- SMA 62 – Provide a hard-wired connection to a safety injection (SI) pump from the alternate safe shutdown system (ASSS) power supply. This modification would reduce the CDF from events that involve loss of power from the 480V vital buses.
- SAMA 65 – Upgrade the alternate safe shutdown system to allow timely restoration of reactor coolant pump seal injection and cooling from events that cause loss of power from the 480-V ac vital buses.

The potentially cost-beneficial SAMAs for IP3 include the following:

- SAMA 7 – Create a reactor cavity flooding system. This modification would enhance core debris cooling and reduce the frequency of containment failure due to core-concrete interaction.
- SAMA 18 – Route the discharge from the main steam safety valves through a structure where a water spray would condense the steam and remove fission products.
- SAMA 19 – Install additional pressure or leak monitoring instrumentation to reduce the frequency of interfacing system loss of coolant accidents.
- SAMA 30 – Provide a portable diesel-driven battery charger to improve dc power reliability. A safety-related disconnect would be used to change a selected battery. This modification would enhance the long-term operation of the turbine-driven AFW pump on battery depletion.
- SAMA 52 – Proceduralize opening the city water supply valve for alternative AFW system pump suction to enhance the availability of the AFW system.
- SAMA 53 – Install an excess flow valve to reduce the risk associated with hydrogen explosions inside the turbine building or primary auxiliary building.
- SAMA 55—Provide the capability of powering one safety injection pump or RHR pump using the Appendix R diesel (MCC 312A) to enhance reactor cooling system injection capability during events that cause loss of power from the 480-V ac vital buses.
- SAMA 61 – Upgrade the alternate safe-shutdown system to allow timely restoration of reactor coolant pump seal injection and cooling from events that cause loss of power from the 480-V ac vital buses.
- SAMA 62 – Install a flood alarm in the 480-V ac switchgear room to mitigate the occurrence of internal floods inside the 480-V ac switchgear room.

In response to an NRC staff inquiry regarding estimated benefits for certain SAMAs and lower cost alternatives, Entergy identified one additional potentially cost-beneficial SAMA (regarding a dedicated main steam safety valve gagging device for SGTR events in both units; this was unnumbered for each unit because the applicant did not initially identify them) (Entergy 2008b); and Entergy determined that one SAMA that was previously identified as potentially cost beneficial was no longer cost beneficial based on correction of an error in the ER (IP3 SAMA 30) (Entergy 2008a, Entergy 2009).

Based on its review of Entergy's SAMA analysis, as revised, the staff concludes that, with the exception of the potentially cost-beneficial SAMAs discussed above, the costs of the SAMAs evaluated would be higher than their associated benefits.

5.2.6 Conclusions

The NRC staff reviewed Entergy's analysis, as revised, and concludes that the methods used, and the implementation of those methods, were sound. The treatment of SAMA benefits and costs support the general conclusion that the SAMA evaluations performed by Entergy are reasonable and sufficient for the license renewal submittal. Although the treatment of SAMAs for external events was somewhat limited, the likelihood of there being cost-beneficial enhancements in this area was minimized by improvements that have been realized as a result of the IPEEE process and inclusion of a multiplier to account for external events.

Based on its review of the SAMA analysis, as revised, the staff concurs with Entergy's identification of areas in which risk can be further reduced in a cost-beneficial manner through the implementation of all or a subset of potentially cost-beneficial SAMAs. Given the potential for cost-beneficial risk reduction, the staff considers that further evaluation of these SAMAs by Entergy is appropriate. However, none of the potentially cost-beneficial SAMAs relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of IP2 and IP3 license renewal pursuant to 10 CFR Part 54.

In a decision issued on June 30, 2010, the Atomic Safety and Licensing Board ("Board") admitted two contentions for litigation, which had been filed by the State of New York in the Indian Point Units 2 and 3 license renewal adjudicatory proceeding. Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3), LBP-10-13, 71 NRC __ (2010). These contentions generally assert that the NRC staff must reach a final determination of the cost-beneficial SAMAs, from the slate of SAMAs that have been found to be potentially cost-beneficial, and that (a) the cost-beneficial SAMAs must be imposed as a "backfit" on the plants' current licensing basis ("CLB"), as a condition for license renewal, or (b) the staff must provide a sufficient explanation for not imposing such a license renewal condition. In this regard, the NRC staff has provided a detailed discussion of SAMA costs and benefits in this SEIS, which satisfies the NRC's obligation, under NEPA and related case law, to consider SAMAs in a license renewal proceeding such as the IP2 and IP3 proceeding. Indeed, as the Board found, while NEPA requires consideration of environmental impacts and alternatives, it does not require that SAMAs be imposed to redress environmental impacts. LBP-10-13, slip op. at 29.

Moreover, the NRC staff has determined that none of the potentially cost-beneficial SAMAs are related to the license renewal requirements in 10 CFR Part 54 (i.e., managing the effects of aging) (SEIS § 5.2.6). Under the NRC's regulatory system, any potentially cost-beneficial SAMAs that do not relate to 10 CFR Part 54 requirements would be considered, to the extent necessary or appropriate, under the agency's oversight of a facility's current operating license in accordance with 10 CFR Part 50 requirements, inasmuch as such matters would pertain not just to the period of extended operation but to operations under the current operating license term as well. Thus, there is no regulatory basis to suggest that potentially cost-beneficial SAMAs that are unrelated to Part 54 requirements must be imposed as a backfit to the CLB, as a condition for license renewal.

Finally, the NRC staff notes that SAMAs, by definition, pertain to severe accidents – i.e., those accidents whose consequences could be severe, but whose probability of occurrence is so low that they may be excluded from the spectrum of design basis accidents ("DBAs") that have been postulated for a plant (see GEIS §§ 5.3.2, 5.3.3, 5.4); this is consistent with the conclusions reached in § 5.2.2 of this SEIS concerning severe accidents at IP2 and IP3. The Commission has previously concluded, as a generic matter, that the probability-weighted radiological consequences of severe accidents are SMALL. GEIS § 5.5.2; 10 CFR Part 51, App. B, Table B

1. As stated in §§ 5.1.1 and 5.1.2 above, no significant new information has been identified that would remove IP2 and IP3 from these generic determinations. Thus, there is no regulatory basis to impose any of the potentially cost-beneficial SAMAs as a condition for license renewal of IP2 and IP3 – even if those potentially cost-beneficial SAMAs are "finally" found to be cost-beneficial.

5.3 References

10 CFR Part 50. Code of Federal Regulations, Title 10, *Energy*, Part 50, "Domestic Licensing of Production and Utilization Facilities."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 100. Code of Federal Regulations, Title 10, *Energy,* Part 100, "Reactor Site Criteria."

Atomic Safety and Licensing Board Panel (ASLBP). *Entergy Nuclear Operations, Inc.* (Indian Point Nuclear Generating Units 2 and 3), LBP-10-13, 71 NRC __ (2010).

Consolidated Edison (Con Ed). 1992. Letter from Stephen B. Bram to U.S. Nuclear Regulatory Commission, Subject: Generic Letter 88-20, Supplement 1: Individual Plant Examination (IPE) for Severe Accident Vulnerabilities—10 CFR 50.54, Indian Point Unit No. 2, August 12, 1992.

Consolidated Edison (Con Ed). 1995. Letter from Stephen E. Quinn to U.S. Nuclear Regulatory Commission, Subject: Final Response to Generic Letter 88-20, Supplement 4: Submittal of Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities, Indian Point Unit No. 2, December 6, 1995.

Entergy Nuclear Operations, Inc. (Entergy). 2007a. "Applicant's Environment Report, Operating License Renewal Stage." (Appendix E to Indian Point, Units 2 and 3, License Renewal Application; Attachment E: Severe Accident Mitigation Alternatives). April 23, 2007. Agencywide Documents Access and Management System (ADAMS) Accession No. ML071210562.

Entergy Nuclear Operations, Inc. (Entergy). 2007b. Letter from Fred Dacimo to U.S. Nuclear Regulatory Commission, Subject: Indian Point Energy Center License Renewal Application, NL-07-039, April 23, 2007. ADAMS Accession No. ML071210512.

Entergy Nuclear Operations, Inc. (Entergy). 2008a. Letter from Fred Dacimo to U.S. Nuclear Regulatory Commission, Subject: Reply to Request for Additional Information Regarding License Renewal Application—Severe Accident Mitigation Alternatives Analysis, NL-08-028, May 22, 2008. ADAMS Accession No. ML080420264.

Entergy Nuclear Operations, Inc. (Entergy). 2008b. Letter from Fred Dacimo to U.S. Nuclear Regulatory Commission, Subject: Supplemental Reply to Request for Additional Information Regarding License Renewal Application—Severe Accident Mitigation Alternatives Analysis, NL-08-086, May 22, 2008. ADAMS Accession No. ML081490336.

Entergy Nuclear Operations, Inc. (Entergy). 2009. Letter from Fred Dacimo to U.S. Nuclear Regulatory Commission, Subject: License Renewal Application – SAMA Reanalysis Using Alternate Meteorological Tower Data, NL-09-165, December 11, 2009. ADAMS Accession No.

ML093580089.

New York Power Authority (NYPA). 1994. Letter from William A. Josiger to U.S. Nuclear Regulatory Commission, Subject: Indian Point 3 Nuclear Power Plant Individual Plant Examination for Internal Events, June 30, 1994.

New York Power Authority (NYPA). 1997. Letter from James Knubel to U.S. Nuclear Regulatory Commission, Subject: Indian Point 3 Nuclear Power Plant Individual Plant Examination of External Events (IPEEE), September 26, 1997.

Nuclear Regulatory Commission (NRC). 1996. "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants." NUREG-1437, Volumes 1 and 2, Washington, DC.

Nuclear Regulatory Commission (NRC). 1997. "Regulatory Analysis Technical Evaluation Handbook." NUREG/BR-0184, Washington, DC.

Nuclear Regulatory Commission (NRC). 1999. "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report," Section 6.3, "Transportation," Table 9.1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." NUREG-1437, Volume 1, Addendum 1, Washington, DC.

Nuclear Regulatory Commission (NRC). 2004. "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission." NUREG/BR-0058, Rev. 4, Washington, DC. ADAMS Accession No. ML042820192.

6.0 ENVIRONMENTAL IMPACTS OF THE URANIUM FUEL CYCLE, SOLID WASTE MANAGEMENT, AND GREENHOUSE GAS EMISSIONS

Environmental issues associated with the uranium fuel cycle and solid waste management are discussed in NUREG-1437, Volumes 1 and 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (hereafter referred to as the GEIS) (NRC 1996, 1999.)[(1)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues are then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1; therefore, additional plant-specific review of these issues is required.

This chapter addresses the issues that are related to the uranium fuel cycle and solid waste management that are listed in Table B-1 of Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of Title 10, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," of the *Code of Federal Regulations* (10 CFR Part 51) and are applicable to the Indian Point Nuclear Generating Unit Nos. 2 and 3 (IP2 and IP3). The generic potential radiological and nonradiological environmental impacts of the uranium fuel cycle and transportation of nuclear fuel and wastes are described in detail in the GEIS based, in part, on the generic impacts provided in 10 CFR 51.51(b), Table S-3, "Table of Uranium Fuel Cycle Environmental Data," and 10 CFR 51.52(c), Table S-4, "Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor." The U.S. Nuclear Regulatory Commission (NRC) staff also addresses the impacts from radon-222 and technetium-99 in the GEIS.

6.1 The Uranium Fuel Cycle

(1) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the GEIS include the GEIS and its Addendum 1.

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, that are applicable to IP2 and IP3 from the uranium fuel cycle and solid waste management are listed in Table 6-1.

Table 6-1. Category 1 Issues Applicable to the Uranium Fuel Cycle and Solid Waste Management during the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
URANIUM FUEL CYCLE AND WASTE MANAGEMENT	
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste)	6.1; 6.2.1; 6.2.2.1; 6.2.2.3; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (collective effects)	6.1; 6.2.2.1; 6.2.3; 6.2.4; 6.6
Offsite radiological impacts (spent fuel and high-level waste disposal)	6.1; 6.2.2.1; 6.2.2.2; 6.2.3; 6.2.4; 6.6
Nonradiological impacts of the uranium fuel cycle	6.1; 6.2.2.6; 6.2.2.7; 6.2.2.8; 6.2.2.9; 6.2.3; 6.2.4; 6.6
Low-level waste storage and disposal	6.1; 6.2.2.2; 6.4.2; 6.4.3; 6.4.4
Mixed waste storage and disposal	6.1; 6.4.5; 6.6
Onsite spent fuel	6.1; 6.4.6; 6.6
Nonradiological waste	6.1; 6.5; 6.6
Transportation	6.1; 6.3, Addendum 1; 6.6

Entergy Nuclear Operations, Inc. (Entergy), stated in the IP2 and IP3 environmental report (ER) (Entergy 2007) that it is not aware of any new and significant information associated with the renewal of the IP2 and IP3 operating licenses, though it did identify leaks to ground water as a potential new issue. The NRC staff addressed this issue in Sections 2.2.7, 4.3, and 4.5 of this supplemental environmental impact statement (SEIS). In Section 4.5, the NRC staff concludes that the abnormal liquid releases (leaks) discussed by Entergy in its ER, while new information, are within the NRC's radiation safety standards contained in 10 CFR Part 20 and are not considered to have a significant impact on plant workers, the public, or the environment (i.e., while the information related to spent fuel pool leakage is new, it is not significant). The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER (Entergy 2007), the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts related to these issues beyond those discussed in the GEIS. For these issues, the NRC staff concluded in the GEIS that the impacts are SMALL (except for the collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, as discussed below) and that additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

A brief description of the NRC staff's review and the GEIS conclusions, as codified in Table B-1 of 10 CFR Part 51, for each of these issues follows:

- Off-site radiological impacts (individual effects from other than the disposal of spent fuel and high-level waste). Based on information in the GEIS, the Commission found the following:

  Off-site impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part (10 CFR 51.51(b)). Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases including radon-222 and technetium-99 are small.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no offsite radiological impacts (individual effects) of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Off-site radiological impacts (collective effects). Based on information in the GEIS, the Commission found the following:

  The 100 year environmental dose commitment to the United States (U.S.) population from the fuel cycle, high level waste and spent fuel disposal excepted, is calculated to be about 14,800 person rem, or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the U.S. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for example no cancer cure in the next one thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.

  Nevertheless, despite all of the uncertainty, some judgement as to the National Environmental Policy Act of 1969, as amended (NEPA) implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the NRC staff's site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no offsite radiological impacts (collective effects) from the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Offsite radiological impacts (spent fuel and high-level waste disposal). Based on information in the GEIS, the Commission found the following:

  For the high-level waste (HLW) and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for off-site releases of radionuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards" (NAS 1995), and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site which will comply with such limits, peak doses to virtually all individuals will be 100 millirem (mrem) (1millisevert [mSv]) per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 mrem per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 mrem (1 mSv) per year. The lifetime individual risk from 100 mrem annual dose limit is about 3×10^{-3}.

  Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by the U.S. Department of Energy (DOE) in the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 (DOE 1980). The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a high level waste repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of

> potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1,000 premature cancer deaths world-wide for a 100,000 metric ton (MT) repository.
>
> Nevertheless, despite all of the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high level waste disposal, this issue is considered Category 1.

On February 15, 2002, based on a recommendation by the Secretary of the DOE, the President recommended the Yucca Mountain site for the development of a repository for the geologic disposal of spent nuclear fuel and HLW. The U.S. Congress approved this recommendation on July 9, 2002, in Joint Resolution 87, which designated Yucca Mountain as the repository for spent nuclear waste. On July 23, 2002, the President signed Joint Resolution 87 into law; Public Law 107-200, 116 Stat. 735 designates Yucca Mountain as the repository for spent nuclear waste. The staff notes that, on March 3, 2010, the U.S. Department of Energy (DOE) submitted a motion to the Atomic Safety and Licensing Board to withdraw with prejudice its application for a permanent geologic repository at Yucca Mountain, NV. The NRC is currently considering DOE's request. Nevertheless, the NRC has evaluated the safety and environmental effects of spent fuel storage and, as set forth in 10 CFR 51.23, "Temporary Storage of Spent Fuel after Cessation of Reactor Operation—Generic Determination of No Significant Impact" (known as the Waste Confidence Rule).

> The Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 30 years beyond the licensed life for operation (which may include the term of a revised or renewed license) of that reactor at its spent fuel storage basin or at either onsite or offsite independent spent fuel storage installations. Further, the Commission believes there is reasonable assurance that at least one mined geologic repository will be available within the

> first quarter of the twenty-first century, and sufficient repository capacity will be available within 30 years beyond the licensed life for operation of any reactor to dispose of the commercial high-level waste and spent fuel originating in such reactor and generated up to that time.

That rule is the subject of an ongoing rulemaking proceeding, as discussed in "Waste Confidence Decision Update," 73 F.R. 59551 (Oct. 9, 2008).

In 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," onsite spent fuel storage is classified as a Category 1 issue that applies to all nuclear power reactors. While the Commission did not assign a single level of significance (i.e., SMALL, MODERATE, or LARGE) in Table B-1 of Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of 10 CFR Part 51 for the impacts associated with spent fuel and HLW disposal, it did conclude that the impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion that for any plant, the option of extended operation under 10 CFR Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," should be eliminated.

The GEIS for license renewal (NUREG-1437) evaluated a variety of spent fuel and waste storage scenarios, including onsite storage of these materials for up to 30 years following expiration of the operating license, transfer of these materials to a different plant, and transfer of these materials to an ISFSI. During dry cask storage and transportation, spent nuclear fuel must be "encased" in NRC-approved casks. An NRC-approved cask is one that has undergone a technical review of its safety aspects and been found to meet all of the NRC's requirements, as specified in 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste" (for storage casks), and 10 CFR Part 71, "Packaging and Transportation of Radioactive Material" (for transportation casks). For each potential scenario involving spent fuel, the GEIS determined that existing regulatory requirements, operating practices, and radiological monitoring programs were sufficient to ensure that impacts resulting from spent fuel and waste storage practices during the term of a renewed operating license would be small.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no offsite radiological impacts related to spent fuel and high-level waste disposal during the renewal term beyond those discussed in the GEIS.

- <u>Nonradiological impacts of the uranium fuel cycle</u>. Based on information in the GEIS, the Commission found the following:

  > The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the NRC staff's site visit, the scoping process, or its evaluation of other available information pertaining to the IP2 and IP3 license renewal application. Therefore, the NRC staff concludes that there are no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

- Low-level waste storage and disposal. Based on information in the GEIS, the Commission found the following:

  The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional on-site land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Mixed waste storage and disposal. Based on information in the GEIS, the Commission found the following:

  The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

- Onsite spent fuel. Based on information in the GEIS, the Commission found the following:

  The expected increase in the volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored

retrievable storage is not available.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

- Nonradiological waste. Based on information in the GEIS, the Commission found the following:

  No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

- Transportation. Based on information contained in the GEIS, the Commission found the following:

  The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 megawatt-days per metric ton of uranium (MWd/MTU) and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4—Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in 10 CFR 51.52.

IP2 and IP3 meet the fuel-enrichment and burnup conditions set forth in Addendum 1 to the GEIS. The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site audit, the scoping process, or evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

There are no Category 2 issues for the uranium fuel cycle and solid waste management.

6.2 Greenhouse Gas Emissions

6.2.1 Introduction

The NRC staff received many comments during the scoping period from individuals and groups regarding the impact of the proposed relicensing of IP2 and IP3 on the release of carbon dioxide (CO_2) and other greenhouse gas (GHG) emissions relative to potential alternative energy sources, including fossil fuels, renewable energy sources, and conservation programs.

6.2.2 IP2 and IP3

The NRC staff has not identified any studies specifically addressing GHGs produced by IP2 and IP3 or their fuel cycles. Although Entergy developed a study identifying gas emissions that would result if IP2 and IP3 were to be decommissioned and their generating capacity replaced with fossil-fuel based sources (Entergy Nuclear Northeast 2002), Entergy did not evaluate GHG emissions related to the existing facility. This study evaluated emissions of CO_2, sulfur dioxide (SO_2), nitrogen oxides (NO_x), particulates (i.e., particulate matter, 10 microns or less in diameter [PM_{10}]), carbon monoxide (CO), and volatile organic compounds (VOCs). The study was intended as an evaluation of the impact of IP2 and IP3 shutdown on air quality in the local New York City area, rather than an evaluation of the impact of IP2 and IP3 shutdown on global GHG emissions.

6.2.3 GEIS

The GEIS provided only qualitative discussions regarding the GHG impacts of the nuclear fuel cycle. In the analysis of potential alternatives to nuclear power plant relicensing, the GEIS referenced CO_2 emissions as one of the substantial operating impacts associated with new coal-fired and oil-fired power plants, although no direct quantitative assessment of GHG emissions was presented. The GEIS also did not address GHG impacts of the nuclear fuel cycle relative to other potential alternatives, such as natural gas, renewable energy sources, or conservation programs.

6.2.4 Other Studies

Since the development of the GEIS, extensive further research into the relative volumes of GHGs emitted by nuclear and other electricity generating methods has been performed. In support of the analysis for this SEIS, the NRC staff performed a survey of the recent literature on the subject. Based on this survey, the NRC staff found that estimates and projections of the carbon footprint of the nuclear power lifecycle vary widely, and considerable debate exists regarding the relative impacts of nuclear and other electricity generation methods on GHG emissions. These recent studies take two different forms:

(1) qualitative discussions of the potential use of nuclear power to address GHG emissions and global warming

(2) technical analyses and quantitative estimates of the actual amount of GHGs generated by the nuclear fuel cycle

6.2.4.1 Qualitative Studies

The qualitative studies primarily consist of broad, large-scale public policy or investment evaluations of whether an expansion of nuclear power is likely to be a technically, economically, and/or politically feasible means of achieving global GHG reductions. Examples of the studies that commenters referenced during the scoping period or that the NRC staff identified during the subsequent literature search include the following:

- Studies conducted to evaluate whether investments in nuclear power in developing countries should be accepted as a flexibility mechanism to assist industrialized nations in

achieving their GHG reduction goals under the Kyoto Protocols (Schneider 2000; International Atomic Energy Agency [IAEA] 2000; NEA 2002; and Nuclear Information and Resource Service and World Information Service on Energy [NIRS/WISE] 2005). Ultimately, the parties did not approve nuclear power as a component under the Clean Development Mechanism (CDM), but not because of concerns about GHGs from the nuclear fuel cycle (NEA 2002). Instead, it was eliminated from consideration for the CDM because it was not considered to meet the criterion of helping developing nations achieve sustainable development because of safety and waste disposal concerns (NEA 2002).

- Analyses developed to assist governments (including the U.S. Government) in making long-term investment and public policy decisions in nuclear power (Keepin 1988; Hagen et al. 2001; Massachusettes Institute of Technology [MIT] 2003).

Although the qualitative studies sometimes reference and critique the rationale contained in the existing quantitative estimates of GHGs produced by the nuclear fuel cycle, their conclusions generally rely heavily on discussions of other aspects of nuclear policy decisions and investment such as safety, cost, waste generation, and political acceptability. Therefore, these studies are not directly applicable to the evaluation of GHG emissions that will be associated with the proposed relicensing of IP2 and IP3.

6.2.4.2 Quantitative Studies

A large number of technical studies, including calculations and estimates of the amount of GHGs emitted by nuclear and other power generation options, are available in the literature. Examples of these studies include Mortimer (1990), Andseta et al. (1998), Spadaro (2000), Storm van Leeuwen and Smith (2005), Fritsche (2006), Paliamentery Office of Science and Technology (POST; 2006), AEA (2006), Weisser (2006), Fthenakis and Kim (2007), and Dones (2007).

Comparison of the different studies is difficult because the assumptions and components of the lifecycles included within each study vary widely. Examples of differing assumptions that make comparability between the studies difficult include the following:

- the type of energy source that may be used to mine uranium deposits in the future
- the amount of reprocessing of nuclear fuel that will be performed in the future
- the type of energy source and process that might be used to enrich uranium in the future
- different calculations regarding the grade and volume of recoverable uranium deposits in the world
- different estimates regarding the GHG emissions associated with declining grades of recoverable coal, natural gas, and oil deposits
- the release of GHG gases other than CO_2, including the conversion of the masses of these gases into grams of CO_2 equivalents per kilowatt-hour (g C_{eq} /kWh)

- the technology to be used for future fossil fuel power systems, including cogeneration systems
- the projected capacity factors assumed for the different generation alternatives
- the different types of nuclear reactors used currently and in the projected future (light water reactor, pressurized-water reactor, Canadian deuterium-natural uranium reactor, breeder)

In addition, studies are inconsistent in their application of full lifecycle analyses, including plant construction, decommissioning, and resource extraction (uranium ore, fossil fuel). For instance, Storm van Leeuwen and Smith (2005) present comparisons of GHG emissions from nuclear versus natural gas that incorporate GHG emissions associated with nuclear plant construction and decommissioning in the values used for comparison.

In the case of the proposed IP2 and IP3 relicensing, the relicensing action will not involve additional GHG emissions associated with construction because the facility already exists. In addition, the proposed relicensing action will not involve additional GHG emissions associated with facility decommissioning, because that decommissioning must occur whether the facility is relicensed or not. In many of these studies, the contribution of GHG emissions from facility construction and decommissioning cannot be separated from the other lifecycle GHG emissions that would be associated with IP2 and IP3 relicensing. Therefore, these studies overestimate the GHG emissions attributed to the proposed IP2 and IP3 relicensing action.

In an early study on the subject, Dr. Nigel Mortimer conducted an analysis of the GHG emissions resulting from the nuclear fuel cycle in 1990 (Mortimer 1990). In this study, Mortimer stressed that the GHG implications of the nuclear fuel cycle were substantially related to the ore grade of uranium that must be mined to support nuclear power generation. Using ore grades that were current as of 1990, this study concluded that nuclear power offered a dramatic reduction in GHG emissions over conventional coal-fired power plants over an estimated 35-year lifecycle. The analysis estimated that a nuclear power plant would generate 230,000 tons (209,000 metric tons (MT)) of CO_2 over a 35-year life span, or about 3.9 percent of the 5,912,000 tons (5,363,000 MT) that an equivalent coal-fired plant would generate (Mortimer 1990). The study also projected that most of this 230,000 tons (209,000 MT) of CO_2 resulted from the use of a coal-fired plant to perform uranium enrichment by gaseous diffusion, and that using nuclear power and alternative enrichment methods in the future could reduce the amount to 21,000 tons (19,000 MT) (Mortimer 1990).

Mortimer's study went on to demonstrate that the GHG impact of the nuclear fuel cycle would increase as the grade of uranium ore mined dropped, and that the net emissions of CO_2 from the nuclear and coal-fired alternatives would become equal once uranium ore grades reached 0.01-percent uranium oxide. However, Mortimer does not address differences in energy consumption from future extraction and enrichment methods, the potential for higher grade resource discovery, and technology improvements. Based on his cutoff ore grade and projections of ore reserves, Mortimer estimated GHG emissions of nuclear and natural gas generation would be similar after a period of 23 years (Mortimer 1990). The analysis also compared GHG emissions associated with the nuclear fuel cycle with other electricity generation and efficiency options, including hydroelectric, wind, tidal power, and new types of insulation and lighting (but not including natural gas). The conclusion was that nuclear power

had lower GHG emissions compared to coal, but that GHG emissions associated with the nuclear fuel cycle still exceeded those for renewable generation and conservation options (Mortimer 1990).

The Mortimer (1990) study is not presented here to support a definitive conclusion regarding whether nuclear energy produces fewer GHG emissions than other alternatives and similar discussions will not be presented in this SEIS for each of the available studies. Instead, the NRC staff presents the Mortimer (1990) study to provide an example of the types of considerations underlying the calculations and arguments presented by the various authors. Almost every existing study has been critiqued, and its assumptions challenged, by later authors. Therefore, no single study has been selected to represent definitive results in this SEIS. Instead, the results from a variety of the studies are presented in Tables 6-2, 6-3, and 6-4 to provide a weight-of-evidence argument comparing the relative GHG emissions resulting from the proposed IP2 and IP3 relicensing compared to the potential alternative use of coal-fired plants, natural gas-fired plants, and renewable energy sources.

6.2.5 Summary of Nuclear Greenhouse Gas Emissions Compared to Coal

Because coal is the fuel most commonly used to generate electricity in the United States, and the burning of coal results in the largest emissions of GHGs for any of the likely alternatives to nuclear power, most of the available quantitative studies have focused on comparisons of the relative GHG emissions of nuclear to coal-fired generation. The quantitative estimates of the GHG emissions associated with the nuclear fuel cycle, as compared to an equivalent coal-fired plant, are presented in Table 6-2.

Table 6-2. Nuclear GHG Emissions Compared to Coal

Source	GHG Emission Results
Mortimer 1990	Nuclear—230,000 tons CO_2 Coal—5,912,000 tons CO_2 Note: Future GHG emissions from nuclear to increase because of declining ore grade
Andseta et al. 1998	Nuclear energy produces 1.4 percent of the GHG emissions compared to coal. Note: Future reprocessing and use of nuclear-generated electrical power in the mining and enrichment steps are likely to change the projections of earlier authors, such as Mortimer (1990).

Spadaro 2000	Nuclear—2.5 to 5.7 g C_{eq}/kWh Coal—264 to 357 g C_{eq}/kWh
Storm van Leeuwen and Smith 2005	Authors did not evaluate nuclear versus coal.
Fritsche 2006 (values estimated from graph in Figure 4)	Nuclear—33 g C_{eq}/kWh Coal—950 g C_{eq}/kWh
POST 2006 (Nuclear calculations from AEA 2006)	Nuclear—5 g C_{eq}/kWh Coal—>1000 g C_{eq}/kWh Note: Decrease of uranium ore grade to 0.03% would raise nuclear to 6.8 g C_{eq} /kWh. Future improved technology and carbon capture and storage could reduce coal-fired GHG emissions by 90 percent.
Weisser 2006 (compilation of results from other studies)	Nuclear—2.8 to 24 g C_{eq}/kWh Coal—950 to 1250 g Ceq/kWh
Fthenakis and Kim (2007)	Authors did not evaluate nuclear versus coal.
Dones 2007	Author did not evaluate nuclear versus coal.

6.2.6 Summary of Nuclear Greenhouse Gas Emissions Compared to Natural Gas

The quantitative estimates of the GHG emissions associated with the nuclear fuel cycle, as compared to an equivalent natural gas-fired plant, are presented in Table 6-3.

Table 6-3. Nuclear GHG Emissions Compared to Natural Gas

Source	GHG Emission Results
Mortimer 1990	Author did not evaluate nuclear versus natural gas.
Andseta 1998	Author did not evaluate nuclear versus natural gas.
Spadaro 2000	Nuclear—2.5 to 5.7 g C_{eq}/kWh Natural Gas—120 to 188 g C_{eq}/kWh
Storm van Leeuwen and Smith 2005	Nuclear fuel cycle produces 20 to 33% of the GHG emissions compared to natural gas (at high ore grades). Note: Future nuclear GHG emissions to increase because of declining ore grade.

Fritsche 2006 (values estimated from graph in Figure 4)	Nuclear—33 g C_{eq}/kWh Cogeneration Combined Cycle Natural Gas—150 g C_{eq}/kWh
POST 2006 (Nuclear calculations from AEA 2006)	Nuclear—5 g C_{eq}/kWh Natural Gas—500 g C_{eq}/kWh Note: Decrease of uranium ore grade to 0.03% would raise nuclear to 6.8 g C_{eq}/kWh. Future improved technology and carbon capture and storage could reduce natural gas GHG emissions by 90%.
Weisser 2006 (compilation of results from other studies)	Nuclear—2.8 to 24 g C_{eq}/kWh Natural Gas—440 to 780 g C_{eq}/kWh
Fthenakis and Kim (2007)	Authors did not evaluate nuclear versus natural gas.
Dones 2007	Author critiqued methods and assumptions of Storm van Leeuwen and Smith (2005), and concluded that the nuclear fuel cycle produces 15 to 27% of the GHG emissions of natural gas.

6.2.7 Summary of Nuclear Greenhouse Gas Emissions Compared to Renewable Energy Sources

The quantitative estimates of the GHG emissions associated with the nuclear fuel cycle, as compared to equivalent renewable energy sources, are presented in Table 6-4. Calculation of GHG emissions associated with these sources is more difficult than the calculations for nuclear energy and fossil fuels because the efficiencies of the different energy sources vary so much by location. For instance, the efficiency of solar and wind energy is highly dependent on the location in which the power generation facility is installed. Similarly, the range of GHG emissions estimates for hydropower varies greatly depending on the type of dam or reservoir involved. Therefore, the GHG emissions estimates for these energy sources have a greater range of variability than the estimates for nuclear and fossil fuel sources.

Table 6-4. Nuclear GHG Emissions Compared to Renewable Energy Sources

Source	GHG Emission Results
Mortimer 1990	Nuclear—230,000 tons CO_2 Hydropower—78,000 tons CO_2 Wind power—54,000 tons CO_2 Tidal power—52,500 tons CO_2 Note: Future GHG emissions from nuclear to increase because of declining ore grade.

Andseta 1998	Author did not evaluate nuclear versus renewable energy sources.
Spadaro 2000	Nuclear—2.5 to 5.7 g C_{eq}/kWh Solar PV—27.3 to 76.4 g C_{eq}/kWh Hydroelectric—1.1 to 64.6 g C_{eq}/kWh Biomass—8.4 to 16.6 g C_{eq}/kWh Wind—2.5 to 13.1 g C_{eq}/kWh
Storm van Leeuwen and Smith 2005	Author did not evaluate nuclear versus renewable energy sources.
Fritsche 2006 (values estimated from graph in Figure 4)	Nuclear—33 g C_{eq}/kWh Solar PV—125 g C_{eq}/kWh Hydroelectric—50 g C_{eq}/kWh Wind—20 g C_{eq}/kWh
POST 2006 (Nuclear calculations from AEA 2006)	Nuclear—5 g C_{eq}/kWh Biomass—25 to 93 g C_{eq}/kWh Solar PV—35 to 58 g C_{eq}/kWh Wave/Tidal—25 to 50 g C_{eq}/kWh Hydroelectric—5 to 30 g C_{eq}/kWh Wind—4.64 to 5.25 g C_{eq}/kWh Note: Decrease of uranium ore grade to 0.03% would raise nuclear to 6.8 g C_{eq}/kWh.
Weisser 2006 (compilation of results from other studies)	Nuclear—2.8 to 24 g C_{eq}/kWh Solar PV—43 to 73 g C_{eq}/kWh Hydroelectric—1 to 34 g C_{eq}/kWh Biomass—35 to 99 g C_{eq}/kWh Wind—8 to 30 g C_{eq}/kWh
Fthenakis and Kim (2007)	Nuclear—16 to 55 g C_{eq}/kWh Solar PV—17 to 49 g C_{eq}/kWh
Dones 2007	Author did not evaluate nuclear versus renewable energy sources.

6.2.8 Conclusions

Estimating the GHG emissions associated with current nuclear energy sources is challenging because of differing assumptions and noncomparable analyses performed by the various authors. The differences and complexities in these assumptions and analyses increase when

using them to project future GHG emissions. However, even with these differences, the NRC staff can draw several conclusions.

First, the studies indicate a consensus that nuclear power currently produces fewer GHG emissions than fossil-fuel-based electrical generation. Based on the literature review, the lifecycle GHG emissions from the complete nuclear fuel cycle currently range from 2.5 to 33 g C_{eq}/kWh. The comparable lifecycle GHG emissions from the current use of coal range from 264 to 1250 g C_{eq}/kWh, and GHG emissions from the current use of natural gas range from 120 to 780 g C_{eq}/kWh. The existing studies also provided estimates of GHG emissions from five renewable energy sources, based on current technology. These estimates included solar-photovoltaic (17 to 125 g C_{eq}/kWh), hydroelectric (1 to 64.6 g C_{eq}/kWh), biomass (8.4 to 99 g C_{eq}/kWh), wind (2.5 to 30 g C_{eq}/kWh), and tidal (25 to 50 g C_{eq}/kWh). The range of these estimates is very wide, but the general conclusion is that the current GHG emissions from the nuclear fuel cycle are of the same order of magnitude as those for these renewable energy sources.

Second, the studies indicate no consensus on future relative GHG emissions from nuclear power and other sources of electricity. There is substantial disagreement among the various authors regarding the GHG emissions associated with declining uranium ore concentrations, future uranium enrichment methods, and other factors, including changes in technology. Similar disagreement exists regarding future GHG emissions associated with coal and natural gas electricity generation. Even the most conservative studies conclude that the nuclear fuel cycle currently produces fewer GHG emissions than fossil-fuel-based sources, and are expected to continue to do so in the near future. The primary difference between the authors is the projected cross-over date (the time at which GHG emissions from the nuclear fuel cycle exceed those of fossil-fuel-based sources) or whether cross-over will actually occur at all.

Considering the current estimates and future uncertainties, it appears that GHG emissions associated with the proposed IP2 and IP3 relicensing action are likely to be lower than those associated with fossil-fuel-based energy sources. The NRC staff bases this conclusion on the following rationale:

(1) The current estimates of GHG emissions from the nuclear fuel cycle are far below those for fossil-fuel-based energy sources.

(2) IP2 and IP3 license renewal will involve continued uranium mining, processing, and enrichment, but will not result in increased GHG emissions associated with plant construction or decommissioning (as the plant will have to be decommissioned at some point whether the license is renewed or not).

(3) Few studies predict that nuclear fuel cycle emissions will exceed those of fossil fuels within a timeframe that includes the IP2 and IP3 periods of extended operation. Several studies suggest that future extraction and enrichment methods, the potential for higher grade resource discovery, and technology improvements could extend this timeframe.

With respect to comparison of GHG emissions between the proposed IP2 and IP3 license renewal action and renewable energy sources, it appears likely that there will be future technology improvements and changes in the type of energy used for mining, processing, and constructing facilities in both areas. Currently, the GHG emissions associated with the nuclear fuel cycle and renewable energy sources are within the same range. Because nuclear fuel production is the most significant contributor to possible future increases in GHG emissions

from nuclear power, and because most renewable energy sources lack a fuel component, it is likely that GHG emissions from renewable energy sources would be lower than those associated with IP2 and IP3 at some point during the period of extended operation.

6.3 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

10 CFR Part 63. Code of Federal Regulations, Title 10, *Energy,* Part 63, "Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada."

40 CFR Part 191. Code of Federal Regulations, Title 40, *Protection of Environment*, Part 191, "Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Waste."

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7.0 ENVIRONMENTAL IMPACTS OF DECOMMISSIONING

Environmental impacts from the activities associated with the decommissioning of any reactor before or at the end of an initial or renewed license are evaluated in NUREG-0586, Supplement 1, "Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities: Supplement 1, Regarding the Decommissioning of Nuclear Power Reactors" (NRC 2002). The U.S. Nuclear Regulatory Commission (NRC) staff's evaluation of the environmental impacts of decommissioning presented in NUREG-0586, Supplement 1, identifies a range of impacts for each environmental issue.

The incremental environmental impacts associated with decommissioning activities resulting from continued plant operation during the renewal term are discussed in NUREG-1437, Volumes 1 and 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (hereafter referred to as the GEIS) (NRC 1996, 1999).[(1)] The GEIS includes a determination of whether the analysis of the environmental issue could be applied to all plants and whether additional mitigation measures would be warranted. Issues were then assigned a Category 1 or a Category 2 designation. As set forth in the GEIS, Category 1 issues are those that meet all of the following criteria:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

For issues that meet the three Category 1 criteria, no additional plant-specific analysis is required unless new and significant information is identified.

Category 2 issues are those that do not meet one or more of the criteria for Category 1; therefore, additional plant-specific review of these issues is required. There are no Category 2 issues related to decommissioning.

7.1 Decommissioning

Category 1 issues in Table B-1 of Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of Title 10, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," of the *Code of Federal Regulations* (10 CFR Part 51) that are applicable to IP2 and IP3 decommissioning following the renewal term are listed in Table 7-1. Entergy Nuclear Operations, Inc. (Entergy), stated in the IP2 and IP3 environmental report (ER) (Entergy 2007) that it is not aware of any new and significant information regarding the environmental impacts of IP2 and IP3 license renewal, though it did identify leaks from spent fuel pools as a potential new issue. The NRC staff

(1) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the GEIS include the GEIS and its Addendum 1.

addressed this issue in Sections 2.2.7, 4.3, and 4.5 of this supplemental environmental impact statement (SEIS). In Section 4.5, the NRC staff concludes that the abnormal liquid releases (leaks) discussed by Entergy in its ER, while new information, are within the NRC's radiation safety standards contained in 10 CFR Part 20 and are not considered to have a significant impact on plant workers, the public, or the environment (i.e., while the information related to spent fuel pool leakage is new, it is not significant).

The NRC staff has not identified any information during its independent review of the IP2 and IP3 ER (Entergy 2007), the site visit, the scoping process, or its evaluation of other available information that is both new and significant. Therefore, the NRC staff concludes that there are no impacts related to the Category 1 issues applicable to the decommissioning of IP2 and IP3 beyond those discussed in the GEIS. For all of these issues, the NRC staff concluded in the GEIS that the impacts are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 7-1. Category 1 Issues Applicable to the Decommissioning of IP2 and IP3 Following the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Section
DECOMMISSIONING	
Radiation doses	7.3.1
Waste management	7.3.2
Air quality	7.3.3
Water quality	7.3.4
Ecological resources	7.3.5
Socioeconomic impacts	7.3.7

A brief description of the NRC staff's review and the GEIS conclusions, as codified in Table B-1, 10 CFR Part 51, for each of the issues follows:

- <u>Radiation doses</u>. Based on information in the GEIS, the Commission found the following:

  Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem caused by buildup of long-lived radionuclides during the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no radiation dose impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Waste management. Based on information in the GEIS, the Commission found the following:

  Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts from solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Air quality. Based on information in the GEIS, the Commission found the following

  Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts on air quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Water quality. Based on information in the GEIS, the Commission found the following:

  The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts on water quality associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Ecological resources. Based on information in the GEIS, the Commission found the following:

  Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no impacts on ecological resources associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

- Socioeconomic Impacts. Based on information in the GEIS, the Commission found the following:

> Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth.

The NRC staff has not identified any new and significant information during its independent review of the IP2 and IP3 ER, the site visit, the scoping process, or its evaluation of other available information. Therefore, the NRC staff concludes that there are no socioeconomic impacts associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

7.2 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

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8.0 ENVIRONMENTAL IMPACTS OF ALTERNATIVES TO LICENSE RENEWAL

This chapter examines the potential environmental impacts associated with (1) a closed-cycle cooling system alternative to replace the Indian Point Nuclear Generating Unit No. 2 (IP2) and Unit No. 3 (IP3) existing once-through cooling-water systems, (2) denying the renewal of both operating licenses for IP2 and IP3 (i.e., the no-action alternative), (3) replacing the electric generation capacity of both units with alternative electric-generation sources or energy conservation, (4) importing electric power from other sources to replace power generated by IP2 and IP3, and (5) combinations of generation and conservation measures to replace power generated by IP2 and/or IP3. In addition, this chapter briefly discusses other alternatives that were deemed unsuitable to replace power generated collectively by IP2 and IP3.

As NRC staff indicated in its 1996 statements of consideration in promulgating the final license renewal environmental rules (61 FR 28467; June 5, 1996), NRC staff evaluates alternative energy sources as direct alternatives to license renewal, and not simply as consequences of the no-action alternative. Many comments received by the staff after the publication of the draft SEIS appear to conflate energy alternatives with the no-action alternative. Whether NRC renews a license or not, all alternatives to license renewal are available to energy planning decision makers. Continued operation, however, is only an available option if NRC grants renewed licenses. NRC evaluates, in this chapter, likely environmental impacts from alternatives in order to provide a comparison that allows NRC to determine whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable (NRC's "decision standard" from 10 CFR 51.95(c)(4)).

This chapter contains a number of updated or revised discussions in response to comments on the draft SEIS. First, NRC staff no longer considers a restoration-based alternative for complying with New York State Department of Environmental Conservation (NYSDEC) determinations on aquatic impacts from IP2 and IP3. As indicated in several comments NRC staff received on the draft SEIS, the U.S. Second Circuit Court of Appeals has held that habitat restoration is an impermissible means of complying with 316(b) (in *Riverkeeper I* and *Riverkeeper II*). Because the restoration alternative relied on habitat restoration to meet 316(b) goals, and would not be capable of meeting 316(b) goals in the absence of the restoration portion, the NRC staff has removed the restoration alternative from this SEIS.

The NRC staff has also removed the coal-fired alternative from the range of alternatives considered in depth (though staff has retained the discussion from the draft SEIS in Section 8.3.4, Alternatives Dismissed from Individual Consideration, based partly on comments regarding greenhouse gas and permitting restrictions in New York State, as well as on indications from the U.S. Department of Energy that coal use in New York State power generation is markedly declining. The Staff has also updated its combination alternatives, recognized that a gas-fired facility could also be a repowering project at an existing power plant, and upgraded its consideration of energy conservation to a full alternative given projections from New York State's energy efficiency (here used interchangeably with energy conservation) programs.

As in the draft SEIS, the NRC staff considered an alternative to the existing IP2 and IP3 cooling-water systems because the New York State Department of Environmental Conservation

(NYSDEC) identified closed-cycle cooling (e.g., cooling towers) as the best technology available (BTA) to reduce fish mortality in the draft New York State Pollutant Discharge Elimination System (SPDES) discharge permit (NYSDEC 2003a). This alternative is described in Section 8.1 of this SEIS. IP2 and IP3 have been operating under timely renewal provisions of the New York SPDES permit process since 1992. In 2004, NYSDEC issued a revised draft SPDES permit, including the BTA determination. The requirements, limits, and conditions of the draft SPDES permit had not been finalized at the time the NRC staff performed the assessment presented in this SEIS, and are subject to ongoing adjudication.

The environmental impacts of alternatives are evaluated using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed based on the Council on Environmental Quality (CEQ) guidelines and set forth in the footnotes to Table B-1 of Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of Title 10, Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions," of the *Code of Federal Regulations* (10 CFR Part 51). The following definitions are used for each category:

> SMALL—Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE—Environmental effects are sufficient to alter noticeably, but not to destabilize important attributes of the resource.
>
> LARGE—Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

The impact categories evaluated in this chapter are the same as those used in NUREG-1437, Volumes 1 and 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (hereafter referred to as the GEIS) (NRC 1996, 1999)[(1)] with the additional impact categories of environmental justice and transportation.

8.1 Alternatives to the Existing IP2 and IP3 Cooling-Water System

IP2 and IP3 currently use once-through cooling-water systems that withdraw water from and discharge water to the Hudson River as described in Section 2.1.3 of this SEIS. The circulating water systems for IP2 and IP3 include two intake structures, each containing seven pumps. The maximum flow rate for the facility is 6,553,000 lpm (1,731,000 gpm) IP2 uses dual-speed pumps and IP3 uses variable-speed pumps.

Warm discharge water from IP2 and IP3 flows from the condensers through six pipes that are 2.4 meters (m) (94 inches (in.)) in diameter and exits beneath the water surface into a discharge canal 12 m (39 feet (ft)) wide. Water flows from the discharge canal to the Hudson River through an outfall structure located south of IP3 at a discharge velocity of about 3.7 meters per second (mps) (12 feet per second (fps)). The design of the outfall is intended to reduce the thermal impact the warm water may potentially have on the river. An assessment of the impacts

(1) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the GEIS include the GEIS and its Addendum 1.

of the current cooling-water system on the environment is presented in Section 4.1 of this SEIS.

Surface water withdrawals and discharges at IP2 and IP3 are regulated under the New York SPDES permit program. In 1975, the U.S. Environmental Protection Agency (EPA) issued National Pollutant Discharge Elimination System (NPDES) permits for the facility. Subsequently, the NYSDEC issued an SPDES permit for the facility in 1987. In 1992, a timely renewal application was filed with the NYSDEC, and terms of the 1992 SPDES have been continued under provisions of the NY State Administrative Procedure Act. Petitioners commenced proceedings in 2002 to mandate that the NYSDEC act on the SPDES permit renewal application. On April 8, 2003, the NYSDEC proposed to modify the SPDES permit to require that IP2 and IP3 reduce the impacts to aquatic organisms caused by the once-through cooling systems and that Entergy Nuclear Operations, Inc. (Entergy), complete a water quality review. NYSDEC published a draft SPDES permit in 2003 (NYSDEC 2003), and then issued a revised draft SPDES permit on March 2, 2004 (NYSDEC 2010a). The 2003 draft and 2004 revised draft identified closed-cycle cooling as the BTA. NYSDEC affirmed this perspective in its April 2, 2010, Notice of Denial of Entergy's Clean Water Act Section 401 Water Quality Certification (NYSDEC 2010b), indicating that closed cycle cooling would minimize aquatic impacts (the denial itself is currently subject to further state-level adjudication). Also, NYSDEC has published a draft policy on BTA (NYSDEC 2010c) indicating that "Wet closed-cycle cooling or its equivalent" is the "minimum performance goal for existing industrial facilities that operate a CWIS [cooling water intake system] in connection with a point source thermal discharge. . ." The policy is in draft form and NYSDEC received public comments through July 9, 2010.

The revised draft SPDES permit requires that immediate and long-term steps be taken to reduce the adverse impacts on the Hudson River estuary once the permit is issued (NYSDEC 2004). The short-term steps include mandatory outage periods, reduced intake during certain times, continued operation of fish-impingement mitigation measures, the payment of $24 million to a Hudson River Estuary Restoration Fund, and various studies. In the long term, IP2 and IP3 will have to implement the BTA to minimize environmental impacts to the aquatic ecology. Should the BTA determination in the revised draft SPDES permit go into effect, final implementation of the BTA is subject to NRC's approval only insofar as the NRC oversees the plant's safety performance and ability to cool itself.).

Specifically, the revised draft SPDES permit states the following:

> Within six months of the effective date of this permit, the permitee must submit to the NYSDEC…its schedule for seeking and obtaining, during its permit term, all necessary approvals from the NRC, Federal Energy Regulatory Commission (FERC), and other government agencies to enable construction and operation of closed-cycle cooling at Indian Point.

NYSDEC (2004) has also indicated that any alternative technology or technologies may be proposed for IP2 and IP3 within 1 year of the permit's effective date. These technologies must be able to minimize the adverse environmental impacts to a level equivalent to that achieved by a closed-cycle cooling system at IP2 and IP3 (NYSDEC 2004).

The NYSDEC identified construction and operation of a closed-cycle cooling system at IP2 and IP3 as its preferred alternative to meet current national performance standards for impingement and entrainment losses. Entergy indicates that Entergy or its predecessors have proposed and

NYSDEC has rejected the following alternative cooling technologies as described in the IP2 and IP3 ER (Entergy 2007). As a result, these options are not discussed further in this SEIS.

- Evaporative ponds, spray ponds, or cooling canals all require significantly more land area than exists at the site.
- Dry cooling towers, which rely totally on sensible heat transfer, lack the efficiency of wet or hybrid towers using evaporative cooling, and thus require a far greater surface area than is available at the site. Additionally, because of their lower efficiency, dry towers are not capable of supporting condenser temperatures necessary to be compatible with IP2 or IP3 turbine design and, therefore, are not a feasible technology.
- Natural draft cooling towers, while potentially feasible, would be 137 to 152 m (450 to 500 ft) above ground level with significant adverse aesthetic impacts in an important viewshed corridor. This option also would raise water vapor plume-related and sound effects concerns. In the original EPA permitting proceeding, New York State opposed natural draft cooling towers on aesthetic grounds.
- Single-stage mechanical-draft wet cooling towers were eliminated for a number of reasons including, but not limited to, the dense water vapor plumes that may compromise station operations (including visual signaling) and equipment over time, and result in increased noise (Enercon 2003).

The EPA has concluded that, in some circumstances, retrofitting a plant to a closed-cycle cooling system lacks demonstrated feasibility or economic practicality (EPA 2004). In addition, Entergy asserts that retrofitting facilities the size and configuration of IP2 and IP3 with a closed-cycle cooling system is neither tried nor proven (Entergy 2007). Entergy also considers mitigation measures currently implemented to protect aquatic wildlife as part of the once-through cooling system to be adequate in terms of minimizing impacts from current operations and operations during the license renewal period (Entergy 2007).

Entergy expressed a number of concerns regarding financial or technical issues related to a closed-cycle cooling retrofit (Entergy 2007), including high cost, a lengthy forced outage, and lost power output due to parasitic losses from new cooling system components

Entergy notes that replacement power during the outage may carry negative air quality impacts, and that the outage may have negative impacts on electric-system reliability and market pricing.

Finally, Entergy indicates that closed-cycle cooling would result in a loss of generating capacity due to lowered thermal efficiency and parasitic loads related to cooling system pumps and auxiliary systems (an average annual loss of 88 megawatts electric [MW(e)], per unit) because of power demands of the closed-cycle system (Entergy 2010).

In the following chapter, the NRC staff will evaluate the environmental impacts associated with installing a closed-cycle cooling system at Indian Point, as well as the environmental impacts associated with a potentially-equivalent combination of plant modifications and restoration activities. Regardless of the NRC staff's findings, the NRC does not have the regulatory authority to implement the requirements of the Clean Water Act (CWA), and it is not up to the NRC staff to judge the validity of Entergy's or others' claims in the ongoing NYSDEC SPDES permit process.

In 2004, EPA issued regulations for reducing impingement and entrainment losses at existing electricity-generating facilities (EPA 2004). These regulations, known as the Phase II rule, established standards for compliance with the requirements of Section 316(b) of the CWA, which calls for intake structures to reflect the BTA for minimizing adverse environmental impact. The EPA's Phase II rule established two compliance alternatives that reduce impingement mortality by 80 to 95 percent of baseline and reduce organism entrainment by 60 to 90 percent of baseline (EPA 2004). These regulations supported the requirements of the draft New York SPDES permit's requirement that immediate and long-term steps be taken to minimize adverse impacts on the Hudson River estuary.

The EPA's rules concerning Phase II of Section 316(b) of the CWA were struck down by the U.S. Court of Appeals in the Second Circuit in January 2007. The Court also mandated the conduct of a cost-benefit analysis under Section 316(b) of the CWA. Specifically, the EPA suspended 40 CFR 122.2(r)(1)(ii) and (5) and Subpart J, "Requirements Applicable to Cooling Water Intake Structures for Phase II Existing Facilities Under Section 316(b) of the Act," of 40 CFR Part 125, "Criteria and Standards for the National Pollutant Discharge Elimination System," with the exception of 40 CFR 125.90(b) (EPA 2007). On April 1, 2009, the Supreme Court ruled that EPA may permissibly use cost-benefit analyses in its Phase II rule, though EPA has yet to reinstate or reissue the rule. Nonetheless, the 1987 SPDES permit remains in effect, pending the conclusion of State-level administrative and legal proceedings.

8.1.1 Closed-Cycle Cooling Alternative

Entergy's preferred close-cycle alternative consists of two hybrid mechanical-draft cooling towers (Enercon 2003, Entergy 2007). IP2 and IP3 would utilize one cooling tower, each, for a total of two towers onsite. Entergy rejected single-stage mechanical draft cooling towers, indicating that the dense water vapor plumes from the towers may compromise station operations (including visual signaling) and equipment over time, and single-stage towers may result in increased noise (Enercon 2003).

Entergy asserts that a hybrid mechanical-draft cooling tower system, also referred to as a "wet/dry" or "plume-abated" mechanical-draft cooling tower, addresses some of the shortcomings of the cooling system types described in Section 8.1 (Entergy 2007). In the ER, Entergy indicates that hybrid towers are "appreciably more expensive" than single-stage towers (Entergy 2007).

A hybrid tower consists of a standard efficiency wet tower segment combined with a dry heat exchanger section above it. The dry section eliminates visible plumes in the majority of atmospheric conditions. After the plume leaves the lower "wet" section of the tower, it travels upward through a "dry" section where heated, relatively dry air is mixed with the plume in the proportions required to achieve a nonvisible plume. Because of the "dry" section, which is on top of the "wet" section, hybrid towers are slightly taller than comparable wet towers and require a larger footprint (Entergy 2007). A potential exists for increased noise from additional fans in the dry section, although Entergy indicates that sound effects can be attenuated (Entergy 2007).

Portions of the site where Entergy could construct cooling towers are heavily forested, with rocky terrain and some steep slopes. Entergy indicates that these areas can be more environmentally sensitive and costly to build on.

The NRC staff has previously assessed closed cycle cooling with a hybrid cooling tower in the license renewal SEIS for Oyster Creek Nuclear Generating Station (OCNGS) (NRC 2006). The NRC staff finds that a hybrid cooling tower system is a reasonable design for the purpose of evaluating potential environmental impacts in a NEPA document. However, the NRC staff does not intend for this analysis to prejudice potential requirements imposed by NYSDEC or other authorities.

8.1.1.1 Description of the Closed-Cycle Cooling Alternative

As described in the Entergy's "Engineering Feasibility and Costs of Conversion of Indian Point Units 2 and 3 to a Closed-Loop Condenser Cooling Water Configuration" (Enercon 2010, prepared for Entergy), new hybrid cooling towers would be large, approximately 160 m (525 ft) in diameter and 50 m (165 ft) high. To provide construction access for tower erection and clearance for air intake, the excavation diameter for each tower would be approximately 215 m (700 ft) (Enercon 2010). The locations for the IP2 and IP3 towers are expected to be approximately 305 m (1000 ft) north of the IP2 reactor and approximately 305 m (1000 ft) south of the IP3 reactor, respectively (Entergy 2007). A detailed description of a round hybrid cooling tower conceptual design is presented in the 2010 engineering feasibility and cost evaluation (Enercon 2010). Crews excavating areas for the cooling tower basins and associated piping will need to blast substantial amounts of rock during the construction process.

As noted in Section 8.1, the closed-cycle cooling alternative would introduce parasitic losses from additional pumps and other equipment. The new circulating pumps would likely be housed in a new pumphouse located along the discharge canal (Enercon 2010). The new, enclosed pumphouse would supply circulating water to the new towers via two concrete-lined steel pipes 3 m (10 ft) in diameter. Flow from the cooling tower basin to the condenser is expected via two pipes 3.7 m (12 ft) in diameter (Enercon 2010).

Enercon also reported that two dedicated substations would likely supply electricity to the closed-cycle cooling system from the 138-kilovolt (kV) offsite switchyard. The substation transformers, switch gear, and system controls for each tower and pumphouse would be housed in prefabricated metal buildings (Enercon 2003).

8.1.1.2 Environmental Impacts of the Closed-Cycle Cooling Alternative

In this section, the NRC staff addresses the impacts that would occur if Entergy constructs and operates the closed-cycle cooling system described in Section 8.1.1.1. The NRC staff summarizes anticipated impacts of the closed-cycle cooling alternative in Table 8-1. In the areas of land use, terrestrial ecology, terrestrial threatened and endangered species, waste, transportation and aesthetics, the environmental impacts of constructing and operating this closed-cycle cooling system would be greater than the impacts associated with the existing once-through cooling system, primarily due to construction-stage impacts. The closed-cycle cooling alternative significantly reduces impacts to aquatic ecology, including impacts from entrainment, impingement, and heat shock. Impacts to aquatic threatened and endangered species – already SMALL – are also likely to further decline. In the following sections, the NRC staff presents the potential environmental impacts of installing and operating a closed-cycle cooling alternative at Indian Point. The NRC staff addresses impacts for each resource area.

- **Land Use**

Construction of two hybrid mechanical-draft cooling towers would entail significant clearing and

excavation of the currently timbered areas within the IP2 and IP3 exclusion area. Each cooling tower requires an excavated area of approximately 3.6 hectares (ha) (9 acres (ac)). Ultimately, approximately 16 ha (40 ac), most of which is presently wooded (though previously disturbed; ENN 2007), would need to be cleared for the two cooling towers, access roads, and support facilities (Enercon 2003). The towers would be located within the property exclusion area boundary adjacent to existing facilities as described in Section 8.1.1.1.

Unlike the IP2 tower, the proposed IP3 cooling tower would be located in the permanent right-of-way (ROW) easement granted to the Algonquin Gas Transmission Company (AGTC) for constructing, maintaining, and operating the two natural gas pipelines that traverse the IP2 and IP3 site (Entergy 2007, ENN 2010, Enercon 2010). These pipelines transport natural gas under the Hudson River, across the IP2 and IP3 site, and exit the site between Bleakley Avenue and the Buchanan substation (see Figure 2-3 in Chapter 2 of this SEIS for a graphical representation).

Entergy indicates that roughly 305 m (1000 ft) of river bank would be clear-cut and excavated to allow for the installation of the four large-diameter water pipes (two 3-m-diameter supply pipes and two 3.7-m-diameter pipes to each condenser) required for each tower (Entergy 2007). In addition, Enercon reports that the base of each tower would be constructed on bedrock at an elevation of about 9.1 m (30 ft) above mean sea level. This would entail the removal of approximately 2 million cubic yards (cy) (1.5 million cubic meters (m^3)) of material, primarily rock and dirt, using traditional excavation methods as well as a significant amount of blasting (Enercon 2010). This volume of material includes material excavated to allow rerouting of the Algonquin pipeline. Disposal of 2 million cy (1.5 million m^3) of material from the excavations for the cooling towers would create some offsite land use impacts. Excavated material also may be recycled or reused, which would reduce these impacts.

Entergy indicates that ROW easement agreement calls for AGTC to relocate the pipelines at Entergy's request. The FERC would first have to review and approve any such action. Entergy must also provide a suitable location for the pipeline on its land or land that it has acquired (Entergy 2007). Entergy indicates that pipeline relocation may require blasting and could also require Entergy to purchase additional land adjacent to the IP2 and IP3 site if onsite areas aren't suitable for the pipeline (Entergy 2007). Entergy's 2010 feasibility and cost evaluation indicates that relocation would be feasible, through additional regulatory approvals (Enercon 2010).

The IP2 and IP3 site is within New York's Coastal Zone. As indicated in Chapter 2, the IP2 and IP3 site is located adjacent to a Significant Coastal Fish and Wildlife Habitat, as well as a Scenic Area of Statewide Significance. Construction activities, such as grading, excavating, and filling, would require a coastal erosion management permit. Permitting restrictions would influence the construction of the cooling towers but they would not likely prevent Entergy from building the towers.

Excavation for the cooling towers would cut into the side of the hills east of IP2 and IP3, resulting in the removal of approximately 2 million cy (1.5 million m^3) of material, including mostly rock as well as dirt (Enercon 2010). In areas where the excavation intersects onsite plumes of groundwater contaminated with tritium, strontium-90, and other radionuclides, Entergy expects that excavated material will also be contaminated. The 2010 feasibility and cost evaluation indicates that at least 6350 cy may be contaminated (Enercon 2010). Any contaminated material would require appropriate disposal as radioactive waste. Currently, the

only available disposal site for low-level radioactive wastes is in Clive, Utah.

Entergy's 2010 feasibility and cost study indicated that clean spoils from blasting could be marketed as commodity crushed stone for construction projects, used as mine fill. Entergy could also dispose of spoils in artificial reef projects off the New Jersey and New York coasts, though their analysis indicates that additional permitting requirements may result (Enercon 2010). The NRC staff concludes that construction activities associated with cooling tower installation at IP2 and IP3 would likely result in SMALL to LARGE land use impacts, depending largely on how much material Entergy is able to reuse or recycle, and where Entergy disposes of excavated material that cannot be reused or recycled.

- **Ecology**

Aquatic ecology. Land-clearing and construction activities can cause short-term, localized impacts on streams and rivers from increased site runoff. These impacts are generally mitigated through the use of erosion and sediment controls. Because of the size of the construction area needed for the cooling towers at the IP2 and IP3 site, such measures would be necessary to limit erosion and sediment deposition in the Hudson River. Construction impacts, however, would be relatively short-lived, and would be offset to some degree by reduced water consumption during prolonged outages at IP2 and IP3 when Entergy or its contractors would connect the closed-cycle cooling system to the units.

Following construction, the closed-cycle cooling alternative will significantly reduce operational impacts on streams and rivers compared to the current once-through cooling system. During the summer months, when water use is at its highest, service and cooling tower makeup water would be withdrawn at a rate of approximately 314,000 lpm (83,000 gpm) for the combined needs of IP2 and IP3. This would be a 95.2-percent reduction in water use compared to the existing IP2 and IP3 once-through systems, which have a maximum flow rate of 6,553,000 lpm (1,731,000 gpm). Without modifications to the intake screening technologies, the NRC staff assumes that the reduction in water intake results in an equivalent reduction in entrainment and impingement. Entergy's feasibility and cost evaluation indicates that 4 of the existing 6 circulating water intake bays would be used at each unit, and the existing service water intake bays would also remain in service (Enercon 2010). The staff concludes that this significant reduction in water demand would likely result in a similarly significant reduction in entrainment- and impingement-related losses compared to the losses created by the current once-through cooling system.

New circulating-water intake pumps would likely continue to utilize the Ristroph traveling screens and fish-return system currently in operation (Entergy 2007). The greatest impact of the closed-cycle system would be a reduction in entrainment and impingement of aquatic species. As described in Section 4.1.3.3 of this SEIS, the NRC staff has concluded that the once-through cooling system has a MODERATE impact from impingement and entrainment. The reduction in flow may also reduce impingement or entrainment of the endangered shortnose sturgeon (*Acipenser brevirostrum)* and macroinvertebrates, such as small clams and mussels (bivalves), snails, worms, crustaceans, and aquatic insects. In Section 4.6.1, the NRC staff had indicated that the impacts to the shortnose sturgeon are already SMALL, though additional reductions in effects may occur as a result of reduced flow.

Under a closed-cycle cooling system, most discharged blowdown water is unheated. Because the closed-cycle cooling system discharges a smaller volume of water, and because the water is

cooler than in a once-through system, the extent of thermal impacts - which could range from SMALL to LARGE for the current once-through system, given uncertainty in the facility's thermal impacts – would be reduced. Thus, the effects of thermal shock also decline. However, the discharge water may be higher in salinity and may contain higher concentrations of biocides, minerals, trace metals, or other chemicals or constituents. To maintain compliance with discharge permits, the water may need to be treated.

Overall, operation of the closed-cycle cooling alternative would produce substantially fewer impacts to the aquatic environment relative to those caused by the existing once-through system. The NRC staff concludes that the aquatic ecological impacts (including those to threatened and endangered species) from the construction and operation of the hybrid mechanical-draft closed-cycle cooling alternative for IP2 and IP3 would be SMALL.

Terrestrial ecology. Construction of the closed-cycle cooling alternative would entail clear-cutting of onsite trees and excavation of areas for the two cooling towers as described in the Land Use section. These activities would destroy fragments of onsite eastern hardwood forest habitat (NYSDEC 2007; NYSDEC 2008a; Enercon 2010). Effects of removing these habitats could include localized reductions in productivity or relocations of some species.

Operation of the cooling towers also could have adverse localized impacts on terrestrial ecology. The cooling towers would be 50 m (165 ft) tall and may produce a visible plume as well as minimal ground fog under certain conditions, though hybrid towers of a round configuration minimize these conditions to the maximum extent possible (Enercon 2010). The potential physical impacts from a cooling tower plume include icing and fogging of surrounding vegetation during winter conditions. Icing can damage trees and other vegetation near the cooling towers. The salt content of the entrained moisture (drift) also has the potential to damage vegetation, depending on concentrations (Enercon 2010), though this is reduced by the higher release height and minimized entrainment inherent in the round, hybrid design. Entergy's feasibility and cost evaluation indicate deposition rates for both towers in the area of highest exposure (between the two towers – an area that includes parking lots, Unit 1, and site infrastructure) is 70 percent of the natural ambient salt deposition rate (Enercon 2010). The hybrid cooling towers evaluated in this section have a drift rate of 0.001 percent (Enercon 2010). This amounts to 26 lpm (7 gpm (0.00001 x 70,000 gpm of water)) drift for both towers. The amount and effects of drift would vary depending on a number of factors, including the concentration of salt in the droplets, the size of the droplets, the number of droplets per unit of surface area, the species of plant affected, and the frequency of local precipitation.

Actual measurements of drift deposition have been collected at only a few nuclear plants. These measurements indicate that, beyond about 1.5 kilometer (km) (about 1 mile (mi)) from nuclear plant cooling towers, salt deposition is generally near natural levels (NRC 1996). The NRC staff reported in the GEIS that the salt-drift rate estimated to cause acute injury to the eastern/Canadian hemlock (a particularly sensitive species) is in excess of 940 kilograms (kg) per square kilometer (km^2) (8.4 pounds per acre) per week (NRC 1996), well above the anticipated deposition rates from the IP2 and IP3 cooling towers. Natural deposition is 160 kg per km^2, while the maximum deposition from both towers is 112 kg per km^2 (Enercon 2010).

The NRC staff does not expect bird collisions with cooling towers to be a significant issue. The NRC staff found in the GEIS that impacts from collisions would be SMALL at all plants with existing cooling towers (NRC 1996).

Section 4.6.2 of this SEIS discusses the effects of license renewal on threatened or endangered terrestrial species. The section identifies the endangered Indiana bat (*Myotis sodalis*), the threatened bog turtle (*Clemmys muhlenbergii*), and the New England cottontail (*Sylvilagus transitionalis*), a candidate species, as being potentially affected. However, because of both the site-specific environment and the lack of evidence of the species existing at the facility, potential impacts to these threatened or endangered species are considered SMALL. Nonetheless, should NYSDEC decide that cooling towers must be installed at the site, then appropriate consultation with Fish and Wildlife Service would need to take place regarding the potential for impacts to these species. Entergy noted in its comments (included in Appendix A of this SEIS) that constructing cooling towers may have an effect on the Indiana Bat or its habitat.

While the effects of this alternative—including onsite land clearing and introduction of cooling tower drift—are greater than the effects of the continued operation of the once-through cooling system and are likely to be noticeable, they are not so great that they will have a destabilizing effect on terrestrial resources in the vicinity of IP2 and IP3. The NRC staff concludes that the overall effect on terrestrial ecology would be SMALL to MODERATE.

- **Water Use and Quality**

During construction of the alternative closed-cycle cooling systems at IP2 and IP3, changes in water usage would likely be negligible. Increases may be seen in potable water demand for construction workers and, if concrete is mixed on site, there would be additional demands. However, these water needs would be short lived and would be at least partially offset by a reduction in water use while IP2 and IP3 are in outages to install the closed-cycle cooling system. For the term of construction, the additional water demands would need to be met by the Village of Buchanan, which supplies water to the site. The Village of Buchanan purchases public drinking water from surface water supplies.

The NYSDEC requires a construction general permit for storm water discharges from a project such as construction of the hybrid cooling towers. In addition, the NYSDEC will require a stormwater pollution prevention plan describing the use of silt fencing and other erosion-control management practices that will be used to minimize impacts on surface water quality. The construction project could also affect ground water as a result of dewatering excavations.

Circulating water makeup (30,000 to 61,000 lpm (7800 to 16,000 gpm) for the cooling towers (Enercon 2010) will have a negligible impact on water flow past the site. The estimated flow 150 m (500 ft) off the shoreline is about 34 million lpm (9 million gpm) in a 150-to-180-m (500-to-600-ft)-wide section (Entergy 2007). Therefore, the evaporation loss would be approximately 0.1 percent of the river flow. Further, the estuarine Hudson River is at sea level, and thus the river's water level would not be affected by the cooling towers' consumptive water use.

To compensate for evaporative and discharge losses, makeup water from the Hudson River would be treated to remove silt, suspended solids, biological material, and debris. Makeup water may also need lime softening, a water treatment process that produces a waste sludge that requires disposal. Biocides, such as hypochlorite, are often added to cooling water to diminish the affects of the biofouling organisms (Entergy 2007). Other chemicals, such as acids, dispersants, scale inhibitors, foam suppressants, and dechlorinators may also be needed for water treatment (NRC 1979).

To manage the chemicals and elevated concentrations of dissolved solids in the discharge

water, treatment would likely be necessary in accordance with the IP2 and IP3 site SPDES permit. The use of biocides or any other chemicals would likely require discharge treatment and additional monitoring.

The IP2 and IP3 site does not utilize ground water for cooling operations, service water, or potable water. As such, the continued operation of the site is not expected to affect local ground water supplies (EPA 2008a). Localized dewatering of ground water from excavations will likely be necessary during construction operations, but because this ground water is not used by Entergy or entities off site, and because the ground water discharges to the Hudson River after exiting the IP2 and IP3 site, construction is not likely to affect either ground water quality or ground water use. Any radiologically contaminated groundwater that construction crews encounter on site would need to be treated to meet release criteria before being discharged. As a result of onsite contamination, crews will need to monitor for radionuclides in liquid discharges and in excavations.

Proper controls of runoff and treatment of other site discharges, as well as appropriate treatment of any contaminated groundwater, will not result in significant impacts on the surface water (Hudson River) and evaporation losses are very small. Also, ground water impacts from construction and operation of the cooling towers are expected to be minor. Therefore, the NRC staff concludes that overall impacts to water resources and water quality from the closed-cycle cooling alternative would be SMALL.

- **Air Quality**

The IP2 and IP3 site is located within the New Jersey-New York-Connecticut Interstate Air Quality Control Region (40 CFR 81.13, "New Jersey-New York-Connecticut Interstate Air Quality Control Region"). The air quality nonattainment issues associated with the portions of these States located within a 50-mi radius are related to ozone (8-hour standard) and particulate matter less than 2.5 microns (μm) in diameter ($PM_{2.5}$). The entire States of New Jersey and Connecticut are designated nonattainment areas for ozone (8-hour standard). Several counties in Central and Southeastern New York within a 50-mi radius are also in nonattainment status for the 8-hour ozone standard (EPA 2008b). Air quality would be affected by three different factors: replacement power during construction-related outages, construction activities and vehicles (including worker transportation), and cooling tower operations.

Entergy contractors indicate that prolonged outages of IP2 and IP3, such as would be required to install cooling towers (TRC Environmental Corp [TRC] 2002) would require replacement power from existing generating facilities within the New York City metropolitan area. They assert that replacement of IP2 and IP3 energy output during cooling tower installation would result in substantial increases in regulated air pollutants. To the extent that coal- and natural-gas-fired facilities replace IP2 and IP3 output, the NRC staff finds that some air quality effects would occur. The NRC staff finds that these effects would largely cease when IP2 and IP3 return to service, with the exception of any output lost to lower efficiency and new parasitic loads from the closed-cycle cooling system (an average of approximately 88 MW, with peak losses of 157.6 MW). Additional air quality impacts could result from power that replaces these parasitic and efficiency losses.

Air quality at or near IP2 and IP3 during the construction of the IP2 and IP3 cooling towers would be affected mostly by exhaust emissions from internal combustion engines. These emissions would include carbon monoxide (CO), nitrogen oxides (NO_x), volatile organic

compounds (VOCs), sulfur oxides (SO_x), carbon dioxide (CO_2), and particulate matter 10 µm or less in diameter (PM_{10}) from operation of gasoline- and diesel-powered heavy-duty construction equipment, delivery vehicles, and workers' personal vehicles (these vehicles would also produce or contribute to production of $PM_{2.5}$). The amount of pollutants emitted from construction vehicles and equipment and construction worker traffic would likely be small compared with total vehicular emissions in the region.

As noted in Section 3.3 of the GEIS, a conformity analysis is required for each pollutant when the total direct and indirect emissions caused by a proposed Federal action would exceed established threshold emission levels in a nonattainment area. In the GEIS, the NRC determined that a major refurbishment activity may increase the facility workforce by up to 2300 construction, refurbishment, and refueling personnel during a significant refurbishment outage period. The construction of two new cooling towers at IP2 and IP3 could approximate such conditions; however, Entergy estimates that the construction activities would require an average workforce of 300 additional workers with a maximum of about 600 workers (Enercon 2003). Because IP2 and IP3 are in a nonattainment area for ozone, and emissions from vehicles of the additional workforce may exceed the ozone air quality thresholds, a conformity analysis would be required before construction.

Fugitive dust, a contributor to PM_{10}, would be generated from site clearing and construction traffic, blasting, and excavation. Given the size of the disturbed area that would be involved (about 16 ha (40 ac)), and assuming that dust management practices would be applied (e.g., watering, silt fences, covering soil piles, revegetation), the fugitive dust impacts generated during construction should be minor. Furthermore, the amount of road dust generated by the vehicles traveling to and from the site transporting workers or hauling rock and dirt would contribute to PM_{10} concentrations. Construction stage impacts, though significant, would be relatively short lived.

Operation stage impacts could be more significant. As previously discussed, the cooling towers would emit tower drift consisting of water, salt, and suspended solids. These emissions would be considered PM_{10}, and some portion may include $PM_{2.5}$. Because IP2 and IP3 are located in a nonattainment area for $PM_{2.5}$, a conformity analysis for the cooling towers would be necessary and may result in additional restrictions on emissions, additional compensatory measures, or further control of drift from the towers. Entergy's feasibility and cost study indicates that particulate emissions would be so great that it may not be possible to obtain construction and air permits (Enercon 2010).

Should operational air quality impacts cause air quality to worsen and thus further exceed limits, the effect would be MODERATE or greater, though some level of emissions trading would limit this impact. During construction, air quality effects would be controlled by site practices and compensatory measures required to maintain compliance with the Clean Air Act (CAA) (should a conformity analysis show the need to take other action). Also, replacement power would be required to comply with CAA requirements (and it would be short lived). Overall, the air quality effects would be driven by operational impacts, and could be SMALL to LARGE, depending on the towers' compliance with CAA requirements and the availability of PM2.5 allowances.

- **Waste**

Construction of the closed-cycle cooling alternative at IP2 and IP3 would generate some construction debris and an estimated 2 million cy (1.5 million m^3) of rock and soil (Entergy

2007). This material may be affected by onsite radiological contamination or by other previous site activities. Depending on the characteristics of the material, it may be possible to reuse or recycle much of it, as discussed in the Land Use portion of this section. If the material cannot be reused or recycled, it will have to be properly managed as a waste. Whether reused, recycled, or disposed of, the material will have to be transported off site. Given the likely size of blasting spoil particles, an onsite crushing operation may be necessary (Enercon 2010).

If disposed of, rather than reused or recycled, the waste may require additional offsite land use. Entergy's feasibility and cost evaluation indicates that at least 6350 cy (4850 m^3; approximately 0.3 percent) is likely to be contaminated, and that contaminated spoils would need to be disposed of as Class A Waste (Enercon 2010). The only current outlet for Class A Waste is in Clive, Utah. Contaminated wastes would need to be appropriately packaged and transported. However, Entergy's feasibility and cost evaluation also indicates that all material, even if it contains low levels of contamination, could possibly be disposed of in the ocean.

Some solid wastes may be generated by water treatment processes. Any such waste would be treated and/or disposed of in accordance with State solid waste regulations. During operation, Entergy will have to maintain release of solids and chemicals to the blowdown water and, subsequently, to the discharge canal and the Hudson River in accordance with IP2 and IP3 SPDES permits. Other solid wastes from tower operation and maintenance (including sludge from the tower basins) would be managed and disposed of in accordance with applicable State regulations at approved offsite facilities. As noted in the Water Quality portion of this section, any contaminated ground water produced by dewatering operations will need to be properly treated before discharge.

Though a large volume of rock and soil would require offsite transportation, at least one disposal option – ocean dumping – would require no additional land.. The NRC staff concludes that waste-related impacts associated with the closed-cycle cooling alternative at IP2 and IP3 could range from SMALL to LARGE, depending on where Entergy disposes of the material, whether the material can be reused or recycled, and the extent to which contaminated spoils require special disposal.

- **Human Health**

Human health impacts for an operating nuclear power plant are identified in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. Potential impacts on human health from the operation of closed-cycle cooling towers at nuclear power plants are evaluated in Section 4.3.6 of the GEIS.

During construction activities there would be risk to workers from typical industrial incidents and accidents. Accidental injuries are not uncommon in the construction industry and accidents resulting in fatalities do occur. However, the occurrence of such events is mitigated by the use of proper industrial hygiene practices, complying with worker safety requirements, and training. Occupational and public health impacts during construction are expected to be controlled by continued application of accepted industrial hygiene protocols, occupational health and safety controls, and radiation protection practices.

Depending on the level of contaminated spoils and groundwater removed during the construction process, it is possible that additional occupational exposures to radiation may occur. Crews would need to comply with existing radiation exposure standards. Given the low level of contamination in soil and groundwater, as well as the limited extent of the

contamination, this is likely not to be a significant issue at the construction site.

Hybrid cooling towers at IP2 and IP3 would be equipped with sound attenuators (Enercon 2010). The topography of the area would provide additional attenuation of the noise levels. An analysis of potential offsite noise levels resulting from both cooling towers operating continuously indicated that the increase in noise levels at sensitive receptor sites would be 1 decibel or less, a level most likely not noticeable by the residents of the Village of Buchanan (Enercon 2010). These sound levels would comply with Village of Buchanan requirements.

The GEIS evaluation of health effects from plants with cooling towers focuses on the threat to workers from microbiological organisms whose presence might be enhanced by the thermal conditions found in cooling towers. The microbiological organisms of concern are freshwater organisms that are present at nuclear plants that use cooling ponds, lakes, or canals and that discharge to small rivers (NRC 1996). Because the closed-cycle system at IP2 and IP3 would operate using brackish water, and because the Hudson River at Indian Point does not meet the NRC's definition of a small river, thermal enhancement of microbiological organisms is not expected to be a concern.

Furthermore, as described in Section 4.3 of this SEIS, the NRC concludes that continued operation of the facility would not increase the impacts of occupational radiation exposures during the relicensing period. Overall, the NRC staff concludes that human health impacts from the closed-cycle cooling alternative would also be SMALL.

- **Socioeconomics**

Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics and social conditions of a region. For example, the number of jobs created by the construction and operation of a closed-cycle cooling could affect regional employment, income, and expenditures. Two types of job creation result from this alternative: (1) construction-related jobs, and (2) operation-related jobs, which have the greater potential for permanent, long-term socioeconomic impacts.

Entergy estimates that construction of the cooling towers would require an average workforce of 300 mostly temporary employees or contractors and could take an estimated 62 months. During the outage phase of the effort, the temporary workforce could peak at 600 (Entergy 2007). For comparison purposes, a workforce of approximately 950 additional workers is on site during a routine refueling outage (Entergy 2007).

As previously described, the impacts of relicensing and refurbishing IP2 and IP3 are addressed in a site-specific case study presented in Appendix C (Section C.4.4) to the GEIS. The case study postulated that major refurbishment activities could result in as many as 2300 workers on site. In the case study, the workers were engaged in a variety of component replacement and inspection activities. The case study employment estimate is significantly larger than Entergy's estimate in the previous paragraph and is considered by the NRC staff to be the maximum potential size of the temporary workforce because the GEIS estimate includes a variety of activities that will not be occurring at Indian Point during an outage to install a closed-cycle cooling system. As of June 2006 the site had approximately 1255 full-time workers (Entergy employees and baseline contractors) during normal plant operations (Entergy 2007).

The GEIS case study concluded that, because the surrounding counties are high population density areas as described in Section 4.4.1 of this SEIS, there will be available housing to

support the influx of workers. Therefore, the GEIS concluded that any construction-related impact on housing availability would likely be small. With even fewer workers on site than anticipated in the GEIS, impacts would be even less noticeable.

As reported by Levitan and Associates, Inc. (2005), payments-in-lieu-of-taxes (PILOT) are made by Entergy to surrounding taxing jurisdictions. The PILOT amounts would not likely be affected by the construction of new closed-cycle cooling systems or other capital expenditures. In accordance with the PILOT agreements, this payment schedule will remain fixed through the term of the current site licenses (Levitan and Associates, Inc. 2005). Because plant valuation is not likely to change drastically with the installation of closed-cycle cooling (though it may increase), PILOT payments are likely to stay at similar relative levels throughout the renewal term.

Electricity costs and grid reliability are outside of the scope of NRC's review, though many commenters have expressed concern about these two issues. The NRC staff notes that the New York Independent System Operator (NYISO) would continue to monitor grid function and reliability, and prices would be established on New York State's restructured electricity market. Approximately 42 weeks of outage would be necessary to complete construction and implement closed-cycle cooling (Enercon 2010).

The NRC staff concludes that most socioeconomic impacts related to construction and operation of cooling towers at the site would be SMALL.

- **Transportation**

Adverse transportation impacts would be likely during construction of cooling towers. The greatest impacts would occur during site excavation and would decline later in construction. These impacts would return to current levels following construction.

Offsite disposal of approximately 2 million cy (1.5 million m^3) of rock and soil from the excavation of the two cooling tower sites would be expected to have a significant impact on local transportation infrastructure. As indicated by Entergy's feasibility and cost evaluation, the blasting and excavation phase of construction would take approximately four years to complete (Enercon 2010). Given 20 cy dump trucks, approximately 100,000 round trips would be needed to remove the excavated materials. During peak excavation periods, 364 to 518 truck loads would leave the site each day. Much of this material could leave the site on barges in the Hudson River (Enercon 2010). Entergy's feasibility and cost evaluation indicates that barge transportation is the most likely option for reused and recycled blasting spoils (Enercon 2010). Earlier estimates by Entergy indicated that each barge may hold 1000 tons of spoils.

Road traffic in the area is heavy and the additional traffic from construction and site workers would cause increased traffic delays, particularly along US Highway 9 and State Highway 9A (Entergy 2007). Barged material may be transferred to trucks at transshipment points along the Hudson, though this is likely to have markedly lower impacts on transportation than if all spoils were trucked offsite along surface roads near Indian Point. In some cases, though, impacts could still be significant. If barged material were transported out to sea and disposed of there, then NRC staff expects that impacts on transportation would be minor.

During operations, NRC staff anticipates that the closed-cycle cooling system would have little to no effect on transportation, and would likely be limited to occasional shipments of waste

cleaned out from cooling tower basins, occasional deliveries of chemicals used to prevent fouling of the towers, and any replacement components necessary throughout the life of the towers. As noted previously, fogging and icing is not expected to be significant.

Based on independent calculations of expected waste volumes from site excavations that were on the same order of magnitude as the Entergy estimates, the NRC staff concludes that impacts from transportation activities, primarily during excavation of the construction site, could be significant and destabilizing, though temporary, during construction and will not be noticeable during operations. Impacts, then, will be SMALL during operations, but SMALL to LARGE during construction.

- **Aesthetics**

IP2 and IP3 are already visible from the Hudson River, scenic overlooks on area highways, and the Palisades Interstate State Park. The property is adjacent to the Scenic Area of Statewide Significance. The addition of the two cooling towers, standing 50 m (165 ft) in height, would make the entire facility more visible as the developed footprint of the facility would be expanded (Entergy's feasibility and cost evaluation includes site renderings to illustrate visual impacts; Enercon 2010. The towers are more aesthetically similar to austere, international-style performance or convention centers than to the hyperbolic natural draft towers many associate with nuclear power plant sites). The clear-cutting of wooded areas for construction of the towers would remove a visual buffer for some site structures. The towers themselves would be clearly visible from offsite vantage points. Entergy has indicated that it would preserve as many trees as possible and that it would plant new trees to reestablish some visual buffers and help attenuate noise (Entergy 2007). Remaining and new trees could act as a partial visual buffer between the construction sites and the river and a visual and noise buffer on land (Entergy 2007).

While the hybrid mechanical-draft cooling towers under consideration are designed to reduce fog and ice production in the local area and minimize presence at ground level, fog and ice produced during operation could still occur. In particular, a visible plume, though attenuated by the hybrid design, may occur under certain meteorological conditions during the year (Enercon 2010). In most cases, these plumes would occur immediately over the towers and Indian Point property, though under worst case conditions, plumes may extend several hundred to thousands of meters (Enercon 2010). Given tower design, it is likely to remain aloft and not occur at ground level thereby reducing the likelihood and severity of fog and ice. Less noticeable moisture and salt deposition from the plume may increase dampness and corrosion on surrounding property, which could affect the visual environment. The circular hybrid design proposed by Entergy disperses remaining drift over a greater area at a lower intensity than a single-stage wet mechanical-draft cooling tower (Enercon 2003).

Given proximity to a Scenic Area of Statewide Significance, Entergy's feasibility and cost evaluation indicates that cooling towers may be incompatible with NYSDEC Visual Policy. From NRC's perspective, this is an issue for Entergy and the State to reconcile, should NYSDEC require cooling towers.

The NRC staff concludes that the impact of construction and operation of a closed-cycle cooling system at IP2 and IP3 on aesthetics would likely be MODERATE to LARGE, given the proximity to important visual resources. Impacts will be greater when atmospheric conditions result in large, visible plumes, and the towers will always be clearly visible.

- **Historic and Archeological Resources**

Should NYSDEC decide that Indian Point must install cooling towers, extensive consultation and further study of onsite historical resources will be necessary. As noted in Section 4.4.5.1 of this SEIS, Entergy's Phase 1b study identified historic and prehistoric resources in the area identified for the south tower (ENN 2009). Based on Entergy's consultation with the New York State Historic Preservation Office, significant additional site study and consultation with other interested groups, particularly Tribal representatives, will be necessary should NYSDEC require cooling tower installation (ENN 2009, NYSHPO 2009). Prior to Entergy's Phase 1b study, a Phase 1A survey was conducted on the property in 2006. The NRC staff identified 76 resources listed on the National Register of Historic Places (NRHP) within 5 miles of IP2 and IP3.

There are registered historically significant buildings and sites within several kilometers of IP2 and IP3 and other nonregistered sites or buildings that may be eligible for registration (NRC 1996). However, the NRC case study presented in the GEIS indicated that some unregistered sites may go unprotected because the sites' significance may be discounted because of their proximity to the IP2 and IP3 facility.

Further studies and consultation with the State Historic Preservation Office and appropriate Native American Tribes, would occur under Section 106 of the National Historic Preservation Act (NHPA) should NYSDEC require that cooling towers be constructed onsite. Any historic or archeological resources are present in previously disturbed areas or in undisturbed areas, they would have to be evaluated for eligibility for listing on the NRHP.

Entergy has procedures for addressing historic and archeological resources (as noted in Section 4.4.5.2), and it has acknowledged the need to survey for unknown resources before construction. As noted in this section, further evaluation and consultation would be necessary prior to cooling tower installation. Historic and archeological resources could be adversely impacted given the potential for historic and prehistoric resources to be discovered on the cooling tower sites. Entergy's early coordination, consultation, and planning could help to reduce or minimize most impacts. . Nonetheless, the NRC staff concludes that the impact from the closed-cycle cooling alternative would likely range from SMALL to MODERATE if historic and archeological resources cannot be avoided.

- **Environmental Justice**

The NRC staff addresses environmental justice impacts of continued operations in Section 4.4.6 of this SEIS. Construction and operation of cooling towers at IP2 and IP3 could have an impact on minority and low-income populations.

The environmental justice impact analysis evaluates the potential for disproportionately high and adverse human health and environmental effects on minority and low-income populations that could result from the construction and operation of a closed-cycle cooling system at Indian Point. Adverse health effects are measured in terms of the risk and rate of fatal or nonfatal adverse impacts on human health. Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant and exceeds the risk or exposure rate for the general population or for another appropriate comparison group. Disproportionately high environmental effects refer to impacts or risk of impact on the natural or physical environment in a minority or low-income community that are significant and appreciably exceeds the environmental impact on the larger community. Such effects may include biological, cultural, economic, or social impacts. Some of these potential effects have been identified in resource areas previously discussed in this section. For example, increased demand for rental housing during construction could disproportionately affect low-income populations. Minority and low-income populations are subsets of the general public residing around IP2 and IP3, and all are exposed to the same hazards generated from constructing and operating a closed-cycle cooling system.

Potential impacts to minority and low-income populations from the construction and operation of a closed-cycle cooling system at Indian Point would mostly consist of environmental and socioeconomic effects (e.g., noise, dust, traffic, employment, and housing impacts). Noise and dust impacts from construction would be short-term and primarily limited to onsite activities. However, minority and low-income populations residing along site access roads could be affected by increased commuter vehicle traffic during shift changes. Increased demand for rental housing during construction of the closed-cycle cooling system could affect low-income populations in the vicinity of IP2 and IP3. However, these effects would be temporary during certain hours of the day and not likely to be high and adverse. Since IP2 and IP3 are located in a high population area and the number of available housing units exceeds demand, any increase in employment would have little or no noticeable effect on the availability of housing in the region. Given the close proximity to the New York metropolitan area, most construction workers would commute to the site thereby reducing the potential demand for rental housing.

As noted earlier in this section, replacement power required during a 42-week outage could increase air quality effects in minority and low-income communities, depending on the location and characteristics of generator units used to replace IP2 and IP3 output. These effects are likely to be short-lived (most will be no longer than the outage period), and may vary with time of year, scheduled outages at other facilities, and generator pricing on the New York Independent System Operator (NYISO) grid. Additionally, impacts would occur near existing facilities and would result from incremental increases rather than new effects. As a result, impacts are likely to be small. Nonetheless, some additional power generation may have to come from other sources to make up for parasitic and efficiency losses. These could contribute to additional air quality and human health impacts. However, it is assumed that emissions from these generator facilities would meet air quality standards.

Based on this information and the analysis of human health and environmental impacts presented in this section, the construction and operation of the closed-cycle cooling system would not have disproportionately high and adverse human health and environmental effects on minority and low-income populations residing in the vicinity of IP2 and IP3.

Table 8-1. Summary of Environmental Impacts of a Closed-Cycle Cooling Alternative at IP2 and IP3

Impact Category	Closed-Cycle Cooling Alternative Impact	Comments
Land Use	SMALL to LARGE	Construction of towers requires about 16 ha (40 ac). Waste disposal may require much offsite land.
Ecology: Aquatic	SMALL	Entrainment and impingement of aquatic organisms, as well as heat shock, would be reduced.
Ecology: Terrestrial	SMALL to MODERATE	Onsite forest habitats disturbed with possible effects to endangered species.
Water Use and Quality	SMALL	Releases to surface water would be treated as necessary to meet permit requirements. Runoff from construction activities is likely to be controlled.
Air Quality	SMALL to LARGE	Primary impacts from operational emissions, as well as replacement power. Existing regulations may limit effects.
Waste	SMALL to LARGE	Construction would generate soil, rock, and debris requiring disposal; impacts vary greatly with disposal options.
Human Health	SMALL	Workers experience minor accident risk and may encounter contaminated blasting spoils during construction, though monitoring will limit potential for impacts.
Socioeconomics	SMALL	No impact to offsite housing or public services occurs.
Transportation	SMALL to LARGE	Increased traffic associated with construction (workers and waste disposal) may be significant, though little effect during operations.
Aesthetics	MODERATE to LARGE	Construction of two towers, 165 ft tall, would have a noticeable impact on the aesthetics of the site. Plume may be highly visible on some days.
Historical and Archeological Resources	SMALL to MODERATE	Recent study indicates potential for resources, though existing procedures should help protect resources on the largely-disturbed site.
Environmental Justice	SMALL	Impacts are not anticipated to be disproportionately high and adverse for minority and low-income communities.

8.2 No-Action Alternative

The NRC regulations implementing the National Environmental Policy Act of 1969, as amended (NEPA) (see 10 CFR Part 51, Subpart A, Appendix A, paragraph 4), specify that the no-action alternative will be discussed in an NRC environmental impact statement.

For license renewal, the no-action alternative refers to a scenario in which the NRC would not renew the IP2 and IP3 operating licenses and Entergy would then cease operating both units on or before the expiration of their current operating licenses. Following the shutdown of each unit, Entergy would initiate decommissioning of the facility in accordance with the NRC decommissioning requirements in 10 CFR 50.82, “Termination of License.” Full dismantling of structures and decontamination of the site may not occur for up to 60 years after plant shutdown.

Regardless of whether or not the IP2 and IP3 operating licenses are renewed, the facility’s owner will eventually be required to shut down the reactors and decommission the IP2 and IP3 facility. If the operating licenses are renewed, shutdown and decommissioning activities would not be avoided but would be postponed for up to an additional 20 years.

The environmental impacts associated with decommissioning, following a license renewal period of up to 20 years or following the no-action alternative, would be bounded by the discussion of impacts in Chapter 7 of the GEIS, Chapter 7 of this SEIS, and NUREG-0586, “Final Environmental Impact Statement on Decommissioning of Nuclear Facilities” (NRC 2002). The impacts of decommissioning after 60 years of operation are not expected to be significantly different from those occurring after 40 years of operation.

1 **Table 8-2. Summary of Environmental Impacts of the No-Action Alternative**

Impact Category	Impact	Comment
Land Use	SMALL	Impacts are expected to be SMALL because plant shutdown is expected to result in few changes to offsite and onsite land use, and transition to alternate uses is expected over an extended timeframe.
Ecology	SMALL	Negative impacts to aquatic ecology of the Hudson River will cease. The overall impact is SMALL.
Water Use and Quality	SMALL	Impacts are expected to be SMALL as no new impacts occur with plant shutdown.
Air Quality	SMALL	Impacts are expected to be SMALL because emissions related to plant operation and worker transportation will decrease.
Waste	SMALL	Impacts are expected to be SMALL because generation of high-level waste will stop and generation of low-level and mixed waste will decrease.
Human Health	SMALL	Impacts are expected to be SMALL because radiological doses to workers and members of the public, which are within regulatory limits, will be reduced.
Socioeconomics	SMALL to MODERATE	Impacts vary by jurisdiction, with some areas experiencing MODERATE effects.
Socioeconomics (Transportation)	SMALL	Impacts are expected to be SMALL because the decrease in employment would reduce traffic.
Aesthetics	SMALL	Impacts are expected to be SMALL because plant structures will remain after plant shutdown.
Historic and Archeological Resources	SMALL	Impacts are expected to be SMALL because shutdown of the plant will not immediately change land use.
Environmental Justice	SMALL	Impacts are not anticipated to be disproportionately high and adverse for minority and low-income populations.

Impacts from the decision to permanently cease operations are not considered in NUREG-0586, or its Supplement 1.[(2)] Therefore, immediate impacts that occur between plant shutdown and the beginning of decommissioning are considered here. These impacts will occur when the units shut down regardless of whether the license is renewed (see Table 8-2).

Plant shutdown will result in a net loss of power generating capacity. The power not generated by IP2 and IP3 during the license renewal term would likely be replaced by (1) power supplied by other producers (either existing or new units) using generating technologies that may differ from that employed at IP2 and IP3, (2) demand-side management and energy conservation, or (3) some combination of these options. The environmental impacts of these options are discussed in Section 8.3 of this SEIS. While these options can be alternatives to license renewal (given sufficient resource availability), they also constitute potential consequences of the no-action alternative. Impacts from these options will addressed in their respective portions of this Section.

This SEIS does not assess the specifics of the need for corrections to reactive power that would be required if IP2 and IP3 were shut down. Reactive power (i.e., power stored in magnetic fields throughout the power grid) is essential for the smooth operation of the transmission grid because it helps hold the voltage to desired levels. It may be possible to use the existing generators at IP2 and IP3 as a source of reactive power even if IP2 and IP3 are shut down. As "synchronous condensers," the generators could add reactive power (but not real power) to the transmission system (National Research Council 2006). Because it is assumed that the generators would be operated as synchronous condensers only until the reactive power could be supported by new, real replacement power generation, their operation is not considered as a significant contributor to the impacts described below. Further, as a shut-down nuclear power plant may not be decommissioned for many years after shutdown, the continued operation of IP2 and IP3 generators would not necessarily slow or impede decommissioning activities.

- **Land Use**

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of continued plant operation on land use would be SMALL. Onsite land use will not be affected immediately by plant shutdowns. Plant structures and other facilities are likely to remain in place until decommissioning. In the near term, the transmission lines associated with IP2 and IP3 will likely remain in place. In the long term, it is possible that the transmission lines that extend from the onsite switchyard to major transmission corridors will be removed. As a result, the transmission line ROWs will no longer be maintained and the ROW will be available for other uses. Also, as a result of plant shutdowns, there would be a reduction in uranium mining activity on approximately 870 ha (2150 ac), or 405 ha (1000 ac) per 1000 MW(e) (NRC 1996). Therefore, the staff concludes that the impacts on land use from plant shutdown would be SMALL.

(2) Appendix J, "Socioeconomic and Environmental Justice Impacts Related to the Decision to Permanently Cease Operations," to NUREG-0586, Supplement 1, discusses the socioeconomic impacts of plant closure, but the results of the analysis in Appendix J are not incorporated in the analysis presented in the main body of the NUREG.

- **Ecology**

In Chapter 4 of this SEIS, the NRC staff concluded that entrainment and impingement of aquatic species would have MODERATE impacts. The NRC staff also concluded that thermal shock could have a SMALL to LARGE impact. Terrestrial ecological impacts were SMALL. Cessation of operations will eliminate cooling water intakes from and discharges to the Hudson River. The environmental impacts to aquatic species, including threatened and endangered species, associated with these changes are generally positive because entrainment and impingement issues will be eliminated, as would impacts from the plant's thermal plume. The NRC staff expects that impacts to aquatic ecology would decline to SMALL if the plant shuts down.

The impacts of plant closure on the terrestrial ecosystem could be both negative and positive, depending on final disposition of the IP2 and IP3 site. Currently, there is a fragment of eastern deciduous hardwood habitat in the exclusion area of the facility that Entergy indicates has not been previously developed. This fragment could be destroyed by new development once access is no longer restricted. Plant closure will not directly affect this fragment, however, and a prolonged period prior to site decontamination may also provide protection for this fragment. Overall, the NRC staff concludes that ecological impacts from shutdown of the plant would be SMALL.

- **Water Use and Quality**

When the plant stops operating and cooling water is no longer needed, there will be an immediate reduction in water withdrawals from and discharge to the Hudson River. This will reduce evaporation from the river in the vicinity of the plant and will result in decreased discharges of biocides and other chemicals. Therefore, the staff concludes that the impacts on surface water use and quality from plant shutdown would be less noticeable than current operations and would remain SMALL.

Ground water at the IP2 and IP3 site contains elevated concentrations of tritium (EPA 2004). In Sections 2.2.7 and 4.5 of this SEIS, the NRC staff examined available information on leakage to ground water and determined that the issue, while new, is not significant. The source of the contamination is believed to be historical leakage from the IP1 and IP2 spent fuel pools. Since discovering the leaks, Entergy has removed fuel from the IP1 spent fuel pool and drained it. The no-action alternative would not, on its own, affect ground water contamination. Consequently, the NRC staff concludes that ground water quality impacts from shutdown of the plant would be SMALL.

- **Air Quality**

In Chapter 4 of this SEIS, the NRC staff adopted the findings in the GEIS that the impacts of continued plant operation on air quality would be SMALL. When the plant stops operating, there will be a reduction in emissions from activities related to plant operation (e.g., use of diesel generators and vehicles to transport workers to the site). As such, the NRC staff concludes that the impact on air quality from shutdown of the plant would be SMALL.

- **Waste**

The impacts of waste generated by continued plant operation are discussed in Chapter 6 of this SEIS. The impacts of low-level and mixed waste from plant operation are characterized as SMALL. When IP2 and IP3 stop operating, the plant will stop generating high-level waste and generation of low-level and mixed waste associated with plant operation will briefly increase, and then will decline. Therefore, the staff concludes that the impacts of waste generated after shutdown of the plant would be SMALL.

Wastes associated with plant decommissioning are unavoidable and will be significant whether the plant is decommissioned at the end of the initial license term or at the end of the period of extended operation. The no-action alternative will not have an appreciable effect on waste volumes associated with decommissioning.

- **Human Health**

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of continued plant operation on human health are SMALL. After cessation of plant operations, the amount of radioactive material released to the environment in gaseous and liquid forms, which are currently within regulatory limits, will be reduced. Therefore, the NRC staff concludes that the impact of plant shutdown on human health also would be SMALL. In addition, the variety of potential accidents at the plant will be reduced to a limited set associated with shutdown events and fuel handling. In Chapter 5 of this SEIS, the staff concluded that impacts of accidents during operation are SMALL. Therefore, the NRC staff concludes that the impacts of potential accidents following shutdown of IP2 and IP3 also would be SMALL.

- **Socioeconomics**

In Chapter 4 of this SEIS, the NRC staff concluded that the socioeconomic impacts of continued plant operation would be SMALL. Should the plant shut down, there would be immediate socioeconomic impacts from loss of jobs (some, though not all, of the approximately 1255 full-time employees and baseline contractors would begin to leave the site); property tax payments to Westchester County may be reduced. These impacts, however, would not be considered significant on a countywide basis because of the large population in the area and because plant workers' residences are not concentrated in a single municipality or county.

PILOT payments and other taxes from IP2 and IP3 are paid directly to the Town of Cortlandt, the Village of Buchanan, and the Hendrick Hudson Central School District. Entergy paid a combined $21.2 million in PILOT payments, property taxes, and other taxes to Westchester County, the Town of Cortlandt, the Village of Buchanan, the Verplanck Fire District, and the Hendrick Hudson Central School District in 2005 (Entergy 2007). PILOT payments, property taxes, and other taxes paid by the site account for a significant portion of revenues for these Government agencies.

The Village of Buchanan, which has over 2100 residents, is the principal local jurisdiction that receives direct revenue from IP2 and IP3. In fiscal year 2005, PILOT payments, property taxes, and other taxes from Entergy contributed about 39 percent of the Village of Buchanan's total revenue of $5.08 million (Entergy 2007). The revenues generated from IP2 and IP3 are used to fund police, fire, health, transportation, recreation, and other community services. Additionally in fiscal year 2005, PILOT payments, property taxes, and other taxes from Entergy contributed

over 35 percent of the total revenue collected for the Hendrick Hudson Central School District, which serves approximately 3000 students (Entergy 2007).

The shutdown of IP2 and IP3 may result in increased property values of the homes in the communities surrounding the site (Levitan and Associates, Inc. 2005). This would result in some increases in tax revenues. However, to fully offset the revenues lost from the shutdown of IP2 and IP3, taxing jurisdictions most likely would have to compensate with higher property taxes (Levitan and Associates, Inc. 2005). The combined increase in property values and increased taxes could have a noticeable effect on some area homeowners and business, though Levitan and Associates did not indicate the magnitude of this effect and whether the net effect would be positive or negative.

Revenue losses from Indian Point operation would affect the communities closest to and most reliant on the plant's tax revenue and PILOT. If property values and property tax revenues increase, some of these effects would be smaller. The NRC staff concludes that the socioeconomic impacts of plant shutdown would likely be SMALL to MODERATE (MODERATE effects for the Hendrick Hudson Central School District, Village of Buchanan, Town of Cortlandt, and the Verplanck Fire District). See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of the potential impacts of plant shutdown.

- **Transportation**

In Chapter 4 of this SEIS, the NRC staff concluded that the impacts of continued plant operation on transportation would be SMALL. Cessation of operations will be accompanied by reduced traffic in the vicinity of the plant. Most of the reduction will be associated with a reduction in plant workforce, but there will also be a reduction in shipment of maintenance materials to and from the plant. Therefore, the staff concludes that the impacts of plant closure on transportation would be SMALL

- **Aesthetics**

In Chapter 4 of this SEIS, the NRC staff concluded that the aesthetic impacts of continued plant operation would be SMALL. Major plant structures and other facilities, such as the containment buildings and turbine buildings, are likely to remain in place until decommissioning begins. The NRC staff also anticipates that the overall appearance of the facility and its grounds would be maintained through the decommissioning. Since no significant changes would occur between shut down and decommissioning, the staff concludes that the aesthetic impacts of plant closure would be SMALL.

- **Historic and Archeological Resources**

In Chapter 4 of this SEIS, the staff concluded that the impacts of continued plant operation on historic and archeological resources would be SMALL. Onsite land use will not be affected immediately by the cessation of operations since plant structures and other facilities are likely to remain in place until decommissioning. Following plant shutdown, there would be no foreseeable need for archeological surveys of the area. Therefore, the NRC staff concludes that the impacts on historic and archeological resources from plant shutdown would be SMALL.

- **Environmental Justice**

In Chapter 4 of this SEIS, the NRC staff concluded that the environmental justice impacts of continued operation of the plant would be SMALL because continued operation of the plant would not have a disproportionately high and adverse impact on minority and low-income populations. Although the NRC staff concluded that the socioeconomic impacts of the plant shutdown would be MODERATE for some jurisdictions, the impacts of the plant shutdown are likely to be felt across the entire community and could disproportionately affect some minority and low-income populations. Some minority and low-income populations located in urban areas could be affected by reduced air quality and increased health risks due to the burning of fossil fuel in existing power plants used to replace the lost power generated by Indian Point.

As described in Section 2.2.8.6, the site contributed over 35 percent of the total revenue collected for the Hendrick Hudson Central School District in 2005. The Hendrick Hudson Central School District has only an 18-percent minority population (compared to a 47-percent Statewide average) and only 5 percent of the students are eligible for a free or reduced-price lunch program (compared to a Statewide average of 44 percent). Therefore, the loss of funding to the Hendrick Hudson Central School District would not disproportionately affect minority and low-income populations (GreatSchools 2008).

The site contributed about 39 percent of the Village of Buchanan's total revenue in 2005 (Entergy 2007). In 2000, less than 4 percent of the population were minorities and less than 4 percent of the individuals were below the poverty level (US Census Bureau 2000). Therefore, the loss of funding to the Village of Buchanan would not disproportionately affect minority and low-income populations.

The NRC staff concludes that the environmental justice impacts of plant shutdown would be SMALL. See Appendix J to NUREG-0586, Supplement 1 (NRC 2002), for additional discussion of these impacts.

8.3 Alternative Energy Sources

This section discusses the environmental impacts associated with developing alternative sources of electric power to replace power generated by IP2 and IP3. The order of alternative energy sources presented in this section does not imply which alternative would be most likely to occur or which is expected to have the least environmental impacts. The NRC staff notes that discussion of supercritical coal-fired generation has been relocated to Section 8.3.

The following central generating station alternatives are considered in detail in the identified sections of this SEIS:

- natural gas combined-cycle (NGCC) generation at either the IP2 and IP3 site or an alternate site (Section 8.3.1)

The NRC staff considers the following nongeneration alternatives to license renewal in detail in the identified sections of this SEIS:

- purchased electrical power (Section 8.3.2)
- energy conservation and efficiency (Section 8.3.3)

The NRC staff also considers two combinations of alternatives that include new or existing generation along with conservation or purchased power in the identified sections of this SEIS:

- continued operation of either IP2 or IP3, renewable generation, and conservation programs (Section 8.3.5.1)
- repowering a retired facility with a new NGCC power plant, renewable generation, and conservation (Section 8.3.5.2)

Alternatives considered by the NRC staff but dismissed from further evaluation as stand-alone alternatives are addressed in Section 8.3.4 of this SEIS. Several of the alternatives discussed in Section 8.3.4 are included in the combinations addressed in Section 8.3.5.

Alternatives Process

Since IP2 and IP3 have a net electric output of 2158 MW(e), the NRC staff evaluated the impacts of alternatives with comparable capabilities.

Of the alternatives mentioned in this section, the NRC staff expects that only a NGCC generation alternative could be wholly developed at the IP2 and IP3 facility because the site is too small to host other alternatives. As noted elsewhere in this Chapter, the NGCC alternative could also be constructed as part of a repowering operation of another existing but retired power plant.

While the alternate site considered need not be situated in New York State, the availability of transmission line capacity to deliver power from a location outside the New York metropolitan region to current IP2 and IP3 customers could constrain siting choices. The DOE has identified critical congestion areas where it is critically important to remedy existing or growing electrical transmission congestion problems because the impacts of the congestion could be severe. It is conceivable that these transmission congestion patterns would influence selection of an alternate site for generating power that is needed in the New York metropolitan region. For purposes of this analysis, however, the NRC staff assumes that adequate transmission will exist – either through planned, new projects (e.g., the proposed New York Regional Interconnect – NYRI , or the Champlain-Hudson Power Express, Inc. – CHPEI – Project, among others) – or by locating the alternatives near to downstate loads.

All of New York's constrained transmission paths move power from areas to the west, south, and north of the State to the loads in and around New York City and Long Island. The New York City metropolitan area consumes major quantities of electricity with less generation capacity than load. Therefore, the region is dependent on imports. Because of the area's current dependence on local power generation from natural gas and oil fuels, the area has high electricity rates (DOE 2006). The replacement of limited local generation sources with additional imported power would place even more demands on the constrained transmission system moving power into the New York City area, though direct current transmission, like CHPEI, could allow greater flexibility. As noted in Section 8.2, it may be necessary to continue operating the IP2 and IP3 generators as synchronous condensers to supply virtual power to the local transmission system after the IP2 and IP3 reactors shut down.

Finally, the NRC staff notes that an infinite number of potential combination alternatives exists, based on varying the amounts or types of power generation means employed or varying the extent to which alternatives rely on energy conservation. The following alternatives are based

on available research and input from the draft SEIS comment process, and represent, in the staff's professional judgment, reasonable examples of combinations that address comments received, ongoing State-level programs, and resource availability in New York State. The staff also notes that none of these combinations are intended to place a limit on available capacities, nor are they intended to supplant State or utility level policy decisions about how to generate electricity, reduce or add to load, set prices, or promote different approaches to generating electricity or managing loads.

EIA Projections

Each year the Energy Information Administration (EIA), a component of DOE, issues an annual energy outlook. In its "Annual Energy Outlook 2010 with Projections to 2035," EIA projects that natural gas-fired plants will account for approximately 46 percent of electric generating capacity additions through 2035 (DOE/EIA 2010), while coal-fired plants will account for approximately 12 percent of generating capacity additions through 2035 (DOE/EIA 2010). EIA projects that renewable energy sources will account for 36 percent of capacity additions through 2035 (DOE/EIA 2010). New nuclear units are expected to account for only 3 percent of additions over the same time period (DOE/EIA 2010).

EIA bases its projections on the assumption that providers of new generating capacity will seek to add generating sources that are cost effective and meet applicable environmental requirements, like air emissions standards. Particularly, uncertainty about future limits on greenhouse gases (GHGs), along with Federal incentives, State energy programs, and rising fossil fuel prices increase competitiveness for renewable and nuclear power (DOE/EIA 2010). Aspects of the American Recovery and Reinvestment Act (ARRA) have also supported renewable capacity growth and will likely continue to do so. EIA notes that regulatory uncertainty also drives capacity decisions. For example, EIA notes that potential future requirements for carbon capture and sequestration (CCS) could result in higher costs for coal generation. Given a smaller future role for coal-fired power, in line with New York State's declining reliance on coal (DOE/EIA 2009) and GHG restrictions imposed by the Regional Greenhouse Gas Initiative (RGGI), the NRC staff has relocated the supercritical coal-fired alternative to Section 8.3.4., Alternatives Dismissed from Individual Consideration. NRC staff addresses the impacts of a new NGCC plant located at either the IP2 and IP3 site or an alternate site in Section 8.3.1 of this SEIS, and considers combinations of alternatives that include substantial amounts of renewable energy sources in Section 8.3.5.

In contrast to many recent AEO editions, EIA no longer indicates, in its overview of future electrical generation capacity, that any new capacity will be fired with oil. NRC staff notes that some gas-fired facilities may fire with oil during periods of high gas demand, but does not consider new oil-fired capacity in this SEIS..

The NRC staff uses EIA's projections to help select reasonable alternatives to license renewal. In the following sections of this chapter, the NRC staff will examine several alternatives in depth, and identify a range of others that staff considered but rejected.

8.3.1 Natural Gas-Fired Combined-Cycle (NGCC) Generation

In this section, the NRC staff examines the environmental impacts of the NGCC alternative at both IP2 and IP3 and at an alternate site. The NRC staff assumed that a natural gas-fired plant would use a closed-cycle cooling system.

This replacement NGCC plant would likely use combined-cycle technology. Compared to simple-cycle combustion turbines, combined-cycle plants are significantly more efficient, and thus provide electricity at lower costs. NGCC power plants also tend to operate at markedly higher thermal efficiencies than other fossil-fuel or nuclear power plants, and require less water for condenser cooling than other thermoelectric alternatives. As such, the NGCC alternative would require smaller cooling towers and substantially less makeup water than the cooling system proposed in Section 8.1.1 of this SEIS. Typically, these plants support intermediate loads but they are capable of supporting a baseload duty cycle; thus they provide an alternative to renewing the IP2 and IP3 operating licenses. Levitan and Associates indicated that gas-fired generation was the most likely alternative to take the place of IP2 and IP3 (Levitan and Associates 2005). Further, New York State is increasingly reliant on natural gas for electrical power.

The NRC evaluated environmental impacts from gas-fired generation alternatives in the GEIS, focusing on combined-cycle plants (NRC 1996). In a combined-cycle unit, hot combustion gases in a combustion turbine rotate the turbine to generate electricity. Waste combustion heat from the combustion turbine is routed through a heat-recovery steam generator, which then powers a steam turbine electrical generator. The combination of two cycles can be as much as 60 percent efficient.

EIA projects that advanced combined-cycle gas turbines can operate at a heat rate as low as 6333 BTU/kWh for units with net output of 400 MW(e) (DOE/EIA 2010b). These units are more efficient than the 408-MW(e) units Entergy considered in its ER, and would consume less fuel, while producing fewer emissions per unit of electrical output. Using five, 400-MW(e) units would slightly underestimate the total impact to some resources, but it provides a useful approximation using more-current technology. .

The NRC staff discusses the overall impacts of the NGCC generating system in the following sections and summarizes them in Table 8-4 of this SEIS. The extent of impacts at an alternate site would depend on the location of the site selected. A third option is that this NGCC alternative could be constructed at an existing, retired or underutilized fossil facility as part of a facility repowering. Impacts would be essentially the same for a repowered facility as for a facility constructed at Indian Point, though available site infrastructure could result in slightly lower or higher impacts at the repowering project. Regardless, a repowered site would already have transmission access, likely access to cooling water, and possible access to gas transmission infrastructure.

- **Land Use**

Existing facilities and infrastructure would be used to the extent practicable if a NGCC complex were to be developed at IP2 and IP3. Specifically, the NRC staff assumed that this alternative would use the existing switchyard, offices, and transmission line ROWs. However, a new mechanical-draft cooling tower would need to be constructed to support the new closed-cycle cooling system.

The GEIS estimated that 45 ha (110 ac) are needed for a 1000-MW(e) natural gas-fired facility. Scaling up for the 2000-MW(e) facility would indicate a land requirement of approximately 90 ha (220 ac). The NRC staff notes that some existing NGCC facilities require less space than the GEIS indicates, and may be more on the order of 16 ha (40 ac) per 1000 MW(e), inclusive of cooling towers. (Entergy's withdrawn proposal for combined-cycle capacity on the IP2 and IP3,

for example, required only 2 ha (5 ac) for 330 MW(e) of capacity (as noted in Levitan and Associates 2005)). The IP2 and IP3 site is only 98 ha (242 ac) with some land unsuitable for construction. Also, much of the site is covered by the IP2 and IP3 containment structures, turbine buildings, other IP2 and IP3 support facilities, and AGTC gas pipeline. Land covered by some IP2 and IP3 facilities would not be available until decommissioning, though land covered by some support facilities may be available prior to the end of the current license. The AGTC pipeline ROW would remain unavailable. Based on previous Entergy proposals and experience at other combined-cycle plants, however, the NRC staff finds it possible that a NGCC alternative could be constructed and operated on the IP2 and IP3 site.

As reported by Levitan and Associates, Inc. (2005), the existing Algonquin pipeline that passes through the IP2 and IP3 site may be adequate for a 330-MW(e) simple-cycle plant that would operate in peaking mode during the summer season, when gas supplies are less constrained by winter-season heating demands. Levitan and Associates (2005) concluded that substantial and expensive pipeline upgrades would probably be necessary to supply natural gas to a combined-cycle alternative throughout the winter heating season and for the additional baseload capacity throughout the year. Given firm demand for natural gas during the winter heating season, it is possible that the NGCC alternative may need to burn fuel oil during several weeks of the year, should conditions of limited supply emerge. This practice is common at gas-fired power plants in the northeastern United States. Another option is that future, proposed liquefied natural gas (LNG) facilities in the northeastern United States or Canadian maritime provinces could reduce demands on the Algonquin pipeline system.

The environmental impacts of locating the NGCC facility at an alternate location would depend on the past use of the location. If the site is a previously undisturbed site the impacts would be more significant than if the site was a previously developed site, or if the site is a repowered, existing facility. Construction and operation of the NGCC facility at an undeveloped site would require construction of a new cooling system, switchyard, offices, gas transmission pipelines, and transmission line ROWs. A previously industrial site may have closer access to existing infrastructure, which would help to minimize environmental impacts. A NGCC alternative constructed at the IP2 and IP3 site would have direct access to a transmission system, an existing pipeline ROW, and an existing dock to receive major components. A repowered facility is likely to have similar access to supporting infrastructure as a facility sited at the Indian Point site, and may have other benefits, like existing connections to natural gas pipelines. In some cases, other onsite support structures may also be repurposed to support the repowering operation.

Regardless of where a NGCC alternative is built, the GEIS indicates that additional land would be required for natural gas wells and collection stations. According to the GEIS, a 1000-MW(e) gas-fired plant requires approximately 1500 ha (3700 ac) for wells, collection stations, and pipelines, or about 3000 ha (7400 ac) for a 2000-MW(e) facility (NRC 1996).

Overall, land use impacts of the NGCC alternative are considered SMALL to MODERATE at the IP2 and IP3 site. NGCC land use impacts at a new previously industrial site or a repowered facility are considered to be SMALL to MODERATE; while NGCC generation at a new undeveloped site would have MODERATE to LARGE impacts.

- **Ecology**

At the IP2 and IP3 site, there would be terrestrial ecological impacts associated with siting a

NGCC facility. These impacts would likely be less than those described in Section 8.1.1.2 of this SEIS, which discusses the ecological impacts of the construction of a closed-cycle cooling system to support IP2 and IP3, as existing portion of the site currently used for support structures like parking lots or outbuildings could be redeveloped for a gas fired alternative. Also, substantially less soil and rock removal would be necessary. The duration of impacts from construction would be less.

Improvements to the existing pipeline network would also be necessary, with some impacts along the already-disturbed ROW. Levitan and Associates (2005) indicated that no transmission system improvements would be necessary to accommodate the NGCC alternative at the IP2 and IP3 site. Overall, construction effects are limited in both scope and duration. Impacts to terrestrial ecology of constructing the NGCC alternative on site are likely to be SMALL. In most cases, impacts at a repowering project would be similarly SMALL, depending on the extent to which existing site structures can be reused. Some transmission improvements may be necessary if the repowered site was previously of smaller capacity.

Ecological impacts at an alternate site would depend on the nature of the land used for the plant and the possible needs for a new gas pipeline and/or transmission lines. Construction of the transmission line and construction and/or upgrade of the gas pipeline to serve a new plant at an alternate site, if necessary, would have substantial ecological impacts, though these would be temporary. Ecological impacts to the plant site and in utility ROWs could include impacts on threatened or endangered species, habitat loss or fragmentation, reduced productivity, and a local reduction in biological diversity. Impacts to terrestrial ecology would likely be SMALL to MODERATE, depending on site characteristics.

Operation of the NGCC alternative at the IP2 and IP3 site or another site would likely not introduce noticeable new terrestrial ecological effects after construction.

The NGCC alternative is unlikely to create significant impacts for aquatic ecology during construction, regardless of location. Because the plant has a relatively small footprint, and because crews would likely implement some measures to control site runoff, it is unlikely that impacts to aquatic ecology would be noticeable. Noticeable effects could occur during construction if new transmission line ROWs or gas pipelines would need to cross streams or rivers.

During operations, aquatic ecological resources would experience significantly smaller effects than they would from a comparable nuclear or coal-fired power plant. The combined-cycle gas plant using closed-cycle cooling would require less than half the cooling water of IP2 and IP3 using closed-cycle cooling. Construction of intake and discharge structures at an alternate site could trigger some impacts to aquatic ecology, but because these impacts are very limited in scope and time, they will likely not affect any important resource characteristics. Thus, aquatic ecological impacts of the NGCC alternative are likely to be SMALL.

At an alternate site, impacts to ecology may range from SMALL to MODERATE, while they are likely to be SMALL if constructed at the existing IP2 and IP3 site or a repowered site.

- **Water Use and Quality**

Surface Water: NGCC plants are highly efficient and require less cooling water than other generation alternatives. Plant discharges would consist mostly of cooling tower blowdown, with the discharge having a slightly higher temperature and increased concentration of dissolved

solids relative to the receiving water body, as well as intermittent, low concentrations of biocides (e.g., chlorine). All discharges from a new plant at the IP2 and IP3 site would be regulated through a New York SPDES permit, which would be issued by NYSDEC. Finally, some erosion would probably occur during construction (NRC 1996), though the GEIS indicates this effect would be SMALL. Plant construction crews would employ at least basic runoff control measures. Because crews would likely not have to construct entirely new intake structures, transmission lines, or a gas pipeline, most activities that could affect water use and quality will not occur for an alternative constructed at the IP2 and IP3 site, or at a repowered site. Like the existing IP2 and IP3, a NGCC alternative located on the site would likely not rely on ground water. Overall, impacts to water use and quality at the IP2 and IP3 site from a NGCC alternative would likely be SMALL for both construction and operation.

At an alternate site, a NGCC alternative would likely rely on surface water for cooling makeup water and blowdown discharge. Intake and discharge would involve relatively small quantities of water compared to once-through cooling and less than a nuclear or coal-fired power plant. The impact on the surface water would depend on the volume of water needed for makeup water, the discharge volume, and the characteristics of the receiving body of water. If a NGCC plant discharges to surface water, the plant would have to meet the requirement of a SPDES permit. The NRC staff expects that any new facility would comply with requirements of the discharge permits issued for its operation. Thus discharges from the plant would be legally obligated to conform to applicable water quality standards. Water withdrawals from a small river or cooling pond, however, could lead to potential water use conflicts. The impacts would be SMALL to MODERATE during operations depending on receiving water characteristics, though they would likely be SMALL at a repowered site. During construction, some erosion would probably occur though the GEIS indicates this would have a SMALL effect (NRC 1996).

Ground Water: IP2 and IP3 currently use no ground water. It is likely that a NGCC alternative at the IP2 and IP3 site would also use no ground water. Impacts at the IP2 and IP3 site would thus be SMALL. Ground water impacts from operations at an alternate site or a repowered site may vary widely depending on whether the plant uses ground water for any of its water needs, though it would be unlikely that a plant on an alternate site would use ground water for cooling system makeup water given the quantity of water required. Ground water impacts at an alternate site could range from SMALL to MODERATE, depending on the quantity of ground water used and characteristics of aquifers used. Construction-stage impacts at both the existing site and a new site are likely to be SMALL.

- **Air Quality**

Natural gas is a relatively clean-burning fuel relative to relative to other fossil fuels. The NGCC alternative would release a variety of emissions, however.

The NRC staff calculates that approximate emissions from the five-unit, 2000-MW NGCC alternative with a heat rate of 6333 BTU/kWh would be:

- SO_x—150 MT/yr (164 tons/yr)
- NO_x—493 MT/yr (543 tons/yr)
- CO—103 MT/yr (113 tons/yr)

- Filterable particulates (PM_{10})—83 MT/yr (92 tons/yr)[(3)]

NGCC power plants primarily emit pollutants as a result of combustion conditions. These pollutants include NO_x, CO, and particulates. Regulations in place to reduce potential health effects from air emissions, especially those promulgated in response to the CAA, drive the types of emissions controls this NGCC alternative would use to limit its effects on air quality. CAA mechanisms like new source performance standards, nonattainment areas, State implementation plans, and specialized programs, including one that limited overall NO_x emissions throughout the Eastern United States, all drive emissions control technologies used in this NGCC alternative.

NO_x is typically the pollutant of greatest concern for a NGCC power plant. Given the proper atmospheric conditions, NO_x helps to form ozone, as well as smog. The NGCC alternative in this case relies on selective catalytic reduction (SCR) to reduce NO_x emissions. As previously discussed, IP2 and IP3 are located within the New Jersey-New York-Connecticut Interstate Air Quality Control Region (40 CFR 81.13). All of the States of New Jersey and Connecticut, as well as several counties in Central and Southeastern New York within a 80-km (50-mi) radius of IP2 and IP3, are designated as nonattainment areas for ozone (8-hour standard) (EPA 2008b). Operators or owners of a NGCC power plant constructed in a nonattainment area would need to purchase offsets for ozone precursor emissions. In this case, NOx is the major ozone precursor emitted by the NGCC power plant. In accordance with NYSDEC regulations, "Emission offsets must exceed the net increase in annual actual emissions from the air contamination source project" (NYSDEC, Chapter 3, Parts 231–15). By design, this regulatory requirement should result in a net reduction in ozone emissions in the region.

A new NGCC generating plant located in a nonattainment area (like that at the IP2 and IP3 site) would need a nonattainment area permit and a Title IV operating permit under the CAA. The plant would need to comply with the new source performance standards for such plants set forth in 40 CFR Part 60, Subpart Da. The standards establish limits for particulate matter and opacity (40 CFR 60.42(a)), SO_2 (40 CFR 60.43(a)), and NO_x (40 CFR 60.44(a)).

In December 2000, EPA issued regulatory findings on emissions of HAPs from electric utility steam-generating units (EPA 2000a). NGCC power plants were found by EPA to emit arsenic, formaldehyde, and nickel (EPA 2000a). Unlike coal- and oil-fired plants, EPA did not determine that emissions of HAPs from NGCC power plants should be regulated under Section 112 of the CAA.

A NGCC plant would have unregulated CO_2 emissions of about 117 pounds per MMBtu (DOE/EIA 2008a). The NRC staff calculates that a five-unit NGCC alternative with technologically advanced turbines rated at 6333 BTU/kWh would emit approximately 5,516,000 MT (6,076,000 tons) of CO_2 per year. Section 6.2 of this SEIS contains a discussion of current and future relative GHG emissions from several energy alternatives including coal, natural gas, nuclear, and renewables. Other emissions and losses during natural gas production or transportation could also increase the relative GHG impact.

Construction activities also would result in some air effects, including those from temporary fugitive dust, though construction crews likely would employ dust control practices to limit this impact. Exhaust emissions also would come from vehicles and motorized equipment used

(3) Additional particulate emissions associated with the cooling towers were not quantified.

during the construction process, though these emissions are likely to be intermittent in nature and will occur over a limited period of time. As such, construction stage impacts would be SMALL.

The overall air quality impact for operation of a new NGCC plant at the IP2 and IP3, at an alternate site, or at a repowered site would be SMALL to MODERATE, depending on air quality in the surrounding airshed. Air quality impacts during construction would be SMALL.

- **Waste**

Burning natural gas fuel generates small amounts of waste. However, a plant using SCR to control NO_X will generate spent SCR catalyst and small amounts of solid waste products (i.e., ash). In the GEIS, the NRC staff concluded that waste generation from gas-fired technology would be minimal (NRC 1996). Waste generation impacts would be minor and would not noticeably alter any important resource attribute.

Constructing a NGCC alternative would generate small amounts of waste, though many construction wastes can be recycled. Construction either at the Indian Point site or at a repowered site would likely require little land-clearing, though some existing on-site structures at either Indian Point or a repowered site may need to be dismantled or demolished. Most of this type of debris would be recycled, transported offsite, or, in the case of demolished concrete, parking lots, and roads, could be reused at road bed material, laydown areas, or for clean fill onsite. Land-clearing debris from construction at an alternate location could be land filled on site. Overall, the waste impacts would be SMALL for a NGCC plant sited at an alternate site or a repowered site.

Cooling towers for a new NGCC alternative would be much smaller than those proposed in 8.1.1, and would not need to be constructed on slopes near the Hudson. Waste generation from plant construction, then, is much less than in 8.1.1.2. The waste-related impacts associated with construction of a five-unit NGCC plant with closed-cycle cooling systems at the IP2 and IP3 site would be SMALL.

- **Human Health**

Human health effects from the operation of a NGCC alternative with SCR emissions controls would likely not be detected or would be sufficiently minor that they would neither destabilize nor noticeably alter any important attribute of the resource.

During construction activities there would be a risk to workers from typical industrial incidents and accidents. Accidental injuries are not uncommon in the construction industry, and accidents resulting in fatalities do occur. However, the occurrence of such events is mitigated by the use of proper industrial hygiene practices, complying with worker safety requirements, and training. Occupational and public health impacts during construction are expected to be controlled by continued application of accepted industrial hygiene protocols, occupational health and safety controls, and radiation protection practices. Fewer workers would be on site for a shorter period of time to construct a NGCC plant than other new generation alternatives, and so exposure to occupational risks tends to be lower than other alternatives.

Overall, the impacts on human health of a NGCC alternative sited at IP2 and IP3, a repowered site, or at an alternate site would be considered SMALL.

- **Socioeconomics**

Construction of a NGCC plant would take approximately 3 years (DOE/EIA 2007b). Peak labor force would be approximately 1090 workers (NRC 1996). The NRC staff assumed that construction of an offsite alternative would take place while IP2 and IP3 continue operation and would be completed by the time the plants permanently cease operations. Entergy indicates that a gas-fired facility could be producing power before IP2 and IP3 shut down (Entergy 2007). Construction time periods and employment figures may vary somewhat a repowering project depending on the extent to which existing structures can be reused.

At the end of construction, the local population would be affected by the loss of as many as 1090 construction jobs. However, this loss would be partially offset by a postconstruction permanent employment. An additional construction workforce would be needed for the decommissioning of IP2 and IP3 which could temporarily offset the impacts of the lost construction and IP2 and IP3 jobs at the IP2 and IP3 site. A new NGCC plant at the IP2 and IP3 site would offset a small portion of lost employment, though, according to Levitan and Associates, it may provide more revenues to the surrounding jurisdictions than IP2 and IP3 do (2005). The large and diverse economic base of the region would help to offset or minimize the significance of job losses.

The NRC staff concludes that the overall socioeconomic impacts from the NGCC alternative could be SMALL to MODERATE during construction and could be SMALL to MODERATE during operation at most sites, depending largely on tax impacts.

- **Transportation**

Impacts associated with transportation of the construction and operating personnel to the plant site would depend on the population density and transportation infrastructure in the vicinity of the site. During the 3-year construction period of the NGCC facility, approximately 1090 construction workers may be working at the site. The addition of these workers would increase traffic on highways and local roads that lead to the construction site. The impact of this additional traffic would have a SMALL to MODERATE impact on nearby roadways, depending on road infrastructure and existing traffic demands. Rural areas would typically experience a greater impact than urban or suburban areas. Impacts associated with plant operating personnel commuting to and from work are considered SMALL at all sites. Because the NGCC alternative relies on pipelined fuel, transportation impacts from natural gas supply are not likely to be noticeable, though plant operators will have to ensure that sufficient gas transportation capacity exists.

- **Aesthetics**

The combustion turbines and the heat-recovery boilers of the NGCC plant would be relatively low structures compared to existing plant facilities, but could be visible from the Hudson River if located at the current IP2 and IP3 site. Some facility structures could be visible from offsite locations as well. The impact on aesthetic resources of a NGCC plant is likely less than the impact of the current nuclear plant, excepting when cooling towers produce noticeable plumes. Overall, aesthetic impacts from a NGCC plant constructed at the IP2 and IP3 site would likely be SMALL. Impacts on a repowered site would be similar to those at the Indian Point site. In some cases, substantial portions of onsite infrastructure may be reused such that the aesthetic impacts of a repowered facility differ little from those of the facility prior to repowering.

At an alternate site, new buildings, cooling towers, cooling tower plumes, and electric

transmission lines would be visible off site. Visual impacts from new transmission lines or a pipeline ROW would also be significant, though these may be minimized by building near existing transmission lines or on previously developed land. Additionally, aesthetic impacts would be minimized if the plant were located in an industrial area adjacent to other power plants. Overall, the aesthetic impacts associated with the NGCC alternative at alternate site could be SMALL to LARGE, though LARGE impacts would be expected only in cases where substantial new transmission is necessary, and the lines have a significant effect on important aesthetic values.

- **Historic and Archeological Resources**

As noted in Section 8.1.1.2, Entergy's recent Phase 1b survey revealed additional onsite historic and prehistoric resources.A cultural resource inventory would be needed for any property at a new site or adjacent to the IP2 and IP3 site that has not been previously surveyed. The survey would include an inventory of field cultural resources, identification and recording of existing historic and archeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other ROWs).

The impacts to historic and archeological resources for the NGCC alternative at the IP2 and IP3 site would be similar to, or less than those described in Section 8.1.1.2 of this SEIS for the closed-cycle cooling alternative (given that the NGCC alternative would require less than half the cooling tower capacity needed by IP2 and IP3. These impacts can likely be effectively managed, and could range from SMALL to MODERATE if surveys reveal unavoidable conflicts between the new facility and onsite resources. Impacts at a repowered site would likely entail similar impacts of disturbance. At a repowered site, it may be possible to begin construction in power block areas at a repowering site, while such reuse or repurposing would not be possible until after Indian Point structures are no longer needed (and, perhaps, until decommissioning occurs).

Historic and archeological resource impacts can generally be effectively managed on alternate sites and, as such, would be considered SMALL to MODERATE at a new, undeveloped site. For a previously developed site, impact on cultural and historic resources would also be SMALL to MODERATE. Previous development would likely have either removed items of archeological interest or may have included a survey for sensitive resources. Any significant resources identified would have to be handled in accordance with the NHPA.

- **Environmental Justice**

As described in Section 8.1.1.2 of this SEIS, impacts to the environment or community from actions at the IP2 and IP3 site, including the construction of a NGCC plant, are not likely to disproportionately affect minority or low-income populations because these populations in the area around the site are proportionately small compared to the geographical region's population. Therefore, the NGCC alternative constructed at the IP2 and IP3 site would have SMALL impacts on environmental justice. At a repowered site or at an alternate site, impacts would depend upon the site chosen, nearby population characteristics, and economic conditions. These impacts would range from SMALL to LARGE, depending on impacts and the distribution of low-income and minority populations. At a repowered site, impact levels would

also depend on the current status of the existing power plant. If the plant is currently operating, then repowering may reduce effects; if the plant is no longer operating, then repowering with a baseload NGCC facility will create more significant impacts.

Table 8-3. Summary of Environmental Impacts of the NGCC Alternative Located at IP2 and IP3 and an Alternate Site

Impact Category	At IP Site or a Repowered Site		New Site	
	Impact	Comments	Impact	Comments
Land Use	SMALL to MODERATE	Onsite land used; most has been previously disturbed.	MODERATE to LARGE	About 90 ha (220 ac) needed for plant construction; additional land may be needed for pipeline and transmission line ROWs.
Ecology	SMALL	Both terrestrial and aquatic impacts would be SMALL because the plant uses mostly disturbed land and uses relatively little water.	SMALL to MODERATE	Impacts would depend on the nature of the land used for the plant and whether a new gas pipeline and/or transmission lines are needed; cooling water would have SMALL aquatic resource impacts.
Water Use and Quality	SMALL	Minor erosion and sedimentation may occur during construction. The plant would use no groundwater.	SMALL to MODERATE	With closed-cycle cooling, the impact would likely be SMALL. Impact depends on the volume of used and characteristics of the water body; impacts from water use conflicts could be MODERATE.
Air Quality	SMALL to MODERATE	• SO_x: 150 MT/yr (164 tons/yr) • NO_x: 493 MT/yr (543 tons/yr) • PM_{10}: 83 MT/yr (92 tons/yr) • CO: 103 MT/yr (113 tons/yr) • CO_2: 5.5 million MT/yr (6.1 million tons/yr)	SMALL to MODERATE	Operational impacts are the same as onsite plant but more emissions from additional construction activities.

1 **Table 8-3** (continued)

Impact Category	At IP Site or a Repowered Site		At a New Site	
	Impact	Comments	Impact	Comments
Waste	SMALL	Small amounts of construction waste would be generated.	SMALL	Small amounts of construction waste with some recycling options; land-clearing debris could be land filled on site.
Human Health	SMALL	Minor risk to workers associated with construction and industrial accidents. Health effects from operational emissions are likely to be SMALL.	SMALL	Same as onsite plant.
Socioeconomics	SMALL to MODERATE	Impacts on housing and jobs in the area surrounding IP2 and IP3 during onsite construction and operation would be relatively minor based on the large population of the area surrounding IP2 and IP3; similar at a repowered site.	SMALL to MODERATE	Construction impacts would likely be no larger than MODERATE at most sites. The largest impacts occur during construction.
Transportation	SMALL to MODERATE	Increased traffic associated with construction could be noticeable, though the number of construction workers is smaller than the number of workers currently at IP2 and IP3; impacts at repowered site likely similar.	SMALL to MODERATE	Transportation impacts associated with construction and operating personnel to the plant site would depend on the population density and infrastructure in the vicinity of the site.

2

Table 8-3 (continued)

Impact Category	At IP Site or a Repowered Site		At a New Site	
	Impact	Comments	Impact	Comments
Aesthetics	SMALL	The impact is likely less than the impacts of the current plant; more land would be cleared and new structures built; repowered site impacts likely to be similar to those of existing structures.	SMALL to LARGE	The greatest impacts would be from new transmission lines, gas line ROW, and plant structures. Impacts depend on the nature of the site.
Historical and Archeological Resource	SMALL to MODERATE	Impacts may reach MODERATE on IP site; most repowerings likely to be SMALL.	SMALL to MODERATE	An alternate location would necessitate cultural resource studies; construction would likely avoid highly sensitive areas. Impacts likely would be managed or mitigated.
Environmental Justice	SMALL to LARGE	SMALL at IP site; SMALL to LARGE at repowered site.	SMALL to LARGE	Impacts would vary depending on population distribution and location of the new plant site.

8.3.2 Purchased Electrical Power

Based on currently scheduled unit retirements and demand growth projections, the NYISO predicted in 2006 that up to 1600 MW(e) from new projects not yet under construction would be needed by 2010 and a total of up to 3300 MW(e) by 2015 (National Research Council 2006).

Within the New York Control Area (NYCA), State power regulators require that load-serving entities (LSE), or power buyers, purchase enough generating capacity to meet their projected needs plus a reserve margin (National Research Council 2006). Entergy is not an LSE. In New York, Entergy owns and operates power plants, but not transmission or distribution systems; therefore, Entergy does not purchase power from other power generators. To replace the output from IP2 and IP3, LSEs, like Consolidated Edison, would need to purchase additional electric power from other sources, which could include new fossil-fueled power plants or renewable alternatives, or it could purchase power from existing facilities at other sites outside the NYCA (National Research Council 2006). Given New York State's power market, all alternatives considered here could supply purchased power. The only constraint on the purchase of electrical power then becomes electric transmission capacity.

Power sources within NYCA have an installed capacity of about 38,000 MW(e) and more than 6300 km (3900 mi) of high-voltage transmission lines (National Research Council 2006). The current power transmission infrastructure makes it difficult to purchase power from outside the southern regions of the NYCA (namely the New York City and Long Island load zones) because there are power transmission constraints or "bottlenecks" between the southern load zones and other power generating areas to the east and north, including Canada. These neighboring areas would be needed to supply additional purchased power to replace power generated by IP2 and IP3. Because of the bottlenecks in the transmission lines, new transmission capacity would likely be necessary to efficiently move purchased power into the southern load zones and provide a partial solution to the retirement of IP2 and IP3 (National Research Council 2006). Such new transmission capacity would likely come in the form of either an expansion of the existing high-voltage alternating current transmission system or the addition of new high-voltage direct current transmission facilities (National Research Council 2006).

The National Research Council found that improvements in transmission capability could significantly relieve congestion in the NYCA and increase delivery capacity from existing and potential electric generation resources to the southern load zones. The Council has proposed a 550-MW(e) west-to-east line across the Hudson River and a new north-to-south transmission line (up to 1000 MW(e)) for better access to upstate New York and Canadian electric resources to provide useful capacity in the 2010 and 2015 time period (National Research Council 2006). However, a variety of institutional and financial obstacles often stand in the way of such plans. In 2006, the Council determined that a "concerted, well-managed, and coordinated effort would be required to replace IP2 and IP3 by 2015 (National Research Council 2006).

Several new transmission projects are currently in planning stages. NRC staff will address two of the proposed projects here as illustrative of the potential for new transmission in congested areas of New York State.

As of November 2010, New York Regional Interconnection (NYRI is seeking the approval of the New York Public Service Commission (NYPSC) to build a 306-km (190-mi) transmission line with a rated power flow of 1200 MW(e) from the Town of Marcy in Oneida County to the towns of Hamptonburgh and New Windsor in Orange County, New York (NYRI 2010). In accordance with the NYRI application to the NYPSC, overhead transmission lines will make up approximately 89 percent of the proposed route, and underground cable will constitute the remainder of the route (NYRI 2008). NYRI has placed the proposed route within or parallel to existing or inactive railroads and energy ROWs for approximately 78 percent of its distance. For the remaining 22 percent of its distance, NYRI will construct the transmission lines in undeveloped areas or areas where there are no existing ROWs. The proposed transmission corridor includes 1155 ha (2854 ac). If approved, NYRI will clear 768 ha (1898 ac) of forested habitat during construction. While the proposed route minimizes the amount of land clearing and habitat destruction necessary, the proposed route also crosses sensitive habitats such as streams and wetlands (NYRI 2008).

NYRI has proposed to construct additional transmission capacity that could be used to import power into the southern load zones for the NYCA, with the potential for it to expand its proposed 1200-MW(e) capacity to 2400 MW(e). In addition, other proposed projects, like CHPEI, have the potential to import additional power from Canada. In the case of CHPEI, the total project would include 2000 MW(e) of transmission, though only 1000 MW(e) would be targeted to the New York metropolitan area (CHPEI 2010). CHPEI is currently in the permitting process, and

expects to be operational by 2015. The NRC staff recognizes that purchased power could be an alternative to IP2 and IP3. To the extent that new transmission projects allow other existing facilities to provide additional power to downstate New York, the environmental impacts are likely to be only the incremental impacts of additional operation. Upstate hydropower, wind power, biomass, nuclear and fossil-fueled plants would likely contribute to additional power supply. On CHPEI, project developers indicate that they expect Canadian hydro and wind power to dominate their power supply (Canada relies extensively on hydropower for its current generation).

To the extent that new generation capacity supplies power to these new projects, construction impacts may be similar to those of other alternatives in this SEIS. New hydropower in Canada, for example, may have substantial environmental impacts during construction and operation.

The actual environmental impacts of purchased power are difficult to determine, Each type of power generation alternative has its own set of potential environmental costs and benefits, and each must be evaluated with respect to the specific location and features of the generator. As a result, the specific environmental impacts of purchased power cannot be reasonably evaluated in the absence of more information. Nonetheless, it is highly likely that any generating source of purchased power will have environmental impacts, the type and magnitude of which cannot be assessed for comparative purposes as an alternative to license renewal of IP2 and IP3. It is also highly likely that projects like NYRI and CHPEI will have separate State, and in the case of CHPEI, Federal, processes for determining environmental impacts. In general, any transmission project will serve to make environmental impacts of power generation more distant from load centers in downstate New York. Impacts from the projects themselves are highly variable and may or may not be substantial. For example, visual impacts from aboveground projects like NYRI could be substantial. CHPEI, in contrast, is likely to be partially constructed underwater or underground along existing waterways and transportation right-of-ways, which should help to reduce effects, but its construction may have short-term impacts on aquatic ecology or affect traffic in the transportation corridors along which it will be installed.

Both of these projects are independent of any decision to grant or deny renewal of the IP2 and IP3 operating licenses, and are subject to other environmental review and regulatory processes over which NRC has no control. Transmission system construction and operation have their own environmental impacts, the specific nature and magnitude of which will vary depending on the length and location of the proposed route. For example, construction through wetland areas could entail significant ecological impacts, while construction through residential areas could entail significant aesthetic impacts. In the absence of any specific route information, NRC staff will not independently evaluate impacts of the transmission projects in this SEIS. They do, however, serve as meaningful illustrations of projects that may improve the availability of power from other regions of the State or Canada to reach the same end-use markets currently served by IP2 and IP3.

8.3.3 Conservation

In this section, the NRC staff evaluates conservation[(4)]as an alternative to license renewal.

(4) The NRC staff notes that conservation typically refers to all programs that reduce energy consumption, while energy efficiency refers to programs that reduce consumption without reducing services. For this section, some conservation measures considered by the NRC staff are also energy efficiency measures.

According to the American Council for an Energy-Efficient Economy (ACEEE) State Energy Efficiency Scorecard for 2006, New York ranks seventh in the country in terms of implementation of energy efficiency programs, suggesting that the State's conservation efforts are significant when compared to other States (ACEEE 2006). New York scored well (2 out of 3) on tax incentives and appliance standards. The State scored low on energy efficiency resource standards (0 out of 5) and utilities' per-capita spending on energy efficiency (5 out of 15), suggesting there is room for improvement in these areas.

The IP2 and IP3 ER (Energy 2007) dismissed conservation as a replacement alternative for IP2 and IP3 because conservation does not meet the criterion of a "single, discrete source." Also, because Entergy is a generator of electricity and not a distributor, it indicated that it does not have the ability to implement regionwide conservation programs (Entergy 2007). However, because of efforts made by the State of New York and comments received during preparation of this SEIS, the NRC staff examines conservation in this SEIS as an alternative to replace at least part of the output of IP2 and IP3.

The New York State Energy Research and Development Authority (NYSERDA) is pursuing initiatives in conservation. Within NYSERDA, the Energy Efficiency Services Program and Residential Efficiency and Affordability Program deploy programs and services to promote energy efficiency and smart energy choices (NYSERDA 2007). According to the NYSERDA, implementation of conservation in the following program areas has resulted in significant energy savings:

- existing buildings and structures
- new buildings and structures
- market/workforce development
- distributed generation and renewables
- industrial process
- transportation

In 2006, the National Research Council's Committee on Alternatives to Indian Point for Meeting Energy Needs developed a report that specifically addressed alternatives to IP2 and IP3 for meeting Statewide power needs (National Research Council 2006). The document reports that in 2005, NYSERDA estimated that its energy efficiency programs had reduced peak energy demands in New York by 860 MW(e). NYSERDA further forecasted that the technical potential of its efficiency programs in New York would result in a cumulative 3800 MW(e)-reduction of peak load by 2012 and 7400 MW(e) by 2022 (National Research Council 2006). "Technical potential" refers to the complete deployment of all applications that are technically feasible.

In addition to the currently anticipated peak load reductions resulting from the NYSERDA energy efficiency initiatives, additional conservation measures and demand-side investments in energy efficiency, demand response, and combined heat and power facilities could significantly offset peak demand Statewide. The National Resource Council estimated that peak demand could be reduced by 1000 MW(e) or more by 2010 and 1500 MW(e) by 2015 (National Research Council 2006).

The National Research Council estimates that economic potential peak demand in the IP2 and

IP3 service area could be expanded by approximately 200 MW(e) by 2010 and 300 MW(e) by 2015 assuming a doubling of the program budgets (National Research Council 2006). "Economic potential" is defined as that portion of the technical potential that the National Research Council judged to be cost effective. This estimate is based partly on the experience with three NYSERDA programs that avoided the need for 715 MW(e) of Statewide peak demand in 2004. Cost-effectiveness is based on a conservation option's ability to lower energy costs (consumers' bills) while energy prices continue to increase using EIA price forecasts. The National Research Council concludes that energy efficiency and demand-side management have great economic potential and could replace at least 800 MW(e) of the energy produced by IP2 and IP3 and possibly much more (National Research Council 2006).

More recently, New York State launched its Energy Efficiency Portfolio Standard program, calling for a 15 percent reduction in energy usage by 2015 compared to forecast levels (sometimes referred to as "15 by 15", and later combined with an augmented renewable portfolio standard in the 45 by 15 plan). Between June 2009 and January 2010, the Public Service Commission approved 45 electric energy efficiency programs and 44 gas efficiency programs (NYSPSC 2010)

Given New York State's aggressive efforts in energy efficiency, as amplified by comments received on the draft SEIS, the NRC staff here considers an energy conservation/energy efficiency alternative, and will also include energy conservation in the combination alternatives.

Analyses in recent NRC license renewal SEISs (See NUREG-1437, Supplements 33 and 37, regarding Shearon Harris and Three Mile Island, Unit 1, respectively), indicate that all impacts from conservation are SMALL. The NRC staff adopts the analyses from those SEISs here, insofar as they identified all SMALL impacts from conservation as an alternative. The NRC staff also notes that loss of tax and PILOT revenue paid to municipalities near IP2 and IP3, as well as lost jobs, may result in SMALL to MODERATE socioeconomic impacts, which will not be offset by conservation.

8.3.4 Alternatives Dismissed from Individual Consideration

Other generation technologies the NRC staff considered but determined to be individually inadequate to serve as alternatives to IP2 and IP3 are discussed in the following paragraphs. The NRC staff has moved the supercritical coal-fired alternative to this section based on comments, a staff review of likely generating alternatives in New York State, and policies like the Regional Greenhouse Gas Initiative that make coal-fired generation unlikely in New York State. The discussion of the supercritical coal-fired alternative in this section has not been updated from the draft SEIS.

8.3.4.1 Wind Power

Studies conducted for the New York State Department of Public Service indicates that the total wind resource potential by 2015 is 8527 MW (NYSDPS 2009). This includes both onshore and offshore resources. offshore wind resources. Wind currently accounts for approximately 1275 MW(e), statewide (NYISO 2010). The NYSIO is managing wind generation projects that are proceeding through the grid interconnection process. These projects have a potential of

generating almost 7000 MW(e) if all are completed (NYISO 2010). NYISO indicates approximately 10% capacity credit, or 124 MW(e) for the 1275 MW(e) of existing wind power based on availability of the resource. Thus, 7000 additional MW(e) of wind capacity would be credited for less than 700 MW(e) of firm capacity(NRC staff further discusses this issue in the combination alternatives later in this chapter).

Generally, wind power, by itself, is not suitable for large baseload capacity. As discussed in Section 8.2.1 of the GEIS, wind has a high degree of intermittency, and average annual capacity factors for wind facilities are relatively low (on the order of 30 to 40 percent). Wind power, in conjunction with energy storage mechanisms or other readily dispatchable power sources like hydropower, might serve as a means of providing baseload power. However, current energy storage technologies are too expensive to allow wind power to serve as a large baseload generator.

Areas of class 3 or higher wind energy potential occur throughout much of the northeastern United States (DOE 1986, 2008). The primary areas of good wind energy resources are the Atlantic coast, the Great Lakes, and exposed hilltops, ridge crests, and mountain summits. Winter is the season of maximum wind power throughout the Northeast when all except the most sheltered areas have class 3 or better wind resource; exposed coastal areas and mountain summits can expect class 6 or 7 wind resource. In summer, the season of minimum wind power, class 3 wind resource can be found only on the outer coastal areas and highest mountain summits (DOE 1986).

Wind power of class 3 and higher is estimated for the high elevations of the Adirondack Mountains of northeastern New York (DOE 1986, 2008). Annual average wind power of class 3 or 4 is found along the coastal areas of both Lake Erie and Lake Ontario, while class 5 winds are estimated to exist in the central part of both lakes (DOE 1986, 2008).

The National Research Council estimated that offshore wind could meet most of the IP2 and IP3 load by 2014 (National Research Council 2006).

Given the difficulties inherent in relying on wind power as a baseload alternative, the NRC staff does not consider wind power to be a suitable stand-alone alternative, though the staff recognizes New York's utility-scale wind resources and active wind resource development. Therefore, the NRC staff includes wind power in the combination alternatives addressed in Section 8.3.5 of this SEIS.

8.3.4.2 Wood and Wood Waste

Wood-burning electric generating facilities can provide baseload power. However, the economic feasibility of a wood-burning facility is highly dependent on the availability of fuel sources and the location of the generating facility. Most wood-fired and other biomass plants are independent power producers and cogenerating stations with capacities on the order of 10 to 25 MW(e), with some plants operating in the 40 to 50 MW(e) range. In the 2007 New York Renewable Electricity Profile (DOE/EIA 2009), New York's power industry reported only 37 MW(e) of generating capacity for wood or wood waste derived power. Power generated by burning wood waste qualifies as renewable under New York's Renewable Portfolio Standard.

Wood-burning energy generation continues to be developed in the northeastern U.S. In 2005, about 16 percent of the nation's energy derived from wood and wood wastes was generated in the New England and Middle Atlantic census divisions (DOE/EIA 2007). Within the region,

about 12 percent of this generating capacity is from wood and wood wastes.

Walsh et al estimated New York's wood resources in a study published in 1999 (Walsh et al 1999). The study presents the amount of resources available in tons per year given a specified price per dry ton delivered. Wood feedstock categories included forest residues, defined as "logging residues; rough, rotten, and salvable dead wood; excess saplings; and small pole trees," and primary mill residues (Walsh 1999). The annual resources available for each of these categories at a delivery cost of less than $50 per dry ton are 1,746,400 and 1,274,000 tons, respectively (Walsh 1999). These volumes, respectively, account for about 4 percent and 1.5 percent of the total resource available in the 48 contiguous States. The neighboring States of New Jersey, Connecticut, Massachusetts, and Vermont have significantly less wood resource. Pennsylvania, however, has comparable resources to New York available. Assumptions in the analysis include transportation distances of less than 50 mi and accessibility of 50 percent of the forest residues from existing roads.

The NRC staff finds that New York has utility-scale wood waste resources, but given uncertainties in supply estimates, as well as the small size and high number of installed facilities necessary to replace IP2 and IP3, the NRC staff does not find wood biomass to be a suitable alternative to IP2 and IP3 operating license renewals. The NRC staff will include wood waste facilities as a contributor to biomass generating capacity in combinations of alternatives addressed in Section 8.3.5 of this SEIS.

8.3.4.3 Hydropower

New York State receives an abundant supply of hydroelectric power from Niagara Falls and other sites. Hydropower accounts for 5990 MW(e)—or about 15 percent—of the State's generating capacity (NYISO 2008).

Studies conducted for the New York State Department of Public Service indicate a potential for 2527 MW of hydroelectric power by 2022 (NYSDPS 2009). NYSDPS estimates that 289 MW of hydropower will come online by 2015, based on Renewable Portfolio Standard supply curves. Though the likely potential by 2015 is too little to replace IP2 or IP3, it is sufficient for inclusion in combination alternatives.

8.3.4.4 Oil-Fired Generation

Oil accounts for about 8 percent of the generating capacity—or 3515 MW(e)—Statewide (NYISO 2008). EIA projects that oil-fired plants will account for very little new generation capacity in the United States during the next 20 years, and higher fuel prices will lead to a decrease in overall oil consumption for electricity generation (DOE/EIA 2007a).

EIA no longer addresses oil as a significant contributor to capacity additions (DOE/EIA 2010), as discussed in Section 8.3. The relatively high cost of oil—even prior to 2008's record high prices—had prompted a steady decline for use in electricity generation. The NRC staff has not evaluated oil-fired generation as an alternative to the renewal of the IP2 and IP3 operating licenses, though the NRC staff notes that oil may temporarily be burned in a gas-fired alternative should gas capacity become constrained during winter heating season.

8.3.4.5 Solar Power

New York has enacted demand-side policies aimed at encouraging the adoption of photovoltaic (PV) technology for residents and businesses. These policies had resulted in the installation of

more than 1.5 MW(e) of demand-side PV energy as of summer 2005 (National Research Council 2006). Through its Clean Energy Initiative, the Long Island Power Authority had issued rebates for PV systems totaling more than 2.63 MW(e) (National Research Council 2006). The National Research Council indicates that PV systems may be in the economic interests of New York customers because of high retail electricity rates and the falling prices of PV-generated electricity (National Research Council 2006).

The National Research Council reported that PV-generated electricity can provide high-value peak-time distributed generation power with minimal environmental emissions, and PV can contribute significantly to grid stability, reliability, and security (National Research Council 2006). Distributed generation refers to the production of electricity at or close to the point of use. Under an aggressive development scenario, the National Research Council estimates that 70 MW(e) of distributed PV could be installed in the NYCA by 2010 and 335 MW(e) by 2015. However, the National Research Council states that there would have to be "reductions in PV costs and a long-term commitment to expand New York's PV programs" in order to reach these goals (National Research Council 2006). Finally, the National Research Council considers most of the projected PV distributed generation as demand-side reductions in peak energy demands. Therefore, the energy-saving impacts of solar power are included in the conservation estimates described in Section 8.3.4 of this SEIS.

More recently, the NRC staff notes that new solar projects are moving forward in the State, including, for example, a proposed 32 MW(e) facility at Brookhaven National Laboratory and a 15 MW(e) facility (with potential to expand to 20 MW(e)) in Coxsackie. Additionally, the New York Power Authority has its own solicitation for 100 MW(e) of photovoltaic power. The New York State Department of Public Service projects that solar photovoltaics will contribute 52.57 MW(e) of capacity for the customer-sited tier of the State's Renewable Portfolio Standard by 2015 (NYSDPS 2009).

The NRC staff does not consider solar power to be a suitable stand-alone alternative to the renewal of the IP2 and IP3 operating licenses, and the capacities being added in New York State are relatively small. The NRC staff does, however, recognize that solar energy is an important component of the NYSERDA demand-side reductions in peak load demands from generating facilities, including IP2 and IP3, as well as a contributor to the Renewable Portfolio Standard. Solar power may contribute to the combination alternatives addressed in Section 8.3.5 of this SEIS as a part of the conservation-derived demand reductions (as described in Section 8.3.4), and may support other generation at peak times.

8.3.4.6 New Nuclear Generation

Given the expressed industry interest in new nuclear construction, the NRC staff has previously evaluated the construction of a new regional nuclear power plant as an alternative to license renewal in SEISs for other nuclear power plant license renewal requests.

Given the current combined license (COL) application schedule, the time needed to review an application, and the anticipated length of construction, the NRC staff does not consider the construction and operation of a new nuclear power plant specifically for the purpose of replacing IP2 and IP3 to be a feasible alternative to license renewal at this time.

8.3.4.7 Geothermal Energy

Geothermal plants are most likely to be sited where hydrothermal reservoirs are prevalent, such

as in the western continental United States, Alaska, and Hawaii. There are no feasible eastern locations for geothermal capacity to serve as an alternative to IP2 and IP3 (NRC 1996), and the New York Renewable Electricity Profile did not indicate any geothermal energy production in New York in 2007 (DOE/EIA 2009). As such, the NRC staff concludes that geothermal energy would not be a feasible alternative to renewal of the IP2 and IP3 operating licenses.

8.3.4.8 Municipal Solid Waste

According to the Integrated Waste Services Association (IWSA), fewer than 90 waste-to-energy plants are operating in the United States, generating approximately 2700 MW(e) of electricity or an average of approximately 30 MW(e) per plant (IWSA 2007). The existing net capacity in the region of IP2 and IP3 is 156 MW(e) generated by six plants, while the technical potential within the region is 1096 MW(e) by 2014 (National Research Council 2006). The 2014 estimate includes production from fuels containing municipal solid waste and construction and demolition wood (a portion likely to be at least partially captured in Walsh et al and referenced in the Wood Waste section of 8.3.4).

Estimates in the GEIS suggest that the overall level of construction impact from a waste-fired plant would be approximately the same as that for a coal-fired plant. Additionally, waste-fired plants have the same or greater operational impacts than coal-fired technologies (including impacts on the aquatic environment, air, and waste disposal). The initial capital costs for municipal solid waste plants are greater than for comparable steam turbine technology at coal facilities or at wood waste facilities because of the need for specialized waste separation and handling equipment.

The decision to burn municipal waste to generate energy (waste-to-energy) is usually driven by the need for an alternative to landfills rather than by energy considerations. The use of landfills as a waste disposal option is likely to increase in the near term; with energy prices increasing, however, it is possible that municipal waste combustion facilities may become attractive. Congress has included waste-to-energy in the Production Tax Credit legislation to encourage development of waste-to-energy and other renewable technologies (IWSA 2008).

Given the small average installed size of municipal solid waste plants, it would take about 70 plants to replace IP2 and IP3. Furthermore, NYSERDA estimates that the Statewide economically achievable potential for summer peak load from municipal solid-waste-derived energy by 2022, well into the relicensing period for IP2 and IP3, is only 190 MW(e) (NYSERDA 2003). Therefore, the NRC staff does not consider municipal solid waste combustion to be a feasible alternative to license renewal. Certain types of refuse-derived fuel, however, may qualify for inclusion in New York's Renewable Portfolio Standard (RPS) as biomass to the extent that they make use of renewable waste streams. Staff addresses biomass contributions as part of the combination alternatives.

8.3.4.9 Other Biomass Derived Fuels

In addition to wood and wood waste fuels, there are several other biomass fuels used for generating electricity. These include burning crops, converting crops to a liquid fuel such as ethanol, gasifying crops, and biogas. Additionally, the National Research Council identifies animal and avian "manure" and wastewater methane as biomass derived fuel sources. The National Research Council estimates that the NYCA has a potential capacity of 41 MW(e) from biogas by 2014 (National Research Council 2006). NYSERDA estimates that the Statewide economically achievable annual load from biomass-derived energy by 2022, well into the

relicensing period for IP2 and IP3, is 1.7 million MW(h) (NYSERDA 2003) or about 190 MW(e). In the period between 2005 and 2007, IP2 and IP3 produced more than 16 million MW(h) annually (Blake 2008). Furthermore, the New York Renewable Electricity Profile did not indicate any energy production in New York from biomass fuels other than wood and wood waste in 2007 (DOE/EIA 2009), which is considered above. For these reasons, the NRC staff concludes that power generation from biomass fuels alone does not offer a feasible alternative to the renewal of the IP2 and IP3 operating licenses. It will, however, be considered as a portion of a combination alternative grouped with wood waste. NRC staff notes that, under New York's RPS, certain other waste streams, which may include source-separated portions of municipal solid waste, may qualify as biomass. This is distinguished from municipal solid waste in that certain portions of a municipal solid waste stream that may qualify as biomass are segregated from other portions of the municipal solid waste stream prior to further treatment (e.g., gasification) or direct combustion.

8.3.4.10 Fuel Cells

Fuel cells work by oxidizing fuels without combustion and the accompanying environmental side effects. The only byproducts are heat, water, and, if the fuel is not pure hydrogen, CO_2. Hydrogen fuel can come from a variety of hydrocarbon resources by subjecting them to steam under pressure. Natural gas is typically used as the source of hydrogen.

The only current program that was identified as being initiated by one of the three major power providers in downstate New York is a program being conducted by the New York Power Authority that involves nine fuel cell installations totaling 2.4 MW(e) using waste gas produced from sewage plants (National Research Council 2006).

At the present time, fuel cells are not economically or technologically competitive with other alternatives for baseload electricity generation. NYSERDA estimates that the Statewide technical potential for annual supply from fuel cells by 2022 is more than 37 million MW(h); however, NYSERDA indicated that the economical potential for 2022 is zero (NYSERDA 2003). NYSERDA defines economic potential as "that amount of technical potential available at technology costs below the current projected costs of conventional electric generation that these resources would avoid." Therefore, while it may be possible to use a distributed array of fuel cells to provide an alternative to IP2 and IP3, it currently would be prohibitively costly to do so. Since fuel cells are not currently economically feasible on such a large scale, the NRC staff concludes that fuel cell-derived power is not a feasible alternative to the IP2 and IP3 license renewals.

8.3.4.11 Delayed Retirement

Plants scheduled for retirement are aging and have higher emissions than newer plants. Keeping older plants online may not be technically or economically achievable when emissions controls or necessary environmental mitigation measures are taken into account. Furthermore, given that the demand for electricity is increasing and, in the near term, planned new sources within the NYCA are just keeping pace with retirements, the NRC staff does not consider additional delays in the retirements of existing plants to be a feasible alternative to compensate for the loss of power from IP2 and IP3. In section 8.3.1, however, NRC staff contemplates the repowering of a shutdown or underutilized facility with a natural gas combined-cycle power plant.

8.3.4.12 Combined Heat and Power

In course of preparing this SEIS, the NRC staff has received comments indicating that it should consider combined heat and power (CHP) as an alternative to license renewal. In some cases, these suggestions have also included an indication of the potential that CHP could have, as well as the environmental advantages of CHP applications.

CHP facilities provide electrical power as well as heat (often in the form of steam) for use by nearby industries or buildings. CHP installations are commonly found on large industrial facilities or in urban centers where many buildings are near to one another. Modern CHP tends to be efficient, in that CHP systems make effective use of some heat that would be wasted by conventional electrical generation. CHP systems can be designed to produce relatively larger proportions of electrical power or heat depending on existing demands.

The NRC staff notes that the current IP2 and IP3 are only used to produce electrical power, and do not supply heat to any offsite users. Combined heat and power, then, fulfills a need not currently met by IP2 and IP3 and is not a direct alternative to IP2 and IP3 license renewal.

8.3.4.13 Supercritical Coal-Fired Generation

The NRC staff has moved the supercritical coal-fired alternative to this section based on public draft SEIS comments, a staff review of likely generating alternatives in New York State, and policies like the Regional Greenhouse Gas Initiative that all suggest that new coal-fired generation is unlikely in New York State. The discussion of the supercritical coal-fired alternative in this section has not been updated from the draft SEIS.

Supercritical coal-fired plants are similar to other coal burners except that they operate at higher temperatures and pressures, which allows for greater thermal efficiency. Supercritical coal-fired boilers are commercially proven and represent an increasing proportion of new coal-fired power plants. In evaluating the supercritical coal-fired alternative, the NRC staff assumed that a new plant located at an alternate site would use a closed-cycle cooling system.

Construction of a coal-fired plant at an alternate site may necessitate the acquisition of additional ROWs for new transmission lines and construction of new lines to transmit power. Transmission line and ROW length would vary with distance to suitable existing lines. In addition, construction at an alternate site may necessitate the construction of an appropriate railroad spur (or other transportation infrastructure) for coal and limestone (used in scrubbers to remove sulfur oxides) deliveries.

For purposes of this analysis, the NRC staff will rely on data published by EIA indicating that a new, scrubbed coal plant constructed in 2015 will operate at a heat rate of 8661 BTU per kilowatt hour (BTU/kWh) (DOE/EIA 2007b). (This reduces the level of emissions for this alternative when compared to the coal-fired alternative Entergy analyzed in the ER for IP2 and IP3 ER by approximately 15 percent for some impact areas).

Impacts of a coal-fired alternative evaluated by the NRC staff assume that the new plant would have a gross electrical capacity of 2200 MW(e). The NRC staff's analysis of the 2200-MW(e) coal-fired plant is based on the factors used to calculate the impacts of the plant that would replace the 2158 MW(e) of power produced by the IP2 and IP3 plants (Entergy 2007). Because up to 10 percent of gross generation may be consumed on site by the coal-fired plant (or its pollution control equipment), the NRC staff's evaluation of a 2200-MW(e) plant may actually slightly understate impacts from this alternative. This ensures, however, that impact levels for alternatives are not overstated when compared to the proposed action.

The NRC staff will present most impacts on an annualized basis. While the renewal period for the IP2 and IP3 operating licenses is only 20 years, the operating lifespan for a new coal-fired plant is likely closer to 40 years, and may even be longer given the lifespans of some existing coal-fired plants. Most impacts will be independent of plant lifespan, though total land area used for waste disposal, for example, will be larger after 40 years than after 20 years. Where these differences exist, the NRC staff will identify them.

For replacing IP2 and IP3, the NRC evaluated an alternative that would use four 550-MW(e)-net coal-fired units to replace the power output of IP2 and IP3. Advanced coal and conventional combined-cycle coal plants could operate at even greater efficiencies (about 7477 and 6866 BTU/kWh, respectively, or greater) by 2015 (DOE/EIA 2007b).

The supercritical coal-fired plant, with a gross output of about 2200 MW(e), would consume approximately 4.9 million metric tons (MT) (5.4 million tons) per year of pulverized bituminous coal with an ash content of approximately 7.11 percent and sulfur content of 1.12 percent (based on New York coal consumption) (DOE/EIA 2001). The NRC staff assumed a capacity factor of 0.85 for the supercritical coal-fired alternative.

Based on Table 8-1 of the GEIS, a pulverized coal-fired facility requires approximately 0.7 ha (1.7 ac) of land per MW of generating capacity. Based on this relationship, a 1540-ha (3805-ac) site would be needed to replace the nuclear power output of IP2 and IP3 with an equivalent capacity coal-fired facility. In more recent SEIS documents, however, the NRC staff indicated that smaller quantities of land may be sufficient to construct coal-fired facilities based on land use at existing coal-fired power plants. Because the existing IP2 and IP3 site includes only 239 ac (97 ha), and much of the area is occupied by plant structures, the NRC staff concludes that there is not sufficient land area at the IP2 and IP3 site to support operations of the alternative. Thus, the coal-fired alternative is analyzed only for an unspecified alternate site. It should be noted that several of the newer coal utilization technologies (e.g., coal-fired integrated gasification combined-cycle systems) could be accommodated on smaller sites than would the conventional pulverized coal concept evaluated here, but likely not a site as small as the IP2 and IP3 site.

The overall impacts of the coal-fired generating facility are discussed in the following sections and summarized in Table 8-3, at the end of Section 8.3.1 of this SEIS. The implications of constructing a new coal-fired plant at an alternate site will depend on the actual location and characteristics of that site. For purposes of this section, the NRC staff assumes that a coal-fired plant located at an alternate site would require the construction of a new transmission line to connect that plant to the regional transmission grid.

Land Use

In the GEIS, the NRC staff estimated that about 0.7 ha (1.7 ac) of land are needed per MW(e) for the construction and operation of a coal-fired power plant. Constructing a 2200-MW(e) coal-fired facility would take approximately 1540 ha (3805 ac). In more recent SEIS documents, the NRC staff indicated that smaller quantities of land may be sufficient to construct coal-fired facilities based on land use at existing coal-fired power plants. A 2200-MW(e) facility may be able to fit on a site with several hundred acres of land rather than the 1540 ha (3805ac) indicated in the GEIS.

Committing land resources to a new coal-fired plant could result in the loss of wildlife habitat or

agricultural land. The potential need for new transmission line corridors and ROWs also drive land use effects for the coal-fired facility. As a result of the substantial site area that would be dedicated to and disrupted by coal-fired operations, the NRC staff views this alternative as having potentially MODERATE land use impacts from construction.

Additionally, for the coal-fired alternative, land use changes would occur at an undetermined coal mining area where approximately 75 square miles (sq mi) (19,400 ha) would be affected for mining coal and disposing of mining wastes to support a 2200-MW(e) coal-fired power plant (the GEIS estimates that approximately 34 sq mi (8800 ha) would be disturbed for a 1000-MW(e) coal-fired plant (NRC 1996). Offsite land use for coal mining would partially be offset by the elimination of the need for offsite uranium mining. In the GEIS, the NRC staff estimated that approximately 405 ha (1000 ac) would be affected for mining the uranium and processing it during the operating life of a 1000-MW(e) nuclear power plant (NRC 1996). Therefore the uranium mining offset for a 2200-MW(e) facility would be approximately 890 ha (2,200 ac) of the 19,400 ha required for the coal-fired alternative, resulting in a net requirement of approximately 18,500 ha (45,700 ac). Impacts from the coal fuel cycle would add to the already MODERATE impacts from plant construction.

A coal-fired alternative would likely receive coal and limestone by rail. The coal-fired option would require approximately 10.4 coal unit trains per week (assuming each train has 100 cars with 100 tons of coal per car). For an undeveloped site, a new rail spur would be necessary. For an existing industrial site, a rail spur may exist but could require improvements to handle these deliveries. Impacts from improving an existing rail spur would be small, as the area is already disturbed and used for industrial purposes. Installing a new rail spur could result in relatively minor impacts depending on the length of the rail spur.

Overall, impacts to land use from construction of the coal-fired alternative and its fuel cycle would be MODERATE to LARGE.

Ecology

Siting a coal-fired plant at an alternate site would introduce construction and operating impacts. Converting as much as 1500 ha (3700 ac) of land to industrial use (generating facilities, coal storage, ash and scrubber sludge disposal) could significantly alter terrestrial ecological resources and could affect aquatic ecological resources. Construction and maintenance of a transmission line and rail spur would incrementally add to the terrestrial ecological impacts. Impacts to terrestrial ecology from coal mining also could be substantial, though terrestrial ecology at many coal mining sites has already been disturbed. Therefore, the NRC staff concludes that the impact to terrestrial ecology would be MODERATE to LARGE, depending largely on the ecological sensitivity of the plant and mine sites.

Use of surface water resources to provide makeup water for a closed-cycle cooling system would have some impact on local aquatic resources. Aquatic impacts of a supercritical coal-fired alternative would likely be similar to the impacts of the proposed closed-cycle cooling system proposed for the existing nuclear reactors described in Section 8.1.1 of this SEIS. The supercritical coal-fired power plant's greater thermal efficiency—when compared to the existing IP2 and IP3—would result in smaller impacts, while the coal-fired alternative has greater potential for deposition of pollutants or runoff from coal, ash, or scrubber waste areas. On the whole, the level of impact would be similar. Therefore, the NRC staff concludes that the impact to aquatic ecology would be SMALL.

Due primarily to the potential effects on terrestrial ecology, the NRC staff concludes that the overall impacts of this alternative would be MODERATE to LARGE.

Water Use and Quality

For coal-fired operations at an alternate site, impacts to surface waters would result from withdrawal of water for various operating needs of the facility. These operating needs would include cooling tower makeup and possibly auxiliary cooling for equipment and potable water requirements. Discharges to surface water could result from cooling tower blowdown, coal pile runoff, and runoff from coal ash and scrubber byproduct disposal areas. Both the use of surface waters and discharges to surface waters would be regulated by the State within which the coal-fired facility is located.

The NRC staff expects that any new coal-fired facility would comply with requirements of the discharge permits issued for its operation. Thus, the utility would be obligated to ensure that discharges from the plant conform to applicable water quality standards. Water withdrawals from a small river or cooling pond, however, could lead to potential water use conflicts. Overall, the NRC staff concludes that the potential impacts to surface water resources and water quality would be SMALL to MODERATE for a new coal-fired facility located at an alternate site.

Potential impacts to ground water quality at an alternate site may occur as a result of seepage to ground water from coal storage areas and onsite ash and scrubber sludge disposal areas. However, a coal-fired plant of this size is unlikely to use ground water for cooling tower makeup. In all cases, the NRC staff expects that a coal-fired facility would comply with a ground water use and discharge permit issued by the State having jurisdiction over the plant. Complying with permit requirements should ensure a small impact. Therefore, the NRC staff concludes that the potential impacts to water resources would be SMALL to MODERATE.

Air Quality

A coal-fired power plant emits a variety of airborne emissions, including SO_x, NO_x, particulate matter, carbon monoxide (CO), hazardous air pollutants (HAPs) (e.g., mercury), and naturally occurring radioactive materials.

A coal-fired alternative built in a nonattainment area (such as exists at the current IP2 and IP3 site) would require a nonattainment area permit and a Title V operating permit under the CAA. A new power plant would also be subject to the new source performance standards for such units in Subpart DA, "Standards of Performance for Electric Utility Steam Generating Units for Which Construction Is Commenced after September 18, 1978," of 40 CFR Part 60, "Standards of Performance for New Stationary Sources." These regulations establish emission limits for particulates, opacity, sulfur dioxide (SO_2), and NO_x. EPA has various regulatory requirements for visibility protection in Subpart P, "Protection of Visibility," of 40 CFR Part 51, "Requirements for Preparation, Adoption, and Submittal of Implementation Plans," including a specific requirement for review of any new major stationary source in an area designated attainment or unclassified under the CAA.

NRC discussions of SO_x and NO_x emissions include the most recent relevant regulations, because the Clean Air Interstate Rule (CAIR) was vacated by the D.C. Circuit Court in July of 2008. On September 24, 2008, EPA filed for a rehearing of the D.C. Circuit Court decision. Until EPA, Congress, or the courts act, elements of future SO_x and NO_x regulatory approaches

remain uncertain.

Emissions of specific pollutants from coal-fired alternatives are as follows:

Sulfur oxides emissions. The NRC staff calculates that a new coal-fired power plant would emit 5236 MT/yr (5767 tons/yr) of SO_x after limestone-based scrubbers remove approximately 99 percent of sulfur compounds from plant exhaust. This plant would be subject to the requirements in Title IV of the CAA. Title IV was enacted to reduce emissions of SO_x and NO_x, the two principal precursors of acid rain, by restricting emissions of these pollutants from power plants. Title IV caps aggregate annual power plant SO_x emissions and imposes controls on SO_x emissions through a system of marketable allowances. EPA issues one allowance for each ton of SO_x that a unit is allowed to emit.

New units do not receive allowances but are required to have allowances to cover their SO_x emissions. Owners of new units must, therefore, acquire allowances from owners of other power plants or reduce SO_x emissions at other power plants they own. Allowances can be banked for use in future years. Thus, a new coal-fired power plant would not add to net regional SO_x emissions, although it might contribute to the local SO_x burden.

Nitrogen oxides emissions. Title IV of the CAA directed EPA to establish technology-based emission limitations for NO_x emissions (see Section 407), rather than a market-based allowance system as is used for SO_x emissions. A new coal-fired power plant would be subject to the new source performance standards for such plants in 40 CFR 60.44a(d)(1). That regulation, issued September 16, 1998 (Volume 63, page 49453 of the *Federal Register* (63 FR 49453)), limits the discharge of any gases that contain nitrogen oxides (expressed as nitrogen dioxide (NO_2)) to 200 nanograms per joule of gross energy output (1.6 pound/megawatt-hour (MW(h)), based on a 30-day rolling average.

As previously discussed, IP2 and IP3 are located within the New Jersey-New York-Connecticut Interstate Air Quality Control Region (40 CFR 81.13). All of the States of New Jersey and Connecticut, as well as several counties in Central and Southeastern New York within a 80-km (50-mi) radius of IP2 and IP3, are designated as nonattainment areas for ozone (8-hour standard) (EPA 2008b). Operators or owners of a coal-fired power plant constructed in a nonattainment area would need to purchase offsets for ozone precursor emissions. In this case, NO_x is the major ozone precursor emitted by a coal-fired power plant. In accordance with NYSDEC regulations, "Emission offsets must exceed the net increase in annual actual emissions from the air contamination source project" (NYSDEC, Chapter 3, Parts 231–15). By design, this regulatory requirement should result in a net reduction in ozone emissions in the region.

This new coal-fired plant would likely use a variety of NO_x control technologies, including low-NO_x burners, overfire air, and selective catalytic reduction. EPA notes that when these emissions controls are used in concert, they can reduce NO_x emissions by up to 95 percent (EPA 1998), for total annual emissions of approximately 1230 MT/yr (1355 tons/yr) or 0.14 pounds/MW(h). This is significantly less than the amount allowed by Title IV of the CAA.

Particulate emissions. The NRC staff estimates that the total annual stack emissions would include 175 MT (192 tons) of total suspended particulates and 40 MT (44 tons) of particulate matter having an aerodynamic diameter less than or equal to 10 µm (PM_{10}) (40 CFR 50.6, "National Primary and Secondary Ambient Air Quality Standards for PM_{10}"). Some of this PM_{10} would also be classified as primary $PM_{2.5}$.

As indicated in the IP2 and IP3 ER, fabric filters or electrostatic precipitators would be used for particulate control. EPA notes that filters or precipitators are each capable of removing more than 99 percent of particulate matter, and that SO_2 scrubbers further reduce particulate matter emissions (EPA 1998). In addition to flue emissions, coal-handling equipment would introduce fugitive particulate emissions from coal piles, reclamation equipment, conveyors, and other sources.

Fugitive dust also would be generated during the construction of a coal-fired plant, and construction vehicles and motorized equipment would further contribute to construction-phase air emissions. These emissions would be short lived and intermittent, and construction crews would likely mitigate some impacts through dust control measures.

Carbon monoxide emissions. The NRC staff estimates that the total CO emissions from coal combustion would be approximately 1230 MT/yr (1354 tons/yr) based on EPA-calculated emissions factors for coal-fired power plants.

Hazardous air pollutants including mercury. Following the D.C. Circuit Court's February 8, 2008, ruling that vacated its Clean Air Mercury Rule (CAMR), EPA is working to evaluate how the court's ruling will affect mercury regulation (EPA 2008d). Before CAMR, EPA determined that coal- and oil-fired electric utility steam-generating units are significant emitters of HAPs (EPA 2000a). EPA determined that coal plants emit arsenic, beryllium, cadmium, chromium, dioxins, hydrogen chloride, hydrogen fluoride, lead, manganese, and mercury (EPA 2000a). EPA concluded that mercury is the HAP of greatest concern and that (1) a link exists between coal combustion and mercury emissions, (2) electric utility steam-generating units are the largest domestic source of mercury emissions, and (3) certain segments of the U.S population (e.g., the developing fetus and subsistence fish-eating populations) are believed to be at potential risk of adverse health effects resulting from mercury exposures caused by the consumption of contaminated fish (EPA 2000a). In light of the recent court decision, EPA will revisit mercury regulation, although it is possible that the agency will continue to regulate mercury as a HAP, thus requiring the use of best available control technology to prevent its release to the environment.

Uranium and thorium. Coal contains uranium and thorium, among other naturally occurring elements. According to Alex Gabbard of Oak Ridge National Laboratory, uranium concentrations are generally in the range of 1 to 10 parts per million (ppm), and thorium concentrations are generally about 2.5 times this level (Gabbard 1993). The U.S. Geological Survey (USGS) indicates that Western and Illinois Basin coals contain uranium and thorium at roughly equal concentrations, mostly between 1 and 4 ppm, but also indicates that some coals may contain concentrations of both elements as high as 20 ppm (USGS 1997). Gabbard indicates that a 1000-MW(e) coal-fired plant could release roughly 4.7 MT (5.2 tons) of uranium and 11.6 MT (12.8 tons) of thorium to the atmosphere each year (Gabbard 1993).

Both USGS and Gabbard, however, indicate that almost all of the uranium, thorium, and most decay products remain in solid coal wastes, especially in the fine glass spheres that constitute much of coal's fly ash. Modern emissions controls, such as those included for this coal-fired alternative, allow for recovery of greater than 99 percent of these solid wastes (EPA 1998), thus retaining most of coal's radioactive elements in solid form rather than releasing it to the atmosphere. Even after concentration in coal waste, the level of radioactive elements remains relatively low—typically 10 to 100 ppm—and consistent with levels found in naturally occurring

granite rocks, shales, and phosphate rocks (USGS 1997). The levels of uranium and thorium contained in coal wastes and discharged to the environment exceed the levels of uranium and thorium released to the environment by IP2 and IP3.

Carbon dioxide: A coal-fired plant would have unregulated CO_2 emissions that could contribute to global warming. Under the current regulatory framework, a coal-fired plant would have unregulated CO_2 emissions during operations as well as during coal mining and processing, and coal and lime transportation. Burning bituminous coal in the United States emits roughly 93.3 kg (205.3 pounds) of CO_2 per million BTU (DOE/EIA 2008a). The four-unit 2200-MW(e) supercritical coal-fired plant would emit approximately 13.1 million MT (14.4 million tons) of CO_2 per year assuming a heat rate of 8661 BTU/kWh (DOE/EIA 2007b). Section 6.2 of this SEIS contains a discussion of current and likely future relative greenhouse gas (GHG) emissions from several energy alternatives, including coal, natural gas, nuclear, and renewables. In Section 6.2, the NRC staff found that GHG emissions from coal would likely exceed those from other energy alternatives throughout the period of extended operation.

Visibility Regulations: Section 169A of the CAA (42 USC 7491) establishes a national goal of preventing future and remedying existing impairment of visibility in mandatory Class I Federal areas when impairment results from manmade air pollution. EPA issued a new regional haze rule in 1999 (64 FR 35714). The rule specifies that for each mandatory Class I Federal area located within a State, the State must establish goals that provide for reasonable progress towards achieving natural visibility conditions. The reasonable progress goals must provide for an improvement in visibility for the most-impaired days over the period of the implementation plan and ensure no degradation in visibility for the least-impaired days over the same period (40 CFR 51.308(d)(1)). If a coal-fired alternative were located close to a mandatory Class I area, additional air pollution control requirements would be imposed. New York has no Class I areas; of the neighboring States, New Jersey and Vermont each have one—the Brigantine Wilderness Area and the Lye Brook Wilderness, respectively. Brigantine is located about 225 km (140 mi) south of IP2 and IP3, while Lye Brook is roughly 215 km (134 mi) north-northeast. A coal-fired alternative located near these areas or any other Class I area may need additional pollution controls to keep from impairing visibility.

Summary. The GEIS analysis did not quantify emissions from coal-fired power plants, but implied that air impacts would be substantial. The GEIS also mentioned global warming from unregulated CO_2 emissions and acid rain from SO_x and NO_x emissions as potential impacts (NRC 1996). The NRC staff's analysis shows that emissions of air pollutants, including SO_x, NO_x, and CO, would be significant and would be greater than all other alternatives. Operational emissions of CO_2 are also greater under the coal-fired alternative than under any other alternative.

The NRC analysis for a coal-fired alternative at an alternative site indicates that impacts from the coal-fired alternative would have clearly noticeable effects, but given existing regulatory regimes, permit requirements, and emissions controls, the coal-fired alternative would not destabilize air quality. Thus, the appropriate characterization of air impacts from coal-fired generation would be MODERATE.

Waste

A four-unit, 2220-MW(e) coal-fired plant with a heat rate of 8661 BTU/kWh (DOE/EIA 2007b) would annually consume approximately 5.4 million tons of coal having an ash content of

7.11 percent (Entergy 2007). After combustion, 99.9 percent of this ash, approximately 348,600 MT (384,000 tons) per year, would be collected and disposed of at either an onsite or offsite landfill, or recycled. Based on industry-average recycling rates, approximately 155,610 MT (171,000 tons), or 45 percent, of the ash content would be recycled, leaving a total of approximately 192,290 MT (209,000 tons) for disposal (ACAA 2007). In addition, approximately 300,300 MT (330,000 tons) of scrubber waste would be disposed of or recycled each year. Based on industry-average recycling rates, approximately 237,000 MT (261,000), or 79 percent, of gypsum scrubber waste would be recycled (ACAA 2007). As mentioned in the Air Quality section, this waste also would contain levels of uranium and thorium in concentrations similar to those found in naturally occurring granites, shales, and phosphate rocks (USGS 1997). In addition to coal combustion wastes, a supercritical coal-fired alternative also would produce small amounts of domestic and hazardous wastes.

Disposal of the waste could noticeably affect land use and ground water quality, but with appropriate management and monitoring, it would not destabilize any resources. After closure of the waste site and revegetation, the land could be available for other uses.

In May 2000, EPA issued a “Notice of Regulatory Determination on Wastes from the Combustion of Fossil Fuels” (EPA 2000b). EPA concluded that some form of national regulation is warranted to address coal combustion waste products because (1) the composition of these wastes could present danger to human health and the environment under certain conditions, (2) EPA has identified 11 documented cases of proven damages to human health and the environment by improper management of these wastes in landfills and surface impoundments, (3) disposal practices are such that, in 1995, these wastes were being managed in 40 to 70 percent of landfills and surface impoundments without reasonable controls in place, particularly in the area of ground water monitoring, and (4) EPA identified gaps in State oversight of coal combustion wastes. Accordingly, EPA announced its intention to issue regulations for disposal of coal combustion waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA). EPA has not yet issued these regulations.

In addition to the waste streams generated during plant operations, considerable debris would be generated during construction of a coal-fired facility. Crews would likely dispose of land-clearing debris on site.

For all of the preceding reasons, the NRC staff considers the impacts of managing waste generated by a coal facility (construction and operating phases) to be MODERATE—the impacts would be clearly noticeable, but would likely not destabilize any important resource.

Human Health

Coal-fired power generation introduces risks to workers at many points in the fuel cycle. These risks include risks from mining coal and limestone, transportation of raw materials, plant construction and operation, and waste management. There also may be public health risks from a coal-fired plant’s operation (routine emissions and coal-pile fires) and fuel cycle (mining and transportation).

During construction activities there would be risk to workers from typical industrial incidents and accidents. Accidental injuries are not uncommon in the construction industry and accidents resulting in fatalities do occur. However, the occurrence of such events is mitigated by the use of proper industrial hygiene practices, complying with worker safety requirements, and training.

Occupational and public health impacts during construction are expected to be controlled by continued application of accepted industrial hygiene protocols, occupational health and safety controls, and radiation protection practices.

In the GEIS, the NRC staff stated that human health impacts (cancer and emphysema) could arise from chronic exposures to coal-fired plant emissions. Emissions contain pollutants such as toxins, particulates, and low levels of naturally occurring radioactive elements. However, Federal and/or State agencies regulate these emissions and enforce emissions standards that are designed to be protective of human health. As a result, power plants install appropriate emission controls to meet regulatory standards.

Coal-fired generation would introduce mechanical sources of noise that would be audible off site. Sources contributing to total noise produced by plant operations are both continuous and intermittent. Continuous sources include the mechanical equipment associated with normal plant operations. Intermittent sources include the coal-handling equipment, solid-waste disposal systems, outside loudspeakers, and commuting activities of plant employees. Noise impacts associated with rail delivery of coal and lime to the generating station site would be most significant for residents living along the new rail spur leading to the plant. Although passing trains significantly raise noise levels near rail corridors, the short duration of the noise tends to minimize impacts.

Based on the cumulative potential impacts of construction activities, emissions, and noise on human health, the NRC staff considers the impact of constructing and operating a new coal-fired facility to be MODERATE.

Socioeconomics

Construction of a coal-fired facility at an alternate site would take approximately 4 years (DOE/EIA 2007b). Based on estimates given in Table 8.1 of the GEIS, the peak workforce is estimated to range from 1.2 to 2.5 additional workers per MW(e) during the construction period. For the 2200-MW(e) plant utilized in this analysis, the peak workforce would range from approximately 2640 to as many as 5500 workers during the 4-year construction period (NRC 1996). During construction, the surrounding communities would experience demands on housing and public services unless some of the workforce is composed of local residents. In the GEIS, the NRC staff stated that socioeconomic impacts would depend on the location of the new plant. For example, at a rural site more of the peak construction workforce would need to relocate (temporarily or permanently) to the area to work. Therefore, socioeconomic impacts could range from SMALL to LARGE depending on whether workers would relocate to be near the site, as well as depending on the size and makeup of the existing community.

At the end of construction, the local population would be affected by the loss of as many as 5000 construction jobs. However, this loss would be partially offset by a postconstruction permanent employment rate of 0.25 workers per MW(e) based on Table 8.2 of the GEIS, or a total of 550 total workers. An additional construction workforce would be needed for the decommissioning of IP2 and IP3 which could temporarily offset the impacts of the lost construction and IP2 and IP3 jobs at the site.

The coal-fired plant would provide new tax revenue to its community. Because this plant would be located in another community, it would have a positive impact on its community while the shutdown of IP2 and IP3 will have a negative impact on the tax base of the IP2 and IP3

community.

The NRC staff concludes that the overall socioeconomic impacts of changes in the local population from the influx of the construction workforce and changes to community tax revenues could be SMALL to LARGE during construction and SMALL to MODERATE during operation, depending on the size and economic structure of the affected communities.

Transportation

During the 4-year construction period of the coal-fired unit, as many as 2640 to 5500 construction workers may be working at the site. During this same time period, trucks and trains would likely be delivering construction materials to the site. The addition of these workers would increase traffic on highways and local roads that lead to the construction site. The impact of this additional traffic could have a MODERATE to LARGE impact on nearby roadways, particularly if the alternate site is in a rural area. Impacts associated with plant operating personnel commuting to work are likely to be SMALL.

For rail transportation of coal and limestone to the alternate site, impacts are likely to range from SMALL to LARGE, depending on local rail characteristics. On average, more than ten 100-car trains per week would deliver coal to the new generating station, and two 10-car trains per week would deliver limestone to the facility. Transportation impacts associated with coal and limestone delivery could range from SMALL to LARGE

Overall, transportation impacts could range from MODERATE to LARGE during construction, and SMALL to LARGE during operation.

Aesthetics

At an alternate site, plant buildings, exhaust stacks, cooling towers, and cooling tower plumes would create aesthetic impacts. The coal-fired alternative's four power plant units would be up to 200 ft (61 m) tall and may be visible off site in daylight hours. The three exhaust stacks could be up to 600 ft (183 m) high (at least 500 ft (152 m) for good engineering practice). If the coal-fired alternative makes use of natural-draft cooling towers, then additional visual impacts will occur from the towers, which may be several hundred feet tall and topped with condensate plumes. Mechanical-draft towers would also generate condensate plumes, but would be markedly shorter than natural-draft towers (or they may use hybrid towers like the alternative described in Section 8.1 of this SEIS). Other buildings on site may also affect aesthetics, as could construction of new transmission lines. Noise and light from plant operations, as well as lighting on plant structures, may be detectable off site.

Aesthetic impacts at the plant site would be minimized if the plant were located in an industrial area adjacent to other power plants or industrial facilities. Development of a new coal-fired facility at an undeveloped alternate site, however, would entail construction of a new transmission line and a new rail spur to bring coal and lime to the plant. The rail spur and transmission line could extend many miles from the site to tie-in points with existing rail and transmission systems. The visual intrusion of these two linear elements, particularly the transmission line, could be significant.

Overall the aesthetic impacts associated with locating at an alternate site would be categorized as MODERATE to LARGE for an undeveloped site, and may be SMALL to MODERATE at a site previously developed for industrial uses.

Historic and Archeological Resources

A cultural resource inventory would be needed for any property that has not been previously surveyed. The survey would include an inventory of field cultural resources, identification and recording of existing historic and archeological resources, and possible mitigation of adverse effects from subsequent ground-disturbing actions related to physical expansion of the plant site. The studies would likely be needed for all areas of potential disturbance at the proposed plant site and along associated corridors where new construction would occur (e.g., roads, transmission corridors, rail lines, or other ROWs).

Historic and archeological resource impacts can generally be effectively managed and, as such, would be considered SMALL to MODERATE at a new undeveloped site, depending on the sensitivity of the site. For a previously developed site, most of which have already been intensively developed, impact on cultural and historic resources would also be SMALL. Previous development would likely have either removed items of archeological interest or may have included a survey for sensitive resources. Any significant resources identified would have to be handled in accordance with the NHPA.

Environmental Justice

As described in Section 8.2 of this SEIS, no environmental impacts were identified that would result in disproportionately high and adverse environmental impacts on minority and low-income populations if IP2 and IP3 were shut down.

Impacts at the location of the new four-unit coal-fired plant would depend upon the site chosen and the nearby population distribution, but would likely be SMALL to MODERATE for most alternate sites, but could reach LARGE. For previously developed industrial sites, impacts could be larger or smaller, depending on the relative proximity of low-income populations.

8.3.5 Combinations of Alternatives

Even though many individual alternatives to license renewal might not be sufficient on their own to replace the 2158-MW(e) total capacity of the IP2 and IP3 units because of the lack of resource availability, technical maturity, or regulatory barriers, it is conceivable that a combination of alternatives might be sufficient. Such alternatives may also include the continued operation of either IP2 or IP3 combined with other alternatives.

There are many possible combinations of alternatives that could be considered to replace the power generated by IP2 and IP3. In the GEIS, NRC staff indicated that consideration of alternatives would be limited to single, discrete generating options, given the virtually unlimited number of combinations available. In this section, the NRC staff examines two possible combinations of alternatives, considering, among others, the work of Levitan and Associates (2005) and the National Research Council (2006) have all addressed combinations of alternatives. The National Research Council (2006) noted, for example, that ". . . the additional 2 gigawatts (GWs) required if IP2 and IP3 were to be closed could be met by some suitable combination of new generation in the New York City area, efficiency improvements and demand-side management, and new transmission capability from upstate." Information available since the publication of the draft SEIS provides additional insight into renewal energy capability and potential transmission options.

The NRC staff presents two possible combinations based partly on analysis by the National Research Council and in part on comments received on the draft SEIS. In one of these combinations, the NRC has included the continued operation of either IP2 or IP3. The second combination considers several alternatives as a complete replacement of IP2 and IP3. The second combination is based entirely on new generation, efficiency improvements or demand-side management (jointly addressed as conservation), and assumes the availability of transmission capacity to carry power from upstate. These combinations include several alternatives that the NRC staff found to be unsuitable for replacing the entirety of IP2 and IP3 electrical capacity. The NRC staff notes that an infinite number of potential combination alternatives exists, based on varying the amounts or types of power generation employed or varying the extent to which alternatives rely on energy conservation. It is not possible to consider all such combinations. Rather, the NRC staff selected the following alternatives based on available research and input from the draft SEIS comment process. They represent, in the staff's judgment, reasonable examples of combinations based upon comments received, ongoing State-level programs, and resource availability in New York State. The staff notes that none of these combinations are intended to place a limit on available resource capacities, nor are they intended to supplant State or utility level policy decisions about how to generate electricity, reduce or add to loads, set prices, or promote different approaches to generating electricity or managing loads.

<u>Combination Alternative 1</u>

- continued operation of either IP2 or IP3
- obtaining 600 MW(e) from renewable energy sources (primarily wind with smaller amounts of hydropower, biomass, and possibly landfill gas; assumes that sufficient hydropower, biomass, and landfill gas capacity exists to compensate for wind power intermittency)
- implementing 600 MW(e) of conservation programs based on the State's "15x15" energy conservation program and other efforts to improve energy efficiency or increase conservation

<u>Combination Alternative 2</u>

- repowering an existing fossil-powered plant in downstate New York with a new 400-MW(e) to 600 MW(e) combined-cycle power plant (the plant could also be located at the Indian Point site)
- obtaining 600 MW(e) from renewable energy sources (primarily wind, biomass, new hydropower, and landfill gas)
- implementing 1000 to 1200 MW(e) of conservation programs

The following sections analyze the impacts of the two combination alternatives outlined above. In some cases, detailed impact analyses for similar actions are described in previous sections of this Chapter. When this occurs, the impacts of the combined alternatives are discussed in a general manner with reference to other sections of this SEIS. A summary of the impacts from

the two combined alternative options is presented in Table 8-5.

8.3.5.1 Impacts of Combination Alternative 1

Each component of the first combination alternative produces different environmental impacts, though several of the options would have impacts similar to—but smaller than—alternatives already addressed in this SEIS. If NYSDEC requires cooling towers, then constructing closed-cycle cooling for one of the existing Indian Point generating units (either IP2 or IP3) would create impacts roughly equal to half of the impacts addressed in 8.1.1 (slightly larger impacts in land use and historical and archaeological resources if IP3 continues to operate as the Algonquin pipeline only needs to be rerouted for the IP3 proposed tower, and Entergy's Phase 1b study identified historic and archaeological resources near the IP3 tower site; potentially larger waste disposal or human health impacts for the IP2 tower as the potential for contaminated blasting spoils and groundwater is greater in that area). Continued operations of either IP2 or IP3 would incur roughly half the impacts of continued operations described in Chapters 3, 4, and 6. (Decommissioning impacts, as described in Chapter 7 of this SEIS, as well as NUREG-0586, would still occur but may occur later than they would if both units retired at the end of their current Operating Licenses.)

The NRC staff has not yet addressed in any depth in this SEIS the impacts of wind power or biomass generation. The New York State Department of Public Service, in late 2009, indicated that renewable generation resources developed under its Renewable Portfolio Standard by 2015 would likely be wind powered (NYSDPS 2009). In the years 2011 through 2015, NYSDPS expects 1076 MW of wind power to come online. Over the same period, it expects 303 MW of biomass (NYSDPS 2009) (including, among other fuel resources, source-separated waste and wood fuel; NYSPSC 2004), 289 MW of hydropower (from upstate New York and Canada), and 95 MW of landfill gas capacity (NYSDPS 2009). These potentials do not indicate an upper bound of the possible resources in the state, but are indicative of the resources most likely to be added based on NYSDPS supply curve projections. By 2015, then, new renewable resource additions could readily supply the 600 MW of renewable capacity considered here with sufficient biomass, hydropower, and landfill gas additions to back up wind power generation.

The wind power portion of this alternative could include onshore or offshore installations, and may include more than one location. Installations have been proposed for many locations around the state, both on- and offshore, and could include wind turbines off Long Island on the Atlantic coast (with easy access to downstate electricity demand), in upstate New York, or on Lake Erie or Lake Ontario. Multiple locations would also allow operators to hedge for poor wind conditions in any one location. A study conducted for NYSERDA (NYSERDA 2005) indicates that unforced capacity – the percentage of installed capacity available at any given time – at New York State wind installations is approximately 10% for onshore installations and 36% at offshore installations (the offshore estimate is based on one location near Long Island). Because wind power installations do not provide full power all the time, the total installed capacity would either need to exceed the capacity stated here or have sufficient backup generation. In this case, NRC staff assumes that other renewables (hydropower, biomass, and landfill gas) could function as a backup.

As noted in Section 8.3.4, under Wood Waste, the biomass alternative would have impacts similar to a coal-fired plant of similar capacity. Unlike a coal-fired plant, however, the biomass plant does not release heavy metals (including mercury, uranium, and thorium) in fly ash.

Biomass plants also tend to be slightly less efficient with slightly lower capacity factors than coal-fired facilities. The types of pollutants would be similar to that shown for the NGCC alternative, but in larger quantities for a given output. New York's RPS does not contemplate direct combustion of municipal solid waste as a qualifying resource (NYSPSC 2004), and thus the more-severe air effects of MSW combustion are not addressed here.

Impacts from conservation measures are likely to be negligible, as the NRC staff indicated in the GEIS (1996) and earlier in this chapter. The primary concerns NRC staff identified in the GEIS related to indoor air quality and waste disposal. In the GEIS, NRC staff indicated that air quality appeared to become an issue when weatherization initiatives exacerbated existing problems, and were expected not to present significant effects. The NRC staff also indicated that waste disposal concerns related to energy-saving measures like fluorescent lighting could be addressed by recycling programs. The NRC staff considers the overall impact from conservation to be SMALL in all resource areas, though measures that provide weatherization assistance to low-income populations may have positive effects on environmental justice.

- **Land Use**

Impacts from this alternative would include the types of impacts discussed for land use in Section 8.1.1.2 and Section 8.3.2.1 of this SEIS. Construction of two hybrid cooling towers would have a SMALL to LARGE impact on land use, depending on where Entergy disposes of excavated material, and construction of one tower would be expected to have approximately half of the impact. If the plant operator constructed only one new cooling tower for the remaining IP unit the land use impacts will also be SMALL to MODERATE, depending on where Entergy disposes of excavated material from the one cooling tower. If no cooling tower was constructed for the remaining unit, the land use impact would be SMALL.

The GEIS notes that gathering fuel for wood-fired plants (a type of biomass plant) can have significant environmental impacts. However, the NRC staff believes that the operation of the 303 MW(e) of biomass-fired generation projected by NYSDPS (NYSDPS 2009) would have minor impacts, especially if the plants were widely distributed and feedstocks were primarily preexisting waste streams. Construction impacts of the biomass plants on land use would be SMALL to MODERATE depending on plant cooling configurations and plant locations. These impacts would be minimized by locating plants on previously disturbed land near other industrial applications, including paper/pulp mills or other forest-product operations where fuels may be readily available. Landfill gas facilities would likely have few new land use impacts as they are typically constructed within or adjacent to existing landfills. New transmission capacity, as discussed in Section 8.3.2 of this SEIS, may be necessary to convey renewables to downstate loads, and could result in additional land use impacts, but staff assumes that adequate transmission will be available.

Impacts from the wind power portion of this alternative would depend largely on whether the wind facility is located onshore or offshore. Onshore wind facilities will incur greater land use impacts than offshore, simply because all towers and supporting infrastructure will be located on land. NRC observations indicate that onshore installations could require several thousand acres, though turbines and infrastructure would actually occupy only a small percentage of that land area. Total land disturbance (temporary and permanent) would be approximately 1 ha (2.5 ac) per MW (NREL 2009). Most of this area (70 percent) is disturbed temporarily during construction. The majority of both temporary and permanent disturbance is a result of roads to

support the project (NREL 2009). Land around wind installations could remain in use for activities like agriculture (a practice consistent with wind farm siting throughout the U.S.). For 600 MW of wind capacity, NRC staff estimates a total land disturbance of 600 ha (1482 ac), of which 180 ha (445 ac) would be disturbed for the duration of the project if the entire project were constructed on land. Offshore turbines would have much smaller land use impacts.

Impacts from hydropower contributions to this combination alternative would depend on the location and type of hydropower installation. Hydropower installations that rely on new impoundments may have substantial land use impacts. Hydropower projects that rely on run-of-river or in-stream generator approaches will have markedly lower impacts.

Overall, the NRC staff considers that the land use impacts from the first combination alternative would be SMALL to MODERATE.

- **Ecology**

As described in Section 8.1.1.2 of the SEIS, the construction of two hybrid cooling towers would have a SMALL impact on aquatic ecology and a SMALL impact on terrestrial ecology (Entergy noted in its comments – included in Appendix A of this SEIS – that constructing cooling towers may have an effect on the Indiana Bat; consultation with the U.S. Fish and Wildlife Service may be necessary in the event that one unit continued to operate and NYSDEC required closed-cycle cooling). Because the combined alternative would involve construction and operation of only one cooling tower, the NRC staff considered the resulting impacts from the construction and operation of a single cooling to be SMALL on both the aquatic and terrestrial ecology. (If the remaining IP unit were to continue operating with once-through cooling, the volume of water used would be cut in half, resulting in lower impingement and entrainment impacts, as well as smaller thermal effects. Such effects would not be eliminated, however, and it is reasonable to expect that they would likely be at least MODERATE for some species, though the NRC staff have not analyzed the specific level of impact for this option. Not constructing a cooling tower would mean a smaller terrestrial impact.)

Offsite construction and operation of biomass plants may have a SMALL to MODERATE impact on both aquatic and terrestrial ecology, depending heavily on the location of the plants.

The principal ecological impacts of an offshore wind farm would be to aquatic ecological resources. An onshore wind farm located in upstate New York would primarily affect terrestrial ecology, with up to 180 ha (445 ac) disturbed for the life of the project, though in many cases this land is already in use for agricultural purposes. Neither type of wind farm would be likely to destabilize ecological resources. Accordingly, a wind farm would have SMALL ecological impacts.

NRC staff expects little or no impact to ecology from landfill gas combustion apart from impacts that may be caused by construction on areas outside the landfill confines. Hydropower, however, may trigger additional ecological effects if substantial construction or the creation of new reservoirs are necessary. Some riparian habitats may be inundated along with some upland areas, depending on depth and area of a reservoir. Impoundments could also disrupt migration of fish species, reduce oxygen content, and disrupt water level patters. Run-of-river and in-stream hydropower generation would have relatively minor impacts.

The NRC staff concludes that substantial ecological impacts could occur during the construction phase but could be managed by choice of construction methods (e.g., avoiding particularly

sensitive habitats) and by avoiding hydropower options that require reservoirs.

Overall, the NRC staff considers that the ecological impacts, both aquatic and terrestrial, from this combination alternative could range from SMALL to LARGE. Selecting low-impact hydropower approaches and less-sensitive windpower locations would minimize impacts.

- **Water Use and Quality**

The primary water use and quality issues from this alternative would occur from the hydropower portion of this alternative. Impacts, however, depend on the location and type of hydropower facility, with in-stream or run-of-river facilities having lower impacts than facilities that block watercourses. For some installations, impacts would be SMALL, while for others, impacts may be greater.

While construction impacts could occur from a wind farm, particularly if located offshore, these impacts are likely to short lived. An offshore windfarm is unlikely to located immediately adjacent to any water users, though construction may increase turbidity. An onshore wind farm could create additional erosion during construction, as would biomass plants. Landfill gas facilities are likely to trigger little to no additional impacts as they are located on sites that are already developed and typically have controls on water runoff and groundwater infiltration (even if such measures were not working properly at a given landfill, the incremental effect of a landfill gas facility would likely be undetectable compared to the effects of a landfill In general, site management practices keep effects from these components to a small level.

During operations, only the biomass and landfill gas plants would require water for cooling. All of these installations would likely use closed-cycle cooling, however, and this would limit the effects on water resources. As the NRC staff indicated for the NGCC alternative, the landfill gas and wood-fired portions of this alternative are likely to rely on surface water for cooling (or, as is the case in some locations, treated sewage effluent).

Effects from the continued operation of one IP unit with closed-cycle cooling would be SMALL, as would continued operation of one unit with the existing cooling system.

The NRC staff considers impacts on water use and quality to be SMALL to LARGE for this combination alternative. Impacts would be SMALL if low-impact hydropower facilities are selected, and IP2 or IP3 operate with closed-cycle cooling.

- **Air Quality**

The first combined alternative will have some impact on air quality as a result of emissions from the biomass plants and the landfill gas facilities. The impacts are likely to be similar to the NGCC alternative considered in this chapter in terms of the type of emissions, though relatively higher on a per-unit-output basis. Based on DPS projections for renewable generation through 2015, NRC staff projects that roughly 60 percent of backup for the windpower portion of this alternative would come from biomass and landfill gas, and these portions would not operate at all times (combustion units provide support to the windpower power portion of this alternative). Hydropower would supply the remainder of the backup to the wind portion. Hydropower itself produces no direct emissions.

Given the relatively small size of backup combustion generation –less than 400 MW from biomass and landfill gas – the emissions levels are likely to be a fraction of those from the NGCC alternative considered in this chapter. Landfill gas units may require pre-treatment of

gas streams in order to avoid emitting toxic gases, though these units also convert methane – a potent greenhouse gas and frequent byproduct of anaerobic decomposition – into carbon dioxide, a less-potent greenhouse gas. Also, these combustion installations are likely to be spread out over several locations in multiple areas. These new facilities would require air permits similar to those discussed for the NGCC alternative, though it is possible that the combustion portions of this alternative may be located outside of non-attainment areas, and thus be subject to less-stringent regulations. Given that a number of areas of New York State are non-attainment areas for ozone, however, it is likely that combustion portions of this alternative would have to offset emissions of NO_x. Overall impacts of these portions of the combination alternative would be SMALL, given the reduced size of this generating source as compared to the NGCC alternative.

Section 8.1.1.2 of this SEIS describes the impacts on air quality from the construction and operation of two hybrid cooling towers to be SMALL to LARGE, depending on CAA compliance. For the construction and operation of a single tower, the impacts would likely be SMALL to MODERATE. The continued operation of one of the nuclear power units without a cooling tower would have SMALL impacts.

Overall, the NRC staff considers that the air quality impacts from the first combination alternative would be SMALL to MODERATE, depending on whether a cooling tower is required at the IP site.

- **Waste**

Constructing a wind farm, biomass generation, and landfill gas generation has the potential to create substantial amounts of waste, as could constructing one cooling tower on the IP site.). Construction impacts could range from SMALL to LARGE during construction depending on site characteristics and the extent to which wastes can be reused, recycled, or readily disposed of.

Operational wastes would come primarily from the biomass power plant. Most of the ash from burned wood waste could be recycled or reused. The waste contribution from the remaining IP2 or IP3 unit would be roughly half of the waste generated by the current plant. Operation of the landfill gas and biomass plants, in addition to generating relatively little waste, would likely reduce or reuse waste streams.

During operations, waste volumes would have only SMALL impacts, while construction stage impacts could range from SMALL to LARGE.

- **Human Health**

The primary health concerns under this option would be occupational health and safety risks during the construction of the new facilities, and excavation for the cooling tower, if necessary. As described in previous sections (NGCC alternative), if the risks are appropriately managed, the human health impacts from these or similar alternatives are SMALL. Impacts from emissions are uncertain, but considered SMALL as the plants would comply with the CAA health-informed standards and other relevant emissions regulations. Continued operation of one IP unit with the existing once-through cooling system would not change this assessment.

Therefore, the NRC staff concludes that the overall human health impact from the first combination alternative would be SMALL.

- **Socioeconomics**

This combination alternative involves the shutdown of either IP2 or IP3. As detailed in Section 8.2 of this SEIS, the socioeconomic impacts of shutting down the plants would be SMALL to MODERATE because of the loss of PILOT payments to local municipalities. Under this option, those payments would be expected to decrease but would not be completely eliminated. Some IP2 or IP3 jobs would be lost with closure of one unit. At the same time, this alternative would create jobs in other locations and also generate new revenues for other municipalities. Overall, the NRC staff concludes that the socioeconomic impacts from the first combined alternative would be SMALL.

- **Socioeconomics (Transportation)**

As described in Section 8.1.1.2 of this SEIS, the construction of two hybrid cooling towers could have up to a LARGE impact on transportation in the area around IP2 and IP3 during construction because of the large volume of rock and debris that would need to be transported off site. Approximately half as much excavated material will need to leave the IP2 and IP3 site under this combination alternative (if the IP unit continued to operate with once-through cooling, no excavated material would need to leave the site and transportation impacts would be eliminated). The other aspects of this alternative will create modest, but noticeable, transportation effects during construction. Given that the biomass facility, hydropower facility, landfill gas installations, and wind farm are likely not be located in the same place, construction-stage impacts are less intense than if they were part of one collocated facility. Construction for the wind-power portion of this alternative may have noticeable impacts while trucks, trains, or ships carry large components to the project sites, but the impacts are limited in duration. The hydropower portion of this alternative is not likely to create transportation impacts unless an impoundment blocked a waterway used for shipping. NRC staff considers this unlikely.

During operation, only the biomass facility is likely to create noticeable impacts on transportation (in gathering materials), and these may not affect any important aspects of local transportation. No other transportation impacts for this alternative are considered to be as severe. Overall, the impact from this combined alternative would likely be MODERATE.

- **Aesthetics**

As described in Section 8.1.1.2 of this SEIS, the construction of two hybrid cooling towers would have a MODERATE impact on aesthetics. Aesthetic impacts from one cooling tower may be slightly smaller, though it would likely still affect the scenic value of the Hudson Valley.

Aesthetic impacts would occur during construction and operation of an offshore wind installation and would depend on its distance from the shore and on its orientation in regard to shoreline communities. The NRC staff estimates that the construction and operational impacts of the facility could be managed, though some may consider the impact to be LARGE, depending on the location of the turbines. An onshore wind facility would also have the potential to create LARGE effects. The aesthetic impacts from new biomass generating plants would likely not have a major effect on visual resources, because the plants are small. Impacts would depend on the plants' locations. Landfill gas facilities would also be unlikely to negative affect aesthetics. Hydropower power facilities would only be likely to have significant effects if they require a large impoundment.

The NRC staff concludes that the overall aesthetic impacts from the first combination alternative could range from SMALL to LARGE, depending primarily on the aesthetic effects of the wind

power portion and whether a cooling tower is required for remaining IP unit.

- **Historic and Archeological Resources**

Onsite impacts to historical and cultural resources from the construction of a hybrid cooling tower may range from SMALL to MODERATE. The offsite impacts from the construction of biomass units, wind installations, landfill gas facilities, and hydropower are also expected to be small given the opportunity to evaluate and select the sites in accordance with applicable regulations and the ability to minimize impacts before construction. The impacts from construction of an onshore wind installation or hydropower facility could range from SMALL to MODERATE, depending on whether historical and archaeological resources are present. In that event, proper management of the resources, in conjunction with State historical preservation authorities, would assure that the impacts are not LARGE. Therefore, the NRC staff concludes that the overall impacts on historic and archeological resources from the first combination alternative would be SMALL to MODERATE.

- **Environmental Justice**

No impacts are anticipated in the IP2 and IP3 area that could disproportionately affect minority or low-income communities. Impacts from offsite activities would depend on the location of the activity. Many conservation measures, especially those involving weatherization or efficiency improvements to low-income households, can have disproportionately positive effects for low-income families. Overall, though, impacts to minority and low-income populations from the first combination alternative would depend substantially on the location of the installations and the characteristics of the surrounding communities. Impacts could range from SMALL to LARGE, depending on the location of the facilities relative to minority and low-income communities.

8.3.5.2 Impacts of Combination Alternative 2

The second combination alternative differs from the first in that it completely replaces IP2 and IP3 capacity. In contrast to the first combination alternative, a 400-MW(e) to 600 MW(e) NGCC plant is included as a repowering of an existing facility. NRC staff notes that it could also be located on the IP site. Either modifications to the existing onsite pipeline would be necessary to provide firm year-round service to the site without removing the service rights of other customers in New York and Connecticut served by the pipeline (Levitan and Associates, Inc. 2005) or new gas supplies would have be available from proposed LNG projects or other sources. A repowered NGCC plant at another site may have similar supply restrictions.

Like the first combination alternative, the second combination alternative employs 600 MW(e) from renewable energy sources (wind backed by other renewables). The impacts of these sources are described in the discussion of Combination Alternative 1 in Section 8.3.5.1 of this SEIS, and are not repeated in this section of the SEIS.

Finally, this option requires more aggressive energy conservation programs that would result in an energy savings of 1000 to 1200 MW(e). As described in Section 8.3.4 of this SEIS, these conservation efforts would have overall SMALL impacts, and are not repeated in this section of the SEIS.

- **Land Use**

Siting 400 to 600 MW(e) of NGCC capacity with a closed-cycle cooling system at a repowered facility would require about 18 ha (45 ac) and would likely have SMALL impacts on land use as the existing site as the unit or units could likely be constructed on previously-disturbed land and may be able to reuse substantial portions of onsite infrastructure. These effects would be similar if the NGCC capacity were located at the IP site

Land use impacts from the renewable portion of this alternative are identical to those in Combination Alternative 1.

Overall, the NRC staff considers that the land use impacts from this combination alternative would be SMALL to MODERATE.

- **Ecology**

As described in Section 8.3.1 of this SEIS, the impacts from the construction of five NGCC units at a repowered site or at IP2 and IP3 would have a SMALL impact on aquatic and terrestrial ecology.

Impacts from the renewable portion are SMALL to LARGE, as was the case in Combination Alternative 1.

Overall, the NRC staff considers that the ecological impacts from the second combination alternative would be SMALL to LARGE, depending on locations selected for each alternative.

- **Water Use and Quality**

Impacts from the renewable portions of this alternative are SMALL to LARGE, as were those considered in Combination Alternative 1.

The NGCC repowering portion of this alternative would create water demands, but would minimize them by relying on closed-cycle cooling. Impacts would be significantly smaller than those considered for the stand-alone NGCC alternative, which were SMALL at the IP site or a repowered site .

The overall effects on water use and quality of the second combination alternative would range from SMALL to LARGE, depending on locations of the alternatives and the type of hydroelectric facility constructed.

- **Air Quality**

The second combination alternative will have some impact on air quality as a result of emissions from the combustion alternatives. The impact from renewable portions would be the same as those described in Combination Alternative 1, which was SMALL to MODERATE. The NGCC, repowered facility would have emissions that range from 20 to 30 percent of those of the stand-alone NGCC alternative (which also had SMALL to MODERATE impacts). Nonetheless, the NRC staff concludes that the overall impacts from all of the new plants would range from SMALL to MODERATE.

- **Waste**

Impacts from renewable portions of this alternative would be the same as those in Combination Alternative 1, which were SMALL to LARGE. Wastes from the NGCC portion of this alternative would be similar in type to those in the stand-alone NGCC alternative, which had SMALL impacts. Overall, the NRC staff concludes that the impacts will be SMALL to LARGE.

- **Human Health**

The primary health concerns under this option would be occupational health and safety risks during construction As described in previous sections (for combination alternative 1 and the NGCC alternatives), if the risks are appropriately managed, the human health impacts from these or similar alternatives are SMALL.

The NRC staff concludes that the overall human health impact from the second combination alternative would be SMALL.

- **Socioeconomics**

The second combination alternative involves the complete shutdown of IP2 and IP3. As detailed in Section 8.2 of this SEIS, the socioeconomic impacts of shutting down the plant would be SMALL to MODERATE because of the loss of PILOT payments.   (Constructing the NGCC portion of this alternative at the IP site could replace some of the PILOT payments. Levitan and Associates (2005) indicated that a smaller gas-fired plant may replace a significant portion of the PILOT payments currently provided by IP2 and IP3.) Some IP2 and IP3 jobs would be lost but replaced with decommissioning jobs and jobs associated with the construction and operation of the gas turbine plant. Other jobs would be generated by the construction of the offsite alternatives. While many of these jobs would cease at the end of construction, a fraction would remain during operation. Overall, the NRC staff concludes that the socioeconomic impacts from the second combination alternative would likely be SMALL to MODERATE, primarily because of the significant loss in revenues from the PILOT payments and the loss of IP2 and IP3 jobs.

- **Socioeconomics (Transportation)**

The aspects of this alternative will create modest transportation effects during construction. The renewable portions of this alternative will have the same impacts as in combination alternative 1, which were MODERATE. Also, construction of this NGCC facility will require fewer workers than the NGCC alternative considered in Section 8.3.1 of this SEIS because it is much smaller.

The NGCC unit may create noticeable impacts on gas transmission, but improvements to gas transmission or new LNG capacity may offset these impacts. Because winter heating customers take priority over utility generation customer, the plant is unlikely to have noticeable effects for other gas users, though it may need to burn fuel oil during peak demand periods.

Transportation impacts for this alternative would be moderated because the construction and operation workforce would be spread over multiple locations. No single project would have a significant long-term impact. Overall, the NRC staff concludes that the impact would likely be MODERATE.

- **Aesthetics**

Aesthetic impacts would occur primarily as a result of the wind power portion of this alternative, and may range from SMALL to LARGE from wind power alone. Other aspects of this alternative are unlikely to have noticeable effects. Particularly, NGCC repowering will have little, if any effect on the repowered site.

As a result, the NRC staff concludes that the overall aesthetic impacts from the second combination alternative would be SMALL to LARGE, depending on the degree to which wind

power installations affect areas where aesthetics are an important value.

- **Historic and Archeological Resources**

Onsite impacts to historical and cultural resources from the construction of a single gas turbine plant are expected to be SMALL. The offsite impacts from the construction of renewable installations are expected to be SMALL to MODERATE, as in Combination Alternative 1, given the opportunity to evaluate and select the sites in accordance with applicable regulations and the ability to minimize impacts before construction. The NGCC portion of this alternative will be constructed on an existing site, using existing infrastructure to the extent possible. Even if constructed on the IP2 and IP3 site, it is likely that the NGCC portion of this alternative could avoid sensitive areas. Therefore, the NRC staff concludes that the overall impacts on historic and archeological resources from the second combination alternative would be SMALL to MODERATE.

- **Environmental Justice**

Impacts from construction and operations would depend on the locations of the activities. Many conservation measures, especially those involving weatherization or efficiency improvements to low-income households, can have disproportionately positive effects for low-income families. Overall, though, impacts to minority and low-income populations from the second combination alternative would depend substantially on the location of the installations and the characteristics of the surrounding communities. Impacts could range from SMALL to LARGE, depending on the location of the facilities relative to minority and low-income communities .

Table 8-4. Summary of Environmental Impacts of Combination Alternatives

Impact Category	Combination 1		Combination 2	
	Impact	**Comments**	**Impact**	**Comments**
Land Use	SMALL to MODERATE	Impacts would depend on location of wind farm, type of hydro facilities, the site selection for the biomass plants, as well as land-disposal of wastes	SMALL to MODERATE	Impacts would depend on location of wind farm, type of hydro facilities, the site selection for the biomass plants.
Ecology	SMALL to LARGE	Impacts substantially depend on the type and location of facilities.	SMALL to LARGE	Impacts substantially depend on the type and location of facilities.
Water Use and Quality	SMALL to LARGE	Impacts depend largely on type and location of hydropower facilities.	SMALL to LARGE	Impacts depend largely on the type and location of hydropower facilities.
Air Quality	SMALL to MODERATE	Air emissions from biomass and landfill gas facilities would be minor given their size and possible multiple locations. One cooling tower could have an effect on air quality.	SMALL to MODERATE	Air emissions of the small biomass and landfill gas facilities would be minor considering their size and possible multiple locations; NGCC facility 20-30 percent of output of alternative in 8.3.1.
Waste	SMALL to LARGE	Construction waste impacts could range from SMALL to LARGE. Operational wastes are SMALL.	SMALL to LARGE	Construction waste impacts could range from SMALL to LARGE. Operational wastes are SMALL.

Table 8-4 (continued)

Impact Category	Combination 1		Combination 2	
	Impact	Comments	Impact	Comments
Human Health	SMALL	Emissions and occupational risks would be managed in accordance with applicable regulations.	SMALL	Emissions and occupational risks would be managed in accordance with applicable regulations.
Socioeconomics	SMALL	Some PILOT payments and jobs may be lost.	SMALL to MODERATE	IP2 and IP3 jobs and PILOT payments lost; some new jobs and taxes; minimum impacts from other power alternatives.
Socioeconomics (Transportation)	MODERATE	Construction impacts may be significant but short-lived.	MODERATE	Transportation effects may be noticeable during construction..
Aesthetics	SMALL to LARGE	Visual impacts from new wind turbines, depend on locations selected. Impacts also from cooling tower, if constructed.	SMALL to LARGE	Visual impacts from new wind turbines depend on the location chosen. Limited impact from combustion facilities.
Historic and Archeological Resources	SMALL to MODERATE	Cultural resources inventories would be needed to identify, evaluate, and mitigate potential impacts from construction.	SMALL to MODERATE	Cultural resources inventories would be needed to identify, evaluate, and mitigate potential impacts from construction.
Environmental Justice	SMALL to LARGE	Impacts would depend on plant locations.	SMALL to LARGE	Impacts would depend on plant locations.

8.4 Summary of Alternatives Considered

In this SEIS, the NRC staff has considered alternative actions to license renewal of IP2 and IP3 including the no-action alternative (discussed in Section 8.2), new generation or energy conservation alternatives (natural gas and conservation alternatives discussed in Sections 8.3.1 through 8.3.2), purchased electrical power (discussed in Section 8.3.3), alternative power-generating technologies that staff dismissed from detailed consideration (including supercritical coal-fired power; discussed in Section 8.3.4), and two combinations of alternatives (discussed in Section 8.3.5).

As established in the GEIS, the need for power from IP2 and IP3 is assumed by the NRC in the

license renewal process. Should the NRC not renew the IP2 and/or IP3 operating licenses, their generating capacity or load reduction (e.g., by conservation) would have to come from an alternative to license renewal (which may include some of the alternatives considered here).

Furthermore, even if the NRC renews the operating licenses, Entergy could elect not to operate either IP2 or IP3 for the full terms of the renewed licenses. Decisions about which alternative to implement, regardless of whether or not the NRC renews the IP2 and IP3 operating licenses, are outside the NRC's authority and are subject to consideration by Entergy, other power producers, and State-level decision makers (or non-NRC Federal-level decision makers where applicable).

Impacts from the conservation alternative are generally lower than those from other alternatives, including the proposed action. Impacts from the NGCC alternative at a repowered site or the IP site has the potential for larger air quality impacts, but smaller aquatic ecology impacts. Impacts from combination alternatives (with or without continued operation of one IP unit) that do not rely on conventional hydropower are likely to have smaller aquatic impacts than continued operation of IP2 and IP3, while they have potentially larger impacts in other areas, including air quality, aesthetics, and land use. Continued operation of one IP unit with closed-cycle cooling as part of a combination alternative would increase impacts to aesthetics, land use, waste, and air quality while reducing aquatic impacts. A NGCC alternative at a new site is likely to have a variety of more-significant impacts than continued operations of IP2 and IP3.

For most impact areas – land use, air quality, waste, transportation, aesthetics, historic and archaeological resources, for example – the closed-cycle cooling alternative has larger impacts that continued operation of IP2 and IP3 with its current cooling system. Its impact to aquatic ecology, however, is smaller than continued operation with the existing once-through cooling system. The NRC staff notes that this evaluation is not intended to preempt or prejudice NYSDEC SPDES proceedings in any way, and resolution of cooling system requirements for IP2 and IP3 remains and issue for resolution in these proceedings.

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9.0 SUMMARY AND CONCLUSIONS

Entergy Nuclear Operations, Inc. (Entergy), Entergy Nuclear Indian Point 2 (IP2), LLC, and Entergy Nuclear Indian Point 3 (IP3), LLC, are joint applicants for the renewal of the IP2 and IP3 operating licenses (joint applicants will be referred to as Entergy). On April 23, 2007, Entergy submitted an application to the U.S. Nuclear Regulatory Commission (NRC) to renew the IP2 and IP3 operating licenses for an additional 20 years each under Title 10, Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants," of the *Code of Federal Regulations* (10 CFR Part 54) (Entergy 2007a). If the operating licenses are renewed, State and Federal (other than NRC) regulatory agencies and Entergy would ultimately decide whether the plant will continue to operate based on factors such as the need for power, power availability from other sources, regulatory mandates, or other matters within the agencies' jurisdictions or the purview of the owners. If the NRC decides not to renew the operating licenses, then the units must be shut down upon the expiration of the current operating licenses, subject to the conclusion of the license renewal process. If the license renewal review is ongoing at the time of license expiration, the units will be allowed to continue operating until the NRC makes a determination. The IP2 operating license will expire on September 28, 2013; the IP3 operating license will expire on December 12, 2015.

Section 102 of the National Environmental Policy Act of 1969, as amended (NEPA), requires an environmental impact statement (EIS) for major Federal actions that significantly affect the quality of the human environment. The NRC has implemented Section 102 of NEPA in 10 CFR Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions." As identified in 10 CFR Part 51, certain licensing and regulatory actions require an EIS. In 10 CFR 51.20(b)(2), the NRC requires preparation of an EIS or a supplement to an EIS for renewal of a reactor operating license. Furthermore, 10 CFR 51.95(c) states that the EIS prepared at the operating license renewal stage will be a supplement to NUREG-1437, Volumes 1 and 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants" (hereafter referred to as the GEIS) (NRC 1996, 1999).[1]

Upon acceptance of the license renewal application for docketing, the NRC began the environmental review process described in 10 CFR Part 51 by publishing, on August 10, 2007, a Notice of Intent to prepare an EIS and conduct scoping (Volume 72, page 45075, of the *Federal Register* (72 FR 45075)). The NRC staff held two public scoping meetings on September 19, 2007, and visited the IP2 and IP3 site to conduct site audits on September 10–14, 2007, and September 24–27, 2007. The NRC staff reviewed the Entergy environmental report (ER) (Entergy 2007b) and compared it to the GEIS, consulted with other agencies, and conducted an independent review of the issues following the guidance set forth in NUREG-1555, Supplement 1, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal" (NRC 2000). The NRC staff also considered the public comments received during the scoping process for preparation of the draft supplemental environmental impact statement (SEIS) for IP2 and IP3. Public comments and NRC staff responses are available in the Scoping Summary Report prepared by the NRC staff (ADAMS Accession Number ML083360115).

The NRC staff issued a draft SEIS in December 2008. Thereafter, the staff held public meetings

(1) The GEIS was originally issued in 1996. Addendum 1 to the GEIS was issued in 1999. Hereafter, all references to the GEIS include the GEIS and its Addendum 1.

in Cortlandt Manor, New York, on February 12, 2009 and presented the preliminary results of the NRC environmental review, answered questions from the public, and received comments on the draft SEIS. The NRC staff considered and addressed all of the comments received. The comments are reflected in this SEIS and/or addressed in Part 2 of Appendix A to this final SEIS.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action (including cumulative impacts), the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse effects. This SEIS also includes the NRC staff's recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decision makers.

The evaluation criterion for the NRC staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine the following:

> … whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current operating licenses.

NRC regulations (10 CFR 51.95(c) (2)) contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within thescope of the generic determination in 10 CFR 51.23(a) and in accordance with 10 CFR 51.23(b).[2]

(2) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operation—generic determination of no significant environmental impact."

The GEIS contains the results of a systematic evaluation of the consequences of renewing an operating license and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality (CEQ) guidelines. The following definitions of the three significance levels are set forth in the footnotes to Table B-1 of Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of 10 CFR Part 51:

> SMALL—Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE—Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE—Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 environmental issues considered in the GEIS, the analysis in the GEIS reached the following conclusions:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the NRC staff relied on conclusions as amplified by supporting information in the GEIS for issues designated as Category 1 in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific SEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized.

This SEIS documents the NRC staff's consideration of all 92 environmental issues identified in the GEIS. The NRC staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the operating licenses for IP2 and IP3), continued operation of either IP2 or IP3, alternative methods of power generation, and conservation. The NRC staff also considered an alternative that included continued operation of IP2 and IP3 with a closed-cycle cooling system.

9.1 Environmental Impacts of the Proposed Action—License Renewal

The NRC staff has established an independent process for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. The NRC staff has not identified any information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. In the IP2 and IP3 ER, Entergy identified leakage from onsite spent fuel pools as potentially new and significant information (Entergy 2007b). The NRC staff has reviewed Entergy's analysis of the leakage and has conducted an extensive onsite inspection of leakage to ground water, as identified in Section 2.2.7 of this SEIS. Based on the NRC staff's review of Entergy's analysis, the NRC staff's adoption of the NRC inspection report findings in this SEIS, and Entergy's subsequent statements (all discussed in Section 2.2.7), the NRC staff concludes that the abnormal liquid releases discussed by Entergy in its ER, while new information, are within the NRC's radiation safety standards contained in 10 CFR Part 20 and are not considered to have a significant impact on plant workers, the public, or the environment (i.e., while the information related to spent fuel pool leakage is new, it is not significant). Therefore, the NRC staff relied upon the conclusions of the GEIS for all Category 1 issues that are applicable to IP2 and IP3.

Entergy's license renewal application contains an analysis of the Category 2 issues that are applicable to IP2 and IP3, plus environmental justice and chronic effects from electromagnetic fields for a total of 23 issues. The NRC staff has reviewed the Entergy analysis and has conducted an independent review of each issue. Six of the Category 2 issues are not applicable because they are related to cooling systems, water use conflicts, and ground water use not found at IP2 and IP3.

As discussed in Chapter 3, scoping comments revealed—and Entergy indicated—that Entergy may replace reactor vessel heads and control rod drive mechanisms (CRDMs) in both units. As a result, the NRC staff addressed the impacts of these replacement activities in Chapter 3. This includes three Category 2 issues that apply only to refurbishment, six Category 2 issues that apply to refurbishment and continued operation, and one uncategorized issue, environmental justice, that applies to both refurbishment and continued operations. The NRC staff determined that all effects from refurbishment activities are of SMALL significance.

The NRC staff addresses twelve Category 2 issues related to impacts from continued operations and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields. Research is continuing in the area of chronic effects on electromagnetic fields, and a scientific consensus has not been reached. Therefore, no further evaluation of this issue is required. The NRC staff concludes that the potential environmental effects for 9 of the 12 categorized issues are of SMALL significance in the context of the standards set forth in the GEIS. The NRC staff concludes that the combined impacts from impingement and entrainment (each a separate issue) are MODERATE. Impacts from heat shock could range from SMALL to LARGE, based on the large uncertainties discussed in Chapter 4. Based on corrected data received since the completion of the draft SEIS, the NRC staff concludes that impacts to the endangered shortnose sturgeon which ranged from SMALL to LARGE in the draft SEIS are likely to be SMALL.

For severe accident mitigation alternatives (SAMAs), the NRC staff concludes that a

reasonable, comprehensive effort was made by Entergy to identify and evaluate SAMAs. Based on its review of the SAMAs for IP2 and IP3, and the plant improvements already made, the NRC staff concludes that several candidate SAMAs may be cost-beneficial. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

For all issues of SMALL significance, current measures to mitigate the environmental impacts of plant operation were found to be adequate. For issues of MODERATE or LARGE significance (i.e., issues related to aquatic ecology), mitigation measures are addressed both in Chapter 4 and in Chapter 8 as alternatives based on determinations in the draft New York State Department of Environmental Conservation (NYSDEC) State Pollutant Discharge Elimination System (SPDES) permit proceeding, Clean Water Act Section 401 proceeding, and in draft policy statements published by the State. In Chapter 8, the NRC staff considers the impacts that may result if the plant converts from once-through cooling to a closed-cycle cooling system (Section 8.1.1).

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. The NRC staff concludes that the cumulative impacts to the environment around IP2 and IP3 license renewal would be LARGE for some affected resources, given historical environmental impacts, current actions, and likely future actions. With the exception of aquatic resources, the contribution of IP2 and IP3 to cumulative impacts is SMALL.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit or operating license because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction and operation have already occurred, have been mitigated, or have been avoided. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

Adverse impacts of continued operation from (a) heat shock and (b) the combined effects of entrainment and impingement of fish and shellfish are considered to be potentially SMALL to LARGE, and MODERATE, respectively. Other adverse impacts are considered to be of SMALL significance.

Adverse impacts of likely alternatives to the operation of IP2 and IP3 vary greatly. Many have smaller impacts to aquatic resources than the proposed renewal of IP2 and IP3, though all have larger impacts than the proposed renewal of IP2 and IP3 in at least one other resource area.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of IP2 and IP3 during the current license period was made when the plant was built. The resource commitments to be considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance, operation, and refurbishment; the nuclear fuel used by the reactors; and ultimately, permanent offsite storage space for the spent fuel assemblies.

Entergy may be required to commit additional resources should the final NYSDEC SPDES permit require closed-cycle cooling (as required in the draft revised SPDES permit) and Entergy decides to (1) build and operate a closed-cycle cooling system to meet the permit's required reductions in impacts to aquatic ecology, or (2) make other modifications that meet the terms of the SPDES permit without retrofitting to closed-cycle cooling. However, regardless of the future status of the SPDES permit, significant resource commitments will be required during the renewal term for additional fuel and the permanent spent fuel storage space. IP2 and IP3 replace a portion of their fuel assemblies during every refueling outage, which typically occurs on a 24-month cycle (Entergy 2007a). Additional resources would also be committed to constructing and installing new reactor vessel heads and CRDMs.

The likely energy alternatives would also require a commitment of resources for construction of the replacement facilities, implementation of conservation measures, and in some cases, fuel to run plants. Significant resource commitments would also be required for development of transmission capacity. These resource commitments, however, would not necessarily come from Entergy as Entergy currently has no obligation to support power production in the New York area should IP2 and IP3 permanently shut down.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between local short-term uses of the environment and maintenance and enhancement of long-term productivity at IP2 and IP3 was set when the plant was approved and construction began. Renewal of the operating licenses for IP2 and IP3 and continued operation of the plant would not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the operating licenses would lead to a shutdown of the plant that will alter the balance in a manner that depends on subsequent uses of the site. Furthermore, new replacement energy sources or conservation options will establish new balances at their respective locations.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the operating licenses for IP2 and IP3. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 through 7 discuss environmental issues associated with renewal of the operating licenses. Environmental issues associated with the no-action alternative and alternatives such as new power generation, purchased power, conservation, and cooling system modifications are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the operating licenses), the no-action alternative (denial of the application), an alternative involving altering plant operations to comply with the NYSDEC draft SPDES discharge permit, construction of gas-fired generating capacity at alternate sites, gas-fired generation of power at IP2 and IP3, and two combinations of alternatives are compared in Table 9-1. All new fossil-fueled alternatives presented in Table 9-1 are assumed to use closed-cycle cooling systems given current New York State regulations for new power plants.

Table 9-1 shows the significance of the plant-specific environmental effects of the proposed action (renewal of IP2 and IP3 operating licenses) as well as the environmental effects of alternatives to the proposed action. Impacts from license renewal would be SMALL for all impact categories except aquatic ecology, which includes the impacts of heat shock, entrainment, and impingement. Chapter 4 of this SEIS describes the MODERATE impacts of plant operation on aquatic ecology through impingement and entrainment (impact levels vary by species), and the potentially SMALL to LARGE impacts from thermal shock. Overall, impacts to aquatic ecology from continued operation of IP2 and IP3 without cooling system modifications or restoration actions are SMALL to LARGE. A single significance level was not assigned for the collective offsite radiological impacts from the fuel cycle and from high-level radioactive waste spent fuel disposal (see Chapter 6) or for the impacts of greenhouse gases (GHG).

The NRC staff is analysis indicates that the no-action alternative has the smallest effect, but it would necessitate additional actions to replace generation capacity (whether with newly-constructed power plants or purchased power) and/or to institute conservation programs. Impacts of the likely consequences of the no-action alternative would be similar to those of the energy alternatives that the NRC staff considered. All other alternative actions have impacts in at least four resource areas that reach SMALL to MODERATE or higher significance. Often, these impacts are the result of constructing new facilities or infrastructure.

9.3 Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS, (2) the ER and other information submitted by Entergy, (3) consultation with Federal, State, Tribal, and local agencies, (4) the NRC staff's consideration of public scoping comments received, and comments on the draft SEIS, and (5) the NRC staff's independent review, the recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for IP2 and IP3 are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable.

Table 9-1. Summary of Environmental Significance of License Renewal and Alternatives

	Proposed Action	No-Action Alternative[b]	License Renewal with New Closed-Cycle Cooling	NGCC	
Impact Category	**License Renewal**	**Plant Shutdown**		**At the IP Site or a Repowered Site**	**At a New Site**
Land Use	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE	MODERATE to LARGE
Ecology—Aquatic	MODERATE and SMALL to LARGE[a]	SMALL	SMALL	SMALL	SMALL
Ecology—Terrestrial	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water Use and Quality	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Waste	SMALL	SMALL	SMALL to LARGE	SMALL	SMALL
Human Health	SMALL [c]	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE
Transportation	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Aesthetics	SMALL	SMALL	MODERATE to LARGE	SMALL	SMALL to LARGE
Historical and Archeological Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	SMALL	SMALL	SMALL	SMALL to LARGE	SMALL to LARGE

Table 9-1 (continued)

Impact Category	Conservation/Energy Efficiency	Combination of Alternatives — Option 1: One IP unit, onsite gas, offsite renewables, and conservation	Combination of Alternatives — Option 2: Gas, offsite renewables, additional imported power, and conservation
Land Use	SMALL	SMALL to MODERATE	SMALL to MODERATE
Ecology – Aquatic	SMALL	SMALL to LARGE	SMALL to LARGE
Ecology – Terrestrial	SMALL	SMALL to LARGE	SMALL to LARGE
Water Use and Quality	SMALL	SMALL to LARGE	SMALL to LARGE
Air Quality	SMALL	SMALL to MODERATE	SMALL to MODERATE
Waste	SMALL	SMALL to LARGE	SMALL to LARGE
Human Health	SMALL	SMALL	SMALL
Socioeconomics	SMALL to MODERATE	SMALL	SMALL to MODERATE
Transportation	SMALL	MODERATE	MODERATE
Aesthetics	SMALL	SMALL to LARGE	SMALL to LARGE
Historical and Archeological Resources	SMALL	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	SMALL	SMALL to LARGE	SMALL to LARGE

(a) NRC staff analysis indicates that impingement and entrainment impacts are MODERATE, but that thermal shock effects could potentially range from SMALL to LARGE.
(b) The no-action alternative does not, on its own, meet the purpose and need of the GEIS. No action would necessitate other generation or conservation actions which may include—but are not limited to—the alternatives addressed in this table.
(c) For the collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, a specific significance level was not assigned. See Chapter 6 for details.
(d) Analysis was based on use of a closed-cycle cooling system.

9.4 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

72 FR 45705. "Entergy Nuclear Operations, Inc., Indian Point Nuclear Generating Unit Nos. 2 and 3; Notice of Intent To Prepare an Environmental Impact Statement and Conduct Scoping Process." August 10, 2007

Entergy Nuclear Operations, Inc. (Entergy). 2007a. "Indian Point, Units 2 & 3, License Renewal Application." April 23, 2007. Agencywide Documents Access and Management System (ADAMS) Accession No. ML071210512.

Entergy Nuclear Operations, Inc. (Entergy). 2007b. "Applicant's Environment Report, Operating License Renewal Stage." (Appendix E to Indian Point, Units 2 and 3, License Renewal Application). April 23, 2007. ADAMS Accession No. ML071210530.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

Nuclear Regulatory Commission (NRC). 1996. NUREG-1437, Volumes 1 and 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS)." Washington, DC. May 1996.

Nuclear Regulatory Commission (NRC). 1999. NUREG-1437, Volume 1, Addendum 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report," Section 6.3, "Transportation," Table 9.1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." Washington, DC.

Nuclear Regulatory Commission (NRC). 2000. NUREG-1555, Supplement 1, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal." Washington, DC.

in Cortlandt Manor, New York, on February 12, 2009 and presented the preliminary results of the NRC environmental review, answered questions from the public, and received comments on the draft SEIS. The NRC staff considered and addressed all of the comments received. The comments are reflected in this SEIS and/or addressed in Part 2 of Appendix A to this final SEIS.

This SEIS includes the NRC staff's analysis that considers and weighs the environmental effects of the proposed action (including cumulative impacts), the environmental impacts of alternatives to the proposed action, and mitigation measures available for reducing or avoiding adverse effects. This SEIS also includes the NRC staff's recommendation regarding the proposed action.

The NRC has adopted the following statement of purpose and need for license renewal from the GEIS:

> The purpose and need for the proposed action (renewal of an operating license) is to provide an option that allows for power generation capability beyond the term of a current nuclear power plant operating license to meet future system generating needs, as such needs may be determined by State, utility, and, where authorized, Federal (other than NRC) decision makers.

The evaluation criterion for the NRC staff's environmental review, as defined in 10 CFR 51.95(c)(4) and the GEIS, is to determine the following:

> … whether or not the adverse environmental impacts of license renewal are so great that preserving the option of license renewal for energy planning decisionmakers would be unreasonable.

Both the statement of purpose and need and the evaluation criterion implicitly acknowledge that there are factors, in addition to license renewal, that will ultimately determine whether an existing nuclear power plant continues to operate beyond the period of the current operating licenses.

NRC regulations (10 CFR 51.95(c) (2)) contain the following statement regarding the content of SEISs prepared at the license renewal stage:

> The supplemental environmental impact statement for license renewal is not required to include discussion of need for power or the economic costs and economic benefits of the proposed action or of alternatives to the proposed action except insofar as such benefits and costs are either essential for a determination regarding the inclusion of an alternative in the range of alternatives considered or relevant to mitigation. In addition, the supplemental environmental impact statement prepared at the license renewal stage need not discuss other issues not related to the environmental effects of the proposed action and the alternatives, or any aspect of the storage of spent fuel for the facility within thescope of the generic determination in 10 CFR 51.23(a) and in accordance with 10 CFR 51.23(b).[(2)]

(2) The title of 10 CFR 51.23 is "Temporary storage of spent fuel after cessation of reactor operation—generic determination of no significant environmental impact."

The GEIS contains the results of a systematic evaluation of the consequences of renewing an operating license and operating a nuclear power plant for an additional 20 years. It evaluates 92 environmental issues using the NRC's three-level standard of significance—SMALL, MODERATE, or LARGE—developed using the Council on Environmental Quality (CEQ) guidelines. The following definitions of the three significance levels are set forth in the footnotes to Table B-1 of Appendix B to Subpart A, "Environmental Effect of Renewing the Operating License of a Nuclear Power Plant," of 10 CFR Part 51:

> SMALL—Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.
>
> MODERATE—Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
>
> LARGE—Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

For 69 of the 92 environmental issues considered in the GEIS, the analysis in the GEIS reached the following conclusions:

(1) The environmental impacts associated with the issue have been determined to apply either to all plants or, for some issues, to plants having a specific type of cooling system or other specified plant or site characteristics.

(2) A single significance level (i.e., SMALL, MODERATE, or LARGE) has been assigned to the impacts (except for collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal).

(3) Mitigation of adverse impacts associated with the issue has been considered in the analysis, and it has been determined that additional plant-specific mitigation measures are likely not to be sufficiently beneficial to warrant implementation.

These 69 issues were identified in the GEIS as Category 1 issues. In the absence of new and significant information, the NRC staff relied on conclusions as amplified by supporting information in the GEIS for issues designated as Category 1 in 10 CFR Part 51, Subpart A, Appendix B, Table B-1.

Of the 23 issues that do not meet the criteria set forth above, 21 are classified as Category 2 issues requiring analysis in a plant-specific SEIS. The remaining two issues, environmental justice and chronic effects of electromagnetic fields, were not categorized.

This SEIS documents the NRC staff's consideration of all 92 environmental issues identified in the GEIS. The NRC staff considered the environmental impacts associated with alternatives to license renewal and compared the environmental impacts of license renewal and the alternatives. The alternatives to license renewal that were considered include the no-action alternative (not renewing the operating licenses for IP2 and IP3), continued operation of either IP2 or IP3, alternative methods of power generation, and conservation. The NRC staff also considered an alternative that included continued operation of IP2 and IP3 with a closed-cycle cooling system.

9.1 Environmental Impacts of the Proposed Action—License Renewal

The NRC staff has established an independent process for identifying and evaluating the significance of any new information on the environmental impacts of license renewal. The NRC staff has not identified any information that is both new and significant related to Category 1 issues that would call into question the conclusions in the GEIS. In the IP2 and IP3 ER, Entergy identified leakage from onsite spent fuel pools as potentially new and significant information (Entergy 2007b). The NRC staff has reviewed Entergy's analysis of the leakage and has conducted an extensive onsite inspection of leakage to ground water, as identified in Section 2.2.7 of this SEIS. Based on the NRC staff's review of Entergy's analysis, the NRC staff's adoption of the NRC inspection report findings in this SEIS, and Entergy's subsequent statements (all discussed in Section 2.2.7), the NRC staff concludes that the abnormal liquid releases discussed by Entergy in its ER, while new information, are within the NRC's radiation safety standards contained in 10 CFR Part 20 and are not considered to have a significant impact on plant workers, the public, or the environment (i.e., while the information related to spent fuel pool leakage is new, it is not significant). Therefore, the NRC staff relied upon the conclusions of the GEIS for all Category 1 issues that are applicable to IP2 and IP3.

Entergy's license renewal application contains an analysis of the Category 2 issues that are applicable to IP2 and IP3, plus environmental justice and chronic effects from electromagnetic fields for a total of 23 issues. The NRC staff has reviewed the Entergy analysis and has conducted an independent review of each issue. Six of the Category 2 issues are not applicable because they are related to cooling systems, water use conflicts, and ground water use not found at IP2 and IP3.

As discussed in Chapter 3, scoping comments revealed—and Entergy indicated—that Entergy may replace reactor vessel heads and control rod drive mechanisms (CRDMs) in both units. As a result, the NRC staff addressed the impacts of these replacement activities in Chapter 3. This includes three Category 2 issues that apply only to refurbishment, six Category 2 issues that apply to refurbishment and continued operation, and one uncategorized issue, environmental justice, that applies to both refurbishment and continued operations. The NRC staff determined that all effects from refurbishment activities are of SMALL significance.

The NRC staff addresses twelve Category 2 issues related to impacts from continued operations and postulated accidents during the renewal term, as well as environmental justice and chronic effects of electromagnetic fields. Research is continuing in the area of chronic effects on electromagnetic fields, and a scientific consensus has not been reached. Therefore, no further evaluation of this issue is required. The NRC staff concludes that the potential environmental effects for 9 of the 12 categorized issues are of SMALL significance in the context of the standards set forth in the GEIS. The NRC staff concludes that the combined impacts from impingement and entrainment (each a separate issue) are MODERATE. Impacts from heat shock could range from SMALL to LARGE, based on the large uncertainties discussed in Chapter 4. Based on corrected data received since the completion of the draft SEIS, the NRC staff concludes that impacts to the endangered shortnose sturgeon which ranged from SMALL to LARGE in the draft SEIS are likely to be SMALL.

For severe accident mitigation alternatives (SAMAs), the NRC staff concludes that a

reasonable, comprehensive effort was made by Entergy to identify and evaluate SAMAs. Based on its review of the SAMAs for IP2 and IP3, and the plant improvements already made, the NRC staff concludes that several candidate SAMAs may be cost-beneficial. However, these SAMAs do not relate to adequately managing the effects of aging during the period of extended operation. Therefore, they need not be implemented as part of license renewal pursuant to 10 CFR Part 54.

For all issues of SMALL significance, current measures to mitigate the environmental impacts of plant operation were found to be adequate. For issues of MODERATE or LARGE significance (i.e., issues related to aquatic ecology), mitigation measures are addressed both in Chapter 4 and in Chapter 8 as alternatives based on determinations in the draft New York State Department of Environmental Conservation (NYSDEC) State Pollutant Discharge Elimination System (SPDES) permit proceeding, Clean Water Act Section 401 proceeding, and in draft policy statements published by the State. In Chapter 8, the NRC staff considers the impacts that may result if the plant converts from once-through cooling to a closed-cycle cooling system (Section 8.1.1).

Cumulative impacts of past, present, and reasonably foreseeable future actions were considered, regardless of what agency (Federal or non-Federal) or person undertakes such other actions. The NRC staff concludes that the cumulative impacts to the environment around IP2 and IP3 license renewal would be LARGE for some affected resources, given historical environmental impacts, current actions, and likely future actions. With the exception of aquatic resources, the contribution of IP2 and IP3 to cumulative impacts is SMALL.

The following sections discuss unavoidable adverse impacts, irreversible or irretrievable commitments of resources, and the relationship between local short-term use of the environment and long-term productivity.

9.1.1 Unavoidable Adverse Impacts

An environmental review conducted at the license renewal stage differs from the review conducted in support of a construction permit or operating license because the plant is in existence at the license renewal stage and has operated for a number of years. As a result, adverse impacts associated with the initial construction and operation have already occurred, have been mitigated, or have been avoided. The environmental impacts to be evaluated for license renewal are those associated with refurbishment and continued operation during the renewal term.

Adverse impacts of continued operation from (a) heat shock and (b) the combined effects of entrainment and impingement of fish and shellfish are considered to be potentially SMALL to LARGE, and MODERATE, respectively. Other adverse impacts are considered to be of SMALL significance.

Adverse impacts of likely alternatives to the operation of IP2 and IP3 vary greatly. Many have smaller impacts to aquatic resources than the proposed renewal of IP2 and IP3, though all have larger impacts than the proposed renewal of IP2 and IP3 in at least one other resource area.

9.1.2 Irreversible or Irretrievable Resource Commitments

The commitment of resources related to construction and operation of IP2 and IP3 during the current license period was made when the plant was built. The resource commitments to be considered in this SEIS are associated with continued operation of the plant for an additional 20 years. These resources include materials and equipment required for plant maintenance, operation, and refurbishment; the nuclear fuel used by the reactors; and ultimately, permanent offsite storage space for the spent fuel assemblies.

Entergy may be required to commit additional resources should the final NYSDEC SPDES permit require closed-cycle cooling (as required in the draft revised SPDES permit) and Entergy decides to (1) build and operate a closed-cycle cooling system to meet the permit's required reductions in impacts to aquatic ecology, or (2) make other modifications that meet the terms of the SPDES permit without retrofitting to closed-cycle cooling. However, regardless of the future status of the SPDES permit, significant resource commitments will be required during the renewal term for additional fuel and the permanent spent fuel storage space. IP2 and IP3 replace a portion of their fuel assemblies during every refueling outage, which typically occurs on a 24-month cycle (Entergy 2007a). Additional resources would also be committed to constructing and installing new reactor vessel heads and CRDMs.

The likely energy alternatives would also require a commitment of resources for construction of the replacement facilities, implementation of conservation measures, and in some cases, fuel to run plants. Significant resource commitments would also be required for development of transmission capacity. These resource commitments, however, would not necessarily come from Entergy as Entergy currently has no obligation to support power production in the New York area should IP2 and IP3 permanently shut down.

9.1.3 Short-Term Use Versus Long-Term Productivity

An initial balance between local short-term uses of the environment and maintenance and enhancement of long-term productivity at IP2 and IP3 was set when the plant was approved and construction began. Renewal of the operating licenses for IP2 and IP3 and continued operation of the plant would not alter the existing balance, but may postpone the availability of the site for other uses. Denial of the application to renew the operating licenses would lead to a shutdown of the plant that will alter the balance in a manner that depends on subsequent uses of the site. Furthermore, new replacement energy sources or conservation options will establish new balances at their respective locations.

9.2 Relative Significance of the Environmental Impacts of License Renewal and Alternatives

The proposed action is renewal of the operating licenses for IP2 and IP3. Chapter 2 describes the site, power plant, and interactions of the plant with the environment. Chapters 3 through 7 discuss environmental issues associated with renewal of the operating licenses. Environmental issues associated with the no-action alternative and alternatives such as new power generation, purchased power, conservation, and cooling system modifications are discussed in Chapter 8.

The significance of the environmental impacts from the proposed action (approval of the application for renewal of the operating licenses), the no-action alternative (denial of the application), an alternative involving altering plant operations to comply with the NYSDEC draft SPDES discharge permit, construction of gas-fired generating capacity at alternate sites, gas-fired generation of power at IP2 and IP3, and two combinations of alternatives are compared in Table 9-1. All new fossil-fueled alternatives presented in Table 9-1 are assumed to use closed-cycle cooling systems given current New York State regulations for new power plants.

Table 9-1 shows the significance of the plant-specific environmental effects of the proposed action (renewal of IP2 and IP3 operating licenses) as well as the environmental effects of alternatives to the proposed action. Impacts from license renewal would be SMALL for all impact categories except aquatic ecology, which includes the impacts of heat shock, entrainment, and impingement. Chapter 4 of this SEIS describes the MODERATE impacts of plant operation on aquatic ecology through impingement and entrainment (impact levels vary by species), and the potentially SMALL to LARGE impacts from thermal shock. Overall, impacts to aquatic ecology from continued operation of IP2 and IP3 without cooling system modifications or restoration actions are SMALL to LARGE. A single significance level was not assigned for the collective offsite radiological impacts from the fuel cycle and from high-level radioactive waste spent fuel disposal (see Chapter 6) or for the impacts of greenhouse gases (GHG).

The NRC staff is analysis indicates that the no-action alternative has the smallest effect, but it would necessitate additional actions to replace generation capacity (whether with newly-constructed power plants or purchased power) and/or to institute conservation programs. Impacts of the likely consequences of the no-action alternative would be similar to those of the energy alternatives that the NRC staff considered. All other alternative actions have impacts in at least four resource areas that reach SMALL to MODERATE or higher significance. Often, these impacts are the result of constructing new facilities or infrastructure.

9.3 Conclusions and Recommendations

Based on (1) the analysis and findings in the GEIS, (2) the ER and other information submitted by Entergy, (3) consultation with Federal, State, Tribal, and local agencies, (4) the NRC staff's consideration of public scoping comments received, and comments on the draft SEIS, and (5) the NRC staff's independent review, the recommendation of the NRC staff is that the Commission determine that the adverse environmental impacts of license renewal for IP2 and IP3 are not so great that preserving the option of license renewal for energy planning decision makers would be unreasonable.

1 **Table 9-1. Summary of Environmental Significance of License Renewal and Alternatives**

Impact Category	Proposed Action License Renewal	No-Action Alternative[b] Plant Shutdown	License Renewal with New Closed-Cycle Cooling	NGCC At the IP Site or a Repowered Site	NGCC At a New Site
Land Use	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE	MODERATE to LARGE
Ecology—Aquatic	MODERATE and SMALL to LARGE[a]	SMALL	SMALL	SMALL	SMALL
Ecology—Terrestrial	SMALL	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE
Water Use and Quality	SMALL	SMALL	SMALL	SMALL	SMALL to MODERATE
Air Quality	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Waste	SMALL	SMALL	SMALL to LARGE	SMALL	SMALL
Human Health	SMALL [c]	SMALL	SMALL	SMALL	SMALL
Socioeconomics	SMALL	SMALL to MODERATE	SMALL	SMALL to MODERATE	SMALL to MODERATE
Transportation	SMALL	SMALL	SMALL to LARGE	SMALL to MODERATE	SMALL to MODERATE
Aesthetics	SMALL	SMALL	MODERATE to LARGE	SMALL	SMALL to LARGE
Historical and Archeological Resources	SMALL	SMALL	SMALL to MODERATE	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	SMALL	SMALL	SMALL	SMALL to LARGE	SMALL to LARGE

2
3

1 **Table 9-1** (continued)

Impact Category	Conservation/Energy Efficiency	Combination of Alternatives: Option 1: One IP unit, onsite gas, offsite renewables, and conservation	Option 2: Gas, offsite renewables, additional imported power, and conservation
Land Use	SMALL	SMALL to MODERATE	SMALL to MODERATE
Ecology – Aquatic	SMALL	SMALL to LARGE	SMALL to LARGE
Ecology – Terrestrial	SMALL	SMALL to LARGE	SMALL to LARGE
Water Use and Quality	SMALL	SMALL to LARGE	SMALL to LARGE
Air Quality	SMALL	SMALL to MODERATE	SMALL to MODERATE
Waste	SMALL	SMALL to LARGE	SMALL to LARGE
Human Health	SMALL	SMALL	SMALL
Socioeconomics	SMALL to MODERATE	SMALL	SMALL to MODERATE
Transportation	SMALL	MODERATE	MODERATE
Aesthetics	SMALL	SMALL to LARGE	SMALL to LARGE
Historical and Archeological Resources	SMALL	SMALL to MODERATE	SMALL to MODERATE
Environmental Justice	SMALL	SMALL to LARGE	SMALL to LARGE

(a) NRC staff analysis indicates that impingement and entrainment impacts are MODERATE, but that thermal shock effects could potentially range from SMALL to LARGE.
(b) The no-action alternative does not, on its own, meet the purpose and need of the GEIS. No action would necessitate other generation or conservation actions which may include—but are not limited to—the alternatives addressed in this table.
(c) For the collective offsite radiological impacts from the fuel cycle and from high-level waste and spent fuel disposal, a specific significance level was not assigned. See Chapter 6 for details.
(d) Analysis was based on use of a closed-cycle cooling system.

9.4 References

10 CFR Part 20. Code of Federal Regulations, Title 10, *Energy*, Part 20, "Standards for Protection Against Radiation."

10 CFR Part 51. Code of Federal Regulations, Title 10, *Energy,* Part 51, "Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions."

10 CFR Part 54. Code of Federal Regulations, Title 10, *Energy,* Part 54, "Requirements for Renewal of Operating Licenses for Nuclear Power Plants."

72 FR 45705. "Entergy Nuclear Operations, Inc., Indian Point Nuclear Generating Unit Nos. 2 and 3; Notice of Intent To Prepare an Environmental Impact Statement and Conduct Scoping Process." August 10, 2007

Entergy Nuclear Operations, Inc. (Entergy). 2007a. "Indian Point, Units 2 & 3, License Renewal Application." April 23, 2007. Agencywide Documents Access and Management System (ADAMS) Accession No. ML071210512.

Entergy Nuclear Operations, Inc. (Entergy). 2007b. "Applicant's Environment Report, Operating License Renewal Stage." (Appendix E to Indian Point, Units 2 and 3, License Renewal Application). April 23, 2007. ADAMS Accession No. ML071210530.

National Environmental Policy Act of 1969, as amended (NEPA). 42 USC 4321, et seq.

Nuclear Regulatory Commission (NRC). 1996. NUREG-1437, Volumes 1 and 2, "Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants (GEIS)." Washington, DC. May 1996.

Nuclear Regulatory Commission (NRC). 1999. NUREG-1437, Volume 1, Addendum 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Main Report," Section 6.3, "Transportation," Table 9.1, "Summary of Findings on NEPA Issues for License Renewal of Nuclear Power Plants, Final Report." Washington, DC.

Nuclear Regulatory Commission (NRC). 2000. NUREG-1555, Supplement 1, "Standard Review Plans for Environmental Reviews for Nuclear Power Plants, Supplement 1: Operating License Renewal." Washington, DC.

Appendix A

Comments Received on the Environmental Review

Appendix A

Comments Received on the Environmental Review

Comments Received During Scoping and Scoping Summary Adoption

In this appendix, the NRC staff adopts the Scoping Summary Report for Indian Point Nuclear Generating Unit Nos. 2 and 3 as prepared by the NRC staff in response to comments received on the scope of the environmental review. The NRC staff issued the scoping summary report on December 19, 2008. The Scoping Summary Report is available for public inspection in the NRC Public Document Room (PDR), located at One White Flint North, 11555 Rockville Pike, Rockville, Maryland, 20852, or from the NRC's Agencywide Documents Access and Management System (ADAMS).

The ADAMS Public Electronic Reading Room is accessible at http://www.nrc.gov/reading-rm/adams/web-based.html. The scoping summary report is listed under Accession No. ML083360115.

Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS should contact the NRC's PDR reference staff by telephone at 1-800-397-4209, or 301-415-4737, or by e-mail at pdr@nrc.gov.

On August 10, 2007, the NRC published a Notice of Intent in the Federal Register (72 FR 45075) to notify the public of the Staff's intent to prepare a plant-specific supplement to the GEIS (SEIS) regarding the renewal application for the IP2 and IP3 operating license. As outlined by NEPA, the NRC initiated the scoping process with the issuance of the Federal Register Notice. The NRC invited the applicant, federal, state, local, and tribal government agencies, local organizations, and individuals to participate in the scoping process by providing oral comments at scheduled public meetings and/or submitting written suggestions and comments no later than October 12, 2007.

The scoping process included two public scoping meetings, which were both held on September 19, 2007, at Colonial Terrace, 119 Oregon Road, Cortlandt Manor, New York. The NRC issued press releases and distributed flyers locally. Both sessions began with NRC staff members providing a brief overview of the license renewal process and the NEPA process. Following the NRC's prepared statements, the meetings were open for public comments. Approximately 50 attendees provided oral comments that were recorded and transcribed by a certified court reporter.

The meeting summary, which was issued on October 24, 2007, and the associated transcripts can be found in the NRC PDR or in ADAMS at Accession No. ML072851079. The transcripts of the meetings can be found in ADAMS at Accession Numbers ML072830682 and ML072890209.

The scoping summary contains all comments received on the review, as well as the NRC staff's responses to those comments. Comments received on the draft SEIS will be included in this Appendix of the final SEIS.

A.1 Comments Received on the Draft SEIS

Pursuant to 10 CFR Part 51, the staff transmitted the *Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Indian Point Nuclear Generating Units 2 and 3, Draft Report for Comment* (NUREG-1437, Supplement 38, referred to as the draft SEIS) to Federal, State, Native American Tribal, and local government agencies as well as interested members of the public. As part of the process to solicit public comments on the DSEIS, the staff:

• placed a copy of the DSEIS in the NRC's electronic Public Document Room, its license renewal website, White Plains Public Library(White Plains, NY), Hendrick Hudson Free Library (Montrose, NY) and the Field Library(Peekskill, NY),

• sent copies of the DSEIS to the applicant, members of the public who requested copies, and certain Federal, State, Native American Tribal, and local agencies,

• published a notice of availability of the DSEIS in the *Federal Register* on December 31, 2008, (71 FR 75280),

• issued press releases and public announcements such as advertisements in local newspapers and postings in public places announcing the issuance of the DSEIS, the public meetings, and instructions on how to comment on the DSEIS,

• held public meetings in Cortlandt Manor, New York, on February 12, 2009, to describe the results of the environmental review and answer related questions,

• established an e-mail address to receive comments on the DSEIS through the Internet.

During the DSEIS comment period, the staff received comments from 183 individuals or groups. Eighty-eight commenters spoke during the public meetings. The staff reviewed the public meeting transcripts and the comment letters that are part of the docket file for the application, all of which are available in the NRC's Agencywide Documents Access Management System (ADAMS). ADAMS is accessible at http://www.nrc.gov/reading-rm/adams.html. Appendix A, Part II, Section A.2, contains a summary of the comments and the staff's responses. Appendix A, Part II, Section A.3, contains the comment letters and commenters excerpts from the transcripts. The comment period closed on March 18, 2009.

No individuals or groups requested an extension of the comment period. Several groups, however, submitted comments months after the close of the comment period, most recently on November 5, 2010. The NRC staff found it impracticable to address these comments, and those late-filed comments are not included in this appendix.

Each comment identified by the staff was assigned a specific commenter identifier (marker). That identifier is typed in the letter's margin at the beginning of the comment discussion.

Table A-1. Individuals and/or Groups Providing Comments on the DSEIS.
Commenters appear in alphabetical order, and each commenter has been given a unique commenter identification number.

Commenter	Affiliation (if stated)	Commenter ID Number
Adams, Kenneth	Business Council of New York State	1

Commenter	Affiliation (if stated)	Commenter ID Number
Allen, Judy	Resident, Putnam Valley	2
American Citizen	American Citizens	3
Anders, Fred	NYS Office of Coastal, Local Government and Community Sustainability	4
Anthony, Rev. Dr. Cheryl	Jude International Christian Center	5
Argintar, Herbert		6
Ball, Gregory	New York State Assembly	7
Banfield, William	Empire State Regional Council of Carpenters	8
Bard Center for Environmental Policy	Auropriya A. Reddy, Emily B. Fischer, Katherine C. Galbraith, Kristine E. Pierce, Shaylah C. Reagan, Michel N. Wahome, Matthew A. Guenther, Kaleena S. Miller, Taryn L. Morris, Joshua Z. Jacobson, Jaclyn Harrison, Lindsay Chapman, Anne E. Kline, Than H. Phoo, Daniel Smith	9
Barthelme, Margaret	Student, Ramapo College	10
Bartholomew, Alice		11
Bassi, Laura		12
Berasi, Pete		13
Bigby, Derry	African American Environmentalist Association	14
Bittermann, Sister Rosemarie	St. Patrick Villa	15
Blades, Adam	Student, Ramapo College	16
Blumenthal, Richard	Connecticut, Attorney General	17
Boorman, Lindsay		18
Bowman, Reginald	NYC Housing Authority's Resident Council	19
Brancato, Deborah	Riverkeeper	20
Brennan, Chris		21
Bron, Gary		22
Burruss, Melvin	African American Men of Westchester	23
Burton, Nancy	Mothers Milk Project	24
Butler, Elizabeth		25
Byrd, Ricardo	National Association of Neighborhoods	26
Calvani, Dorothy		27
Campbell, Joanne	Albany Houses Tenants Association of Brooklyn	28
Capurso, Tom	Local 3	29
Carmody, Greg	Student, Ramapo College	30
Castro, Maria	Hispanic Energy Coalition	31

Commenter	Affiliation (if stated)	Commenter ID Number
Chernoff, Patricia		32
Clark, Pamela	Hudson River Club	33
Clegg, Thomas		34
Cohen, Lisa		35
Connolly, Jerry	Coalition of Labor for Energy and Jobs	36
Cooper, Loraine		37
Cypser, Betty	Raging Grannies	38
Cypser, Rudy		39
Dacimo, Fred	Entergy	40
Daly, Mary Ann		41
Davis, Darwin	Greater Harlem Chamber of Commerce	42
Davis, Jill	Hendrick Hudson Free Library	43
DeAngelo, Carol		44
Degraff, Rev. Jacques	100 Black Men	45
Digby, Derry	African American Environmental Association	46
DiRocco, Steve		47
Donahue, Mayor Al	Mayor, Town of Buchanan	48
Durett, Dan	African American Environmentalists Association	49
Edelstein, Michael	Ramapo College	50
Evans, Laurie	Westchester SAFE	51
Falciano, Patrick		52
Federspiel, John	Hudson Valley Hospital System	53
Feinberg, Janie		54
Filippelli, John	United States Environmental Protection Agency	55
Fitzpatrick, Brian		56
Forehand, Ron	Hudson Valley Gateway Chamber of Commerce	57
Form Letter		58
Foster, Mary	Mayor, Peekskill	59
Fraiser, Andrew	NextGen Network	60
Friedman, Carolyn	Resident, Nyack	61
Frye, Glen	Brooklyn Anti-Violence Coalition	62
Funck, John		63
Furgatch, Lisa		64
Garcia, Frank	Bronx Hispanic Chamber of Commerce	65

Commenter	Affiliation (if stated)	Commenter ID Number
Garisto, Mary Ann		66
Gordon, Marsha	Business Council of Westchester	67
Grady, Peter		68
Raging Grannies		69
Gould, Ross	Attorney (Working with HRSC)	70
Gray, Jennifer		71
Green, George		72
Greene, Manna	Hudson River Sloop Clearwater	73
Hassman, Howard		74
Hawkins, Gerard	Resident, Croton on Hudson	75
Helman, Lucille		76
Hirsh, Seth		77
Hohlfeld, Bill	Local 46 Labor Management Cooperative Trust	78
Hudson River Sloop Clearwater, Inc.	Manna Jo Greene, Ross Gould, Esq.	79
Imoberdorf, Olivia		80
Indusi, Joan		81
Jacobs, Mark		82
Johnson, Tom	Buchanan Firefighter	83
Karamaty, Valery	Raging Grannies	84
Karas, Joe	Carpenters Union Local 11	85
Kardos, Terry	Resident, Cortlandt Manor	86
Kardos, Theresa	Resident, Cortlandt Manor	87
Kearney, Gail		88
Keenan, Jennifer	Student, Ramapo College	89
Kelly, John	Entergy (retired Director of Licensing)	90
Ketchum, Arleen		91
Klein, Tom	Boilermakers Local 5	92
Knolmayer, Liz	Student, Ramapo College	93
Knubel, James	New York AREA	94
Koldewyn, Kennis		95
Kopec, Eileen	Student, Ramapo College	96
Kopshaw, Kaitlin	Student, Ramapo College	97
Kourie, Kathleen	Resident, Garrison	98
Kremer, Arthur	NY AREA (Affordable Reliable Energy Alliance)	99

Commenter	Affiliation (if stated)	Commenter ID Number
Lapido, Helen	Resident, Cortlandt Manor	100
Ledwith, Robert	Metallic Lathers Union and Reinforcing Ironworkers Local 46	101
Lee, Michel	Council on Intelligent Energy and Conservation Policy	102
Leifer, Susan	Sierra Club	103
Likes, Philip		104
Ludwigson, Steve	Boilermakers Local 5	105
Mallon, Sister Florence		106
Mangano, Joe	Radiation and Public Health Project	107
Marzullo, Dominic	Indian Point	108
Mattis, John	Resident, Cortlandt	109
Maturo, Michael	Orangetown Councilman	110
McCann, Dr. Daniel	Superintendent, Hendrick Hudson School District	111
McCormick, John	(enter for Environment Commerce and Energy)	112
McDonald, Norris	(enter for Environment Commerce and Energy)	113
McGrath, John	Easter Seals, New York	114
Miranda, George	New York Teamsters Joint Council 16	115
Miranda, Rick	Brooklyn Hispanic Chamber of Commerce	116
Mitchell, Grace	Resident, Lower Hudson Valley	117
Montague, Virginia	NY Coalition of 100 Black Women	118
Mooney, William	Westchester County Association	119
Moore, Dr. Patrick	Greenspirit Strategies, LLC	120
Murdock, Chad		121
Murphy, Regina		122
Musegaas, Phillip	Riverkeeper	123
Myslinski, Melissa		124
Nemeczek, Jessica	Student, Ramapo College	125
Newman, Janet	West Branch Conservation Association	126
Nicklas, Donald	Local 7	127
NYSDEC	Joan Leary Matthews, John L. Parker	128
NYSO of the Attorney General	Janice A. Dean, John Sipos, Lisa Feiner	129
Oros, George	Westchester County Board of Legislators	130
Otis, Mike	Professor, University	131
Parker, John	NYSDEC Attorney, Region 3	132
Perry, Sharonee	Former Brooklyn Community Board	133

Commenter	Affiliation (if stated)	Commenter ID Number
Perry, Donzella	Resident, Brooklyn	134
Pilder, Leslie		135
Pockriss, Peter	Director of Development for Historic Hudson Valley	136
Puglisi, Linda	Supervisor, Town of Cortlandt	137
Race, Kira	Student, Ramapo College	138
Raddant, Andrew	U.S. Department of the Interior, Regional Environment Officer	139
Riverkeeper, Inc.	Phillip Musegaas, Victor Tafur, Deborah Brancato	140
ROAR		141
Rogers, Sister Mary Christine		142
Rosenfeld, Alice	Resident, Westchester County	143
Ryan, Thomas	Boilermakers Local 5	144
Ryan, Martyn	Resident, Rockland County	145
Safian, Keith	Phelps Memorial Hospital	146
Sambrook, Andrea	Resident, Mamaroneck	147
Samuels, Al	Rockland Business Association	148
Scarola, Julianne	Student, Ramapo College	149
Seeger, Bob	Millwright and Machinery Erectors Local Union No. 740	150
Seeman, Laurie		151
Shapiro, Susan	Sierra Club	152
Shaw, Gary		153
Shepard, Margo	Westchester Citizens Awareness Network	154
Sherman, Andrea	Resident, White Plains	155
Skanes, Brian	Westchester Community Association	156
Slevin, James	Utility Workers Local 1-2	157
Smith, Rev. George Robeson	Mother AME Mount Zion Church in Harlem	158
Smith, Carol	Orange County Chamber of Commerce	159
Sorbello, Dino		160
Starke, Alexis	Resident, Hudson Valley	161
Sullivan, John		162
Swertfager, Diane	Hendrick Hudson H.S.	163
Taormino, Michelle	Student, Ramapo College	164
Tompkins, Dana	Green Infrastructure LLC	165
Tracey, Michael	International Association of Heat & Frost Insulators &	166

Commenter	Affiliation (if stated)	Commenter ID Number
	Allied Workers Local Union 91	
Unknown (Sister Anne ?)		167
Various Authors		168
Vitale, Paul	Business Council of Westchester	169
Walsh, Marion		170
Waltzer, Rosemary		171
Wanshel, Jeff		172
Warren, Roxanne		173
Weininger, Ellen	Resident, White Plains	174
Weininger, Annette		175
Weinstein, Dava		176
Wilson, Craig	SHARE	177
Withrow, Leigh		178
Wolf, Peter		179
Wood, Patti	Grassroots Environmental Education	180
Yanofsky, John	Paramount Center for the Arts	181
Yarme, Judith		182
Yaroscak-Lanzotti, Helen	Resident, Yorktown Heights	183

Table A-2. Technical Issue Categories. Comments were divided into one of the 28 categories below, each of which has a unique abbreviation code.

Abbreviation Code	Technical Issue	Abbreviation Code	Technical Issue
AE	Aquatic Ecology	OM	Operational Maintenance
AL	Alternatives	ON	Opposition to Nuclear
AM	Aging Management	OP	Operational Safety
AS	Aesthetics	OR	Opposition to Relicensing
AQ	Air Quality	OS	Out of Scope
CI	Cumulative Impacts	PA	Postulated Accidents
CR	Cultural Resources	PS	Psycho-Social Effects
DC	Decommissioning/Deregulation	RE	Remediation
DE	Demographics	RG	Regulatory
EC	Energy Costs/Energy Needs	RI	Radiological Impacts
ED	Editorial	RF	Refurbishment
EJ	Environmental Justice	RW	Radiological Waste Management
EP	Emergency Preparedness	SA	Safety
GE	GEIS	SE	Support for Entergy
GI	General Environmental Impacts	SF	Spent Fuel Pool
GL	Global Warming	SM	SAMA
GW	Ground Water	SO	Socioeconomics
HH	Human Health Issues	SR	Support for Relicense
LE	Leaks	ST	Security & Terrorism
LR	License Renewal and its Process	TE	Terrestrial Ecology
LU	Land Use	TL	Transmission Lines
MP	Monitoring Programs	TS	Threatened and Endangered Species
NE	NEPA	UF	Uranium Fuel Cycle
		WA	Water Use and Quality

Table A-3. Comments Received during Scoping Period. Comments are listed alphabetically by commenter, and each comment has a unique comment identification code.

Comment ID	Commenter	Comment Source[a]	Comment Page No(s).	ADAMS Accession Number
1-a-EC/SO/SR	Adams, K.	transcript	176	ML091410355
1-b-EC/SE	Adams, K.	transcript	176	ML091410355
1-c-EC/SO	Adams, K.	transcript	178	ML091410355
1-d-AQ/EC	Adams, K.	transcript	178	ML091410355
1-e-SR	Adams, K.	transcript	180	ML091410355
2-a-AL/RI	Allen, J.	transcript	181	ML091410354
2-b-HH/RI	Allen, J.	transcript	181	ML091410354
2-c-HH	Allen, J.	e-mail	184	ML090640367
3-a-AE/LE/LR	American Citizen	e-mail	186	ML090650458
4-a-AE/LR	Anders, F.	e-mail	187	ML090771329
4-b-AL/LR	Anders, F.	e-mail	188	ML090771329
4-c-LR/SF	Anders, F.	e-mail	189	ML090771329
4-d-CI/LR/SO	Anders, F.	e-mail	189	ML090771329
4-e-LR	Anders, F.	e-mail	190	ML090771329
5-a-AQ/SR	Anthony, Rev. Dr. C.	transcript	191	ML091410354
5-b-AQ/SR	Anthony, Rev. Dr. C.	transcript	192	ML091410354
5-c-AQ/SR	Anthony, Rev. Dr. C.	transcript	192	ML091410354
6-a-EP/OR	Argintar, H.	e-mail	193	ML090700173
7-a-SE/SL	Ball, G.	e-mail	194	ML090640373
7-b-AL	Ball, G.	e-mail	194	ML090640373
7-c-SO	Ball, G.	e-mail	194	ML090640373
7-d-AQ/EC/SR	Ball, G.	e-mail	194	ML090640373
7-e-SR	Ball, G.	e-mail	194	ML090640373
8-a-SR	Banfield, W.	e-mail	196	ML090700180
8-b-SO	Banfield, W.	e-mail	196	ML090700180
8-c-AQ/HH/SO	Banfield, W.	e-mail	196	ML090700180
8-d-SE/SR	Banfield, W.	e-mail	196	ML090700180
9-a-GI	Bard Center for Environmental Policy	e-mail	197	ML090771343
9-b-OR/SA	Bard Center for Environmental Policy	e-mail	198	ML090771343
9-c-LE/PA/RW	Bard Center for Environmental Policy	e-mail	198	ML090771343
9-d-EP	Bard Center for Environmental Policy	e-mail	198	ML090771343
9-e-AE/AL	Bard Center for Environmental Policy	e-mail	198	ML090771343
9-f-AL	Bard Center for Environmental Policy	e-mail	198	ML090771343
9-g-AL/SO	Bard Center for Environmental Policy	e-mail	199	ML090771343
9-h-AE/AL/AQ	Bard Center for	e-mail	199	ML090771343

Comment ID	Commenter	Comment Source[a]	Comment Page No(s).	ADAMS Accession Number
	Environmental Policy			
9-i-AL/ED	Bard Center for Environmental Policy	e-mail	200	ML090771343
9-j-AL/ED	Bard Center for Environmental Policy	e-mail	202	ML090771343
10-a-PA	Barthelme, M.	transcript	204	ML091410355
10-b-AL	Barthelme, M.	transcript	204	ML091410355
10-c-GL	Barthelme, M.	transcript	204	ML091410355
10-d-PA	Barthelme, M.	e-mail	205	ML090720661
11-a-OR	Bartholomew, A.	e-mail	207	ML090650248
11-b-AE	Bartholomew, A.	e-mail	207	ML090650248
11-c-AE	Bartholomew, A.	e-mail	207	ML090650248
11-d-LE	Bartholomew, A.	e-mail	207	ML090650248
11-e-RW/ST	Bartholomew, A.	e-mail	207	ML090650248
11-f-AL/OR	Bartholomew, A.	e-mail	207	ML090650248
12-a-OR	Bassi, L.	e-mail	208	ML090700181
12-b-AE	Bassi, L.	e-mail	208	ML090700181
12-c-AE	Bassi, L.	e-mail	208	ML090700181
12-d-LE	Bassi, L.	e-mail	208	ML090700181
12-e-RW/ST	Bassi, L.	e-mail	208	ML090700181
12-f-AL	Bassi, L.	e-mail	208	ML090700181
13-a-OR	Berasi, P.	e-mail	209	ML090720667
13-b-AE	Berasi, P.	e-mail	209	ML090720667
13-c-PA/SF/ST	Berasi, P.	e-mail	209	ML090720667
13-d-PA/SF	Berasi, P.	e-mail	209	ML090720667
13-e-RW/UF	Berasi, P.	e-mail	209	ML090720667
13-f-AM/GE/OM	Berasi, P.	e-mail	209	ML090720667
13-g-DE/EP	Berasi, P.	e-mail	209	ML090720667
13-h-OR	Berasi, P.	e-mail	210	ML090720667
13-i-OR	Berasi, P.	e-mail	210	ML090720667
14-a-AQ/EJ/SR	Bigby, D.	hand-in	212	ML091740490
14-b-AQ/EJ/SR	Bigby, D.	hand-in	213	ML091740490
14-c-AL/AQ	Bigby, D.	hand-in	214	ML091740490
14-d-AL/EJ/GL	Bigby, D.	hand-in	214	ML091740490
14-e-SR	Bigby, D.	hand-in	216	ML091740490
15-a-OR	Bittermann, Sister R.	letter	217	ML090860661
16-a-DE/PA	Blades, A.	e-mail	218	ML090720679
16-b-PS/ST	Blades, A.	e-mail	218	ML090720679
16-c-EP/PA/PS	Blades, A.	e-mail	218	ML090720679
16-d-LR	Blades, A.	e-mail	219	ML090720679
17-a-NE/SF	Blumenthal, R.	e-mail	221	ML090720677

Comment ID	Commenter	Comment Source(a)	Comment Page No(s).	ADAMS Accession Number
				ML090820081
17-b-EP/ST	Blumenthal, R.	e-mail	221	ML090720677 ML090820081
17-c-NE	Blumenthal, R.	e-mail	222	ML090720677 ML090820081
17-d-DE	Blumenthal, R.	e-mail	224	ML090720677 ML090820081
17-e-NE/PA	Blumenthal, R.	e-mail	225	ML090720677 ML090820081
17-f-PA	Blumenthal, R.	e-mail	225	ML090720677 ML090820081
17-g-ST	Blumenthal, R.	e-mail	226	ML090720677 ML090820081
17-h-SF	Blumenthal, R.	e-mail	227	ML090720677 ML090820081
17-i-SF/ST	Blumenthal, R.	e-mail	227	ML090720677 ML090820081
17-j-SF	Blumenthal, R.	e-mail	227	ML090720677 ML090820081
17-k-SF/ST	Blumenthal, R.	e-mail	228	ML090720677 ML090820081
17-l-SF/ST	Blumenthal, R.	e-mail	229	ML090720677 ML090820081
17-m-EP	Blumenthal, R.	e-mail	230	ML090720677 ML090820081
17-n-EP/PA/ST	Blumenthal, R.	e-mail	230	ML090720677 ML090820081
17-o-AE/NE	Blumenthal, R.	e-mail	231	ML090720677 ML090820081
17-p-EP/PA/RI	Blumenthal, R.	e-mail	232	ML090720677 ML090820081
17-q-AE/NE	Blumenthal, R.	e-mail	233	ML090720677 ML090820081
17-r-EP/GI/RI	Blumenthal, R.	e-mail	234	ML090720677 ML090820081
18-a-LE/OR	Boorman, L.	e-mail	235	ML090720666
18-b-DE/ST	Boorman, L.	e-mail	235	ML090720666
18-c-AE	Boorman, L.	e-mail	235	ML090720666
18-d-OR	Boorman, L.	e-mail	235	ML090720666
19-a-EC/SR	Bowman, R.	transcript	236	ML091410354
19-b-EC/SO/SR	Bowman, R.	transcript	237	ML091410354
19-c-EC/SO/SR	Bowman, R.	transcript	238	ML091410354

Comment ID	Commenter	Comment Source[a]	Comment Page No(s).	ADAMS Accession Number
20-a-PA/SF/ST	Brancato, D.	transcript	239	ML091410354
20-b-HH	Brancato, D.	transcript	239	ML091410354
20-c-AE/OR	Brancato, D.	transcript	240	ML091410354
21-a-AE/OR/SF	Brennan, C.	e-mail	242	ML090640369
21-b-GI/OR	Brennan, C.	e-mail	242	ML090640369
22-a-HH/OR/PA	Bron, G.	e-mail	243	ML090700171
23-a-SE/SR	Burruss, M.	transcript	244	ML091410355
23-b-SO	Burruss, M.	transcript	244	ML091410355
23-c-AL/AQ	Burruss, M.	transcript	244	ML091410355
23-d-EC	Burruss, M.	transcript	244	ML091410355
23-e-AQ	Burruss, M.	transcript	245	ML091410355
23-f-EC/SO	Burruss, M.	transcript	245	ML091410355
23-g-SR	Burruss, M.	transcript	246	ML091410355
23-h-AL/AQ	Burruss, M.	hand-in	247	ML091740490
23-i-EC/SO/SR	Burruss, M.	hand-in	247	ML091740490
24-a-HH/OR/RI	Burton, N.	transcript	248	ML091410354
24-b-HH/OR/RI	Burton, N.	hand-in	251	ML091740490
25-a-OR	Butler, E.	e-mail	255	ML090720676
26-a-EC/LR	Byrd, R.	transcript	256	ML091410354
26-b-OP	Byrd, R.	transcript	257	ML091410354
26-c-EC/SO/SR	Byrd, R.	transcript	258	ML091410354
27-a-OR	Calvani, D.	e-mail	259	ML090700183
27-b-AE	Calvani, D.	e-mail	259	ML090700183
27-c-AE	Calvani, D.	e-mail	259	ML090700183
27-d-LE	Calvani, D.	e-mail	259	ML090700183
27-e-SF/ST	Calvani, D.	e-mail	259	ML090700183
27-f-OR	Calvani, D.	e-mail	259	ML090700183
28-a-EC/SR	Campbell, J.	transcript	260	ML091410354
28-b-EC/SO	Campbell, J.	transcript	260	ML091410354
29-a-SO/SR	Capurso, T.	transcript	262	ML091410355
29-b-OP	Capurso, T.	transcript	262	ML091410355
29-c-EC/SA	Capurso, T.	transcript	262	ML091410355
30-a-AL/AQ/AS/ EJ/GE	Carmody, G.	e-mail	265	ML090700187
31-a-EJ/SR	Castro, M.	transcript	266	ML091410355
31-b-EC/EJ/HH	Castro, M.	transcript	266	ML091410355
31-c-AQ/SR	Castro, M.	transcript	266	ML091410355
32-a-AM/OP/PA	Chernoff, P.	e-mail	268	ML090640374
33-a-AE/GL/LE	Clark, P.	e-mail	269	ML090640400
34-a-AL/EC	Clegg, T.	transcript	270	ML091410355
34-b-AL/EC	Clegg, T.	transcript	270	ML091410355
35-a-LE/OM	Cohen, L.	e-mail	272	ML909640370

Comment ID	Commenter	Comment Source[(a)]	Comment Page No(s).	ADAMS Accession Number
35-b-EP	Cohen, L.	e-mail	272	ML909640370
35-c-AM/RW	Cohen, L.	e-mail	272	ML909640370
35-d-OR	Cohen, L.	e-mail	272	ML909640370
35-e-OR/RE	Cohen, L.	e-mail	272	ML909640370
36-a-SR	Connolly, J.	transcript	273	ML091410355
36-b-OP	Connolly, J.	transcript	273	ML091410355
36-c-AL/AQ/EC	Connolly, J.	transcript	274	ML091410355
36-d-OP/SO	Connolly, J.	transcript	274	ML091410355
36-e-OP/SO	Connolly, J.	transcript	275	ML091410355
37-a-AE/OR	Cooper, L.	letter	276	ML091100401
37-b-LE/SF/ST	Cooper, L.	letter	276	ML091100401
38-a-ON	Cypser, B.	transcript	277	ML091410354
38-b-PA/RW/ST	Cypser, B.	e-mail	278	ML090640364
38-c-RW/SF/ST	Cypser, B.	e-mail	278	ML090640364
38-d-AL	Cypser, B.	e-mail	278	ML090640364
38-e-RW/SF	Cypser, B.	e-mail	278	ML090640364
38-f-RW/SF	Cypser, B.	hand-in	279	ML091740490
38-g-RW	Cypser, B.	hand-in	279	ML091740490
38-h-ST	Cypser, B.	hand-in	279	ML091740490
38-i-RW	Cypser, B.	hand-in	279	ML091740490
39-a-RW/SF	Cypser, R.	transcript	280	ML091410355
39-b-LE	Cypser, R.	transcript	280	ML091410355
39-c-PA/ST	Cypser, R.	transcript	280	ML091410355
39-d-PA/ST	Cypser, R.	transcript	281	ML091410355
40-a-SR	Dacimo, F.	transcript	282	ML091410355
40-b-AE	Dacimo, F.	transcript	282	ML091410355
40-c-AE	Dacimo, F.	transcript	283	ML091410355
40-d-AE	Dacimo, F.	transcript	284	ML091410355
40-e-AE	Dacimo, F.	transcript	284	ML091410355
40-f-AE	Dacimo, F.	transcript	284	ML091410355
40-g-EC	Dacimo, F.	transcript	285	ML091410355
40-h-SR	Dacimo, F.	email	286	ML091040133
40-i-OS	Dacimo, F.	email	287	ML091040133
40-j-AE/AL	Dacimo, F.	email	287	ML091040133
40-k-AE	Dacimo, F.	email	292	ML091040133
40-l-ED	Dacimo, F.	email	292	ML091040133
40-m-ED	Dacimo, F.	email	292	ML091040133
40-n-AE/ED	Dacimo, F.	email	292	ML091040133
40-o-ED/RG	Dacimo, F.	email	292	ML091040133
40-p-AE	Dacimo, F.	email	293	ML091040133
40-q-AE	Dacimo, F.	email	293	ML091040133
40-r-AE	Dacimo, F.	email	294	ML091040133

Comment ID	Commenter	Comment Source[(a)]	Comment Page No(s).	ADAMS Accession Number
40-s-AE	Dacimo, F.	email	294	ML091040133
40-t-AE/ED	Dacimo, F.	email	295	ML091040133
40-u-ED/TS	Dacimo, F.	email	295	ML091040133
40-v-AL/TS	Dacimo, F.	email	295	ML091040133
40-x-ED	Dacimo, F.	email	296	ML091040133
40-y-AE	Dacimo, F.	email	296	ML091040133
40-z-AE	Dacimo, F.	email	296	ML091040133
40-aa-ED	Dacimo, F.	email	296	ML091040133
40-bb-AE/ED	Dacimo, F.	email	296	ML091040133
40-cc-AE/ED	Dacimo, F.	email	298	ML091040133
40-dd-AE/AL	Dacimo, F.	email	298	ML091040133
40-ee-AE	Dacimo, F.	email	299	ML091040133
40-ff-AE/ED	Dacimo, F.	email	299	ML091040133
40-gg-AE	Dacimo, F.	email	299	ML091040133
40-hh-AE	Dacimo, F.	email	300	ML091040133
40-ii-AE/AL/TS	Dacimo, F.	email	300	ML091040133
40-jj-AE	Dacimo, F.	email	301	ML091040133
40-kk-AE/ED	Dacimo, F.	email	301	ML091040133
40-ll-AE	Dacimo, F.	email	301	ML091040133
40-mm-AE/ED	Dacimo, F.	email	302	ML091040133
40-nn-AE	Dacimo, F.	email	302	ML091040133
40-oo-AE	Dacimo, F.	email	303	ML091040133
40-pp-AL	Dacimo, F.	email	303	ML091040133
40-qq-AE/ED	Dacimo, F.	email	303	ML091040133
40-rr-AE/ED/TL	Dacimo, F.	email	303	ML091040133
40-ss-ED	Dacimo, F.	email	304	ML091040133
40-tt-AE	Dacimo, F.	email	304	ML091040133
40-uu-AE	Dacimo, F.	email	305	ML091040133
40-vv-ED	Dacimo, F.	email	305	ML091040133
40-ww-ED/SM	Dacimo, F.	email	305	ML091040133
40-xx-AL/AQ	Dacimo, F.	email	306	ML091040133
40-yy-ED	Dacimo, F.	email	306	ML091040133
40-zz-AL	Dacimo, F.	email	307	ML091040133
40-aaa-AE/AL	Dacimo, F.	email	309	ML091040133
40-bbb-AL	Dacimo, F.	email	310	ML091040133
40-ccc-AL/TE	Dacimo, F.	email	311	ML091040133
40-ddd-AL/TS	Dacimo, F.	email	312	ML091040133
40-eee-AL/AQ	Dacimo, F.	email	312	ML091040133
40-fff-AL/AQ	Dacimo, F.	email	313	ML091040133
40-ggg-AL	Dacimo, F.	email	313	ML091040133
40-hhh-AL/ED	Dacimo, F.	email	315	ML091040133
40-iii-ED	Dacimo, F.	email	316	ML091040133
40-jjj- AE	Dacimo, F.	email	318	ML091040133

Comment ID	Commenter	Comment Source[(a)]	Comment Page No(s).	ADAMS Accession Number
40-kkk-AL	Dacimo, F.	email	318	ML091040133
40-lll-ED/SM	Dacimo, F.	email	318	ML091040133
40-mmm-AE	Dacimo, F.	email	320	ML091040133
40-nnn-AE	Dacimo, F.	email	324	ML091040133
40-ooo-AE/ED	Dacimo, F.	email	324	ML091040133
40-ppp-AE/CE	Dacimo, F.	email	325	ML091040133
40-qqq-AE	Dacimo, F.	email	328	ML091040133
40-rrr-AL	Dacimo, F.	email	341	ML091040133
40-sss-AL	Dacimo, F.	email	344	ML091040133
40-ttt-AE	Dacimo, F.	email	347	ML091040133
40-uuu-AE	Dacimo, F.	email	348	ML091040133
40-vvv-AE	Dacimo, F.	email	348	ML091040133
40-www-AL	Dacimo, F.	email	348	ML091040133
40-xxx-AE/ED	Dacimo, F.	email	349	ML091040133
40-yyy-AE	Dacimo, F.	email	349	ML091040133
40-zzz-AE	Dacimo, F.	email	350	ML091040133
40-aaaa-TS	Dacimo, F.	email	350	ML091040133
40-bbbb-TS	Dacimo, F.	email	351	ML091040133
40-cccc-TS	Dacimo, F.	email	352	ML091040133
40-dddd-TS	Dacimo, F.	email	352	ML091040133
40-eeee-AE	Dacimo, F.	email	353	ML091040133
40-ffff-AE	Dacimo, F.	email	353	ML091040133
40-gggg-AL	Dacimo, F.	email	367	ML091040133
40-hhhh-AL	Dacimo, F.	email	370	ML091040133
40-iiii-AL	Dacimo, F.	email	374	ML091040133
40-jjjj-AL	Dacimo, F.	email	377	ML091040133
40-kkkk-AL	Dacimo, F.	email	382	ML091040133
40-llll-AL	Dacimo, F.	email	384	ML091040133
40-mmmm-AL	Dacimo, F.	email	387	ML091040133
40-nnnn-AL	Dacimo, F.	email	390	ML091040133
40-oooo-AL	Dacimo, F.	email	428	ML091040133
40-pppp-AL	Dacimo, F.	email	435	ML091040133
40-qqqq-AE	Dacimo, F.	email	442	ML091040133
40-rrrr-AE	Dacimo, F.	email	457	ML091040133
40-ssss-AE	Dacimo, F.	email	459	ML091040133
40-tttt-AE	Dacimo, F.	email	461	ML091040133
40-uuuu-AE	Dacimo, F.	email	463	ML091040133
40-vvvv-AE	Dacimo, F.	email	471	ML091040133
40-wwww-AE	Dacimo, F.	email	472	ML091040133
40-xxxx-AE	Dacimo, F.	email	475	ML091040133
40-yyyy-AE	Dacimo, F.	email	476	ML091040133
40-zzzz-AE	Dacimo, F.	email	479	ML091040133
40-aaaaa-AE	Dacimo, F.	email	480	ML091040133

Comment ID	Commenter	Comment Source[(a)]	Comment Page No(s).	ADAMS Accession Number
40-bbbbb-AE	Dacimo, F.	email	480	ML091040133
40-ccccc-AE	Dacimo, F.	email	480	ML091040133
40-ddddd-AE	Dacimo, F.	email	482	ML091040133
40-eeeee-AE	Dacimo, F.	email	482	ML091040133
40-fffff-AE	Dacimo, F.	email	483	ML091040133
40-ggggg-AE	Dacimo, F.	email	483	ML091040133
40-hhhhh-AE	Dacimo, F.	email	483	ML091040133
40-iiiii-AE	Dacimo, F.	email	485	ML091040133
40-jjjjj-AE	Dacimo, F.	email	487	ML091040133
40-kkkkk-AE	Dacimo, F.	email	489	ML091040133
40-lllll-AE	Dacimo, F.	email	495	ML091040133
40-mmmmm-AE	Dacimo, F.	email	513	ML091040133
40-nnnnn-TS	Dacimo, F.	email	513	ML091040133
40-ooooo-TS	Dacimo, F.	email	515	ML091040133
40-ppppp-AE	Dacimo, F.	email	523	ML091040133
40-qqqqq-AE	Dacimo, F.	email	525	ML091040133
40-rrrrr-AE	Dacimo, F.	email	533	ML091040133
40-sssss-AE	Dacimo, F.	email	538	ML091040133
40-ttttt-AE	Dacimo, F.	email	553	ML091040133
40-uuuuu-AE	Dacimo, F.	email	574	ML091040133
40-vvvvv-AE	Dacimo, F.	email	577	ML091040133
40-wwwww-GE/LR	Dacimo, F.	hand-in	595	ML091740490
40-xxxxx-SE	Dacimo, F.	hand-in	596	ML091740490
40-yyyyy-AE	Dacimo, F.	hand-in	596	ML091740490
40-zzzzz-AE	Dacimo, F.	hand-in	596	ML091740490
40-aaaaaa-AE	Dacimo, F.	hand-in	597	ML091740490
40-bbbbbb-AE	Dacimo, F.	hand-in	600	ML091740490
40-cccccc-AL/RG	Dacimo, F.	hand-in	601	ML091740490
41-a-OR	Daly, Mary A.	letter	604	ML090860664
41-b-AM/SF	Daly, Mary A.	letter	604	ML090860664
41-c-AE/LE	Daly, Mary A.	letter	604	ML090860664
41-d-AL	Daly, Mary A.	letter	604	ML090860664
42-a-EC/SR	Davis, D.	transcript	605	ML091410354
42-b-EC/SO	Davis, D.	transcript	605	ML091410354
42-c-HH	Davis, D.	transcript	605	ML091410354
42-d-SE/SR	Davis, D.	transcript	605	ML091410354
42-e-SR	Davis, D.	hand-in	607	ML091740490
42-f-EC/SO	Davis, D.	hand-in	607	ML091740490
42-g-AL/AQ	Davis, D.	hand-in	607	ML091740490
42-h-SE/SL	Davis, D.	hand-in	607	ML091740490
43-a-SE/SO	Davis, J.	hand-in	608	ML091740490
44-a-OR	DeAngelo, C.	e-mail	610	ML090771348

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44-b-AM/DE/SF	DeAngelo, C.	e-mail	610		ML090771348 ML090860663
44-c-AE/LE	DeAngelo, C.	e-mail	610		ML090771348 ML090860663
44-d-OR	DeAngelo, C.	e-mail	610		ML090771348 ML090860663
45-a-AQ/EJ	Degraff, Rev. Jacques	transcript	611		ML091410354
45-b-AL/EC/EJ	Degraff, Rev. Jacques	transcript	612		ML091410354
45-c-LR	Degraff, Rev. Jacques	transcript	612		ML091410354
46-a-EC/SR	Digby, D.	transcript	614		ML091410355
46-b-AQ/EJ	Digby, D.	transcript	614		ML091410355
46-c-AL/EJ/SR	Digby, D.	transcript	615		ML091410355
47-a-SF	DiRocco, S.	e-mail	616		ML090771334
47-b- LE/EP/SF	DiRocco, S.	e-mail	616		ML090771334
47-c-RW	DiRocco, S.	e-mail	616		ML090771334
48-a-OP	Donahue, Mayor A.	transcript	617		ML091410354
48-b-EC/SO	Donahue, Mayor A.	transcript	617		ML091410354
48-c-SE/SO	Donahue, Mayor A.	transcript	618		ML091410354
48-d-AQ/SO	Donahue, Mayor A.	transcript	618		ML091410354
48-e-OP/SR	Donahue, Mayor A.	transcript	619	5 9	ML091410354
48-f-SE	Donahue, Mayor A.	transcript	619		ML091410354
48-g-AQ/SO	Donahue, Mayor A.	transcript	620		ML091410354
49-a-SR	Durett, D.	transcript	621	5 9	ML091410354
49-b-AQ/EJ	Durett, D.	transcript	622		ML091410354
49-c-LR/SR	Durett, D.	transcript	622	5 4 / 6 0	ML091410354
49-d-AQ/EJ/SR	Durett, D.	hand-in	625	5 9	ML091740490
49-e-AL/EJ	Durett, D.	hand-in	626		ML091740490
49-f-AQ/EJ	Durett, D.	hand-in	628		ML091740490
49-g-AL/AQ/EJ	Durett, D.	hand-in	630		ML091740490
49-h-AQ/EC	Durett, D.	hand-in	632		ML091740490
49-i-SR	Durett, D.	hand-in	633		ML091740490
50-a-LR	Edelstein, M.	transcript	634		ML091410355
50-b-DE/PA	Edelstein, M.	transcript	635		ML091410355

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50-c-PA	Edelstein, M.	transcript	636	ML091410355
50-d-EP/HH	Edelstein, M.	transcript	636	ML091410355
50-e-NE	Edelstein, M.	transcript	637	ML091410355
50-f-NE	Edelstein, M.	e-mail	639	ML090700188
50-g-GE/SF	Edelstein, M.	e-mail	639	ML090700188
50-h-DE/PA	Edelstein, M.	e-mail	639	ML090700188
50-i-EJ/LE	Edelstein, M.	e-mail	640	ML090700188
50-j-EJ/PA	Edelstein, M.	e-mail	640	ML090700188
50-k-PA	Edelstein, M.	e-mail	640	ML090700188
50-l-HH/PA	Edelstein, M.	e-mail	641	ML090700188
50-m-PA/ST	Edelstein, M.	e-mail	641	ML090700188
50-n-RW/SF	Edelstein, M.	e-mail	641	ML090700188
50-o-HH/LE/PA	Edelstein, M.	e-mail	641	ML090700188
50-p-DE/EP/NE	Edelstein, M.	e-mail	642	ML090700188
50-q-DE/EP	Edelstein, M.	e-mail	642	ML090700188
50-r-EP/PS	Edelstein, M.	e-mail	643	ML090700188
50-s-SO	Edelstein, M.	e-mail	643	ML090700188
50-t-EJ	Edelstein, M.	e-mail	643	ML090700188
50-u-GL/UF	Edelstein, M.	e-mail	644	ML090700188
51-a-HH/PA/UF	Evans, L.	transcript	645	ML091410355
51-b-AL	Evans, L.	transcript	645	ML091410355
51-c-AL	Evans, L.	transcript	645	ML091410355
52-a-SA	Falciano, P.	transcript	647	ML091410355
52-b-ST	Falciano, P.	transcript	647	ML091410355
52-c-AL/AQ/EC	Falciano, P.	transcript	648	ML091410355
52-d-AL	Falciano, P.	transcript	648	ML091410355
52-e-SR	Falciano, P.	transcript	649	ML091410355
53-a-SE/SR	Federspiel, J.	transcript	650	ML091410354
54-a-LE/OR/RW/SF	Feinberg, J.	e-mail	652	ML090720670
54-b-DE/ST	Feinberg, J.	e-mail	652	ML090720670
54-c-AE	Feinberg, J.	e-mail	652	ML090720670
54-d-OR	Feinberg, J.	e-mail	652	ML090720670
55-a-OS	Filippelli, J.	letter	653	ML090860878
55-b-AE/RG	Filippelli, J.	letter	654	ML090860878
55-c-RW	Filippelli, J.	letter	654	ML090860878
55-d-SM	Filippelli, J.	letter	654	ML090860878
55-e-PA	Filippelli, J.	letter	654	ML090860878
55-f-AE/PA/RW	Filippelli, J.	letter	655	ML090860878
56-a-AL/AQ/EC	Fitzpatrick, B.	e-mail	656	ML090700182
56-b-SO	Fitzpatrick, B.	e-mail	656	ML090700182
56-c-HH	Fitzpatrick, B.	e-mail	657	ML090700182
56-d-EP	Fitzpatrick, B.	e-mail	657	ML090700182

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56-e-SE	Fitzpatrick, B.	e-mail	657	ML090700182
56-f-AL/SA	Fitzpatrick, B.	e-mail	657	ML090700182
57-a-SA	Forehand, R.	transcript	658	ML091410355
57-b-AQ/EC/SO	Forehand, R.	transcript	658	ML091410355
57-c-SA/SE/SO	Forehand, R.	transcript	659	ML091410355
57-d-SL	Forehand, R.	letter	660	ML090700172
57-e-EC/OP/SO	Forehand, R.	letter	660	ML091680295
57-f-AL/AQ	Forehand, R.	letter	660	ML091680295
57-g-SR	Forehand, R.	letter	660	ML091680295
57-h-SE/SR	Forehand, R.	letter	660	ML091680295
58-a-SR	Form Letter	letter	661	ML091100591
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58-b-AL/AQ/EJ	Form Letter	letter	661	ML091100591
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