

IPRenewal NPEmails

From: Stuyvenberg, Andrew
Sent: Wednesday, September 28, 2011 3:10 PM
To: Gray, Dara F; Zoli, Elise N
Cc: IPRenewal NPEmails; Turk, Sherwin; Imboden, Andy
Subject: FW: NRC staff's review of Entergy's 9-21 response
Attachments: Indian Point Excerpts for NMFS.pdf

FYI . . . Please contact me if you have any questions regarding this e-mail or the attached excerpts.

Best,
Drew

From: Stuyvenberg, Andrew
Sent: Wednesday, September 28, 2011 8:25 AM
To: Mark.Murray-Brown@noaa.gov; 'Julie Crocker'; Julie Williams
Cc: Turk, Sherwin; Logan, Dennis; Imboden, Andy; Pelton, David; IPRenewal NPEmails
Subject: NRC staff's review of Entergy's 9-21 response

Julie –

Per your request, I have reviewed Elise Zoli's E-mail comments (submitted on behalf of Entergy) from September 21, 2011. It appears to me that they are accurate with regard to the NRC staff's conclusions in the Indian Point License Renewal Final SEIS. I've attached several excerpts from our Final SEIS (from December 2010) for your convenience and to assist you as you complete your review.

Radionuclides

Elise Zoli correctly quoted from the NRC staff's Final SEIS with regard to its discussion of environmental radionuclides. In the attached excerpt, you will find pages 2-107 to 2-111 of the Final SEIS, in which the staff reviewed the 2009 environmental radiological sampling results. The NRC staff's review identified no unusual trends or significant radiological impacts to the environment due to operation of the Indian Point facility. See Final SEIS at 2-107, 2-109, 2-110, and 2-111. As Ms. Zoli noted, the NRC staff reported an issue in the Final SEIS regarding the reliability of Strontium-90 sampling in fish tissues in 2009 (Final SEIS at 2-107); this issue was resolved in Entergy's 2010 Radiological Environmental Operating Report. (I've also excerpted and included pages 2-105 and 2-106 from the Final SEIS, wherein staff found that strontium-90 levels reported in 2006 REMP sampling were likely to due to atmospheric weapons testing.)

Also, I note that Riverkeeper had expressed concern about radionuclides in aquatic species in its comments on the NRC staff's Draft SEIS, and the NRC staff responded to those comments in the Final SEIS. Specifically, the NRC staff synopsisized and responded to these comments on pages A-79 through A-81 of the Final SEIS. I have excerpted and attached those pages to this e-mail for your convenience.

The NRC staff addressed groundwater contamination in the Final SEIS at pages 2-108, 2-110 to 2-112, 4-41, and 4-56. For your convenience, I have excerpted and attached those pages to this e-mail.

In addition, the staff responded to numerous comments about onsite groundwater contamination and its potential effects on human health and the Hudson River. The staff synopsisized and responded to these comments on pages A-60 through A-62 of the Final SEIS. For your convenience, those pages are excerpted and attached, as well.

Finally, in reporting New York State's views on the potential for radionuclides from groundwater to contaminate fish, the NRC staff relied on a 2007 Community Fact Sheet developed by NYSDEC and presented to the NRC during the SEIS scoping period. It is available in ADAMS at ML081000369 (I can convey a copy by e-mail if you desire). The NRC staff did not rely on the Skinner and Sinnott (NYSDEC, Nov. 2009) report that Ms. Zoli conveyed to you, although I note that the NYSDEC report's findings are consistent with the NRC staff's findings in the Final SEIS. As noted in the NYSDEC report, Skinner and Sinnott studied fish bones and blue crab carapaces, while sampling performed for the REMP addresses edible portions of aquatic organisms. Neither NYSDEC (Skinner and Sinnott) nor Entergy (REMP) identified unusual radionuclide levels due to operation of the Indian Point facility.

Indian Point Unit 1 Intake

Ms. Zoli's comments on the Indian Point Unit 1 intake system contain a greater depth of information than NRC staff had presented in the Final SEIS, and a greater depth of information than Entergy had presented in its Environmental Report for license renewal (ER; available in ADAMS at ML071210530). Without addressing the specific information provided by Ms. Zoli regarding the Unit 1 intake structure, I note that her assertion that total flow through the IP1 intake is quite small in comparison to the flow rate of other intakes at the Indian Point facility is consistent with the NRC staff's review of the matter.

For your convenience, I've excerpted and attached pages 3-4 and 3-5 of Entergy's license renewal ER, which is the description Entergy provided to the NRC in 2007.

General Matters, Reference Documents, Etc.

Please contact me if you need additional clarification or documentation regarding this matter. I will be happy to convey any documents cited in this response.

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Excerpts from the NRC Staff's Final SEIS

1 natural and other sources in the vicinity, as well as fallout from nuclear weapons tests. The
2 preoperational radiological data include both natural and manmade sources of environmental
3 radioactivity. These background environmental data permit the detection and assessment of
4 current levels of environmental activity attributable to plant operations.

5 The REMP at IP2 and IP3 directs Entergy to sample environmental media in the environs
6 around the site to analyze and measure the radioactivity levels that may be present. The REMP
7 designates sampling locations for the collection of environmental media for analysis. These
8 sampling locations are divided into indicator and control locations. Indicator locations are
9 established near the site, where the presence of radioactivity of plant origin is most likely to be
10 detected. Control locations are established farther away (and upwind/upstream, where
11 applicable) from the site, where the level would not generally be affected by plant discharges or
12 effluents. The use of indicator and control locations enables the identification of potential
13 sources of detected radioactivity as either background or from plant operations. The media
14 samples are representative of the radiation exposure pathways to the public from all plant
15 radioactive effluents. A total of 1342 analyses was performed in 2006. This amount is higher
16 than required because of the inclusion of additional sample locations and media.

17 The REMP is used to measure the direct radiation and the airborne and waterborne pathway
18 activity in the vicinity of the IP2 and IP3 site. Direct radiation pathways include radiation from
19 buildings and plant structures, airborne material that may be released from the plant, or from
20 cosmic radiation, fallout, and the naturally occurring radioactive materials in soil, air, and water.
21 Analysis of thermoluminescent dosimeters (TLDs), which measure direct radiation, indicated
22 that there were no increased radiation levels attributable to plant operations.

23 The airborne pathway includes measurements of air, precipitation, drinking water, and broadleaf
24 vegetation samples. The airborne pathway measurements indicated that there was no
25 increased radioactivity attributable to 2006 IP2 and IP3 station operation.

26 The waterborne pathway consists of Hudson River water, fish and invertebrates, aquatic
27 vegetation, bottom sediment, and shoreline sediment. Measurements of the media comprising
28 the waterborne pathway indicated that, while some very low levels of plant discharged
29 radioactivity were detected, there was no adverse radiological impact to the surrounding
30 environment attributed to IP2 and IP3 operations (Entergy 2007d).

31 2006 REMP Results

32 The following is a detailed discussion of the radionuclides detected by the 2006 REMP that may
33 be attributable to current plant operations (all information summarized from Entergy 2007d).

34 During 2006, cesium-137, strontium-90, and tritium were the only potentially plant-related
35 radionuclides detected in some environmental samples. Tritium may be present in the local
36 environment because of either natural occurrence, other manmade sources, or plant operations.
37 Small amounts of tritium were detected in one of four quarterly composite samples from the
38 discharge mixing zone (386 picocuries per liter (pCi/L) (14.28 becquerel per liter (Bq/L)). This
39 composite sample was detected at a value much lower than the required lower limit of detection
40 (LLD) of 3000 pCi/L (111 Bq/L).

41 In 2006, the detected radionuclide(s) attributable to past atmospheric weapons testing consisted
42 of cesium-137 and strontium-90 in some media. The levels detected for cesium-137 were
43 consistent with the historical levels of radionuclides resulting from weapons tests as measured

1 in previous years. Before 2006, strontium-90 analysis had not been conducted since 1984, so
2 comparison to recent historical levels is not possible. However, the low levels detected in the
3 environment are consistent with decayed quantities of activity from historic atmospheric
4 weapons testing. Strontium-90 was detected in four fish and invertebrate samples, three in the
5 control samples and one in the indicator samples. Since the levels detected were comparable
6 in the indicator and control location samples, atmospheric weapons testing is the likely cause.
7 Of 18 special water samples, 5 indicated strontium-90 at levels close to the level of detection, at
8 an average of 0.78 pCi/L (0.028 Bq/L). All of these detections are considered to be residual
9 levels from atmospheric weapons tests.

10 Iodine-131 is also produced in fission reactors but can result from nonplant-related manmade
11 sources (e.g., medical administrations). Iodine-131 was not detected in 2006. Cobalt-58 and
12 cobalt-60 are activation/corrosion products also related to plant operations. They are produced
13 by neutron activation in the reactor core. As cobalt-58 has a much shorter half-life, its absence
14 "dates" the presence of cobalt-60 as residual. When significant concentrations of cobalt-60 are
15 detected but no cobalt-58, there is an increased likelihood that the cobalt-60 results from
16 residual cobalt-60 from past operations. There was no cobalt-58 or cobalt-60 detected in the
17 2006 REMP, though cobalt-58 and cobalt-60 have been observed in previous years.

18 Data resulting from analysis of the special water samples for gamma emitters, tritium analysis,
19 and strontium-90 show that 18 samples were analyzed for strontium-90, and 5 of them showed
20 detectable amounts of strontium-90. All of the results were very low (with a range of 0.49–
21 1.26 pCi/L (0.018–0.046 Bq/L)) and within the range considered to be residual levels from
22 atmospheric weapons tests. Other than the above, only naturally occurring radionuclides were
23 detected in the special water samples.

24 The results of the gamma spectroscopy analyses of the monthly drinking water samples and
25 results of tritium analysis of quarterly composites showed that, other than naturally occurring
26 radionuclides, no radionuclides from plant operation were detected in drinking water samples.
27 The data indicate that operation of IP2 and IP3 had no detectable radiological effect on drinking
28 water.

29 The results of the analysis of bottom sediment samples for cesium-137 showed that it was
30 detected at 7 of 10 indicator station samples, and at 1 of 3 control station samples. Cesium-134
31 was not detected in any bottom sediment samples. The lack of cesium-134 suggests that the
32 primary source of the cesium-137 in bottom sediment is from historical plant releases at least
33 several years old and from residual weapons test fallout.

34 While not required by the ODCM, strontium-90 analysis was conducted at three indicator
35 locations and one control location in August 2006. Strontium-90 was not identified in any of the
36 samples. The detection of cesium-137 in bottom sediment has been generally decreasing over
37 the last 10 years, and cesium-134 has not been detected in bottom sediment since 2002. The
38 data for 2006 are consistent with but slightly lower than historical levels.

39 In summary, IP2- and IP3-related radionuclides were detected in 2006; however, residual
40 radioactivity from atmospheric weapons tests and naturally occurring radioactivity were the
41 predominant sources of radioactivity in the samples collected. The 2006 levels of radionuclides
42 in the environment surrounding IP2 and IP3 are well below the NRC's reporting levels as a
43 result of IP2 and IP3 operations. The radioactivity levels in the environment were within the
44 historical ranges (i.e., previous levels resulting from natural and manmade sources for the

detected radionuclides). Further, IP2 and IP3 operations did not result in an adverse impact to the public greater than environmental background levels. (Entergy 2007d)

2009 REMP Results

Because of the time period between the Staff's original review of the REMP data and the issuance of the final SEIS, the Staff extended the scope of its review to include the most current available data from the 2009 REMP report (all data from Entergy 2010b).

The following is a summary of the results of 2009 radiological environmental monitoring program contained in the applicant's annual REMP report.

Direct Radiation

The 2009 and previous years' data show that there is no measurable direct radiation in the environment due to the operation of the Indian Point site.

Airborne Particulates and Radioiodine

No airborne radioactivity attributable to the operation of Indian Point was detected in 2009.

Hudson River Water

No radionuclides other than those that are naturally occurring were detected in the Hudson River Water samples.

Drinking Water

The data indicates that operation of the Indian Point units had no detectable radiological impact on drinking water.

Hudson River Shoreline Soil

Cs-137 has been and continues to be present in this media, both at indicator and control locations, at a consistent level over the past ten years.

Broad Leaf Vegetation

The detection of low levels of Cs-137 has occurred sporadically at both indicator and control locations at relatively low concentrations for the past ten years and not at all in the last five years; however, Cs-137 was not detected in 2009.

Fish and Invertebrates

The fish and invertebrate sample analysis results showed there were no plant related gamma emitting radionuclides detected in 2009. However, the results for Sr-90 in fish and invertebrate samples were reported as not reliable and under review. When the results are available and certified, Entergy will submit them as an addendum to the REMP report. The NRC staff reviewed the 2008 results for Sr-90 in fish and invertebrates, in place of the 2009 results. As in 2009, no plant related gamma emitting radionuclides were detected in the samples. Sr-90 was found in two of six indicator samples (8.8 pCi/kg average) in the vicinity of the plant. Sr-90 was also found in two of six control samples (16.3 pCi/kg average) located approximately 20 miles upriver from the plant. The lower limit of detection (i.e., sensitivity of the analysis) was approximately 5 pCi/kg. The NRC's reporting level (i.e., the concentration value in an environmental sample, if exceeded, which must be reported to the NRC) for Sr-90 in fish samples is 40 pCi/kg.

Plant and the Environment

Aquatic Vegetation

Positive results for Cs-137 (17.3 +/- 4.1 pCi/kg) were reported for the sampling location at Lents Cove. However, the amount was at a level below the lower limit of detection of the measuring instrument. At his level even activity-free samples would, about 5% of the time, show a positive result due to normal background statistical fluctuations. In the historical record, a 17 pCi/kg result was reported for a 2005 aquatic vegetation sample. There are about five samples per year, varying from 3 to 10, going back to 2005. No I-131 was detected.

Hudson River Bottom Sediment

Cs-137 was detected at six of six indicator station samples and at one of two control station samples. This frequency of detection is not unusual. Cs-134 was not detected in any bottom sediment samples. The lack of Cs-134 suggests that the primary source of the Cs-137 in bottom sediment is from historical plant releases over the years and from residual weapons test fallout. Notably, the discharge canal bottom sediments were 232 pCi/kg and 1810 pCi/kg on samples taken three months apart. There is nothing in effluent release data and in monitoring well data that corresponds to this difference, yet the larger result is significantly different from other indicator and control locations from 2009 and the historical record. The average in 2009 is 493 pCi/kg. This is consistent with historical annual average concentration for indicator locations. Samples taken in 2010 will be examined for their corroborative value. The detection of Cs-137 in bottom sediment generally decreased from an average of 1200 pCi/kg in the early 1990s to 500 pCi/kg in the mid-1990s to a recent value of 250 pCi/kg over the last three years. Cs-134 has not been detected in bottom sediment since 2002.

Precipitation

Other than naturally occurring radionuclides, no radionuclides were detected in precipitation samples. A review of historical data over the last 10 years indicates tritium had been detected in both indicator and control precipitation samples in 1999; however, there have been no instances of positive values since that time.

Soil

Other than naturally occurring radionuclides, no plant-related activity was detected in any of the soil samples.

Groundwater

Tritium was detected at very low concentrations in seven of the 40 groundwater samples analyzed. The amount detected ranged from 193 to 329 pCi/L and averaged 244 pCi/L - which are well below the required LLD of 3000 pCi/L. Other than tritium, there were no potentially plant-related radionuclides detected in the groundwater samples.

Land Use Census

A census was performed in the vicinity of Indian Point in 2009. This census consisted of a milch animal and a residence census. The results of the 2009 census were generally same as the 2007 census results. The New York Agricultural Statistic Service showed there were no animals producing milk for human consumption found 4-8 within 5 miles (8 km) of the plant. Field observations also yielded no milching animal locations within five miles. The 2009 land use census indicated there were no new residences that were closer in proximity to IPEC.

1 *Conclusion*

2 The applicant concludes that the 2009 REMP results demonstrate the relative contributions of
3 different radionuclide sources, both natural and anthropogenic, to the environmental
4 concentrations. The results indicate that the fallout from previous atmospheric weapons testing
5 continues to contribute to detection of Cs-137 in some environmental samples. There are
6 infrequent detections of plant related radionuclides in the environs; however, the radiological
7 effects are very low and are significantly less than those from natural background and other
8 anthropogenic sources (Entergy 2010b).

9 The NRC staff reviewed the IP2 and IP3 annual radiological environmental operating reports for
10 2002 through 2006 and 2009 and looked for any significant impacts to the environment or any
11 unusual trends in the data. A multi-year period provides a representative data set that covers a
12 broad range of activities that occur at IP2 and IP3 such as, refueling outages, non-refueling
13 outage years, routine operation, and years where there may be significant maintenance
14 activities

15 Based on the NRC Staff's review of the applicant's historical and 2009 REMP data, no unusual
16 trends were observed, and the data showed that there was no significant radiological impact to
17 the environment from operations at the IP2 and IP3 site. Small amounts of radioactive material
18 (i.e., tritium, cesium-137, iodine-131, and strontium-90) were detected that are below NRC's
19 reporting values for radionuclides in environmental samples. Overall, the results were
20 comparable to historical REMP results.

21 New York State Department of Health Monitoring

22 The New York State Department of Health (NYSDOH) also performs sampling and analysis of
23 selected independent environmental media around IP2 and IP3. The NYSDOH environmental
24 radiation monitoring program collects various types of samples to measure the concentrations of
25 selected radionuclides in the environment. Samples of air, water, milk, sediment, vegetation,
26 animals, and fish are typically obtained. In addition, TLDs are used to measure environmental
27 gamma radiation levels in the immediate proximity of IP2 and IP3. The NRC staff reviewed the
28 published data for the years 1993 and 1994, the most current publicly available reports. The
29 data indicated that the radiation levels observed in the environment around IP2 and IP3 were
30 low, or consistent with background radiation, and some samples were below the detection
31 sensitivity for the analysis. No samples exceeded any of the New York State guidelines.

32 The following information was reported in the 1993 report (NYSDOH 1994):

- 33 • Radioactivity in air samples showed low levels of gross beta activity and levels of
34 iodine-131 were usually below detection levels.
- 35 • No milk sample was collected, as the remaining nearby dairy farm had closed.
- 36 • Radioactivity in water samples showed low levels of gross beta activity.
- 37 • Tritium levels were at typical background levels.
- 38 • The levels for other radioisotopes were low with most samples below minimum
39 detectable levels.

Plant and the Environment

- Direct environmental radiation shows that the TLD data are typical of the normal background level in this area.

The following information was reported in the 1994 report (NYSDOH 1995):

- Radioactivity in air samples showed low levels of gross beta activity, and levels of iodine-131 were below detection levels.
- No milk samples were collected in 1994, as the last dairy farm closed in 1992.
- Radioactivity in water samples showed low levels of gross beta activity.
- Tritium levels were at typical background levels.
- The levels for other radioisotopes were low with most samples below minimum detectable levels.
- Radioactivity in fish samples showed that naturally occurring potassium-40 is responsible for most of the activity. All other isotopes are below detectable levels.

Direct environmental radiation values for the TLD data are typical of the normal background level in this area.

Staff's review of groundwater contamination.

Groundwater Contamination and Monitoring

In August of 2005, Entergy discovered tritium contamination in groundwater outside the IP2 spent fuel pool (SFP). As a result, Entergy began an on-site and off-site groundwater monitoring program (in September of 2005) in addition to the routine REMP. Entergy used this monitoring program to characterize the on-site contamination, to quantify and determine its on-site and off-site radiological impact to the workers, public and surrounding environment, and to aid in identification and repair of any leaking systems, structures or components (Entergy 2006d).

In Section 5.1 of its ER, Entergy identified the release of radionuclides to groundwater as a potentially new issue based on NRC staff analysis in a previous license renewal proceeding. In its discussion of the issue, Entergy concluded that the radionuclide release does not affect the onsite workforce, and that Entergy anticipated the leakage would not affect other environmental resources, such as water use, land use, terrestrial or aquatic ecology, air quality, or socioeconomics. In addition, Entergy asserted that no NRC dose limits have been exceeded, and EPA drinking water limits are not applicable since no drinking water exposure pathway exists (Entergy 2007a).

Entergy has taken measures to control releases from the IP1 and IP2 SFPs using waste management equipment and processes. Additional monitoring actions have also been developed as part of the site's groundwater monitoring program, which supplements the existing REMP to monitor potential impacts of site operations throughout the license renewal term and to monitor potential impacts of site operations and waste and effluent management programs (Entergy 2007a).

In addition to Entergy's assertions in the IP2 and IP3 ER, Entergy provided the NRC additional information, by report dated January 11, 2008, that included the conclusions of a 2-year investigation of onsite leaks to groundwater that it had initiated following the 2005 discovery of

1 SFP leakage. Entergy stated that it had characterized and modeled the affected groundwater
2 regime, and that it had identified sources of leakage and determined the radiological impacts
3 resulting from this leakage. In the same letter, Entergy reported that it had begun a long-term
4 groundwater monitoring program and initiated a remediation program to address the site
5 groundwater conditions. Entergy also stated that it had performed radiological dose impact
6 assessments and that it will continue to perform them, and report results to the NRC in each
7 annual Radiological Effluent Release Report. Radiological Effluent Release Reports are
8 publically available through the NRC. Entergy's investigation indicates that the only noteworthy
9 dose pathway resulting from contaminated groundwater migration to the Hudson River is
10 through the consumption of fish and invertebrates from the river. According to Entergy, the
11 resultant calculated dose to a member of the public is below 1/100 of the federal limits (Entergy
12 2008c).

13 As part of the NRC's ongoing regulatory oversight program, the NRC staff performed an
14 extensive inspection of Entergy's actions to respond to the abnormal leakage as well as Entergy's
15 groundwater monitoring program. This inspection focused on assessing Entergy's groundwater
16 investigation to evaluate the extent of contamination, as well as the effectiveness of actions
17 taken or planned to effect mitigation and remediation of the condition. The NRC staff adopts the
18 findings and content of the inspection report, released by letter dated May 13, 2008, in this SEIS
19 (NRC 2008). The inspection findings include the following key points (NRC 2008):

20 (12) Currently, there is no drinking water exposure pathway to humans that is affected by the
21 contaminated groundwater conditions at the IP2 and IP3 site. Potable water sources in
22 the area of concern are not presently derived from groundwater sources or the Hudson
23 River, a fact confirmed by the New York State Department of Health. The principal
24 exposure pathway to humans is from the assumed consumption of aquatic foods (i.e.,
25 fish or invertebrates) taken from the Hudson River in the vicinity of Indian Point that has
26 the potential to be affected by radiological effluent releases. However, no radioactivity
27 distinguishable from background was detected during the most recent sampling and
28 analysis of fish and crabs taken from the affected portion of the Hudson River and
29 designated control locations.

30 (13) The annual calculated exposure to the maximum exposed hypothetical individual, based
31 on application of Regulatory Guide 1.109, "Calculation of Annual Doses to Man from
32 Routine Release of Reactor Effluents for the Purpose of Evaluation Compliance with 10
33 CFR Part 50, Appendix I," relative to the liquid effluent aquatic food exposure pathway is
34 currently, and expected to remain, less than 0.1 % of the NRC's "As Low As is
35 Reasonably Achievable (ALARA)" guidelines of Appendix I of Part 50 (3 mrem/yr (0.03
36 mSv/yr) total body and 10 mrem/yr (0.1 mSv/yr) maximum organ), which is considered to
37 be negligible with respect to public health and safety, and the environment.

38 Finally, by letter dated May 15, 2008, Entergy reaffirmed its January 11th letter and provided the
39 NRC a list of commitments for further actions to address groundwater contamination (Entergy
40 2008d). Entergy indicated that it would remove spent fuel from the IP1 SFP, process remaining
41 water and "bottoms" from the IP1 SFP, and incorporate aspects of the long-term groundwater
42 monitoring program in the site's ODCM and associated procedures. To date, NRC staff has
43 observed that Entergy has removed all spent fuel from the IP1 SFP and drained the pool, as
44 well as incorporated aspects of the monitoring program into the ODCM and associated
45 procedures. As of October, 2009, Entergy had drained and cleaned the IP1 SFP (NRC 2009).

Also, NRC findings since the 2008 inspection reports have been consistent with the 2008 inspection report.

New York State Groundwater Investigations

New York State performed its own groundwater investigation of the tritium leakage at Indian Point and reported its findings in a Community Fact Sheet (NYSDEC 2007d) as follows:

The New York State Department of Environmental Conservation (DEC) and the New York State Department of Health (DOH) have been participating in the ongoing groundwater investigation of radionuclide contamination in groundwater under the plant, and the release of that water to the Hudson River. The purpose of our involvement is to protect the interests of the citizens and the environment of the State of New York by helping to ensure that Entergy performs a timely, comprehensive characterization of site groundwater contamination, takes appropriate actions to identify and stop the sources of the leak, and undertakes any necessary remedial actions.

The key findings reported by New York State are listed below:

- There are no residential or municipal drinking water wells or surface reservoirs near the plant.
- There are no known impacts to any drinking water source.
- No contaminated groundwater is moving toward surrounding properties.
- Contaminated groundwater is moving into the Hudson River.
- Public exposure can occur from the groundwater entering the Hudson River through consumption of fish.
- NYSDOH has confirmed Entergy's calculated dose to humans from fish.
- Strontium-90 levels in fish near the site (18.8 pCi/kg (0.69 Bq/kg)) are no higher than in those fish collected from background locations across the State.
- Recent strontium-90 data in fish are limited. (The State plans to conduct additional sampling.)

Dose Impacts to the Public

The results of the IP2 and IP3 radiological releases into the environment are summarized in the IP2 and IP3 Annual Radioactive Effluent Release Reports. Limits for all radiological releases are specified in the IP2 and IP3 ODCMs and used to meet Federal radiation protection standards. In the draft SEIS, the NRC staff performed a review of historical radiological release data during the period 2002 through 2006 and the resultant dose calculations revealed that the calculated doses to maximally exposed individuals in the vicinity of IP2 and IP3 were a small fraction of the limits specified in the IP2 and IP3 ODCM to meet the dose design objectives in Appendix I to 10 CFR Part 50, as well as the dose limits in 10 CFR Part 20 and EPA's 40 CFR Part 190, as indicated in the following summary list. The NRC staff has reviewed data from 2009 and confirmed that calculated doses to maximally exposed individuals in the vicinity

Category 1 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, applicable to IP2 and IP3 in regard to radiological impacts of normal operations are listed in Table 4-7. Entergy stated in its ER that it was aware of one new issue associated with the renewal of the IP2 and IP3 operating licenses—potential ground water contamination and a new radioactive liquid effluent release pathway as a result of leakage from the plant. The NRC staff has discussed this issue and the various studies relating to it in Section 2.2.7 of this SEIS, and addresses the significance of this issue in Section 4.5. The NRC staff has not identified any new and significant information, beyond the new issue identified by the applicant in its ER, during its independent review of Entergy’s ER, the site audit, the scoping process, NRC inspection reports, or its evaluation of other available information.

As discussed in Sections 2.2.7 and 4.5 of this SEIS, the NRC staff concludes that the new issue is not significant, and thus does not challenge the finding in the GEIS. According to the GEIS, the impacts to human health during license renewal term are SMALL, and additional plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted.

Table 4-7. Category 1 Issues Applicable to Radiological Impacts of Normal Operations during the Renewal Term

ISSUE—10 CFR Part 51, Subpart A, Appendix B, Table B-1	GEIS Sections
HUMAN HEALTH	
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

The NRC staff has not identified any new and significant information, beyond the new issue identified by the applicant in its ER concerning potential ground water contamination and a new radioactive effluent release pathway for leakage from the plant, during its independent review of Entergy’s ER, the site audit, the scoping process, NRC inspection reports, or its evaluation of other available information. The NRC evaluated the detailed information provided by the applicant, State agencies, and NRC inspections on the new issue and concluded that the new issue is not significant and that the impacts to human health during the license renewal term are SMALL. Therefore, the NRC staff concludes that there would be no impact from radiation exposures to the public or to workers during the renewal term beyond those discussed in the GEIS.

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, “Standards for Protection against Radiation,” and are not considered to have a significant impact on plant workers, the public, or the environment. Furthermore, the NRC staff acknowledges that the commitments made by Entergy—and identified in Section 2.2.7 of this SEIS—for long-term monitoring and remediation will help to minimize the potential impacts from contaminated ground water and help maintain radiological impacts within NRC radiation safety standards.

- Radiation exposures to public (license renewal term). Based on information in the GEIS, the Commission found the following:

Radiation doses to the public will continue at current levels associated with

Environmental Impacts of Operation

The NRC staff presents a summary of results from the IP2 and IP3 REMP program in Section 2.2.7 of this SEIS. The results of the 2006 REMP (the most recent available) demonstrate that the routine operation at the IP2 and IP3 site has had no significant or measurable radiological impact on the environment. No elevated radiation levels were detected in the offsite environment as a result of plant operations and the storage of radioactive waste. The results of the REMP continue to demonstrate that the operation of IP2 and IP3 did not result in a significant measurable dose to a member of the general population or adversely impact the environment as a result of radiological effluents. The REMP continues to demonstrate that the dose to a member of the public from the operation of IP2 and IP3 remains significantly below the Federally required dose limits specified in 10 CFR Part 20 and 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations."

The NRC staff's review of recent REMP monitoring results shows that concentrations of contaminants in native leafy vegetation, soils and sediments, surface water, and fish in areas surrounding IP2 and IP3 have been quite low (at or near the threshold of detection) and seldom above background levels. Consequently, the NRC staff concludes that no disproportionately high and adverse human health impacts would be expected in special pathway receptor populations in the region as a result of subsistence consumption of fish and wildlife.

4.5 Ground Water Use and Quality

No Category 1 or Category 2 issues in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, are potentially applicable to IP2 and IP3 ground water use and quality during the renewal term. The applicant stated in its ER that IP2 and IP3 do not use any ground water, though onsite monitoring wells exist for the purpose of monitoring ground water conditions.

In the IP2 and IP3 ER, Entergy identified leakage from onsite spent fuel pools as potentially new and significant information (Entergy 2007a). 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).

4.6 Threatened or Endangered Species

Potential impacts to threatened or endangered species are listed as a Category 2 issue in 10 CFR Part 51, Subpart A, Appendix B, Table B-1. This issue is listed in Table 4-10.

A.2.3 Comments in Opposition to License Renewal for Indian Point Nuclear Generating Units 2 and 3

The following comments express opposition to license renewal:

6-a-EP/OR/OS; 9-b-OE/OR/SA; 11-a-OR; 11-f-AL/OR; 12-a-OR; 13-a-OR; 13-h-OR; 15-a-OR; 18-a-LE/OR; 18-d-OR; 21-a-AE/LI/OR/SF; 21-b-GI/OR; 22-a-HH/OR/OS/PA; 24-a-HH/OR/RI; 24-b-HH/OR; 25-a-OR; 27-a-OR; 27-f-OR; 35-d-OR; 35-e-OR/RE; 37-a-AE/OR; 41-a-OR; 44-a-OR; 44-d-OR; 50-f-NE/OR; 54-a-LE/OR/RW; 54-d-OR; 61-a-AE/AL/OR; 63-a-OR; 63-g-OR; 66-a-GI/OR; 69-a-HH/LE/OR/PA; 70-c-OR; 70-d-OR; 72-a-EP/LE/OR/RW; 75-a-OR; 76-a-AE/LE/OR; 76-b-OR/PA; 77-a-AE/OR; 80-a-EP/OR/RW/ST; 80-c-OR/OS; 81-d-OR; 82-a-OR; 86-a-OR; 86-e-OR; 91-a-OR; 91-e-OR/RW/ST; 96-p-OR; 98-a-EP/OR/PA; 98-d-OR/RE; 100-a-OR; 110-a-OP/OR; 121-a-DE/OR; 121-c-OR/PA; 135-a-LE/OR; 143-a-GI/OR/RW; 141-a-OR; 141-d-AL/OR; 142-a-LE/OR; 145-f-DE/OR; 147-d-OE/OR; 151-a-OR; 151-e-OR; 155-d-OR; 161-d-GI/OR; 161-i-AL/OR; 162-c-OE/OR; 162-f-OE/OR; 165-a-OR/PA; 167-b-OR/RW/SF; 170-a-OE/OR; 170-h-HH/OE/OR; 173-b-AL/OR; 174-j-OR; 175-a-OP/OR/PA; 182-a-LE/OR; 182-d-AL/EJ/OR; 176-a-OR; 176-f-OR; 179-h-OR/SA

Response: Portions of these comments that express general opposition to renewing the licenses for IP2 and IP3 provide no new and significant information and have not resulted in any changes to this SEIS. Portions of these comments that address particular technical issues are addressed in the respective technical sections of this appendix.

The following comments are opposed to nuclear energy:

38-a-ON; 70-a-ON; 84-c-ON

Response: The comments oppose license renewal of Indian Point and are general in nature. The comments provide no new and significant information; therefore, no changes were made to the SEIS in response to these comments.

A.2.4 Comments Concerning Surface-Water Quality, Hydrology, Groundwater, and Use Issues

The following comments indicate opposition to license renewal because of the continuing leaks of radioactive water into the groundwater and the Hudson River and the residual contamination of Cs-137 and Sr-90 into the Hudson River.

3-a-AE/LE/LR; 11-d-LE; 12-d-LE; 35-a-LE/OM; 37-b-LE/SF/ST; 41-c-AE/LE; 44-c-AE/LE; 47-b-LE/EP/SF; 61-b-LE/RW/ST; 63-d-LE; 69-a-HH/LE/OR/PA; 72-a-EP/LE/OR/RW; 74-a-LE; 75-b-EP/LE/OP/ST; 76-a-AE/LE/OR; 80-b-LE/RW/SF/ST; 91-d-LE; 106-a-AE/LE/RW/SF; 110-b-LE/WA; 121-b-AM/LE; 122-b-LE; 126-c-LE; 126-d-LE/RI

Response: The dSEIS, in chapters 2 and 4, addressed the impacts of the radioactive material leaks. The NRC staff concluded that the calculated maximum dose to a member of the public exposed to all sources of radioactive material from IPEC was below NRC and EPA radiation dose limits. Additional information on the impacts from the leaks is contained in the Human Health response section.

The following comment indicates that radioactive tritium released from IPEC is also found in nature and does not have a significant impact.

33-a-AE/GL/LE

Response: It is true that tritium is a naturally occurring radioactive form of hydrogen. It is produced in the atmosphere when cosmic rays collide with air molecules. As a result, tritium is found in very small or trace amounts in groundwater throughout the world. It is also a byproduct of the production of electricity by nuclear power plants.

The comment does not present any significant new information that would warrant a change to the final SEIS.

The following comment indicates that leaking radioactive material from IPEC, including Sr-90; are causing cancer and contaminating mother's milk.

39-b-LE; 73-b-EJ/LE; 96-d-HH/LE/RI

Response: The comments are addressed in the Human Health section.

The following comments indicate that the EIS does not adequately discuss the long term health impacts from the radionuclides leaking from the spent fuel pool into the groundwater and the Hudson River, including eating fish from the Hudson River.

73-c-EJ/HH/LE; 96-e-HH/LE/WA; 96-f-DC/LE/WA; 97-k-EJ/HH/LE; 98-c-HH/LE/RI

Response: The NRC staff performed a site specific evaluation of the leaks of radioactive material at IPEC. The evaluation is contained in Chapters 2 and 4 of the dSEIS. The comments are addressed in the Human Health section.

The following comments indicate that plant aging will cause an increase in the number of leaks.

71-c-LE/RW; 96-c-AM/LE/OM; 96-n-AM/LE

Response: The NRC staff reviewed the issue of radioactive effluent releases from normal routine pathways and of the abnormal leaks from the spent fuel pools. There is a thorough discussion of these issues in Chapters 2 and 4 of the dSEIS that address the impacts to human health from routine and abnormal radioactive releases.

As part of its review, the NRC staff reviewed five years of historical radioactive and radiological environmental monitoring data. Based on the data, the Staff concluded that the calculated doses to a member of the public from the normal and abnormal radioactive releases were within NRC's radiation dose standards. The environmental data showed some radionuclides associated with the operation of IPEC; however, residual radioactivity from atmospheric weapons tests and naturally occurring radioactivity were the predominant sources of radioactivity in the samples collected. The Staff concluded that IPEC operations did not result in an adverse impact to the public greater than environmental background levels.

The NRC staff also evaluated the impacts from the leaking radioactive material into the groundwater and into the Hudson River in Chapter 2. For the evaluation contained in the dSEIS, the NRC staff used information from an Inspection conducted by personnel from NRC's Region I office and NRC's Headquarters office. The NRC thoroughly inspected this issue at IPEC, starting with initial notification of the leaks in September 2005 and followed the issue until the inspection closed in May, 2008. The NRC Inspection Report (ADAMS Accession number ML081340425) made the following summary statement; "Our inspection determined that public health and safety has not been, nor is likely to be, adversely affected, and the dose consequences to the public that can be attributed to current on-site conditions associated with

groundwater contamination is negligible.” In the body of the Inspection Report there are two key conclusions relevant to the potential human health impacts from the leaks. They are presented in Chapter 2 of the SEIS:

The NRC has already fully considered and addressed the issue in the SEIS and the comments do not present any significant new information or arguments that would warrant a change to the final SEIS.

The comment indicates that Indian Point took corrective action to identify and mitigate the leaks of Sr-90 and tritium, including installation of monitoring wells and continued inspection of the spent fuel pool for indications of leakage.

120-o-LE

Response: The comment is noted. The comment does not present any significant new and significant information that would warrant a change to the final SEIS.

A.2.5 Comments Concerning Aquatic Ecology, Terrestrial Ecology, General Ecology, and Threatened and Endangered Species

The following comments indicate that data on impingement and entrainment were collected at IP2 and IP3 between 1981 and 1990 and thus may be too old to be reliable, especially because differences in the fish populations between the 1990s and the present are great. The comments also indicate that no impingement or entrainment monitoring has been conducted since the installation of Ristroph screens.

17-q-AE/NE/OE; 21-a-AE/UF/OR/SF; 79-l-AE; 96-k-AE/OE/TS; 96-l-AE/AL/RG; 140-c-AE; 140-f-AE; 140-tt-AE; 140-uu-TS

Response: The responsibility for requiring monitoring of entrainment, impingement, and thermal effects at IP2 and IP3 lies with New York State and not the NRC. In describing the available data and in its analysis, NRC staff described the age of the data from each of these in-plant monitoring programs and acknowledged the shortcomings of relying on such old data. The weight of evidence approach employed by the NRC included two primary lines of evidence: assessment of aquatic population trends in the Hudson River and an evaluation of strength of connection (i.e., relationship of the aquatic resources to power plant operations). NRC staff used population trend data available from 1974 or 1975, depending on the sampling program, through 2005 in its assessment. The staff also used impingement and entrainment data available from 1975 through 1990 to determine the strength of connection. Although entrainment and impingement monitoring was not conducted at IP2 and IP3 after 1990, NRC staff believes that sufficient information is available to determine the strength of connection between plant operations and aquatic resources in the Hudson River. These comments do not present the kind of new and significant information that would warrant a change in the final SEIS.

The following comment suggests a change in the description of the fish return system discharge in SEIS Chapter 2.

40-k-AE

Response: The text has been modified.

The following comment indicates that the NRC staff's assessment of a large impact on Hudson river bluefish is contrary to observations that very few adult bluefish are impinged, few if any bluefish eggs and larvae have ever been entrained, and survival of adult bluefish of the intake screens is likely very high.

40-c-AE; 40-hh-AE; 128-h-AE/AL

Response: Based on comments on the draft SEIS and new and revised information provided by Entergy, the NRC Staff developed an alternative approach to assessing strength-of-connection. Information of this alternative analysis is found in Appendix H, Section H.1.3, Combined Effects of Impingement and Entrainment, and in Chapter 4. The NRC staff revised the levels of impact for bluefish and other Hudson River species in the final SEIS based on the revised methodology.

The following comment indicates that NYSDEC believes that the impact level from continued operation of Indian Point's cooling water system should be large for striped bass, white perch, and Atlantic tomcod based on population trends, likelihood of impinging young-of-the-year, likelihood of reducing a food resource, and historical impingement and entrainment data collected at IP2 and IP3.

128-h-AE/AL

Response: NRC staff assesses environmental impact levels in relation to NRC's regulations, which may have different requirements than New York State's regulations. The aquatic resources impact assessment in the final SEIS uses the best available data and a weight of evidence approach that encompasses two lines of evidence, each made up of several measures. The NRC staff's assessment and conclusions do not supersede the State of New York's authority to implement and enforce standards under the Clean Water Act.

The following comment indicates that impacts to fish populations should cause the NRC staff to propose closed cycle cooling at Indian Point.

128-h-AE/AL

Response: New York State DEC is responsible for insuring that intake and discharge structures comply with requirements of the Clean Water Act. New York State has indicated that closed-cycle cooling would be preferable, but has not required that Indian Point convert to closed-cycle cooling.

The following comment indicates that New York State has been collecting and analyzing data for decades, and the NRC staff's recent analysis of aquatic impacts cannot supplant NYSDEC's analysis.

128-g-AE

Response: The NRC staff assesses environmental impacts in relation to NEPA and NRC's regulations, which may have different purposes and requirements than New York State's regulations. The NRC staff's analysis does not supplant NYSDEC's analysis.

The following comments assert that the SEIS does not assess the effects of radionuclides released from IP2 and IP3 in groundwater and food web accumulation on aquatic biota, including the shortnose sturgeon:

140-s-TS; 140-z-AE/CI

Response: As part of NRC's operating reactor oversight program, the NRC staff performed independent sampling and analysis of environmental media related to the leaks of radioactive water from the spent fuel pools 2008. The NRC conducted an independent analysis of groundwater, Hudson River water, and fish during its inspection of IPEC's actions in response to the leaks. The following two key findings related to human health are also presented in the Chapter 2 of the SEIS. The first specifically addresses radiation levels identified in fish sampling, and the second addresses human exposures through fish consumption.

1) "Currently, there is no drinking water exposure pathway to humans that is affected by the contaminated groundwater conditions at Indian Point Energy Center. Potable water sources in the area of concern are not presently derived from groundwater sources or the Hudson River, a fact confirmed by the New York State Department of Health. The principal exposure pathway to humans is from the assumed consumption of aquatic foods (i.e., fish or invertebrates) taken from the Hudson River in the vicinity of Indian Point, that has the potential to be affected by radiological effluent releases. Notwithstanding, no radioactivity distinguishable from background was detected during the most recent sampling and analysis of fish and crabs taken from the affected portion of the Hudson River and designated control locations."

2) "The annual calculated exposure to the maximum exposed hypothetical individual, based on application of Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Release of Reactor Effluents for the Purpose of Evaluation Compliance with 10 CFR Part 50, Appendix I," relative to the liquid effluent aquatic food exposure pathway is currently, and expected to remain, less than 0.1% of the NRC's "As Low As is Reasonably Achievable (ALARA)" guidelines of Appendix I of Part 50 (3 mrem/yr total body and 10 mrem/yr maximum organ), which is considered to be negligible with respect to public health and safety, and the environment."

The complete discussion of NRC actions and its inspection are contained in the NRC inspection report dated May 13, 2008. The full report is available to the public through the ADAMS electronic reading room on the NRC's website (www.NRC.gov). The ADAMS accession number for the inspection report is ML081340425.

In addition to the 2008 inspection report, IP2 and IP3 conduct a radiological environmental monitoring program (REMP) in which radiological impacts to the environment and the public are monitored, documented, and compared to NRC standards. Entergy summarizes the results of its REMP in an Annual Radiological Environmental Operating Report, and NRC reviews these reports. The reports are publicly available on the NRC's public website. The IP2 and IP3 REMP enables the identification and quantification of changes in the radioactivity of the area and to measure radionuclide concentrations in the environment attributable to operations at the IP2 and IP3 site.

The REMP samples environmental media in the environs around the site to analyze and measure the radioactivity levels that may be present. Within the REMP, the waterborne pathway consists of measurements of Hudson River surface water, fish and invertebrates, aquatic vegetation, bottom sediment, and shoreline soil.

While neither the 2008 inspection report process nor the REMP specifically sampled the shortnose sturgeon – an endangered and thus protected species – the inspection report

1 examined – and the REMP continues to examine – radionuclide levels in other fish and aquatic
2 species.

3 The comment does not present any significant new information and no change has been made
4 to the final SEIS.

5 The following comment indicates that the NRC staff did not include data or assess
6 impacts associated with operation of Indian Point Unit 1.

7 **140-q-TS**

8 **Response:** Indian Point Unit 1 (IP1) no longer operates and is in a condition known as
9 SAFSTOR. The subject of this SEIS is Entergy's application to renew the operating licenses of
10 IP2 and IP3 for an additional 20 years of operation beyond the term of the original licenses. IP1
11 operated from September 1962 through October 1974, and so affected the Hudson River
12 aquatic resources before the start of the long-term ecological sampling programs used to
13 assess environmental impacts in this SEIS.

14 The following comment indicates that some aspects of the methodology used by the
15 NRC staff for assessing impact to aquatic resources were unclear in the draft SEIS and
16 were clarified only during a conference call with NRC staff and consultants.

17 **40-ppppp-AE**

18 **Response:** In the draft SEIS, the NRC staff presented methods, sources of data, assumptions,
19 and conclusions in Appendices H and I, and summarized them in Chapter 4. Based on new
20 information provided by Entergy in its comments and the comments of others on the DSEIS, the
21 NRC Staff modified its approach for assessing the aquatic population trends and strength-of-
22 connection lines of evidence. The revised methods are shown in Chapter 4 and Appendices H
23 and I of this final SEIS.

24 The following comments indicate that two types of errors could occur in the
25 methodology used by NRC to classify aquatic impacts into small, moderate, and large:
26 identifying a potential impact when none actually exists and failure to identify a potential
27 impact when in fact it does exist. The DSEIS provides no discussion of these types of
28 errors or the relative degree of protection the classification process provides against
29 each type.

30 **40-qqqqq-AE; 40-ccccc-AE**

31 **Response:** Based on new information provided by Entergy in its comments and on the
32 comments of others on the draft SEIS, the NRC revised the Weight of Evidence approach in the
33 final SEIS and taken the decision rule process used in the draft out of the probabilistic-testing
34 scenario, which makes this question less relevant.

35 The following comment indicates that the US Fish and Wildlife Service is unable to
36 concur with the determination that continued operation of IP2 and IP3 are not likely to
37 adversely affect Indiana bats as NRC staff has not provided information on how the
38 project may indirectly affect Indiana bats and their forage area.

39 **139-a-TS**

Excerpt from the Indian Point Environmental Report

length. The bottoms of the intakes are 27 feet below MSL (see [Figure 3-6](#)). The equipment deck and ice curtain wall are as described for IP2. At IP3, modified Ristroph screens are installed at the pump bay entrances from the common plenum. [[CHGEC](#), Section IV.B.2.c.ii]

IP3 has six variable-speed circulating water pumps. Flow rates generated by these pumps range from 140,000 gpm when operated at full speed to 64,000 gpm when operated at the lowest speed (46% of full speed). When the pumps are operating at full flow, the intake water approach velocity is approximately one (1) fps; at reduced flow it is about 0.6 fps. [[CHGEC](#), Section IV.B.2.c.ii]

The circulating water intake bays at IP3 are outfitted with modified vertical (Ristroph-type) traveling water screens. Design features incorporated into the machines were developed and tested in concert with the Hudson River Fishermen's Association [[CHGEC](#), Section IV.B.2.c.i]. Key components of these screens are identical to those installed at IP2. A fish return system discharges at the northwest corner of the station's cooling water discharge canal (See [Figure 3-9](#) for IP2 fish return system which is similar). [[CHGEC](#), Section IV.B.2.c.ii]

3.2.2.2.3 IP2 and IP3 Circulating System Operations

In accordance with the terms of an October 1997 Consent Order, Entergy uses its best reasonable efforts to operate IP2 and IP3's dual/variable speed pumps so as to keep the volume of river water drawn into the plants at the minimum required for efficient operation, with due regard to ambient river water temperature, plant operating status, and the need to meet water quality standards or other permit conditions.

3.2.2.2.4 Service Water

The primary function of the service water system is to provide river water as a cooling medium to those systems or components requiring heat removal for proper functioning during normal plant operation and abnormal plant conditions, such as the maximum credible accident condition. The secondary functions of the service water system are (1) to protect certain equipment from potential contamination from river water by providing cooling to intermediate freshwater systems as required, (2) to provide water for washing the traveling screens, and (3) to provide seal water for the main circulating water pumps [[CHGEC](#), Section IV.B.2.d].

IP2 is fitted with six identical vertical, centrifugal sump type pumps, each having a capacity of at least 5,000 gpm at 220-ft total design head (TDH) [[IP2 UFSAR](#), Section 9.6.1.2]. IP3 has six similar pumps located at its intake structure, each rated at 6,000 gpm and 195-ft TDH. In addition, there are three back-up service water pumps located on a platform over the discharge canal at IP3. [[IP3 UFSAR](#), Section 9.6.1]

Additional service water to the non-essential service water header for IP2 and spray wash water for the Ristroph screens at IP2 is provided through the IP1 river water intake structure. The IP1 intake ([Figure 3-2](#)) is outfitted with coarse bar screens at each of the four intake bays, which are arranged in two sets of two bays each. These were designed to provide two channels for screening water drawn in by each of the two circulating water pumps. A single 0.125-in. mesh-

outfitted dual-flow screen is located within the service water portion of each of the two intake bay sets. These dual-flow screens filter water drawn in by the single 16,000-gpm river water pump and the two 1500-gpm spray wash pumps in each of the two intake bay sets. The screens are washed automatically when head differentials exceed predetermined settings. Materials removed from the mesh are sluiced to the Hudson River. During normal operation only one of the two river water pumps and two of the spray wash pumps are in operation at any given time. [CHGEC, Section IV.B.2.d]

In IP2 and IP3, the service water intake bays (one service water bay per unit) are centrally located within each of the intake structures. Six service water pumps (5000 gpm/pump at IP2, and 6,000 gpm/pump at IP3) draw water from each of these bays for the operation of heat exchange equipment, such as turbine lubricating oil coolers and systems required for the safe shutdown of each unit. Two 6-ft-wide modified Ristroph screens have been installed within the service water bays at IP2 and IP3, as shown in Figures 3-3 and 3-5. The calculated average approach velocity at the entrance to the service water bays is about 0.2 fps when all six service water pumps are operating. [CHGEC, Section IV.B.2.d]

3.2.2.3 Discharge Structures

The cooling water from the condensers at IP2 and IP3 flows downward from the discharge water boxes via six 96-inch down pipes and exits beneath the surface of the water in the discharge canal (Figure 3-7). The discharge velocity in the 40-ft-wide discharge canal is approximately 4.5 fps at full flow. The average transit time for cooling water traveling from the IP2 intake to the outfall structure (Outfall 001) is 9.7 minutes; from IP3 it is 5.6 minutes. [CHGEC, Section IV.B.2.e]

The outfall or discharge structure for the IP2 and IP3 facility is designed to enhance mixing of cooling water and river water in such a way as to minimize thermal impact in the river. It can accommodate the combined cooling water flow from both IP2 and IP3 (about 1.75 million gpm, including service water). The cooling water from the discharge channel is released to the Hudson River via an outfall structure located south of IP3. The outfall structure, depicted schematically in Figure 3-8, consists of 12 submerged rectangular ports equipped with adjustable gates that are in line and parallel to the river axis. The ports, 4 feet high by 15 feet wide and spaced 21 feet apart (center to center), are submerged to a depth of 12 feet (center to surface) at mlw. The first upstream port is approximately 600 ft from the IP3 intake; the length of the total port section is approximately 252 feet. The discharge port gates can be adjusted mechanically to maintain a minimum hydraulic head differential of 1.75 feet across the outfall structure, which assures a discharge velocity of approximately 10 fps. [CHGEC, Section IV.B.2.e]

3.2.3 **Radioactive Waste Treatment Processes (Gaseous, Liquid, and Solid)**

The site uses liquid, gaseous, and solid waste processing systems to collect and treat, as needed, radioactive materials that are produced as a by-product of plant operations. Radioactive materials in liquid and gaseous effluents are reduced to levels as low as reasonably achievable. Radionuclides removed from the liquid and gaseous effluents are converted to a solid waste form for eventual disposal with other solid radioactive wastes in a licensed disposal facility.