06 | 1.96E-07 | 9.96E-07 | 1.66E-06 | 1.67E-09 | 5.46E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.60E+01 | 6.76E-02 | 1.35E+01 | 2.90E-02 | 5.76E+00 | 6.95E+00 | 5.90E-03 | 4.33E+00 | 3.29E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.18E+05 | 2.68E+01 | 3.98E+04 | 2.37E+01 | 1.90E+04 | 2.10E+04 | 1.61E+01 | 2.06E+04 | 8.56E+03 | 7.91E+03 | 1.17E+03 |

The cost of implementation for this SAMA is judged to be $100,000.

This information was used as input to the cost benefit calculation. As can be seen, there are negligible changes in the CDF and the release category frequencies. This leads to a negligible change in averted cost risk. The results of this calculation are provided in the following table:

**SAMA Number 136 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $4,462,000 | $0 | $100,000 | -$100,000 |

[1] Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.38 SAMA 138: PROTECT TRANSFORMERS

The main and startup transformers are located approximately 15' apart. The Oyster Creek PSA development and quantification has assessed the current transformer configuration and characterizes the potential for common failures using available generic data which has been Bayesian updated with Oyster Creek experience. Nevertheless, there is a postulated failure mode that an explosive failure of one transformer could impact the other. Because this event has never happened at Oyster Creek, it is speculated for this SAMA evaluation that there could be an impact on the order of 1E-2/yr to the plant-centered LOOP frequency based on assuming one explosive transformer failure per year in the nuclear industry. The base PRA model does not include the impact of this speculated hazard. Therefore, the SAMA cost benefit calculation must be performed by <u>increasing</u> the CDF and dose risk associated with this postulated hazard. Then, the benefit to be achieved will be the difference between the cost-risk with no additional protection for the hazard and the current base risk level which assumes the postulated hazard risk is near zero.

The modeling change to address this option is conservatively approximated by adding 1E-2/yr to the %LOOP initiating event frequency (%LOOP increased from 4.62E-2/yr to 5.62E-2/yr).

The results from this case indicate an 8.7 percent increase in CDF ($CDF_{new}$=1.14E-5 per year) if the hazard exists and no protection is provided. A further breakdown of this information is provided below according to release category.

**SAMA 138 PRA and MACCS Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.14E-05 | 2.87E-06 | 3.87E-06 | 1.96E-07 | 1.14E-06 | 1.66E-06 | 1.67E-09 | 6.13E-07 | 8.32E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.957E+01 | 7.18E-02 | 1.56E+01 | 2.91E-02 | 6.62E+00 | 6.97E+00 | 5.90E-03 | 4.86E+00 | 3.49E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.299E+05 | 2.85E+01 | 4.56E+04 | 2.38E+01 | 2.18E+04 | 2.11E+04 | 1.61E+01 | 2.31E+04 | 9.07E+03 | 7.91E+03 | 1.17E+03 |

Oyster Creek System Managers have reviewed this SAMA. Building a protective wall between the transformers is not feasible because the structure would need to be quite substantial and would interfere with normal access to equipment. The only technically feasible option would be to excavate a bus duct and "pull" the associated cables to protect the offsite supply circuitry. This has been estimated to cost $780,000.

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**SAMA Number 138 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000[2] | $4,908,000[2] | $446,000[2] | $780,000 | -$334,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

(2) The base PRA model does not include the impact of this postulated hazard. Therefore, the SAMA cost benefit calculation must be performed by increasing the CDF and dose risk associated with this postulated hazard. Then, the benefit to be achieved will be the difference between: (1) the cost-risk with no additional protection for the hazard; and, (2) the current base risk level which assumes the postulated hazard risk is near zero (equivalent to the maximum benefit achieved by the SAMA).

Given that the cost of implementation is greater than the averted cost-risk for this SAMA, this enhancement is not cost beneficial based on the SAMA methodology.

## F.6.39 COMBINED IMPACT OF SAMAS

This section is purely for planning purposes, i.e., as input into the decision-making process. Once a SAMA is decided upon and implemented, then the PRA would be re-evaluated with the SAMA included. Following this re-baselining, the remaining individual SAMAs could be assessed with regard to their residual net value. This section provides estimates of the impact on the net value due to implementing combinations of SAMAs. These impact estimates provide needed input to decision-makers in their selection of possible plant or procedure changes.

While it is important to examine the impact of implementation for each individual SAMA, some combinations of SAMAs may act synergistically to yield a combined risk reduction greater than the sum of individual components. However, it is also important to note that implementation of cost-beneficial SAMAs may reduce the benefit of more marginal SAMAs by eliminating sequences that apply to the lower significant SAMAs.

The following sub-sections document the review of the impact of combinations of SAMAs.

Section F.6.39.1 addresses those SAMAs that are cost-beneficial on their own but may be non-cost-beneficial after the implementation of other, more beneficial, SAMAs.

Section F.6.39.2 addresses those SAMAs that are non-cost-beneficial on their own but may be cost-beneficial when implemented along with other SAMAs.

It is recognized that modeling and quantifying all possible combinations of SAMA would be a very resource intensive activity. Therefore, combinations of SAMAs for further review were developed based on a review of the Phase II single SAMA cost-benefit assessment as well as an overall consideration of the more significant aspects of the PRA.

### F.6.39.1 Review of Cost Beneficial SAMA That Are Reduced In Benefit By Other SAMA

It is possible for an otherwise cost-beneficial item to be non-cost-beneficial when another more cost-beneficial item has been implemented. This section discusses the review of cost-beneficial SAMAs when assessed individually to determine if combinations of SAMAs would reduce the perceived benefit (i.e., net value).

The Phase II cost-beneficial items are shown in Table F-18. The results of these combination evaluations are discussed further in sub-section F.6.39.3.

The descriptions of the tabular columns in Table F-18 are as follows:

- Column 1 is the SAMA number from previous sections (See Table F-16).
- Column 2 is a brief description of the SAMA.
- Column 3 is the individual net value – i.e., the present value of averted cost risk of implementing the SAMA minus the cost of implementation.
- Column 4 is an "item" identifier to designate the specific combination and order of the SAMA combination.

- Column 5 is the SAMA used in combination to assess the net benefit.
- Column 6 is the combination designator used in Section F.6.39.
- Column 7 is the marginal value of implementing the second SAMA.
- Column 8 is an assessment of whether the combination appears to be desirable to implement.

The following is a brief summary of the individual SAMAs that are evaluated in this section to assess the impacts of performing multiple SAMAs. All possible combinations are not modeled. Instead, model results and cutsets are reviewed to determine which SAMA combinations are most beneficial to quantitatively evaluate.

SAMA 91 – This involves improvements related to AC power by allowing crossties of the safety related buses. Related synergy is considered in combinations A1 and A2.

SAMA 99 – This SAMA involves scenarios with loss of AC power. Related synergy is considered in combinations A2 and A3.

SAMA 109 – This SAMA involves scenarios with loss of AC power. Related synergy is considered in combination A3.

SAMA 125 – This SAMA involves fire related accident sequences in areas with potentially dominant contributors to risk. The overlapping benefit associated with SAMA 109 is also evaluated in Section F.6.28. The SAMA 125B modification to install a circuit breaker to minimize the propagation of fire impacts has little or no impact on non-fire scenarios but does reduce the residual fire risk.

SAMA 127 – This SAMA relates to "across-the-board" operator training on PRA significant results. This SAMA is not envisioned to be non-cost-beneficial under any circumstances. It is considered cost-beneficial to continue to train the operators on the PRA results.

SAMA 130 – This SAMA involves AC power. Related synergy is considered in combination A4.

SAMA 134 – This SAMA involves scenarios with loss of AC power. Related synergy is considered in combination A4.

The combinations identified by an engineering review of the individual SAMAs and their potential for synergistic effects are identified in Table F.18 and are each discussed in the following text. The discussion of each combination includes:

- The calculated averted cost risk for the combination
- The net value comparison of the individual contributing SAMAs and the combination net value
- The assessment when the SAMAs are applied in reverse order

## Table F-18
## Evaluation of Combinations of SAMAS

| SAMA No. | Description | Individual Net Value ($) | Item | Related SAMA | Combination | Marginal Value with Related SAMA Implemented ($) | Does Combination Increase Net Value |
|---|---|---|---|---|---|---|---|
| 91 | Allow 4160 VAC Bus IC And ID Crosstie | $28,000 | A | 99 | A1 | $472,000 | No(1) |
| | | | B | 109 | A2 | $547,000 | No(2) |
| 99 | Provide an Alternate Method for IC Shell Level Determination | $524,000 | C | 91 | A1 | -$24,000 | No |
| | | | D | 109 | A3 | -$25,000 | No |
| 109 | Portable DC Battery Charger to Preserve IC and EMRV Operability Along With Adequate Instrumentation | $599,000 | E | 91 | A2 | -$24,000 | No |
| | | | F | 99 | A3 | -$100,000 | No |
| 125B | Reduce fire impact in dominant fire areas | $233,000 | G | 109(3) | (3) | $233,000 | Yes |
| 127 | Operator training | | H | N/A(4) | _(4) | _(4) | _(4) |
| 130 | Protect Combustion Turbines | $147,000 | I | 134 | A4 | -$132,000 | No |
| 134 | Upgrade Fire Pump House Structural Integrity | $288,000 | J | 130 | A4 | -$273,000 | No |

(1) Dependent on the sequence of implementation. Refer to Item C for the combination effectiveness.
(2) Dependent on the sequence of implementation. Refer to Item E for the combination effectiveness.
(3) The SAMA 125B is evaluated only in combination with SAMA 109.
(4) Judged to be a prudent and therefore cost beneficial activity.

SAMA 91, 99, Combination: Combination A1

The following two SAMAs are investigated for synergies as Combination A1:

- SAMA 91 4160V AC Bus Cross-Tie
- SAMA 99 Local IC Operation, Shell Level Instrument

A model developed for SAMA 99 was modified by including those changes developed to model SAMA 91. The results of this model, when compared to the baseline, show the benefits of SAMA 91 and SAMA 99 implemented in combination. The following table shows these results:

**Combination A1: SAMA Combination 99-91 Results by Release Category**

| Calculation Description | Total | Release Category: Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.80E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 8.69E-06 | 2.57E-06 | 2.33E-06 | 7.40E-08 | 9.62E-07 | 1.46E-06 | 1.67E-09 | 5.31E-07 | 5.44E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 2.96E+01 | 6.42E-02 | 9.35E+00 | 1.09E-02 | 5.57E+00 | 6.14E+00 | 5.90E-03 | 4.21E+00 | 2.28E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 9.94E+04 | 2.55E+01 | 2.75E+04 | 8.95E+00 | 1.84E+04 | 1.86E+04 | 1.61E+01 | 2.00E+04 | 5.93E+03 | 7.91E+03 | 1.17E+03 |

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**Combination A1: SAMA Number 99 and 91 Combination Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation (SAMA 91 + SAMA 99) | Net Value |
|---|---|---|---|---|
| $4,462,000 | $3,722,000 | $740,000 | $240,000 | $500,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

The net value for SAMA 99 alone is $524,000 (Section F.6.15). Therefore, implementation of SAMA 91, given implementation of SAMA 99, yields a reduction in net value of $24,000 (i.e., $500,000 - $524,000). Thus, the total net value of the combination is reduced significantly from $ 524,000, but is still positive. (See table below.)

**Comparison of Combination 91 and 99 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 99 | Local IC Operation, Shell Level Instrument | $524,000 | -- |
| Combination 91 to 99 | Combined 91 to 99 | $28,000 | $500,000 |
| Marginal Value associated with adding 91 to 99 | 4160V AC Bus Cross-Tie | $500,000 - $524,000 = -$24,000 | |

The incremental change in net value is negative when SAMA 91 is subsequently added to SAMA 99 to be implemented. Therefore, with SAMA 99 implemented, SAMA 91 would not be cost beneficial.

Reverse Sequence of Implementation for Combination A1

This combination can also be examined assuming that SAMA 91 is implemented first. In that case, it is found that:

The net value for SAMA 91 alone is $28,000 (Section F.6.11). Therefore, implementation of SAMA 99, given implementation of SAMA 91, yields an additional benefit of $472,000 (i.e., $500,000 - $28,000). Thus, the benefit of SAMA 99, is reduced from $524,000 (Section F.6.15), but remains positive. (See table below.)

**Comparison of Combination 91 and 109 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 91 | 4160V AC Bus Cross-Tie | $28,000 | -- |
| Combination 99 to 91 | Combined 99 to 91 | $524,000 | $500,000 |
| Marginal Value associated with adding 99 to 91 | Local IC Operation, Shell Level Instrument | $500,000 - $28,000 = $472,000 | |

The incremental change in net value is positive, however, the net value of the combination remains less than the maximum net value achieved by implementation of 99 alone.

Conclusion

The conclusion is that if SAMA 99 is to be implemented, SAMA 91 would become not cost beneficial to implement. For planning purposes, it is not justified to implement SAMA 91 first and then SAMA 99 even though each individual step could be shown to be cost beneficial.

SAMA 91, 109 Combination: Combination A2

The following two SAMAs are investigated for synergies as Combination A2:

- SAMA 109 Availability of Portable DC Battery Charger
- SAMA 91 4160V AC Bus Cross-Tie

Investigation of these two SAMAs is to identify if there are overlaps in the benefits that might arise by performing the two modifications that would eliminate one of the SAMAs as cost beneficial.

A model developed for SAMA 109 was modified by including those changes developed to model SAMA 91. The results of this model, when compared to the baseline, show the benefits of SAMA 91 and SAMA 109 implemented in combination. The following table shows these results:

**Combination A2: SAMA Combination 109-91 Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.80E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 8.69E-06 | 2.57E-06 | 2.33E-06 | 7.40E-08 | 9.62E-07 | 1.46E-06 | 1.67E-09 | 5.31E-07 | 5.44E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 2.96E+01 | 6.42E-02 | 9.35E+00 | 1.09E-02 | 5.57E+00 | 6.14E+00 | 5.90E-03 | 4.21E+00 | 2.28E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 9.94E+04 | 2.55E+01 | 2.75E+04 | 8.95E+00 | 1.84E+04 | 1.86E+04 | 1.61E+01 | 2.00E+04 | 5.93E+03 | 7.91E+03 | 1.17E+03 |

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**Combination A2: SAMA Number 91 and 109 Net Value**

| Base Case: Cost-Risk[(1)] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $3,722,000 | $740,000 | $165,000 | $575,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

The net value for SAMA 109 alone is $599,000 (Section F.6.23). Therefore, implementation of SAMA 91, given implementation of SAMA 109, yields a reduction in Net Value of $24,000 ($575,000 – $599,000). Thus, there is no increase in net value calculated for implementation of SAMA 91 in combination with SAMA 109. In fact, the benefit of SAMA 91, is reduced significantly from $28,000 (Section F.6.11) to -$24,000, if SAMA 109 is also implemented. Thus, if SAMA 109 is implemented, SAMA 91 is no longer cost-beneficial.

See the table below that summarizes these results.

**Comparison of Combination 91 and 109 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 109 | Portable DC Battery Charger | $599,000 | -- |
| Combination 91 to 109 | Combined 91 to 109 | -- | $575,000 |
| Marginal Value associated with adding 91 to 109 | 4160V AC Cross-Tie | $575,000 - $599,000 = -$24,000 | |

The incremental change in net value is negative when SAMA 91 is subsequently added to SAMA 109.

<u>Reverse Sequence of Implementation for Combination A2</u>

This combination can also be examined assuming that SAMA 91 is implemented first. In that case, it is found that:

The net value for SAMA 91 alone is $28,000 (Section F.6.11). Therefore, implementation of SAMA 109, given implementation of SAMA 91, yields an additional benefit of $547,000 (i.e., $575,000 - $28,000). Thus, the benefit of SAMA 109, is reduced from $599,000 (Section F.6.23), but remains positive. (See table below.)

**Comparison of Combination 109 and 91 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 91 | 4160V AC Bus Cross-Tie | $28,000 | -- |
| Combination 109 to 91 | Combined 109 to 91 | -- | $575,000 |
| Marginal Value associated with adding 99 to 91 | Portable DC Battery Charger | $575,000 - $28,000 = $547,000 | |

The incremental change in net value due to the order of implementation is positive, however, for planning purposes the net value of implementing the combination is <u>less than</u> the maximum net value achieved by implementation of SAMA 109 alone.

Conclusion

The conclusion is that SAMA 109 is cost beneficial and if implemented, then SAMA 91 is not cost beneficial.

SAMA 99, 109 Combination: Combination A3

The following two SAMAs are investigated for synergies as Combination A3:

- SAMA 109 Availability of Portable DC Battery Charger
- SAMA 99 Local IC Operation, Shell Level Instrument

Investigation of these two SAMAs is to identify if there are overlaps in the benefits that might arise by performing the two modifications that would eliminate one of the SAMAs as cost beneficial.

A model developed for SAMA 109 was modified by including those changes developed to model SAMA 99. The results of this model, when compared to the baseline, show the benefits of SAMA 99 and SAMA 109 implemented in combination. The following table shows these results:

**Combination A3: SAMA Combination 109-99 Results By Release Category**

| Calculation Description | Total | Release Category | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.80E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 8.70E-06 | 2.59E-06 | 2.32E-06 | 6.23E-08 | 9.85E-07 | 1.45E-06 | 1.67E-09 | 5.41E-07 | 5.31E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 2.97E+01 | 6.47E-02 | 9.34E+00 | 9.21E-03 | 5.70E+00 | 6.08E+00 | 5.90E-03 | 4.29E+00 | 2.23E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 9.99E+04 | 2.57E+01 | 2.74E+04 | 7.53E+00 | 1.88E+04 | 1.84E+04 | 1.61E+01 | 2.04E+04 | 5.79E+03 | 7.91E+03 | 1.17E+03 |

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**Combination A3: SAMA Number 99 and 109 Net Value**

| Base Case: Cost-Risk[(1)] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $4,462,000 | $3,738,000 | $724,000 | $225,000 | $499,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

The net value for SAMA 109 alone is $599,000 (Section F.6.23). Therefore, implementation of SAMA 99, given implementation of SAMA 109, yields a reduction in Net Value of $100,000 ($499,000 – $599,000). Thus, the total net value of the combination is reduced significantly from $599,000. This is a -$100,000 incremental value. Thus, SAMA 99 becomes not cost-beneficial if SAMA 109 is implemented.

See the table below that summarizes these results.

**Comparison of Combination 99 and 109 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 109 | Portable DC Battery Charger | $599,000 | -- |
| Combination 99 to 109 | Combined 99 to 109 | $524,000 | $499,000 |
| Marginal Value associated with adding 99 to 109 | Local IC Operation, Shell Level Instrument | -- | -100,000 |

The incremental change in net value is negative when SAMA 99 is subsequently added to SAMA 109 implementation.

Reverse Sequence of Implementation for Combination A3

This combination can also be examined assuming that SAMA 99 is implemented first. In that case, it is found that:

The net value for SAMA 99 alone is $524,000 (Section F.6.15). Therefore, implementation of SAMA 109, given implementation of SAMA 99, yields a reduction in net value of $25,000 (i.e., $499,000 - $524,000). Thus, the benefit of SAMA 109, is reduced significantly from $599,000.

**Comparison of Combination 109 and 99 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 99 | Local IC Operation, Shell Level Instrument | $524,000 | $ |
| Combination 99 to 109 | Combined 109 to 99 | $599,000 | $499,000 |
| Marginal Value associated with adding 109 to 99 | Portable DC Battery Charger | -- | -$25,000 |

The incremental change of the net value is negative when SAMA 109 is subsequently added to SAMA 99 implementation.

Conclusion

The conclusion is that only one of these SAMAs is cost beneficial to implement. The highest individual net value is calculated for SAMA 109.

SAMA 130, 134 Combination: Combination A4

The following two SAMAs are investigated for synergies as Combination A4:

- SAMA 130 Protect Combustion Turbines
- SAMA 134 Upgrade Fire Pump House Structural Integrity

Investigation of these two SAMAs is to identify if there are overlaps in the benefits that might arise by performing the two modifications that would eliminate one of the SAMAs as cost beneficial.

A model developed for SAMA 130 was modified by including those changes developed to model SAMA 134. The results of this model, when compared to the baseline, show the benefits of SAMA 130 and SAMA 134 implemented in combination. The following table shows these results:

**Combination A4: SAMA Combination 130-134 Results By Release Category**

| Rel. Cat. | CDF | Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.80E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. | 7.26E-06 | 2.12E-06 | 1.66E-06 | 1.95E-07 | 4.75E-07 | 1.64E-06 | 1.67E-09 | 3.08E-07 | 6.34E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Dose-Risk | 2.35E+01 | 5.30E-02 | 6.69E+00 | 2.88E-02 | 2.75E+00 | 6.90E+00 | 5.90E-03 | 2.44E+00 | 2.66E+00 | 1.58E+00 | 4.01E-01 |
| SAMA OECR | 7.72E+04 | 2.10E+01 | 1.96E+04 | 2.36E+01 | 9.07E+03 | 2.09E+04 | 1.61E+01 | 1.16E+04 | 6.91E+03 | 7.91E+03 | 1.17E+03 |

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**Combination A4: SAMA Number 130 and 134 Net Value**

| Base Case: Cost-Risk[1] for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation | Net Value |
|---|---|---|---|---|
| $2,231,000 | $1,466,000 | $765,000 | $750,000 | $15,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

The net value for SAMA 130 alone is $147,000 (Section F.6.33). Therefore, implementation of SAMA 134, given implementation of SAMA 130, yields reduction in net value of $132,000 ($15,000 - $147,000). Thus, there is no net benefit calculated for implementation of SAMA 134 in combination with SAMA 130.

See the table below that summarizes these results.

**Comparison of Combination 130 and 134 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 130 | Protect Combustion Turbines | $147,000 | -- |
| Combination 130 with 134 | Combined 134 to 130 | $288,000 | $15,000 |
| Marginal Value associated with adding 134 to 130 | Upgrade Fire Pump House Structural Integrity | -- | -$132,000 |

Reverse Sequence of Implementation for Combination A4

This combination can also be examined assuming that SAMA 134 is implemented first. In that case, it is found that the net value for SAMA 134 alone is $288,000 (Section F.6.36). Therefore, implementation of SAMA 130, given implementation of SAMA 134, yields a reduction in net value of -$273,000 ($15,000 - $288,000).

**Comparison of Combination 134 and 130 Net Value with Individual Net Value Assessment**

| SAMA | Description | Individual Net Value | Combination Net Value |
|---|---|---|---|
| 134 | Upgrade Fire Pump House Structural Integrity | $288,000 | -- |
| Combination 134 with 130 | Combined 130 to 134 | $147,000 | $15,000 |
| Marginal Benefit associated with adding 130 to 134 | Protect Combustion Turbines | -- | -$273,000 |

Conclusion

These two SAMAs address the same accident sequences (i.e., risk contributors); therefore, they are mutually exclusive in terms of the potential benefit to be derived. The SAMA with the highest net value of the pair is SAMA 134 – Upgrade the Fire Pump House Structural Integrity.

### F.6.39.2 Synergies Among Non-Cost-Beneficial SAMAs

The impact of implementation for each individual Phase II SAMA is documented in Table F-16. However, some combinations of SAMAs may act synergistically to yield a combined risk reduction greater than the individual components.

A reasonable attempt at identifying such synergistic combinations of SAMAs for the purpose of evaluating the overall cost-benefit is a desirable step. It is judged that the most likely synergistic effect that will prove cost beneficial are combinations of those SAMAs that are already close to cost effective, i.e., have net values of between $0 and -$50,000. The first step in this assessment is to collect all the "marginally non-cost-beneficial" SAMAs. For this purpose, marginal SAMAs are those within $50,000 of being cost neutral (i.e., Net Value > -$50,000). This grouping resulted in the following eight SAMAs being selected for assessment in combination as a group of SAMAs.

| SAMA No. | Description | Averted Cost-Risk ($) | Cost ($) | Net Value ($) |
|---|---|---|---|---|
| 25 | Bypass Low Pressure Permissive | 4,000 | 50,000 | -46,000 |
| 88 | Containment Vent | -- | 50,000 | -50,000 |
| 89 | Improve Procedure for Aligning SDC with High DW Pressure | -- | 50,000 | -50,000 |
| 94 | Increase Success Probability for Fire Protection Alignment | -- | 50,000 | -50,000 |
| 101 | Provide A Procedure For Determining RPV Level Using Fuel Zone Level Indicators A and C With SLC Operating | -- | 50,000 | -50,000 |
| 102 | Revise ATWS EOP to provide RPV Level Correction Based on Power | -- | 50,000 | -50,000 |
| 106 | Provide Direction for Cooldown in Loss of RBCCW | 34,000 | 50,000 | -16,000 |
| 132 | Reduce Probability of Multi-CT Operation | 46,000 | 50,000 | -4,000 |

SAMA 95 is not included as it is not considered to have any measurable risk reduction benefit.

Combination B1

In order to assess this combination of SAMAs, a separate model was developed. The base model, OC-LEV2.caf, was adjusted to include the changes necessary to capture each of the "marginal" SAMAs listed above. The following table shows the results of this quantification.

**Combination B1: Marginal SAMA Results by Release Category**

| Calculation Description | Total | Release Category: Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.48E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.02E-05 | 2.64E-06 | 3.28E-06 | 1.95E-07 | 9.45E-07 | 1.65E-06 | 1.65E-09 | 5.29E-07 | 7.74E-07 | 2.07E-07 | 3.05E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.51E+01 | 6.61E-02 | 1.32E+01 | 2.89E-02 | 5.47E+00 | 6.95E+00 | 5.82E-03 | 4.19E+00 | 3.24E+00 | 1.56E+00 | 3.79E-1 |
| SAMA OECR ($/yr.) | 1.15E+05 | 2.62E+1 | 3.87E+04 | 2.36E+01 | 1.80E+04 | 2.10E+04 | 1.59E+01 | 1.99E+04 | 8.44E+03 | 7.80E+03 | 1.11E+03 |

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**Combination B1 - MARGINAL SAMA Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation(1) | Net Value(2) |
|---|---|---|---|---|
| $4,462,000 | $4,348,000 | $114,000 | $400,000 | -$286,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

This represents the combined implementation of eight otherwise non-cost-beneficial SAMAs.

Combination B2

In order to further assess the potential synergies of otherwise non-cost-beneficial SAMAs, a separate model was developed to evaluate three particular marginal SAMAs implemented in combination. The base model, OC-LEV2.caf, was adjusted to include the changes necessary to the combination of SAMA 25,106, and 132.

| SAMA No. | Description | Averted Cost-Risk ($) | Cost ($) | Net Value ($) |
|---|---|---|---|---|
| 25 | Bypass low pressure permission | 4,000 | 50,000 | -46,000 |
| 106 | Provide direction for cooldown in loss of RBCCW | 34,000 | 50,000 | -16,000 |
| 132 | Reduce probability of Multi-CT operation | 46,000 | 50,000 | -4,000 |

The following table shows the results of this quantification.

(1) The cost of implementation is based on the sum of all costs associated with the individual SAMAs. Dependent on the sequence of implementation. Refer to item D for the combination effectiveness.
(2) The net value is calculated based on a $100,000 cost of implementation.

**Combination B2: Marginal SAMA 25,106,132 Results By Release Category**

| Calculation Description | Total | Release Category: Intact | L-LL/E, L-LL/I | L-LL/L | M/E | M/I | M/L | H/E | H/I | H/L | BOC |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Baseline Freq. (per yr.) | 1.05E-05 | 2.71E-06 | 3.38E-06 | 1.96E-07 | 9.99E-07 | 1.66E-06 | 1.67E-09 | 5.80E-07 | 7.86E-07 | 2.10E-07 | 3.23E-08 |
| SAMA Freq. (per yr.) | 1.03E-05 | 2.66E-06 | 3.28E-06 | 1.96E-07 | 9.61E-07 | 1.65E-06 | 1.65E-09 | 5.29E-07 | 7.74E-07 | 2.08E-07 | 3.23E-08 |
| SAMA Dose-Risk (Person Rem/yr.) | 3.52E+01 | 6.65E-02 | 1.32E+01 | 2.90E-02 | 5.57E+00 | 6.95E+00 | 5.82E-03 | 4.20E+00 | 3.24E+00 | 1.56E+00 | 4.01E-01 |
| SAMA OECR ($/yr.) | 1.16E+05 | 2.64E+01 | 3.87E+04 | 2.37E+01 | 1.84E+04 | 2.10E+04 | 1.59E+01 | 2.00E+04 | 8.44E+03 | 7.80E+03 | 1.17E+03 |

This information was used as input to the cost benefit calculation. The results of this calculation are provided in the following table:

**Combination B2: Marginal SAMA 25,106,132 SAMA Net Value**

| Base Case: Cost-Risk(1) for Oyster Creek (site) | Cost-Risk for Oyster Creek With SAMA Changes | Averted Cost-Risk | Cost of Implementation(1) | Net Value(2) |
|---|---|---|---|---|
| $4,462,000 | $4,378,000 | $84,000 | $150,000 | -$66,000 |

(1) Present Value Cost-Risk. The derivation of the present value cost-risk includes the OECR plus the other contributors to cost-risk described in Section F.3.

This represents the combined implementation of these three selected, but otherwise non-cost-beneficial SAMAs.

(1) The cost of implementation is based on the sum of all costs associated with the individual SAMAs.
(2) The net value is calculated based on a $100,000 cost of implementation.

### F.6.39.3 Summary of Combinations

There are individual SAMAs that are cost beneficial. When these cost beneficial SAMAs are combined with other cost beneficial SAMAs, there may be some loss in net benefit, i.e., shadowing effect. The following table summarizes the net value for the combinations investigated in Section F.6.39.1:

**Summary of Cost Beneficial SAMAs**

| SAMA Combination | SAMAs Included | Averted Cost-Risk ($) | Cost of Implementation ($) | Net Value ($) |
|---|---|---|---|---|
| A1 | 91, 99 | 740,000 | 240,000 | 500,000 |
| A2 | 91, 109 | 740,000 | 165,000 | 575,000 |
| A3 | 99, 109 | 724,000 | 225,000 | 499,000 |
| A4 | 130, 134 | 765,000 | 750,000 | 15,000 |

While each of the Combinations A1 through A4 can be shown to be cost beneficial individually, this is not an optimum strategy. The maximum net value is achieved by implementing selected SAMAs. Then, the residual SAMAs will not be cost beneficial.

The conclusions from the analysis are as follows:

| SAMA Combination | Optimum Action from Assessed Net Value |
|---|---|
| A1 | Implement 99; Do not implement 91 |
| A2 | Implement 109; Do not implement 91 |
| A3 | Implement 109; Select 109 over 99 |
| A4 | Implement 134; Do not implement 130 |

The priority for SAMA implementation based on the individual maximum net value and the conclusions from the above assessed combinations is as follows: (1) 109; (2) 134; (3) 125B; and, (4) 127.

In addition to the assessment of SAMAs that are individually cost beneficial in Section F.6.39.1, the Section F.6.39.2 examined combinations of SAMAs that are not cost beneficial on an individual basis. The results for combinations of individual non-cost beneficial SAMAs evaluated in Section F.6.39.2 are presented in the following table.

**Summary of SAMA Combinations**

| SAMA Combination | SAMAs Included | Averted Cost-Risk ($) | Cost of Implementation ($) | Net Value ($) |
|---|---|---|---|---|
| B1 | Eight SAMAs: 25, 88, 89, 94, 101, 102, 106, 132 | 114,000 | 400,000 | -286,000 |
| B2 | Three SAMAs: 25, 106, 132 | 64,000 | 150,000 | -66,000 |

This summary table shows that the combinations of individual SAMAs, that were (1) found to be not cost beneficial, and (2) were judged to have the highest potential for a cost beneficial synergy, resulted in <u>not</u> being cost beneficial.

### F.6.40 PHASE II SAMA ANALYSIS SUMMARY

The SAMA candidates which could not be eliminated from consideration by the Phase I baseline screening process or other PRA insights required the performance of a detailed analysis of the averted cost-risk and SAMA implementation costs. SAMA candidates are potentially justified only if the averted cost-risk resulting from the modification is greater than the cost of implementing the SAMA. Several of the SAMAs analyzed were found to be cost-beneficial as defined by the methodology used in this study. However, this evaluation should not necessarily be considered a definitive guide in determining the disposition of a plant modification that has been analyzed using other engineering methods. These results are intended to provide information about the relative estimated risk benefit associated with a plant change or modification compared with its cost of implementation and should be used as an aid in the decision-making process.

Table F-19 summarizes the results of the Phase II best estimate SAMA evaluation of individual SAMAs. Table F-19 provides the following information for each Phase II SAMA considered independently:

- The SAMA Number
- The Averted Cost-Risk
- The Cost of Implementation
- The Net Value
- The determination of whether the SAMA is cost beneficial based on this best estimate assessment

**Table F-19. Summary of the Detailed Phase II SAMA Analyses**

| Phase II SAMA ID | Averted Cost-Risk | Cost of Implementation | Net Value | Cost Beneficial?(5) |
|---|---|---|---|---|
| SAMA 7 | $174,000 | $500,000 | -$326,000 | no |
| SAMA 10 | $788,000 | $1,000,000 | -$212,000 | no |
| SAMA 18 | $8,000 | $265,000 | -$257,000 | no |
| SAMA 20 | $4,000 | $400,000 | -$396,000 | no |
| SAMA 23 | $42,000 | $150,000 | -$108,000 | no |
| SAMA 25 | $4,000 | $50,000 | -$46,000 | no |
| SAMA 67 | $65,000 | $1,000,000 | -$935,000 | no |
| SAMA 84 | $80,000 | $150,000 | -$70,000 | no |
| SAMA 88 | $0 | $50,000 | -$50,000 | no |
| SAMA 89 | (1) | $50,000 | (1) | no |
| SAMA 91 | $118,000 | $90,000 | +$28,000 | yes |
| SAMA 92 | $36,000 | $100,000 | -$64,000 | no |
| SAMA 94 | $0 | $50,000 | -$50,000 | no |
| SAMA 95 | (2) | $50,000 | (2) | no |
| SAMA 99 | $674,000 | $150,000 | +$524,000 | yes |
| SAMA 100 | $146,000 | $500,000 | -$354,000 | no |
| SAMA 101 | $0 | $50,000 | -$50,000 | no |
| SAMA 102 | $0 | $100,000 | -$100,000 | no |
| SAMA 104 | $44,000 | $250,000 | -$206,000 | no |
| SAMA 106 | $34,000 | $50,000 | -$16,000 | no |
| SAMA 107 | $0 | $150,000 | -$150,000 | no |
| SAMA 108 | (1) | ~$500,000 (est.) | (1) | no |
| SAMA 109 | $674,000 | $75,000 | +$599,000 | yes |
| SAMA 110 | (1) | ~$75,000 | (1) | no |
| SAMA 111 | (1) | $500,000 | (1) | no |
| SAMA 112 | $8,000 | $1,000,000 | -$992,000 | no |
| SAMA 124 | $84,000 | $150,000 | -$66,000 | no |
| SAMA 125B | $333,000 | $100,000 | +$233,000 | yes |
| SAMA 125C | $397,000 | $750,000 | -$353,000 | no |
| SAMA 127 | (4) | (4) | (4) | yes |
| SAMA 128 | $20,000 | $200,000 | -$180,000 | no |
| SAMA 129 | $56,000 | $100,000 | -$44,000 | no |
| SAMA 130 | $747,000 | $600,000 | +$147,000 | yes |
| SAMA 132 | $46,000 | $50,000 | -$4,000 | no |
| SAMA 133 | $72,000 | $250,000 | -$178,000 | no |
| SAMA 134 | $438,000 | $150,000 | +$288,000 | yes |
| SAMA 136 | $0 | $100,000 | -$100,000 | no |
| SAMA 138 | $446,000 | $780,000 | -$334,000 | no |

Notes to Table F-19:

(1) Based on the small reduction in CDF, the SAMA is considered not cost beneficial and no cost benefit calculation is performed.

(2) No risk reduction benefit results; therefore, the SAMA is considered not cost beneficial.

(3) Averted cost-risk is considered negligible; therefore, no cost benefit is calculated and the SAMA is not cost beneficial.

(4) SAMA 127 recommends increased operator training on the importance of PRA identified key systems and operator actions and is deemed cost beneficial. SAMA 127 is considered one that is important to implement even though a specific net value is not identified.

(5) There is a potential interaction between these SAMAs. As pointed out in Section F.6.39, it is found that certain of the cost beneficial SAMAs have "shadowing" effects on other SAMAs, such that, when they are implemented the other SAMAs become significantly less important.

# F.7 Sensitivity Analysis

The decision regarding the cost-beneficial aspects of a candidate SAMA has traditionally been made on a best estimate basis. The previous section of Appendix F has described these best estimates for both cost-risk and implementation cost. However, in addition to this perspective, the decision-maker may also glean some insights from reasonable variations in key assumptions[1] used in the development of the cost-risk. This section examines two of the variables that represent key inputs to the cost-risk evaluation.

The following two sensitivities are investigated as to their impact on the overall SAMA evaluation for use as input to the decision-makers:

- Assume a real discount rate of 3 percent, instead of 7 percent used in the original base case present value analysis of the cost-risk analysis.
- Use the 95$^{th}$ percentile PRA results in place of the mean PRA results.

These two sensitivities both bias the net value high, that is, examine the potential to increase the net value of performing a SAMA. No sensitivities are presented here that decease the net value.

The Phase I SAMA list of Table F-15 was reviewed to determine if increases in averted costs associated with the sensitivities would impact the disposition of any SAMAs that were originally screened based on cost (i.e., Screening codes "C" and "F"). All other items from the Phase I screening were considered to remain screened because of: (1) competing risks; (2) not applicable to Oyster Creek; (3) already implemented at Oyster Creek; or (4) addressed by a similar SAMA. The investigation into the two types of sensitivities is documented in Table F.7-1. As a short cut to understanding and evaluating the sensitivities, it is noted that:

(1) the use of an RDR of 3% results in an increase in averted cost of a factor of 1.4

(2) the use of the 95% upper bound results in an increase in averted cost of approximately 2.5

Therefore, a screening can be performed using the factor of 2.5 increase to bound the maximum averted cost for each of the SAMAs. This value can then be compared with the individual SAMA costs to provide a conservative method of screening for both sensitivities. It is noted that Table F-15 is used in Section F.5 to describe the screening of SAMAs based on the MMACR. However, it is known from the calculations in Section F.6 that individual SAMAs have substantially less averted cost than the MMACR. Using this knowledge, in the sensitivity evaluation screening performed as part of Table F.7-1, the MMACR is not used, rather a conservative estimate of the specific SAMA impact on the averted cost is used. Table F.7-1 summarizes the results of this review. No items evaluated in Phase I for transfer to Phase II were changed based on the sensitivity screening in Table F.7-1.

[1] Section F.3.8 has provided parametric sensitivities with regard to MACCS2 inputs (such as population, evacuation time and speed, meteorology, release height).

### F.7.1 REAL DISCOUNT RATE

A sensitivity study has been performed in order to identify how the conclusions of the SAMA analysis might change based on the value assigned to the real discount rate (RDR). The baseline, best estimate RDR of 7 percent has been changed to 3 percent and the modified maximum averted cost-risk was recalculated using the methodology outlined in Section F.4. The Phase I screening was re-examined as described above to identify any SAMA candidates that could no longer be screened based on the premise that their costs of implementation exceeded all possible benefit. In addition, the Phase II analysis was re-performed using the 3 percent RDR.

Implementation of the 3 percent RDR increased the averted costs by approximately 38 percent compared with the case where a 7 percent RDR was used.

The Phase II SAMAs were reevaluated based on the more conservative real discount rate (RDR) of 3 percent to calculate the net values for the SAMAs. Table F.7-2 provides a summary of the Phase II SAMA evaluations for the two different RDR assumptions. The determination of cost effectiveness changed for one Phase II SAMA (SAMA 132) when the 3 percent RDR was used in lieu of a 7 percent RDR.

SAMA 132 is a procedure change that would eliminate the direction to secure CTs prior to restarting them in LOOP scenarios.

These insights confirm the robust nature of the best estimate evaluation. The change in SAMA 132 is not viewed as significant compared to other insights from this study but is included for decision-maker use in evaluating uncertainty impacts on the cost-benefit calculation.

## F.7.2 95TH PERCENTILE PRA RESULTS

The results of the SAMA analysis can be impacted by implementing conservative values from the PRA uncertainty distribution. If the best estimate failure probability values are consistently lower than the "actual" failure probabilities, the PRA model would underestimate plant risk and yield lower than "actual" averted cost-risk values for potential SAMAs. Re-assessing the cost benefit calculations using the high end of the failure probability distribution is a means of

equipment and operator actions included in the PRA model.

The 95th percentile core damage frequency (CDF) results are estimated for Oyster Creek for use in the reassessment. It is assumed that the factor by which the 95th percentile CDF results exceed the point estimate CDF is similar for many industry PRA models. While the degree of incorporation of plant specific data varies from plant to plant, the use of a similar generic database and the methods used to incorporate plant specific data are becoming more standardized. As a result, the characteristics of data uncertainties should be trending toward conformity.

The following is a summary of the point estimate CDF and 95th percentile CDFs for three SAMA submittals:

| Plant | Point Estimate CDF | 95th Percentile CDF | Factor by Which the 95th Percentile Results are Greater than the Point Estimates |
|---|---|---|---|
| V.C. Summer | $5.59 \times 10^{-5}$/yr | $1.32 \times 10^{-4}$/yr | 2.36 |
| Robinson | $4.32 \times 10^{-5}$/yr | $1.06 \times 10^{-4}$/yr | 2.45 |
| Brunswick | $4.19 \times 10^{-5}$/yr | $9.83 \times 10^{-5}$/yr | 2.35 |

For the plants identified above, the 95th percentile CDF is between 2.35 and 2.45 times greater than the point estimate CDF. A factor of 2.5 is greater than the other industry examples and is judged acceptable for identifying the impact of data uncertainty on the Oyster Creek SAMAs.

### *PHASE I IMPACT*

For Phase I screening, use of the 95th percentile CDF results will increase the modified maximum averted cost-risk and may prevent the screening of some of the higher cost modifications. However, the impact on the overall SAMA results due to the retention of the higher cost SAMAs for Phase II analysis is small. This is due to the fact that the benefit gleaned from the implementation of those SAMAs must be extremely large in order to be cost beneficial.

The impact of uncertainty in the PRA results on the Phase I SAMA analysis is examined as described above and reported in Table F.7-1.

As discussed above, the 95th percentile CDF results are assessed to be a factor of 2.5 greater than the point estimate CDF. For Oyster Creek, this corresponds to a CDF at the 95th percentile of 2.63E-5/yr. The dose-risk and offsite economic cost-risk are also increased by a factor of 2.5 to simulate the increase in the CDF resulting from the use of the 95th percentile CDF.

The Phase I SAMA list of Table F-15 has been re-examined using the revised modified maximum averted cost-risk to assess the impact of this set of assumptions. Table F.7-1 summarizes the results of this review[1]. No items evaluated in Phase I for transfer to Phase II were changed based on the sensitivity screening documented in Table F.7-1.

### *PHASE II IMPACT*

The 95th percentile results have been represented by increasing the base dose-risk and offsite economic cost-risk in proportion to the Level 1 results. The factor of 2.5 is also assumed to propagate through the results for the model runs performed for the Phase II detailed calculations. This means that the averted cost-risks for each case will be increased by the same factor.

Table F.7-3 provides a summary of the impact of using the 95th percentile CDF results in the detailed cost benefit calculations that have been performed as part of Phase II.

When the 95th percentile CDF results are used, seven of the Phase II SAMAs that were previously classified as "not cost beneficial", using a realistic assessment of risk, are determined to be cost beneficial. Table F.7-4 summarizes these seven SAMAs. However, the use of the 95th percentile PRA results is not considered to provide the most realistic assessment of the cost effectiveness of a SAMA. Nevertheless, this information is included for decision-maker use in evaluating the impact of uncertainties.

The $750,000 cable rerouting based option for fire mitigation would be cost-beneficial under the 95th percentile sensitivity as it is structured. This option is discussed as case 125 C in Section F.6.28. With an averted cost of $397,000 and an implementation cost of $750,000, the option would become cost-beneficial if the averted cost were multiplied by 2.5 as per the 95th percentile case. This option would not be considered cost beneficial under the conditions that are applied to the 3% RDR sensitivity. This option is not highlighted further in this section because, as noted in Section F.6.28, the cost of rerouting cables has been conservatively estimated and it is not considered likely that this improvement would be ultimately cost-beneficial using a more detailed cost estimate.

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(1) The investigation into the two types of sensitivities is documented in Table F.7-1. As a short cut to understanding and evaluating the sensitivities, it is noted that:

(1) The use of an RDR of 3% results in an increase in averted cost of a factor of 1.4
(2) The use of the 95% upper bound results in an increase in averted cost of approximately 2.5

Therefore, a screening can be performed using the factor of 2.5 increase to bound the maximum averted cost for each of the SAMAs. This value can then be compared with the individual SAMA costs to provide a conservative method of screening for <u>both</u> sensitivities.

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95$^{th}$ Upper Bound Sensitivities[(1), (2), (3)]

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 2 | Additional HP Injection System | An additional high pressure injection system would increase high pressure injection diversity and reduce the probability of requiring RPV depressurization early in an accident. An additional HP injection system would also impact the contribution of liner melt-through sequences in the Level 2 evaluation by reducing the frequency of high pressure core melt accident class. The benefit of this SAMA would be increased if the pump was 1) diesel powered, 2) could provide power to operate its own injection valves, and 3) be located in a flood safe zone. | F, I –Installation of another high pressure injection system is costly and is not offset by benefits. Benefits associated with an additional high pressure injection source are minimized by the Oyster Creek features of IC and CRD. IC is a passive high pressure inventory control method and the Oyster Creek CRD includes a dedicated bypass line that allows significant flow. SAMA improvement related to CRD is included in Item 92. Improving CRD flow would provide an additional high pressure injection system for scenarios wherein CRD is not currently credited.<br><br>Cost of a self-powered, high pressure injection system, located in a separate fire and flood zone is expected to cost $10,000,000. This is in excess of the maximum averted cost. | As a sensitivity, the base model was requantified after modifying logic to "AND" a new basic event with feedwater. This basic event is intended to represent a new high pressure injection system, with no support system requirements. The value was set equal to 5E-2. The resultant CDF was 7.34E-6/yr for a delta CDF of 3.15E-6/yr.<br><br>This benefit (CDF reduction) is similar in magnitude to that of SAMA 130. SAMA 130 yields an averted cost of $747,000. Using this averted cost as a surrogate to estimate the benefit of SAMA 2 and multiplying this by a factor of 2.5, to bound both the RDR and 95$^{th}$ sensitivities, a value that is still far below the implementation cost is obtained (i.e., $1,867,500 versus $10,000,000). Therefore, this SAMA remains not cost beneficial despite the use of the conservatively biased sensitivity inputs. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 3 | Enhance Depressurization and Injection Cues | RPV depressurization, while a reliable action, is an important contributor to plant risk. The cognitive portion of this action is specifically identified as an important contributor for another BWR. Potential means of improving the probability of identifying the need for depressurization include: adding a unique audible alarm and/or a highly visible alarm light to denote the need for depressurization. Installation of a large, graphical core display for water level is an additional enhancement. | F – Monticello estimated the cost of this modification to be about $700,000. This is the result of combining the costs of performing the training/procedural changes and the required hardware changes. Procedural changes are generally on the order of $50,000 to $100,000 [F-20] and the hardware costs are estimated based on the $600,000 cost of installing computer aided instrumentation in the main control room. This will not significantly reduce operator error rate as annunicators are currently in place and improvement potential is minimal. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because the potential for improvement over the current capabilities is negligible. |
| 6 | Drywell Igniters or Passive Hydrogen Ignition System | This SAMA would provide a means to reduce the chance of hydrogen detonation. | F - Benefit is negligible because Oyster Creek containment operates with an inerted environment. Therefore, for inerted containments, such as the Oyster Creek Mark I containment, the NRC has previously concluded that igniters are not safety significant. The Calvert Cliffs application for license renewal [F-3] estimates the cost of a passive hydrogen ignition system to be $760,000. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because the potential for improvement over the current capabilities is negligible. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 8 | Additional DFP for Fire Service Water System | An additional diesel fire pump would provide another source of water for RPV injection and containment spray. This could be achieved through the implementation of a procedure to direct the pressurization of the Fire Protection system using a fire truck. | D – Oyster Creek currently has 1 electric and 2 diesel fire pumps. The electric pump is powered from normal AC power and uses a tank with limited volume. The two-diesel fire pumps are located outside the protected area in a standard metal sided building with concrete foundation.<br><br>F – Addition of a third diesel fire pump is judged to have exceedingly small incremental benefit for RPV injection. This is because:<br>• OC has numerous injection sources<br>• Common-cause failure among the fire pumps dominates regardless if there are 2 or 3 pumps.<br><br>The containment spray enhancement is treated under SAMA 111. | As a sensitivity, the base model was requantified after modifying logic to "AND" a new basic event with the other fire pumps. This basic event is intended to represent a new diesel fire pump, with no support system requirements. The value was set equal to 5E-2. The resultant CDF was 1.05E-5/yr for a delta CDF of 1.91E-8/yr.<br><br>This benefit remains very small and clearly would yield a small averted cost. This SAMA is not cost-beneficial even if the benefit is multiplied by a factor of 2.5, or more. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 9 | Enhance, Test and Train on Alternate Boron Injection | Another BWR has the capability to use the RWCU and CRD systems to inject boron into the RPV; however, these alignments are not practiced. The RWCU alignment is not credited in the PRA model due to the length of time required for alignment. Changes to make these connections permanent and capable of being aligned from the MCR would improve their reliability. Additional training and practice of the alignments in the simulator and with mock-up test rigs would also improve alternate boron injection reliability. | I – Oyster Creek has a reliable SLC system and the proceduralized capability for two alternate injection pathways.<br><br>F - The cost of making the available options directly operable from the control room is expected to cost $4,000,000. This includes making the proceduralized hose connections of the alternate systems into hard pipe connections. The benefit is minimal because the RPS is reliable and the existing SLC system provides an adequately reliable backup. | As a sensitivity, the base model was requantified after modifying logic to "AND" a new basic event with the existing SLC hardware (I.e., Under Gate BIG00MEB). This basic event is intended to represent a new SLC train, with no support system requirements. The value was set equal to 5E-2. The resultant CDF was 1.04E-5/yr for a delta CDF of 7.87E-8/yr.<br><br>This benefit remains small and clearly would yield a small averted cost. This SAMA remains not cost-beneficial even if the benefit is multiplied by a factor of 2.5 or more. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**
Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for
RDR and $95^{th}$ Upper Bound Sensitivities[(1), (2), (3)]

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 14 | Post an Operator at the ASDS Panel Full Time | In the event that a fire in the Main Control Room requires evacuation to the ASDS panel, having a full time operator at the panel would allow for a more rapid transition to alternate reactor control. This is important for loss of injection cases where there is currently not enough time for the operators to evacuate the main control room and assume control at the ASDS panel (Class 1A). | C - The cost of implementation for this SAMA is based on an estimated base salary and the cost of benefits for 5 additional licensed operators. Five operators are justified considering that personnel are required to cover all shifts, 7 days a week and that 20 percent of operator time is spent in training. Assuming that an operator's salary and benefits cost $100,000 per year and that the panel will be manned for the 20 year license renewal period, the cost of implementation would be $10 million, not including raises. This cost is above the maximum averted cost for Oyster Creek. | The benefit of this SAMA is difficult to quantify because it intends to improve an already excellent operating capability. A complete reduction in Class IA events would produce a delta CDF of 2.46E-6/yr.<br><br>This level of risk-reduction is less than that noted for SAMA 130. SAMA 130 yields an averted cost of $747,000. Using this averted cost as a surrogate to estimate the benefit of SAMA 14 and multiplying this by a factor of 2.5, to bound both the RDR and $95^{th}$ sensitivities, a value that is still far below the implementation cost is obtained (i.e., $1,867,500 versus $10,000,000). Therefore, this SAMA remains not cost beneficial despite the use of the conservatively biased sensitivity inputs. |
| 32 | Use fuel cells instead of lead-acid batteries. | SAMA would extend DC power availability in an SBO. | I, F – Oyster Creek has diverse battery design presently. The system is already reliable. Evaluation of a portable DC charger is viewed as more beneficial. See Item 109. Also, note that the fuel cell option is new technology, never used in such a manner. It is judged expensive. A small, engine driven charger is considered a more cost-efficient and proven approach. | Due to competing risks and the availability of a more conventional option (i.e., SAMA 109), this SAMA is not considered cost-beneficial. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 44 | Install an independent method of suppression pool cooling. | This SAMA would decrease the probability of loss of containment heat removal. | F – IC provides an alternate method of DHR that eliminates heat discharge to the torus for non-LOCA scenarios. Development of another means beyond containment spray is viewed as limited benefit compared to a high cost for such a modification. An independent system is judged to cost $5,000,000. This is in excess of the maximum averted cost. | A complete reduction in Class II events would produce a delta CDF of 1.65E-6/yr.<br><br>This level of risk-reduction is less than that noted for SAMA 130. SAMA 130 yields an averted cost of $747,000. Using this averted cost as a surrogate to estimate the benefit of SAMA 44 and multiplying this by a factor of 2.5, to bound both the RDR and 95th sensitivities, a value that is still far below the implementation cost is obtained (i.e., $1,867,500 versus $5,000,000). Therefore, this SAMA remains not cost beneficial despite the use of the conservatively biased sensitivity inputs. |
| 45 | Install a filtered containment vent to remove decay heat. | This SAMA would provide an alternate decay heat removal method for non-ATWS events, with the released fission products being scrubbed.<br>Option 1: Gravel Bed Filter<br>Option 2: Multiple Venturi Scrubber | F – Cost is high at > $4M as assessed for Shoreham. The benefits in dose reduction are limited because of the Mark I shell failure mode and ATWS challenges that would fail containment.<br><br>SAMA would not address core damage and does not address Noble gas release. This was not found cost-beneficial for Peach Bottom. Estimated to cost in excess of the maximum averted cost. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because the potential for improvement over the current capabilities is small. Considering the high cost, the small variations in quantification characterization do not point to altering the conclusion for this SAMA. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 46 | Install a containment vent large enough to remove ATWS decay heat. | Assuming that injection is available, this SAMA would provide alternate decay heat removal in an ATWS event. | F – Cost is high and benefits, in terms of dose reduction, are limited because of the small ATWS contribution to the risk profile. Containment vent size is sufficient to prevent containment failure as long as reactivity management tasks are completed as modeled in the PRA (i.e., RPV level control and SLC initiation). ATWS power levels without reactivity control would be in the range of 10% to 40% of full power. This requires a substantially larger containment vent than the current hard pipe vent. To achieve an operational "ATWS Vent" of hard pipe configuration and adequate size is estimated to cost in excess of $2M. This is above the benefit to be achieved for elimination of the small ATWS contribution to risk at Oyster Creek. | Completely removing the ATWS contribution would lead to a delta CDF of 1.81E-7/yr. This level of benefit does not lead to any significant averted cost for this SAMA even if it could completely eliminate all ATWS risk.<br><br>Therefore, the implementation cost far outweighs the small averted cost and the SAMA is not cost beneficial even for these conservatively biased assumptions. |
| 48 | Install a passive containment spray system. | This SAMA would provide redundant containment spray method without high cost. | F – High cost modification. Gravity feed system would provide limited benefit beyond that considered in Item 111 and would likely increase internal flooding risk. | Due to competing risks and the availability of a more conventional option (i.e., SAMA 111), this SAMA is not considered cost-beneficial. |
| 49 | Construct a building to be connected to primary/secondary containment that is maintained at a vacuum. | This SAMA would provide a method to depressurize containment and reduce fission product release. | C – This item is viewed as having a very large cost (> $10 Million) and is well beyond the maximum averted cost for Oyster Creek. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because the potential for improvement over the current capabilities is small. Considering the high cost, variations in quantification assumptions do not point to altering the conclusion for this SAMA. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities[(1), (2), (3)]

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 51 | Provide an additional diesel generator. | This SAMA would increase the reliability and availability of onsite emergency AC power sources. | C – Cost of an additional building and diesel is estimated at more than $5M. This is greater than the maximum cost averted benefit. | The EDGs have a risk reduction worth (RRW) importance of 1.14. This suggests a potential delta CDF of 1.47E-6/yr (1.05E-5*(1.14-1)). This level of risk-reduction is less than that noted for SAMA 130. SAMA 130 yields an averted cost of $747,000. Using this averted cost as a surrogate to estimate the benefit of SAMA 51 and multiplying this by a factor of 2.5, to bound both the RDR and 95th sensitivities, a value that is still far below the implementation cost is remains not cost beneficial despite the use of the conservatively biased sensitivity inputs. |
| 62 | Modify Reactor Water Cleanup (RWCU) for use as a decay heat proceduralize use. | This SAMA would provide an additional source of decay heat removal. | C – The RWCU system is currently proceduralized and used "as is" to provide decay heat removal over a portion of the spectrum of shutdowns. However, the RWCU system has very small heat removal capability and therefore, does not have the capability to provide a significant benefit.<br><br>No options for significant capacity improvement have been identified that would cost less than $4M. | A complete reduction in Class II events would produce a delta CDF of 1.65E-6/yr. This level of risk-reduction is less than that noted for SAMA 130. SAMA 130 yields an averted cost of $747,000. Using this averted cost as a surrogate to estimate the benefit of SAMA 62 and multiplying this by a factor of 2.5, to bound both the RDR and 95th sensitivities, a value that is still far below the implementation cost is obtained (i.e., $1,867,500 versus $4,000,000). Therefore, this SAMA remains not cost beneficial despite the use of the conservatively biased sensitivity inputs. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95$^{th}$ Upper Bound Sensitivities[(1), (2), (3)]

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 65 | Suppression Pool Jockey Pump | This SAMA will improve prevention of core melt sequences by providing a small makeup pump to provide low pressure decay heat removal from the RPV using the suppression pool as a source of water. | F – Not viewed as a significant benefit. The small pump with suction from the suppression pool could provide water to the RPV. The flow rate may be adequate to supply MRDIR flow dictated in the SAMGs but is not considered sufficient for the prevention of core damage. Support systems for the pump will govern its availability to fulfill this role. No measurable risk decrease is judged achievable. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because no measurable improvement was identified. Considering the high cost, variations in quantification assumptions do not point to altering the conclusion for this SAMA. |
| 68 | Improved Vacuum Breakers (redundant valves in each line) | This SAMA reduces the probability of a stuck open vacuum breaker. | F - Oyster Creek has 14 single torus to drywell vacuum breakers arranged in 7 parallel lines, which can impact vapor suppression. Adding valves in series is highly expensive and reduces the success probability for the open on demand function. Benefit impacts only low frequency accident sequences. Added redundancy has only minor impact on the risk profile. Cost estimated by system manager to be $2,000,000. | A complete reduction in Class III (i.e., LOCA) events would produce a delta CDF of 1.42E-6/yr. This level of risk-reduction is less than that noted for SAMA 130. SAMA 130 yields an averted cost of $747,000. Using this averted cost as a surrogate to estimate the benefit of SAMA 68 and multiplying this by a factor of 2.5, to bound both the RDR and 95$^{th}$ sensitivities, a value that is still below the implementation cost is obtained (i.e., $1,867,500 versus $2,000,000). Therefore, this SAMA remains not cost beneficial despite the use of the conservatively biased sensitivity inputs. |
| 69 | Improved MSIV Design | Replace MSIVs with improved design. | C – Replacing MSIVs is estimated by system manager to cost $10 million which is beyond the maximum averted cost. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because the potential for improvement over the current capabilities is small. Considering the high cost, variations in quantification assumptions do not point to altering the conclusion for this SAMA. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 70 | Steam Driven Turbine Generator | This SAMA would provide a steam driven turbine generator which uses reactor steam and exhausts to the suppression pool. If large enough, it could provide power to additional equipment. | C – Adding such a system is judged to require a new building and therefore, involves a cost greater than $10 million which is beyond the maximum averted cost. | Such as system would introduce competing risks such as high energy line breaks (HELB). While its benefits could be significant, the costs and competing risks are large enough that this SAMA cannot be recommended for further consideration. |
| 72 | Dedicated RHR (bunkered) Power Supply | Install new electric distribution subsystem. | C – There may be some benefit for security or seismic related challenges but the cost of implementation far exceeds the maximum averted cost. A bunkered power supply is judged to require a new building and involve a cost greater than $5 million.<br><br>While the IC is a decay heat removal system in addition to an inventory control system, it is not an RHR system. The IC can operate independent of all electric support. A portable battery charger would allow operators to utilize the ICs during a long-term loss of all AC electrical subsystems with higher reliability. Therefore, one alternative is judged to reside with the portable charger included as Item 109. | Due to high costs and the availability of a more conventional option (i.e., SAMA 109), this SAMA is not considered cost-beneficial. |
| 77 | Procedures for actions on loss of HVAC. | This SAMA would provide for improved credit to be taken for loss of HVAC sequences (improved affected electrical equipment reliability upon a loss of Control Building HVAC). | F – Oyster Creek has procedures for opening doors and installing portable fans as appropriate. No specific improvements have been identified. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because no measurable improvement was identified. Considering the limited benefit, variations in quantification assumptions do not point to altering the conclusion for this SAMA. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 79 | Use of CRD for alternate boron injection. | This SAMA provides an additional system to address ATWS with SLC failure or unavailability. | F – Alternate methods of boron injection already exist for Oyster Creek. Additional alternate systems would not provide a cost-beneficial option.<br><br>D – Oyster Creek has a reliable SLC system and the proceduralized capability for two alternate injection pathways.<br><br>C - The cost of making the available options directly operable from the control room is expected to cost $4,000,000. This includes making the proceduralized hose connections of the alternate systems hard pipe connections. The benefit is minimal because the RPS is reliable and the existing SLC system provides adequately reliable as a backup. | Completely removing the ATWS contribution would lead to a delta CDF of 1.81E-7/yr. This level of benefit does not lead to any reasonable level of cost-benefit for this SAMA even if it could completely eliminate all ATWS risk. |
| 80 | Improved drywell head bolts | Replace drywell head bolts with stronger material. | F - The Oyster Creek Drywell Head bolt failure mode is an insignificant contributor to containment failure at low temperatures (200 °F), but its contribution increases and becomes more significant as a function of temperature up to 800 °F. However, other important failure modes such as Mark I shell failure, penetrations, hatches, the pedestal, and RPV skirt at these temperatures are also via the Drywell. The presence of these other failure modes limits the benefit of the improved head bolts such that the benefit is judged to be outweighed by the cost of $250K. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because the potential for improvement over the current capabilities is small. Considering the high cost, variations in quantification assumptions do not point to altering the conclusion for this SAMA. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for
RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 103 | Modify fuel zone logic to provide RPV level correction based on power | Modify instrumentation to account for reactor power (See also Item 102) | F – More costly than Item 102 with similar benefit. See Item 102 for disposition.<br><br>(Note 102 found not to be cost beneficial.) | SAMA 102 analysis resulted in a negligible benefit. Since the benefit is exceedingly small, variations in quantification assumptions do not point<br><br>SAMA. |
| 105 | Improve loss of circulating water response | The plant could be modified to provide an auto-swap from circulating water to service water.<br><br>(See also Item 104) | F – More costly than Item 104 with similar benefit. See Item 104 for disposition. | SAMA 104 was not determined to be cost-beneficial under the RDR and 95th percentile cases documented in Tables F.7-1 and F.7-2. With a higher cost and similar benefit, this SAMA cannot be considered cost-beneficial under an set of analysis assumptions. |
| 115 | CT Battery Spacers | Consider the addition of battery spacers in the CT battery compartments. | F – CT Battery was reviewed in more detail and additional battery spacers were determined to represent a negligible benefit (RAI-2 7/26/2000) (LAR 88242.20) | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because no measurable improvement was identified. Considering the limited benefit, variations in quantification assumptions do not point to altering the conclusion for this SAMA. |

**Table F.7-1. Summary of Sensitivity Review of Phase I Screened SAMA**

Review of Items Screened Due to Cost (C) or Cost Exceed Benefit (F) for RDR and 95th Upper Bound Sensitivities(1), (2), (3)

| NO. | SAMA TITLE | SAMA DESCRIPTION | PHASE I DISPOSITION | SCREENING REVIEW |
|---|---|---|---|---|
| 135 | Increase structural integrity of IC makeup piping | The water supply to makeup to the Iso Condensers is neither safety related nor seismic. Upgrade of the Condensate Transfer System supply to the ICs would possibly increase their long term availability. | C – The Oyster Creek IPEEE analysis included IC performance during seismic events. Using the EPRI hazard curves, the IC contributed 4.97% to the overall CDF of 3.6E-6/yr. If the IC could be made perfect, it would reduce contribution by a value of 1.79E-7/yr (3.6E-6*4.87%). Considering such a modification is expected to cost at least $5,000,000, this option is considered not cost-beneficial. | The 1.79E-7/yr risk reduction discussed in the Phase I disposition is far less than that noted for SAMA 130. SAMA 130 yields an averted cost of $747,000. Using this averted cost as a surrogate to estimate the benefit of SAMA 135 and multiplying this by a factor of 2.5, to bound both the RDR and 95th sensitivities, a value that is still far below the implementation cost is obtained (i.e., $1,867,500 versus $5,000,000). Therefore, this SAMA remains not cost beneficial despite the use of the conservatively biased sensitivity inputs (i.e., $1,867,500 versus $5,000,000). |
| 137 | Create a crib house | Currently, some equipment related to the intake structure is exposed to the elements. Creating an expanded crib house may improve equipment reliability. | F – No specific reliability problems associated with environmental exposure of OC equipment have been identified. Such a structure is expected to cost $500,000. Since no quantifiable benefit exists, this item is not considered cost-beneficial. | Regardless of the assumptions used to assess the value of risk-reduction, this SAMA is not judged cost-beneficial because no measurable improvement was identified. Considering the limited benefit, variations in quantification assumptions do not point to altering the conclusion for this SAMA. |

Notes on Table F.7-1

(1) Table F.7-1 provides a Phase I re-review of those SAMAs that were screened in Section F.5 based on the best estimate evaluations of CDF and 7% RDR. The re-review focuses on SAMAs screened on Cost (C or F). The re-review includes an increase in the estimated averted cost for the SAMA compared with the estimated cost of implementation. It is noted that Table F-15 is used in Section F.5 to describe the screening of SAMAs based on the MMACR. However, it is known from the calculations in F.6 that individual SAMAs have substantially less averted cost then the MMACR. Using this knowledge in the sensitivity evaluation screening performed as part of Table F.7-1, the MMACR is not used, rather a conservative estimate of the specific SAMA impact on the averted cost is used.

(2) All other items from the Phase I screening were considered to remain screened because of: (1) competing risks; (2) not applicable to Oyster Creek; (3) already implemented at Oyster Creek; or (4) addressed by a similar SAMA.

(3) The impact of the sensitivities evaluated here is to increase the averted cost (i.e., benefit) for a given SAMA. Based on a review of the Phase II sensitivity quantifications summarized in Table F.7-2, it is determined that the averted cost is increased by a factor of 1.4 in cases when an RDR of 3% is used instead of 7%. Similarly, the impact of the 95$^{th}$ percentile sensitivity (Table F.7-3) is to increase the averted cost by a factor of 2.5. This knowledge is used in the reconsideration of Phase I SAMAs which are screened based on the consideration of averted cost (i.e., benefit). To bound both sensitivity cases (i.e., RDR and 95$^{th}$ percentile), an averted cost multiplier of 2.5 is used in this review of Phase I SAMAs. In many cases, the Phase I SAMAs are not evaluated to determine a specific averted cost. In these cases, a conservative estimate is applied to approximate the level of benefit provided by the SAMA. This is similar in technique to the averted cost analysis used for the Phase II SAMA, but instead of converting a CDF impact to an averted cost value, determinations are made directly using the CDF impact. Because the CDF impact of these SAMA are generally small, making determinations based on CDF impact is deemed an acceptable approach.

**Table F.7-2. Summary of SAMA Discount Sensitivity**

| SAMA ID | Cost of Implementation ($) | 7 % RDR Averted Cost- Risk ($) | 7 % RDR Net Value ($) | 3 % RDR Averted Cost- Risk ($) | 3 % RDR Net Value ($) | Change in Cost Effectiveness to make the SAMA Cost Beneficial? |
|---|---|---|---|---|---|---|
| 7 | 500,000 | 174,000 | -326,000 | 240,000 | -260,000 | No |
| 10 | 1,000,000 | 788,000 | -212,000 | 1,088,000 | 88,000 | No(2) |
| 18 | 265,000 | 8,000 | -257,000 | 10,000 | -255,000 | No |
| 20 | 400,000 | 4,000 | -396,000 | 6,000 | -394,000 | No |
| 23 | 150,000 | 42,000 | -108,000 | 58,000 | -92,000 | No |
| 25 | 50,000 | 4,000 | -46,000 | 6,000 | -44,000 | No |
| 67 | 1,000,000 | 65,000 | -935,000 | 88,000 | -912,000 | No |
| 84 | 150,000 | 80,000 | -70,000 | 110,000 | 40,000 | No |
| 88 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 89 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 91 | 90,000 | 118,000 | +28,000 | 162,000 | +72,000 | No(1) |
| 92 | 100,000 | 36,000 | -64,000 | 50,000 | -50,000 | No |
| 94 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 95 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 99 | 150,000 | 674,000 | +524,000 | 928,000 | +778,000 | No(1) |
| 100 | 500,000 | 146,000 | -354,000 | 204,000 | -296,000 | No |
| 101 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 102 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 104 | 250,000 | 44,000 | -206,000 | 60,000 | -40,000 | No |
| 106 | 50,000 | 34,000 | -16,000 | 46,000 | -4,000 | No |
| 107 | 250,000 | 0 | -250,000 | 0 | -250,000 | No |
| 108 | 1,000,000 | 0 | -1,000,000 | 0 | -1,000,000 | No |
| 109 | 75,000 | 674,000 | +599,000 | 928,000 | +853,000 | No(1) |
| 110 | 75,000 | 0 | -75,000 | 0 | -75,000 | No |
| 111 | 500,000 | 0 | -500,000 | 0 | -500,000 | No |
| 112 | 1,000,000 | 8,000 | -992,000 | 10,000 | -990,000 | No |
| 124 | 150,000 | 84,000 | -66,000 | 115,000 | -35,000 | No |
| 125B | 100,000 | 333,000 | 233,000 | 458,000 | 358,000 | No(1) |
| 125C | 750,000 | 397,000 | -353,000 | 540,000 | -210,000 | No |
| 127 | 50,000 | (3) | (3) | (3) | (3) | No(3) |
| 130 | 600,000 | 747,000 | +147,000 | 1,032,000 | +432,000 | No |
| 132 | 50,000 | 46,000 | -4,000 | 64,000 | +14,000 | Yes |
| 133 | 250,000 | 72,000 | -178,000 | 10,000 | -150,000 | No |
| 134 | 150,000 | 438,000 | +288,000 | 606,000 | +456,000 | No(1) |
| 136 | 100,000 | 0 | -100,000 | 0 | -100,000 | No |
| 138 | 780,000 | 446,000 | -334,000 | 616,000 | -164,000 | No |

Notes to Table F.7-2:

(1) These SAMAs are considered cost beneficial after the baseline 7% RDR Phase II analyses; therefore, there is no change in cost benefit resulting from the sensitivity analysis.

(2) The calculation with RDR = 3% shows a cost beneficial result but the cost-risk calculation does not account for the significant competing risks.

(3) SAMA 127 recommends increased operator training on the importance of PRA identified key systems and operator actions. SAMA 127 is judged cost beneficial after the baseline 7% RDR Phase II analyses; therefore, there is no change in cost benefit resulting from the sensitivity analysis.

## Table F.7-3. Summary of 95th Percentile Sensitivity Analysis

| SAMA ID | Cost of Implementation ($) | Base Averted Cost- Risk ($) | Base Net Value ($) | 95% Averted Cost- Risk($) | 95% Net Value($) | Change in Cost Effectiveness to make the SAMA Cost Beneficial? |
|---|---|---|---|---|---|---|
| 7 | 500,000 | 174,000 | -326,000 | 435,000 | -65,000 | No |
| 10 | 1,000,000 | 788,000 | -212,000 | 1,970,000 | 970,000 | Yes |
| 18 | 265,000 | 8,000 | -257,000 | 20,000 | -245,000 | No |
| 20 | 400,000 | 4,000 | -396,000 | 10,000 | -390,000 | No |
| 23 | 150,000 | 42,000 | -108,000 | 105,000 | -45,000 | No |
| 25 | 50,000 | 4,000 | -46,000 | 10,000 | -40,000 | No |
| 67 | 1,000,000 | 65,000 | -935,000 | 162,500 | -837,500 | No |
| 84 | 150,000 | 80,000 | -70,000 | 200,000 | 50,000 | Yes |
| 88 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 89 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 91 | 90,000 | 118,000 | 28,000 | 295,000 | 205,000 | No(1) |
| 92 | 100,000 | 36,000 | -64,000 | 90,000 | -10,000 | No |
| 94 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 95 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 99 | 150,000 | 674,000 | 524,000 | 1,685,000 | 1,535,000 | No(1) |
| 100 | 500,000 | 146,000 | -354,000 | 365,000 | -135,000 | No |
| 101 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 102 | 50,000 | 0 | -50,000 | 0 | -50,000 | No |
| 104 | 250,000 | 44,000 | -206,000 | 110,000 | -140,000 | No |
| 106 | 50,000 | 34,000 | -16,000 | 85,000 | 35,000 | Yes |
| 107 | 250,000 | 0 | -250,000 | 0 | -250,000 | No |
| 108 | 1,000,000 | 0 | -1,000,000 | 0 | -1,000,000 | No |
| 109 | 75,000 | 674,000 | 599,000 | 1,685,000 | 1,610,000 | No(1) |
| 110 | 75,000 | 0 | -75,000 | 0 | -75,000 | No |
| 111 | 500,000 | 0 | -500,000 | 0 | -500,000 | No |
| 112 | 1,000,000 | 8,000 | -992,000 | 20,000 | -980,000 | No |
| 124 | 150,000 | 84,000 | -66,000 | 210,000 | 60,000 | Yes |
| 125B | 100,000 | 333,000 | 233,000 | 832,500 | 732,500 | No(1) |
| 125C | 750,000 | 397,000 | -353,000 | 992,500 | 242,500 | Yes |
| 127 | 50,000 | (2) | (2) | (2) | (2) | No(2) |
| 130 | 600,000 | 747,000 | 147,000 | 1,867,500 | 1,267,500 | No(1) |
| 132 | 50,000 | 46,000 | -4,000 | 115,000 | 65,000 | Yes |
| 133 | 250,000 | 72,000 | -178,000 | 180,000 | -70,000 | No |
| 134 | 150,000 | 438,000 | 288,000 | 1,095,000 | 945,000 | No(1) |
| 136 | 100,000 | 0 | -100,000 | 0 | -100,000 | No |
| 138 | 780,000 | 446,000 | -334,000 | 1,115,000 | 325,000 | Yes |

Notes to Table F.7-3:

(1) These SAMAs were considered cost beneficial after the baseline mean CDF Phase II analyses; therefore, there is no change in cost benefit resulting from the sensitivity analysis.

(2) SAMA 127 recommends increased operator training as the importance of PRA identified key systems and operator actions and was deemed cost beneficial after the baseline 7% RDR Phase II analyses; therefore, there is no change in cost benefit resulting from the sensitivity analysis.

Table F.7-4

**Summary of "New" Cost Beneficial SAMAs if CDF Increased to 95th Percentile**

| SAMA No. | Description | Discussion | Competing Risks Accounted for |
|---|---|---|---|
| 10 | This SAMA would reduce the risk of catastrophic failure of the containment. The current Torus Hard Pipe Vent includes a rupture disk beyond an isolation valve; however, an alternate path to the Torus Hard Pipe Vent could be made in the wetwell using a rupture disk that would fail at about 60 psid. Alternatively, the containment vent valves could be changed so that they "fail open" on loss of support. Given this change, the vent path would be open on loss of support with the exception of the rupture disk. To prevent premature opening of the vent path during scenarios with loss of vent valve support, the strength of the rupture disk could be increased so that it is closer to the EOP vent pressure. | This SAMA would introduces a few significant competing risk. One such competing risk is the potential to cause low NSPH for ECCS systems during intended or spurious actuation of the system. Also, containment would be bypassed during spurious system actuation. | Competing Risks could be significant but are not accounted for. |
| 84 | Provide capability to vent primary containment without support systems with procedure/training | The 95th percentile sensitivity is considered an extreme case but the benefit of this modification becomes marginally cost-beneficial under these sensitivity case conditions. | No significant competing risks noted. |
| 106 | Revise ABN-19 to include guidance to implement a $<90^{\circ}$F/hr cooldown as soon as possible following a loss of RBCCW to supplement protection of recirc seals by reducing RPV pressure. | The 95th percentile sensitivity is considered an extreme case but the benefit of this modification becomes marginally cost-beneficial under these sensitivity case conditions. | No significant competing risks noted. |

**Table F.7-4**
**Summary of "New" Cost Beneficial SAMAs if CDF Increased to 95th Percentile**

| SAMA No. | Description | Discussion | Competing Risks Accounted for |
|---|---|---|---|
| 124 | Block wall 53 reinforcement | The 95th percentile sensitivity is considered an extreme case. Also, the benefit is based on the IPEEE seismic analysis which was not performed with the intent of supporting detailed cost-benefit assessments. Also, the seismic analysis has not been updated since it was completed in 1996. | No significant competing risks noted. |
| 125C | Cable re-routing in 480V AC "A" switchgear room | Using the 95th percentile sensitivity assessment and the "low" cost of implementation results in a cost beneficial case. | Competing risks could be significant but are <u>not</u> accounted for. |
| 132 | When both CTs are in operation, alignment for Oyster Creek LOOP response takes additional time due to need for CTs to coast down prior to switching. This SAMA would eliminate procedural guidance to shutdown CTs, if initially running. | Under the extreme conditions of the 95th percentile sensitivity assessment, this SAMA becomes cost-beneficial. | No significant competing risks noted. |
| 138 | The main and startup transformers are located approximately 15' apart. There is a concern that a failure of one could impact the other. | Under the extreme conditions of the 95th percentile sensitivity assessment, this SAMA becomes cost-beneficial. | No significant competing risks noted. |

# F.8 Conclusions

## F.8.1 OVERVIEW

The benefits of revising the operational strategies in place at Oyster Creek and/or implementing hardware modifications can be evaluated without the insight from a risk-based analysis. Use of the PRA in conjunction with cost benefit analysis methodologies has, however, provided an enhanced understanding of the effects of the proposed changes relative to the cost of implementation and projected impact on future population. The results of this study indicate that of the identified potential improvements that can be made at Oyster Creek, several are cost beneficial based on the methodology applied in this analysis and warrant further review for potential implementation.

The review of past license renewal submittals and the Oyster Creek PRA has resulted in the identification of 136 candidate SAMAs for consideration.

This group of 136 candidate SAMAs is screened for obvious cases where cost of implementation would be significantly greater than the cost-risk averted. This so called Phase I screening resulted in 37 candidate SAMAs transferred to Phase II for detailed analysis. These 37 candidate SAMAs are treated in Phase II using specific cost estimates for each of the items and explicit PRA modeling of the incorporation of the SAMA. Both internal and external events are considered in this PRA evaluation. The Phase II analysis results in seven SAMAs that are considered potentially cost beneficial. Section F.8.2 identifies these seven SAMAs. Section F.8.2 also identifies that three of these seven SAMAs are not cost beneficial when implemented in tandem with more cost beneficial SAMAs. Based on the results of the Oyster Creek SAMA analysis, Exelon concludes that several cost-beneficial options exist to reduce plant risk but that none are related to plant aging.

## F.8.2 BEST ESTIMATE RESULTS

Of the 37 candidate SAMAs transferred into Phase II, there are seven (7) SAMAs that resulted in potential for a positive cost benefit if the identified SAMA is implemented and a best estimate analysis is performed. This list of potentially cost beneficial SAMAs is identified in Table F.8-1:

**Table F.8-1**
**Cost Beneficial SAMAS When Considered Separately**

| SAMA No. | Description | Best Estimate Net Value (20 Year Life) |
|---|---|---|
| 91 | Allow 4160V AC Bus IC and ID cross tie | $28,000 |
| 99 | Provide an alternate method for IC shell level determination | $524,000 |
| 109 | Portable DC battery charger to preserve IC and EMRV operability along with adequate instrumentation | $599,000 |
| 125B | Reduce fire impact in dominant fire area of the 480V AC switchgear via a circuit breaker addition | $233,000 |
| 127 | Increased training on the systems and operator actions determined to be important from the PRA. | Judgment |
| 130 | Protect combustion turbines | $147,000 |
| 134 | Upgrade fire pump house building integrity so that fire system would be capable of withstanding a severe weather event. | $288,000 |

The net values are considered optimistic based on the SAMA methodology because of the consideration that competing risks associated with diluting the training curricula and diverting management and engineering resources have not yet been quantified.

These seven SAMAs are identified as "Cost Beneficial".

SAMA 127 is considered one that is important to implement even though a specific net value is not identified.

Of the remaining six SAMAs that are potentially cost beneficial, there is a potential interaction between these SAMAs.

As pointed out in Section F.6.39, it is found that certain of the cost beneficial SAMAs have "shadowing" effects on other SAMAs such that when they are implemented the other SAMAs become significantly less important. For example, the SAMAs that are found not cost beneficial when SAMAs 109 and 134 are implemented are 91, 99, and 130.

The priority for SAMA implementation based solely on the maximum net value is:

| Priority | SAMA No. | Description | Best Est. Net Value (20 yr. Life) |
|---|---|---|---|
| 1 | 109 | Portable DC Battery Charger to Preserve IC and EMRV Operability Along With Adequate Instrumentation | $599,000 |
| 2 | 134 | Upgrade Fire Pump House Structural Integrity | $288,000 |
| 3 | 125B | 480V AC switchgear circuit breaker addition[(1)] | $233,000 |
| 4 | 127 | Operator Training | Judgement |

(1) It is noted that SAMA 125 related to reduction in the fire induced CDF in the 480V AC switchgear room is found cost beneficial with or without SAMA 109 implementation. If SAMA 109 is not implemented, the more capital intensive change 125C should be considered.

An examination of SAMA combinations found no significant positive synergies among the individual SAMAs that alter the overall conclusions of the individual SAMA evaluations, i.e., no increase in net value when multiple SAMAs are implemented together.

## F.8.3 SENSITIVITY ANALYSIS RESULTS

The list of SAMAs have also been assessed using different assumptions for two key inputs to examine the impact of uncertainties:

- The estimate of core damage frequency
- The real discount rate (RDR)

The results of these sensitivity cases provide yet another perspective on the results of the SAMA evaluation reflecting the uncertainty in these two input variables.

### F.8.3.1 RDR Change: A Sensitivity Evaluation

The change in RDR from 7% to 3% causes one additional SAMA to be considered cost beneficial. Table F.8-2 summarizes this SAMA.

It is noted that the net value for the "new" candidate SAMA is not significant given the nature of the sensitivities and the conservatism involved in the overall assessment of these SAMA. Therefore, no significant insight is judged derived from these sensitivity analyses that affect the decisions.

These insights are not viewed as significant compared to other insights from this study but are included for decision-maker use in evaluating uncertainty impacts on the cost-benefit calculation.

**Table F.8-2. Summary of Additional Cost Beneficial SAMA if RDR Changed to 3%**

| | | Net Value | |
|---|---|---|---|
| SAMA No. | SAMA DESCRIPTION | Best Est. (7% RDR) | 3% RDR |
| 132 | When both CTs are in operation, alignment for Oyster Creek LOOP response takes additional time due to need for CTs to coast down prior to switching. This SAMA would eliminate procedural guidance to shutdown CTs, if initially running. | -$4,000 | $14,000 |

### F.8.3.2 Risk Profile Changes: A Sensitivity Evaluation

If the CDF used in the risk analysis increased to the 95$^{th}$ percentile, then the cost-risk for the individual SAMAs will increase because of the additional perceived risk. Using this extreme assumption results in the addition of seven (7) SAMAs to the list of SAMAs that could be considered by decision-makers. Table F.8-3 summarizes this list of seven (7) SAMAs along with the net value calculated for the best estimate evaluation and the 95$^{th}$ percentile sensitivity evaluation.

However, the use of the 95$^{th}$ percentile PRA results is not considered to provide the most realistic assessment of the cost effectiveness of a SAMA. Nevertheless, this information is included for decision-maker use in evaluating the impact of uncertainties.

**Table F.8-3. Summary of Additional Cost Beneficial SAMA if CDF Increased to 95$^{th}$ Percentile**

| | | Net Value | |
|---|---|---|---|
| **SAMA No.** | **Description** | **Best Est.** | **95$^{th}$ Percentile CDF** |
| 10 | This SAMA would reduce the risk of catastrophic failure of the containment. The current Torus Hard Pipe Vent includes a rupture disk beyond an isolation valve; however, an alternate path to the Torus Hard Pipe Vent could be made in the wetwell using a rupture disk that would fail at about 60 psid. Alternatively, the containment vent valves could be changed so that they "fail open" on loss of support. Given this change, the vent path would be open on loss of support with the exception of the rupture disk. To prevent premature opening of the vent path during scenarios with loss of vent valve support, the strength of the rupture disk could be increased so that it is closer to the EOP vent pressure. | -$212,000 | $970,000[(1)] |
| 84 | Provide capability to vent primary containment without support systems with procedure/training | -$70,000 | $50,000 |
| 106 | Revise ABN-19 to include guidance to implement a <90°F/hr cooldown as soon as possible following a loss of RBCCW to supplement protection of recirc seals by reducing RPV pressure. | -$16,000 | $35,000 |
| 124 | Block wall 53 reinforcement | -$66,000 | $60,000 |
| 125C | Cable re-routing in 480V AC "A" switchgear room | -$353,000 | $242,000[(1)] |
| 132 | When both CTs are in operation, alignment for Oyster Creek LOOP response takes additional time due to procedure for CTs to coast down prior to switching. This SAMA would change the procedure such that they can be switched to the SBO transformer under load, eliminating the need for the CTs to coast down, if running. | -$4,000 | $65,000 |
| 138 | The main and startup transformers are located approximately 15' apart. There is a concern that a failure of one could impact the other. | -$334,000 | $325,000 |

[(1)] Competing risks could be significant, but are <u>not</u> accounted for.

## F.9 References

[F-1] GE Nuclear Energy, "Technical Support Document for the ABWR," 25A5680, Rev. 1, November 1994.

[F-2] U.S. Nuclear Regulatory Commission, "Regulatory Analysis Technical Evaluation Handbook," NUREG/BR-0184, 1997.

[F-3] Calvert Cliffs Application for License Renewal, Attachment 2, Appendix F, "Severe Accident Mitigation Alternatives Analysis," April 1998.

[F-4] Applicant's Environmental Report; Operating License Renewal Stage; H. B. Robinson Steam Electric Plant Unit No. 2, Appendix F Severe Accident Mitigation Alternatives, Letter, J. W. Moyer, CP&L, to United States Nuclear Regulatory Commission, June 14, 2002, Application for Renewal of Operating License. Available on U. S. Nuclear Regulatory Commission website at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/robinson.html.

[F-5] Edwin I. Hatch Nuclear Plant Application for License Renewal, Environmental Report, Appendix D, Attachment F, February 2000.

[F-6] Peach Bottom Application for License Renewal, Appendix E, Environmental Report, Appendix G, "Severe Accident Mitigation Alternatives."

[F-7] Applicant's Environmental Report; Operating License Renewal Stage; Dresden Nuclear Power Station Units 2 and 3, Section 4.20 Severe Accident Mitigation Alternatives (SAMA) and Appendix F SAMA Analysis, Letter, Benjamin, Exelon, to U. S. Nuclear Regulatory Commission, January 3, 2003, Application for Renewed Operating Licenses. Available on U. S. Nuclear Regulatory Commission website at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/dresden-quad.html.

[F-8] Applicant's Environmental Report; Operating License Renewal Stage; Quad Cities Nuclear Power Station Units 1 and 2, Section 4.20 Severe Accident Mitigation Alternatives (SAMA) and Appendix F SAMA Analysis, Letter, Benjamin, Exelon, to U. S. Nuclear Regulatory Commission, January 3, 2003, Application for Renewed Operating Licenses. Available on U. S. Nuclear Regulatory Commission website at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/dresden-quad.html

[F-9] ASME RA-S-2002, Standard for Probabilistic Risk Assessment for Nuclear Power Plant Applications, April 2002.

[F-10] Applicant's Environmental Report; Operating License Renewal Stage; Browns Ferry Nuclear Power Plant Units 1,2 and 3, Appendix E, Section 4.20 Severe Accident Mitigation Alternatives (SAMA), December 2003. Available on U.S. Nuclear Regulatory Commission website at http://www.nrc.gov/reactors/operating/licensing/renewal/applications/browns-ferry/env-bfn-2.pdf

[F-11] Applicant's Environmental Report; Operating License Renewal Stage; Nine Mile Point Units 1 and 2, Appendix E, Section 4.16 Severe Accident Mitigation Alternatives

(SAMA), May 2004. Available on U.S. Nuclear Regulatory Commission website at http://www.nrc.gov/reactors/opertating/licensing/renewal/applications/nine-mile-pt/er-reprot.pdf

[F-12] EPRI NP-6041, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Revision 1, August 1991.

[F-13] Applicant's Environmental Report; Operating License Renewal Stage; Monticello Nuclear Generating Plant, Appendix F SAMA Analysis, Draft version, November 2004.

[F-14] Chanin, D. and Young, M., Code Manual for MACCS2: User's-Guide, NUREG/CR-6613, Volume 1, SAND 97-0594, May 1998.

[F-15] Canavan, et.al., "Oyster Creek Individual Plant Examination (IPE)", August 1992.

[F-16] NUREG/CR-6525, "SECPOP2000: Sector Population, Land Fraction, and Economic Estimation Program," U.S. Nuclear Regulatory Commission, Washington, D.C., Rev. 1, August 2003.

[F-17] U.S. Department of Agriculture, "1997 Census of Agriculture," National Agricultural Statistics Service, 1998. http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm

[F-18] U.S. Department of Agriculture, "Usual Planting and Harvesting Dates for U.S. Field Crops," National Agricultural Statistics Service, December 1997. http://usda.mannlib.cornell.edu/reports/nassr/field/planting/uph97.pdf

[F-19] NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," U. S. Nuclear Regulatory Commission, Washington, D.C., June 1989.

[F-20] Applicant's Environmental Report; Operating License Renewal Stage; Brunswick Steam Electric Plant, Appendix F SAMA Analysis, Draft version, November 2004.

[F-21] NUREG-1437, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Oconee Nuclear Station," Supplement 2, U.S. Nuclear Regulatory Commission, Washington, D.C., December 1999.

[F-22] Canavan, et.al., "Oyster Creek Individual Plant Examination for External Events (IPEEE)", 12/1/95.

[F-23] EPRI, "Fire Induced Vulnerability Evaluation (FIVE)," EPRI TR-100370, April 1992.

[F-24] EPRI, "Probabilistic Seismic Hazard Evaluation at Nuclear Power Plant Sites in the Central and Eastern United States: Resolution of the Charlston Issue," NP-6395-D, 1989.

[F-25] 2004B Oyster Creek PRA

[F-26] USNRC, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," NUREG-1407, June 1991.

[F-27] USNRC, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants - LWR Edition," NUREG-75/087, December 1975.

[F-28] Integrated Plant Safety Assessment Systematic Evaluation Program, Oyster Creek Nuclear Generating Station, NUREG 0822, Supplement No. 1, USNRC, January 1983.

[F-29] USNRC, "Safety Evaluation Report, Hartsville Nuclear Plants A1, A2, B1, B2," NUREG-0014.

[F-30] EPRI Special Report, "Guidelines for Permanent BWR Hydrogen Water Chemistry Installations – 1987 Revision," EPRI NP-5283-SR-A, September 1987.

[F-31] USNRC, Regulatory Guide 1.91, "Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants," Revision 1, February 1978.

[F-32] Stolz, J.F. (NRC) letter to Barton, J.J., (GPU Nuclear), "Issuance of Safety Evaluation Report Relating to the Full-Term Operating License for Oyster Creek Nuclear Generating Station."

[F-33] USNRC, Regulatory Guide 1.78, "Assumptions for Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release," June 1974.

[F-34] Dromerick, A.W., (NRC) to Barton, J.J., (GPU Nuclear), "Issuance of Amendment TAC No. M81848."

[F-35] Dromerick, A.W, (NRC) to Barton, J.J., (GPU Nuclear), "Review of Oyster Creek Nuclear Generating Station Individual Plant Examination (IPE) Submittal (TAC No. M74443)," August 2, 1994.

[F-36] Pastis, H.N., (NRC) to DeGregorio (Amergen Energy), "Review of Oyster Creek Nuclear Generating Station Individual Plant Examination of External Events (IPEEE) Submittal (TAC No. M83652)," February 8, 2001.

[F-37] Chanin, D. and Young, M., Code Manual for MACCS2: User's Guide, NUREG/CR-6613, Vol. 1, SAND 97-0594, May 1998.

[F-38] NUREG/CR-6525, "SECPOP2000: Sector Population, Land Fraction, and Economic Estimation Program," U.S. Nuclear Regulatory Commission, Washington, D.C., Rev. 1, August 2003.

[F-39] U.S. Department of Agriculture, "1997 Census of Agriculture," National Agriculture Statistics Service, 1998. http://www.nass.usda.gov/census/census97/volume1/vol1pubs.htm

[F-40] U.S. Department of Agriculture, "Usual Planting and Harvesting Dates for U.S. Field Crops," National Agriculture Statistics Service, December 1997. http://usda.mannlib.cornell.edu/reports/nassr/field/planting/uph97.pdf

[F-41] NUREG-1150, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, D.C., June 1989.

[F-42] Evacuation Time Estimates for the Plume Exposure Pathway Emergency Planning Zone: Oyster Creek Nuclear Generating Station, Earth Tech, February 2003.

[F-43] 2002 Census of Agriculture, New Jersey State and County Data, Volume 1, Geographic Area Series Part 30, AC-02-A-30, June 2004.

[F-44] Eide, S.A., Gentillon, C.D., Wierman, T.E., and Rasmuson, D.M., Evaluation of Loss of Offsite Power Events at Nuclear Power Plants: 1986-2003, NUREG/CR-INEEL/EXT-04-02326, (DRAFT) October 2004.

[F-45] Perspectives Gained From the Individual Plant Examination of External Events (IPEEE) Program, US NRC, NUREG-1742, April 2002.

[F-46] Holzworth, G.C., Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States, U.S. EPA AP-101, January 1972.

## *ADDENDUM FA*

# External Events Excerpts From NUREG-1437 Vol I

*Oyster Creek Nuclear Generating Station*

Severe accidents initiated by external phenomena such as tornadoes, floods, earthquakes, fires, and sabotage have not traditionally been discussed in quantitative terms in Final Environmental Statements (FESs). With the exception of sabotage, the NRC staff has, however, reviewed or performed detailed probabilistic assessments of external events for Zion Units 1 and 2, Indian Point Units 2 and 3, Limerick Units 1 and 2, Surry Unit 1, Peach Bottom Unit 2, and Millstone Unit 3. In most cases, the external event risks were determined to be comparable to internal event risks. However, for Zion and Limerick, the licensee's PRAs indicated that external events could be significant contributors to risk. For the Indian Point units, NRC staff evaluations also indicated that external events could significantly contribute to severe accident risk. The most recent NRC analysis of external events has been the NUREG-1150 external events assessment for Surry Unit 1 and Peach Bottom Unit 1. This analysis examined a broad range of external events and found that they could range from negligible to significant contributors to risk when compared with internal initiators. It should be noted, however, that in cases where external event risk was shown to be a significant contributor to the overall risk, the majority of the estimated risk arose from large beyond design basis earthquakes; but in all cases, the total risk (internal and external) is still small.

NRC's earthquake design standards have been conservatively developed to ensure protection of the public health and safety from earthquakes whose magnitudes are well above the most likely earthquake magnitude when considering the collective earthquake history for specific plant sites in the United States. Therefore, earthquakes exceeding NRC seismic design standards are extremely unlikely. However, in the unlikely event of such an earthquake, there would be substantial damage to older residential structures, commercial structures, and high-hazard facilities such as dams whose seismic design standards are below nuclear seismic design standards. The societal impact due to the non-nuclear losses alone from an earthquake larger than the design basis of a nuclear plant, including property damage, injuries, and fatalities, would be major. The technology for assessing losses from such large earthquakes is a developing one, and there are several ongoing studies of this technology, including work at the United States Geological Survey. Presently there is no agreed-upon method for performing such assessments, although a recent report of the National Academy of Sciences suggests some broad guidelines CNAS 1989). The NRC has not developed a method for assessing the societal losses from large earthquakes such that the reactor contribution to accident consequences can be quantitatively compared with the non-nuclear losses. However, as supported by at least one study (Lee et al. 1979), the commission expects that the reactor accident contribution to the losses from large beyond design basis earthquakes would be small relative to the non-nuclear losses. While this in itself does not mean the reactor consequences from such an earthquake would be small, the Commission concludes that even with potentially high consequences from a beyond design basis earthquake, the extremely low probability of such an earthquake yields a small risk from beyond design basis earthquakes at existing nuclear power plants.

With regard to sabotage, quantitative estimates of risk from sabotage are not made in external event analyses because such estimates are beyond the current state of the art for performing risk assessments. The commission has long used deterministic criteria to establish a set of regulatory requirements for the physical protection of nuclear power plants from the threat of sabotage. 10 CFR Part 73, "Physical Protection of Plants and Materials", delineates these regulatory requirements. In addition, as a result of the World Trade Center bombing, the Commission amended 10 CFR Part 73 to provide protection against malevolent use of vehicles, including land vehicle bombs. This amendment requires licenses to establish vehicle control measures, including vehicle barrier systems to protect against vehicular sabotage. The regulatory requirements under 10 CFR part 73 provide reasonable assurance that the risk from sabotage is small. Although the threat of sabotage events cannot be accurately quantified, the commission believes that acts of sabotage are not reasonably expected. Nonetheless, if such events were to occur, the commission would expect that resultant core damage and radiological releases would be no worse than those expected from internally initiated events.

Based on the above, the commission concludes that the risk from sabotage and beyond design basis earthquakes at existing nuclear power plants is small and additionally, that the risks from other external events, are adequately addressed by a generic consideration of internally initiated severe accidents.

The NRC is continuing to evaluate ways to reduce the risk from nuclear power plants from external events. For example, each licensee is performing an individual plant examination to look for plant vulnerabilities to internally and externally initiated events and considering potential improvements to reduce the frequency or consequences of such events.