CHAPTER 6

ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

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ACRONYMS AND ABBREVIATIONS

Acronym	Definition
amsl	above mean sea level
bgs	below ground surface
BOD	biological oxygen demand
CDF	confined disposal facility
CFR	Code of Federal Regulations
COL	combined license
CWA	Clean Water Act
°C	degrees Celsius
°F	degrees Fahrenheit
DRBC	Delaware River Basin Commission
EEP	Estuary Enhancement Program
EPA	U.S. Environmental Protection Agency
ER	Environmental Report
ESP	early site permit
ft.	feet
HCGS	Hope Creek Generating Station
Hg	mercury
JFT	joint frequency table
m	meter
m/s	meters per second
Mgd	million gallons per day
mi.	mile
mph	miles per hour
NAD 83	1983 North American Datum
NAVD	North American Vertical Datum
NEI	Nuclear Energy Institute
NJAC	New Jersey Administrative Code

ACRONYMS AND ABBREVIATIONS (CONTINUED)

Acronym	Definition
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System
NOAA	National Oceanic and Atmospheric Administration
NRC	U.S. Nuclear Regulatory Commission
ODCM	Off-Site Dose Calculation Manual
REMP	Radiological Environmental Monitoring Program
RG	Regulatory Guide
RGPP	Radiological Groundwater Protection Program
SACTI	Seasonal/Annual Cooling Tower Impact
SGS	Salem Generating Station
SSAR	Site Safety Analysis Report
TLD	thermoluminescent dosimetry
TOC	total organic carbon
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
yr	year

CHAPTER 6

ENVIRONMENTAL MEASUREMENTS AND MONITORING PROGRAMS

6.0 INTRODUCTION

This chapter describes the environmental measurement and monitoring programs for the new plant. Programs now in place for the Hope Creek Generating Station (HCGS) and Salem Generating Station (SGS) will be modified to include new plant requirements where appropriate. Proposed monitoring programs for the new plant are based on an understanding of the local environmental setting as developed during the early site permit (ESP) application process, and known and anticipated permitting requirements. The discussion of environmental measurements and monitoring programs is divided into the following sections:

- Thermal Monitoring (Section 6.1)
- Radiological Environmental Monitoring (Section 6.2)
- Hydrological Monitoring (Section 6.3)
- Meteorological Monitoring (Section 6.4)
- Ecological Monitoring (Section 6.5)
- Chemical Monitoring (Section 6.6)
- Summary of Monitoring Programs (Section 6.7)

Monitoring details, including sampling equipment, constituents, parameters, frequency, and locations for each phase of the overall program are described in each of these sections.

6.1 THERMAL MONITORING

Thermal monitoring is conducted in accordance with New Jersey Department of Environmental Protection (NJDEP) regulations; specifically, the New Jersey Pollutant Discharge Elimination System (NJPDES) permit process.

Subsection 2.3.1 provides a characterization of the Delaware River thermal conditions in the vicinity of the PSEG Site. Pertinent information related to HCGS and SGS thermal discharge monitoring is presented in the context of NJPDES permitting requirements in Subsection 2.3.3. Subsections 5.2.3 and 5.3.2 describe the analysis of the new plant predicted thermal plume.

Thermal monitoring associated with the preapplication, construction/preoperational, and operational phases of the project are described below. Water temperature acceptance criteria are based on federal, state, and regional requirements.

6.1.1 PREAPPLICATION MONITORING PROGRAM

Each of the existing plants on the PSEG Site holds an NJPDES permit: Permit Number NJ0025411 for the HCGS (Reference 6.1-1); and Permit Number NJ0005622 for the SGS (Reference 6.1-2). For both plants, their respective permits require a monitoring program that consists of continuous thermal monitoring of intake water temperature and discharge temperatures to the Delaware River. No other thermal monitoring within the Delaware River is required.

Preapplication thermal monitoring was conducted in association with the water quality characterization program for this ESP application. This program, described in Subsection 2.3.3, includes quarterly sampling of marsh creeks, on-site water bodies, and the Delaware River.

As discussed in Subsection 2.3.1, extensive data collection related to the SGS thermal discharge was completed in 1998. This included extensive field measurements within the Delaware River to document and evaluate horizontal and vertical temperature variability as part of the plant's Section 316(a) demonstration. Routine or ongoing temperature monitoring is not required or performed for thermal characteristics within the Delaware River.

6.1.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

During the construction phase, thermal monitoring consists of the continuation of the routine intake and discharge temperature monitoring associated with the NJPDES permit requirements at HCGS and SGS. This monitoring is ongoing and serves as a baseline during the construction phase.

6.1.3 OPERATIONAL MONITORING

Modeling conducted for this application indicates that the new plant discharge affects a small percent of the water column in the immediate discharge vicinity, and the effects dissipate over a short distance (Subsection 5.2.3).

A NJPDES permit is required for the new plant and it is anticipated that monitoring requirements will be similar to those for HCGS and SGS. Specifically, continuous temperature monitoring at the cooling water intake structures and at the discharge to the Delaware River.

6.1.4 REFERENCES

6.1-1 New Jersey Department of Environmental Protection, Final Surface Water Renewal Permit Action, Hope Creek Generating Station, NJPDES Permit Number NJ0025411, December 31, 2002.

6.1-2 New Jersey Department of Environmental Protection, Final Surface Water Renewal Permit Action, Salem Generating Station, NJPDES Permit Number NJ0005622, June 29, 2001.

6.2 RADIOLOGICAL ENVIRONMENTAL MONITORING

The new plant radiological environmental monitoring program (REMP) will be incorporated, as appropriate, into the existing PSEG monitoring program that is common to HCGS and SGS. The REMP was established to monitor and determine the effects of small amounts of radioactive material releases to the environment associated with normal operation of a nuclear power generating station.

6.2.1 PREAPPLICATION MONITORING

6.2.1.1 Existing Radiological Environmental Monitoring Program Basis

The existing REMP is described in detail in the respective HCGS and SGS Off-Site Dose Calculation Manuals (ODCM) (References 6.2-2 and 6.2-3), the Annual Radiological Environmental Operating Report (Reference 6.2-4), and in the following subsections.

6.2.1.2 Existing Radiological Environmental Monitoring Program Contents

Preoperational environmental radiological data collected from 1973 to 1976 provided a baseline for the existing HCGS and SGS REMP. The measurement of radiation levels, concentrations (including surface area), and/or other quantities of radioactive material are used to evaluate potential exposures and doses to members of the public and the environment.

The following radiation exposure pathways are routinely monitored as part of the REMP for the HCGS and SGS:

- Direct (dosimeters)
- Airborne (iodine and particulates)
- Waterborne (surface and ground water, drinking water, and sediment)
- Ingestion (milk, vegetation, fish and invertebrates)

Sampling results and locations are evaluated to determine the effects from seasonal yields and variations from baseline data. Figures 6.2-1 and 6.2-2 identify the existing sampling locations for the HCGS and SGS REMP (Reference 6.2-2). Table 6.2-1 provides details of the radiation exposure pathways monitored and the monitoring frequencies for those pathways (References 6.2-2 and 6.2-3). Sensitivity analyses provide information regarding changes in background levels. They also determine the adequacy of analysis techniques in light of program results and changes in technology, when compared to baseline measurements. Changes in program implementation (including sampling techniques, frequencies and locations) may be incorporated in response to monitoring results.

In late 2002, a leak of spent fuel pool water from SGS Unit 1 to the shallow groundwater immediately adjacent to the plant was identified. The original leak was stopped in early 2003. The tritium activity released is present in the shallow groundwater. The spread of the contaminated groundwater was partially contained by a foundation cofferdam system that surrounds both SGS units. During original construction, the area within the cofferdam was excavated to the top of the competent layer and backfilled with lean concrete. Materials within the cofferdam are compacted fill, lean concrete, structural fill, or pipe bedding. In 2003 PSEG initiated a NJDEP approved remediation project to remove and monitor the residual tritium

activity. Periodic reporting is provided to NJDEP and the NRC, as well as routine reporting in the annual Radiological Effluent Monitoring Report. In addition to the remediation wells, PSEG installed a number of monitoring wells to provide early detection of any migration of tritium outside the cofferdam, in both the shallow groundwater, and the Vincentown Formation. In general the tritium is immediately adjacent to SGS Unit 1 and several thousand feet downgradient from the PSEG Site. Additionally, PSEG has installed monitoring wells as part of the Radioactive Groundwater Protection Program (RGPP) that provides early detection of any groundwater radionuclide contamination. The RGPP was initiated by PSEG in 2006 to determine whether groundwater at, and in the vicinity of, HCGS and SGS is adversely impacted by any radionuclide releases (including tritium) related to nuclear station operations. The RGPP is a voluntary program implemented by PSEG in conjunction with the nuclear industry initiatives and associated guidance in Nuclear Energy Institute (NEI) 07-07 (Reference 6.2-1). Although it is designed to be separate, the RGPP complements the existing REMP. The long-term groundwater sampling program is one of the key elements of the RGPP that provides for early leak detection. The other key elements that comprise the RGPP and contribute to public safety are spill/leak prevention and effective remediation.

6.2.1.3 Existing Radiological Environmental Monitoring Program Reporting

An Annual Radiological Environmental Operating Report is submitted to the NRC in accordance with the respective HCGS and SGS Technical Specifications and ODCM. The Annual Radiological Environmental Operating Report includes summaries, interpretations, and an analysis of the radiological environmental surveillance activities for the report period. These reports include a comparison with preoperational studies with operational controls (as appropriate), previous environmental surveillance reports, and an assessment of the observed impacts of the plant operation on the environment (Reference 6.2-4).

A land use census is conducted annually to ensure that changes at and beyond the site boundary are identified and that modifications to the radiological environmental monitoring program are made, if required. This census entails door-to-door surveys, aerial surveys, and consultation with local agricultural authorities. The best information from the census is used. This census satisfies the requirements of Section IV.B.3 of 10 CFR Part 50, Appendix I, *Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.* (References 6.2-2 and 6.2-3) Land use census results are included in the Annual Radiological Environmental Operating Report. The Annual Radiological Environmental Operating Report also includes the status of the RGPP.

6.2.1.4 Existing Quality Assurance Program

An Inter-Laboratory Comparison Program ensures that independent checks are performed on the precision and accuracy of the measurements of radioactive material in environmental sample matrices. This is part of the quality assurance program for environmental monitoring demonstrating that the results are reasonably valid for the purposes of 10 CFR Part 50, Appendix I, Section IV.B.2 (References 6.2-2 and 6.2-3). The results are included in the Annual Radiological Environmental Operating Report.

The REMP is conducted in accordance with the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide (RG) 4.15, *Quality Assurance for Radiological Monitoring Programs (Normal*

Operations)-Effluent Streams and the Environment, Revision 1 (1979). Quality assurance is provided in the existing NRC-approved REMP through quality training, program implementation by periodic tests, the Inter-laboratory Comparison Program, and administrative and technical procedures.

6.2.2 CONTRUCTION/PREOPERATIONAL MONITORING

6.2.2.1 Radiological Monitoring Program

The existing PSEG REMP serves as the new plant construction/preoperational radiological monitoring program. Additional on-site thermoluminescent dosimetry (TLD) monitoring locations will be added to the north of the HCGS to support the ODCM/REMP for the construction and preoperational period. A description of the new monitoring locations and other applicable parameters will be provided in the combined license (COL) application.

6.2.3 OPERATIONAL MONITORING

6.2.3.1 Radiological Monitoring Program

As described in Subsection 6.2.2, the existing PSEG REMP serves as the new plant operational radiological monitoring program. The operational program for the new plant will comply with RG 4.1, *Radiological Environmental Monitoring for Nuclear Power Plants*, Revision 2 (2009), and *Radiological Assessment Branch Technical Position Regarding Radiological Environmental Monitoring Programs* (1979). The ODCM for the new plant operational monitoring program will be consistent with the HCGS and SGS ODCMs and the requirements of 10 CFR 50 Appendix I. Additional on-site TLD monitoring locations will be added to the north of the HCGS to support the ODCM/REMP for the new plant as shown in Figure 6.2-3. A description of the new monitoring locations and other applicable parameters will be provided in the COL application. The quality assurance program for the new plant REMP will be in accordance with RG 4.15, *Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) - Effluent Streams and the Environment*, Revision 2 (2007).

6.2.4 REFERENCES

6.2-1 NEI 07-07, Industry Groundwater Protection Initiative-Final Guidance Document, Nuclear Energy Institute, Washington, DC, June 2007.

6.2-2 PSEG Nuclear LLC, 2008 Annual Radioactive Effluent Release Report for the Salem and Hope Creek Generating Stations, May 2009, and Appendix C, Salem Offsite Dose Calculation Manual, Rev 21.

6.2-3 PSEG Nuclear LLC, 2006 Annual Radioactive Effluent Release Report for the Salem and Hope Creek Generating Stations, April 2007, and Appendix D, Hope Creek Offsite Dose Calculation Manual, Rev 23.

6.2-4 PSEG Power LLC, 2008 Annual Radiological Environmental Operating Report for Salem Generating Station Unit 1, Salem Generating Station Unit 2, Hope Creek Generating Station, April 2009.

Table 6.2-1
Radiological Monitoring Program (Pathways) [(a)]

Radiation Exposure Pathway Monitored	Parameters	Frequency of Analysis
Direct	Gamma Dose	Quarterly
Airborne	Radioiodine	Weekly
	Particulates: Gross beta radioactivity	Weekly after filter change.
	Gamma isotopic analysis	Quarterly
Waterborne	Surface water: Gamma isotopic analysis	Monthly
	Surface water: Tritium	Quarterly
	Groundwater: Gamma isotopic analysis	Monthly
	Groundwater: Tritium	Quarterly
	Drinking water: Radioiodine	Biweekly or monthly, depending on calculated dose
	Drinking water: Gross beta radioactivity and gamma isotopic analysis	Monthly
	Drinking water: Tritium	Quarterly
	Sediment: Gamma isotopic analysis	Semiannually
Ingestion	Milk: Gamma isotopic analysis and radioiodine	Semi-monthly when animals are on pasture; monthly at other times.
	Fish and invertebrates: Gamma isotopic analysis	Sample in season or semiannually if not seasonal; perform analysis on edible portions.
	Food products: Gamma isotopic analysis	Sample at time of harvest; analysis on edible portions.

a) Radiological monitoring program for preapplication, construction/preoperation, and operation.

6.3 HYDROLOGICAL MONITORING

This section discusses the new plant program for monitoring the effects of the new plant on hydrology. This program monitoring includes flow rates, water levels, sediment loads, and groundwater levels.

As described in Section 2.3, extensive hydrologic monitoring information in the vicinity of the site is available from ongoing monitoring associated with the existing HCGS and SGS. Monitoring was also conducted by various agencies associated with general data collection for the Delaware River (U.S. Geological Survey [USGS] and National Oceanic and Atmospheric Administration [NOAA]) or program-specific needs (e.g., the U.S. Army Corps of Engineers' [USACE] proposed deepening of the Delaware River navigation channel). This section describes site-specific hydrologic monitoring information for preapplication, construction and preoperation, and operations. Specific equipment and monitoring locations will be determined subsequent to reactor technology selection and detail design. Implementation procedures, schedules, and processes will be in accordance with detail terms and conditions of applicable NJDEP and DRBC permits.

6.3.1 PREAPPLICATION MONITORING

6.3.1.1 Surface Water

PSEG currently conducts surface water and surface water discharge monitoring in accordance with Clean Water Act (CWA) requirements, including NJPDES permits for the HCGS and SGS. Additionally, other short-term surface water monitoring has been completed for those facilities under various permit conditions. The HCGS NJPDES Permit and SGS NJPDES Permit both require monitoring and recording of cooling water intake/discharge rates (References 6.3-1 and 6.3-2). The NJPDES monitoring locations are shown in Figure 6.3-1; those that include a hydrological monitoring requirement are described on Table 6.3-1.

Surface water monitoring was conducted as part of the field effort for the development of the ESP Environmental Report (ER), including periodic stage or level measurements at a number of locations along tidal creek segments. These measurement locations are shown on Figure 2.3-15 and described on Table 6.3-2.

6.3.1.2 Groundwater

PSEG measures groundwater elevations in the different water-bearing zones under separate monitoring programs including:

- Groundwater supply well monitoring program
- ESP application baseline studies
- Radiological groundwater monitoring protection program
- Tritium remediation monitoring program (SGS)

Data from the well monitoring for the groundwater supply program and that collected from wells installed in support of the ESP application are used for this evaluation. These

wells are evaluated to assess the local geology and hydrogeology as discussed further in Section 2.3.

6.3.1.2.1 Groundwater Supply Wells

There are six water production wells that are permitted to withdraw groundwater for HCGS and SGS and four additional observation wells that are monitored to evaluate potential aquifer impacts under Water Allocation Permit No. WAP040001 (Reference 6.3-4). These wells are shown on Figure 6.3-2, and a summary of the monitoring program is presented in Table 6.3-3. The information from this monitoring program will be used in the design of the additional groundwater production wells.

6.3.1.2.2 ESP Application Wells

As described in Section 2.3, 16 well pairs were installed at the PSEG Site to evaluate groundwater flow, quality, and local hydrogeology. The wells were paired in the shallow water-bearing strata (riverbed sand and gravel) and the Vincentown aquifer. Monthly groundwater level measurements were collected, and the data is used to support groundwater flow estimates and the modeling effort. Well locations are identified on Figure 6.3-2 and Table 6.3-4. In addition, 10 shallow piezometers are installed within surface water bodies. At each of these locations, the depth to groundwater was compared to the depth to surface water to evaluate the hydraulic communication between the shallow groundwater and the surface water bodies. Piezometers located on the PSEG Site were measured monthly, whereas piezometers located in nearby streams were measured quarterly.

6.3.1.2.3 Radiological Groundwater Protection Program and Tritium Remediation Monitoring Wells

The wells installed for the RGPP at HCGS and SGS and for tritium remediation monitoring at SGS are generally located in the shallow water-bearing strata or the Vincentown aquifer, consistent with the wells installed in conjunction with the ESP Application. For each program, depth to groundwater was measured from a surveyed point using a slope indicator, air line, or tape (or equivalent) water level meter.

6.3.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

6.3.2.1 Surface Water

Surface water discharges during construction includes storm water runoff and construction dewatering discharges. Hydrologic monitoring (turbidity) may be performed in conjunction with construction phase dredging activities for the new plant intake and barge facilities. Monitoring will be conducted in accordance with NJPDES and dredging permit requirements. Delaware River monitoring performed in accordance with HCGS and SGS permit requirements also provides information regarding hydrologic conditions of receiving water throughout the construction period.

6.3.2.2 Groundwater

Groundwater monitoring during construction includes test wells that measure water levels within the zone of influence created by dewatering activities and subsequent discharge or recharge areas. Monitoring includes wells screened within different water-bearing zones such as the hydraulic fill materials, the riverbed deposits, and the Kirkwood Formation-Vincentown Formation. Monitoring will be conducted in accordance with permit requirements and will include wells located at HCGS and SGS to monitor the extent of the dewatering influence and confirm no impact to the operating plants.

6.3.3 OPERATIONAL MONITORING

6.3.3.1 Surface Water

Surface water hydrologic monitoring during plant operation will be developed in coordination with the NJPDES permit requirements and the Delaware River Basin Commission (DRBC) docket requirements. It is anticipated that the monitoring requirements and program will be similar to the existing HCGS surface water hydrologic monitoring requirements and programs. The new plant has a closed-cycle cooling water system similar to the HCGS in terms of potential surface water hydrologic impacts.

The new plant is a new facility under the Phase I, New Facility requirements specified in 40 CFR 125.84 (Federal Register, 2001). Monitoring to demonstrate compliance with U.S. Environmental Protection Agency (EPA) requirements of 40 CFR 125.87 will be specified in the NJPDES permit. With regard to hydrology, the two elements of this proposed monitoring program are (1) velocity monitoring of the surface intake screen systems; and (2) visual/remote inspections of design and construction technologies. Results of these monitoring activities are used to support the interpretation of impingement and entrainment monitoring as described in Subsection 6.5.2.

6.3.3.2 Groundwater

NJDEP water allocation permit and DRBC docket requirements will provide ongoing monitoring requirements for the water supply wells.

6.3.4 REFERENCES

6.3-1 New Jersey Department of Environmental Protection, Final Surface Water Renewal Permit Action, Hope Creek Generating Station, NJPDES Permit Number NJ0025411, December 31, 2002.

6.3-2 New Jersey Department of Environmental Protection, Final Surface Water Renewal Permit Action, Salem Generating Station, NJPDES Permit Number NJ0005622, June 29, 2001.

6.3-3 New Jersey Department of Environmental Protection, NJPDES Surface Water Discharges in New Jersey, (1:12,000) Version 20090126, accessed January 7, 2010.

6.3-4 New Jersey Department of Environmental Protection, Water Allocation Permit – Minor Modification, Program Interest ID:2216P, Activity No WAP040001, December 30, 2004.

Table 6.3-1
Existing Surface Water Hydrological Monitoring Program

Monitoring Location	Units	Frequency	Type
Salem Generating Station			
048C (internal discharge to 481, 482, 484, and/or 485 on batch-type basis)	Mgd	Daily	Calculated
481A (cooling water)	Mgd	Daily	Calculated
482A (cooling water)	Mgd	Daily	Calculated
483A (cooling water)	Mgd	Daily	Calculated
484A (cooling water)	Mgd	Daily	Calculated
485A (cooling water)	Mgd	Daily	Calculated
486A (cooling water)	Mgd	Daily	Calculated
487B (#3 effluent skim tank)	Mgd	Discharge Event	Calculated
489A (south yard drain/Oil Water Separator)	Mgd	Monthly	Calculated
Hope Creek Generating Station			
462B (sewage treatment system effluent – internal; flows to 461A)	Mgd	Continuous	Metered
461C (Low Volume and Oily Waste System)	Mgd	Daily	Metered
461A (cooling tower blowdown)	Mgd	Continuous	Metered

Mgd = million gallons per day

References 6.3-1 and 6.3-2

Table 6.3-2
Surface Water Monitoring Locations in Support of the ESP Application

Sample ID	Location	Water Flow Measurements
AS-1 through AS-3	Proposed access road north of PSEG Site	Quarterly
AS-4 through AS-6, and AS-9	Surface Waters within the PSEG Site boundary	Monthly
AS-08	Delaware River near the new plant	Monthly
AS-10	Surface Waters along the East Site	Monthly
AS-11	Hope Creek, along current access road	Quarterly
AS-15	Within the confined disposal facility (CDF) Property	Quarterly

Table 6.3-3
Groundwater Monitoring Program to Support Water Allocation Permit

Well ID	Requirement	Frequency	Monitored Parameter	Monitoring Method
Well PW-2[a] (standby) Well PW-3[a] (standby) Well PW-5[a] Well HC-1[a] Well HC-2[a] Well PW-6[a] Well J[b] Well 6[b] Well I[b] Well G[b]	Static water levels for each well indicated shall be monitored and reported on forms provided by the NJDEP (New Jersey Administrative Code [NJAC] 7:19-2)	Monthly	Static Water Level	Airline, Tape, or Gage
Permit # WAP0400D1 Well PW-2 (standby) 3400000758, Well PW-3 (standby) 3400001031, Well PW-5 3400001073, Well HC-1 3400001074, Well HC-2 3400001512, Well PW-6	The monthly diversion shall be monitored and recorded on forms provided by the NJDEP (NJAC 7:19-2)	Monthly	Water Diverted	Meter
HCGS and SGS, 2216P Water Allocation Permit-All Diversion Sources	Total amount of water incorporated into product(s) during the calendar year shall be calculated at the end of each year. This value shall be recorded in the December block on the fourth Quarterly Report. [DRBC Resolution No. 2001-8]	Annually	Annual Total Water Incorporated in Product	Calculated
HCGS and SGS, 2216P Water Allocation Permit-All Diversion Sources	Total evaporative loss amount of all water diverted for the calendar year shall be calculated at the end of each year. This value shall be recorded in the December block on the fourth Quarterly Report. [DRBC Resolution No. 2001-8]	Annually	Annual Total Evaporative Loss	Calculated

Reference 6.3-4
a) Production wells
b) Observation wells

Table 6.3-4
Groundwater Monitoring Program to Support the ESP Application

Well Identification	Northing (U.S. ft., NAD 83)	Easting (U.S. ft., NAD 83)	Screen Interval (ft. bgs)	Reference Point Elevation (ft. NAVD 88)	Formation of Screen Installation	Monitoring Frequency
Wells						
NOW-1U	234542.7	198443.4	46-56	15.20	Alluvium	Monthly
NOW-1L	234564.0	198449.8	80-90	15.19	Vincentown	Monthly
NOW-2U	235207.4	197754.9	52-62	10.80	Alluvium	Monthly
NOW-2L	235227.7	197752.8	103-113	11.18	Vincentown	Monthly
NOW-3U	234552.8	197885.2	40-50	7.71	Alluvium	Monthly
NOW-3L	234565.5	197897.9	90-100	7.66	Vincentown	Monthly
NOW-4UB	233963.0	198147.1	42-52	13.56	Alluvium	Monthly
NOW-4L	233972.7	198147.9	73-83	14.08	Vincentown	Monthly
NOW-5U	234907.5	198444.5	20-30	10.23	Hydraulic Deposits	Monthly
NOW-5L	234927.5	198438.4	90-100	10.54	Vincentown	Monthly
NOW-6U	235269.4	198313.5	35-45	8.59	Alluvium	Monthly
NOW-6L	235287.9	198312.8	80-90	7.95	Vincentown	Monthly
NOW-7U	234975.8	199694.3	48-58	8.25	Alluvium	Monthly
NOW-7L	234973.4	199675.9	85-95	8.70	Vincentown	Monthly
NOW-8U	234141.6	199755.9	37-47	11.68	Alluvium	Monthly
NOW-8L	234139.1	199736.2	100-110	11.61	Vincentown	Monthly
EOW-1U	232321.6	202758.0	38-48	18.01	Alluvium	Monthly
EOW-1L	232297.6	202758.1	95-105	17.91	Vincentown	Monthly
EOW-2U	233274.6	202157.9	39-49	16.51	Alluvium	Monthly
EOW-2L	233271.5	202177.7	99-109	16.73	Vincentown	Monthly
EOW-4U	231791.9	202012.1	22-32	22.73	Hydraulic Deposits	Monthly
EOW-4L	231772.9	202021.2	110.2-120.2	22.31	Vincentown	Monthly
EOW-5U	233056.8	203007.3	35-45	15.85	Alluvium	Monthly
EOW-5L	233039.7	203021.5	110-120	16.17	Vincentown	Monthly
EOW-6U	232587.1	203281.4	47-57	15.99	Alluvium	Monthly
EOW-6L	232588.1	203300.7	90-100	15.23	Vincentown	Monthly
EOW-8U	231144.2	203520.4	30-40	18.38	Alluvium	Monthly
EOW-8L	231163.5	203516.0	67-77	17.89	Vincentown	Monthly
EOW-9U	230917.2	202826.0	50-60	20.67	Alluvium	Monthly
EOW-9L	230925.6	202844.6	117.5-127.5	18.21	Vincentown	Monthly
EOW-10U	231687.2	203521.3	17-27	14.79	Alluvium	Monthly
EOW-10L	231706.7	203521.9	85-95	14.27	Vincentown	Monthly
Piezometers						
AS-01	251116.5	207546.8	N/A	3.67	N/A	Quarterly
AS-02	243284.6	205316.6	N/A	4.17	N/A	Quarterly
AS-03	239115.6	204823.3	N/A	2.50	N/A	Quarterly
AS-04	234890.4	199526.2	N/A	6.27	N/A	Monthly
AS-05	234871.1	200189.1	N/A	6.51	N/A	Monthly
AS-06	234559.8	201798.2	N/A	4.15	N/A	Monthly
AS-08	233915.5	197783.4	N/A	4.78	N/A	Monthly
AS-09	234162.4	199619.5	N/A	8.12	N/A	Monthly
AS-10	231426.1	204401.6	N/A	6.22	N/A	Monthly
AS-11	229374.8	211156.9	N/A	3.91	N/A	Quarterly

ft. bgs = feet below ground surface, determined from well installation records.
NAD 83 = 1983 North American Datum, NAVD = North American Vertical Datum 88.

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6.4 METEOROLOGICAL MONITORING

Meteorological monitoring associated with the preapplication, construction/preoperational, and operational phases of the project are discussed in the following subsections.

6.4.1 PREAPPLICATION MONITORING

The new plant preapplication meteorological monitoring program is the existing HCGS and SGS on-site monitoring program, which is described below.

6.4.1.1 General Program Description

The HCGS and SGS meteorological monitoring program conforms to the requirements of RG 1.23 Revision 0. PSEG maintains an existing on-site primary meteorological tower. It is a 300-foot (ft.) structure supported by guy wires. Its geographic coordinates are 39° 27' 48.9" north latitude, 75° 31' 11.76" west longitude. The primary tower location is 5470 ft. southeast of the new plant power block area. The base of the primary tower is at 11.3 ft. NAVD. As discussed in Site Safety Analysis Report (SSAR) Subsection 2.3.3.2, a portion of the site, including the new plant power block area will be raised 25 ft., to 36.9 ft. NAVD. That raised ground elevation does not affect the applicability of the meteorological tower measurements for this ER, or affect the suitability of future tower measurements for use during new plant operation. This is due to the distance from the new plant and lack of any substantial grade changes across the PSEG Site.

Terrain maps of topographic features within a 5-mile (mi.) radius of the PSEG Site and terrain elevation profiles along each of the 16 standard 22.5-degree compass radials out to a distance of 50 mi. from the new plant are shown in SSAR Figures 2.3.2-41 through 2.3.2-49. Those maps and profiles show that site region topographic relief is minimal. The major local feature is the Delaware River, which is 2.5 mi. wide and oriented north-south adjacent to and west of the PSEG Site. Regional ground surface character is mixed marsh, cropland, and woodland. The maximum terrain elevation within 5 mi. of the PSEG Site is less than 60 ft. above grade, in the west direction. The nearest topographic elevations greater than 500 ft. above grade are at a distance of 15 mi. in the northwest direction. Local topography is not a factor in meteorological instrumentation siting or exposure because it does not have significant effects on local airflow.

The primary tower is of lattice construction, which minimizes its effects on airflow. Primary tower instrumentation is mounted on booms oriented into the prevailing wind, which is from the northwest. The sensors are mounted on the booms at distances equal to more than twice the tower maximum horizontal width. The primary tower has been in operation for more than 30 years (yr) and has been a reliable source of data for on-site meteorological conditions during that period to support plant operations and reporting for the existing HCGS and SGS.

PSEG maintains a backup meteorological tower, consisting of a 10-meter (m) (33-ft.) utility pole. It is located 386 ft. south of the primary tower. The primary tower serves as the main source of site meteorological data. The backup tower is used for periods of equipment failure on the primary tower. Backup tower measurements include wind speed, wind direction, and sigma-theta determinations at the 10-m (33-ft.) elevation only. The existing primary and backup on-site meteorological systems include instrumentation as described in Table 6.4-1.

To meet RG 1.23 Revision 1, enhancements were made to the primary meteorological tower instrumentation during June 2008. Relative humidity sensors were added at the 300-ft. and 33-ft. levels. A dry bulb temperature sensor was added at the 300-ft. level. Wind direction, wind speed, sigma theta, and 197-33 ft. delta-temperature sensors were added at the 197 ft. level. Vertical temperature difference resolution was also upgraded to 0.01 degrees Celsius (°C). Those enhancements improved on a system that was already providing high quality data.

6.4.1.2 Location, Elevation, and Exposure of Instruments

As described above, the primary tower location is 5470 ft. southeast of the new plant power block area. The backup tower, as described above, is located 386 ft. south of the primary tower.

Whenever possible, wind measurements should be made at a distance of at least ten times the height of any nearby obstruction that exceeds one-half the height of the wind measurement. The tallest site structures are the existing HCGS and SGS containments and HCGS cooling tower, and the new plant containments and cooling towers. The existing HCGS and SGS containments are located at least 4500 ft. west of the meteorological towers and the tallest (HCGS) is 203 ft. high. This distance and height yield a distance/height ratio of 22.2:1, which meets the 10:1 distance/height ratio criterion. The existing HCGS cooling tower is located 4700 ft. northwest of the meteorological towers and is 512 ft. high. This distance and height yield a distance/height ratio of 9.2:1. Although this is less than the 10:1 distance/height ratio criterion, the 10:1 distance/height ratio criterion is based on rectangular structures. A tall and aerodynamically smooth structure such as the existing HCGS cooling tower produces a downwind wake influence smaller than predicted by the 10:1 ratio. In addition, the terrain at the PSEG Site is generally flat with little relief. Therefore, the HCGS cooling tower does not have an adverse aerodynamic effect on tower wind measurements.

The containments for the new plant are located 5470 ft. northwest of the meteorological towers (measuring from the nearest point at the southeast corner of the new plant power block area). The new plant cooling towers are located 6800 ft. northwest of the meteorological towers (measuring from the nearest point at the southeast corner of the new plant cooling tower area). As shown in SSAR Table 1.3-1, the bounding plant parameter envelope values for the new plant containment heights and cooling tower heights are 234 ft. and 590 ft., respectively. These values yield distance/height ratios of 23.3:1 for the containments and 11.5:1 for the cooling towers. Both of these ratios meet the 10:1 distance/height ratio criterion in RG 1.23.

Generally, the local topography is quite flat. There are no significant groups of trees in the vicinity. Therefore, topographic features and trees do not affect meteorological tower wind measurements.

The maximum height of influence of a structure wake generally does not exceed 2.5 times the structure height for a squat building (width greater than height), such as the meteorological building at the base of the primary meteorological tower. The meteorological building is 12 ft. high. Based on the building height, the upper limit of the meteorological building aerodynamic wake does not exceed a height of 30 feet. The building aerodynamic wake height is below the lowest wind instrument (33 ft.) on the primary tower. Therefore, the meteorological building aerodynamic wake does not affect meteorological tower wind measurements. Additionally, the 10:1 distance/height ratio criterion does not apply to the meteorological building because its height (12 ft.) does not exceed one-half the height of the lowest wind measurement (33 ft.).

In summary, the topography, including raising the grade for a portion of the site, and existing and new plant structures in the vicinity of the on-site meteorological towers do not adversely affect meteorological measurements. Similarly, vegetation and minor structures in the vicinity of the meteorological towers, such as the meteorological building, do not adversely affect meteorological measurements.

In addition to the on-site meteorological data, NOAA regional meteorological datasets for the January 1, 2006, through December 31, 2008, period of record were used to supplement evaluations of atmospheric dispersion. The following datasets were used: Wilmington, Delaware (DE), hourly surface observations; and Sterling, Virginia (VA) Dulles Airport upper-air soundings and twice-daily mixing heights. The representativeness of Wilmington surface data is described in SSAR Subsection 2.3.1.5.6. Upper-air and mixing height data from Sterling VA Dulles Airport are appropriate because that station is the closest representative upper-air station, as described in Subsection 5.3.3.1.2.

6.4.1.3 Instrumentation Maintenance

Meteorological instrumentation is inspected and serviced regularly. Channel checks are made daily via data downloads and data reviews for inoperable sensors. Sensor and system repairs are made as needed. Site maintenance visits are made weekly. Indicator checks are made once per month. Surveillance and data and system backups are done at six month intervals. Channel calibrations are conducted semiannually. System calibrations encompass entire data channels, including recorders and displays. Calibration of instruments checks from the sensors to the computer displays in the meteorological building. Guyed towers are inspected annually and anchors are inspected every 3 yr.

6.4.1.4 Data Collection and Analysis

The on-site meteorological monitoring system includes display, processing, and communication components. A meteorological building at the base of the primary meteorological tower houses the equipment for processing, recording, display, and transmission of data measured at the primary and backup towers.

Measurements are digitally sampled once per second. Measurements are compiled as 15-minute averages for real-time display at the tower base meteorological building, HCGS and SGS Control Rooms and Technical Support Centers via fiber optic cable or modem. Fifteen minute averages are compiled as hourly values for historical and dispersion analyses. Precipitation values are hourly totals. Daily, meteorological data are downloaded, and reviewed via software and manual checks for reasonableness. Data are reviewed and validated for archive.

Archived on-site meteorological data collected by the monitoring system during the three year period from January 1, 2006 through December 31, 2008 were used to describe local meteorology in Section 2.7 and to evaluate atmospheric dispersion in other sections. Table 6.4-2 presents year-by-year values of percent data recovery for the measured meteorological parameters during those three years. Composite recovery values for joint frequency tables (JFTs) (of 33-ft. wind direction and 33-ft. wind speed, versus Pasquill stability class based on 150-33 ft. delta-T) of 95 percent or greater were achieved during each of the three years. The

only instrument with annual data recovery values less than the 90 percent target was the 33-ft. dew point temperature sensor during 2006 and 2008.

The 33-ft. dew point temperature sensor failed on October 19, 2008, which caused a 90 percent data recovery goal to not be met for the dew point parameter during the year 2008. However, that dew point sensor failure occurred after the June 2008 equipment upgrade which included installation of a 33-ft. relative humidity sensor. Because regulatory guidance requires atmospheric moisture measurement (for example, dew point or relative humidity), the 90 percent data recovery goal was effectively met during that year. The 33-ft. dew point sensor was subsequently replaced during 2009.

Atmospheric moisture measurements are used for predictions of cooling tower atmospheric impacts. Those predictions, described in Subsections 5.3.3.1 and 5.3.3.2, used the Seasonal/Annual Cooling Tower Impact (SACTI) computer code with the available valid dew point temperature measurements.

6.4.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

Because the new plant is colocated with the HCGS and SGS, the construction and preoperational meteorological monitoring program is the existing HCGS and SGS program described above in Subsection 6.4.1.

6.4.3 OPERATIONAL MONITORING

Because the new plant is colocated with the HCGS and SGS, the operational meteorological monitoring program is the existing HCGS and SGS program described above in Subsection 6.4.1.

6.4.4 AIR QUALITY AND EMISSIONS MONITORING

A NJDEP Air Operating Permit, under Title V of the Clean Air Act will be obtained for the new plant. This permit addresses compliance with state and federal air pollution regulations. Requirements for monitoring air emissions and air quality are included in the Title V Operating Permit in accordance with the NJDEP regulations and permitting policies in effect at the time of permitting. These may include periodic stack tests for combustion sources and other monitoring such as fuel use measurements. The specific terms and conditions of any permitting will follow reactor technology selection and detail design, because the specification of auxiliary boilers and other combustion equipment is necessary to define the appropriate limitations. Based upon modeling and prior studies as discussed in Subsection 5.3.3.2, deposition monitoring for cooling tower particulate emissions is not anticipated.

Table 6.4-1 (Sheet 1 of 3)
Meteorological Instrumentation Descriptions and Accuracies for the On-Site Meteorological Monitoring System[a, b]

Measured Parameter	Primary Tower 300 ft. Wind Direction	Primary Tower 300 ft. Wind Speed	Primary Tower 300 ft. Sigma Theta	Primary Tower 300-33 ft. Delta-T	Primary Tower 150 ft. Wind Direction	Primary Tower 150 ft. Wind Speed	Primary Tower 150 ft. Sigma Theta	Primary Tower 150-33 ft. Delta-T
Manufacturer	Met One	Met One	Met One	Met One	Met One	Met One	Met One	Met One
Model	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 062MP (matched pair)	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 062MP (matched pair)
Units	degrees azimuth	mph	degrees azimuth	°C per 267 ft.	degrees azimuth	mph	degrees	°C per 117 ft.
Precision	to nearest degree	to 0.1 mph	to nearest degree (to 0.1 degree)	to 0.1°C (to 0.01°C)	to nearest degree	to 0.1 mph	to nearest degree (to 0.1 degree)	to 0.1°C (to 0.01°C)
Range	0 to 360	0.0 to 111.8 mph		-5.0 to 10.0°C	0 to 360	0.0 to 111.8 mph		-5.0 to 10.0°C
System Accuracy	+/- 5 degrees	+/- 0.45 mph or 5 percent of observed speed		+/- 0.1°C	+/- 5 degrees	+/- 0.45 mph or 5 percent of observed speed		+/- 0.1°C
Starting Threshold	0.1 m/s (0.22 mph)	0.1 m/s (0.22 mph)			0.1 m/s (0.22 mph)	0.1 m/s (0.22 mph)		

Table 6.4-1 (Sheet 2 of 3)
Meteorological Instrumentation Descriptions and Accuracies for the On-Site Meteorological Monitoring System[a, b]

Measured Parameter	Primary Tower 33 ft. Wind Direction	Primary Tower 33 ft. Wind Speed	Primary Tower 33 ft. Sigma Theta	Primary Tower 33 ft. Temperature	Primary Tower 33 ft. Dew Point	Primary Tower Ground Barometric Pressure	Primary Tower Ground Precipitation	Primary Tower Ground Solar Radiation
Manufacturer	Met One	Met One	Met One	Met One	Edge Tech	Met One	Met One	Met One
Model	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 060A-2	200M Chilled Mirror Sensor	Model 090D	Model 375 Tipping Rain/Snow Gauge	Model 95
Units	degrees azimuth	mph	degrees	°F	˚F or ˚C	inches Hg	inches	Langleys per minute
Precision	to nearest degree	to 0.1 mph	to nearest degree (to 0.1 deg)	to 0.1°F	to 0.1°F or °C	to 0.01 inch	to 0.01 inch	to 0.01 Langley
Range	0 to 360	0.0 to 111.8 mph		-50.0 to 50.0°C	-75.0 to 60.0°C	26 to 32 inches Hg	0.00 to 1.00 inch/hour	0.00 to 2.00 Langleys
System Accuracy	+/- 5 degrees	+/- 0.45 mph or 5 percent of observed speed		+/- 0.5°C	+/- 1.5°C		+/- 10 percent of volume or 0.1 inches precipitation for rates < 2 inches per hour	
Starting Threshold	0.1 m/s (0.22 mph)	0.1 m/s (0.22 mph)						

Table 6.4-1 (Sheet 3 of 3)
Meteorological Instrumentation Descriptions and Accuracies for the On-Site Meteorological Monitoring System[a, b]

Measured Parameter	Backup Tower 33 ft. Wind Direction	Backup Tower 33 ft. Wind Speed	Backup Tower 33 ft. Sigma Theta	Time (recorded by data logger and work stations)
Manufacturer	Met One	Met One	Met One	Met One
Model	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 50.5H Sonic Wind Sensor	Model 0455A
Units	degrees azimuth	mph	degrees	
Precision	to nearest degree	to 0.1 mph	to nearest degree (to 0.1 degree)	1 min.
Range	0 to 360	0.0 to 111.8 mph		
System Accuracy	+/- 5 degrees	+/- 0.45 mph or 5 percent of observed speed		+/- 5 min.
Starting Threshold	0.1 m/s (0.22 mph)	0.1 m/s (0.22 mph)		

a) Upgrades implemented as of July 1, 2008 to meet RG 1.23 Revision 1 include the following:

- Relative humidity sensors (0.1% precision) added at the 300-ft. and 33-ft. levels.
- Dry bulb temperature sensor added at the 300-ft. level.
- Wind direction, wind speed, sigma theta, and 197-33-ft. delta-temperature (0.01 ºC precision) sensors added at the 197-ft. level.
- All vertical temperature difference resolutions upgraded to 0.01 ˚C.

b) Precisions and accuracies in parentheses are values for upgraded equipment, if different.

Hg = mercury
mph = miles per hour
m/s = meters per second

Table 6.4-2
Annual Data Recovery Statistics for the On-Site Meteorological Monitoring System

		Year		
Tower	**Parameter**	**2006**	**2007**	**2008**
Primary	300-ft. Wind Direction	99.1	97.8	94.11
Primary	300-ft. Wind Speed	99.1	97.8	94.11
Primary	300-33-ft. Delta-T	99.9	98.7	99.23
Primary	150-ft. Wind Direction	97.8	99.9	98.44
Primary	150-ft. Wind Speed	97.8	99.9	98.44
Primary	150-33-ft. Delta-T	99.9	97.8	99.11
Primary	33-ft. Wind Direction	99.5	98.1	98.7
Primary	33-ft. Wind Speed	99.5	98.1	98.7
Primary	33-ft. Temperature	99.9	99.6	99.74
Primary	33-ft. Dew Point Temperature	83.9	99.6	79.19
Primary	Ground Barometric Pressure	100.0	99.98	99.86
Primary	Ground Precipitation	91.7	97.4	99.35
Primary	Ground Solar Radiation	100.0	99.98	99.84
Backup	33-ft. Wind Direction	97.3	98.0	98.5
Backup	33-ft. Wind Speed	97.3	98.0	98.5
Not applicable	JFT (150-33-ft. frequency using delta-T based stability class, and 33-ft. wind direction and speed on primary tower)	99.44	95.98	97.93

6.5 ECOLOGICAL MONITORING

This section addresses ecological monitoring for terrestrial ecology, land cover, and aquatic ecology of the areas likely to be affected by new plant site preparation, construction, and operation. The ecological monitoring programs are based on the anticipated environmental impacts due to the new plant implementation and expectations of permitting requirements.

The ongoing ecological monitoring programs are designed to establish baseline conditions, facilitate impact assessment, and detect changes, if present, in the site ecology during new plant site preparation, construction, and operation. In addition, these monitoring programs help guide the development of future permit conditions, mitigation measures, and effectiveness or success of such measures.

6.5.1 PREAPPLICATION MONITORING

6.5.1.1 Terrestrial Ecology and Land Use

Subsequent subsections describe the ecological monitoring for terrestrial ecology during site preparation, construction, and operation of the new plant. The ecological monitoring is designed based on anticipated environmental impacts through the various project phases.

Section 2.2 and Figure 2.2-1 describe the PSEG Site land use. Subsection 2.4.1 describes the preapplication field studies performed to establish baseline conditions, including the major plant communities, resident wildlife, and important species and habitats. This section also includes information on the distribution and abundance of important species and habitats, and life history information such as feeding/foraging areas, wintering areas and breeding.

Preapplication field studies coupled with agency consultation are used to determine if a suitable habitat for federal and state listed species of concern exists and to aid in identifying important species on-site. Baseline conditions, established through preapplication field studies, are used in the planning stages to avoid and minimize impacts to terrestrial natural resources. These studies are used to identify and quantify new plant construction-related and operational impacts as described in Section 4.3 and Subsections 5.3.3.3 and 5.6.1.

Preapplication studies included wetland delineation activities and wetland mitigation monitoring plan development, as described in Subsection 6.5.2. Wetlands are described in Subsection 2.4.1 and mapped wetland boundaries are depicted in Figure 2.4-5.

6.5.1.2 Aquatic Ecology

Aquatic ecosystem monitoring at the PSEG Site has been conducted for over 30 years (since the preoperational baseline studies of SGS) (Subsection 2.4.2). Since 1995, this has included comprehensive aquatic ecological monitoring performed as a condition of the Salem NJPDES permit. This inclusive program integrates impingement and entrainment sampling at the SGS with surveys of the Delaware River and marsh creeks in the vicinity of the PSEG Site. Subsection 2.4.2 summarizes the methods (e.g., locations, gear types) and results of the aquatic ecology aspects of this program, which includes quarterly sampling for fish in on-site and adjacent habitats, and a spring and fall sampling program for benthic invertebrates. PSEG publishes annual monitoring reports. These data provide a basis for describing the aquatic

resources found in the vicinity of the new plant. Other important aquatic species occurring near SGS, such as those of commercial and/or recreational importance, are generally abundant in the Delaware River. Subsection 2.4.2 provides life history information for fish and invertebrate species considered important for this study (Table 2.4-24).

6.5.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

6.5.2.1 Terrestrial Ecology and Land Use

Mitigation is required for wetland impacts resulting from the new plant and potential off-site transmission line construction. This mitigation will begin prior to or concurrent with project construction. Mitigation for the unavoidable loss of wetland resources will be guided by the USACE and NJDEP permit requirements, in accordance with current regulations under Sections 401 and 404 of the CWA, and other regulatory requirements as listed in Section 1.3.

As discussed in Section 4.3, it is expected that mitigation for unavoidable wetlands impacts resulting from new plant and causeway construction will entail wetland restoration of coastal marshes degraded by hydrologic alteration and by invasive species (notably *Phragmites australis,* the invasive strain of common reed). PSEG has extensive knowledge, experience and demonstrated success in restoring coastal wetlands as part of its Estuary Enhancement Program (EEP). Any monitoring required during site preparation, construction, and preoperation will follow guidelines developed by the USACE and NJDEP, in accordance with conditions specified in required permits. Specific monitoring requirements are established in the project compensatory wetland mitigation plan and submitted to the USACE and NJDEP. As specified in future permit conditions, monitoring reports will be developed and sent to the USACE and/or NJDEP to demonstrate compliance with performance standards.

Additional monitoring programs are not proposed for impacts to important species and habitats (Subsection 4.3.1). Construction phase monitoring of ecosystems potentially affected by off-site transmission will be determined subsequent to future routing studies and permitting.

6.5.2.2 Aquatic Ecology

Subsection 4.3.2 describes the proposed construction activities (e.g., dredging, stream bank clearing, and filling of wetlands) and their potential effect on the existing condition of aquatic communities at the site. Detention ponds collect stormwater runoff from areas disturbed during construction. This stormwater is discharged in accordance with applicable stormwater management plans and future permits.

Construction phase monitoring may be required to monitor the effects of dredging activities (related to intake, discharge, and barge facility construction) on benthic invertebrates of the Delaware River. Section 10/404 permit conditions from the USACE and Section 401 permit conditions from NJDEP determines the methodology, location, and duration of this monitoring. Because of the robust nature of the ongoing monitoring associated with the Salem NJPDES permit, additional monitoring of aquatic ecosystems is not proposed during the construction and preoperational phase.

6.5.3 OPERATIONAL MONITORING

6.5.3.1 Terrestrial Ecology and Land Use

Additional terrestrial monitoring programs are not proposed for the operational phase of the new plant. The location of a potential off-site transmission line has not been determined. However, a general discussion of anticipated impacts associated with the operation and maintenance of a typical off-site transmission line is provided in Subsection 5.6.1. If an off-site transmission line is required, monitoring will be developed in accordance with appropriate state and/or federal requirements.

There are no continuous monitoring programs proposed for terrestrial ecology and land use in this phase of the project.

6.5.3.2 Aquatic Ecology

The new plant will be designed to meet the Phase I new facility requirements specified in 40 CFR 125.84. PSEG is required to perform monitoring at the new plant to demonstrate compliance with USEPA requirements specified in 40 CFR 125.84. With regard to aquatic ecology, the two elements of this proposed monitoring program are impingement sampling and entrainment sampling at the new intake for a minimum of two yr. Once per month, in accordance with Phase I rules, impingement samples will be collected for a 24-hour period while the cooling water intake structure is in operation. Fish and shellfish species from these samples are enumerated, measured (total length in millimeters) and weighed (in grams). During operation, 24-hour entrainment samples are collected once every two weeks during the primary period of reproduction, larval recruitment, and peak abundance identified in the Source Water Baseline Biological Characterization. Species are enumerated, and the life stage of each specimen is recorded.

In terms of statistical validity, sampling methodologies are similar to those used in the ongoing studies required by PSEG's NJPDES permit for SGS. Thus, data collected for the new plant will be comparable to other PSEG data sets. Records are kept of all data used to demonstrate compliance with these monitoring requirements. Appropriate reporting will summarize the biological monitoring data.

Impingement and entrainment programs include monitoring of head loss across the surface intake screen systems and correlation with the design intake velocity, and visual/remote inspections of design and construction technologies (Section 6.3). While not strictly related to aquatic ecology, these activities provide information used to interpret impingement and entrainment monitoring data.

There are no monitoring programs proposed other than the NJPDES required impingement and entrainment monitoring programs.

6.6 CHEMICAL MONITORING

The following subsections describe the chemical monitoring program for surface water and groundwater quality and include the following topics:

- Preapplication monitoring that supports the water quality and baseline environmental water quality descriptions in Chapter 2.

- Construction and preoperational monitoring to evaluate potential changes in baseline conditions that are attributable to site preparation, construction, and preoperational activities associated with the new plant. Anticipated impacts to surface water and groundwater are discussed in Section 4.2.

- Operational monitoring to identify potential effects attributable to the new plant operation. Anticipated impacts to surface water and groundwater are discussed in Section 5.2.

6.6.1 PREAPPLICATION MONITORING

The purpose of the preapplication monitoring program is to provide data to support the assessment of potential impacts that result from the construction and operation of the new plant. The program includes ongoing surface water monitoring per the requirements of the HCGS and SGS NJPDES permits, routine monitoring of the potable groundwater wells, and sampling of surface water systems performed in conjunction with the preparation of the ESP application.

6.6.1.1 Surface Water

PSEG currently conducts routine surface water monitoring of HCGS and SGS intake and discharges in accordance with CWA requirements, as specified in the NJPDES permits for each facility. The HCGS NJPDES Permit (NJ0025411) and SGS NJPDES Permit (NJ0005622) both require monitoring and reporting of intake and discharge water chemical characteristics. Sampling program parameters, frequency, and methodology are summarized in Table 6.6-1 (References 6.6-2 and 6.6-3) (Figure 6.3-1 for locations). Limited surface water monitoring has been completed for this ESP ER, including periodic sample collection at a limited number of locations along tidal marsh creeks. Surface water quality parameters evaluated as part of the ER are consistent with NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*, requirements and are discussed in Subsection 2.3.3. This program has characterized current site conditions and provides baseline data for evaluating potential impacts of plant construction and operations.

6.6.1.2 Groundwater

Two groundwater programs (diesel fuel remediation and routine monitoring of potable water wells) require chemical monitoring at the existing HCGS and SGS. NUREG-1555 calls for a

discussion of chemical groundwater monitoring programs that are conducted within the area, or at HCGS or SGS. A historic discharge of fuel oil to the SGS environment is currently being remediated. The location and distribution of fuel oil impacted groundwater does not indicate any impacts to the new plant location on the PSEG Site. The diesel fuel oil remediation program is associated with a release at SGS that has been characterized, including remedial actions approved by NJDEP, demonstrating that the impacted area is defined and that the remediation is appropriate to prevent further migration of any impacted water. Groundwater monitoring associated with this program is ongoing and has demonstrated that the fuel oil-impacted groundwater is contained in a localized area well south (and down-gradient) of the new plant location. Groundwater from this area is not anticipated to reach the new plant location, even as a result of dewatering activities (Section 4.2). Therefore, additional monitoring programs are not needed.

In addition to the groundwater monitoring, PSEG withdraws groundwater for potable water and plant makeup water. The NJDEP and DRBC regulate water withdrawals, and NJDEP requires routine monitoring of the potable water supply. Additional quarterly sampling for chlorides is required by PSEG's Water Allocation Permit (Reference 6.6-4). The groundwater monitoring program is summarized in Table 6.6-2.

In addition to required monitoring programs, groundwater samples were collected to support ESP development. Groundwater quality parameters evaluated as part of the ESP are consistent with NUREG-1555 requirements and are listed in Subsection 2.3.3. This program is used to characterize current site conditions and is used as a baseline for evaluating potential impacts from plant construction and operations.

6.6.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

Surface water and groundwater monitoring will be conducted during the construction and preoperational stages to evaluate potential impacts.

Surface water discharges during construction include stormwater runoff and construction dewatering discharges. These construction phase discharges will be monitored in accordance with NJPDES permit requirements. Delaware River monitoring, performed in accordance with HCGS and SGS permit requirements, provides data regarding receiving water quality throughout the construction period.

Groundwater monitoring of the existing potable wells will continue during construction and plant operations. Wells installed in the shallow river bed alluvium and the underlying Vincentown Aquifers will be used to assess the potential changes in groundwater quality associated with construction of the new plant.

6.6.3 OPERATIONAL MONITORING

After construction, surface water and groundwater monitoring will continue in accordance with state and federal requirements.

Surface water quality monitoring during plant operation will be conducted in accordance with NJPDES permit and the DRBC docket requirements. It is anticipated that monitoring requirements will be similar to those of the existing HCGS water quality monitoring programs.

Two new groundwater withdrawal wells are anticipated to support the new plant. Operational groundwater monitoring will be conducted in accordance with NJDEP permit requirements and will be similar to the program described in Table 6.6-2.

6.6.4 REFERENCES

6.6-1 New Jersey Department of Environmental Protection, Division of Water Supply, Website, http://www.state.nj.us/dep/watersupply/monitoring.htm, accessed on August 27, 2009.

6.6-2 New Jersey Department of Environmental Protection, Final Surface Water Renewal Permit Action, Hope Creek Generating Station, NJPDES Permit Number NJ0025411, December 31, 2002.

6.6-3 New Jersey Department of Environmental Protection, Final Surface Water Renewal Permit Action, Salem Generating Station, NJPDES Permit Number NJ0005622, June 29, 2001.

6.6-4 New Jersey Department of Environmental Protection, Water Allocation Permit WAP040001, Program Interest ID: 2216P, January 1, 2005.

Table 6.6-1
Surface Water Quality Monitoring Program

Monitoring Location	Constituents	Frequency	Sample Type
Salem Generating Station			
48C	TSS, Ammonia, Petroleum Hydrocarbons, TOC	Twice per month	TSS, Ammonia and TOC: Composite. Petroleum hydrocarbons: Grab.
481A	pH, chlorine produced oxidants	pH measured once per week; chlorine produced oxidants measured three times per week.	Grab
482A	pH, chlorine produced oxidants	pH measured once per week; chlorine produced oxidants measured three times per week.	Grab
483A	pH, chlorine produced oxidants	pH measured once per week; chlorine produced oxidants measured three times per week.	Grab
484A	pH, chlorine produced oxidants	pH measured once per week; chlorine produced oxidants measured three times per week.	Grab
485A	pH, chlorine produced oxidants	pH measured once per week; chlorine produced measured three times per week	Grab
486A	pH, chlorine produced oxidants	pH measured once per week; chlorine produced measured three times per week	Grab
487B	pH, TSS, petroleum hydrocarbons, TOC	Once per batch	Grab
489A	pH, petroleum hydrocarbons, TOC	Once per month	Grab
Hope Creek Generating Station			
461A	pH, TOC, chlorine produced oxidants	pH measured at 1/week; chlorine produced oxidants measured continuously; TOC at 1/month.	pH and TOC: Grab. Chlorine produced oxidants is measured continuously via meter.
461C	TSS, TOC, and petroleum hydrocarbons	TSS and TOC once per month; petroleum hydrocarbons measured twice per month.	TSS and TOC: Composite. Petroleum hydrocarbons: Grab.
462B	BOD, TSS, oil and grease, fecal coliform	Once per month	BOD Composite and Calculated. TSS: Composite Oil and Grease and fecal coliform: Grab.

TSS – Total Suspended Solids
BOD – Biological Oxygen Demand
TOC – Total Organic Carbon

Reference 6.6-2 and 6.6-3

Table 6.6-2
Groundwater Monitoring Program

HCGS and SGS Wells	Chlorides	Total Coliform	Volatile Organic Compounds	Nitrate	Lead	Copper	Inorganics
Wells: PW-2, PW-5, PW-6, Well J, Well I, and Well G	Quarterly[a]	NA	NA	NA	NA	NA	NA
Well HC-1	Quarterly[a]	NA	Triennial[b]	Annual[c]	NA	NA	Triennial[b]
Well HC-2	Quarterly[a]	NA	Triennial[b]	Annual[c]	NA	NA	Triennial[b]
Hope Creek Distribution System	NA	Monthly[d]	NA	NA	Triennial[e]	Triennial[e]	NA
Salem Common Header 1	NA	NA	Triennial[b]	Annual[c]	NA	NA	Triennial[b]
Salem Distribution System	NA	Quarterly[f]	NA	NA	Triennial[e]	Triennial[e]	NA

a) Reference 6.6-4.
b) One sample to be collected anytime during 2010 (Reference 6.6-1).
c) One sample to be collected anytime during 2009 (Reference 6.6-1).
d) Two samples collected per month during 2009 (Reference 6.6-1).
e) Ten samples collected between June 1 2009 and September 30 2009 (Reference 6.6-1).
f) One sample collected per quarter for 2009 (Reference 6.6-1).
NA = not applicable
Well pumping rates, water levels, and locations are discussed in Section 2.3

6.7 SUMMARY OF MONITORING PROGRAMS

This section summarizes the environmental monitoring programs described in the preceding sections of Chapter 6 (Table 6.7-1). The summary is divided into three sections:

- Preapplication monitoring.
- Construction and preoperational monitoring.
- Operational monitoring.

6.7.1 PREAPPLICATION MONITORING

Preapplication monitoring requirements for the new plant are fulfilled in part by the ongoing thermal, radiological, hydrological, meteorological, ecological, and chemical monitoring programs for the existing HCGS and SGS. In addition to pre-existing hydrological monitoring, additional observation wells were installed and monitored, as discussed in Subsection 6.3.1, in and around the proposed project footprint to better characterize the site hydrologically. Hydrologic monitoring also included a slug test and a tidal response study. Surface water monitoring was performed at an array of locations to document hydrologic characteristics of marsh creeks, on-site water bodies, and the Delaware River.

Preapplication ecological monitoring was performed on terrestrial and aquatic ecosystems on-site and off-site to determine the current characteristics of these systems. Information collected historically and from ongoing programs form a basis to assess the new plant impacts.

6.7.2 CONSTRUCTION AND PREOPERATIONAL MONITORING

The current thermal, radiological, hydrological, meteorological, ecological, and chemical monitoring programs for the existing HCGS and SGS will continue through the new plant construction and preoperational phases.

Additional monitoring during construction and preoperation will be conducted in accordance with applicable permit requirements. Parameters to be monitored include hydrological, chemical and ecological. Data collected will be evaluated and impacts assessed and mitigated as required.

6.7.3 OPERATIONAL MONITORING

The purpose of the operational monitoring program is to identify and assess impacts resulting from new plant operation. Operational monitoring programs are prescribed by the various permits required for new plant operation (e.g., air permit, NJPDES permit) or by federal regulations.

The existing SGS and HCGS operational monitoring programs will serve as the basis for development of programs for the new plant. These programs may be modified as a result of future consultations with regulatory agencies. The need for modifications to existing monitoring programs, including locations, parameters, collection techniques, or analytical procedures, will be established prior to new plant operation. Data collected will be evaluated and impacts assessed and mitigated as required.

Table 6.7-1 (Sheet 1 of 4)
Summary of Monitoring Programs

Resource	Program	Scope/Content	Status
Preapplication			
Water	Thermal Monitoring	Thermal monitoring performed as part of routine NJPDES permitting requirements for HCGS and SGS. This monitoring is ongoing and has served as baseline.	Ongoing
		Supplemental thermal monitoring performed for the new plant as part of baseline quarterly water quality sampling at surface water sampling locations.	Complete
	Hydrological Monitoring	Groundwater monitoring performed to provide monthly water level data for baseline analysis.	Complete
		Delaware River monitoring through ongoing requirements for HCGS and SGS NJPDES permits.	Ongoing
		Monitoring performed during groundwater pumping tests in the new plant area to establish design level criteria.	Complete
	Chemical Monitoring	Chemical monitoring performed quarterly as part of baseline monitoring of surface water and groundwater resources.	Complete
Ecology	Ecological Monitoring	Quarterly baseline monitoring performed to characterize plant communities and seasonal use of birds, mammals and herpetofauna for the site and off-site areas.	Complete
		Aquatic ecological monitoring performed as part of the ongoing Salem NJPDES impingement and entrainment monitoring. This monitoring is ongoing and has served as baseline.	Ongoing
		Supplemental quarterly baseline monitoring performed within the on-site marsh creek system and within perched water bodies potentially affected by the new plant (including the USACE CDF facility).	Complete
		Supplemental seasonal (spring and fall) monitoring of benthic invertebrates performed to establish baselines of marsh creeks, the Delaware River, and perched water bodies.	Complete

Table 6.7-1 (Sheet 2 of 4)
Summary of Monitoring Programs

Resource	Program	Scope/Content	Status
Human Health	Radiological Monitoring	No additional radiological monitoring performed.	NA
Air Quality and Meteorology	Meteorological Monitoring	The existing meteorological monitoring program for HCGS and SGS was used for preapplication analyses. Air quality/emissions monitoring in accordance with applicable NJDEP permits.	Existing
Construction and Preoperational			
Water	Thermal Monitoring	Thermal monitoring to be performed as part of routine NJPDES permitting requirements for HCGS and SGS. This monitoring is ongoing and has served as baseline.	Ongoing
	Hydrological Monitoring	Groundwater and surface water monitoring to be performed during dewatering activities at the power block. Specific monitoring as part of the NJPDES permit process for construction activities occurring off-site (e.g., causeway construction, transmission line development, etc.) as applicable. Surface water monitoring in vicinity of dredging of intake/discharge/barge area to monitor for applicable hydrologic parameters including turbidity, as required. Stormwater discharges will be monitored in accordance with NJDEP permits, as applicable.	To be developed
	Chemical Monitoring	Chemical monitoring to be performed at stormwater outfall and/or release points in accordance with NJDEP permits, as applicable. Groundwater monitoring will continue during portions of construction and preoperation to ascertain the chemical effects of construction and/or dewatering on local groundwater.	To be developed

Table 6.7-1 (Sheet 3 of 4)
Summary of Monitoring Programs

Resource	Program	Scope/Content	Status
Ecology	Ecological Monitoring	Aquatic ecological monitoring to be performed as part of the ongoing impingement and entrainment monitoring at SGS.	Ongoing
		Monitoring of wetland mitigation to be performed in accordance with NJDEP and USACE permitting requirements, as applicable.	To be developed
		Supplemental monitoring of benthic invertebrates is required to support NJDEP/USACE permit application for dredging of intake/barge areas.	To be developed
Human Health	Radiological Monitoring	Existing REMP for HCGS and SGS to encompass needs of new plant.	Existing
Air Quality and Meteorology	Meteorological Monitoring	The existing meteorological monitoring program for HCGS and SGS will be used during these phases.	Existing
		Air quality / emissions monitoring in accordance with applicable NJDEP permits	
Operational			
Water	Thermal Monitoring	Thermal monitoring to be performed as part of routine NJPDES permitting requirements at intake structure and discharge of new plant.	To be developed
	Hydrological Monitoring	Intake structure head loss measurements to be conducted in accordance with NJPDES permit requirements.	To be developed
		Groundwater monitoring to be performed for on-site wells in accordance with NJDEP permit requirements.	
	Chemical Monitoring	Chemical monitoring to be performed as part of routine NJPDES permitting requirements at discharge of new plant.	To be developed
		Monitoring of stormwater outfalls will be performed in accordance with permit requirements, as applicable.	

Table 6.7-1 (Sheet 4 of 4)
Summary of Monitoring Programs

Resource	Program	Scope/Content	Status
Ecology	Ecological Monitoring	Impingement and entrainment studies to be performed at intake structure in accordance with NJPDES permit requirements. Monitoring of wetland mitigation performance parameters to be performed in accordance with NJDEP and USACE permitting requirements, as applicable.	To be developed
Human Health	Radiological	The monitoring program specified in Section 6.2 will be conducted.	Existing/ modified
Air Quality and Meteorology	Meteorological Monitoring	The existing meteorological monitoring program for SGS and HCGS will be used during this phase. Air quality/emissions monitoring in accordance with applicable NJDEP permits	Existing