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Chapter 6 Environmental Measurements and Monitoring Programs

Chapter 6 describes the environmental monitoring programs in place or proposed at the VCS site to monitor various media for different impacts during the pre-application, construction, pre-operational, and operational periods. The chapter is divided into seven sections:

- Thermal Monitoring (Section 6.1)
- Radiological 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)

Information for the different phases of the overall program is provided in each of these sections.

6.1 Thermal Monitoring

The following section describes the thermal monitoring programs for surface water, which include pre-application monitoring to establish baseline conditions in water bodies potentially affected by facility construction and operation and may include operational monitoring of Guadalupe River temperatures to identify potential impacts from operation of the new units.

6.1.1 Pre-Application Monitoring

Exelon implemented the pre-application monitoring program to obtain baseline information characterizing temperature regimes in water bodies potentially affected by construction and operation of the units at VCS. These water bodies are shown in Figures 2.3.1-12 and 2.3.3-4. The data collected during the preoperational monitoring program also supports the assessment of cooling system discharge impacts to aquatic communities in Subsection 5.3.2 of the Environmental Report. As discussed in Subsection 2.3.3, the pre-application thermal monitoring program consisted of semiannual measurements of water temperature at locations in five water bodies (Guadalupe River, Coleto Creek, Linn Lake, Kuy Creek, and the Calhoun Canal, which is considered as an alternate raw water makeup system intake location in Section 9.4) in conjunction with the collection of water samples for a variety of radiological and chemical analyses (Section 6.2 and 6.6, respectively). Figure 2.3.3-4 shows these monitoring locations. In addition, water quality data, including temperature data, was obtained from the Texas Commission on Environmental Quality (TCEQ) and U.S. Geological Survey (USGS) web sites to augment temperature data collected in the field. TCEQ and USGS water quality monitoring stations are shown in Figure 2.3.3-3.

Consistent with NUREG-1555, sufficient temperature data has been collected to “characterize seasonal variations throughout an annual cycle.” Table 6.1-1 shows sources of temperature data and the frequency of data collection.

Three pre-application surface water monitoring datasets (i.e., VCS, TCEQ, and USGS) that include field measurements of water temperature, sampling location, and date are discussed in Subsection 2.3.3.

6.1.2 Construction Monitoring

A Texas Pollutant Discharge Elimination System (TPDES) permit could be required to discharge treated sanitary effluent to surface water during construction. Monitoring would be conducted in accordance with the permit, as applicable.

Given that the pre-application monitoring was conducted to provide adequate baseline data, no additional thermal monitoring is planned during construction.

6.1.3 Preoperational and Operational Monitoring

Modeling conducted for this application indicates that the discharge from the proposed units would affect a very small area of the Guadalupe River in the immediate vicinity of the blowdown line outfall and the effects would dissipate over a short distance upstream and downstream (Subsection 5.3.2). A TPDES permit would be necessary to discharge to the Guadalupe River, and monitoring of blowdown temperatures may be required in conjunction with a TPDES permit.

TCEQ would identify thermal monitoring requirements as part of the TPDES permit process and list any such requirements in a facility's TPDES permit. An operational monitoring program would be implemented to identify any changes in water quality that may result from the operation of VCS and to assess the effectiveness of the related effluent treatment systems. The specific elements of the operational monitoring program, including thermal monitoring of the Guadalupe River, would be developed in consultation with the TCEQ in the course of applying for a TPDES permit. Table 6.6-2 provides typical TPDES permit parameters.

Table 6.1-1
Sources of Temperature Data Used in Environmental Report

	Exelon Monitoring Program		TCEQ Monitoring Program		USGS Monitoring Program	
Water Body	**Frequency**	**Monitoring Period**	**Frequency**	**Monitoring Period**	**Frequency**	**Monitoring Period**
Guadalupe River	Semiannual (two locations)	2007–2008	Quarterly (seven locations)	Various	Various	1980–1999
Coleto Creek	Semiannual	2007–2008	Quarterly	1994–1997	—	—
Linn Lake	Semiannual	2007–2008	—	—	—	—
Kuy Creek	Semiannual	2007–2008	—	—	—	—
Calhoun Canal	Semiannual	2007–2008	—	—	Biannually	1996–2005
San Antonio River	—	—	Quarterly	2003–2007	—	—
Victoria Barge Canal	—	—	Quarterly	2004–2007	—	—

— Data not available or not sampled.

6.2 Radiological Monitoring

The purpose of the Radiological Environmental Monitoring Program (REMP) is to verify that VCS is operating within its design parameters and to ensure that offsite doses are ALARA. The REMP confirms that radioactive materials released in effluents are not reconcentrated in the environment and that the concentrations, if observed, are as modeled in the proposed VCS Offsite Dose Calculation Manual (OCDM). This section presents the basis, contents, reporting, and quality assurance aspects of the REMP.

6.2.1 Radiological Environmental Monitoring Program Basis

The VCS REMP will characterize the radiological environment in the vicinity of VCS. It will provide data on measurable levels of radiation and radioactive materials in the site environs, and provide baseline data on surveillance of principal pathways of exposure to the public. This program will follow the guidance provided, either in NUREG-1301, *Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors*, (U.S. NRC 1991a), or, NUREG-1302, *Offsite Dose Calculation Model Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors (*U.S. NRC Apr 1991b); *Branch Technical Position on An Acceptable Radiological Environmental Monitoring Program,* Revision 1 (U.S. NRC Nov 1979); RG 4.1, Revision 2, *Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants* (U.S. NRC Jun 2009) and the requirements of 10 CFR 20 Subpart F. The preoperational monitoring program for each media type is given in Table 6.2-1 and will be initiated two years before a proposed VCS unit begins operation.

There will be no radiological effluents released during the pre-application and preconstruction phases. Therefore, radiological monitoring to assess the impact of radiological effluent releases during these phases is not necessary. However, a preconstruction/construction program to collect baseline data will be conducted before the comprehensive preoperational program begins. The operational monitoring program will be the same as the preoperational program.

The following description of the VCS REMP includes: (1) number and location of sample collection points and/or measuring devices and pathway sampled or measured, (2) sample collection frequency, (3) type and frequency of analysis, (4) general types of sample collection and measuring equipment, and (5) quality assurance. The lower limit of detection for each analysis will be provided in the VCS ODCM, which will be developed and available for NRC review before a unit begins operation.

6.2.2 Radiological Environmental Monitoring Program Contents

The VCS REMP will monitor the environment by sampling air, water, sediment, fish, and food products, as well as measuring radiation directly. Milk samples will not be collected and analyzed because milk-producing animals (cows or goats) and dairy farms are not present within 20 miles of the plant. The REMP will include sampling indicator and control locations within 30 miles of the plant. These indicator locations are used to identify increases or buildup of radioactivity that might occur due to operation of the proposed units. The control locations, which are beyond the area of plant influence, will be used to indicate the naturally occurring or background radioactivity levels. Indicator results will be compared with control and preoperational (i.e., baseline) results to assess a detectable increase in the surrounding environment that could be the result of VCS operations.

Airborne effluents would normally be released through the building plant stacks. Liquid radioactive effluents would be mixed with and diluted by the cooling basin blowdown before discharge to the Guadalupe River.

6.2.2.1 Pathways Monitored

Airborne, direct radiation, waterborne, vegetation, and ingestion pathways will be monitored in accordance with NRC guidance for an ODCM (U.S. NRC Apr 1991). A description of preoperational and operational monitoring and sampling locations used to monitor the exposure pathways is provided in Table 6.2-2 and shown in Figures 6.2-1 through 6.2-4. Preconstruction and construction monitoring and sampling locations, selected from preoperational and operational program locations, are also identified in Table 6.2-2 and shown in Figure 6.2-5. The preoperational and operational monitoring and sampling programs consist of all locations identified in Table 6.2-3, which also identifies the subset of those locations to be used for baseline monitoring during the preconstruction and construction phases.

The following media associated with the radiation exposure pathways will be monitored in the VCS preconstruction/construction, preoperation, and operation REMP:

- Direct (thermoluminescent dosimeters, or TLDs)
- Airborne (iodine canisters and particulate filters)
- Waterborne (surface water, groundwater, drinking water, and sediment)
- Foodstuffs (broadleaf vegetables, fish and invertebrates, and meat)
- Vegetation (forage)

Direct radiation monitoring locations will consist of an inner ring of TLDs in the general area of the VCS site boundary with a TLD in each compass direction (sector). An outer ring of TLDs will be located approximately 5 miles from the site. In addition, airborne particulates and radioiodine will be monitored close to the site boundary in the predominant wind direction that has the highest calculated annual average ground level deposition. Section 2.7 identifies south-southeast as the predominant wind direction at the VCS site. Direct radiation monitoring will also be provided at three elementary schools, which are identified in Table 6.2-2 and shown in Figure 6.2-4.

Subsection 2.3.1.1 indicates that surface water runs through the VCS site southward by ways of Kuy Creek, Dry Kuy Creek, and Linn Lake, and eventually flows into either Hynes Bay or Guadalupe Bay. Accordingly, the VCS surface water monitoring program will consist of monitoring and sampling locations in the VCS cooling basin, at Linn Lake, at the VCS discharge blowdown outfall at the Guadalupe River, and downstream at Kuy Creek and Dry Kuy Creek. Shoreline sediment and surface water monitoring will also be conducted at the entrances of Hynes Bay and Guadalupe Bay.

Groundwater monitoring and sampling locations will consist of wells in the general area of the site boundary and around the VCS cooling basin dikes. Subsection 2.3.1.2 indicates that groundwater flow in the vicinity of the site is toward Linn Lake in the east-northeast direction and is expected to continue to flow in that direction after the cooling basin is constructed and filled. Accordingly, several wells will be located downgradient from the site and the cooling basin in the area west of Linn Lake. In addition, tritium will be monitored at the 17 onsite wells (single and couplet).

Preoperational and operational radiological monitoring programs will include measurements to evaluate the possible effects from the operation of one or more units at VCS during the construction of additional units at VCS to ensure that changes in environmental radioactivity can be detected.

Frequencies of various monitoring activities are provided in Table 6.2-3. Sampling results and locations will be evaluated to determine effects from seasonal yields and variations. Trending and comparison reviews performed as part of the program will be used to identify changes in background levels, when compared to baseline measurements. Changes in program implementation, including sampling techniques, frequencies, and locations, may occur based on monitoring results, preference of analytical techniques, and changes in technology.

6.2.2.2 Land Use Census

A land-use census will be conducted in accordance with NRC guidance for an ODCM (U.S. NRC Apr 1991). The purpose of this census is to identify changes in land use within 5 miles of VCS that would require modifications to the REMP or the ODCM. The most important activities associated with this census are the determination of locations, in each sector, of the nearest (1) residence, (2) milk animal for human consumption, and (3) garden of greater than 500 square feet producing broadleaf vegetation. The potential nearest residence, meat animal, and garden in each sector for the proposed VCS are identified and presented in Figure 6.2-6. Currently, no milk-producing animals have been identified within 20 miles of VCS.

6.2.2.3 Quality Assurance Program

The VCS REMP will be conducted in accordance with RG 4.15, Revision 2, *Quality Assurance for Radiological Monitoring Programs (Inception Through Normal Operations to License Termination)—Effluent Streams and the Environment*. Quality assurance will be provided through training, quality assurance program implementation, and administrative and technical procedures. Participation in an Interlaboratory Comparison Program ensures that independent checks on the precision and accuracy of the measurements of radioactive material are performed as part of the quality assurance program. This demonstrates that the measurement results are valid for the purpose of Section IV.B.2, Appendix I of 10 CFR 50. These Interlaboratory Comparison Program results will be reported in the annual REMP report.

6.2.3 References

U.S. NRC Apr 1991a. U.S. Nuclear Regulatory Commission, *Offsite Dose Calculation Manual Guidance; Standard Radiological Effluent Controls for Pressurized Water Reactors,* NUREG-1301, Washington, D.C., April 1999.

U.S. NRC Apr 1991b. U.S. Nuclear Regulatory Commission, *Offsite Dose Calculation Manual Guidance; Standard Radiological Effluent Controls for Boiling Water Reactors*, NUREG-1302, Washington, D.C., April 1991.

U.S. NRC Apr 1975. U.S. Nuclear Regulatory Commission, Programs for *Monitoring Radioactivity in the Environs of Nuclear Power Plants*, RG 4.1, Revision 2, Washington, D.C., June 2009.

U.S. NRC Nov 1979. U.S. Nuclear Regulatory Commission, Branch Technical Position on *An Acceptable Radiological Environmental Monitoring Program*, Revision 1, Washington, D.C., November 1979.

Table 6.2-1
Duration of Preoperational Program for Specific Media

Duration	Specific Media
6 months	Airborne iodine Iodine in milk (animals in pasture)[(a)]
1 year	Airborne particulates Milk (remaining analyses)[a] Surface water Groundwater Drinking water
2 years	Direct radiation Fish and invertebrates Food products Sediment from shoreline

(a) Milk samples will not be collected and analyzed because milk-producing animals (cows or goats) and dairy farms are not present within 20 miles of the plant.

Table 6.2-2 (Sheet 1 of 3)
Radiological Environmental Monitoring Program Sample Station Locations (Preconstruction/Construction, Preoperation, and Operation)

Location Code	Description	Approximate Distance (mile) from Center of Power Block and Location Description	Direction/Vector
C-1	Combined (TLD, Soil, Air Particulates/ Radioiodine)	1.0 (1-Mile ring in PWD)	N
C-2 (P)		1.0 (1-Mile ring in PWD)	NNW
C-3		1.0 (1-Mile ring in PWD)	NW
C-4		1.0 (1-Mile ring in PWD)	WNW
C-5 (c) (P)		5.0 (In minimal wind direction)	E
C-6		8.7 (Slightly off PWD)	WSW
C-7		9.6 (Medium distance in PWD)	NW
C-8		30.0 (Long distance in PWD)	NNW
Cb-1	Crab (when present)	0.7 (At the discharge outfall in the CB)	ESE
Cb-2		3.2 (At the far end of the CB)	ESE
D-1 (c) (P)	Combined (Soil, Surface Water, Sediment, Crab, Fish, Pasture Grass)	5.0 (Upstream of the BD outfall at GR)	NE
D-2 (P)		4.8 (Downstream of the BD outfall at GR)	ENE
D-3		8.2 (Downstream before GR/SAR Intersection)	ESE
D-4 (c)		8.7 (At SAR)	WSW
D-5		5.5 (Downstream at Dry Kuy Creek)	SE
D-6 (c)		20.2 (Downstream at Hynes Bay)	SE
D-7 (c)		17.5(Downstream at Guadalupe Bay)	SE
D-8		5.5 (Downstream at Kuy Creek)	SE
F-1	Fish (when present)	0.7 (At the discharge outfall in the CB)	ESE
F-2		3.2 (At the far end of the CB)	ESE
Gp-1	Grass	1.3 (Outside the EAB and within the SB)	NE
Gp-2 (P)		0.7 (Within the EAB)	N
Gp-3		0.7 (Within the EAB)	WNW
Gp-5		4.9 (Downstream of Linn Lake)	E
Gw-1(c)(P)	Groundwater	0.8 (Outside the EAB and within the SB)	W
Gw-2		1.2 (Outside the EAB and within the SB)	SSW
Gw-3 (P)		3.8 (South corner of the CB)	SSE
Gw-4		4.1 (South end of the CB and Dry Kuy Creek)	SE
Gw-5		4.2 (East side of the CB)	ESE
Gw-6 (P)		4.5 (South end of Linn Lake)	E
Gw-7		2.6 (North east side of the CB and Linn Lake)	ENE
Gw-8 (P)		1.2 (Outside the EAB and within the SB)	NE
Gw-9		1.4 (Outside the EAB and within the SB)	NNE
H-1 (c) (P)	Tritium	0.8 (Within the EAB and upstream of GWFD)	SW
H-2 (c)		2.2 (Double wells, upstream of GWFD)	S
H-3 (c)		2.2 (Double wells, upstream of GWFD)	S
H-4 (c)		3.9 (Double wells, upstream of GWFD)	SSE
H-5		4.7 (Downstream of Dry Kuy Creek)	SE
H-6		4.4 (South end of the CB)	ESE
H-7		4.7 (East end of CB and south of Linn Lake)	E
H-8		4.0 (Double wells, downstream of Linn Lake)	E
H-9		4.0 (Double wells, downstream of Linn Lake)	E
H-10 (P)		3.3 (East of CB and downstream of GWFD)	E

Table 6.2-2 (Sheet 2 of 3)
Radiological Environmental Monitoring Program Sample Station Locations (Preconstruction/Construction, Preoperation, and Operation)

Location Code	Description	Approximate Distance (mile) from Center of Power Block and Location Description	Direction/Vector
H-11	Tritium (cont.)	2.8 (Double wells, North end of Linn Lake)	ENE
H-12		2.8 (Double wells, North end of Linn Lake)	ENE
H-13		2.4 (North of CB and downstream of GWFD)	ENE
H-14 (P)		1.9 (North side of CB)	NE
H-15		1.5 (North side of CB)	NE
H-16		0.3 (East end of Unit 2)	NE
H-17		0.4 (East end of Unit 2)	NNE
Oy-1	Oyster	17.3 (Downstream of GR at Hynes Bay)	SE
Oy-2		20.1 (Downstream of GR at Guadalupe Bay)	SE
Sb-1	Sediment — Bottom	0.8 (At the intake of the CB)	SE
Sb-2		0.8 (At the discharge outfall of the CB)	ESE
Sb-3		3.7 (At the south end of the CB)	ESE
So-1	Soil	0.4 (Within the EAB and in PWD)	NNE
So-2		0.4 (Within the EAB and in PWD)	NNW
So-3 (P)		0.5 (Within the EAB and in PWD)	NNW
So-4		0.5 (Within the EAB and in PWD)	WNW
So-5		0.6 (Within the EAB and in PWD)	W
So-6		1.3 (Outside the EAB and south of the PBA)	NE
Ss-1	Sediment — Shoreline	3.2 (North end of Linn Lake)	ENE
Ss-2		3.6 (South end of Linn Lake)	E
Sw-1	Surface Water	0.5 (West stormwater retention pond)	SW
Sw-2		0.7 (East stormwater retention pond)	NE
Sw-3		3.5 (At the south end of CB)	ESE
Sw-5 (P)		3.3 (At the middle of Linn Lake)	ENE
T-1 (P)	TLD (Direct Radiation)	1.0 (1-Mile Ring around the PBA)	SSW
T-2		0.4 (1-Mile Ring around the PBA)	S
T-3		0.3 (1-Mile Ring around the PBA)	SSE
T-4		0.2 (1-Mile Ring around the PBA)	SE
T-5		0.3 (1-Mile Ring around the PBA)	ESE
T-6		0.3 (1-Mile Ring around the PBA)	E
T-7		0.5 (1-Mile Ring around the PBA)	ENE
T-8 (P)		1.0 (1-Mile Ring around the PBA)	NE
T-9 (P)		1.0 (1-Mile Ring around the PBA)	NNE
T-10 (P)		1.0 (1-Mile Ring around the PBA)	W
T-11 (P)		1.0 (1-Mile Ring around the PBA)	WSW
T-12 (P)		1.0 (1-Mile Ring around the PBA)	SW
T-13		1.3 (Ring around the CB)	SSW
T-14		2.0 (Ring around the CB)	S
T-15		2.7 (Ring around the CB)	SSE
T-16		3.2 (Ring around the CB)	SSE
T-17		4.0 (Ring around the CB)	SE
T-18		4.0 (Ring around the CB)	SE
T-19		4.3 (Ring around the CB)	ESE
T-20		4.6 (East side of CB)	ESE

Table 6.2-2 (Sheet 3 of 3)
Radiological Environmental Monitoring Program Sample Station Locations (Preconstruction/Construction, Preoperation, and Operation)

Location Code	Description	Approximate Distance (mile) from Center of Power Block and Location Description	Direction/Vector
T-21	TLD (Direct Radiation) (cont.)	3.3 (Ring around the CB)	ESE
T-22		2.6 (Ring around the CB)	E
T-23		2.0 (Ring around the CB)	ENE
T-24		1.7 (Ring around the CB)	NE
T-25		5.0 (5-Mile ring around the PBA)	NNE
T-26		5.0 (5-Mile ring around the PBA)	N
T-27 (P)		5.0 (5-Mile ring around the PBA)	N
T-28		5.0 (5-Mile ring around the PBA)	NW
T-29		5.0 (5-Mile ring around the PBA)	WNW
T-30		5.0 (5-Mile ring around the PBA)	W
T-31 (P)		5.0 (5-Mile ring around the PBA)	WSW
T-32		5.0 (5-Mile ring around the PBA)	SW
T-33		5.0 (5-Mile ring around the PBA)	SSW
T-34		5.0 (5-Mile ring around the PBA)	S
T-35 (P)		5.0 (5-Mile ring around the PBA)	SSE
T-36 (c) (P)		5.0 (5-Mile ring around the PBA)	E
T-37		5.0 (5-Mile ring around the PBA)	ENE
T-38		5.0 (5-Mile ring around the PBA)	NE
T-39 (c) (P)		8.5 (Bloomington Elementary)	ENE
T-40 (c) (P)		13.8 (Tivoli Elementary School)	SE
T-41 (P)		11.9 (Dudley Elementary School)	NNE
Ww-1 (P)	Well Water	0.4 (Upstream of the GWFD)	SW
Ww-2 (P)		4.0 (South end of CB and within SB)	SE

Footnote: Location codes Gp-4 and Sw-4 are not used.

Legend:

BD	Blowdown Discharge Outfall
C	Combined (TLD, Soil, Air Particulates/Radioiodine)
CB	cooling basin
(c)	control location
D	Combined (soil, surface water, sediment, crab, fish, grass)
EAB	exclusion area boundary (4000 ft)
GR	Guadalupe River
GWFD	groundwater flow direction
(P)	preconstruction/construction location
PBA	power block area
PWD	predominant wind direction
SAR	San Antonio River
SB	site boundary

Table 6.2-3 (Sheet 1 of 4)
Radiological Environmental Monitoring Program (Preconstruction/Construction, Preoperation, Operation)

Sample Media, Number, Approximate Location and Distance of Sample Stations from Containment	No. Sampling Stations	Routine Sampling Mode	Sampling and Collection Frequency	Analysis Type	Minimum Analysis Frequency
Direction Radiation					
Exposure Media: TLD 16 – Located in all 16 meteorological sectors, at or inside 1-mile ring around PBA 14 – Located in 14 meteorological sectors, at the 5-mile ring around the PBA 12 – Located around the CB dikes 3 – Located in special interest areas (e.g., elementary schools), within 14 miles (T-39, T-40, T-41) 3 – Located outside the LPZ in predominant wind direction 8–30 miles (C-6/WSW sector, C-7/NW, C-8/NNW) -- 4 – Control stations located in areas of minimal wind direction 5 to 14 miles (C-5/E, T-36/E, T-39/ENE, T-40/SE); selected from above-listed locations and not counted in the total	48	Continuously	Quarterly	Gamma Dose	Quarterly
Airborne Particulates and Radioiodine					
Exposure Media: Charcoal and Particulate Filters	8	Continuous sampler operations	Weekly or more frequently if required by dust loading		
4 – Located at 1-Mile ring (C-1/N, C-2/NNW, C-3/NW, C-4/WNW)				Radionuclide Canister: I-131	Weekly
3 – Located outside the LPZ in predominant wind direction, 8–30 miles (C-6/WSW, C-7/NW, C-8/NNW)				Particulate Sampler: Gross Beta Activity	Following filter change
1 – Control Station, located in minimal wind direction 5 miles (C-5/E)				Gamma Isotopic of composite (by location)	Quarterly

Table 6.2-3 (Sheet 2 of 4)
Radiological Environmental Monitoring Program (Preconstruction/Construction, Preoperation, Operation)

Waterborne					
Surface Water 2 – Located at the two stormwater retention ponds within the PBA, 0.5-0.7 mile (Sw-1, Sw-2) 1 – Located at the far end of the CB, 4 miles (Sw-3) 1 – Located to the east of the site on Linn Lake, 5 miles (Sw-5) 1 – Control location, located upstream on GR not influenced by VCS discharge, 5 miles (D-1) 2 – Located downstream from blowdown outfall into GR, 5 miles (D-2, D-3) 2 – Located downstream from the CB on Dry Kuy Creek and Kuy Creek, 5.5 miles (D-5, D-8) 2 – Located at Hynes Bay and Guadalupe Bay, 18-20 miles (D-6, D-7) 1 – Located upstream of SAR, 8 miles (D-4)	12	Composite sample over a 1 month period (grab if not available)	Monthly	Gamma-Isotopic Tritium	Monthly Quarterly Composite
Groundwater 3 – Located at wells upgradient in the shallow aquifer (Gw-1, Gw-2, Gw-3) within SB 6 – Located at wells downgradient in the shallow aquifer (Gw-4, Gw-5, Gw-6, Gw-7, Gw-8, Gw-9) within SB	9	Grab	Quarterly	Gamma Isotopic, Gross Beta, and Tritium	Quarterly
Drinking Water (Tap) 1 – Located within the PBA (Ww-1) 1 – Located at a control well at the south end of the CB (Ww-2)	2	Grab	Monthly	Gross Alpha, Gross Beta, Gamma Isotopic, and Tritium	Monthly Quarterly Composite
Sediment – Bottom 1 – Located above VCS on GR, not influenced by plant discharge (D-1) 2 – Located downstream from blowdown outfall at GR (D-2, D-3) 3 – Located in CB (Sb-1, Sb-2, Sb-3)	6	Grab	Semiannually	Gamma Isotopic	Semiannually
Sediment – Shoreline 2 – Located downstream of the CB at Dry Kuy Creek and Kuy Creek (D-5, D-8) 2 – Located at Hynes Bay and Guadalupe Bay (D-6, D-7)	4	Grab	Semiannually	Gamma Isotopic	Semiannually

Table 6.2-3 (Sheet 3 of 4)
Radiological Environmental Monitoring Program (Preconstruction/Construction, Preoperation, Operation)

Waterborne (cont.)					
Tritium 2 – Control wells within the SB (H-1, H-4) 2 – Control double wells within the SB (H-2, H-3) 13 – Located within the PBA and around the CB (H-5, H-6, H-7, H-8, H-9, H-10, H-11, H-12, H-13, H-14, H-15, H-16, H-17)	17	Grab		Tritium	Quarterly
Ingestion					
Milk There is no milk producing animal (cow or goat) or dairy farm identified within 20 miles of VCS.	0				
Broadleaf Vegetation 2 – Located inside the EAB (Gp-2/N sector, Gp 3/WNW sector) 1 – Located outside the EAB within the SB (Gp-1/NE sector) 1 – Located in a minimal wind direction (E sector) (Gp-5) 7 – Located 5 to 20 miles from VCS (D-2, D-3, D-4, D-5, D-6, D-7, D-8) 1 – Control location, located 5 miles from VCS (D-1/NE sector)	12	Grab	Monthly during growing season (when available)	Gamma-Isotopic and I-131	As collected
Fish and Invertebrates (Edible portions) 7 – Representing commercially or recreationally important species in vicinity of VCS that may be influenced by plant operation (D-2, D-3, D-4, D-5, D-6, D-7, D-8) 1 – Control location, located 5 miles from VCS (D-1/NE sector) 2 – Same or Analogous species in the CB (Cb-1, Cb-2, F-1, F-2)	10	Grab	Sample semiannually	Gamma-Isotopic on edible portions	As collected
Agriculture Products Crops grown either commercially or domestically exclusively within 10 miles of VCS 2 – Control locations (09, 13, Figure 6.2-6) 6 – Sampling locations (01, 03, 04, 05, 06, 16, Figure 6.2-6)	8	Grab	At time of harvest	Gamma-Isotopic on edible portions	As collected

Table 6.2-3 (Sheet 4 of 4)
Radiological Environmental Monitoring Program (Preconstruction/Construction, Preoperation, Operation)

Ingestion (cont.)					
Domestic Meat Represents domestic stock fed on crops grown exclusively within 10 miles of VCS 2 – Control locations (09, 13, Figure 6.2-6) 6 – Sampling locations (01, 02, 03, 04, 06, 16, Figure 6.2-6)	8	Grab	Annually	Gamma-Isotopic	As collected

Legend:

EAB	exclusion area boundary (4000 ft)
CB	cooling basin
GR	Guadalupe River
PBA	power block area
PWD	predominant wind direction
SB	site boundary
TLD	thermoluminescent dosimeter
SAR	San Antonio River

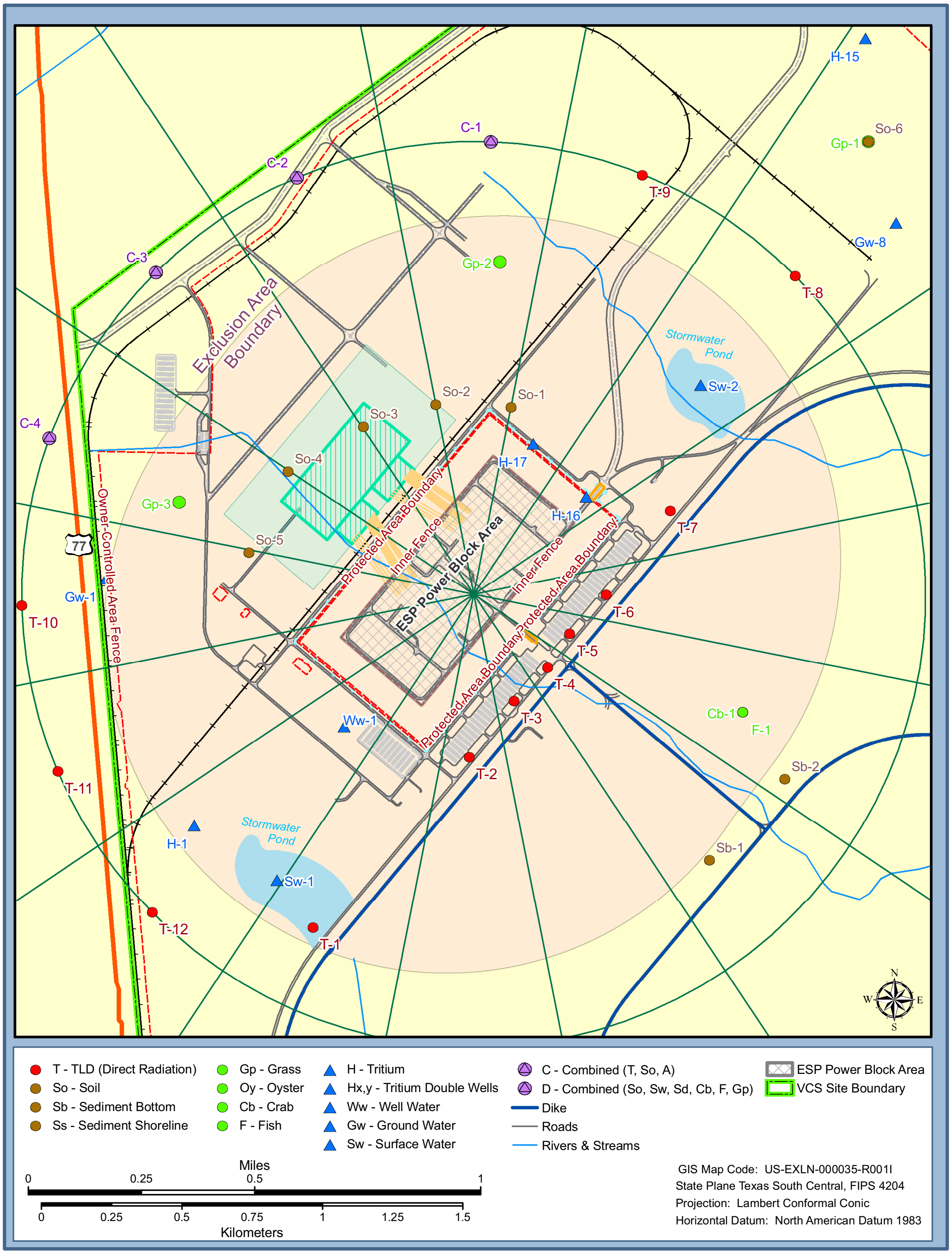


Figure 6.2-1 VCS Exclusion Area Radiological Monitoring Locations

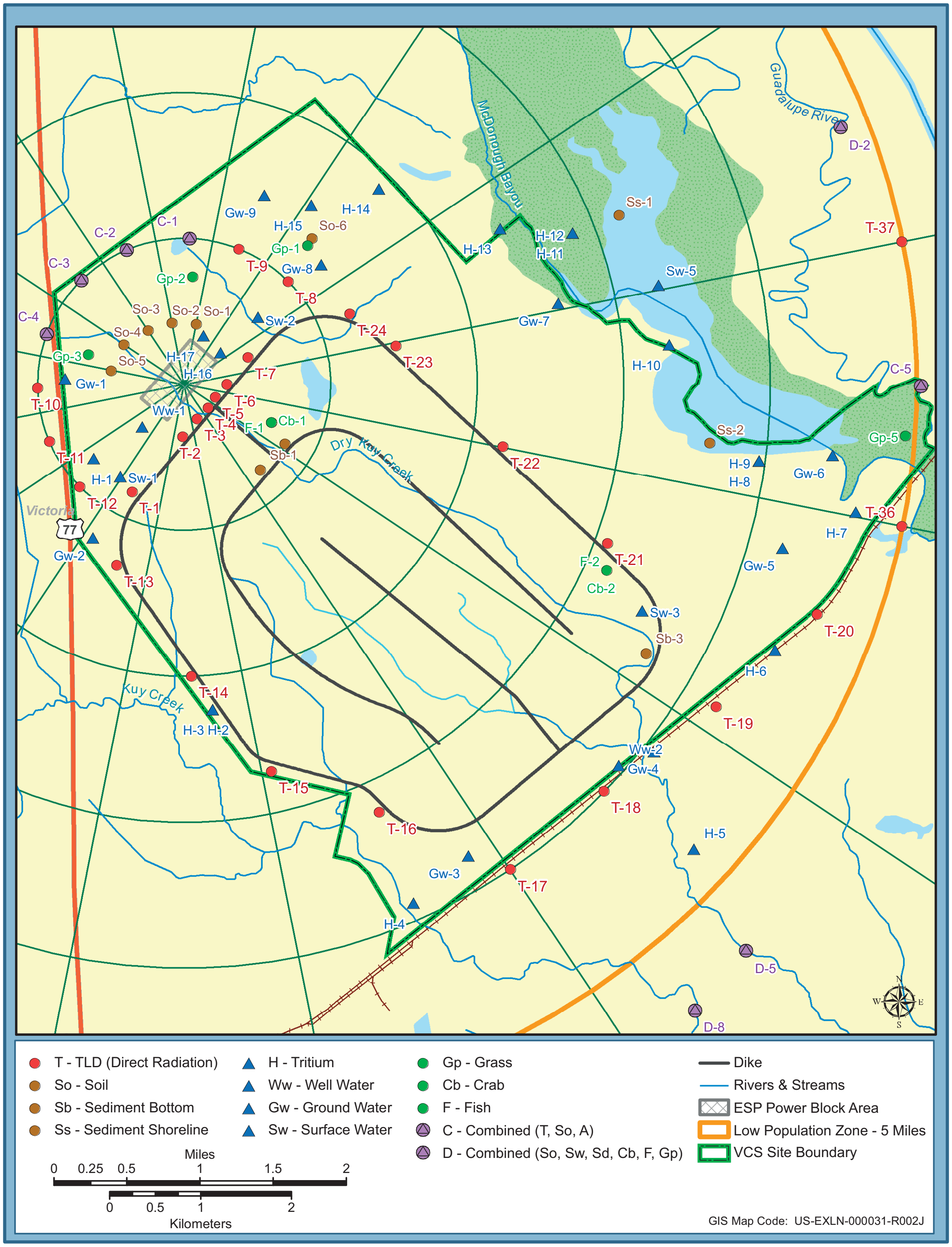


Figure 6.2-2 VCS Site Area Radiological Monitoring Locations

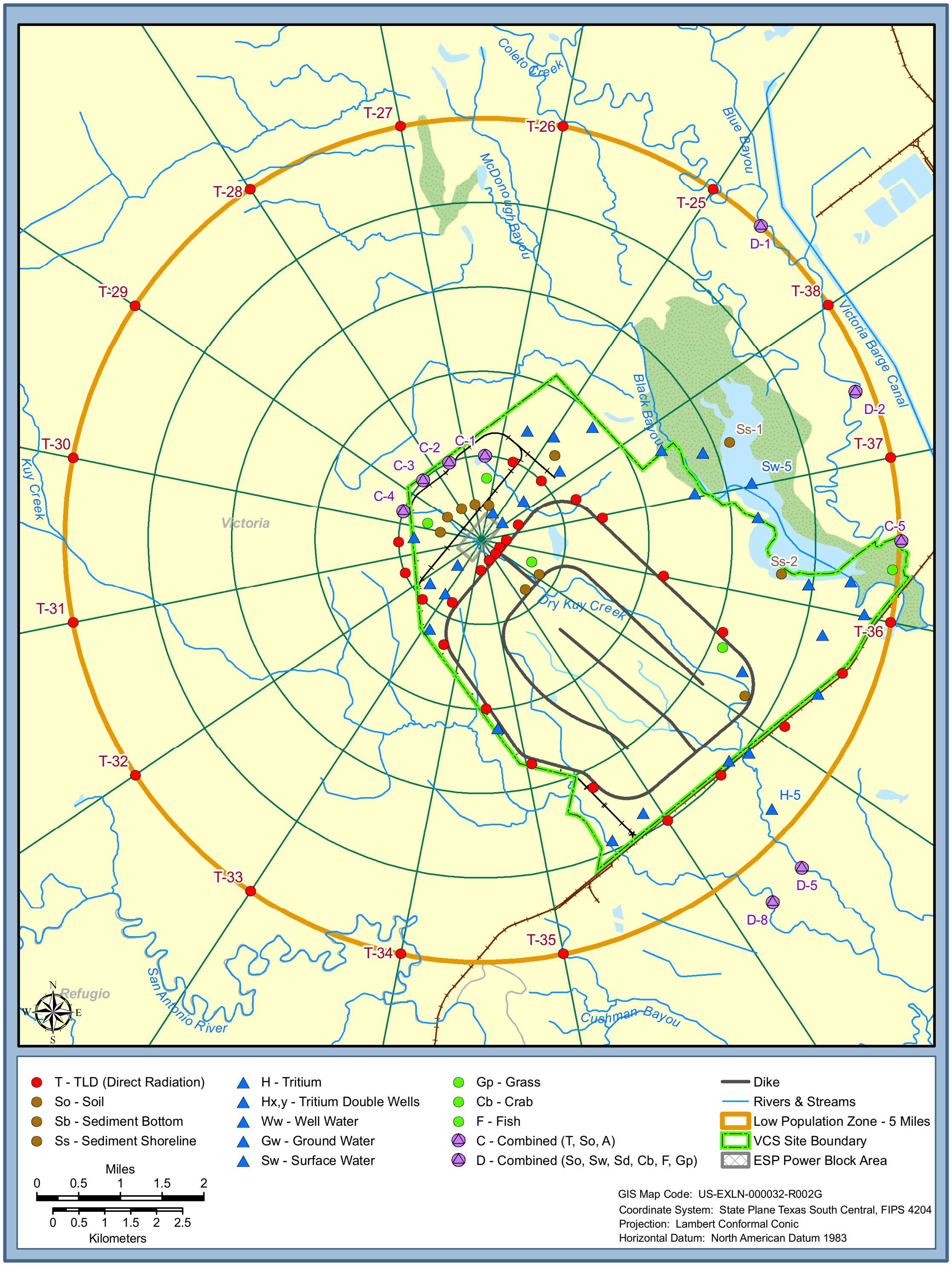


Figure 6.2-3 VCS Low Population Zone (LPZ) Radiological Monitoring Locations

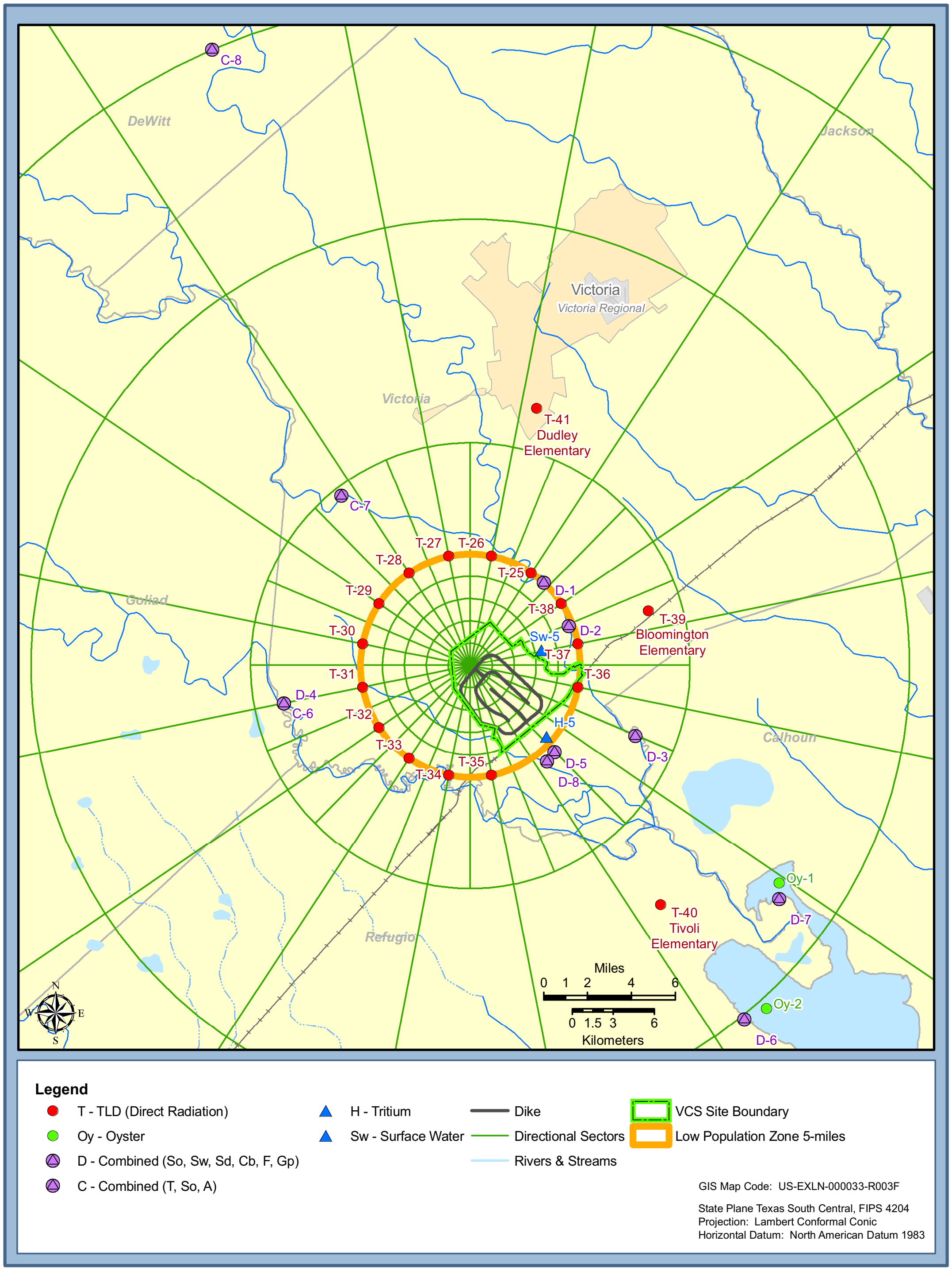


Figure 6.2-4 VCS Regional Radiological Monitoring Locations

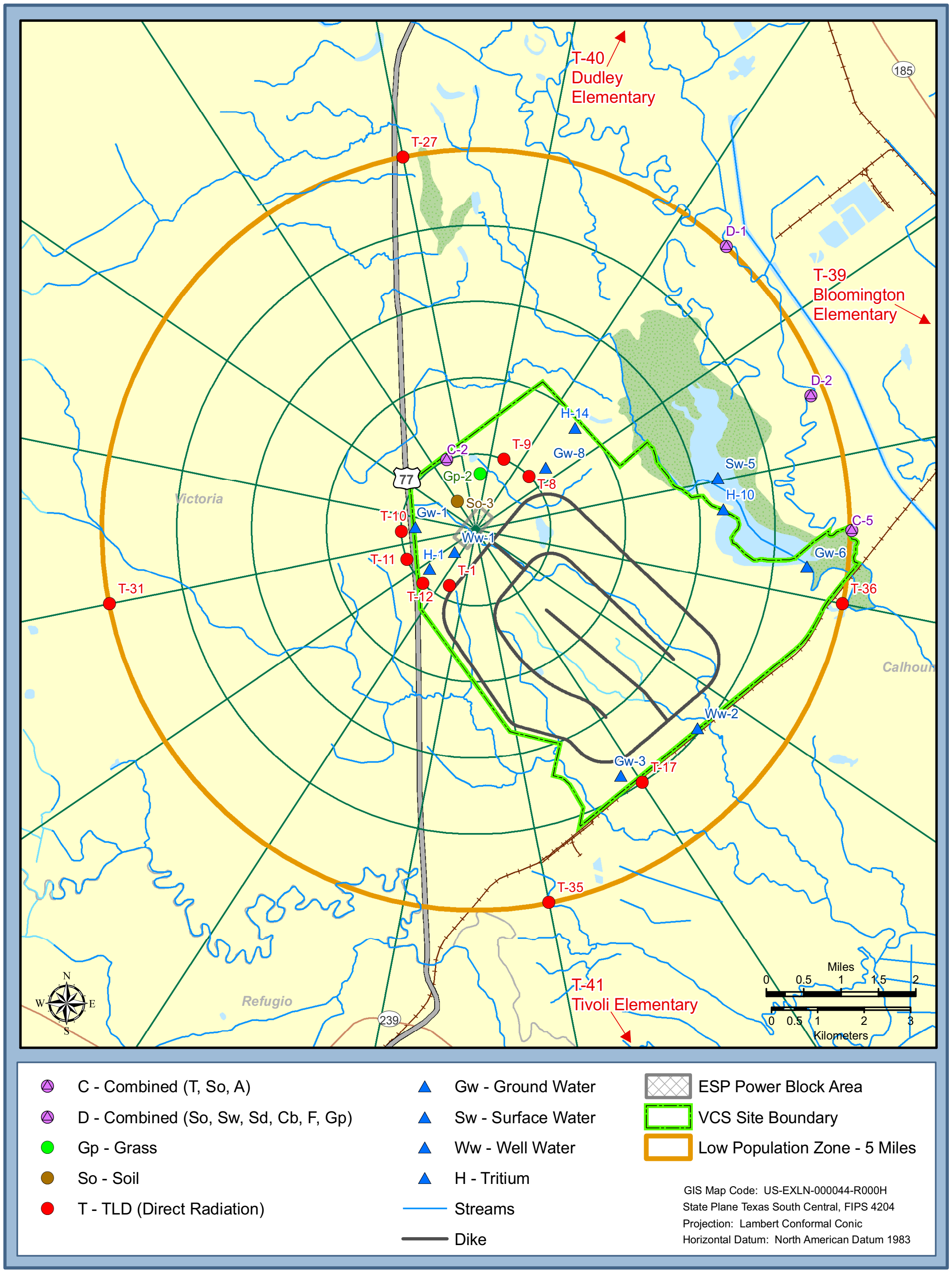
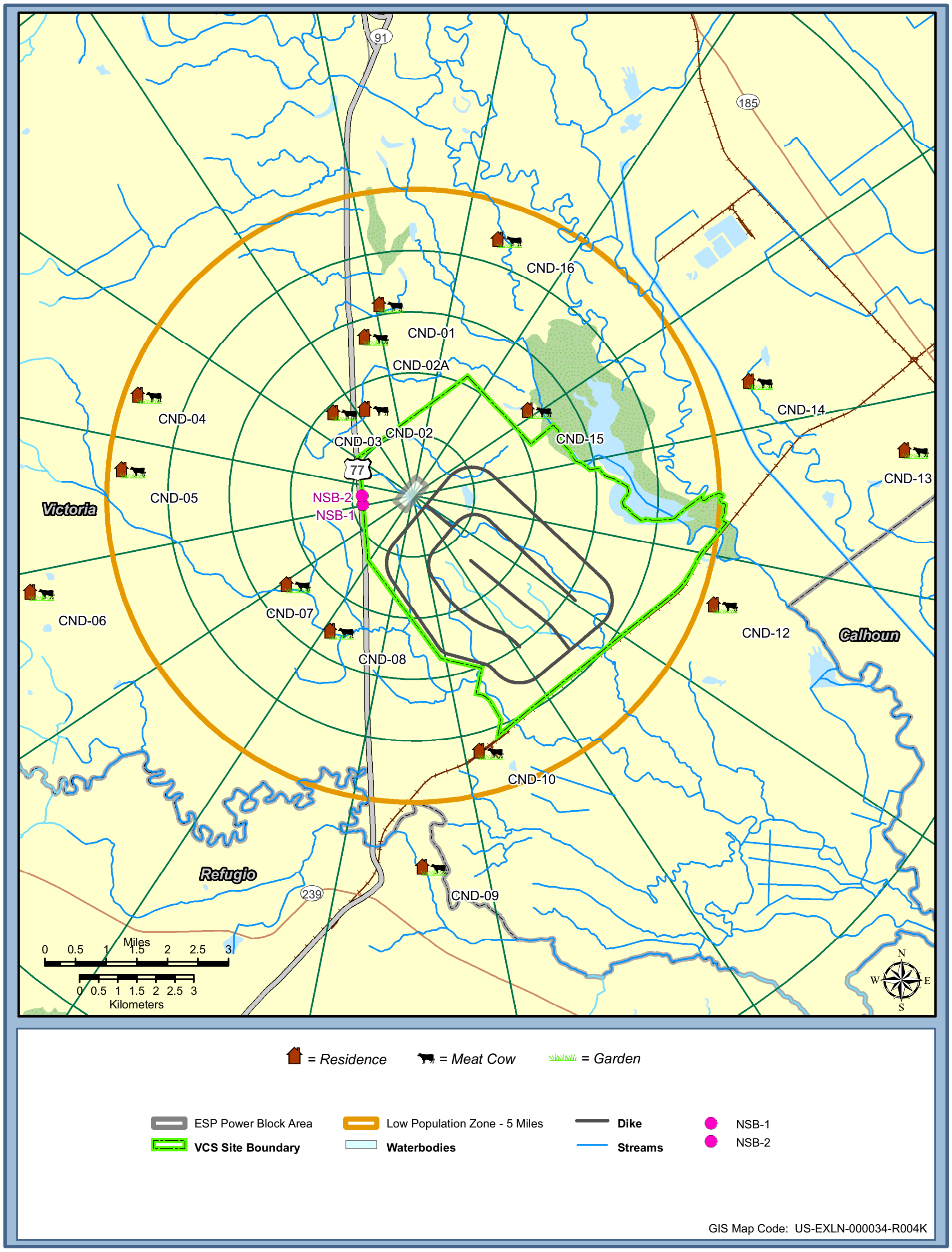


Figure 6.2-5 VCS Preconstruction/Construction Radiological Monitoring Locations



Note:Distances indicated on this figure assume a site with two conventional units, having the following reactor building coordinates: Unit 1 at N28° 36' 48" W97° 1' 54" and Unit 2 at N28° 36' 56" W97° 1' 47."

Figure 6.2-6 Potential VCS Nearest Receptor Maximally Exposed Individual (MEI) Locations

6.3 Hydrological Monitoring

This section describes the hydrological monitoring activities that were conducted during the pre-application phase and those that would be implemented to monitor the hydrological setting during the construction, preoperational, and operational phases for the proposed VCS site, including monitoring flow rates, water levels, sediment transport, and groundwater levels. Monitoring activities include the following:

- Pre-application study and monitoring of Guadalupe River flows and groundwater levels/gradients in the vicinity of the VCS site to establish baseline hydrological descriptions. Details of the program results are discussed in Section 2.3.
- Construction and preoperational monitoring of surface water and groundwater to identify potential impacts of construction activities.
- Operational monitoring programs to identify potential impacts of VCS operation.

VCS would obtain a Texas Pollutant Discharge and Elimination System (TPDES) permit to discharge effluents to the Guadalupe River. The Texas Commission on Environmental Quality (TCEQ) was delegated authority by the EPA to oversee the state's National Pollutant Discharge and Elimination System program. This oversight includes issuance of TPDES permits with effluent limitations. TPDES effluent limitations are based on state water quality standards, found in the Texas Administrative Code at Title 30, Section 307.4 (General Criteria) and Section 307.7 (Site-Specific Criteria). TPDES permit limitations and monitoring requirements are based on these standards. Segment 1803 of the Guadalupe River, in the vicinity of the site, has specific standards for temperature, dissolved oxygen, and several chemical constituents. Hydrologic monitoring is addressed indirectly in these standards, because dilution flows are a consideration when monitoring temperatures and chemical constituents. There are no TCEQ regulations specific to hydrological monitoring of groundwater. However, groundwater intended for public use (drinking water) is monitored in accordance with Texas Administrative Code, Title 30, which addresses site-specific sampling requirements, analysis, and reporting.

Equipment used for hydrologic monitoring, as well as documentation of data quality objectives, would be consistent with EPA Region 6 standard operating procedures and NRC guidelines, as applicable.

6.3.1 Pre-Application Monitoring

The pre-application hydrologic monitoring consists of both surface water and groundwater monitoring. Each is discussed separately below.

6.3.1.1 Surface Water

The hydrology of the VCS site and vicinity is described in Subsection 2.3.1. The following pre-application surface hydrologic monitoring was performed to verify the existing site and vicinity hydrologic conditions:

- Bathymetric surveys were conducted in March 2008 and 2009 in the Guadalupe River near the VCS site. Some of the surveyed river cross sections are provided in Subsection 2.3.1.

- Historical stream flow data for the Guadalupe-San Antonio River basin was compiled for 1947 through 2006. The flow data was used to describe the seasonal variations in hydrology in the river basins and is discussed in Subsection 2.3.1 and Section 5.2.

- Local surface water quality in the Guadalupe and San Antonio Rivers, Coleto Creek, Linn Lake, Kuy Creek, and the Calhoun Canal (an alternate raw water makeup [RWMU] system intake location discussed in Section 9.4) was evaluated and is discussed in Subsection 2.3.3.

- Historical annual sediment loads in the Guadalupe and San Antonio Rivers were compiled for 1974 to 1994 and are discussed in Subsection 2.3.1.

Data sets were used to: (1) verify that the Guadalupe River flows would support the VCS estimated water use during the 40-year license period of the plant, (2) substantiate the design assumptions, and (3) establish the baseline for the Environmental Report and the TPDES permit.

6.3.1.2 Groundwater

In October 2007, a groundwater investigation program was initiated as part of the subsurface study to evaluate current geologic and hydrogeologic conditions at the VCS site. Sixty-two observation wells and two test wells were installed at the locations shown in Figure 2.3.1-23. All of the observation wells were installed in the Chicot Aquifer. The regional and local hydrogeologic setting is discussed in Subsection 2.3.1.2. A site hydrograph is provided as Figure 2.3.1-24.

A groundwater investigation and field and laboratory tests (conducted October 2007 through August 2009) were performed to initially characterize soil and aquifer permeability and groundwater flow direction and velocity. The results of these investigations are provided in Subsection 2.3.1.2. The projected groundwater flow path is to the east-northeast towards the Guadalupe River as shown in Figure 2.3.1-24.

During the groundwater investigation, samples were collected from nine shallow, onsite wells and one deep, offsite well at the locations shown in Figure 2.3.3-1 and analyzed for the parameters listed in Tables 2.3.3-2 and 2.3.3-3. Results of local groundwater quality analyses are discussed in Subsection 2.3.3.

6.3.2 Construction and Preoperational Monitoring

Hydrological monitoring to observe the effects from site construction includes pre-application monitoring to establish a baseline. Although construction impacts are expected to be small, both surface water and groundwater monitoring are planned for the construction phase to confirm the baseline information obtained during the pre-application monitoring.

6.3.2.1 Surface Water

Stream flow monitoring data would continue to be evaluated throughout the construction phase of the project. The relationship between upstream U.S. Geological Survey (USGS) gaging stations and the Guadalupe River reach(es) that could potentially be affected by plant construction and operation has been established; thus, the construction phase monitoring program would include evaluation of the data collected at these stations.

Stormwater discharges from large construction activities (defined as those involving five or more acres) in Texas are regulated under TPDES General Permit TXR150000 (TCEQ Mar 2008). A Stormwater Pollution Prevention Plan (SWPPP) incorporating best construction management practices (including measures to limit erosion and sedimentation) must be completed before obtaining authorization to discharge under the General Permit. These SWPPPs normally require periodic inspections of erosion and sediment control measures to ensure they are working as designed and may include monitoring of stormwater or downgradient watercourses as well.

6.3.2.2 Groundwater

Construction groundwater monitoring is typically undertaken when the proposed activities, such as dewatering, have the potential to adversely affect local groundwater conditions. As noted previously, observation wells were monitored between October 2007 and August 2009 to establish baseline characteristics of groundwater at the VCS site. Some of these would be abandoned during the construction phase, and additional wells would be installed around the periphery of the construction site. Monitoring at the additional wells would identify the direct impacts of excavation and dewatering on groundwater in the vicinity of the site, as well as the potential indirect impacts to downgradient wetlands and surface waters into which groundwater seeps or flows.

Monthly groundwater level gaging of both existing and replacement wells would be conducted during portions of the construction phase to monitor the potential drawdown, caused by dewatering or other construction activities, and to substantiate design assumptions related to hydrostatic loading that may result from filling of the cooling basin. The construction groundwater monitoring system would consist of a minimum of nine wells (Gw-1 through Gw-9). The wells would be located in the general area of the site boundary and around the VCS cooling basin at the locations shown on Figure 6.2-2. Subsection 2.3.1.2 indicates that groundwater from the Chicot Aquifer flows from the site east towards the Guadalupe River Valley. Accordingly, several of the monitoring wells would be located hydraulically downgradient of VCS in the area west of Linn Lake.

Potential hydrologic alterations resulting from construction activities could include increased groundwater recharge as a result of seepage from the cooling basin, temporary local changes in shallow groundwater levels from dewatering of foundation excavations and/or general rising and falling of the groundwater table in localized areas due to topographic alterations. Groundwater level monitoring would be designed to record changes and demonstrate stabilization of the water table once construction has been completed. If anomalies are noted during the data review, investigations will be conducted to determine the causes. Construction effects on groundwater hydrology are discussed in Section 4.2. During the last stages of construction of each unit (before fuel loading), the groundwater level monitoring data set would be evaluated to remap groundwater contours and to design the operational groundwater monitoring program.

6.3.3 Operational Monitoring

This subsection discusses operational monitoring to evaluate the effects of station operation.

6.3.3.1 Surface Water Hydrologic Monitoring

Exelon would continue to obtain Guadalupe River flow data from USGS Gaging Station 08176500 (Victoria) and Gaging Station 08188800 (GBRA saltwater barrier near Tivoli).

6.3.3.2 Groundwater Hydrologic Monitoring

As noted previously, groundwater contours would be mapped before VCS operation. Continued monitoring of groundwater levels, along with radiological monitoring of groundwater (Section 6.2), would be used to evaluate the groundwater pathway for potential movement of radionuclides into the environment. This monitoring would be consistent with the Nuclear Energy Institute Groundwater Protection Initiative.

6.3.4 References

TCEQ Mar 2008. Texas Commission on Environmental Quality, *General Permit to Discharge Wastes*, TPDES General Permit Number TXR150000, March 5, 2008.

6.4 Meteorological Monitoring

The section describes the meteorological monitoring program at the VCS site, and its adequacy for characterizing atmospheric transport and diffusion conditions representative of the site and surrounding area and providing a meteorological database for evaluation of the effects of construction and operation for a plant to be potentially built at the site.

This description of the meteorological monitoring program includes an evaluation of the:

- Tower location and instrument siting
- Meteorological parameters measured
- Meteorological sensors
- Data recording and transmission
- Instrument surveillance, maintenance, and calibration
- Data acquisition and reduction
- Data screening and validation
- Data display and archiving
- System accuracy
- Emergency preparedness and response support
- Annual data recovery rate and joint frequency distribution data
- Need for additional data sources for airflow trajectories

This evaluation demonstrates that the meteorological monitoring program for the site meets the relevant requirements of 10 CFR 50, Appendix I; 10 CFR 51.45(c); 10 CFR 51.50; 10 CFR 52.17(a)(1); 10 CFR 100.20(c)(2); the guidance in Section C of RG 1.23, Revision 1; Section C.4 of RG 1.111, Revision 1; and RG 1.21, Revision 2.

6.4.1 General Monitoring Program Description

The onsite meteorological monitoring program consists of three phases:

1. Pre-application Monitoring Phase — Two years of the meteorological data collected on site from July 1, 2007 through June 30, 2009 is used to support the ESP application, specifically for:

    - Description of atmospheric transport and diffusion characteristics of the site and surrounding area.
    - Calculation of the dispersion estimates for both postulated accidental and routine airborne releases of effluents.
    - Evaluation of the environmental risk from the radiological consequences of a spectrum of severe accidents.
    - Assessment of the nonradiological impacts due to site preparation and construction, and to plant operation.

2. Preoperational Monitoring Phase — Before plant operation, one year of onsite meteorological monitoring is planned to provide a basis for identifying and assessing environmental impacts resulting from plant operation.

    Monitoring during plant construction is not planned because no significant construction impacts have been identified in Chapter 4 of the Environmental Report that warrant onsite meteorological monitoring.

3. Operational Monitoring Phase — The operational monitoring program will be implemented to provide data for use in evaluating the environmental impacts of plant operations, including radiological and nonradiological impacts, and for emergency preparedness support.

The onsite meteorological measurements program included an instrumented 60-meter, guyed tower. The program began operation on June 28, 2007. The location of the meteorological tower and instrumentation conforms to Revision 1 of RG 1.23 (U.S. NRC Mar 2007). Instrument surveillance (i.e., operation, maintenance, and calibration), and data processing and validation in accordance with the applicable regulatory and relevant industry guidance were routinely performed during the pre-application monitoring phase to ensure data quality as well as to achieve acceptable annualized data recovery rates greater than or equal to 90 percent. No backup onsite meteorological data collection system was used, because the monthly data recovery rate from the 60-meter tower was greater than 90 percent since program operation began.

6.4.2 Meteorological Tower and Instrument Siting

The subsections that follow provide an evaluation of the general and local exposure of the meteorological tower and instruments relative to potential plant structures and other features of the plant site. In the evaluation, the location of the meteorological tower, surrounding terrain and vegetation, potential power block buildings, cooling towers, and cooling basin were examined to determine whether the measurements made on the tower represent the overall site meteorology. The conformance status of the tower and instrument siting is summarized in Tables 6.4-1 and 6.4-2, respectively.

6.4.2.1 Site Description and Topographic Features of the Site Area

The following briefly describes the topographic features of the VCS site. This description, together with the description in Section 2.7 regarding the topographic features and dispersion characteristics of the site area, forms the basis for assessing the adequacy of the meteorological monitoring program for the site.

The site is located in Victoria County in southern Texas, approximately 127 miles southwest of Houston, 60 miles north-northeast of Corpus Christi, and 13.3 miles south of the city of Victoria. The site area is approximately 11,500 acres and is bounded by Linn Lake to the east, U.S. Highway 77 and Kuy Creek on the west, and a Union Pacific railroad line on the south. The north-south running Guadalupe River flows between Linn Lake and the Victoria Barge Canal, which is approximately 5 miles east of the site. Most of the site has been used for a cattle ranch.

The site is located in the Texas coastal plain, midway between the southern and the eastern extremities of the Texas Gulf Coast. Terrain of the site is generally flat, ranging in elevation between 65 and 85 feet NAVD 88. To the east of the site, elevation decreases from approximately 85 feet NAVD 88 to approximately 12 feet NAVD 88 at Linn Lake. The area to the southwest of the site towards Kuy Creek decreases in elevation from approximately 80 feet to 50 feet NAVD 88.

Within 50 miles (80 kilometers) of the site, the terrain is generally flat to gently rolling, except towards the west and northwest. At the outer boundary of the 50-mile radius, measured from the power block area, the terrain rises to 550 feet NAVD 88. The major influence on local meteorological conditions is the Gulf of Mexico, located approximately 35 miles to the southeast of the site at its closest approach.

Site area maps within a 5-mile (8-kilometer), 10-mile (16-kilometer), and 50-mile (80-kilometer) radius are shown in Figures 6.4-1, 6.4-2, and 6.4-3, respectively. See Figure 2.7-14 for plots of terrain elevation by downwind direction sector to a distance of 50 miles from the site.

6.4.2.2 Meteorological Tower Exposure

The meteorological tower is located near the northwestern corner of the site. The geographical coordinates for the tower are: Latitude: N 28º 37' 01.49" and Longitude: W 97º 02' 27.04".

The location of the meteorological tower with respect to the power block area where the reactor units and other plant features would reside is shown in Figure 6.4-4. The base of the meteorological tower, located in an open field, is 82.4 feet NAVD 88. Finished plant grade at the new units will be 95 feet NAVD 88.

As shown in Figure 6.4-1, the area within a 5-mile radius of VCS is generally flat with terrain variations less than 100 feet. Because the base of the tower is at approximately the same elevation as finished plant grade and terrain variation is minimal in the vicinity of the site, it is concluded that the location of the tower and the plant site have similar meteorological exposures.

6.4.2.3 Potential Airflow Alteration

Wind sensors should be located over level, open terrain at a distance of at least 10 times the height of any nearby natural or man-made obstruction (e.g., terrain, trees, buildings), if the height of the obstruction exceeds one-half the height of the wind measurements (U.S. NRC Mar 2007). The surrounding terrain, nearby trees, and structures (existing and planned) were evaluated to determine whether they would affect the wind measurements on the tower. The findings are described below.

The tower is sited in an area clear of trees. Nearby trees and shrubs are more than 1000 feet from the tower and are relatively short (i.e., less than 15 feet) when compared to upper wind sensor height (i.e., 197 feet or 60 meters) and the lower wind sensor height (i.e., 33 feet or 10 meters).

There are no existing structures higher than 16.4 feet or 5 meters that are located near the meteorological tower. An environmentally-controlled equipment shelter at the base of the tower, which housed the data processing and recording equipment, is 8 feet by 8 feet by 8 feet. The base of the shelter sits 4 feet above the ground to protect it from flooding. Therefore, the elevation of the shelter roof is 12 feet above ground, which is less than half the height of the lower level wind sensor height (i.e., 33 feet or 10 meters above ground).

The meteorological tower is located approximately 3185 feet from the center of the power block area where the plant structures would potentially reside, and the shortest distance from the tower to the closest edge of the power block area is approximately 2230 feet. Typically, a plant vent stack is higher than the plant building that it serves. However, its width is much smaller when compared to its height. Airflow alteration caused by such a vent stack is not expected to be discernible beyond 5 times its height downwind. This is consistent with the regulatory guidance provided in NUREG-1555, Section 6.4 (U.S. NRC Oct. 1999). Once constructed, the tallest plant building (i.e., either the reactor or the turbine building) could be as tall as 230 feet above grade, depending on the selected reactor type; however, it is expected to be located 10 times its height or more away from the meteorological tower at its closest point. With this large distance separation, airflow alteration caused by this potential tallest structure is considered to be minimal. Other potential obstructions within 5000 feet of the meteorological tower have also been evaluated against the “10 times the obstruction height” guideline (U.S. NRC Mar 2007) and have been found to be a distance of at least 10 times their height from the meteorological tower.

6.4.2.4 Heat and Moisture Sources Influence

Ambient temperature and atmospheric moisture measurements (e.g., dew point temperature, relative humidity, or wet bulb temperature) should be made, avoiding air modification caused by the nearby sources of heat and moisture (e.g., ventilation sources, cooling towers, water bodies, and large parking lots). The potential for modifications of ambient temperature and relative humidity measurements made on the tower were assessed. The findings of this evaluation are described below.

Existing Environment

The meteorological tower is located in an open field with natural vegetation surrounding the tower. At the base of the tower, light-colored gravel has been placed inside a 25-foot by 25-foot fenced-in compound surrounding the tower. There are no large concrete or asphalt parking lots or other temporary land disturbances, such as plowed fields or storage areas, located nearby. The nearest asphalt surface is U.S. Highway 77, a four-lane divided highway lying approximately 1200 feet west of the tower. With this large distance separation, the thin layer of warm air generated by the paved highway during hot sunny days is expected to have negligible heat effects on the temperature measurements made on the tower.

The nearest large body of water is Linn Lake located approximately 3 miles east of the meteorological tower. Because of the large distance separation, relative humidity measurements made on the tower are not expected to be affected by the lake.

Potential As-Built Environment

Based on Figure 6.4-4, the minimum distances from the meteorological tower to the gravel substation yard and the power block area are approximately 370 feet and 2230 feet, respectively. The closest planned large concrete or asphalt parking lot or ventilation source would potentially be located more than 1030 feet from the meteorological tower. With these large distance separations between the existing and planned heat sources, the heat effect on the temperature measurements made on the tower is expected to be insignificant.

A mechanical draft cooling tower system is proposed to be used if the selected reactor type requires an external ultimate heat sink (UHS) and/or a plant service water system. The nearest cooling tower would be located more than 2230 feet from the meteorological tower. As reported in Subsection 5.3.3.1.1, the predicted annual average cooling tower plume length and plume height are 0.45 mile (2376 meters) and 295 feet (90 meters), respectively. In addition, the annual median plume length is 634 feet, while the predicted median plume height is 98 feet. Based on these predictions, it is concluded that the visible cooling tower plume height at 2400 feet downwind of the cooling tower would exceed the height of the relative humidity and temperature sensors installed at the 10-meter (33-foot) level of the meteorological tower (see Subsection 5.3.3.3 for a more detailed description). Therefore, operation of the proposed cooling towers on site would have negligible effect on the relative humidity and temperature measurements made on the meteorological tower.

The plant cooling system would include an approximately 4900-acre cooling water basin, which would be located approximately 4480 feet from the meteorological tower at its closest point. During plant operation, moisture content and temperature in the air immediately above the basin are expected to increase slightly due to natural evaporation from the basin and basin warming from the plant thermal discharge, respectively. As shown in Figure 6.4-4, winds from the east-northeast through south-southeast directions could potentially carry moist air over the basin toward the meteorological tower location. However, given the approximately 4480-foot separation between the meteorological tower and the cooling basin, nonrepresentative influences on the ambient air temperature and relative humidity measurements on the tower during plant operation are expected to be minimal.

6.4.2.5 Potential Changes on Site Diffusion Climate

The influence of the planned cooling basin on the diffusion climate of the site and its relation to dispersion of accidental or routine radioactive releases has been examined. The findings are summarized as follows.

In general, the wind speed increases as air moves from land over a low-friction water surface that would enhance local dispersion. However, the mechanical turbulence tends to decrease when air moves from land over water, independent of temperature difference, and would hinder local diffusion. The surface roughness changes on both turbulence and wind speeds could be significant when considered by itself. However, the combination of these changes is generally offsetting, thereby having negligible effects on the local diffusion climate of the area.

The presence of a cooling basin would alter the frictional effects on adjacent land surface; however, the impact of this on wind speed and direction is expected to be limited to the immediate vicinity of the basin.

Temperature difference between the cooling basin and the ambient air boundary layer could influence air flow at receptors downwind of the reactor. When the basin water is warmer than the adjacent air, the increases of lower level ambient temperature would create thermal instability. Subsequently, more unstable atmospheric stability (i.e., favorable diffusion environment) is expected.

Given the 4480-foot separation between the meteorological tower and the cooling basin, influences of the cooling basin on the wind speed, wind direction, and vertical temperature differential measurements on the tower during plant operation are expected to be minimal.

6.4.2.6 Instrument Siting

For siting of wind sensors, data from Corpus Christi and Houston was initially used to determine the average wind direction characteristics of the site. This data indicated that the winds were predominantly from the southeast. This was consistent with the predominant winds (i.e., southeast to south-southeast) found at Victoria Regional Airport, Texas, approximately 17 miles from the site (see Figure 2.7-1). Based on the results of this evaluation, the wind sensors were mounted on the south side of the tower (i.e., the upwind side of the tower, under the predominant wind directions expected at the site) to minimize the effects of the tower on those measurements.

Because the tower structure itself could affect downwind measurements, the wind sensors were mounted on an 8-foot retractable boom, which was oriented to the southeast and extended approximately 6.5 feet from the tower (greater than twice the tower's width of 1.5 feet), to minimize the effects of the tower structure on wind measurements. Thus, the wind speed and wind direction measurements were free from the influence of the tower.

Temperature and humidity sensors were mounted in fan-aspirated radiation shields that point north with the shield inlet approximately 2.5 feet from the tower (more than 1.5 times the tower width of 1.5 feet) to minimize the impact of thermal radiation on the tower and radiation shield.

6.4.3 Pre-Application Monitoring Phase

Two years of onsite data were collected during the pre-application monitoring phase. In preparing the ESP application for the VCS site, the adequacy and accuracy of the onsite meteorological data collection system was evaluated, based on the guidance provided in RG 1.23 (U.S. NRC Mar 2007). The areas specifically examined include: tower siting and sensor location for determination of the representativeness of the 2 years of data collected by the system; accuracy of the sensor performance specifications; adequacy of the methods and equipment for recording sensor output; data acquisition, reduction, and validation procedures; and the quality assurance program for sensors, recorders, and data reduction to ensure accurate and valid data was collected. The representativeness of the meteorological tower and instrument siting has been established in Subsection 6.4.2. The findings of the remaining evaluations are described below.

6.4.3.1 Meteorological Parameters Measured

Meteorological measurements were made at two levels on the 60-meter tower: the 10-meter level and the 60-meter level. The parameters measured at each level are summarized in Table 6.4-3. A meteorological monitoring system block diagram for the configuration used during the pre-application monitoring phase is provided in Figure 6.4-5. The monitoring system was equipped with lightning protection.

Wind speed and wind direction were measured at 33 feet (10 meters) and 197 feet (60 meters) above ground level. The routine and potential accidental atmospheric release points include the plant stack (assuming the plant stack is no taller than 279 feet) along with several other locations with elevations below the stack height. The meteorological parameters measured at the prescribed elevations for evaluation of the radiological impacts of these releases (i.e., windspeed and direction) are consistent with Regulatory Position 2.1 of RG 1.23 (U.S. NRC Mar 2007).

Ambient temperature was monitored at the 10- and 60-meter levels. Vertical differential temperature (i.e., delta-T) was based on the difference between the temperatures measured at the 60- and 10-meter levels. Relative humidity (RH) was directly measured using instrumentation located at both the 10- and 60-meter levels. The 60-meter level RH sensor was installed on November 28, 2008, to facilitate and provide flexibility in selection of the type of heat dissipation system for a UHS, if required, and/or a plant service water system. The dew point temperature was calculated based on the coincident ambient temperature and RH measurements. The atmospheric moisture content near the ground was quantified by the calculated dew point temperature for the 10-meter level and was used in the cooling basin fogging potential evaluation. Because the physical height of a typical UHS and/or plant service water cooling tower is approximately 60 feet (18.3 meters), the atmospheric moisture content at the height of the water vapor release from the cooling towers can be adequately represented by the dew point temperatures calculated for the 10-meter measurement level.

Precipitation was measured using an 8-inch diameter, tipping bucket precipitation gage mounted at ground level away from the tower shelter to prevent any interference in precipitation capture. The precipitation gage was equipped with a heating element in case of frozen precipitation. Windshields were provided to prevent wind-induced under-recording of precipitation. The rain gage windshield was one-half inch above the level plain of the rain gage orifice. This is consistent with the shield's installation instructions and the National Weather Service National Training Center documentation for Standard Rain Gages.

Solar radiation was measured at 4.6 meters above ground, but the data collected was not used in preparing the ESP application.

6.4.3.2 Meteorological Sensors Used

A description of the meteorological sensors, including type, manufacturer, model number, specifications (including starting threshold, range, and measurement resolution, as applicable), and accuracy for the data collection system at the site during the pre-application monitoring phase, is provided in Table 6.4-4.

The meteorological sensors installed on the tower are designed to operate under the range of environmental conditions expected at the site. Specifically, these sensors and the meteorological tower are capable of withstanding the following environmental conditions:

- Ambient temperature range of –22ºF to +122ºF (–30ºC to +50ºC).
- Relative humidity range of 0 to 100 percent.
- Tower design conforms to standard TIA/EIA-222-F for 100 mph (44.7 m/s) fastest-mile wind speed with no ice, and the 2003 International Building Code using a 120-mph (53.6 m/s) 3-second gust basic wind speed.

No adverse effects on the sensors from corrosion, blowing sand, salt, air pollutants, birds, or insects were observed during the pre-application monitoring period.

6.4.3.3 Data Recording and Storage

From the onsite meteorological tower, analog input signals from sensors were converted to digital signals via an A/D converter and displayed in meteorological units. The processing and recording equipment were housed in an environmentally controlled instrument shelter.

The Campbell Scientific data logger sampled sensor output once per second. For most parameters, hourly averaged values were based on 3600 data points per hour. Data averaging was arithmetic with the exception of that for wind direction, which was a vector average. Precipitation data was recorded as a cumulative hourly total. Values were archived as hourly averages in accordance with Regulatory Position 6 in Section C of RG 1.23 (U.S. NRC Mar 2007).

The data traces produced by an independent recorder software (from Darwin digital recorder) are to facilitate review and documentation of data collection. The traces were reviewed weekly for data quality assurance purposes.

Once each week, the data that had been stored on the local data collection computer was transferred to a computer dedicated for housing the site database. Once each week, the site database was also backed up to a server and a portable backup drive that was subsequently stored in an offsite fireproof safe deposit box.

6.4.3.4 Data Reduction and Reporting

The following data reduction and reporting program was implemented during the pre-application monitoring phase to ensure a valid, accurate, and representative meteorological database.

6.4.3.4.1 Data Screening and Validation

On a daily basis, the Campbell Scientific Loggernet software, which was located offsite at the environmental consultant's office, called the Campbell Scientific CR1000 data logger at the site. Data acquired since the last data collection (nominally 24 hours prior) was downloaded to a personal computer.

In the screening process, each parameter was analyzed by data screening software. A sample list of the data screening criteria is provided as follows:

- Wind speeds less than 1 mph, greater than 50 mph, or invariant for 2 or more consecutive hours were flagged on the data printout.
- When the lower wind speed exceeded the upper wind speed or the upper wind speed exceeded the lower wind speed by 15 mph, the wind speeds were flagged on the data printout.
- Wind directions were flagged on the printout if invariant for 2 or more consecutive hours, or the (automatically calculated) sigma-theta value equaled or exceeded 50 degrees.
- Wind directions were flagged on the printout if direction shear greater than 60 degrees existed between the lower and upper level directions.
- Ambient temperature values would be flagged on the printout if they were lower than a specified seasonally determined temperature, higher than a specified seasonally determined temperature, or more than a 6ºF change in an hour occurred.
- Vertical delta-T values were flagged on the printout if they were above 10ºF or below –10ºF.
- Dew point values, which were calculated using concurrent humidity and ambient temperature data, were flagged on the printout if they were below 0ºF, greater than 80ºF, or greater than a 6ºF change in a given hour.

- Precipitation values were flagged on the printout if they were greater than 0.25 inches per hour.

Subsequently, the data and screening results were reviewed by professional meteorologists to determine the data validity on a daily basis.

In addition, the daily data was also compared to measurements from a nearby observing station (i.e., Victoria Regional Airport). The data from the onsite monitoring program and the nearby, offsite location was not expected to match; however, the meteorologist looked for consistency in the temperature, atmospheric moisture, precipitation (timing and, to a lesser extent, the amount), wind speed, and wind direction. Information from maintenance logs and calibration results was taken into consideration as well in determining data validity.

As an integral part of the screening process, data from the Darwin digital recorder was retrieved via modem on a weekly basis. The data traces produced by the recorder software were reviewed and documented by a meteorologist. The field services manager and/or project manager were notified of any problems identified during the digital trace review.

If problems were discovered in the data screening or validation process, they were communicated to field services and management staff in a timely manner for corrective action. Routine site visitation logs, calibration logs, and equipment maintenance logs were generated in accordance with the Project Procedures Manual (Murray and Trettel Jul 2007) and included in the site monthly reports.

6.4.3.4.2 Identification and Handling of Suspect Data

At the end of each month, the designated project manager reviewed the data and edited the data as appropriate. Erroneous data was invalidated, while questionable data was reviewed further and a determination made as to whether the data would be invalidated or replaced. While the goal is to achieve full data recovery, a minimum of 90 percent valid data recovery is acceptable for all parameters measured, including the joint recovery of wind speed and wind direction for each level, and the joint recovery of wind speed and wind direction by atmospheric stability class for each level.

The following methodologies were followed, if required, for data substitution:

- Where data for a given parameter was missing for brief periods (e.g., 1 to 5 hours), interpolation could be used to fill data gaps.

- If wind direction data was missing or was invalid from one level, data from the other level could be used as a substitute. The average difference in directions could also be used as an offset to the available direction level.

- If wind speed data was missing or was invalid from one level, data from the other level could be substituted using the Power Law based on the surface roughness around the tower, time of day, and stability class to correct for height differences.

- Delta-T was used to determine and classify atmospheric stability in accordance with Table 1 of RG 1.23. When interpolation was necessary to fill stability gaps, time of day, season, and weather conditions (e.g., variations in wind speed and the presence or absence of precipitation) at the time were considered. The atmosphere is generally more unstable during daylight hours (and in particular during the afternoon hours), more stable during the nighttime hours, and neutral when it is overcast. Unstable conditions are more common during the warmer months and extend over a greater period of time during the day.

- Missing precipitation data could have been estimated using data collected at either Victoria Regional Airport or other nearby local observation stations.

Based on 2 years (i.e., July 1, 2007 through June 30, 2009) of data collected on site, there were only 46 hours of data measured at the lower measurement level missing and 47 hours of data from the upper level missing. For a given missing hour of data, the data could be for wind speed, wind direction, stability class, or a combination of these parameters. The overall data recovery rate of the 2-year of data well exceeds the RG 1.23 (U.S. NRC Mar 2007) specification of at least 90 percent. Because only a small amount of data is missing (i.e., less than 0.3 percent), no data substitution was necessary.

6.4.3.4.3 Data Reporting

After all data had been validated and verified by the project manager, monthly reports were generated. The monthly reports described:

- The activities that occurred at the site during the month.

- Valid data recovery rates for each parameter and a composite of wind speed, wind direction, and stability class.

- A summary of the data collection and reporting processes.

- Equipment maintenance logs, calibration logs, or routine site visitation logs that had been generated during the month.

6.4.3.5 Instrumentation Surveillance

Inspection, maintenance, and calibration of the onsite meteorological monitoring system were performed in accordance with Regulatory Position 5 (Instrument Maintenance and Servicing Schedules) in Section C of RG 1.23 (U.S. NRC Mar 2007) and Section 7 (System Performance) of ANSI/ ANS-3.11-2005 (ANSI/ANS Dec 2005).

Once each month, the meteorological monitoring site was visually inspected by field services personnel. A routine site visitation log was completed on site each month. The routine site visitation was a means of logging the site visit, which included the following activities:

- Verification that the data logger, digital recorder, and the uninterruptible power supply were working properly.
- Visual check of the tower.
- Comparison of visual wind indications versus the data shown on the digital recorder.
- Verification that the rain gage was functioning properly (unless it was raining or snowing at the time of visit) and was free of debris and cleaned, if necessary.
- Verification of ambient temperature and atmospheric moisture measurements using a psychrometer. A psychrometer measurement was taken to provide dry bulb and wet bulb temperatures. The dry bulb temperature was compared to the 10-meter ambient temperature reading. The dry and wet bulb temperatures were then used to calculate a dew point, which was compared to that being recorded at the 10-meter level.

Detailed instrument calibration procedures and acceptance criteria were strictly followed by qualified technicians during system calibrations. These calibrations helped to verify and, if necessary, reestablish the accuracies of sensors, associated signal processing equipment, and data displays. Routine calibrations included obtaining both “as-found” (before maintenance) and “as-left” (final configuration for operation) results. The end-to-end results were compared with expected values. Any observed anomalies that might have affected equipment performance or reliability were reported to the field service manager for corrective action. If any acceptance criteria were not met during performance of calibration procedures, timely corrective measures (e.g., adjusting response on site to conform to desired results or replacing a sensor with a calibrated spare) were initiated. At the end of each month, the project manager performed a thorough data consistency check and edited the data accordingly.

Specifically, the pre-application meteorological monitoring system was calibrated once every 4 months as specified in site procedures. System calibrations included ambient temperature at the

10-meter level, delta-T between 60 and 10 meters, relative humidity at the 10- and 60-meter levels, wind speed and wind direction at the 10- and 60-meter levels, solar radiation, and precipitation. For each calibration, the wind speed sensors were replaced with calibrated sensors. The sensors that were removed were tested “as found.” The wind sensors were tested at variable speeds, while the wind direction was tested on the tower.

These calibrations also included checks of the power supply, data logger, and digital recorder. Site meteorological calibration logs were completed while on site and were included in the monthly report. For the pre-application monitoring phase, calibration logs were stored at the meteorological consultant's offices.

At a minimum, routine bearing replacement occurred every 12 months for the wind direction sensors and every 6 months for the wind speed sensors. Those sensors removed from the tower were tested in an “as-found” condition. A spare set of calibrated sensors was installed upon removal to minimize downtime. An “as-left” calibration was then performed after the bearings had been replaced. The “as-found” and “as-left” values were recorded during the sensor calibration process.

The guy wires of the meteorological tower were inspected annually.

6.4.3.6 System Accuracy

Based on Regulatory Position 4 in Section C of RG 1.23 (U.S. NRC Mar 2007), determining the accuracy of time-averaged data from digital measurement systems should account for errors introduced by sensors, cables, signal conditioners, temperature environments for signal conditioning and recording equipment, recorders, processors, data displays, and the data reduction process.

System accuracy reflects the performance of the total system, from the sensors, through all processing components, to the display of measured values in their final form. System accuracy can be estimated by performing system calibrations or by calculating the overall accuracy based on the system's individual components. Accuracy tests involve configuring the system to near normal operation, exposing the system to multiple known operating conditions representative of normal operation, and observing the results. Industry guidance on methods for calculating system accuracy is provided in ANSI/ANS-3.11-2005 (ANSI/ANS Dec 2005).

During the pre-application monitoring phase, data collected on the meteorological tower was recorded and processed at the base of the tower inside an environmentally controlled shelter. System accuracies of the site meteorological data collection system were estimated by performing system calibrations, as one of the options suggested in Section 7.1 of ANSI/ANS-3.11-2005 (ANSI/ANS Dec 2005). Specifically, system accuracy for each measured parameter was determined by performing system calibration (i.e., from the meteorological sensor output to the output of the data loggers).

Both sensor accuracies and system accuracies were compared to the regulatory and industry requirements, and the findings are summarized in Table 6.4-4. As shown in the table, the sensor and system accuracies meet the regulatory guidance in RG 1.23 (U.S. NRC Mar 2007) and ANSI/ANS-3.11-2005 (ANSI/ANS Dec 2005).

6.4.4 Preoperational Monitoring Phase

Before plant operation, one year of onsite meteorological monitoring is planned to provide a basis that reflects the as-built environment for identifying and assessing environmental impacts resulting from plant operation.

6.4.4.1 Meteorological Parameters Measured

Meteorological parameters measured on the tower include wind speed, wind direction, and ambient temperature at the 10- and 60-meter levels, a 60-10-meter delta-T being referenced to the 10-meter ambient temperature, relative humidity at the 10-meter level, and precipitation at ground level.

The potential influence of plant structures and the potential effects of plant heat dissipation system operation on local meteorology were qualitatively examined. The results of this examination are described in Subsection 6.4.6.1.

6.4.4.2 Data Collection System

An onsite meteorological monitoring system similar to the ESP pre-application system will be used for preoperational monitoring. The instrumentation and sensors used will conform to RG 1.23, while instrument surveillance and data processing and validation will be carried out in accordance with the applicable regulatory requirements and relevant industry guidance, such as those for the pre-application monitoring.

6.4.5 Operational Monitoring Phase

The onsite meteorological monitoring program for the operational phase is expected to be similar to that described in Subsection 6.4.3 for the pre-application phase. The functional requirements of the operational phase monitoring program are described below relative to the system configuration for pre-application monitoring.

6.4.5.1 Description of Monitoring Program

The locations of the meteorological tower and instrumentation are not anticipated to change from those for the pre-application monitoring phase during the operational monitoring phase, although monitoring of certain parameters not related to atmospheric dispersion may be discontinued. Instrumentation surveillance and methods for data recording, transmittal, acquisition and reduction, while expected to be similar during the operational phase, will be controlled by plant-specific instrumentation design and procedures to be developed during the COL phase. Other anticipated, phase-specific monitoring program differences are addressed below.

- Meteorological parameters measured during plant operation include wind speed, wind direction, and ambient temperature at the 10- and 60-meter levels, a 60-10-meter delta-T being referenced to the 10-meter ambient temperature, relative humidity at the 10-meter level, and precipitation at ground level.
- During the ESP pre-application phase, meteorological data was collected locally at the tower and recorded as hourly average values. During the plant operational phase, 15-minute average values of wind speed, wind direction, and atmospheric stability class will also be required to be determined. Hourly averages would be compiled and archived for reporting purposes.
- Although RG 1.97, Revision 4 (U.S. NRC Jun 2006) allows flexible, performance-based criteria for the selection, performance, design, qualification, display, and quality assurance of accident monitoring variables, the 15-minute average data would be transmitted to the plant control room, technical support center, and/or emergency operations facility designated to serve the new units to be built on the VCS site.
- For instrumentation surveillance, channel checks would be performed daily.
- During system servicing, channel calibrations would be performed no less than semiannually. System calibrations encompass the entire data channel, including all recorders and displays (e.g., those local at the meteorological tower and in the emergency response facilities, as well as those used to compile the historical data set).
- Wind speed, wind direction, and atmospheric stability data collected by the plant computer system would be submitted as input to the NRC's Emergency Response Data System.
- Meteorological monitoring requirements for emergency preparedness and response support are described in Subsection 6.4.5.2.

Annual operating reports of effluent releases (both routine and batch) and waste disposal that include meteorological data collected on site would be prepared and submitted in accordance with RG 1.21, Revision 1 (U.S. NRC Jun 1974).

6.4.5.2 Emergency Preparedness Support

During the operational phase, the onsite meteorological monitoring program would also provide representative data for real-time atmospheric transport and diffusion estimates within the plume exposure pathway emergency planning zone (i.e., within approximately 10 miles) to support the dose assessments that are required during and following any accidental atmospheric radiological releases. (U.S. NRC Nov 1980, U.S. NRC Feb 1981, U.S. NRC Mar 2002, and U.S. NRC Jun 2006). At the COL stage, the meteorological tower and associated instrumentation will be reevaluated to ensure that they comply with the requirements of the most current revisions of NRC regulations and industry standards for monitoring onsite meteorological conditions (e.g., air temperature, wind speed, and wind direction).

The dispersion estimates input to the dose assessment calculations would be made using the most recent 15-minute averages of wind speed, wind direction, and atmospheric stability class (based on data from the onsite meteorological measurement system or other alternative estimates) (U.S. NRC Jun 2006). These 15-minute average values would be compiled for real-time display in the control room, technical support center, and/or emergency operations facility designated to serve the new units. All the meteorological channels required for input to the dose assessment models would be available and presented in a format compatible for their use (U.S. NRC Jun 2006).

Provisions would be in place to obtain representative regional meteorological data such as that from the Victoria Regional Airport, Texas, a meteorological consulting contractor, or via the internet to provide real-time data and forecasts, if the onsite meteorological system is unavailable following a radiological accident.

6.4.6 Meteorological Data

The following subsections provide a description of the meteorological data that was used in preparing the ESP application.

6.4.6.1 Representativeness and Adequacy of Meteorological Data

As previously described, wind speed, wind direction, and temperature difference measurements collected on site were used to estimate the site-specific dispersion factors for the new units if built at the VCS site.

Subsection 6.4.2 describes topographical characteristics, natural and assumed plant-specific features in relation to siting the meteorological tower, and the installed instrumentation. Because terrain variations between the tower base and planned finished plant grade in the power block area are minimal (i.e., <15 feet) and the assumed locations of plant structures and other nearby obstructions to airflow (e.g., trees) are all at approximately or more than 10 times their physical height away from the tower, no significant alteration to local airflow is expected and the meteorological tower location offers a local exposure similar to the area around the power block area for the new units.

Subsection 6.4.2 also identified the nearest asphalt surface being U.S. Highway 77 located approximately 1200 feet west of the tower. The closest edge of the potential plant gravel switchyard would be approximately 370 feet east of the tower, while a large concrete or asphalt parking lot, is planned for a location approximately 1030 feet from the tower. The nearest potential ventilation source would be located more than 2230 feet from the tower. An evaluation of their heat effects on the temperature measurements made at the tower was concluded to be negligible.

In addition, Linn Lake is approximately 3 miles east of the meteorological tower. The cooling towers, assumed to be located in the power block area, could be as close as 2230 feet from the meteorological tower. Subsection 6.4.2 describes and Figure 6.4-4 illustrates the relative positions of the meteorological tower and the plant cooling basin. Winds from the east-northeast through south-southeast directions could potentially carry moist air over the basin toward the meteorological tower, located 4480 feet west-northwest. However, due to the large distance separation between the meteorological tower and Linn Lake, the cooling towers, and the cooling basin, it has been previously concluded that nonrepresentative influences on the ambient air temperature and relative humidity measurements on the tower during plant operation are expected to be minimal.

Based on the description and findings above, it has been determined that the meteorological data collected from the onsite monitoring program is representative of the overall site meteorology and the multiphase onsite monitoring program provides an adequate database for making the required dispersion estimates.

6.4.6.2 Long-Term and Climatological Conditions

Meteorological data collected at Victoria Regional Airport, Texas, and that collected at the VCS site were examined to determine how well the onsite data represents long-term conditions at the site.

Evidence should be presented to show how well the meteorological data collected at the VCS site represents long-term conditions at the site (RG 1.206, C.I.2.3.3). If practical, the climate representativeness of the joint frequency distribution is checked by comparison with nearby stations which have collected reliable meteorological data over a long period of time (10-20 years). The distributions are compared with sites in similar geographical and topographical locations to ensure that the data are reasonable (NUREG-0800, Section 2.3.3). The joint frequency distribution is referring to the joint frequency distribution of wind speed and wind direction by stability class that is used for determining dispersion estimates.

Victoria Regional Airport is the closest observing station located approximately 17 miles north of VCS within the same climatological region (see Figure 2.7-1).Terrain between the VCS site and the airport is relatively flat. The base of the VCS meteorological tower is 82.4 feet NAVD 88, while the airport observing station is at 104 feet NAVD 88. The overall meteorological exposure of these two observing stations is similar. Thus, data collected at the airport is expected to be reasonably representative of the VCS site.

Since long periods of meteorological records (i.e., for 24 or more years of wind speed, wind direction, ambient temperature and precipitation) have been collected at the airport, these records can serve as a basis for comparing with the VCS data to demonstrate that the short-term VCS data is also representative of long-term conditions at the site.

Meteorological instrumentation (i.e., sensor exposure, instrument starting threshold, measurement elevation, and methods of data recording) at the airport observing station and the onsite monitoring system are different due to the nature of the data applications. Therefore, data comparison was limited to an assessment of consistency of the data collected at these two locations.

Specifically, comparisons of wind speed, wind direction, temperature, and precipitation were made. Vertical temperature difference (i.e., delta-T) was measured on site for atmospheric stability class determination, but this meteorological parameter is not measured at the airport. Because of this difference, determinations of the stability classes at the two locations would have different bases, and any comparison of the resulting data would not be a meaningful exercise. Accordingly, a comparison of the stability classes for the airport and VCS data sets was not performed.

6.4.6.2.1 Comparison of Wind Speed and Wind Direction

Two years (i.e., July 1, 2007 through June 30, 2009) of wind data recorded at the VCS site were analyzed and the resulting average annual and seasonal wind direction and wind speed conditions were discussed in Subsection 2.7.4.2. In addition, comparisons of the wind data collected onsite with those listed in the Local Climatological Data (LCD) Summary (which reports mainly the normals, means and extremes) for the Victoria, Texas, NWS station at the Victoria Regional Airport were made in the same subsection.

In summary, these specific data analyses, discussions and comparisons conclude the following:

- The wind direction distribution at the 10-meter level of the onsite meteorological tower (Table 2.7.10 Sheet 1) indicates a prevailing wind from the south-southeast on an annual basis with approximately 50 percent of the wind blowing from the southeast quadrant. Winds from the north and north-northeast sectors combined occur approximately 18 percent of the time annually. On a seasonal basis, winds from the southeast quadrant appear to predominate throughout the year, especially during the spring and summer. During the winter, winds from the north sector become more prevalent. Autumn represents a transitional season with winds from northeast and southeast quadrants occur with about the same frequency.

- Wind measurements made at 6.1 meters (20 feet) above ground and summarized in the LCD for the Victoria, Texas NWS station (NCDC, 2007) indicate a prevailing south-southeasterly wind direction on an annual basis, as well as seasonal variations, that appear to be reasonably similar to the 10-meter-level wind flow at the VCS site.

- Seasonal and annual mean wind speeds based on measurements from the lower (10-meter) level of the onsite meteorological tower over the 2-year period, and from instrumentation at the Victoria, Texas, NWS station based on a 24-year period of record that are summarized in the LCD are provided in Table 2.7.6. On an annual basis, mean wind speed at the 10-meter level is 4.0 meters per second at the VCS site. The annual mean wind speed at Victoria (4.2 meters per second) is similar to the 10-meter level at the VCS site, differing by only 0.2 meter per second. Seasonal average wind speeds are similar throughout the year, except during autumn when speeds average approximately 0.7 meters per second lower at the VCS site than Victoria. Seasonal mean wind speeds for both locations follow the same pattern.

In addition to these comparisons made in Subsection 2.7.4.2, a comparison of the wind frequency distribution based on the VCS data and the distribution associated with the Victoria Regional Airport data was made in this section to further confirm that the two years of VCS data reasonably represent the climatological conditions of the site area.

Wind measurements made at Victoria Regional Airport location are in 10-degree increments (i.e., 0 to 360 degrees rounded to the nearest 10 degrees). Five years (2003 through 2007) of hourly Victoria Regional Airport wind data were analyzed and the resulting wind frequency distribution is provided in Table 6.4-5.

Findings from the wind data comparison indicate the following:

- The wind frequency distribution of the 2-year combined VCS data collected at the 10-meter level as shown in Table 2.7-10 shows good agreement with the frequency distribution for the 5-year Victoria Regional Airport wind data set as shown in Table 6.4-5. Specifically, the

5-years of airport data indicate winds blowing from the southeast quadrant (i.e., 100 to 190 degrees) at approximately 45 percent while the winds from north and north-northeast sectors (i.e., 360 to 40 degrees) combined occur 16.3 percent on an annual basis.

- The prevailing (i.e., highest) wind direction was south-southeast (i.e., a 22.5 degrees sector centered at 157.5 degrees) and 160 degrees at the VCS site and the Victoria, Texas NWS station at the Victoria Regional Airport, respectively. The highest averaged wind speed for each location and time period was also found to be associated with the prevailing wind direction.
- As shown in the Victoria LCD, winds from the north sector become more prevalent from October through February. This pattern was in concert with the recent 5-years airport data and the 2 years of the VCS site data.
- The specific wind direction that was recorded least often was, in general, a west wind. Average wind speed was also the lowest when the wind direction had a westerly component.

In summary, there is strong evidence that winds from the southeast quadrant predominate throughout the year at both the VCS site and the nearby Victoria Regional Airport. Winds from the north sector are more prevalent during winter. West winds recorded the least at both sites. The highest averaged wind speed for each location is associated with the prevailing wind direction, while the lowest average wind speed is with a west wind.

As shown in Table 6.4-6, the wind data collected at the VCS meteorological monitoring site is consistent with the long-term LCD summary and the recent 5 years data from the Victoria Regional Airport. Thus, the two years of VCS site data is considered to be reasonably representative of the climatological conditions of the site area.

6.4.6.2.2 Comparison of Temperature and Precipitation

A qualitative assessment was performed to determine how well the onsite temperature and precipitation data represents long-term conditions at the site.

Data examined include the following:

<u>Victoria Regional Airport</u>

- Long-term (i.e., >30 years) local climatological data summary
- Recent one-year (i.e., July 2007 through June 2008) local climatological data summary

Victoria County Station

- One year (i.e., July 2007 through June 2008) of VCS onsite data

Due to the nature of precipitation events, which are point observations, in southeast Texas, comparing precipitation totals from locations that are several miles distant from one another is difficult. Heavy rain that falls during thunderstorms, causes precipitation to differ significantly over short distance. Thunderstorms that are common in southeast Texas can be evidenced in the following example: on July 16, 2007, the Victoria Regional Airport recorded 1.18 inches less rainfall than the VCS site. On the following day, the VCS site recorded 1.26 inches less rain than the airport.

Monthly total precipitation and monthly average ambient temperature were reviewed for a one-year period (July 2007 through June 2008). The airport reported greater monthly precipitation totals than the VCS site for the year reviewed. Both sites recorded record-breaking rainfall during July 2007. Victoria Regional Airport recorded 20.34 inches of rain while the VCS site recorded 17.95 inches of rain. During July, the airport recorded more precipitation than the VCS site on 13 days, less precipitation on 9 days and an equal amount on 9 days.

Temperature was measured at 10 meters at the VCS site, while temperature was measured closer to ground level at the Victoria Regional Airport. The average monthly temperature was slightly higher at the airport during the warmer months (May through November) and slightly cooler at the airport during the colder months (December through April). This phenomenon is expected due to the difference of the measuring heights.

In conclusion, the precipitation and temperature data collected at the VCS meteorological monitoring tower can be considered to be consistent with data from the Victoria Regional Airport, due to the nature of the precipitation events occurring in southeast Texas and the difference in measurement height at both locations for temperature.

6.4.6.3 Need for Additional Data Sources for Airflow Trajectories

The site and its surroundings are considered to be situated in open terrain for the following reasons:

- As previously described in Subsection 6.4.2.1, the site and surrounding area (i.e., area within 5 miles) are generally flat, ranging in elevation between 10 and 85 feet NAVD 88 and the terrain within 50 miles (80 kilometers) of the site is generally flat to gently rolling, except towards the west and northwest with terrain rising to 550 feet NAVD 88. The major influence on local meteorological conditions is the Gulf of Mexico. Prolonged air stagnation that limits dispersion is infrequent in the area.

- Based on 2 years of data collected on site, the predominant winds at the site are from southeast to south-southeast, and the VCS site is not a low-wind site that would be favorable for air stagnation.

As a result, data collected by the onsite meteorological monitoring program can be used for the description of atmospheric transport and diffusion characteristics within 50 miles (80 kilometers) of the plant site, such as that evaluated using the U.S. NRC-sponsored XOQDOQ dispersion model (Sagendorf, Goll, and Sandusky Sep 1982) referenced in RG 1.111 (U.S. NRC Jul 1977).

6.4.6.4 Supplemental Data for Environmental Impact Evaluation

Supplemental data from the Victoria Regional Airport is considered to be suitable for making impact predictions resulting from operation of the plant cooling towers, regarding visible plume, drift deposition, fogging and icing. In particular, the bases/reasons for making this determination are summarized below:

- Victoria Regional Airport is located approximately 17 miles north of VCS within the same climatological region.
- Data (i.e., wind speed, wind direction and ambient temperature) collected at the Airport are consistent with those collected at the VCS site (Subsection 6.4.6.2).
- There is no body of water nearby that would significantly influence the relative humidity or wet bulb measurements made in these two locations (Subsection 6.4.6.1).
- The Seasonal and Annual Cooling Tower Impact (SACTI) model used for predicting cooling tower plume impacts calls for twice daily mixing height, cloud ceiling, cloud cover, dry bulb, wet bulb, wind speed, and wind directions, which are routinely measured at Victoria Regional Airport (except mixing height), but were not measured at the VCS site for all parameters.
- Long-term meteorological data at Victoria Regional Airport is readily available that allows the year-to-year variation in meteorological data to be factored into the cooling tower plume impact predictions.

6.4.6.5 Period of Data and Data Used to Support the Application

Data collected from July 1, 2007 through June 30, 2009 is used to support the application. Specifically, an electronic sequential, hour-by-hour listing of the data set, in the format specified in Appendix A of RG 1.23 (U.S. NRC Mar 2007), is provided.

The annualized data recovery rates for the period from July 1, 2007 through June 30, 2009 are presented in Table 6.4-7 for the individual parameters (i.e., wind speed, wind direction, ambient temperature, delta-T, relative humidity, and precipitation) and for the composite dispersion-related parameters (i.e., wind speed, wind direction, and delta-T). All data recovery rates meet the RG 1.23 (U.S. NRC Mar 2007) specification of at least 90 percent.

Joint frequency distributions of wind speed, wind direction, and atmospheric stability class for the 2 years of onsite data are presented in Tables 2.7-9 and 2.7-10 for the 10- and 60-meter wind measurement levels. The format follows the example shown in Table 3 of RG 1.23 (U.S. NRC Mar 2007) for each stability class and for all stability classes combined.

The two years of available onsite data were used to calculate both the short-term and long-term atmospheric dispersion estimates presented in Section 2.7.

6.4.7 References

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Table 6.4-1
Meteorological Tower Siting Conformance Status

RG 1.23 Criteria for Tower Siting	Conformance Status	Remarks
The meteorological tower site has similar exposure as the site.	Conforms	The site is generally flat, ranging in elevation mostly between 65 and 85 feet NAVD 88. The meteorological tower is located in the northwestern part of the VCS site.
The tower base elevation is approximately the same as finished plant grade.	Conforms	Tower base elevation: 82.4 feet NAVD 88 Finished plant grade: 95 feet NAVD 88.
Location of the tower is not near a large body of water, such that the wind speed, wind direction, relative humidity, ambient temperature, vertical temperature differential measurements made on the tower would be affected.	Conforms	Linn Lake is approximately 3 miles east of the meteorological tower, and it is too far to influence the measurements made on the tower. The meteorological tower is approximately 4480 feet from the cooling basin at its closest point. Considering the large distance of separation between the meteorological tower and the cooling basin, nonrepresentative influences on the wind speed, wind direction, relative humidity, ambient temperature, and vertical temperature differential measurements are expected to be minimal.
Tower is not located on or near permanent man-made surfaces such that the ambient temperature measurements made on the tower would be affected.	Conforms	The meteorological tower is located in an area of open fields with natural vegetation (i.e., grasses and small shrubs). A 25-foot by 25-foot bed of light-colored gravel has been placed at the base of the tower. There is no existing large asphalt parking lot near the meteorological tower and U.S. Highway 77 is approximately 1200 feet from the tower. The minimum distance to the planned large gravel switchyard is 370 feet, while the closest concrete or asphalt parking lot is more than 1030 feet from the tower. With these large distance separations between these heat sources, the heat effect on the temperature measurements made on the tower is expected to be insignificant.

Table 6.4-2 (Sheet 1 of 2)
Meteorological Sensor Siting Conformance Status

RG 1.23 Criteria	Conformance Status	Remarks
Wind sensors should be located away from nearby obstructions to airflow (e.g., plant buildings, other structures, trees, nearby terrain) by a distance of at least 10 times the height of any such obstruction that exceeds one-half the height of the wind measurement level to avoid any modifications to airflow (i.e., turbulent wake effects).	Conforms	The only nearby existing structure is the meteorological equipment shelter which is 8 feet high, sitting 4 feet above ground near the base of the tower. Therefore, the roof elevation of the shelter is at 12 feet above ground, which is less than half of the lower wind sensor height at 10 meters (33 feet). Nearby trees and shrubs are relatively short (less than 15 feet tall) and are located 1000 feet or more from the tower. The tallest structure to be built at the VCS site could be as high as 230 feet. All nearby plant buildings and other structures would be located at approximately or more than 10 times the structure height away from the tower.
Wind sensors should be located to reduce airflow modification and turbulence induced by the supporting structure itself.	Conforms	The wind sensors were boom-mounted more than 6.5 feet from the tower (more than twice the tower's width of 1.5 feet) on the south side of the tower.
Ambient air temperature and atmospheric moisture sensors should be located in such a way so as to avoid modification by heat and moisture sources (e.g., ventilation systems, water bodies, or the influence of large parking lots or other paved surfaces).	Conforms	No large water bodies, ventilation systems, large parking lots, or other paved or improved surfaces existed or are planned within 1030 feet of the tower. The existing U.S. Highway 77 and the planned gravel switchyard are approximately 1200 feet and 370 feet at their closest approach to the tower. With these large distance separations between these heat sources, the heat effect on the temperature measurements made on the tower is expected to be insignificant. The ground surface at the base of the tower is natural vegetation and a small gravel-covered area around the base of the tower.
Temperature sensors should be mounted in fan-aspirated radiation shields to minimize adverse influences of thermal radiation and precipitation. Aspirated temperature shields should either be pointed downward or laterally towards the north. The shield inlet should be at least 1.5 times the tower horizontal width away from the nearest point on the tower.	Conforms	Temperature sensors were mounted in fan-aspirated radiation shields pointing to the north. The shield inlet was situated approximately 2.5 feet from the tower (more than 1.5 times the tower's width of 1.5 feet).

Table 6.4-2 (Sheet 2 of 2)
Meteorological Sensor Siting Conformance Status

RG 1.23 Criteria	Conformance Status	Remarks
Precipitation should be measured near ground level near the base of the tower. Precipitation gages should be equipped with wind shields to minimize wind-caused loss of precipitation and, where appropriate, equipped with heaters to melt frozen precipitation.	Conforms	Precipitation was measured using an 8-inch diameter heated tipping bucket gage, mounted at ground level but away from the tower shelter to prevent any interference in precipitation capture. Windshields were provided to prevent wind-caused under recording of precipitation. The rain gage wind shield was one-half inch above the level plain of the rain gage orifice. This is consistent with the shield's installation instructions and the National Weather Service National Training Center documentation for Standard Rain gages.

Table 6.4-3
Victoria County Station — Meteorological Tower Instrumentation

Parameter	Meteorological Tower Level (meters)
Wind Speed	10, 60
Wind Direction	10, 60
Ambient Temperature	10, 60
Differential Temperature (Delta-T)	A 60–10 meter delta-T measurement being referenced to the 10-meter ambient temperature.
Precipitation	Ground level
Solar Radiation[a]	4.6
Relative Humidity/Temperature[b]	10, 60
Dew Point	Calculated from ambient temperature with the coincident relative humidity measurements

(a) Solar radiometer was installed at 4.6 meters above ground. Data collected is not used in preparing the ESP application.

(b) The relative humidity sensors for the 10- and 60-meter levels were installed June 28, 2007, and during November 25–28, 2007, respectively.
(Note: The proposed plant normal cooling system is a cooling basin. The cooling towers considered to be used at the VCS site are of conventional wet mechanical draft type with typical physical tower height of approximately 66 feet (20.1 meters). The moisture content in the ambient air at the height of the cooling tower plume can be adequately represented by the relative humidity measurements made at the 10-meter level.)

Table 6.4-4 (Sheet 1 of 2)
Meteorological Monitoring System Configuration

Sensed Parameter[a]	Sensor Type, Manufacturer/ Model No./ P/N	Range	Sensor Accuracy	System Accuracy	System Accuracy per RG 1.23[b]	Starting Threshold	Starting Threshold per RG 1.23[b]	Measurement Resolution	Measurement Resolution per RG 1.23[b]	Elevation
Wind Speed	3 Cup Anemometer, Climatronics/ F460/ P/N 100075	0–100 mph (0–44.7 m/s)	±0.15 mph (±0.07 m/s)	0.15<x<0.45 mph	±0.45 mph (±0.2 m/s) or 5% of observed wind speed	0.5 mph (0.22 m/s)	1 mph (<0.45 m/s)	0.1 mph	0.1 mph (0.1 m/s)	10 m 60 m
Wind Direction	Wind Vane, Climatronics/ F460/ P/N 100076	0-540° (0–360°) (mechanical)	±2°	±5°	±5°	0.5 mph (0.22 m/s)	1 mph (<0.45 m/s)	1.0°	1.0°	10 m 60 m
Ambient Temperature	Thermistor, Climatronics/ P/N 100093	-22°F to +122°F (-30°C to +50°C)	±0.27°F (±0.15°C)	< ±0.9°F <(±0.5°C)	±0.9°F (±0.5°C)	N/A	N/A	0.1°F (0.1°C)	0.1°F (0.1°C)	10 m 60 m
Differential Temperature (Delta-T)[c]	Thermistor, Climatronics/ P/N 100093	-10°F to +10°F (-5.6°C to +5.6°C)	N/A	±0.18°F (±0.1°C)	±0.18°F (±0.1°C)	N/A	N/A	0.01°F (0.01°C)	0.01°F (0.01°C)	60-10 m
Precipitation	8-inch diameter tipping bucket (heated), Climatronics/ P/N 100097-1-10	N/A	± 1% for rain rates up to 1”-3”/hr. (2.54 to 7.6 cm/hr.) & ± 3% for rain rates of 0 to 6”/hr. (0 to 15.24 cm/hr.)	< ±10% for a volume equivalent to 2.54 mm (0.1 in) of precipitation at a rate <50 mm/h (<2 in/h)	±10% for a volume equivalent to 2.54 mm (0.1 in) of precipitation at a rate <50 mm/h (<2 in/h)	N/A	N/A	0.01 in (0.24 mm)	0.25 mm or 0.01 in	Ground Elevation
Relative Humidity[d]	Capacitive, Climatronics/ P/N 102273	0% to 100%	<±1% RH from 0% to 100%	±4%	±4%	N/A	N/A	0.1%	0.1%	10 m 60 m

Table 6.4-4 (Sheet 2 of 2)
Meteorological Monitoring System Configuration

Sensed Parameter[a]	Sensor Type, Manufacturer/ Model No./ P/N	Range	Sensor Accuracy	System Accuracy	System Accuracy per RG 1.23[b]	Starting Threshold	Starting Threshold per RG 1.23[b]	Measurement Resolution	Measurement Resolution per RG 1.23[b]	Elevation
Dew Point	Calculated from ambient temperature with the coincident relative humidity measurements	N/A	N/A	±1.5°C (±2.7°F)	±1.5°C (±2.7°F)	N/A	N/A	0.1°C (0.1°F)	0.1°C (0.1°F)	Calculated as noted under sensor type

(a) All sensor output was recorded at the base of the tower inside an environmentally controlled shelter. Hourly average values were calculated by the data logger at the shelter, and this hourly data was reviewed daily.

(b) The criteria in ANSI/ANS-3.11-2005 are identical to that in RG 1.23, Revision 1, for the parameters shown.

(c) Differential temperature is the change of temperature with height of a 60-meter delta-T measurement being referenced to the 10-meter temperature.

(d) The onsite meteorological system began operation on June 28, 2007, with the exception of the 60-meter relative humidity sensor, which was installed during November 25–28, 2007.

Table 6.4-5
5-Year (2003–2007) Wind Frequency Data at Victoria Regional Airport

	Wind Speed (MPH)										
Wind Dir[(a)]	**0-3**	**4-6**	**7-10**	**11-16**	**17-21**	**22-27**	**28-33**	**34-40**	**Over 40**	**Total Occurrences (%)**	**Avg. Speed**
01	0.25	0.87	1.34	1.00	0.30	0.04				3.81	9.65
02	0.21	0.70	1.22	0.72	0.13	0.03				3.01	9.09
03	0.33	0.91	1.21	0.55	0.07	0.01	0.00			3.08	8.05
04	0.30	0.93	1.19	0.39	0.05		0.00			2.86	7.67
05	0.29	0.94	1.14	0.36	0.06	0.01				2.80	7.67
06	0.31	0.88	1.09	0.40	0.04	0.00	0.01			2.74	7.67
07	0.26	0.84	0.96	0.30	0.01	0.00				2.38	7.35
08	0.27	0.71	0.81	0.30	0.02					2.11	7.37
09	0.31	0.72	0.81	0.22	0.02					2.08	7.14
10	0.32	0.81	0.81	0.29	0.03					2.27	7.29
11	0.32	0.85	1.00	0.49	0.09					2.76	8.04
12	0.27	0.81	1.40	1.12	0.32	0.02				3.94	9.70
13	0.21	0.95	2.45	1.51	0.29	0.03				5.43	9.64
14	0.19	0.88	2.49	1.44	0.39	0.07	0.00			5.46	9.93
15	0.19	0.87	1.96	1.93	0.65	0.13	0.00			5.72	11.07
16[(b)]	0.20	0.85	2.07	2.32	0.98	0.25	0.02			6.70	11.88
17	0.23	0.82	1.79	1.92	0.72	0.21	0.01			5.70	11.46
18	0.22	0.58	1.37	1.17	0.42	0.13	0.01			3.91	10.86
19	0.18	0.52	0.89	0.71	0.25	0.06	0.02			2.64	10.34
20	0.18	0.43	0.68	0.43	0.11	0.03				1.86	9.13
21	0.17	0.38	0.48	0.23	0.04					1.30	8.10
22	0.10	0.29	0.38	0.14	0.02					0.93	7.72
23	0.09	0.22	0.23	0.08	0.01					0.64	7.17
24	0.09	0.21	0.26	0.03		0.00				0.59	6.78
25	0.07	0.19	0.22	0.07	0.01					0.57	7.48
26	0.09	0.14	0.19	0.03	0.01					0.46	6.77
27	0.07	0.18	0.14	0.05	0.01	0.01				0.47	7.40
28	0.07	0.18	0.23	0.06	0.03					0.57	7.81
29	0.07	0.21	0.29	0.08	0.03	0.00	0.00			0.69	8.16
30	0.07	0.27	0.29	0.11	0.03	0.01	0.00			0.78	8.27
31	0.08	0.27	0.45	0.14	0.07	0.04	0.00			1.04	9.16
32	0.11	0.34	0.54	0.21	0.09	0.05	0.02			1.34	9.46
33	0.12	0.37	0.55	0.31	0.12	0.08	0.00			1.55	9.91
34	0.14	0.49	0.67	0.42	0.19	0.05	0.01			1.97	9.74
35	0.20	0.56	0.83	0.73	0.27	0.05	0.01			2.65	10.16
36	0.22	0.71	1.23	0.97	0.28	0.05	0.01			3.48	9.96
Calm	9.70									9.70	
	16.52	20.88	33.66	21.22	6.17	1.39	0.16	0.01	0	100	8.52

(a) Wind direction recorded at the Victoria Regional Airport is in 10-degree intervals (e.g., direction 36 is north and direction 18 is south).

(b) Prevailing wind direction is a wind direction with the highest percentage of occurrence.

Table 6.4-6
Summary of Wind Frequency Data

	Avg Wind Speed (mph)	Prevailing Wind Direction	Avg Wind Speed (mph) Associated with Prevailing Wind Direction	Least Wind Direction	Avg Wind Speed (mph) Associated with Least Wind Direction
Victoria Regional Airport					
Long-term (24 yrs)	9.7 (4.3 m/s)	SSE (Dir 16)	10.5 (4.7 m/s)	N/A	N/A
5 Years (2003–2007)	8.5 (3.8 m/s)	SSE (Dir 16)	11.9 (5.3 m/s)	W (Dir 26)	6.8 (3.0 m/s)
Victoria County Station					
Recent 2 Years (7/2007–6/2009)	9.0 (4.0 m/s)	SSE (Dir 16)	11.2 (5.0 m/s)	WSW (Dir 25)	5.6 (2.5 m/s)

Table 6.4-7
Annual Data Recovery Rates (Percent) for the VCS Meteorological Monitoring System (7/1/2007–6/30/2009)[a]

Parameter	7/1/07–6/30/09[b]
Wind Speed (10 meter)	99.9
Wind Speed (60 meter)	99.7
Wind Direction (10 meter)	99.7
Wind Direction (60 meter)	99.9
Delta-Temperature (60 meter–10 meter)[c]	99.7
Ambient Temperature (10 meter)	99.7
Relative Humidity (10 meter)	99.7
Precipitation (Ground-Level)	99.9
Composite Parameters	
WS/WD (10m), Delta-T (60m–10m)[c]	99.7
WS/WD (60m), Delta-T (60m–10m)[c]	99.7

(a) Pre-application monitoring began June 28, 2007. Meteorological data from July 1, 2007 to June 30, 2009 was used to make the dispersion estimates (i.e., X/Qs) in the ESP application.
(b) Relative humidity measured at the 60-meter level began November 28, 2007.
(c) Delta-T between 60-meter and 10-meter levels.

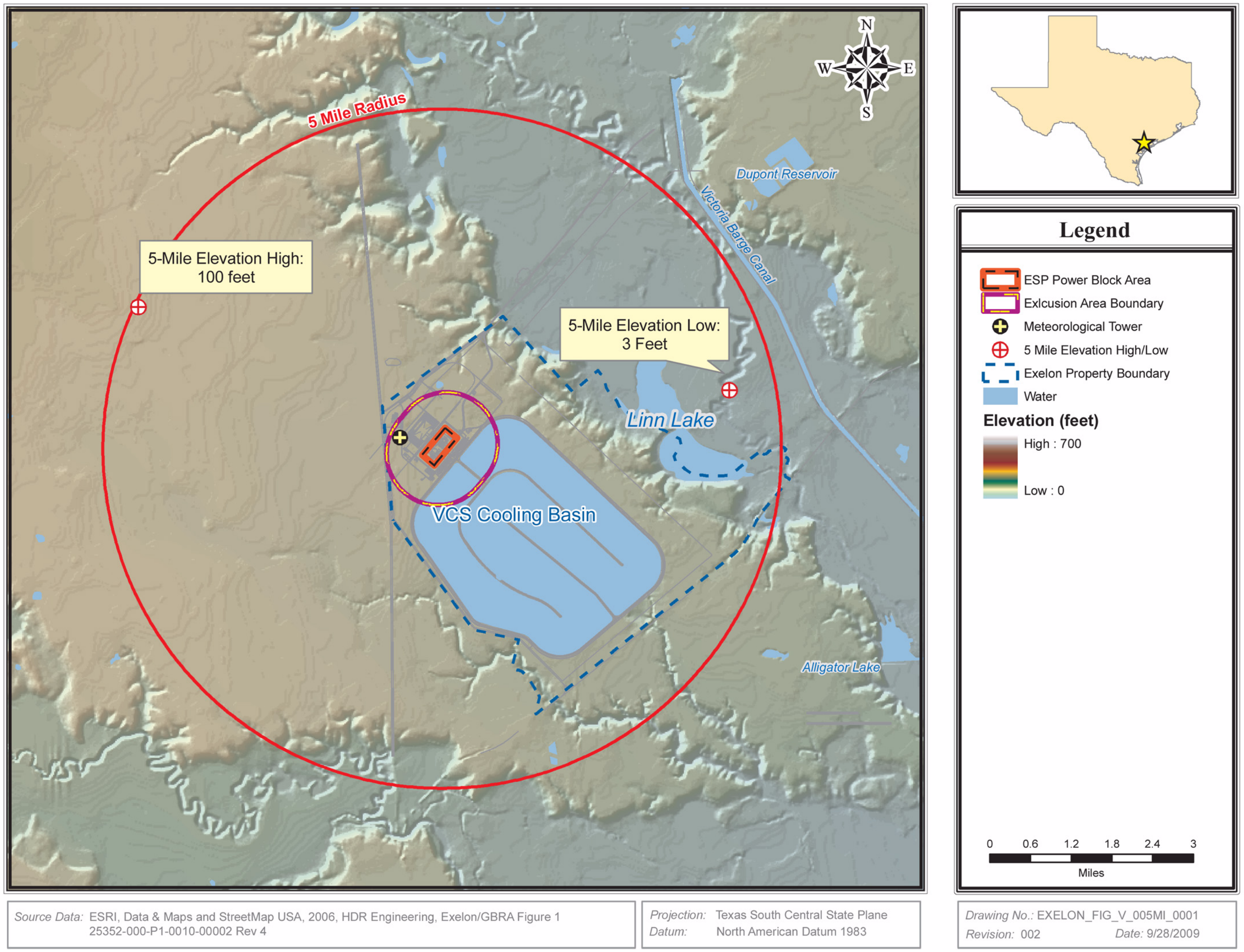
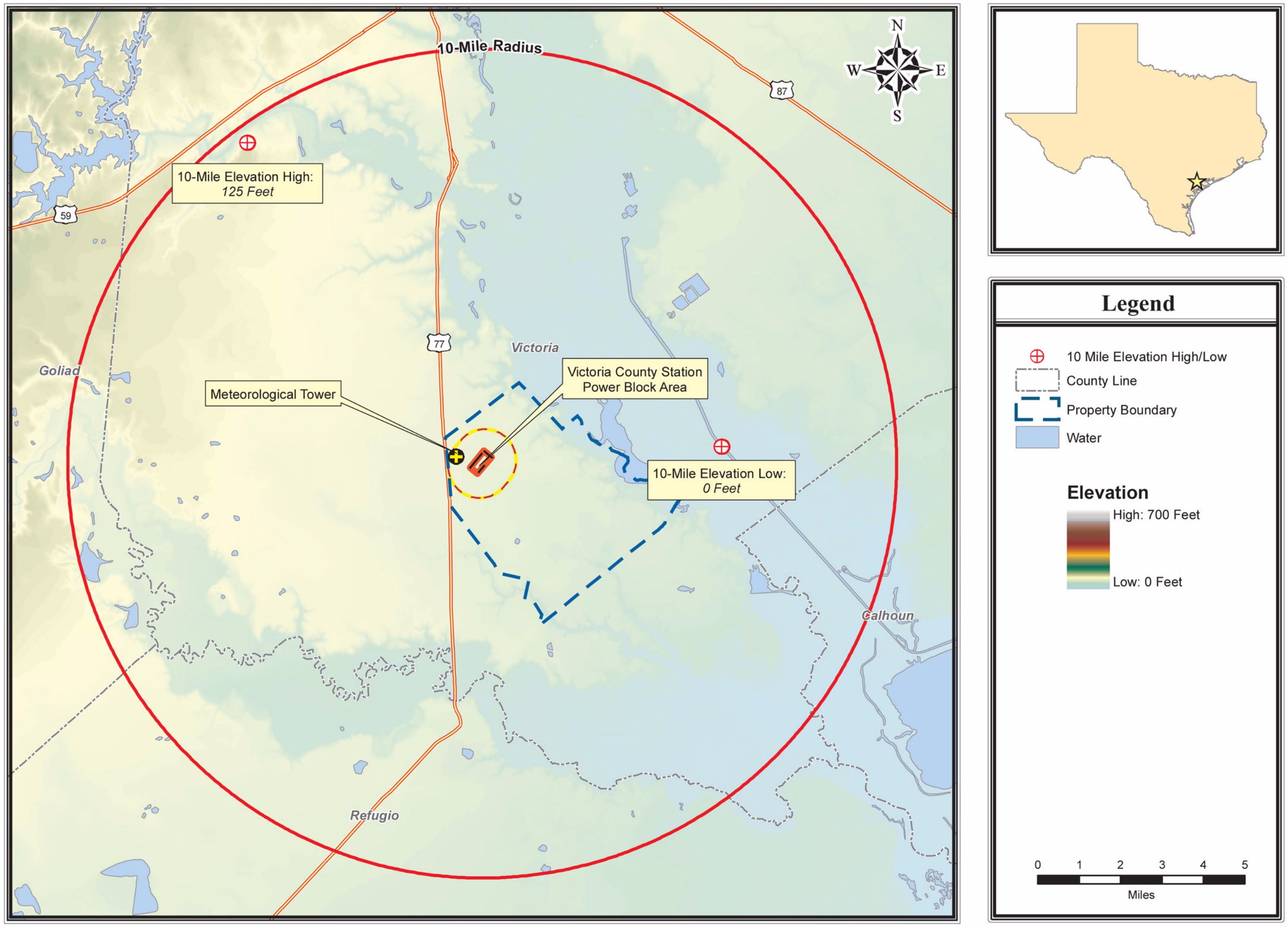


Figure 6.4-1 Site and Vicinity Map (5-Mile Radius)

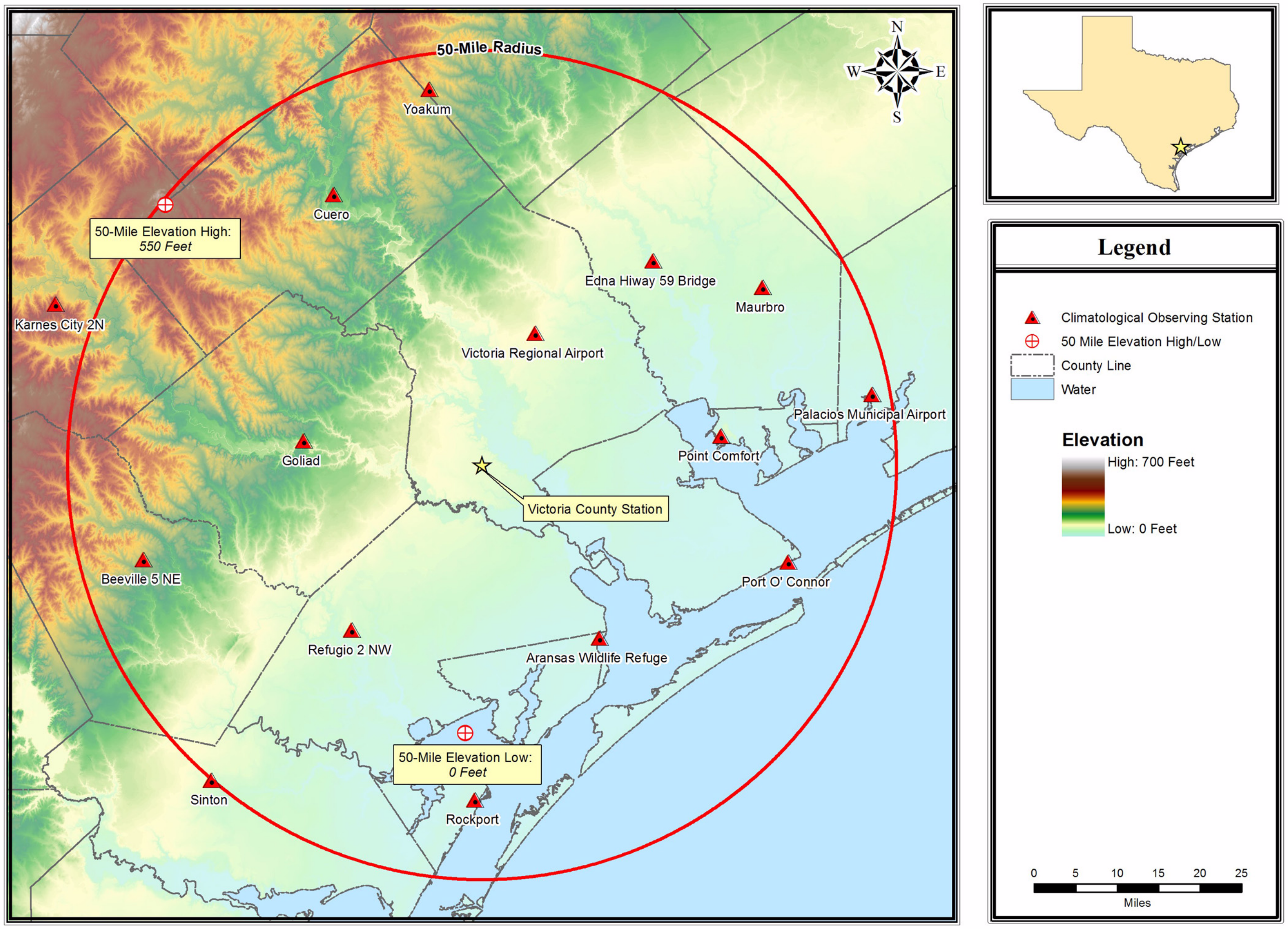


Source Data: ESRI, Data & Maps and StreetMap USA, 2006.
USGS, National Elevation Dataset, 1999.
25352-000-P1-0010-00002 Rev. 4

Projection: Texas South Central State Plane
Datum: North American Datum 1983

Drawing No.: EXELON_FIG_T_010MI_000
Revision: 005 Date: 9/28/2009

Figure 6.4-2 Site and Vicinity Map (10-Mile Radius)



Source Data: ESRI, Data & Maps and StreetMap USA, 2005.
Climatography of the United States, No. 20, 1971-2000, Monthly Station Climate Summaries (NCDC 2005).
National Climatic Data Center, Climate-Radar Data Inventories, http://www.ncdc.noaa.gov/oa/climate/stationlocator.html (NCDC 2007)

Projection: Texas South Central State Plane
Datum: North American Datum 1983

Drawing No.: EXELON_FIG_T_050MI_000
Revision: 006 *Date:* 9/28/09

Figure 6.4-3 Climatological Observing Stations near the Victoria County Station

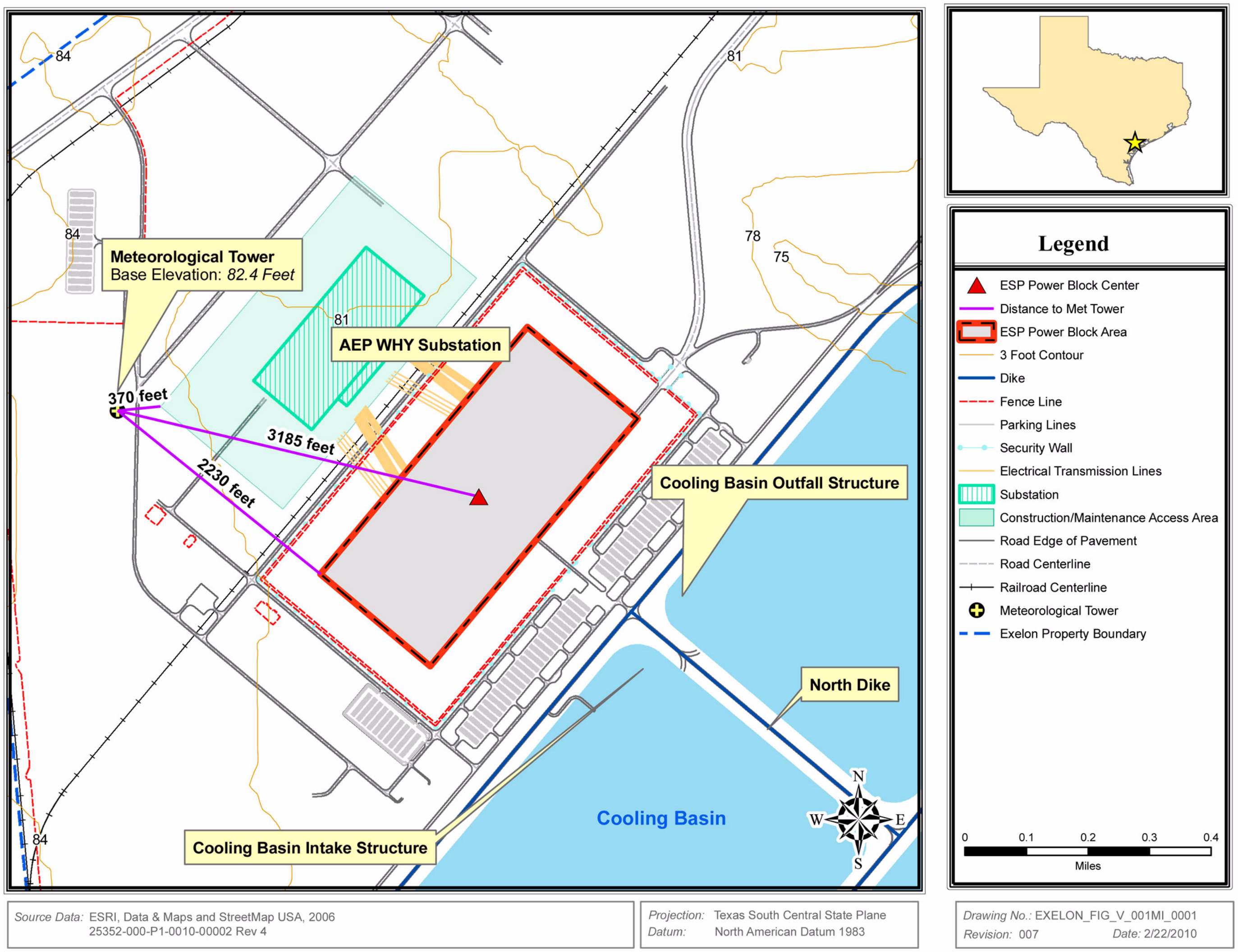


Figure 6.4-4 Location of Meteorological Tower Relative to Major Plant Structures and Other Features

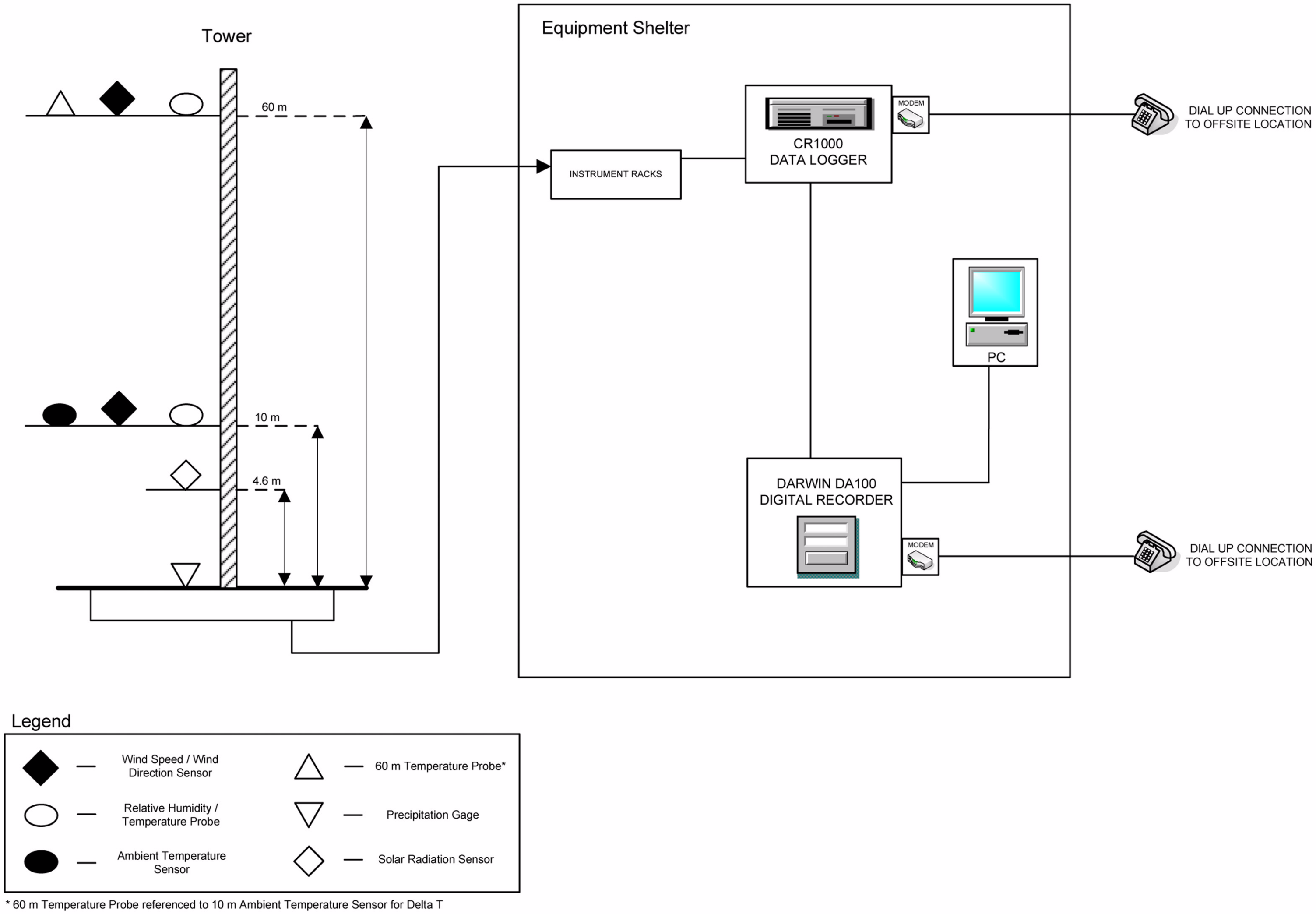


Figure 6.4-5 ESP Onsite Meteorological Monitoring System Block Diagram

6.5 Ecological Monitoring

Ecological monitoring programs are adopted to address the elements of the ecosystem for which a causal relationship between new unit construction and/or operational activities and adverse change is established or strongly suspected (U.S. NRC Oct 1999). The following is a description of ecological monitoring for terrestrial resources (Subsection 6.5.1) and aquatic resources (Subsection 6.5.2) associated with VCS.

6.5.1 Terrestrial Ecology and Land Use

6.5.1.1 Pre-Application Terrestrial Ecological Monitoring

As described in Subsection 2.4.1, the VCS site consists of approximately 11,500 acres and is characterized by gently rolling rangeland for cattle interspersed with ephemeral streams and wetlands and small clusters of trees (typically oak “mottes”). The rangeland generally consists of coastal prairie/bluestem grassland (McMahan et al., 1984) maintained in various stages of succession by prescribed burning, rotation of grazing livestock, and shrub control measures. The eastern edge of the site slopes sharply towards Black Bayou and Linn Lake. Hardwoods and shrubs dominate the slopes and transition into bottomland hardwood regions closer to the water bodies. Approximately 5785 acres are dedicated to the plant’s cooling basin (including associated berms surrounding this structure).

Plant and wildlife species found throughout the VCS site during pre-application surveys are common in similar habitats throughout the Texas Coastal Prairie region (see Subsection 2.4.1). Wildlife presence and habitat occurrence were determined during a series of surveys documenting the amphibians, birds, mammals, and reptiles onsite. Surveys for birds, threatened and endangered species, and general wildlife were conducted on the VCS site seasonally from October 2007 to October 2008.

The avian monitoring events consisted of 2 to 3 days of timed, pedestrian surveys of the various habitats on the proposed VCS site (Figure 2.4.1-1) to determine their seasonal species composition and relative abundance. Approximately 100 species of birds were documented on the VCS site.

Specific surveys for mammals, reptiles, and amphibians were conducted in April and May 2008. These were onetime surveys during the peak of activity of these species to document presence and relative abundance. For mammals, surveys included 800 total trap nights (Sherman live traps) in the various habitats of the VCS site, five remote game cameras left onsite for 25 days, one nighttime spotlight survey, and one night of mist nets set for bats. Sixteen total mammal species were observed on the VCS site with the greatest diversity found in the bluestem grasslands (Subsection 2.4.1, Figure 2.4.1-2).

Herpetological surveys included timed searches of the various habitat types (28 total hours), audible call counts, funnel traps in aquatic habitats (three nights), and a nocturnal road cruise. Twenty-two (22) total herpetological species were observed on the VCS site, with the greatest diversity found in the isolated wetland habitat type (Subsection 2.4.1, Figure 2.4-2).

As reported in Subsection 2.4.1, the only protected species, “important” species, critical habitat, or otherwise important habitat (as defined in NUREG-1555) that have been observed on or nearby the site are the bald eagle (state-listed as threatened), white-tailed hawk (state-listed as threatened), wood stork (state-listed as threatened), and game species such as deer, northern bobwhites, waterfowl, and doves. No protected or otherwise “important” plant species are listed for Victoria County and none were found on the VCS site. Exelon has initiated discussions with the appropriate federal and state agencies regarding endangered and threatened species (Appendix A). Jurisdictional and non-jurisdictional wetland habitats could be impacted by site construction, although the extent of this impact on jurisdictional wetlands is pending USACE determination.

Each of the three bald eagle sightings occurred at the site during a pre-application survey—one in October 2007 and two in October 2008. Each sighting documented a single bird soaring near the border of the VCS site and Linn Lake, where it was likely foraging. Bald eagle nests were not observed at the VCS site or Linn Lake during pre-application surveys.

White-tailed hawks are found in small numbers in the open range portions of the VCS site, but no nests have been observed on the site. The number of these hawks observed during the pre-application surveys is small (i.e., less than five). A single wood stork was observed in a drying pool within the river bottomlands in the southeastern corner of the VCS site in July 2008. In October 2008, a flock of approximately 30 wood storks was observed flying over the southern end of Linn Lake, but they did not land. The Texas coastal prairie region is generally important for migrating and wintering avian species because of its proximity to three migratory flyways, habitat diversity, and climate (Shackelford et al., Nov 2005). Seasonal use of the site by avian species is reported in Subsection 2.4.1. Additional monitoring of seasonal avian use in the region near the VCS site occurs during the Christmas Bird Counts (wintering populations) and Breeding Bird Surveys (nesting season populations) that occur within 10–20 miles of the VCS site (see description in Subsection 2.4.1). These surveys have occurred annually for several years. Information from these surveys can be used to document shifts, if any, of regional avian populations.

6.5.1.2 Construction, Preoperational, and Operational Monitoring

Habitats and wildlife species occurring on the VCS site are common throughout the region. Occurrence of “important species” on site primarily includes game species (deer, rabbits, quail, and doves), although low numbers of three state-listed species (white-tailed hawks, bald eagle, and wood stork) were observed on or near the site. These avian species as well as the large, mobile game species, will disperse to nearby similar habitats. Mobile avian species will lose habitats to VCS construction activities, but also should disperse to nearby similar habitats. Waterfowl and other water birds will gain habitat by the creation of the cooling basin.

For small, less mobile species (most amphibians, small mammals, and reptiles) within the construction footprint of the VCS facilities and cooling basin, local populations would be impacted as their habitat is removed during construction. Some may be able to shift to nearby habitats, but others would suffer mortality. However, similar habitats with similar fauna exist throughout the region, and thus regional populations would not be significantly impacted.

Plant communities within the VCS site (bluestem grasslands, ephemeral streams and wet depressions, oak forest) are common throughout the region. No “listed” plants occur in Victoria County or on the VCS site. Therefore, site construction should not reduce local or regional plant diversity.

Since the flora and fauna found on the VCS site are common throughout the region, and impacts to “important” fauna (primarily game species) are limited to displacement to nearby habitats, monitoring of terrestrial plant and animal communities during construction, preoperational, and operation phases is not warranted and is not proposed.

Offsite areas supporting the VCS site include the makeup water pipeline, the cooling basin blowdown discharge pipeline, and transmission corridors to the Coleto Creek, Hillje, Blessing, and Cholla substations (Figures 2.2-3, 2.2-4, and 2.2-5). As described in Subsection 2.4.1, construction of the new corridors and potential modifications (expansion, new towers, etc.) to existing transmission corridors would not impact protected wildlife species or critical habitats. American Electric Power maintains and monitors vegetation within the transmission corridor annually and has existing procedures for documenting and reporting mortality of avian species and occurrence of protected species to the appropriate regulatory agency. The only impacts of these transmission corridors may be to bottomland wetlands within the Guadalupe River basin and other possible stream and river crossings. A bald eagle nest has been reported in the vicinity of the proposed cooling water basin blowdown discharge pipeline corridor. Once the scope of work on the east side of the site and associated offsite areas has been finalized, the appropriate agencies would be consulted concerning potential impacts to this nesting area and the potential need for monitoring. The impacts to terrestrial resources along these corridors are small and should not require additional monitoring.

In summary, as construction of the VCS commences, large game animals and most avian species are expected to move to nearby areas offering suitable habitat. Smaller, less mobile animals (e.g., amphibians, reptiles, and small mammals) that are unable to disperse to adjoining tracts of land would be impacted. There could be impacts to wildlife from construction of the cooling water basin discharge pipeline, development of new transmission corridors, and expansion of existing transmission corridors, but impacts would be temporary, lasting only as long as the construction activity. Based on available information, Exelon concludes that monitoring during the construction, preoperational, and operational phases of the project would not be necessary.

6.5.2 Aquatic Ecology

Pre-application monitoring programs are carried out to aid in the assessment of site suitability and create a baseline against which to "identify and evaluate potential impacts to the aquatic environment that would result from construction and operation of the proposed project" (U.S. NRC Oct 1999). Site preparation and construction monitoring are normally required only when "specific adverse impacts are predicted and when conscientious construction practices" are insufficient (U.S. NRC Oct 1999). Preoperational and operational monitoring are typically carried out as a requirement or condition of a National Pollutant Discharge Elimination System (NPDES) permit, in coordination with state permitting agencies.

6.5.2.1 Pre-Application Monitoring

Exelon implemented a pre-application monitoring program in January 2007 to characterize the fish and benthic macroinvertebrate communities of the VCS site, the nearby Guadalupe River, and portions of the Guadalupe-Blanco River Authority (GBRA) canal system. The GBRA canal system is considered as an alternate raw water makeup (RWMU) system intake location in Section.9.4. Consistent with the NRC's (Oct 1999) *Environmental Standard Review Plan*, this monitoring program is intended to support the descriptions of aquatic communities in Subsection 2.4.2 of the Environmental Report and serve as the basis for the assessment of potential impacts from construction and operation of the proposed facility.

Exelon's pre-application monitoring program encompassed fish and benthic macroinvertebrate sampling of onsite and "near-site" water bodies including several wetlands, a stock pond, permanent and intermittent streams draining the site, and two natural lakes; juvenile and adult fish sampling along approximately 18 miles of the Guadalupe River; ichthyoplankton sampling at the point where water is diverted from the Guadalupe River to the GBRA canal system; juvenile and adult fish sampling at Goff Bayou, which conveys water within the GBRA canal system; juvenile and adult fish sampling at a station in the GBRA Main Canal; and ichthyoplankton sampling at a station in Goff Bayou and a station in the GBRA Main Canal. Subsection 2.4.2 summarizes the results of these surveys. No state- or federally listed aquatic species have been collected by Exelon during pre-application monitoring, and no critical habitat has been identified in the project area.

Twelve sampling stations (designated MC-01 through MC-12) have been established in the immediate vicinity of the site (Subsection 2.4.2). These stations encompass intermittent and perennial streams, wetlands, borrow pits, a stock pond, headwaters of a small lake (Cypress Lake), and a larger oxbow lake (Linn Lake). Baseline data collected from these sampling stations allowed Exelon to identify changes in fish and benthic macroinvertebrate assemblages associated with facility and infrastructure construction. Fish were collected at these survey stations seasonally in 2008 using beach seines ("two-stick" seines), minnow traps, gill nets, and backpack electrofishing gear, as indicated in Table 6.5-1. Benthic macroinvertebrates are collected at selected sampling stations using an Ekman dredge.

6.5.2.1.1 Guadalupe River Surveys

Guadalupe River adult fish surveys were conducted monthly at five stations (designated GR-01 through GR-05; Subsection 2.4.2) from January 2008 to December 2008. Stations were selected to provide baseline data for the assessment of construction and operations impacts. A boat-mounted electrofishing unit of conventional design was used to collect adult and juvenile fish. Electrofishing was conducted along well-marked transects (marked with stakes, PVC pipes, day-glo flagging) for 30–60 minutes (no less than 15 minutes of "pedal time," when current was actually applied to the water, per station). Transects were chosen to encompass a variety of bank types, cover types, microhabitats, snags, etc. To the extent practicable, electrofishing was conducted in the early morning, when light levels were low and fish were in shallows.

Adult fish collected were identified by species, counted, measured (total length in millimeters [mm]), and weighed (grams). When large numbers of small, juvenile fish or forage fish (e.g., shiners or threadfin shad) were collected, they were identified, counted, and weighed in aggregate. The number of fish collected at each station was recorded and percent occurrence ("relative abundance") was calculated. Total weights and relative weights (percent of total) were recorded for each species at each station. Catch-per-unit-effort was calculated for each species at each station to normalize the data.

Fish eggs and larvae were sampled once in February, twice monthly over the March-June peak spawning period, twice in July, and once per month in August, September, and October at Station GR-05. No samples were collected in winter months (November–January) because the February sampling event yielded minimal numbers of fish eggs and larvae. Fish eggs and larvae were collected with paired 0.5-meter-diameter plankton nets constructed of 335 micron mesh and towed at near-surface and mid-depths. The net(s) were fitted with a flow-meter and sample volumes (greater than 50 cubic meters per sample) were recorded. Daytime (afternoon) and nighttime (at least 2 hours after "legal" sunset) samples were collected, so that diel differences could be examined. Nets were towed along an established transect that lies immediately west of and perpendicular to the diversion canal and diversion gates.

Samples were preserved in the field and transported to the laboratory for analysis. In the laboratory, fish eggs and larvae were sorted and separated from debris and plant material. Larval fish and eggs were identified with the aid of a stereomicroscope. To the extent practicable, fish eggs and larvae were identified to species. Fish eggs and larvae were counted in order that number per sample and densities (based on volume of water filtered by the nets) could be calculated. Numbers of eggs and larvae of each species were noted; densities of eggs and larvae of each species and percent occurrence of eggs and larvae of each species were calculated.

At each sampling station, measurements of temperature, dissolved oxygen, turbidity, pH, and conductivity were taken at a 1-meter depth, at a mid-depth (middle of water column), and (near) bottom. This data was noted in a field log along with station name, time, and other pertinent information (river level, debris load, water clarity, approximate ambient temperature, etc), as it may have influenced distribution and abundance of fish and affected efficiency of sampling gear.

6.5.2.1.2 Calhoun Canal System Surveys

As described previously, the GBRA Canal System is being considered as an alternate RWMU system intake location in Section 9.4. The goal of the Calhoun Canal system surveys was to characterize the seasonal abundance of fish in Goff Bayou and the GBRA Main Canal that might be vulnerable to impingement (juvenile and adult fish) and entrainment (ichthyoplankton). Juvenile and adult fish were sampled monthly from Goff Bayou and the GBRA Main Canal using a boat-mounted electrofishing unit, as described previously. Transects have been established in both locations and marked as described previously. Juvenile/adult fish were collected, handled, and processed as described in Subsection 6.5.2.1.1.

Fish eggs and larvae were sampled once in February 2008, twice monthly over the March-June 2008 peak spawning period, twice in July 2008, and once monthly in August, September, and October 2008 at Goff Bayou and the GBRA Main Canal. No samples were collected in winter months (November-January) because the February 2008 sampling event yielded minimal numbers of fish eggs and larvae consistent with regional species generally spawning in warmer portions of the year. Fish eggs and larvae were collected with paired 0.5-meter-diameter plankton nets constructed of 335 micron mesh and towed at near-surface and mid-depths. The net(s) were fitted with a flow-meter and sample volumes (greater than 50 cubic meters per sample) recorded. Daytime (afternoon) and nighttime (at least 2 hours after “legal” sunset) samples were collected. Nets were towed along established transects in Goff Bayou and the GBRA Main Canal.

Samples were preserved in the field and transported to the laboratory for analysis. Samples were sorted, separated from debris and plant material, and identified. To the extent practicable, fish eggs and larvae were identified to species. All fish eggs and larvae were counted in order that number per sample and densities (based on volume of water filtered) could be calculated. Numbers of eggs and larvae of each species were noted; densities of eggs and larvae of each species and percent occurrence of eggs and larvae of each species were calculated.

Measurements of temperature, dissolved oxygen, turbidity, pH, and conductivity were taken at a 1-meter depth, at a mid-depth (middle of water column), and (near) bottom before sampling commences (afternoon and night). These data were noted in a field log along with station name, time, and other pertinent information (canal level, debris load, water clarity, approximate ambient temperature, etc).

Subsection 2.4.2 summarizes the results of onsite/near-site surveys, Guadalupe River surveys, and Calhoun Canal system surveys. Survey results were augmented by data obtained from The Academy of Natural Sciences of Philadelphia. No state or federally listed species have been collected by Exelon contractors during pre-application monitoring, and no critical habitat has been identified in the project area.

6.5.2.2 Construction Monitoring

The construction activities that could temporarily affect water quality, and thus aquatic organisms, include extensive site preparation and excavation in support of generating facility development and the new cooling basin. Additionally, there would be temporary impacts to water quality and impacts associated with construction of the RWMU system intake canal and a blowdown discharge structure on the Guadalupe River, including the associated cooling water basin blowdown discharge line and RWMU system pipelines. Soil disturbed during construction could move downgradient into several small streams that drain the site, as well as into the Guadalupe River. However, Exelon would use best construction management practices to control erosion and limit the amount of soil and sediment-laden water entering this waterway.

Construction activities or dredging within or adjacent to navigable waterways (waters of the United States) would require permits from the U.S. Army Corps of Engineers. Stormwater discharges from large construction activities (5 acres or more) in Texas are regulated under Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR150000 (TCEQ Feb 2008). A Stormwater Pollution Prevention Plan with proposed best construction management practices (including measures to limit erosion and sedimentation) must be completed before obtaining authorization to discharge under one of these General Permits. The proposed construction activities would be of relatively short duration, and would be guided by a Stormwater Pollution Prevention Plan. Additionally, there are no sensitive habitats or populations in the areas proposed for construction. Accordingly, Exelon concludes that impacts to aquatic communities from construction would be small, localized, and temporary, and would not require additional formal monitoring beyond that described previously.

6.5.2.3 Preoperational and Operational Monitoring

Although closed-cycle cooling systems are known to be relatively benign with respect to aquatic communities, the TCEQ could require preoperational and operational monitoring of aquatic communities. The NRC's (Oct 1999) *Environmental Standard Review Plan* notes that "any necessary pre-operational monitoring will ordinarily be defined in the NPDES permit." Likewise, the Environmental Standard Review Plan observes that "any necessary operational monitoring will be covered under the relevant NPDES permit." Exelon concludes that operational impacts to aquatic communities would be small and localized, and the need for operational monitoring will be determined during permitting activities at the COL stage.

6.5.3 References

Baker and Greene Mar 1989. Baker, W.B., and Greene, G.N. *Final Report: 1987–1988 Special Ecological Studies for the South Texas Project, Matagorda County, Texas,* March 1989.

McMahan et al 1984. McMahan, C.A., Frye, R.G. and Brown, K.L. *Vegetation Types of Texas Including Cropland*, 1984.

Shackelford et al Nov 2005. Shackelford, C.E., Rozenburg, E.R. Hunter, W.C. and Lockwood, M.W. *Migration and Migratory Birds of Texas: Who They Are and Where Are They Going* (4th Edition), PWD BK W7000-511 (11/05), November 2005, Texas Parks and Wildlife.

TCEQ Feb 2008. Texas Commission on Environmental Quality, *General Permit to Discharge Wastes*, TPDES General Permit No. TXR150000, February 15, 2008.

USFWS 2008. U.S. Fish and Wildlife Service, *Texas Colonial Waterbird Census: Most Recent Texas Colonial Waterbird Database*. Available at http://www.fws.gov/texascoastalprogram/TCWC.htm, accessed April 9, 2008.

U.S. NRC Oct 1999. U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, *Environmental Standard Review Plan: Standard Review Plans for Environmental Reviews for Nuclear Power Plants,* October 1999.

Table 6.5-1
Onsite and Near-Site Aquatic Surveys

	Samples Collected				
Station	Minnow Traps	Beach Seine	Gill Nets	Backpack Electrofisher	Benthos
MC-01 (unnamed stream)	√	√		√	√
MC-02 (unnamed stream)	√	√			√
MC-03 (borrow pit)	√	√			√
MC-04 (borrow pit)	√	√			√
MC-05 (Kuy Creek)	√	√		√	√
MC-06 (Dry Kuy Creek)	√	√			√
MC-07 (Black Bayou)	√	√		√	√
MC-08 (Linn Lake)	√	√	√		√
MC-09 (Linn Lake)	√	√			√
MC-10 (Upper Cypress Lake)	√	√		√	√
MC-11 (stock pond)	√	√	√		√
MC-12 (wetland)	√			√	√

6.6 Chemical Monitoring

The following section describes the chemical monitoring programs at VCS for surface water and groundwater quality, including:

- Pre-application monitoring that supports, in part, the baseline water quality descriptions in Chapters 2 and 3.
- Construction/preoperational monitoring intended to identify potential impacts of preconstruction and construction activities and provide a basis for identifying and assessing environmental impacts from VCS operation.
- Operational discharge monitoring intended for evaluation of environmental impacts from VCS operations.

Discussions related to historic, current, and future water use, and potential discharges and pollutant sources are found in Subsection 2.3.2 and 2.3.3 and Sections 3.3, 3.6, 5.2, and 5.5. Baseline environmental water quality is described in Subsection 2.3.3 and anticipated wastewater generation is described in Sections 3.6 and 5.5.

6.6.1 Pre-Application Monitoring

Exelon implemented a pre-application monitoring program to provide water quality baseline information that supports the assessment of potential impacts resulting from construction and operation of VCS. The pre-application chemical monitoring program included surface water quality monitoring of five surface water bodies (Guadalupe River, Coleto Creek, Linn Lake, Kuy Creek, and Calhoun Canal) and groundwater monitoring of nine onsite wells and one offsite well. The GBRA canal system is considered as an alternate raw water makeup (RWMU) system intake location in Section 9.4.

These surface water bodies and groundwater wells were monitored for the parameters identified in Table 6.6-1. Table 6.6-1 also provides the analytical methods used and sample preservation and handling procedures.

Two pre-application surface water and groundwater monitoring datasets (one collected in November 2007 and the other in April 2008) are discussed in Subsection 2.3.3. A review of historic surface water quality data from the Texas Commission on Environmental Quality (TCEQ) and U.S. Geological Survey monitoring stations in the site vicinity indicates that temporal variability in surface water quality in the area is minimal. However, the two pre-application datasets were collected to confirm there is minimal seasonal variation (between autumn and spring) in water quality at and near the site.

6.6.1.1 Surface Water Monitoring

Six surface water monitoring locations in the vicinity of the proposed VCS site comprise the pre-application surface water monitoring program. These monitoring locations are discussed in detail in Subsection 2.3.3 and are shown in Figure 2.3.3-4.

The first monitoring location (SW-01) is located on the Guadalupe River near the Guadalupe-Blanco River Authority (GBRA) salt water barrier. This location was selected to characterize surface water hydraulically downgradient of the proposed VCS, including the cooling basin blowdown. Additionally, this location coincides with the proposed location for the RWMU system intake canal, which would divert Guadalupe River water to the RWMU system intake structure and pumphouse.

The second monitoring location (SW-02) is located on Kuy Creek near the entrance to the VCS site from McFaddin. Review of site topography indicates that shallow surface water from the southern and southwestern corner of the site likely drains into Kuy Creek.

The third monitoring location (SW-03) is located near the southeast end of Linn Lake adjacent to the levee. Review of site topography indicates that shallow surface water from the northeastern and eastern edge of the site likely drains into Linn Lake. In addition, the cooling basin would have a spillway on its southeastern flank that could allow water to flow into Linn Lake during potential overfill events.

The fourth and fifth monitoring locations (SW-04 and SW-05) are located on Coleto Creek and the Guadalupe River, respectively, at locations hydraulically upgradient of the site and are used as control points from unaffected locations.

The sixth monitoring location (SW-06) is located on the GBRA's Calhoun Canal adjacent to the GBRA Relift #1 Pump Station. This location coincides with the proposed alternate location for the raw water makeup pumphouse on the canal.

Two quarterly surface water sampling data sets were obtained in accordance with EPA standard operating procedures. This data provides a baseline of water quality in the vicinity of the proposed VCS. The two rounds of surface water quality monitoring, coupled with historical surface water quality data in the vicinity of VCS, provide adequate characterization of seasonal variation over an annual cycle. The data obtained through this sampling program supports the environmental descriptions for hydrology, water use, water quality, and aquatic ecology discussed in Chapter 2.

6.6.1.2 Groundwater Monitoring

Nine groundwater monitoring locations at the site and one groundwater monitoring location south of the site comprise the pre-application groundwater monitoring program. These monitoring well locations are detailed in Subsection 2.3.3 and shown in Figure 2.3.3-1.

The nine onsite groundwater monitoring locations consist of two pre-existing livestock wells and seven observation wells that were installed in the northwest half of the VCS site during pre-application activities. The nine shallow onsite wells sampled during the pre-application phase are screened in the shallow Chicot Aquifer. The well locations were selected to provide a baseline for the identification and measurement of potential shallow groundwater quality impacts from VCS operation.

Exelon proposes to withdraw groundwater for potable and other water uses from the Evangeline Aquifer. Because no wells on the site are screened in the Evangeline Aquifer, a deep irrigation well (TWDB #7932602) located south and hydraulically downgradient of the site near the town of McFaddin was selected for inclusion in the April 2008 monitoring event. The well is screened in the Evangeline Aquifer at a depth of 595 feet below ground surface.

6.6.2 Construction and Preoperational Monitoring

6.6.2.1 Surface Water Monitoring

Preconstruction and construction activities at the proposed VCS site will likely require a Texas Pollutant Discharge Elimination System (TPDES) general stormwater construction permit issued by the TCEQ. The TPDES permit would contain requirements to be implemented in the monitoring program (TCEQ Feb 2008). The TCEQ may not require monitoring of receiving waters as part of a TPDES general stormwater permit. However, a limited monitoring program may be implemented in the vicinity of the stormwater discharges to assess the effectiveness of erosion controls established during construction, as warranted by site conditions.

Surface water bodies that may be included in the construction and preoperational monitoring are the Guadalupe River, Kuy Creek, Dry Kuy Creek, and Linn Lake. The surface water monitoring stations could include the locations (D-1, D-2, D-3, D-5, D-8, Sw-5) listed in Table 6.2-2 and shown in Figure 6.2-4.

In addition to identifying potential water quality impacts related to preconstruction and construction activities, a goal of surface water monitoring during these activities would be to provide a baseline for the identification and assessment of potential surface water quality impacts associated with plant operation. The VCS pre-application monitoring program provides adequate baseline data to support this goal. However, if preconstruction/construction site conditions or regional water quality conditions (as reported by the TCEQ) warrant it, preconstruction/construction monitoring may be conducted to update the baseline conditions prior to the start of operational monitoring. Monitoring frequency would be dictated by site conditions or permit requirements.

Additionally, a Texas Pollutant Discharge Elimination System (TPDES) permit could be required to discharge treated sanitary effluent to surface water during construction. Monitoring would be conducted in accordance with the permit, as applicable.

6.6.2.2 Groundwater Monitoring

The construction and preoperational groundwater monitoring program has not been fully developed because of expected abandonment of most existing onsite wells prior to construction. However, a construction and preoperational groundwater monitoring system would be installed prior to or during the initial construction phase. The groundwater monitoring system would consist of a minimum of nine wells (Gw-1 through Gw-9) to be installed. The wells would be located near the power block and around the perimeter of the VCS cooling basin at the locations listed in Table 6.2-2 and shown on Figure 6.2-2. The final locations of the proposed groundwater monitoring points described in Section 6.2 could be adjusted prior to installation, if warranted by onsite or offsite conditions. The groundwater well system would be configured to monitor groundwater hydraulically upgradient, downgradient, and laterally gradient to the power block and cooling basin. Subsection 2.3.1.2 indicates that groundwater from the Chicot and Evangeline Aquifers flows east towards the Guadalupe River Valley. Accordingly, several of these monitoring wells (Gw-5, Gw-6, and Gw-7) would be located hydraulically downgradient of the proposed VCS in the area west of Linn Lake.

Groundwater would be monitored during portions of the construction and preoperational phases for the parameters listed in Table 6.6-1 to provide data necessary to assess potential changes in groundwater quality associated with construction, and to provide a baseline for the identification and measurement of water quality impacts from VCS operations. Monitoring frequency would be dictated by site conditions.

6.6.3 Operational Monitoring

Exelon has no operating facility and no existing TPDES permit on which to base a proposed operational monitoring program. However, the South Texas Project's (STP's) TPDES monitoring program was used as a model for the operational monitoring program proposed in this section, because STP has a cooling reservoir-based condenser cooling system similar to that proposed for VCS, and its TPDES permit is issued by the same state agency (i.e., TCEQ). Ultimately, the operational program will be based on the TPDES permit issued by the TCEQ.

6.6.3.1 Surface Water Monitoring

The proposed VCS would have a single combined discharge for cooling basin blowdown, process wastewater, and diluted liquid radiological effluent. Process wastewater and cooling basin blowdown would be discharged into the Guadalupe River through a diffuser to ensure effective mixing. The TPDES permit for VCS operations would establish effluent monitoring and sampling requirements. The streams to be sampled, locations of sampling stations (outfalls), constituents to be monitored or target analytes, frequency of sampling, types of samples (e.g., grab or composite), times of day, and time periods of required monitoring would be part of the permit. Table 6.6-2 provides expected outfall monitoring requirements for the proposed VCS site based on a typical TPDES permit issued by the TCEQ (TCEQ Jul 2005).

For the TPDES monitoring, data quality would be assured by using applicable sample gathering, preservation, chain-of-custody, and analytical QA/QC standards. Samples would be analyzed by a certified laboratory and using methodologies in accordance with 40 CFR 136. These analytical requirements apply to surface water and groundwater samples analyzed for the purpose of showing compliance with applicable permits. Statistical methods used to interpret surface water and groundwater results would include methods approved by the EPA (U.S. EPA Feb 2006).

Routine sampling for TPDES outfalls would be performed either by manually collected grab samples or by automated samplers collecting composite samples. Analytical methods for groundwater and surface water are presented in Tables 2.3.3-2 and 2.3.3-18, respectively.

The data obtained would be recorded, analyzed, and reported in accordance with TCEQ reporting requirements.

6.6.3.2 Groundwater Monitoring

Operational groundwater monitoring would be performed in conjunction with the radiological monitoring described in Section 6.2 and monitoring of wells installed to provide potable water to VCS. Subsection 3.3.1.1.1 describes the proposed VCS potable water system, which would include two or three water supply wells, a treatment system, a storage tank, and a distribution system.

As noted previously in this section, STP was used as a model for the operational monitoring programs described in this section. Potable water at VCS, like that of STP, would be monitored in accordance with Title 30, Texas Administrative Code, Chapter 290, which addresses sampling, analysis, and reporting requirements for public drinking water systems. Table 6.6-3 summarizes STP's drinking water monitoring program, which includes daily monitoring of disinfectant (chlorine) residual, monthly monitoring of microbiological contaminants, and monitoring of metals on a 6-year cycle.

6.6.4 References

TCEQ Feb 2008. *Texas Commission on Environmental Quality. TPDES General Permit No. TXR150000.* Available at http://www.tceq.state.tx.us/assets/public/permitting/waterquality/attachments/stormwater/txr150000.pdf, accessed March 28, 2008.

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U.S. EPA Feb 2006. U.S. Environmental Protection Agency. *Data Quality Assessment: Statistical Methods for Practitioners, EPA QA/G-9S.* Available at http://www.epa.gov/QUALITY/qs-docs/g9s-final.pdf, accessed May 26, 2008.

Table 6.6-1 (Sheet 1 of 2)
Pre-Application Groundwater and Surface Water Monitoring Parameter List, Analytical Methods, and Handling Procedures

Parameter List	Analytical Method	Holding Time	Container Type (Typical)	Preservative
GENERAL CHEMISTRY				
Temperature	Field measurement	Not applicable	Not applicable	Not applicable
pH	Field measurement	Not applicable	Not applicable	Not applicable
Total Suspended Solids (TSS)	SM 2540/EPA 160.2	7 Days	250 mL Poly or Glass	None
Total Dissolved Solids (TDS)	SM 2540/EPA 160.1	7 Days	250 mL Poly or Glass	None
Hardness	EPA 130.0	180 Days	500 mL Poly	HNO_3 to pH<2
Turbidity	EPA 180.1	48 Hours	500 mL Poly	Cool 4 ºC
Color	EPA 110.2	48 Hours	500 mL Poly	Cool 4 ºC
Odor	EPA 140.1	48 Hours	500 mL Poly	Cool 4 ºC
Conductivity	EPA 120.1	28 Days	500 mL Poly	Cool 4 ºC
Dissolved Oxygen	Field Measurement	Not Applicable	Not Applicable	Not Applicable
Biochemical Oxygen Demand	SM 5210/EPA 405.1	48 Hours	1 L Poly or Glass	None
Chemical Oxygen Demand	SM 5220/EPA 410	28 Days	250 mL Poly or Glass	H_2SO_4 to pH<2
Phosphorus (total)	SM 4500/EPA 365	28 Days	250 mL Poly or Glass	HNO_3 to pH<2
Orthophosphorus	SM 4500/EPA 365/300	48 Hours	250 mL Poly or Glass	None
Nitrogen, Ammonia	SM 4500/EPA 350	28 Days	500 mL Poly or Glass	HNO_3 to pH<2
Nitrogen, Nitrate, Nitrite	SM 4500/EPA 300/354	48 Hours	250 mL Poly or Glass	None
Alkalinity	SM 2320/EPA 310	14 Days	250 mL Poly or Glass	None
Bicarbonate Alkalinity	SM 2320	14 Days	250 mL Poly or Glass	None
Carbon Dioxide	SM 4500 CO2D	14 Days	250 mL Poly or Glass	None
Chloride	SM 5220/EPA 410	28 Days	250 mL Poly or Glass	None
Sulfate	SM 4500/EPA 300/375	28 Days	250 mL Poly or Glass	None
Sodium	EPA 200.7	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Calcium	EPA 200.7	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Silica (Total)	EPA 370.1	28 Days	250 mL Poly	Cool 4 ºC

Table 6.6-1 (Sheet 2 of 2)
Pre-Application Groundwater and Surface Water Monitoring Parameter List, Analytical Methods, and Handling Procedures

Parameter List	Analytical Method	Holding Time	Container Type (Typical)	Preservative
BACTERIA AND PLANKTON				
Total Coliform	SM 9223B/9221D	30 Hours	125 mL Poly	None
Fecal Coliform	SM 9222D	8 Hours	120 mL Sterile	$Na_2S_2O_3$
Fecal Streptococci	SM 9230C	8 Hours	120 mL Sterile	$Na_2S_2O_3$
Phytoplankton (Chlorophyll*a*)[(a)]	SM 10200	7 Days	1 L Amber Glass	Cool 4 ºC
METALS				
Arsenic	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Barium	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Cadmium	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Chromium	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Iron	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Lead	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Magnesium	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Mercury	EPA 7470B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Potassium	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2
Silver	EPA 6010B	180 Days	500 mL Poly or Glass	HNO_3 to pH<2

(a) Analyzed for surface water samples only.

SM = Standard Methods of the Examination of Water and Waste Water, 19th Edition
L = Liter
mL = Milliliter
$Na_2S_2O_3$ = Sodium Thiosulfate
HNO_3 = Nitric Acid
H_2SO_4 = Sulfuric Acid

Table 6.6-2
Typical TPDES Surface Water Quality Monitoring Requirements[a]

Waste Stream	Constituents (Units)	Monitoring Frequency	Sample Type
Combined waste streams from the VCS site to the Guadalupe River, including recirculated cooling water, cooling basin blowdown, PME, and makeup water from the Guadalupe River	Flow (mgd)	Continuous[b]	Record
	Guadalupe River Flow	1 per day[b]	Estimate
	Temperature	Continuous[b]	In-situ
	Total residual chlorine (mg/L)	1 per week[b]	Grab
Low Volume Waste Discharges and Stormwater	Flow (mgd)	1 per day[b]	Estimate Source: 30 TAC §290
	Total suspended solids (mgL)	1 per week	Grab
	Oil and Grease (mg/L)	1 per week	Grab
Sanitary waste, car wash discharge, air conditioning condensate, and HVAC blowdown	Flow (mgd)	1 per day[b]	Estimate
	Biochemical oxygen demand (mg/L)	1 per week	Grab
	Total suspended solids (mg/L)	1 per week	Grab
Metal Cleaning Waste	Flow (mgd)	1 per day[b]	Estimate
	Iron, total (mg/L)	1 per week[b]	Grab
	Copper, total (mg/L)	1 per week[b]	Grab

(a) Parameters based on the South Texas Project TPDES permit (TCEQ July 2005), which is also in Texas and is issued permits by the TCEQ.
(b) When discharge occurs.
mgd = million gallons per day
TPDES = Texas Pollutant Discharge Elimination Discharge Permit
PME = Previously monitored effluent
mg/L = milligrams per liter

Table 6.6-3
Drinking Water Monitoring Program Parameters

Parameter Monitored	Frequency
Disinfectant residuals	Daily
Microbiological contaminants	Monthly
Pb/Cu[(a)]	3-Year
$MINO_3$[(b)]	3-Year
All metals[(c)]	6-Year
NO_3	1-Year
HAA5/TTHM	3-Year
VOC	6-Year/1-Year[(d)]

(a) Lead and copper are sampled at multiple sampling locations.
(b) Minerals: calcium, chloride, fluoride, magnesium, total nitrate, sodium, sulfate, total hardness, conductivity, total alkalinity, bicarbonate, carbonate, dissolved solids, calcium carbonate
(c) Metals: aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, sodium, thallium, zinc.
(d) Dependent on system.

HAA5/TTHM = haloacetic acids/ total trihalomethanes
VOC = volatile organic compounds
Source: Texas Administrative Code, Title 30 Part 1, Chapter 290

Note: Chemical monitoring frequency is subject to change. Monitoring may be increased or reduced by the State based on chemical sampling history or other factors

6.7 Summary of Monitoring Programs

The VCS monitoring programs are described in detail in Sections 6.1 through 6.6 and in summary in the following subsections. Also, Table 6.7-1 identifies key elements of the monitoring programs to be implemented during the construction, preoperational, and operational phases.

6.7.1 Pre-Application Monitoring

Exelon performed water quality, hydrological, meteorological, and ecological studies for the proposed VCS site during the pre-application phase. The results of these studies have been used to characterize site-specific environmental conditions at the VCS site area. Measurements of surface water temperature were conducted in the course of performing water quality characterization described in Subsection 2.3.3 and Section 6.1. No pre-application radiological monitoring has been performed. Hydrological studies included a bathymetric survey of the Guadalupe River in the vicinity of the VCS site, collection of historical surface water data, and initiation of a groundwater investigation program described in Subsection 2.3.1 and Section 6.3. A pre-application meteorological monitoring program was initiated onsite in 2007, and 2 years of baseline data were collected for the site and surrounding area, as described in Sections 2.7 and 6.4. Terrestrial and aquatic ecological surveys were performed during 2007 and 2008, as described in Sections 2.4 and 6.5. Baseline water quality studies for both surface water and groundwater were conducted and are described in Subsection 2.3.3 and Section 6.6.

6.7.2 Preconstruction/Construction Monitoring

No thermal monitoring is planned during the preconstruction and construction phases because there would be no thermal effluents from the site during these periods. Radiological monitoring is planned during the preconstruction and construction phases to collect baseline data, overlapping with the more comprehensive preoperational and operational monitoring programs (Section 6.2). Hydrological monitoring would consist of continued evaluation of stream flow monitoring data through the construction phase, as well as monitoring required by the Texas Commission on Environmental Quality (TCEQ) for the construction stormwater permit. Groundwater elevation monitoring would be performed to measure the effects of dewatering. All planned environmental hydrological monitoring is described in Sections 4.2 and 6.3. Meteorological monitoring during plant construction is not planned because no significant air quality and meteorological related construction impacts have been identified that warrant onsite monitoring. Based on the results of pre-application ecological surveys and the small impact of construction activities, continued ecological monitoring is not planned. Although sampling frequency will be dictated by site conditions, it is expected that surface water and groundwater would be monitored during portions of the construction phase to provide data for assessing changes in surface water or groundwater quality. This potential monitoring is described in Section 6.6.

6.7.3 Preoperational Monitoring

No specific thermal monitoring is currently planned. Radiological monitoring would be expanded over preconstruction/construction monitoring to include the features listed in Table 6.2-2. The preoperational radiological monitoring program would begin up to 2 years before operation of the first unit, as identified in Table 6.2-1. Hydrological preoperational monitoring would be a continuation of construction-phase monitoring. Before plant operation, 1 year of onsite meteorological monitoring (with a filled or partially filled cooling basin), is planned to provide a basis for identifying and assessing environmental impacts resulting from plant operation, according to the monitoring program described in Subsection 6.4.4. No specific ecological monitoring is proposed. Chemical monitoring would be a continuation of pre-construction/construction groundwater monitoring, as applicable.

6.7.4 Operational Monitoring

Thermal monitoring, if required, would be in accordance with the Texas Pollutant Discharge and Elimination System (TPDES) permit in effect at that time. Radiological monitoring would be the same as for preoperational monitoring. Hydrological monitoring would include continued collection of river flow data, bathymetry at the discharge to the river as needed, and collection of groundwater-elevation measurements during the course of implementing the radiological monitoring program. Meteorological monitoring would be a continuation of the preoperational monitoring program described in Section 6.4. No specific ecological monitoring is proposed. The chemical monitoring program would be that specified in the TPDES operational permit issued by TCEQ, as well as any sampling required for operation of the onsite public drinking water system.

Table 6.7-1 (Sheet 1 of 3)
Summary of Monitoring Programs To Be Implemented

Resource	Program	Scope/Content	Requiring Agency
		PRECONSTRUCTION/CONSTRUCTION	
Water and ecology	Thermal Monitoring	No thermal monitoring is proposed.	N/A
Human health	Radiological Monitoring	Radiological monitoring program is planned to collect baseline data.	N/A
Water	Hydrological Monitoring	Exelon would evaluate U.S. Geological Survey data on Guadalupe River flow.	N/A
		Stormwater discharges would be monitored in accordance with a TCEQ permit, as applicable.	TCEQ[a]
		Groundwater monitoring would be conducted during portions of construction.	N/A
Air quality and meteorology	Meteorological Monitoring	A meteorological tower was installed with instrumentation listed in Table 6.4-3. Data was collected over a 2-year period during the pre-application phase to build a baseline dataset for the site. Monitoring during plant construction is not planned because no significant air quality and meteorological related construction impacts have been identified that warrant onsite meteorological monitoring.	N/A
Ecology	Ecological Monitoring	No ecological monitoring is planned.	N/A
Water	Chemical Monitoring	Surface water monitoring would identify potential impacts of site construction, if warranted by site conditions.	TCEQ[a]
		Monitoring at stormwater outfall and/or treated sanitary effluent discharge from the VCS site would be performed in accordance with permit requirements, as applicable.	TCEQ[a]
		Groundwater monitoring would be conducted during portions of construction and preoperation to ascertain the chemical effects of construction on local groundwater quality, as applicable.	N/A
		No ecological monitoring is planned.	
		Drinking water quality would be monitored at the VCS site.	TCEQ[a]

Table 6.7-1 (Sheet 2 of 3)
Summary of Monitoring Programs To Be Implemented

Resource	Program	Scope/Content	Requiring Agency
		PREOPERATIONAL	
Water and ecology	Thermal Monitoring	No thermal monitoring is proposed.	N/A
Human health	Radiological Monitoring	The preoperational monitoring program described in Section 6.2 would be initiated 2 years before the first unit begins operation.	NRC
Water	Hydrological Monitoring	Exelon would continue to evaluate USGS data on Guadalupe River flow.	N/A
		Stormwater discharges would be monitored in accordance with a TCEQ permit, as applicable.	TCEQ[(a)]
		Groundwater monitoring would be conducted as necessary.	N/A
Air quality and meteorology	Meteorological Monitoring	A meteorological tower was installed with instrumentation listed in Table 6.4-3. Before plant operation, 1 year of onsite meteorological monitoring (with a filled or partially filled cooling basin) is planned to provide a basis for identifying and assessing environmental impacts resulting from plant operation.	NRC
Ecology	Ecological Monitoring	No ecological monitoring is planned.	N/A
Water	Chemical Monitoring	Preconstruction and construction surface water monitoring could continue to identify potential impacts of site construction, if warranted by site conditions.	N/A
		Monitoring for chemical parameters at stormwater outfall and/or treated sanitary effluent discharge points from the VCS would be performed in accordance with the permit requirements, as applicable.	TCEQ[(a)]
		Groundwater monitoring would continue during portions of construction and preoperation to ascertain the chemical effects of construction on local groundwater quality.	N/A
		Drinking water quality would be monitored at the VCS site.	TCEQ[(a)]

Table 6.7-1 (Sheet 3 of 3)
Summary of Monitoring Programs To Be Implemented

Resource	Program	Scope/Content	Requiring Agency
		OPERATIONAL	
Water and ecology	Thermal Monitoring	Thermal monitoring for discharges to the Guadalupe River when blowdown occurs from the cooling basin would be conducted, if required by the TPDES permit.	TCEQ[(a)]
Human health	Radiological Monitoring	The monitoring program specified in Section 6.2 would be conducted.	NRC
Water	Hydrological Monitoring	Hydrological monitoring would continue to include collection of river flow data; also, bathymetry at the discharge to the river could be performed as needed, and groundwater-level measurements would be collected in the course of the radiological monitoring program.	N/A
		The industrial stormwater permit may require monitoring.	TCEQ[(a)]
Air quality and meteorology	Meteorological Monitoring	The operational monitoring program will be implemented to provide data for use in evaluating the environmental impacts of plant operations, including radiological and nonradiological impacts, and for emergency preparedness support.	NRC
Ecology	Ecological Monitoring	Aquatic ecological monitoring would be conducted in accordance with permit requirements, as applicable.	N/A
Water	Chemical Monitoring	Monitoring of surface water discharges for chemical parameters would be conducted, if required by the TPDES permit.	TCEQ[(a)]
		Drinking water quality would be monitored at the VCS site.	TCEQ[(a)]

(a) Permit application to be developed later. Refer to Tables 1.2-1 and 1.2-2.
N/A: Not applicable.