NP-12-0028
July 13, 2012 10 CFR 52, Subpart A

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: Exelon Nuclear Texas Holdings, LLC
Victoria County Station
Early Site Permit Application
Environmental Report – Responses to ER RAI Letters No.12 and No.13
Docket No. 52-042

References: (1) USNRC letter to Ms. Marilyn C. Kray, Environmental Request for Additional Information Letter No.12 Related to Radiological Health Impacts for Victoria County Station Early Site Permit Application, dated May 31, 2012

(2) USNRC letter to Ms. Marilyn C. Kray, Environmental Request for Additional Information Letter No.13 Related to Radioactive Waste Management Systems and Nonradioactive Waste Management Systems for Victoria County Station Early Site Permit Application, dated May 31, 2012

Exelon is responding to the following questions contained in NRC Request for Additional Information (RAI) letters No.12 (Reference 1) and No.13 (Reference 2):

RAI Letter No.	RAI	eRAI	Attachment
12	HP-1	6505	1
12	HP-5.4.1-1	6506	2
12	HP-5.4.1-4	6506	3
12	HP-5.4.1-5	6506	4
12	HP-5.4.1-6	6506	5
12	HP-5.4.1-7	6506	6
12	HP-5.4.1-8	6506	7
12	HP-5.4.3-1	6506	8
12	HP-5.4.3-2	6506	9
12	HP-5.4.4-1	6506	10
12	HP-5-11-1	6507	11
12	HP-6.2-1	6508	12
12	HP-9.3.3-1	6509	13
13	RW 3.5.-2	6454	14
13	RW 3.5.-3	6454	15
13	NRW 3.6-1	6530	16

Exelon's responses to the above-referenced RAIs constitute complete responses to NRC RAI Letters No.12 and No.13.

As indicated in the above table, the RAI responses comprise Attachments 1-16. Regulatory commitments are summarized in Attachment 17.

If additional information is required, please contact Joshua Trembley at (610) 765-5345.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 13th day of July, 2012.

Respectfully,

Marilyn C. Kray
Vice President, Nuclear Project Development

Attachments:

(1) Response to HP-1 (eRAI No.6505)
(2) Response to HP-5.4.1-1 (eRAI No.6506)
(3) Response to HP-5.4.1-4 (eRAI No.6506)
(4) Response to HP-5.4.1-5 (eRAI No.6506)
(5) Response to HP-5.4.1-6 (eRAI No.6506)
(6) Response to HP-5.4.1-7 (eRAI No.6506)
(7) Response to HP-5.4.1-8 (eRAI No.6506)
(8) Response to HP-5.4.3-1 (eRAI No.6506)
(9) Response to HP-5.4.3-2 (eRAI No.6506)
(10) Response to HP-5.4.4-1 (eRAI No.6506)
(11) Response to HP-5-11-1 (eRAI No.6507)
(12) Response to HP-6.2-1 (eRAI No.6508)
(13) Response to HP-9.3.3-1 (eRAI No.6509)
(14) Response to RW 3.5.-2 (eRAI No.6454)
(15) Response to RW 3.5.-3 (eRAI No.6454)
(16) Response to NRW 3.6-1 (eRAI No.6530)
(17) Summary of Commitments

cc: USNRC, Director, Office of New Reactors/NRLPO
USNRC, Project Manager, VCS, Division of New Reactor Licensing
USNRC, Environmental Project Manager, VCS, Division of New Reactor Licensing
USNRC Region IV, Regional Administrator
Argonne National Laboratory, Project Manager, VCS
EDMS

HP-1 (eRAI 6505):

NRC Request:

HP- 1 According to ESRP 4.5 Section I, information is needed for "the number and principal location of construction workers who will be exposed to the radiation sources described above and the total amount of time per year that they will spend at those locations." The ER Section 4.5 does not provide the basis for the assumption that NNE direction is the most representative location for construction worker dose estimates. Provide the basis for the assumption that the NNE direction is the most representative location for construction worker dose estimates.

Response:

Based on the expected configuration of two conventional units, it is assumed that Unit 2 is located north-northeast (NNE) of Unit 1 and that Unit 1 will be constructed before Unit 2. The actual location of the construction unit relative to the operating unit will be confirmed in the COLA, after a reactor design has been selected. If a design, such as mPower, with more than two units is selected, or if the location of the first unit operating (relative to the second) is changed, the COLA will be revised accordingly to address the dose to construction workers.

ER Subsection 4.5.1 will be revised to explicitly state the assumption about the assumed locations of two conventional units.

Associated ER revisions:

The following changes will be made in a future revision to the ESPA:

4.5.1 Site Layout

The location of the power block area is provided in Figure 3.1-2. For the purpose of calculating doses to construction workers from the operating unit, it is assumed that the average location of the workers will be the center of the second reactor—a distance of 0.25 mile. It is further assumed that Unit 1 will be operational first and will be a radiation source for Unit 2 construction workers. These assumptions are to be confirmed at the time of the COLA.

HP-5.4.1-1 (eRAI No.6506):

NRC Request:

HP- 5.4.1-1 ESRP Section 5.4.1 directs the staff to review the description of the environmental pathways by which radiation and radioactive effluents can be transmitted from the proposed plant to living organisms. The following information is needed to perform the dose calculation from liquid effluent releases: (1) the transit times and dilution factors at each appropriate receptor location and transit times to unrestricted area boundaries and diluted stream flows at these boundaries; and (2) the predicted dilution factors at specified locations. Provide justification/clarification for the transit time used in the LADTAP calculations for liquid discharges for the different receptors. Provide justification/clarification for the transit time used in LADTAP code dose calculations for liquid discharges for different receptor intake locations (commercial fish and invertebrate catch locations, drinking water intake locations, irrigation water intake locations).

Response:

In response to this RAI, the liquid effluent dose analysis has been revised as follows:

- Transit Times – In LADTAP, a transit time of zero is used for individual and population pathways associated with sport fishing, commercial fishing, sport invertebrate, commercial invertebrate, drinking water, shoreline usage, swimming, boating, and irrigated foods.
- Dilution Factors – In LADTAP, a dilution factor of one is used for all pathways affecting individual and population doses.

Table 5.4-1 already shows a dilution factor of one, and is revised to reflect the transit time of zero. The change in transit times affects the MEI doses in Table 5.4-4 and the population doses in Table 5.4-8, and these tables are revised to reflect the change.

As a number of ER Section 5.4 RAIs pertaining to the liquid effluent pathway are interrelated, the responses to the other RAIs are provided below.

<u>Response to RAI 5.4.1-4:</u>

RAI 5.4.1-4 requests justification for the percentage of the population within 50 miles of the plant that consumes fish and invertebrate. The following changes have been made to the analysis in response to this RAI:

- Guadalupe River as the Source of Fish and Invertebrate Consumption within 50 Miles – Of the fish and invertebrate consumed by the 50-mile population, the fraction that comes from the Guadalupe River has been increased from 50% to 100%, meaning that the river is the source of all fish and invertebrate consumed within 50 miles of the plant.
- Fraction of the Population Consuming Sport Fish and Invertebrate – As already stated in Table 5.4-1, 2.75% of the population within 50 miles engages in sport fishing and sport invertebrate harvesting, based on data from U.S. Fish and Wildlife Service. The fraction of the population that consumes sport fish and invertebrate has been increased from 2.75% to 11% by assuming that for every

individual who catches the fish or invertebrate, there are four who consume the catch.

- Fraction of the Population Consuming Commercial Fish and Invertebrate – With the Guadalupe River being the source of 11% of sport fish and invertebrate consumed within 50 miles, the remaining 89% of consumption is assumed to be from commercial fishing and invertebrate harvesting from the Guadalupe River.

Table 5.4-1 will be revised to reflect the changes in the following LADTAP parameters:

- 50-Mile Sport Fishing Harvest – Increased from 6.69E4 to 2.67E5 kg/yr to reflect the change in sport fish consumption from 2.75% to 11%.
- 50-Mile Commercial Fishing Harvest – Increased from 1.15E6 to 2.17E6 kg/yr to reflect the change in commercial fish consumption from 47.25% to 89%.
- 50-Mile Sport Invertebrate Harvest – Increased from 9.71E3 to 3.88E4 kg/yr to reflect the change in sport invertebrate consumption from 2.75% to 11%.
- 50-Mile Commercial Invertebrate Harvest – Increased from 1.67E5 to 3.15E5 kg/yr to reflect the change in commercial invertebrate consumption from 47.25% to 89%.

The changes in fish and invertebrate parameters affect the population doses in Table 5.4-8, which is revised to reflect the changes.

<u>Response to RAI 5.4.1-7:</u>

RAI 5.4.1-7 requests justification for excluding the irrigated milk pathway for liquid effluent doses to the MEI. It also asks liquid effluent doses to be provided for all pathways and age groups. As no milk cows were identified within five miles of the plant, the milk pathway was previously neglected. Nevertheless, the revised MEI analysis conservatively includes the irrigated milk pathway. Table 5.4-4 will be revised to include the irrigated milk pathway and to provide a breakdown of liquid effluent doses by age group, pathway, and organ. Specifically, Table 5.4-4 will be replaced by the following series of tables:

- Table 5.4-4a – Adult doses by pathway and organ.
- Table 5.4-4b – Teen doses by pathway and organ.
- Table 5.4-4c – Child doses by pathway and organ.
- Table 5.4-4d – Infant doses by pathway and organ.
- Table 5.4-4e – MEI doses by age and organ, including the identification of the age group receiving the maximum dose for each organ.

The pathways in the above tables are the same as those in the LADTAP output, including irrigated vegetables, irrigated non-leafy vegetables, irrigated meat, and irrigated milk.

<u>Associated ESPA Revisions:</u>

ER Tables 5.4-1, 5.4-4, 5.4-6, 5.4-7, and 5.4-8 will be revised in a future revision to the ESPA as shown below.

In addition to the changes described above, the table revisions include the following changes associated with other RAIs:

- Table 5.4-1 – Changes to the bases of the impoundment reconcentration model and flow rate in receiving water body in response to RAI RW-3.5-2.
- Table 5.4-6 – Changes to gaseous effluent doses in response to RAI 5.4.3-1.
- Table 5.4-7 – Changes to gaseous effluent doses in response to RAIs 5.4.1-8 and 5.4.3-1.

Table 5.4-1
Liquid Pathway Parameters

Parameter	Value	Basis/Source(s)
Impoundment Reconcentration Model	None	~~This model does not apply to the river discharge scenario.~~ Reconcentration is negligible when compared to conservatism associated with the assumed river flow rate (480 cfs versus mean flow of 2001 cfs).
Flow Rate in Receiving Water Body	480 cfs	This is a conservative flow rate that represents ~~95th~~ approximately 85th percentile of all observed annual average flow rates in the Guadalupe River from 1935 to 2008. Effluent activity is assumed to be released directly into the river without any prior dilution.
Transit Time to Receptor	~~See RG 1.109~~ 0	~~The default transit times from RG 1.109, Table D-1 are used.~~ Conservative assumption takes no additional decay beyond the default distribution transport times based on RG 1.109 that are built into LADTAP II.
50-Mile Sport Fishing Harvest	~~6.69×10^4 kg/yr~~ 2.67×10^5 kg/yr	Based on RG 1.109, Appendix D and Table E-4, the average individual consumes 5.9 kg/yr of fish. Multiplying this by the 2080 population (414,902) yields the total annual consumption of fish within 50 miles of 2.43×10^6 kg/yr. Of the state population of 20.9 million (U.S. Census Bureau 2006), 0.574 million (U.S. Fish & Wildlife Service 2006) or about 2.75% engages in sport fishing in rivers. ~~It is assumed that 2.75%~~ Assuming that for every individual who catches fish, there are four who consume the catch, 11% of the fish consumption within 50 miles is due to sport fishing from Guadalupe River.
50-Mile Commercial Fishing Harvest	~~1.15×10^6 kg/yr~~ 2.17×10^6 kg/yr	As the previous entry indicates, of the total fish consumption within 50 miles of 2.43×10^6 kg/yr, ~~2.75%~~11% is due to sport fishing. It is assumed that Guadalupe River is the source of ~~50%~~100% of the fish consumed within 50 miles, with the remaining ~~47.25%~~89% coming from commercial fishing.
50-Mile Sport Invertebrate Harvest	~~9.71×10^3 kg/yr~~ 3.88×10^4 kg/yr	Based on RG 1.109, Appendix D and Table E-4, the average individual consumes 0.85 kg/yr of invertebrate. Multiplying this by the 2080 population yields the total annual consumption of invertebrate within 50 miles of 3.53×10^5 kg/yr. As with sport fishing, it is assumed that ~~2.75%~~11% of the invertebrate consumption within 50 miles is due to sport invertebrate harvest from the Guadalupe River.
50-Mile Commercial Invertebrate Harvest	~~1.67×10^5 kg/yr~~ 3.15×10^5 kg/yr	As the previous entry indicates, of the total invertebrate consumption within 50 miles of 3.53×10^5 kg/yr, ~~2.75%~~11% is due to sport invertebrate harvest. It is assumed that Guadalupe River is the source of ~~50%~~100% of the invertebrate consumed within 50 miles, with the remaining ~~47.25%~~89% coming from commercial harvest.

Table 5.4-4a
Liquid Pathway Doses for Adult

Pathway	Dose (mrem/yr) per Unit							
	Total Body	GI-LLI	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish	3.30×10^{-1}	1.48×10^{-1}	7.40×10^{-1}	4.56×10^{-1}	1.56×10^{-1}	2.73×10^{-2}	4.87×10^{-2}	–
Invertebrate	4.37×10^{-2}	1.47×10^{-1}	5.49×10^{-2}	7.64×10^{-2}	2.82×10^{-2}	2.95×10^{-3}	6.92×10^{-3}	–
Drinking	1.69×10^{-1}	1.92×10^{-1}	5.98×10^{-3}	1.71×10^{-1}	1.67×10^{-1}	2.24×10^{-1}	1.64×10^{-1}	–
Shoreline	5.32×10^{-4}	5.32×10^{-4}	5.32×10^{-4}	5.32×10^{-4}	5.32×10^{-4}	5.32×10^{-4}	5.32×10^{-4}	6.24×10^{-4}
Swimming	1.49×10^{-5}	1.49×10^{-5}	1.49×10^{-5}	1.49×10^{-5}	1.49×10^{-5}	1.49×10^{-5}	1.49×10^{-5}	–
Boating	7.46×10^{-6}	7.46×10^{-6}	7.46×10^{-6}	7.46×10^{-6}	7.46×10^{-6}	7.46×10^{-6}	7.46×10^{-6}	–
Irrigated Vegetables Non-Leafy	1.49×10^{-1}	2.77×10^{-1}	3.60×10^{-2}	1.61×10^{-1}	1.35×10^{-1}	1.50×10^{-1}	1.21×10^{-1}	–
Irrigated Vegetables Leafy	1.86×10^{-2}	3.49×10^{-2}	4.61×10^{-3}	2.00×10^{-2}	1.68×10^{-2}	2.75×10^{-2}	1.49×10^{-2}	–
Irrigated Milk	9.79×10^{-2}	7.59×10^{-2}	2.49×10^{-2}	1.09×10^{-1}	8.33×10^{-2}	1.25×10^{-1}	7.35×10^{-2}	–
Irrigated Meat	3.09×10^{-2}	1.42	2.52×10^{-2}	2.95×10^{-2}	6.77×10^{-2}	2.65×10^{-2}	2.52×10^{-2}	–
Total	8.40×10^{-1}	2.30	8.92×10^{-1}	1.02	6.55×10^{-1}	5.84×10^{-1}	4.55×10^{-1}	6.24×10^{-4}

Note: Values from LADTAP II output.

Table 5.4-4b
Liquid Pathway Doses for Teen

Pathway	Dose (mrem/yr) per Unit							
	Total Body	GI-LLI	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish	2.12×10^{-1}	1.12×10^{-1}	7.98×10^{-1}	4.68×10^{-1}	1.57×10^{-1}	2.51×10^{-2}	5.57×10^{-2}	–
Invertebrate	2.95×10^{-2}	1.08×10^{-1}	5.85×10^{-2}	7.71×10^{-2}	2.82×10^{-2}	2.61×10^{-3}	7.74×10^{-3}	–
Drinking	1.18×10^{-1}	1.36×10^{-1}	5.72×10^{-3}	1.22×10^{-1}	1.19×10^{-1}	1.68×10^{-1}	1.16×10^{-1}	–
Shoreline	2.97×10^{-3}	2.97×10^{-3}	2.97×10^{-3}	2.97×10^{-3}	2.97×10^{-3}	2.97×10^{-3}	2.97×10^{-3}	3.49×10^{-3}
Swimming	8.33×10^{-5}	8.33×10^{-5}	8.33×10^{-5}	8.33×10^{-5}	8.33×10^{-5}	8.33×10^{-5}	8.33×10^{-5}	–
Boating	4.17×10^{-5}	4.17×10^{-5}	4.17×10^{-5}	4.17×10^{-5}	4.17×10^{-5}	4.17×10^{-5}	4.17×10^{-5}	–
Irrigated Vegetables Non-Leafy	1.73×10^{-1}	3.46×10^{-1}	5.95×10^{-2}	2.15×10^{-1}	1.73×10^{-1}	1.92×10^{-1}	1.51×10^{-1}	–
Irrigated Vegetables Leafy	1.17×10^{-2}	2.36×10^{-2}	4.13×10^{-3}	1.45×10^{-2}	1.17×10^{-2}	2.01×10^{-2}	1.01×10^{-2}	–
Irrigated Milk	1.19×10^{-1}	9.80×10^{-2}	4.45×10^{-2}	1.59×10^{-1}	1.14×10^{-1}	1.78×10^{-1}	9.86×10^{-2}	–
Irrigated Meat	1.87×10^{-2}	8.86×10^{-1}	2.11×10^{-2}	1.86×10^{-2}	5.08×10^{-2}	1.61×10^{-2}	1.52×10^{-2}	–
Total	6.85×10^{-1}	1.71	9.95×10^{-1}	1.08	6.57×10^{-1}	6.05×10^{-1}	4.57×10^{-1}	3.49×10^{-3}

Note: Values from LADTAP II output.

Table 5.4-4c
Liquid Pathway Doses for Child

Pathway	Dose (mrem/yr) per Unit							
	Total Body	GI-LLI	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish	1.17×10^{-1}	4.55×10^{-2}	1.02	4.10×10^{-1}	1.32×10^{-1}	2.62×10^{-2}	4.40×10^{-2}	–
Invertebrate	1.87×10^{-2}	4.24×10^{-2}	7.65×10^{-2}	6.78×10^{-2}	2.40×10^{-2}	2.73×10^{-3}	6.39×10^{-3}	–
Drinking	2.25×10^{-1}	2.41×10^{-1}	1.64×10^{-2}	2.35×10^{-1}	2.28×10^{-1}	3.54×10^{-1}	2.22×10^{-1}	–
Shoreline	6.21×10^{-4}	6.21×10^{-4}	6.21×10^{-4}	6.21×10^{-4}	6.21×10^{-4}	6.21×10^{-4}	6.21×10^{-4}	7.28×10^{-4}
Swimming	1.74×10^{-5}	1.74×10^{-5}	1.74×10^{-5}	1.74×10^{-5}	1.74×10^{-5}	1.74×10^{-5}	1.74×10^{-5}	–
Boating	8.70×10^{-6}	8.70×10^{-6}	8.70×10^{-6}	8.70×10^{-6}	8.70×10^{-6}	8.70×10^{-6}	8.70×10^{-6}	–
Irrigated Vegetables Non-Leafy	2.53×10^{-1}	3.86×10^{-1}	1.41×10^{-1}	3.47×10^{-1}	2.76×10^{-1}	3.24×10^{-1}	2.39×10^{-1}	–
Irrigated Vegetables Leafy	1.28×10^{-2}	1.96×10^{-2}	7.34×10^{-3}	1.76×10^{-2}	1.40×10^{-2}	2.72×10^{-2}	1.20×10^{-2}	–
Irrigated Milk	1.68×10^{-1}	1.48×10^{-1}	1.06×10^{-1}	2.57×10^{-1}	1.82×10^{-1}	3.17×10^{-1}	1.56×10^{-1}	–
Irrigated Meat	2.35×10^{-2}	5.50×10^{-1}	3.97×10^{-2}	2.28×10^{-2}	6.54×10^{-2}	1.99×10^{-2}	1.85×10^{-2}	–
Total	8.19×10^{-1}	1.43	1.41	1.36	9.22×10^{-1}	1.07	6.99×10^{-1}	7.28×10^{-4}

Note: Values from LADTAP II output.

Table 5.4-4d
Liquid Pathway Doses for Infant

Pathway	Dose (mrem/yr) per Unit							
	Total Body	GI-LLI	Bone	Liver	Kidney	Thyroid	Lung	Skin
Fish	0	0	0	0	0	0	0	–
Invertebrate	–	–	–	–	–	–	–	–
Drinking	2.20×10^{-1}	2.30×10^{-1}	1.74×10^{-2}	2.35×10^{-1}	2.24×10^{-1}	4.26×10^{-1}	2.18×10^{-1}	–
Shoreline	0	0	0	0	0	0	0	0
Swimming	–	–	–	–	–	–	–	–
Boating	–	–	–	–	–	–	–	–
Irrigated Vegetables Non-Leafy	–	–	–	–	–	–	–	–
Irrigated Vegetables Leafy	–	–	–	–	–	–	–	–
Irrigated Milk	–	–	–	–	–	–	–	–
Irrigated Meat	–	–	–	–	–	–	–	–
Total	2.20×10^{-1}	2.30×10^{-1}	1.74×10^{-2}	2.35×10^{-1}	2.24×10^{-1}	4.26×10^{-1}	2.18×10^{-1}	0

Note: Values from LADTAP II output.

Table 5.4-4e
Liquid Pathway Doses for Maximally Exposed Individuals

Group	Dose (mrem/yr) per Unit							
	Total Body	GI-LLI	Bone	Liver	Kidney	Thyroid	Lung	Skin
Adult	8.4×10^{-1}	2.3	8.9×10^{-1}	1.0	6.5×10^{-1}	5.8×10^{-1}	4.5×10^{-1}	6.2×10^{-4}
Teen	6.8×10^{-1}	1.7	9.9×10^{-1}	1.1	6.6×10^{-1}	6.1×10^{-1}	4.6×10^{-1}	3.5×10^{-3}
Child	8.2×10^{-1}	1.4	1.4	1.4	9.2×10^{-1}	1.1	7.0×10^{-1}	7.3×10^{-4}
Infant	2.2×10^{-1}	2.3×10^{-1}	1.7×10^{-2}	2.4×10^{-1}	2.2×10^{-1}	4.3×10^{-1}	2.2×10^{-1}	0.0
Maximum	8.4×10^{-1}	2.3	1.4	1.4	9.2×10^{-1}	1.1	7.0×10^{-1}	3.5×10^{-3}
Maximum Group	Adult	Adult	Child	Child	Child	Child	Child	Teen

Note: Maximum is the maximum of the values for each age group (i.e., adult, teen, child, and infant). Values for each age group are the totals taken from Tables 5.4-4a through -4d.

Table 5.4-6
Comparison of Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria

Type of Dose	Location	Annual Dose per Unit[(a)]	
		VCS	Limit
Liquid Effluent[(b)]			
Total Body (mrem)	Guadalupe River	~~0.74~~ 0.84	3
Maximum Organ – GI-LLI (mrem)	Guadalupe River	~~2.2~~ 2.3	10
Gaseous Effluent[(c)]			
Gamma Air (mrad)	Site Boundary	3.0	10
Beta Air (mrad)	Site Boundary	7.5	20
Total Body (mrem)	~~Site Boundary~~ Residence	~~2.8~~ 0.77	5
Skin (mrem)	~~Site Boundary~~ Residence	~~7.7~~ 2.0	15
Iodines and Particulates, Maximum Organ — Thyroid (mrem)	Residence/Garden/ Meat ~~Cow~~ Animal	~~11~~ 12	15

(a) “Unit” refers to one conventional unit or six modular mPower reactors.

(b) Liquid Effluents – The total body dose is the maximum total body value from Table 5.4-4e. The maximum organ dose is the largest value of all the organ doses in Table 5.4-4e.

(c) Gaseous Effluents – The thyroid dose in this table is obtained by summing GASPAR II output for particulates and iodines due to all pathways. All other doses in this table are obtained by summing GASPAR II output for particulates, iodines, and gases due to external pathways only.

Table 5.4-7
Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria

	Site[a][b] Dose (mrem/yr)				
	Liquid	**Gaseous**	**Direct**	**Total**	**Limit**
Total Body	~~1.5~~ 1.7	~~5.8~~ 4.4	5.0	~~12~~ 11	25
Thyroid	~~1.3~~ 2.1	~~25~~ 28	5.0	~~32~~ 35	75
Other Organ - Bone	~~2.6~~ 2.8	~~11~~ 16	5.0	~~19~~ 24	25

(a) "Site" refers to two conventional units or 12 modular mPower reactors.

(b) Site doses for two units are obtained by doubling the doses from a single unit. Liquid effluent doses are obtained by doubling the MEI doses in Table 5.4-4e. Gaseous effluent doses are obtained by doubling the ~~higher of site boundary and~~ MEI doses in Table 5.4-5. The direct radiation dose is obtained by doubling 2.5 mrem/yr, the dose outside the controlled area corresponding to the shielding criteria for the ABWR (GE 1997, Table 3.2a); this is the largest direct dose component for the reactor technologies being evaluated.

Table 5.4-8
Collective Doses Within 50 Miles in 2080

	Dose (person-rem/yr) per Unit[a]		Site[b] Dose (person-rem/yr)	
Pathway	**Total Body**	**Thyroid**	**Total Body**	**Thyroid**
Liquid Effluents	~~8.7~~ 13	~~8.4~~ 9.1	~~17~~ 26	~~17~~ 18
Gaseous Effluents				
Noble Gases	0.29	0.29	0.58	0.58
Iodines	0.0066	2.6	0.013	5.2
Particulates	0.14	0.11	0.28	0.21
C-14	0.59	0.59	1.2	1.2
H-3	0.10	0.10	0.21	0.21
Total Gaseous Effluents	1.1	3.7	2.3	7.4
Total	~~9.9~~ 14	~~12~~ 13	~~20~~ 28	~~24~~ 26
Natural Background[c]	1.2×10^5			

(a) "Unit" refers to one conventional unit or six modular mPower reactors. Liquid doses per unit are from LADTAP II. Gaseous doses per unit are obtained by summing GASPAR II results for particulates, iodines, and gases.

(b) "Site" refers to two conventional units or 12 modular mPower reactors. Site doses are for the new units only and are obtained by doubling the doses per unit.

(c) Based on dose rate of 300 mrem/yr (NCRP 1987).

HP-5.4.1-4 (eRAI No.6506):

NRC Request:

HP-5.4.1-4 According to ESRP Section 5.4.1, the following information is needed to perform dose calculations – “the present commercial fish and invertebrate catch (in kg/yr) from waters within 80 km (50 mi) downstream (or 80-km [50-mi] radius for lake or coastal sites) of the plant radwaste discharge….” Table 5.4-1 of the ER lists liquid pathway parameter values for 50-mile sport fishing harvest, commercial fishing harvest, sport invertebrate harvest, and commercial invertebrate harvest but does not provide references/justifications for the in-between parameters used in these estimations.

Provide the following information:

- Reference/justification for assumption that 50% of fish consumed within 50 miles are from the Guadalupe River
- Reference/justification for assumption that 2.75% of population engages in sport fishing
- Reference/justification for assumption that 2.75% of population engages in sport invertebrate harvest

Response:

The response to this RAI is included in the response to RAI HP-5.4.1-1, also provided in NRC’s Environmental Request for Information Letter No. 12, dated May 31, 2012.

Associated ESPA Revisions:

ESPA changes associated with the response to this RAI are included in the ESPA changes provided with the response to RAI HP-5.4.1-1.

HP-5.4.1-5 (eRAI No.6506):

NRC Request:

HP-5.4.1-5 ESRP Section 5.4.1 directs the staff to review the identification and description of the environmental pathways by which radiation and radioactive effluents can be transmitted from the proposed plant to living organisms. The irrigation rate,...for irrigated land using water withdrawn within 80 km (50 mi) of the plant radwaste discharge (downstream or radius) is needed to perform dose calculations. Table 5.4-1 of the ER lists irrigation rate used, but does not provide references/justifications for the value used. Provide the reference/justification for assumption that irrigation rate is 110 l/m2 per month.

Response:

The irrigation rate of food products is assumed to be 1 inch per week, which converts to the rate in Table 5.4-1 as follows:

$$\left(\frac{1\text{ in}}{\text{wk}}\right)\left(\frac{0.0254\text{ m}}{\text{in}}\right)\left(\frac{1000\ \ell}{\text{m}^3}\right)\left(\frac{52\text{ wk}}{\text{yr}}\right)\left(\frac{1\text{ yr}}{12\text{ mon}}\right)=\frac{110\ \ell}{\text{m}^2-\text{mon}}$$

According to the Texas Water Development Board (TWDB), the Guadalupe River is used for irrigation by four counties within 50 miles of the plant. The total irrigation rate within these four counties is calculated as follows:

County	Total Irrigated Land Area (acre)	Use of Guadalupe River for Irrigation (acre-ft/yr)	Irrigation Rate	
			ft/yr	in/wk
DeWitt	1.21E+03	2.40E+01	1.98E-02	4.57E-03
Goliad	9.03E+02	2.85E+02	3.16E-01	7.28E-02
Jackson	8.85E+03	4.01E+03	4.53E-01	1.05E-01
Victoria	2.84E+03	3.56E+02	1.25E-01	2.89E-02
Total	1.38E+04	4.68E+03	9.14E-01	2.11E-01
Column	1	2	3	4

The information in the columns is obtained as follows:

1. Column 1 values are from Texas Agriculture Census [Ref 1, Table 10].
2. Column 2 values are from TWDB [Ref 2].
3. Column 3 is obtained by dividing Column 2 by Column 1 by county and adding.
4. Column 4 is obtained by multiplying Column 3 by 12 in/ft and dividing by 52 wk/yr.

Based on the table, the total irrigation rate within 50 miles is 0.21 inch per week, which is less than the assumed value of 1 inch per week, making the dose analysis conservative.

References:

1. *2007 Census of Agriculture*, Texas State and County Data, Volume 1, U.S. Department of Agriculture, September 2009, http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/Texas/index.asp.
2. *Water Use Estimates by Location of Use*, Texas Water Development Board, Retrieved 6/9/08 from http://www.twdb.state.tx.us/wushistorical/DesktopDefault.aspx?PageID=1.

Associated ESPA Revisions:

There are no ER changes associated with this response.

HP-5.4.1-6 (eRAI No.6506):

NRC Request

HP-5.4.1-6 According to ESRP 5.4.1, the following information is needed to perform site-specific analysis – “unusual animals, plants, agricultural practices, game harvests, or food processing operations having the potential for contributing 10% or more to either individual or population doses .....” Section 2.2 of the ER does not address any unusual animals, plants, agricultural practices, game harvests (e.g., organized seasonal deer hunting), or food processing operations. Provide discussion on the unusual animals, plants, agricultural practices, game harvests, or food processing operations having the potential to contribute 10% or more to either individual or population doses in areas affected by liquid effluents, as well as food-processing operations involving large quantities of water.

Response:

NUREG-1555 presents examples of unusual animals, plants, agricultural practices, game harvests, or food processing operations that may have the potential to contribute 10% or more to either individual or population doses. A review of animals and plants located within the vicinity of the VCS site along with agricultural, game harvesting, and food processing activities in the region were reviewed. No unusual animals, plants, agricultural practices, game harvests, or food processing operations were identified that would contribute 10% or more to either individual or population doses. Data and conclusions for each category are presented in the subsections below.

Animals and Game Hunting

ER Subsection 2.4.1.4.1.1 discusses mammals either observed or indicated by tracks and other signs on the VCS site, during seasonal avian surveys and specific mammal surveys conducted on the VCS site. ER Tables 2.4-1 through 2.4-10 list various avian, mammalian, amphibian and reptile, fish, and invertebrate species observed on the VCS site or in nearby waters. ER Subsection 2.4.1.6 identifies game species that fall within the “commercially or recreationally valuable” species category. The primary game species observed on the VCS site include white-tail deer, feral pigs, rabbits, northern bobwhites, various species of doves, and waterfowl.

As indicated in RG 1.109, the radionuclide concentration in an animal product such as meat or milk is affected by the amount of contaminated feed or forage eaten by the animal and its intake of contaminated water. The pathway by which an individual or population could receive a dose from unusual animals or game affected by liquid effluent is consumption. Therefore, the potential dose to humans attributable to animals is from irrigated milk and meat. The consumption of any game is expected to be on a limited basis (i.e., not enter full-scale food production) and would be significantly less than that of livestock, as ER Subsection 5.8.3.2 states that no populations were found with dependencies on subsistence hunting or fishing.

As indicated in NUREG/CR-6910, beef is usually the representative animal product for all meat (including beef, pork, wild game, and other meat), cows are the representative milk-producing animal, and chicken is the representative poultry animal and egg producer. Thus beef cows, milk cows and broilers (chickens) have been modeled in calculating the individual and population dose for VCS. Additionally, fish and invertebrate consumption are also modeled in calculating the individual and population dose for VCS. No unusual animals or subsistence activities were identified which would contribute more than 10% of the individual or population dose and thus would necessitate using a different representative animal, irrigation data, or other parameter used in calculating doses from liquid effluent pathways.

Plants

ER Section 2.2 identifies land use at the VCS site and in the vicinity and ER Subsection 2.4.1.2 identifies the terrestrial plants and ecology present in the vicinity of the VCS site. Subsection 5.8.3.2 states that no populations were found with dependencies on subsistence agriculture (including plant farming).

As identified in RG 1.109, the concentration of radioactive material in vegetation results from deposition onto the plant foliage and from uptake from the soil of activity deposits on the ground. The pathway by which an individual or population would receive a dose from an unusual plant affected by liquid effluent is via consumption or indirect transfers via the food chain.

As indicated in NUREG/CR-6910, irrigated leafy and non-leafy vegetables are included in radiological assessment models. Thus, leafy and non-leafy vegetables have been modeled in calculating the individual and population dose for VCS. There were no uncommon food products or plants (such as those indicated in NUREG/CR-6910, e.g., non-cultivated foods such as berries and mushrooms or forest products consumed by humans) in areas affected by plant effluent with the potential to contribute more than 10% of the individual or population dose.

Agricultural Practices

ER Section 2.2 identifies land use at the VCS site and in the vicinity. Based on geographic information system (GIS) and aerial interpretation using U.S. Geological Survey (USGS) land use classifications, the largest use category is rangeland. Of the approximately 71,936 acres within 6 miles of the VCS site (ER Figure 2.2-2 and ER Table 2.2-1), approximately 0.9 percent is water and 99.1 percent is land. Of the total land, 47 percent is classified as rangeland, 24.5 percent is forestland, 19 percent is agricultural, and 7.4 percent is wetland. A search of the U.S. Environmental Protection Agency (EPA) Enviromapper database identified Austwell Aquaculture, a commercial shrimp farm, in Refugio County. This farm uses water from the San Antonio Bay to which the Guadalupe River discharges. However, any discharges from the VCS site to the Guadalupe River would be highly diluted by the time they reached the Bay.

In addition to the doses via vegetable, milk, and meat production accounted for in the dose analysis, the VCS effluent dose calculation accounts for sport and commercial invertebrate consumption and conservatively assumes the catch location is just downstream of the discharge location. Therefore, there are no agricultural practices affected by plant effluent in the vicinity of the VCS site with the potential to contribute more than 10% of the individual or population dose.

Food Processing

There were no food processing operations affected by VCS liquid effluent identified which would use large amounts of water resulting in changes in radionuclide concentration in foods. Victoria, Calhoun, and Refugio counties are located adjacent or downstream of the VCS site. Of these Victoria and Calhoun do not process food at high levels (ED&T, 2012). Although Refugio is noted as processing food at above average level (ED&T, 2012), a search of the EPA Enviromapper database did not identify any food processor directly downstream of the liquid effluent discharge.

References:

(ED&T, 2012) Texas Economic Development and Tourism, Office of the Governor, *Food Processing*, available online at:
http://www.governor.state.tx.us/files/ecodev/profilefood.pdf, accessed Spring 2012.

(EPA, 2012) U.S. Environmental Protection Agency, *Enviromapper for Envirofacts*, available online at:
http://www.epa.gov/emefdata/em4ef.html?ve=9,28.79637908935547,-96.97151184082031&pText=Victoria, accessed June 20, 2012.

Associated ESPA Revisions:

There are no ER changes associated with this response.

HP-5.4.1-7 (eRAI No.6506):

NRC Request

HP-5.4.1-7 ESRP Section 5.4.1 directs the staff to review the identification and description of the environmental pathways by which radiation and radioactive effluents can be transmitted from the proposed plant to living organisms. Section 5.4.2.1 of the ER lists consumption of milk in areas irrigated with contaminated water as one pathway in calculating doses to the MEI from liquid effluent releases but Irrigated milk pathway is not included in ER Table 5.4-4. Provide justification/clarification why milk pathway is not included in calculating the MEI dose from liquid effluent releases. Provide clarification/ justification that there are no milk pathways within 5 miles of liquid effluent discharge location. Table 5.4-4 does not provide doses for all receptors (adult, teen, child, and infant). Provide doses for all receptors (adult, teen, child, and infant) from liquid effluent releases.

Response:

The response to this RAI is included in the response to RAI HP-5.4.1-1, also provided in NRC's Environmental Request for Information Letter No. 12, dated May 31, 2012.

Associated ESPA Revisions:

ESPA changes associated with the response to this RAI are included in the ESPA changes provided with the response to RAI HP-5.4.1-1.

HP-5.4.1-8 (eRAI No.6506):

NRC Request:

HP-5.4.1-8 ESRP Section 5.4.1 directs the staff to review the identification and description of the environmental pathways by which radiation and radioactive effluents can be transmitted from the proposed plant to living organisms presented in the ER. Table 5.4-3 lists the receptor locations exposed to gaseous effluent. Meat animal distance is at the residence location but the meat animal can spend time closer to the power block. Provide justification/verification of the nearest meat animal location.

Response:

Table 5.4-3 shows the nearest meat animal at 1.4 miles NNW, based on a survey conducted at and around the VCS site. However, because the meat animal may not be restricted to its owner's ranch, it is assumed that it can wander as close as the site boundary; accordingly, the footnote to Table 5.4-3 will be revised to indicate that distance to the site boundary (0.62 mi) is used for the calculation of doses due to the meat animal.

The meat pathway doses in Table 5.4-5 will be revised to reflect the new location of the meat animal. This table will also be revised to remove the site boundary as a receptor location for the maximally exposed individual (MEI) in response to RAI 5.4.3-1. Further discussion on the response to this RAI is provided below. Table 5.4-7 will also be revised to reflect the change in the meat animal location.

Response to RAI 5.4.3-1

RAI 5.4.3-1 asks why all pathways are not considered at the site boundary when evaluating this location for the MEI.

Table 5.4-5 currently shows gaseous effluent doses at four locations: site boundary, residence, vegetable garden, and meat animal. The doses at the last three locations are added to obtain the total MEI dose. Although no individual resides at the site boundary, plume, ground, and inhalation doses at this location are conservatively considered in demonstrating compliance with 10 CFR 50, Appendix I. Table 5.4-6 shows the larger of the site boundary and MEI doses from Table 5.4-5 for each dose type.

However, to provide additional clarification, Table 5.4-5 will be revised to remove the site boundary as an MEI location and to show the following pathways as contributing to the MEI doses:

- Plume at nearest residence
- Ground deposition at nearest residence
- Inhalation at nearest residence
- Vegetable ingestion from nearest garden
- Meat ingestion from animal at the site boundary

Table 5.4-6 will be revised to reflect the exposure pathways listed above for the total body, skin, and maximum organ MEI doses, but the site boundary will be retained as the unrestricted area receiving the maximum doses in air. Table 5.4-7 will also be revised to reflect the changes in the MEI location and the exposure pathways.

Associated ESPA Revisions:

The last paragraph of ER Subsection 5.4.2.2 will be revised as follows:

> There are no milk animals within 5 miles of the ~~plant~~ gaseous effluent discharge location. The gaseous activity releases (source terms) are shown in Table 3.5-2. Annual doses to the maximally exposed adult, teenager, child, and infant are calculated. The maximum total body and organ doses are presented in Table 5.4-5. In this table, the contributions from viable pathways are summed to obtain a total dose for each organ and age group.

ER Tables 5.4-3, 5.4-5, 5.4-6, and 5.4-7 will be revised in a future revision to the ESPA as shown below.

In addition to the changes described above, revisions to Tables 5.4-6 and 5.4-7 also reflect changes to liquid effluent doses in response to RAIs 5.4.1-1 and 5.4.1-7.

Table 5.4-3
Gaseous Pathway Receptor Locations

Receptor	Direction	Distance (mi)
Site Boundary	SW	0.62
Residence	NNW	1.40
Vegetable Garden	NW	1.65
Meat Animal	NNW	1.40
Biota	NW	0.25

Note: The site boundary and residence, garden, and meat animal locations indicated in this table are shown in Figure 6.2-6. The distance to the receptor location is from the edge of the power block. Because it is not restricted to the location shown in Figure 6.2-6, for calculation of doses, it is assumed that the meat animal is located at the site boundary (0.62 mi).

Table 5.4-5 (Sheet 1 of 2)
Gaseous Pathway Doses for Maximally Exposed Individuals

	Dose (mrem/yr) per Unit[a]							
Pathway	**Total Body**	**GI-Tract**	**Bone**	**Liver**	**Kidney**	**Thyroid**	**Lung**	**Skin**
~~Site Boundary~~								
~~External~~								
~~Plume~~	~~1.9~~	~~1.9~~	~~1.9~~	~~1.9~~	~~1.9~~	~~1.9~~	~~2.0~~	~~6.7~~
~~Ground~~	~~0.85~~	~~0.85~~	~~0.85~~	~~0.85~~	~~0.85~~	~~0.85~~	~~0.85~~	~~1.0~~
~~Total~~	~~2.8~~	~~2.8~~	~~2.8~~	~~2.8~~	~~2.8~~	~~2.8~~	~~2.8~~	~~7.7~~
~~Inhalation~~								
~~Adult~~	~~0.11~~	~~0.13~~	~~0.029~~	~~0.13~~	~~0.14~~	~~3.2~~	~~0.17~~	~~0~~
~~Teen~~	~~0.12~~	~~0.13~~	~~0.037~~	~~0.14~~	~~0.16~~	~~4.1~~	~~0.21~~	~~0~~
~~Child~~	~~0.11~~	~~0.11~~	~~0.047~~	~~0.13~~	~~0.14~~	~~5.0~~	~~0.18~~	~~0~~
~~Infant~~	~~0.062~~	~~0.060~~	~~0.030~~	~~0.084~~	~~0.085~~	~~4.6~~	~~0.12~~	~~0~~
~~Total~~								
~~Adult~~	~~2.9~~	~~2.9~~	~~2.8~~	~~2.9~~	~~2.9~~	~~5.9~~	~~3.0~~	~~7.7~~
~~Teen~~	~~2.9~~	~~2.9~~	~~2.8~~	~~2.9~~	~~2.9~~	~~6.9~~	~~3.1~~	~~7.7~~
~~Child~~	~~2.9~~	~~2.9~~	~~2.8~~	~~2.9~~	~~2.9~~	~~7.8~~	~~3.0~~	~~7.7~~
~~Infant~~	~~2.8~~	~~2.8~~	~~2.8~~	~~2.9~~	~~2.9~~	~~7.4~~	~~3.0~~	~~7.7~~
Residence								
External								
Plume	0.54	0.54	0.54	0.54	0.54	0.54	0.55	1.7
Ground	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.27
Total	0.77	0.77	0.77	0.77	0.77	0.77	0.78	2.0
Inhalation								
Adult	0.025	0.028	0.0062	0.029	0.032	0.70	0.038	0
Teen	0.026	0.029	0.0080	0.031	0.035	0.90	0.046	0
Child	0.024	0.024	0.010	0.028	0.032	1.1	0.039	0
Infant	0.014	0.013	0.0065	0.019	0.019	1.0	0.026	0
Vegetable								
Adult	0.24	0.24	1.2	0.25	0.23	4.3	0.20	0
Teen	0.35	0.35	1.8	0.39	0.36	5.4	0.31	0
Child	0.75	0.73	4.2	0.84	0.78	10	0.70	0
Meat								
Adult	~~0.10~~ 0.45	~~0.16~~ 0.66	~~0.45~~ 2.0	~~0.11~~ 0.47	~~0.10~~ 0.45	~~0.39~~ 1.5	~~0.094~~ 0.42	0
Teen	~~0.083~~ 0.37	~~0.11~~ 0.48	~~0.38~~ 1.7	~~0.089~~ 0.39	~~0.083~~ 0.37	~~0.29~~ 1.1	~~0.078~~ 0.35	0
Child	~~0.15~~ 0.66	~~0.16~~ 0.71	~~0.71~~ 3.2	~~0.16~~ 0.69	~~0.15~~ 0.67	~~0.46~~ 1.8	~~0.14~~ 0.64	0

Table 5.4-5 (Sheet 2 of 2)
Gaseous Pathway Doses for Maximally Exposed Individuals

	Dose (mrem/yr) per Unit[(a)]							
Pathway	**Total Body**	**GI-Tract**	**Bone**	**Liver**	**Kidney**	**Thyroid**	**Lung**	**Skin**
Total MEI Dose[(b)]								
Adult	~~1.1~~ 1.5	~~1.2~~ 1.7	~~2.4~~ 3.9	~~1.2~~ 1.5	~~1.1~~ 1.5	~~6.1~~ 7.2	~~1.1~~ 1.4	2.0
Teen	~~1.2~~ 1.5	~~1.3~~ 1.6	~~2.9~~ 4.2	~~1.3~~ 1.6	~~1.2~~ 1.5	~~7.4~~ 8.2	~~1.2~~ 1.5	2.0
Child	~~1.7~~ 2.2	~~1.7~~ 2.2	~~5.6~~ 8.1	~~1.8~~ 2.3	~~1.7~~ 2.2	~~13~~ 14	~~1.7~~ 2.2	2.0
Infant	0.78	0.78	0.77	0.79	0.79	1.8	0.81	2.0

(a) "Unit" refers to one conventional unit or six modular mPower reactors.

(b) "Total" MEI dose is the sum of the residence, vegetable, and meat pathways. There are no milk animals within five miles of the gaseous effluent discharge location.

(c) Gaseous doses are obtained by summing GASPAR II output for particulates, iodines, and gases.

Table 5.4-6
Comparison of Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria

		Annual Dose per Unit[(a)]	
Type of Dose	**Location**	**VCS**	**Limit**
Liquid Effluent[(b)]			
Total Body (mrem)	Guadalupe River	~~0.74~~ 0.84	3
Maximum Organ – GI-LLI (mrem)	Guadalupe River	~~2.2~~ 2.3	10
Gaseous Effluent[(c)]			
Gamma Air (mrad)	Site Boundary	3.0	10
Beta Air (mrad)	Site Boundary	7.5	20
Total Body (mrem)	~~Site Boundary~~ Residence	~~2.8~~ 0.77	5
Skin (mrem)	~~Site Boundary~~ Residence	~~7.7~~ 2.0	15
Iodines and Particulates, Maximum Organ — Thyroid (mrem)	Residence/Garden/ Meat ~~Cow~~ Animal	~~11~~ 12	15

(a) "Unit" refers to one conventional unit or six modular mPower reactors.

(b) Liquid Effluents – The total body dose is the maximum total body value from Table 5.4-4e. The maximum organ dose is the largest value of all the organ doses in Table 5.4-4e.

(c) Gaseous Effluents – The thyroid dose in this table is obtained by summing GASPAR II output for particulates and iodines due to all pathways. All other doses in this table are obtained by summing GASPAR II output for particulates, iodines, and gases due to external pathways only.

Table 5.4-7
Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria

	Site[a][b] Dose (mrem/yr)				
	Liquid	**Gaseous**	**Direct**	**Total**	**Limit**
Total Body	~~1.5~~ 1.7	~~5.8~~ 4.4	5.0	~~12~~ 11	25
Thyroid	~~1.3~~ 2.1	~~25~~ 28	5.0	~~32~~ 35	75
Other Organ - Bone	~~2.6~~ 2.8	~~11~~ 16	5.0	~~19~~ 24	25

(a) "Site" refers to two conventional units or 12 modular mPower reactors.

(b) Site doses for two units are obtained by doubling the doses from a single unit. Liquid effluent doses are obtained by doubling the MEI doses in Table 5.4-4e. Gaseous effluent doses are obtained by doubling the ~~higher of site boundary and~~ MEI doses in Table 5.4-5. The direct radiation dose is obtained by doubling 2.5 mrem/yr, the dose outside the controlled area corresponding to the shielding criteria for the ABWR (GE 1997, Table 3.2a); this is the largest direct dose component for the reactor technologies being evaluated.

HP-5.4.3-1 (eRAI No.6506):

NRC Request

HP-5.4.3-1 According to ESRP Section 5.4.3, the applicant's estimated maximum individual doses should be compared with the design objectives of 10 CFR 50 Appendix I with respect to radiological impacts to individuals from the radiological effluent releases from reactors. Table 5.4-6 in the ER lists total body and skin dose at the site boundary from gaseous effluent releases. However, the site boundary location only considers plume and ground doses. For comparison to the limits in 10 CFR 50 Appendix I, the total dose utilized is to be at the nearest MEI and should also include all pathway doses at the MEI. This change would also affect the results in Table 5.4-7. Re-evaluate the dose values listed for MEI in Table 5.4-6 from gaseous effluent releases. Note: **This is also submitted as a safety RAI6303**

RAI Response:

The response to this RAI is included in the response to RAI HP-5.4.1-8, also provided in NRC's Environmental Request for Information Letter No. 12, dated May 31, 2012

Associated ESPA Revisions:

ESPA changes associated with the response to this RAI are included in the ESPA changes provided with the response to RAI HP-5.4.1-8.

HP-5.4.3-2 (eRAI No.6506):

NRC Request

HP-5.4.3-2 According to ESRP Section 5.4.3, the individual dose equivalent to any member of the public from all nuclear fuel cycle facilities must be considered against the limits of 40 CFR 190 and 10 CFR 20.1301(e). Table 5.4-7 in the ER lists the total dose to maximally exposed individual from VCS site, but the estimated dose values do not match with the dose values listed in Table 5.4-6 (e.g., the thyroid dose listed in Table 5.4-6 is 11 mrem/yr from gaseous effluent, this implies that the dose from two units would be 22 mrem from gaseous effluents but the value listed in Table 5.4-7 for thyroid dose is 16 mrem/yr). Provide justification of the site dose values listed in Table 5.4-7.

Response:

Table 5.4-7 will be revised to correctly show the doses to the maximally exposed individual (MEI) from all units on the VCS site (either two conventional units or 12 modular mPower units).

Site liquid doses are obtained by doubling the MEI doses from a single unit. The MEI doses from a single unit are obtained from Table 5.4-4e, a new table added in response to RAIs 5.4.1-1 and 5.4.1-7.

Site gaseous doses are obtained by doubling the MEI doses from a single unit. The MEI doses from a single unit are obtained from Table 5.4-5, which is being revised in response to RAIs 5.4.1-8 and 5.4.3-1.

Please note that, in demonstrating compliance with a criterion in 10 CFR 50 Appendix I, Table 5.4-6 shows gaseous effluent thyroid dose due to iodines and particulates only, whereas Table 5.4-5 includes all radionuclides (iodines, particulates, and gases).

Associated ESPA Revisions:

ER Table 5.4-7 will be revised as follows in a future revision to the ESPA:

Table 5.4-7
Comparison of Maximally Exposed Individual Doses with 40 CFR 190 Criteria

	Site[(a)(b)] Dose (mrem/yr)				
	Liquid	**Gaseous**	**Direct**	**Total**	**Limit**
Total Body	~~1.5~~ 1.7	~~5.8~~ 4.4	5.0	~~12~~ 11	25
Thyroid	~~1.3~~ 2.1	~~25~~ 28	5.0	~~32~~ 35	75
Other Organ - Bone	~~2.6~~ 2.8	~~11~~ 16	5.0	~~19~~ 24	25

(a) "Site" refers to two conventional units or 12 modular mPower reactors.

(b) Site doses for two units are obtained by doubling the doses from a single unit. Liquid effluent doses are obtained by doubling the MEI doses in Table 5.4-4e. Gaseous effluent doses are obtained by doubling the ~~higher of site boundary and~~ MEI doses in Table 5.4-5. The direct radiation dose is obtained by doubling 2.5 mrem/yr, the dose outside the controlled area corresponding to the shielding criteria for the ABWR (GE 1997, Table 3.2a); this is the largest direct dose component for the reactor technologies being evaluated.

HP-5.4.4-1 (eRAI No.6506):

NRC Request

HP-5.4.4-1 According to ESRP Section 5.4.4, "the biota to be considered in this evaluation should include those in the pathways identified in ESRP 5.4.1, those appearing on the endangered/threatened species lists, and others of significance." Provide justification /verification of the level of exposure of certain threatened and endangered species on and within 50 miles of the proposed VCS site (ER Section 2.4.1.5 includes the discussion on threatened and endangered species such as whooping cranes, bald eagle, white-tailed hawk, etc). Provide discussion on the relationship of the calculated biota doses for surrogate species to the endangered/threatened species observed on the proposed VCS site.

Response:

The only federally listed species observed on the VCS site during wildlife surveys was the bald eagle, and the only state listed species observed on the site during the same surveys were the white-tailed hawk and wood stork. These three species are represented by the heron as a surrogate species, which is discussed in ER Section 5.4.4. The endangered whooping crane winters in the Aransas National Wildlife Refuge approximately 30 miles south-southeast of the VCS liquid waste discharge location. The whooping crane is also represented by the heron as a surrogate species.

The liquid exposure pathway for the heron is internal exposure from ingestion of fish and external exposure from shoreline activities, as discussed in ER Section 5.4.4.1. The gaseous exposure pathway is discussed in ER Section 5.4.4.2. For both pathways, the heron is an appropriate surrogate species for the bald eagle, white-tailed hawk, wood stork, and whooping crane due to similar avian behaviors.

Associated ESPA Revisions:

There are no ER changes associated with this response.

HP-5-11-1 (eRAI No.6507):

NRC Request

HP-5.11-1 ESRP Section 5.11 directs the staff to review the potential cumulative environmental impacts associated with proposed project presented in the ER. Section 5.11.6 of the ER discusses cumulative radiological health impacts for the proposed VCS site from the operation of the South Texas Nuclear Power Plant (STP), but does not discuss other nuclear facilities (such as Goliad Project). The ER does not discuss cumulative radiological health impacts of the alternative sites. Provide an explicit statement regarding how contributions from existing and proposed nuclear power plants and other nuclear facilities within 50 mi radius are incorporated in the assessment of cumulative radiological health impacts for the proposed VCS site and other alternative sites.

Response:

Exelon is evaluating the plant proposed for VCS at each alternative site (with some differences in the cooling systems).

Victoria County Station Cumulative Radiological Impacts

As stated in the RAI, Section 5.11.6 of the VCS ER discusses radiological impacts cumulative with the STP site in Matagorda County. The only other radiological project within 50 miles of VCS is the in-situ uranium recovery project in Goliad County.

The Goliad project is a planned in-situ uranium recovery operation for northeast Goliad County under development by the Uranium Energy Corporation (UEC). The site is approximately 13 miles from the VCS site. UEC has received all permits and expects to begin well field development in 2012. The total acreage for the 13 current in-situ uranium mining leases is 1421 acres. In-situ uranium mining involves injecting a solution of water and chemicals into a well to mix with and dissolve (leach) the uranium from the ore body, then pumping the leachate to the surface for recovery of uranium. The wastewater produced from in-situ uranium mining is then later injected into a wastewater well for disposal. This process generates no tailings. The principal radiological impact is from radon emissions.

NRC has evaluated the radiological impacts of in-situ uranium recovery facilities in a generic environmental impact statement, NUREG-1910 (NRC 2009). This GEIS reports, “Because of the distance to offsite receptors, radiological doses from normal operations are expected to have a SMALL impact on the general public.” Table 4.2-2 of the GEIS reports radiological doses to nearby receptors, the highest of which is the Crow Butte facility in Nebraska. NRC’s environmental assessment for the Crow Butte facility expansion (NRC 2007) states, “The highest doses are estimated to be 25, 18.9, 16.2, and 15.5 mrem/yr to the four nearest residents to the site, with all other nearby residents receiving less than 8 mrem/yr.” Although variations in the size of the facility, the number of well fields in operation and restoration at any one time, and the facility processing flow rates can affect the dose, Exelon believes these values are representative of what could occur at the Goliad project.

Table 5.4-5 of the VCS ER reports the total dose to the maximally exposed individual (MEI), a child in a residence 1.4 miles northwest of the site (Table 5.4-3). Table 5.4-5 is being updated as the result of Exelon's response to ER RAI Letter No. 12 (dated May 31, 2012), to be submitted to the NRC no later than July 13, 2012, in accordance with the 45 day response time requested in the RAI letter). The revised dose from two VCS units is 4.4 mrem per year. Doses farther to the northwest, in the direction of the Goliad project, would be less. While it is not possible to quantitatively determine cumulative impacts of the two facilities without extensive data and modeling, the data presented here suggest that the cumulative MEI dose would be near the Goliad Project and would be strongly dominated by radon emissions from the Goliad Project. Exelon concludes that the cumulative impact would be SMALL, because the cumulative dose would be negligibly larger than what NRC had determined to be SMALL for the MEI dose for uranium in situ recovery facilities.

Matagorda County Site Cumulative Radiological Impacts

The South Texas Project (STP) is approximately 12 miles to the northeast of the proposed Matagorda County site. STP's COL application (STPNOC 2011) reports that the Units 3 and 4 MEI dose is 5.7 mrem per year (Table 5.4-8), at a distance of 2.2 miles (Table 5.4-4) west-southwest (the approximate direction of the Matagorda County site). Units 1 and 2 contribute approximately an additional 0.01 mrem per year. These doses would rapidly decrease with distance. While the cumulative dose from the two facilities (STP and Matagorda County) cannot be quantitatively determined without modeling, it is clear that the cumulative MEI dose would likely be a small amount greater than the 4.4 mrem per year at the Matagorda County site MEI location (assuming the same modeling as for VCS) and a small amount greater than the 5.71 mrem per year at the STP MEI location. The Environmental Protection Agency limit for cumulative uranium fuel cycle dose is 25 mrem per year (40 CFR 190, "Environmental Radiation Protection Standards for Nuclear Power Operations"). Therefore, Exelon concludes that the cumulative radiological impact would be SMALL.

Buckeye Site Cumulative Radiological Impacts

STP is approximately 5 miles to the south of the proposed Buckeye site. Given the close proximity of these sites and the fact that both sites use the Colorado River, radiological doses would be expected to be cumulative. Exelon conservatively added the liquid and gaseous doses of Table 5.4-7 of the VCS ER (being modified as described above for Table 5.4-5) and applied the resulting 6.1 mrem per year, 2-unit MEI dose to the Buckeye site. (Direct radiation was ignored as not being cumulative. The calculation is conservative because the liquid and gaseous receptors are not the same.) As reported above, the STP four-unit MEI dose is 5.71 mrem per year. Conservatively adding (that is, without any attenuation) these two contributors yields 12 mrem per year to the MEI. This is less than the 25 mrem per year criterion of 40 CFR 190. Therefore, Exelon concludes that the cumulative impact would be SMALL.

Alpha Site Cumulative Radiological Impacts

There are no large radiological facilities within 50 miles of the Alpha Site. Any small contributions from hospital sewage discharges are not evaluated. Reactors at Texas A&M are farther than 50 miles away. Reactors at STP are farther than 50 miles away.

Bravo Site Cumulative Radiological Impacts

There are no large radiological facilities within 50 miles of the Bravo Site. Any small contributions from hospital sewage discharges are not evaluated. Reactors at Texas A&M are farther than 50 miles away. Reactors at Comanche Peak are farther than 50 miles away.

References:

NRC (U.S. Nuclear Regulatory Commission) 2007 *Environmental Assessment for Amendment to Source Materials License SUA-1534 for a Central Processing Plant Upgrade, Crow Butte Resources, Inc. In-Situ Uranium Recovery Facility*, Crawford, Dawes County, Nebraska.

NRC (U.S. Nuclear Regulatory Commission) 2009. *Generic Environmental Impact Statement for In-Situ Leach Uranium Milling Facilities*, NUREG-1910, Office of Federal and State Materials and Environmental Management Programs, May.

STPNOC (South Texas Project Nuclear Operating Company) 2011. *South Texas Project Units 3 and 4 Combined License Application, Part 3, Environmental Report*. Revision 5, Bay City, Texas. Accession No. ML110340962.

Associated ESPA Revisions:

There are no ER changes associated with this response.

HP-6.2-1 (eRAI No.6508):

NRC Request

HP-6.2-1 ESRP Section 6.2 directs the staff to review the proposed radiological environmental monitoring plan. Section 6.2.2.1 on page 6.2-2 of the ER lists the pathways/media monitored but does not include any pathway linked to identify leakage from the blowdown discharge piping. Provide a description of the leakage monitoring program for the blowdown discharge piping.

Response:

Exelon will develop a leakage monitoring program for discharge blowdown piping at the COL stage of the project.

Associated ESPA Revisions

The first paragraph of ER Subsection 6.2.2.1 will revised as shown in a future ESPA revision to include a commitment to develop a discharge monitoring program for the discharge blowdown piping:

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. Exelon will develop a leakage monitoring program for discharge blowdown piping at the COL stage of the project.

HP-9.3.3-1 (eRAI No.6509):

NRC Request

HP- 9.3.3-1 ESRP 9.3 requires comparison of the proposed and alternative sites for various topics including "radiological and non-radiological health impacts." The ER Section 9.3.3 discusses alternative sites but the discussion does not include health impacts from radioactive effluent releases. Provide a discussion of health impacts from radioactive effluent releases from each alternative site.

Response:

Exelon has evaluated the alternative sites using the plant described in the ER for the VCS site, with some differences in cooling systems. Section 5.4.5 of the ER reports that collective worker doses at VCS would be as great as 99 person-rem per year. This value is representative of collective worker doses at each of the alternative sites.

For the dose to the maximally exposed individual (MEI), the same gaseous radiological releases would occur at each alternative site; however, the location of the MEI and meteorology would likely be different at each plant. Nevertheless, the VCS two-unit, gaseous-release, MEI dose is a reasonable representation of what could occur at the alternative sites. For VCS, this value is reported in ER Table 5.4-5. ER Table 5.4-5 is being updated as the result of Exelon's response to ER RAI Letter No. 12 (dated May 31, 2012), to be submitted to the NRC no later than July 13, 2012, in accordance with the 45 day response time requested in the RAI letter. The revised single-unit gaseous release dose is 2.2 mrem per year to a child resident 1.4 miles north-northwest of the plant. The two-unit dose would, thus, be 4.4 mrem per year, which is less than the 25 mrem per year dose limit of 40 CFR 190, "Environmental Radiation Protection Standards for Nuclear Power Operations." The alternative sites could experience a value somewhat larger or smaller than this value, depending on the location of the MEI in the context of the local meteorology.

For the liquid release dose to the MEI, there would be differences among the sites somewhat greater than those for the air pathway. The Matagorda County site discharges to Tres Palacios Bay, which provides a large amount of dilution, but potentially has more aquatic food consumption. The Buckeye site discharges to the Colorado River, upstream of the STP discharge. The Alpha site discharges to the Brazos River. The Bravo site discharges to the water retention basin, which has occasional blowdown to Walnut Creek.

Based on these radiological liquid discharge differences, Exelon believes it is reasonable, in the absence of specific modeling, to assume that VCS, Buckeye, and Alpha have similar discharge and dilution characteristics, and thus, could have similar liquid release MEI doses. For VCS, this value is reported in ER Table 5.4-6. ER Table 5.4-6 is being updated as described above for Table 5.4-5. The revised VCS liquid release MEI dose is 1.7 mrem per year (0.84 per unit). For the Matagorda County and Bravo sites, it is not clear whether values would be larger or smaller than this value; however, Exelon believes there is no reason to assume order-of-magnitude differences, given that all power reactors conduct liquid discharges and purify the water to the extent practicable to meet the 10 CFR 50, Appendix I ALARA criterion of 3 mrem per year per unit.

Collective dose depends strongly on the size of the exposed population and their locations. It also depends on site-specific meteorology. Taking into account differences in meteorology at the alternative sites would require modeling and site-specific knowledge not available at the reconnaissance level. Therefore, as a first order approximation, Exelon assumes each site has sufficiently similar meteorology as to not make large differences in dispersion of radiological air emissions. This may not be true for Matagorda County site, which could experience diurnal land and sea breezes. However, during the times that the wind is toward the sea, the radiological emissions would be moving toward an area with no receptors, decreasing the radiological impact.

For population differences, Exelon used GIS methods to compute the total 2010 population within 10 miles and within 50 miles of the site, using 2010 census data. The results are as follows:

Table 1. Populations Surrounding VCS and Alternative Sites

Site	10-Mile Population	50-Mile Population
VCS[a,b]	6,012	239,897
Matagorda County	6,080	172,575
Buckeye	7,636	280,391
Alpha	18,786	3,980,617
Bravo	17,669	694,238

a. Values are from Table B2.5.1-1 of Appendix B, a new appendix to the ER to be provided under the response to RAI 6461. The response to NRC RAI letter No. 16, including RAI 6461, will be submitted to the NRC no later than July 13, 2012, in accordance with the 45 day response time requested in the RAI letter.
b. Transients (2,028) were subtracted to make the values on equal terms with population data for the alternative sites.

First, the 50-mile population was selected to scale VCS collective dose to calculate the alternative site collective dose. The VCS projected collective dose from VCS ER Table 5.4-8 is 1.1 person-rem per year. To account for two units, this value would double to 2.2 person-rem per year. The scaling was calculated as shown in Table 2. There is no regulatory limit for collective dose.

Table 2. Population Scaling of VCS Collective Dose

Site	50-Mile Population Scaling Factor	Collective Dose (person-rem)
VCS	1.0	2.2
Matagorda County	0.72	1.6
Buckeye	1.2	2.6
Alpha	17	37
Bravo	2.9	6.4

Next, the 10-mile populations were examined. This is because the nearer receptors would receive greater individual doses. However, the 10-mile population has far few people than does the 50-mile population. It is not clear what would be the magnitude of any adjustments to the scaled collective dose in Table 2. Nevertheless, examination of the data suggests that 10-mile ratios are approximately the same as the 50-mile ratios for all sites except Alpha. The Alpha site 10-mile ratio is 1.3, whereas its 50-mile ratio is 17, as indicated above. This suggests that the 50-mile scaling for Alpha may have overestimated the collective dose.

For comparison with the scaled Buckeye values, Exelon notes that the STP Units 3 and 4 (5 miles south of the Buckeye site) collective dose from the gaseous pathway is 0.58 person-rem per year (STPNOC 2011), somewhat less than the value shown in Table 2.

Exelon concludes that radiological impacts from the alternative sites would be SMALL, because doses are less than applicable guidance and regulations.

References:

STPNOC (South Texas Project Nuclear Operating Company) 2011. South Texas Project Units 3 and 4 Combined License Application, Part 3, Environmental Report. Revision 5, Bay City, Texas. Accession No. ML110340962.

Associated ESPA Revisions:

There are no ER changes associated with this response.

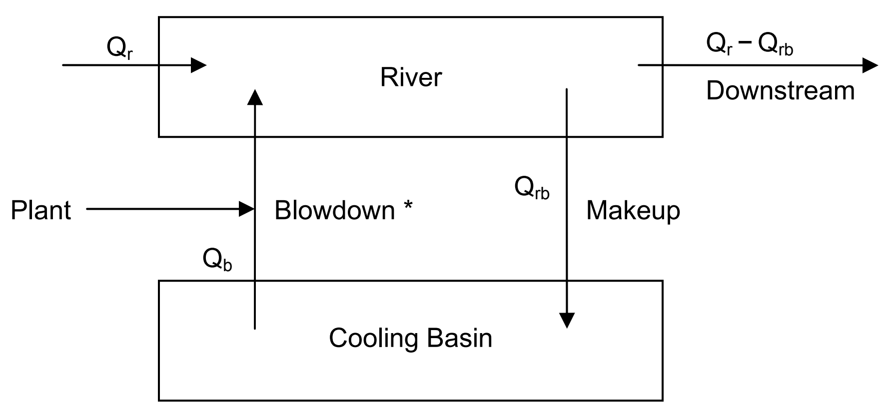
RW 3.5-2 (eRAI No.6454):

NRC Request

RW 3.5.-2 - ESRP Section 3.5 directs the staff to review the applicant's design of radioactive waste management and effluent control systems presented in the Environmental Report (ER). The blowdown discharge location for liquid effluent release is upstream of the raw water makeup intake structure (ER Figure 2.3.1-1). The releases upstream have a potential to get in the cooling basin through the raw water makeup system downstream. This mechanism could result in contaminating the cooling basin. ESRP Section 5.4.2 directs the staff to review the applicant's evaluation of doses due to radioactive gaseous and liquid effluent discharges presented in the ER. Licensees are responsible for evaluating any new exposure pathways and the resultant radiological hazards associated with the return of radioactive material to the operating facility and its subsequent discharge to the environment. As described in Regulatory Guide 1.109, “Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, ”Revision 1, issued October 1977, licensees must evaluate any new exposure pathways to members of the public that contribute 10 percent or more of the total effluent dose and include these dose assessments in their demonstration of compliance with Appendix I to 10 CFR Part 50 Agencywide Documents Access and Management System at Accession No. ML072120368. Provide an evaluation of the potential radioactivity buildup concentration (pCi/L) in the cooling basin from the operation of proposed VCS units. Additionally, based on the radioactivity buildup concentration in the cooling basin, provide estimate of dose impacts to different receptors.

Response:

Liquid effluent from the proposed facility is to be discharged into the Guadalupe River via the cooling basin blowdown line. Downstream of the discharge point, a fraction of the river water is diverted to the plant as makeup for the cooling basin. As indicated in Regulatory Guide 1.113, for large water volumes with small blowdown rates, the concentrations of long-lived isotopes may build up over a period of several years [Ref 1, Sheet 37].



* Q_b is negligible compared to Q_r

If the portion of the river between the discharge and intake points is considered a control volume, the activity in this volume may be calculated as follows:

$$\frac{dA}{dt} = P - \lambda A$$ (Equation 1)

Where:

- A = Activity in river (µCi)
- P = Effluent activity from plant, assumed to be released directly into river (µCi/sec)
- λ = Rate of activity removal from river (sec^{-1})
- t = Time (sec)

The steady-state concentration in the river may be determined by setting the differential equation to zero, solving for A, and dividing by the volume of the river:

$$C = \frac{P}{\lambda V}$$ (Equation 2)

Where:

- C = Concentration in river (µCi/ml)
- V = Volume of river (ml)

For a given isotope, activity is removed due to decay and flow out of the volume:

$$\lambda = \frac{\ln(2)}{t_{1/2}} + \frac{Q}{V}$$

Where:

- $t_{1/2}$ = Half-life of isotope (sec)
- Q = River flow rate (ml/sec)

For a long-lived isotope such as tritium, the decay term may be neglected, with λ simply becoming Q/V and Equation 2 reducing to the following [Ref 1, Sheet 26], with subscript r denoting the river:

$$C_r = \frac{P}{Q_r}$$ (Equation 3)

If the cooling basin is the control volume, the concentration of a long-lived isotope in the cooling basin may be estimated by using a modified version of Equation 3, considering the activity in the river to be the production term for the cooling basin.

$$C_b = \frac{C_r Q_{rb}}{Q_b}$$ (Equation 4)

Where:

- C_b = Concentration in cooling basin (µCi/ml)

- Q_{rb} = Makeup flow rate from river to cooling basin (ml/sec)
- Q_b = Removal rate from cooling basin (ml/sec)

Impact on Cooling Basin Concentrations

Equation 4 indicates that the concentration in the cooling basin may be conservatively estimated by multiplying the concentration in the river by the ratio of makeup rate to removal rate. The normal flow rates in the cooling basin are as follows, conservatively neglecting precipitation and losses via cooling towers [ER Figure 3.3-2]:

		Flow Rate (gpm)
Makeup		42250
Removal	Evaporation	39030
	Seepage	5700
	Blowdown	6500
	Total with Evaporation	51230
	Total without Evaporation	12200
		Ratio (Makeup/Removal)
With Evaporation		0.82
Without Evaporation		3.5

The ratio of makeup rate to removal rate constitutes a reconcentration factor for the cooling basin. The table shows reconcentration factors of 0.82 and 3.5 with and without evaporation, respectively. While tritium will be removed via evaporation, particulates would be expected to remain in the liquid phase. The tritium reconcentration factor of 0.82 indicates that the concentration in the cooling basin would be less than that in the river. Based on a conservative composite of liquid effluent source terms and a river flow of 480 cfs, the tritium concentration in the river is 0.75% of the effluent concentration limit (ECL) of 10 CFR 20, as shown in SSAR Table 11.2.3-3. The table also shows that the sum of the fractions of ECLs is less than 0.0005 for isotopes other than tritium. Multiplying this sum of fractions of ECLs by the reconcentration factor of 3.5 yields 0.0018, meaning that the maximum concentration of isotopes other than tritium is less than 0.18% of the ECLs.

The intake point of the makeup water is located downstream of the confluence of Guadalupe and San Antonio Rivers, with the latter providing additional dilution of the effluent activities. Even neglecting the dilution provided by the San Antonio River and assuming a conservatively low river flow of 480 cfs, the isotopic concentrations in the cooling basin are less than 1% of the 10 CFR 20 limits for drinking water. Therefore, the concentrations in the cooling basin may be regarded as negligible.

Impact on River Concentrations and Effluent Doses

The maximum instantaneous makeup water flow from the river to the cooling basin is 97,396 gpm [ER Figure 3.3-2] or 217 cfs. Based on daily statistics from 1935 to 2008, the mean river flow rate is 2001 cfs [Reference 2]. Therefore, approximately 11% of the historical mean river flow may be diverted to the cooling basin, where there is potential for concentration buildup before being returned to the river via the blowdown pathway.

As indicated above, there is no buildup of tritium in the cooling basin, but particulates may be potentially affected by a reconcentration factor of 3.5.

As indicated in ER Table 5.4-1, liquid effluent doses have been calculated using a conservatively low Guadalupe River flow rate of 480 cfs. This flow rate bounds the impact of recirculation. Unlike short-term accident doses, normal effluent doses are calculated using realistic and average parameters, as these are annual doses. For example, while the design control documents for the AP1000, the APWR, the ABWR, and the ESBWR include both realistic and maximum effluent source terms, the accepted practice is to use the former to calculate annual doses.

Equation 3 indicates that concentrations in the river are inversely proportional to the river flow rate. Dividing the realistic flow of 2001 cfs by the assumed flow of 480 cfs yields a factor of 4.2 conservatism in river concentrations. This conservatism in the flow rate offsets the potential increase in the concentration of particulates by a factor 3.5 in a small portion of the river flow that recirculates through the cooling basin. As liquid effluent doses in LADTAP II are directly proportional to the concentrations in the river, the doses are also conservative by a factor of 4.2, offsetting the reconcentration effect of recirculation.

It is concluded that the impact of cooling basin recirculation on long-lived isotopes in the river and the resulting doses at liquid effluent receptors is negligible in light of the conservatism in the assumed river flow rate. Table 5.4-1 will be revised to clarify this conservatism. Furthermore, the liquid effluent source terms are based on a conservative composite of multiple reactor designs.

References:

1. Regulatory Guide 1.113, *Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I*, U.S. Nuclear Regulatory Commission, Rev 1.
2. United States Geological Survey, National Water Information System: Web Interface, USGS 08176500 Guadalupe Rv at Victoria, TX, Retrieved 7/3/12, http://waterdata.usgs.gov/nwis/dvstat?referred_module=sw&search_site_no=08176500&format=sites_selection_links.

Associated ESPA Revisions:

The following changes will be made in a future revision to the ESPA:

The following paragraph will be inserted at the end of ER Subsection 5.4.2.1:

Exelon evaluated cooling basin recirculation effects on cooling basin and Guadalupe River radionuclide concentrations, concluding that cooling basin concentrations would be negligible and that the liquid effluent doses presented in Table 5.4-4 are conservative.

ER Table 5.4-1 will be revised as follows:

Table 5.4-1
Liquid Pathway Parameters

Parameter	Value	Basis/Source(s)
Impoundment Reconcentration Model	None	~~This model does not apply to the river discharge scenario.~~ Reconcentration is negligible when compared to conservatism associated with the assumed river flow rate (480 cfs versus mean flow of 2001 cfs).
Flow Rate in Receiving Water Body	480 cfs	This is a conservative flow rate that represents ~~95th~~ approximately 85th percentile of all observed annual average flow rates in the Guadalupe River from 1935 to 2008. Effluent activity is assumed to be released directly into the river without any prior dilution.

To maintain consistency in the ESP, two SSAR tables have also been revised.

Exelon transmitted Revision 1 of the response to RAI 11.03-4 via Letter NP-12-0027, dated 6/26/12. This letter showed changes to SSAR Table 11.2.3-1. To maintain consistency with ER Table 5.4-1, the SSAR table will be revised as follows:

Table 11.2.3-1
Liquid Pathway Parameters

Parameter	Value	Basis/Source(s)
Impoundment Reconcentration Model	None	~~This model does not apply to the river discharge scenario.~~ Reconcentration is negligible when compared to conservatism associated with the assumed river flow rate (480 cfs versus mean flow of 2001 cfs).
Discharge Flow Rate	480 cfs	This is a conservative flow rate that represents ~~95th~~ approximately 85th percentile of all observed annual average flow rates in the Guadalupe River from 1935 to 2008. Effluent activity is assumed to be released directly into the river without any prior dilution.
Transit Time to Receptor	~~See RG 1.109~~ 0	~~The default transit times from RG 1.109, Table D-1 are used.~~ Conservative assumption takes no additional decay beyond the default distribution transport times based on RG 1.109 that are built into LADTAP II.
50-Mile Sport Fishing Harvest	~~$6.69\text{x}10^{4}$ kg/yr~~ $2.67\text{x}10^{5}$ kg/yr	Based on RG 1.109, Appendix D and Table E-4, the average individual consumes 5.9 kg/yr of fish. Multiplying this by the 2080 population (414,902) yields the total annual consumption of fish within 50 miles of 2.43 $\text{x}10^{6}$ kg/yr. Of the state population of 20.9 million (Reference 11.2.3-3), 0.574 million (Reference 11.2.3-4) or about 2.75% engages in sport fishing in rivers. ~~It is assumed that 2.75%~~ Assuming that for every individual who catches fish, there are four who consume the catch, 11% of the fish consumption within 50 miles is due to sport fishing from Guadalupe River.
50-Mile Commercial Fishing Harvest	~~$1.15\text{x}10^{6}$ kg/yr~~ $2.17\text{x}10^{6}$ kg/yr	As the previous entry indicates, of the total fish consumption within 50 miles of 2.43 $\text{x}10^{6}$ kg/yr, ~~2.75%~~11% is due to sport fishing. It is assumed that Guadalupe River is the source of ~~50%~~100% of the fish consumed within 50 miles, with the remaining ~~47.25%~~89% coming from commercial fishing.
50-Mile Sport Invertebrate Harvest	~~$9.71\text{x}10^{3}$ kg/yr~~ $3.88\text{x}10^{4}$ kg/yr	Based on RG 1.109, Appendix D and Table E-4, the average individual consumes 0.85 kg/yr of invertebrate. Multiplying this by the 2080 population yields the total annual consumption of invertebrate within 50 miles of $3.53\text{x}10^{5}$ kg/yr. As with sport fishing, it is assumed that ~~2.75%~~11% of the invertebrate consumption within 50 miles is due to sport invertebrate harvest from the Guadalupe River.
50-Mile Commercial Invertebrate Harvest	~~$1.67\text{x}10^{5}$ kg/yr~~ $3.15\text{x}10^{5}$ kg/yr	As the previous entry indicates, of the total invertebrate consumption within 50 miles of $3.53\text{x}10^{5}$ kg/yr, ~~2.75%~~11% is due to sport invertebrate harvest. It is assumed that Guadalupe River is the source of ~~50%~~100% of the invertebrate consumed within 50 miles, with the remaining ~~47.25%~~89% coming from commercial harvest.

The footnote to SSAR Table 11.2.3-3 (Sheet 2 of 2) will be revised as follows:

The Guadalupe River flow rate is assumed to be 480 cfs (~~based on~~representing approximately ~~9~~85th percentile ~~value of 486 cfs from a statistical analysis~~ of USGS data showing ~~80,811 daily~~ average flow rates for the Guadalupe River from 1935 to 2008). Although releases are shown per unit, concentrations are for the whole site, which consists of two units. In the case of mPower, six modules are equivalent to one unit

RW 3.5-3 (eRAI No.6454):

NRC Request

RW 3.5-3 - According to ESRP Section 3.5 the principal release points for radioactive material to the environment and the direct radiation sources stored onsite out-of-plant as solid waste (e.g., independent fuel storage) need to be identified. ESRP Section 5.5.2 directs the staff to review the applicant's evaluation of impacts from storage or disposal of mixed radioactive wastes presented in the ER. ESRP Section 5.7 directs the staff to ensure that all conclusions given in Appendix A to the ESRP are appropriate for the proposed project. A list of potential sources of radioactive and mixed waste generated from operations along with the disposal plans and estimated health effects related to radioactive and mixed waste testing and storage is needed. Provide clarification/justification for determining that the bounding total annual activity and generated volume of solid radwaste is 9600 Ci/yr and 16,722 ft3/year per unit respectively (see Section 3.5.4 of the ER). Provide information concerning the expected volume and classification of mixed waste expected to be generated per year per unit. The information should include:

- Expected volume each of radioactive waste category (e.g., low level radioactive waste, mixed waste, spent fuel) on an annual basis for each reactor design cited in the ER
- Quantity in Curies per year of each radionuclide in the solid waste stream
- Expected solid waste volume for each reactor design cited in the ER
- Citation of the document(s) relied upon as the source for each of the design-specific values

Provide clarification/justification for the disposal options for the different categories of radioactive and mixed waste to be generated from potential operations of the proposed VCS units that includes:

- Potential disposal sites for each radioactive and mixed waste material category (LLW within and external to the Texas Compact, HLW, and transuranic waste)
- Impacts on the disposal capacity of the potential disposal sites
- Measures to reduce the generation of Class B and C LLW
- Potential to construct and operate additional onsite storage facilities for mixed, LLW, HLW, and transuranics with their impacts

Response:

In ER Section 3.5.4, Exelon identified a bounding total annual activity and generated volume for solid low-level waste (LLW) of 9600 Ci/yr and 16,722 ft^3/yr per unit, respectively. The volume is based on the estimated annual shipped waste volume for the ABWR presented in ER Table 3.5-12 (and FSAR Table 11.4-3) of the South Texas Project (STP) COLA (NINA 2011a). The bounding volume includes the estimated LLW and mixed waste shipped volumes. The bounding activity is based on estimates for ABWR radiation sources provided by the ABWR reactor vendor (GE-Hitachi Nuclear Energy 2009) based on Section 12.2 of the STP COLA FSAR (NINA 2011b). Table 1 provides an estimated activity by radionuclide. As discussed in the response to RAI 6375 (ESP EIS 7.10-3) submitted on June 5, 2012 by Exelon letter NP-12-0023, the Exelon ESP application uses a Plant Parameter Envelope (PPE) approach. A PPE is a set of plant design parameters that serve as a surrogate for actual reactor design information when a specific reactor design has not yet been selected for the proposed site. The PPE values are selected by the applicant to bound a range of possible current and future reactor designs that might be deployed at the proposed site. The PPE approach for an ESP allows consideration of existing reactor designs, as well as future advanced reactor designs for which detailed design information has not yet been developed. The ESP evaluation to determine site suitability is based on the bounding LLW volume and activity identified in ER Section 3.5.4. When Exelon selects a reactor design at the COL stage, then the design specific radioactive waste information will be considered. If the PPE values are not bounded a reevaluation will be performed.

The ESP application included a radioactive materials transportation analysis for four reactor technologies: AP1000, ESBWR, ABWR, and APWR. Information used in that analysis regarding the anticipated annual LLW (nonhazardous) and mixed waste volumes for each reactor technology is summarized in Table 2 to facilitate the NRC review. Annual estimates for spent fuel generation are also provided based on the anticipated refueling requirements considered in the radioactive materials transportation analysis. Spent fuel estimates are expressed as metric tons of uranium (MTU) – the unit of measure typically associated with management of spent nuclear fuel. The data available for the mPower reactor will not support an evaluation of radioactive waste related impacts. Should Exelon select the mPower technology for the VCS, an evaluation will be provided as part of the COL application.

Management of radioactive waste is included in the standard design for each reactor technology:

- AP1000 – Section 11.4.2.1 of the AP1000 DCD describes the radioactive waste storage for the AP1000 (Westinghouse 2008). The total volume of waste to be stored in the radwaste building packaged waste storage room is 1417 cubic feet per year at the expected rate and 2544 cubic feet per year at the maximum rate. The packaged waste storage room has a useful storage volume of approximately 3900 cubic feet and provides storage for more than 2 years at the expected rate of generation of more than a year at the maximum rate of generation.

  As described in Section 11.4.2.3.4 of the AP1000 DCD, mixed wastes from the radiologically controlled area would be collected in suitable containers and brought to the radwaste building. Mixed liquid waste is anticipated to fill less than three drums (17 ft^3) per year. Mixed wastes would be sent to an offsite facility having mixed waste processing and disposal capabilities.

- ESWBR – The “Container Storage Subsystem” portion of Section 11.4.2.1 of the ESBWR DCD (GE-Hitachi Nuclear Energy 2007) indicates there is onsite storage space for 6 months production of LLW.

  As described in the “Mixed Waste Processing” portion of Section 11.4.2.1 of the ESBWR DCD, mixed waste volumes generated at ESBWR facilities are anticipated to be less than or equal to the volumes provided in Table 11.4-2 (equivalent to two 55-gallon drums). Mixed waste is collected primarily in 55-gallon collection drums and sent offsite to an appropriately permitted vendor processor.

- ABWR – Section 11.4.2.1 of the ABWR DCD (GE Nuclear Energy 1997) indicates there is sufficient onsite storage provided to hold at least 6 months production of LLW.

The ABWR DCD does not project generation of mixed waste.

- APWR – Section 11.4.2.1 of the APWR DCD (MHI 2008) describes the storage of radioactive waste in the auxiliary building. Sufficient onsite storage is provided to hold solid waste for at least 30 days in accordance with ANSI 55.1.

  As described in Section 11.4.2.3 of the APWR DCD, operating procedures and administrative controls are implemented to prevent or minimize the use of listed or characteristic chemicals. If mixed waste is generated, it is collected primarily in 55-gallon drums and sent offsite to an appropriately licensed processor. When circumstances dictate the storage or disposal of mixed waste, those operations will be in accordance with the applicable regulatory requirements and associated permits.

Commercial LLW is classified as A, B, C, or greater than Class C in accordance with 10 CFR 61.55 and 61.56. The designation transuranic is not applied to commercial LLW.

Exelon would dispose of LLW at a licensed disposal facility. The ESP application does not propose storage of LLW beyond the capacity included in the reactor vendors' standard plant designs. The LLW generated from VCS operations is expected to be a combination of Class A and Class B wastes with the majority of the volume being Class A. (For example, 89 percent of the projected APWR LLW volume is expected to be Class A waste.) Disposal sites for such wastes are expected to be available at the time the VCS unit(s) are operational. On September 10, 2009, the Texas Commission on Environmental Quality (TCEQ) issued Radioactive Material License R04100 to Waste Control Specialists, LLC (WCS) for the construction of a low-level waste facility in Andrews County, Texas (TCEQ 2009). On April 25, 2012, WCS was authorized to begin accepting LLW for disposal (TCEQ 2012). The WCS facility will accept Class A, B, and C LLW. Because Exelon would have access to disposal capacity for any Class B and C waste generated from VCS operations, provisions for extended storage of such LLW are not necessary. Class A LLW can also be disposed of at the EnergySolutions' disposal site in Clive, Utah. It is likely that the WCS facility or other licensed disposal sites will be available to Exelon for disposal of LLW from VCS. No impact on the availability of commercial LLW disposal capacity is expected.

Exelon would arrange for treatment or disposal of mixed waste at an offsite facility authorized to manage such waste. Commercial facilities are currently available including those operated by Perma-Fix in Florida, Tennessee, and Washington; Energy Solutions in Utah; and WCS and NSSI in Texas. Given the limited quantities of mixed waste that might be generated from VCS operations, there would be no impact on the availability of commercial capacity to manage such waste.

The Nuclear Waste Policy Act as amended (42 USC 10101 et seq.), mandates the siting, construction, and operation of repositories for deep geologic disposal of HLW and spent nuclear fuel. The NRC's Waste Confidence Decision, 10 CFR 51.23(a), states that "[t]he Commission has made a generic determination that, if necessary, spent fuel generated in any reactor can be stored safely and without significant environmental impacts for at least 60 years beyond the licensed life for operation […] of that reactor in a combination of storage in its spent fuel storage basin and at either onsite or offsite independent spent fuel storage installations." That regulation also states that "the Commission believes there is reasonable assurance that sufficient mined geologic repository capacity will be available to dispose of the commercial HLW and spent fuel generated in any reactor when necessary." A standard contract with the Department of Energy (DOE) for disposal of spent nuclear fuel (10 CFR Part 961) is required for the operation of a nuclear power plant. As indicated in ER Table 1.2-2, item 2.6, Exelon initiated preliminary spent fuel contract discussions with DOE and those discussions will resume at the COL stage. Disposal of spent fuel will be in accordance with national planning for the management of such material. As described in ER Section 3.8.2, each reactor technology provides spent fuel pool storage capacity for at least 8 calendar years of fuel discharges. The ESP application does not propose dry storage of spent fuel at the VCS site.

References:

GE-Hitachi Nuclear Energy 2007. ESBWR Design Control Document, Tier 2, Revision 4, September 2007.

GE-Hitachi Nuclear Energy 2009. Letter from GE-Hitachi Nuclear Energy to Exelon, "Response to Request for ABWR Plant Parameter Envelope Values," dated September 11, 2009.

GE Nuclear Energy 1997. ABWR Design Control Document, Tier 2, Revision 4, March 1997.

MHI (Mitsubishi Heavy Industries, LTD) 2008. Design Control Document for the US-APWR, Revision 1, August 2008.

NINA (Nuclear Innovation North America) 2011a. South Texas Project Units 3&4 COLA, Environmental Report, Rev. 5, Release date March 1, 2011. Available at: http://pbadupws.nrc.gov/docs/ML1103/ML110340962.html

NINA 2011b. South Texas Project Units 3&4 COLA, Final Safety Analysis Report, Rev. 5, Release date March 1, 2011. Available at: http://pbadupws.nrc.gov/docs/ML1103/ML110340881.html.

TCEQ (Texas Commission on Environmental Quality) 2009. Radioactive Material License No. R04100, issued September 10, 2009.

TCEQ 2012. Letter from Brent Wade, TCEQ Office of Waste to Rodney Baltzer, President Waste Control Specialists, LLC. Re: Low Level Radioactive Waste Disposal Activity under Radioactive Material License R04100, dated April 25, 2012.

Westinghouse 2008. Westinghouse Electric Company, LLC, *AP1000 Design Control Document*, Revision 17, September 2008.

Associated ESPA Revisions:

There are no ER changes associated with this response.

Table 1. Principal Radionuclides in Solid Waste

Radionuclide	Ci/yr
Fe-55	564
Fe-59	28.7
Co-60	434
Mn-54	75.1
Cr-51	5240
Co-58	196
Ni-63	1090
Nb-95	7.73
Ag-110m	1.06
Zr-95	7.73
Ba-140	262
La-140	262
Np-239	1500
Total	9660

a. Numbers in column will not sum to total due to rounding.

Table 2. Estimated Radioactive Wastes (Sheet 1 of 2)

Reactor Type	Value	Basis
AP1000		
Low-level radioactive waste (nonhazardous)	530 ft^3/yr (wet) 1409 ft^3/yr (dry)	Expected LLW volume estimates from Table 11.4-1 of the AP1000 DCD (Westinghouse 2008)
Mixed waste	17 ft^3/yr (liquid) 7.5 ft^3/yr (solid)	Expected mixed waste volume estimates from Table 11.4-1 of the AP1000 DCD (Westinghouse 2008)
Spent fuel	22.97 MTU/yr	Estimate developed for Exelon radioactive materials transportation analysis.
ESBWR		
Low-level radioactive waste (nonhazardous)	15,859 ft^3/yr	Table 11.4-2 of the ESBWR DCD (GE-Hitachi Nuclear Energy 2007)
Mixed waste	14.71 ft^3/yr	Table 11.4-2 of the ESBWR DCD (GE-Hitachi Nuclear Energy 2007)
Spent fuel	38.54 MTU/yr	Estimate developed for Exelon radioactive materials transportation analysis.
ABWR		
Low-level radioactive waste (nonhazardous)	16,704 ft^3/yr	The response to RAI 6430 TR 3.8-3 submitted by Exelon letter NP-12-0022 dated June 18, 2012 identifies the LLW volume estimates for the ABWR. Total annual generation is approximately 473 m^3/yr or 16,704 ft^3/yr.[1]
Mixed waste	<18 ft^3/yr	The ABWR DCD does not project any mixed waste generation. Per the STP COLA ER, if mixed waste is generated, then it is expected to be 18 ft^3/yr or less (NINA 2011).
Spent fuel	30.15 MTU/yr	Estimate developed for Exelon radioactive materials transportation analysis.

[1] The bounding value of 16,722 ft^3 per year includes both LLW and mixed waste. The two types and their respective volumes are presented separately here.

Table 2. Estimated Radioactive Wastes (Sheet 2 of 2)

Reactor Type	Value	Basis
APWR		
Low-level radioactive waste (nonhazardous)	15,278 ft^3/yr	Table 11.4-3 of the APWR DCD (MHI 2008)
Mixed waste	-	The APWR DCD does not project any mixed waste generation. Comanche Peak COLA did not anticipate mixed waste generation associated with the APWR.
Spent fuel	34.82 MTU/yr	Estimate developed for Exelon radioactive materials transportation analysis.

NRW 3.6-1 (eRAI No.6530):

NRC Request

NRW 3.6-1 - ESRP Section 5.5.1 directs the staff to review the applicant's evaluation of impacts from nonradioactive effluent discharges presented in the ER. Sufficient detail of nonradioactive wastes is needed to assess the potential nonradioactive waste system impacts (ESRP Section 5.5.1). The data needed includes quantities of wastes, their pollutant concentration at points of release (ESRP Section 3.6.3), and frequency of waste discharges to water, land, and air. Provide the volume of different categories of nonradioactive waste (such as industrial waste, municipal waste, construction debris, spoils generated from dredging activities, sludge, sanitary waste, hazardous waste) generated from construction and operation of the proposed VCS units. Specify the disposal options/impacts associated with disposal of different categories of nonradioactive waste.

Response:

Construction

Wastes generated during VCS construction would be handled according to county, State, and Federal regulations. Exelon would obtain county and State permits and would comply with regulations for handling and disposal of solids. USACE permits for disposal of dredged spoils would be obtained and implemented. Exelon has little basis for quantifying the amounts of specific waste types that would be generated during VCS construction; however, impacts can be inferred from the available capacity for managing the wastes and the restrictions imposed on waste handling and disposal to preclude adverse effects on human health and the environment.

As discussed in ER Section 3.9.1.13, the reactor designs under consideration for VCS use high degrees of modularization. This construction technique enables power block components to be fabricated offsite and delivered in modular units, thereby reducing the generation of onsite waste. Construction activities at the VCS site would generate small quantities of waste, such as scrap wood, wallboard, plastics, paper, and metal, which would be recycled or disposed in a local landfill appropriate for handling building debris. Municipal trash generated by the workforce during construction activities may include food waste, glass, metals, cloth, plastics, and paper. Trash would be collected in local designated trash receptacles, transferred to onsite dumpsters, and disposed of in an offsite permitted landfill.

Dredging would be associated with the construction of the raw water makeup (RWMU) system intake at the Guadalupe River. Dredging activities and the management and disposal of the resulting spoils would be conducted in accordance with a USACE issued permit, as well as other applicable permits and regulations. Based on the cut-and-fill balance for the proposed RWMU intake canal, pumphouse and fish return, there would be a spoils balance of approximately 171,000 cubic yards. Fill would be placed in the proposed easement area adjacent to the intake canal to an elevation of 10 feet, accommodating approximately 75,000 cubic yards. The remainder of the spoils (approximately 96,000 cubic yards) would be removed from the floodplain. The disposal site(s) would be selected in coordination with the USACE to avoid sensitive areas (e.g., wetlands or waterways) and to maximize the effectiveness of water quality best management practices (BMPs). Due to the low permeability of the local soils, excavation with conventional earth moving equipment would be expected. If dewatering is required due to precipitation or infiltration, a sump/sediment trap would be used to limit fine sediment from entering the pumping structure. The water would be pumped to an adjacent pond constructed within the easement area to allow sediment to settle prior to draining or pumping back to the Guadalupe River. Basins for dredge materials and dewatering settling would be designed in accordance with USACE standards. Considering that dredging and disposal activities would be conducted in accordance with applicable permits and regulations, utilizing BMPs for site selection and water quality protection, the impacts associated with the disposal of dredge spoils would be SMALL.

As described in ER Section 3.9.1.2, clearing the site would begin with the removal of trees to the minimum extent necessary. Scrub vegetation and brush removal would be accomplished through the use of appropriate and approved techniques that may include controlled burning. Significant earthwork would be required to establish finish grades at the VCS site, especially to provide for the embedment of major power block area structures, to achieve cooling basin base level, to raise the power block area to finish grade, and to provide for cooling basin embankment dams and interior dikes. Existing topsoil from areas identified to require stripping would be removed and moved to the storage areas for later use during final site grading. The material below the topsoil could be used to build other structures as appropriate. Excess topsoil would be transported offsite, deposited on the outer perimeter of the cooling basin, and/or placed in established onsite spoils areas. Spoils areas for excavated materials are shown on ER Figure 4.1-1 (see response to RAI 6427, TE-5, data will be included in Figure 4.1-1 in a future revision of the Environmental Report). Soil transported offsite would be reused or disposed of in accordance with applicable laws and regulations. Management of the spoils would have SMALL impacts to site ecology, soil, and water resources.

Sanitary waste management is described in ER Section 3.6.2. Portable sanitary facilities would be used until a permanent sanitary waste treatment facility is functional, and as needed during peak construction to augment the permanent system. The waste collected from these temporary facilities would be disposed of offsite by a licensed sanitary waste disposal contractor. A typical publicly owned treatment works (POTW) generates 0.16 pounds (dry weight) of sewage sludge per day per person served (Penn State undated). Assuming that sludge generation rate, the VCS sanitary wastewater treatment system could generate up to 1000 pounds of sludge per day from the peak onsite construction workforce of 6300 or approximately 660 pounds of sludge per day for an average onsite workforce of 4100 during the 82-month construction period. Impacts associated with sanitary waste management would be SMALL.

Hazardous and nonhazardous solid wastes would be managed following county and State-specific handling and transportation regulations. As described in ER Section 3.9.5.8, Exelon would implement a solid waste management program that is compliant with the relevant environmental requirements including county and state-specific waste handling and transportation practices and approvals. The program would include waste minimization activities and offsite recycling of certain common construction wastes (e.g., used oil, antifreeze, scrap metal, wood). In the event that hazardous materials such as asbestos, asbestos-containing material, or lead-based paint are encountered, a process would be established to address the county/state-specific regulatory requirements for containment and/or removal of such materials by trained, authorized personnel. Impacts associated with hazardous and nonhazardous solid waste management would be SMALL.

<u>Operation</u>

Table 1 provides estimated annual quantities for the waste types generated during operation of VCS. The estimates were developed based on operating experience from Exelon's existing fleet of nuclear electric generating plants.

Table 1. Typical waste generation during operation (per unit except where noted)

Waste type/management	Average annual quantity
MSW	
• Landfilled (tons)	193
• Recycled (tons)	35
Scrap metal (tons)	120
Nonhazardous regulated waste	
• Landfilled (tons)	53
• Recycled (tons)	29
Hazardous waste (tons)	<13[a]
Dredge spoils (ft^3)	4100[b]

MSW = municipal solid waste. Definition varies by state.

a. Based on anticipated small quantity hazardous waste generator status (220 to 2200 pounds per month).

b. Projected annual dredged volume for the VCS RWMU intake system.

To reduce impacts of solid wastes, Exelon would implement waste minimization and recycling programs at VCS similar to those underway at its existing fleet of power plants. For example, Exelon implemented Project H.E.R.E (Helping the Environment by Recycling at Exelon) to raise awareness of recyclable materials and encourage changes to reduce waste generation and increase recycling when waste cannot be avoided. The program was implemented in 2005 to minimize and recycle common office wastes such as paper, cardboard, aluminum cans, plastic bottles, and glass. Exelon recycled nearly 2500 tons of office waste in 2010 through Project H.E.R.E. Exelon also developed a corporate-wide program to reuse and recycle electronic equipment. The program ensures proper management of broken or obsolete electronic equipment through de-manufacturing for reuse or reclamation, or refreshing for resale, in accordance with U.S health, safety, and environmental regulations. In 2010, Exelon sent approximately 400,000 pounds of electronic waste for processing and reuse. An additional 95,000 pounds was dispositioned through charitable donation. These and other Exelon corporate initiatives would be implemented to minimize the waste management impacts for VCS.

Sanitary Waste

Sanitary waste management is described in ER Section 3.6.2. The permanent sanitary waste treatment and discharge system for VCS would be designed to collect and transfer sanitary water/waste from the potable water and sanitary waste system to the sewage treatment facility. The sewage treatment facility would be a standard industry design for processing the sanitary water/waste to meet local and state regulations for the effluent quality. Operation of the permanent sewage treatment system would be independent of plant operational mode (full power operation, shutdown/refueling, and startup). Figure 3.3-1 provides expected (100 gpm) and maximum (200 gpm) sanitary waste generation rates for the VCS site.

A typical POTW generates 0.16 pounds (dry weight) of sewage sludge per day per person served (Penn State undated). Assuming that sludge generation rate, the VCS sanitary wastewater treatment system could generate up to 130 pounds of sludge per day from the peak onsite workforce of 800 during operation. Impacts associated with sanitary waste management would be SMALL.

Hazardous Waste

Hazardous waste management is described in ER Section 3.6.3.4. Based on Exelon's fleet operating experience, VCS would be expected to be registered as a small quantity generator for hazardous waste and would typically generate no more than 2200 pounds (between 220 and 2200 pounds) of hazardous waste per month. VCS would implement a waste minimization plan, as described in ER Section 5.5.2.3. Wastes would be stored temporarily on site, packaged in an approved U.S. Department of Transportation container, and periodically disposed of at a permitted disposal facility. All hazardous waste activities would be performed in compliance with federal regulations. Treatment, storage, and disposal of wastes generated by construction and operations of VCS would be governed by local and federal regulations.

Impacts associated with hazardous wastes are addressed in ER Subsection 5.5.1.2. There are two hazardous waste disposal facilities in Texas: U.S. Ecology Texas, with a rated capacity of approximately 1.5 million cubic yards, and Waste Control Specialists, LLC, with existing capacity of over 5 million cubic yards. The available disposal capacity in the state far exceeds the projected demands for hazardous waste disposal associated with VCS operations. The annual quantity of hazardous waste generated in Texas in 2009 exceeds 13 million tons (EPA 2010). As a small quantity generator, VCS would generate less than 27,000 pounds (13 tons) of hazardous waste on an annual basis. This amount is very small in comparison to the hazardous waste generated in the state and would result in negligible impacts.

Nonhazardous waste

Nonhazardous waste management is described in ER Section 3.6.3.3. Nonradioactive solid wastes typically include industrial wastes such as metal, wood, and paper, and process wastes like resins and sludges. To the extent practicable, scrap metal, lead-acid batteries, and paper would be recycled offsite at an approved recycling facility. Nonradioactive hazardous wastes would be collected and stored temporarily on site until disposed of at licensed offsite commercial waste disposal facilities or recovered at an offsite permitted recycling or recovery facility. Debris (e.g., vegetation) collected on trash screens at the water intake structure(s) would be disposed of either on site or offsite as solid waste in accordance with TCEQ regulations.

As discussed in ER Section 5.5.1.2, VCS would generate nonhazardous waste that would be classified as municipal solid waste and disposed of in accordance with TCEQ regulations at landfills permitted to receive such wastes. Municipal solid waste planning in Texas is the responsibility of 24 councils of governments. The VCS site is located in the Golden Crescent Regional Planning Commission. This area has one landfill, City of Victoria Landfill, a municipal solid waste landfill with 22 years of remaining capacity based on 2006 data, as indicated in the ER. The most recent TCEQ assessment using 2010 data (TCEQ 2011) projects 27 years of remaining capacity for this landfill. Municipal solid waste landfills in adjacent council areas include the El Centro Landfill in Nueces County, which had 57 years of remaining capacity, and the Fort Bend Regional

Landfill in Fort Bend County, which had 147 years of remaining capacity based on 2006 data. The most recent TCEQ assessment using 2010 data (TCEQ 2011) projected 82 years of remaining capacity for the El Centro Landfill and 49 years of remaining capacity for the Fort Bend Regional Landfill. A construction and demolition debris landfill is located in Fort Bend County, Sprint Fort Bend County Landfill, and had 52 years of remaining capacity using 2006 data. The most recent TCEQ assessment using 2010 data (TCEQ 2011) projects 49 years of remaining capacity for the Sprint Fort Bend County Landfill. TCEQ concluded that Texas appears to have an adequate reserve of landfill capacity in 2010. TCEQ (2011) noted concern for adequacy of landfill capacity for the councils of government with remaining capacity on the order of 10 years. The area in which the VCS site is located has projected capacity well beyond the 10-year threshold that TCEQ applies to evaluate whether the development of landfill capacity is keeping pace with regional waste generation.

As an electric generating facility, VCS would be considered an industrial waste generator. The TCEQ (Title 30, Texas Administrative Code, Sections 330.3 and 330.173) defines nonhazardous industrial waste in three classes—Class 1, 2, and 3—and establishes which landfills are acceptable for disposal of the classes.

- Class 1 industrial non-hazardous waste includes waste that, based on its constituents and properties, may pose a substantial danger to human health or the environment if not properly managed. There are special handling requirements for Class 1 wastes. Solidified industrial sludge containing metals or organics is an example of Class 1 waste.

- Class 2 is a category for industrial solid waste that cannot be described as hazardous, Class 1, or Class 3. Activated sludge from industrial biological wastewater treatment and trash from plant offices are examples of Class 2 wastes.

- Class 3 wastes are inert and essentially insoluble industrial solid wastes that are not readily decomposable. Examples of Class 3 wastes include demolition debris and bricks from an industrial facility that are insoluble, do not react with other materials, and do not decompose.

VCS wastes would likely be categorized as Class 2 or 3 industrial wastes. Most municipal solid waste landfills can accept Class 2 and 3 industrial wastes (TCEQ 2011). In addition, the U.S. Ecology Texas landfill in Robstown in Nueces County accepts industrial solid waste in Classes 1, 2, and 3 and has nonhazardous waste rated disposal capacity of 93,000 cubic yards (TNRCC 2000).

As indicated in Table 1, an average of approximately 250 tons of solid wastes would be landfilled during each year of VCS operations. For comparison, a recent analysis for the City of Victoria reported residential refuse collections of 24,000 tons per year excluding brush and bulky items (R.W. Beck 2006). Based on 2010 data, the City of Victoria Landfill receives more than 135,000 tons per year for disposal with remaining capacity for approximately 3.7 million tons (TCEQ 2011). The demand for landfill capacity associated with VCS operation is equivalent to approximately 1 percent of the demand for the City of Victoria's residential refuse collection services and less than 0.2 percent of the annual disposal rate for the City of Victoria Landfill. Consequently, VCS is not expected to alter demand or planning for solid waste disposal capacity in the region.

There is adequate capacity in the vicinity of VCS to meet the projected demand for nonhazardous municipal or industrial solid waste disposal for several decades. Waste generated from VCS operation would have SMALL impact on the available capacity.

Spoils

As discussed in ER Section 5.5.1.5, periodic dredging would be required as part of maintenance activities associated with the raw water makeup system intake canal. Dredging activities and the management and disposal of the resulting spoils would be conducted in accordance with a USACE issued permit, as well as other applicable permits and regulations. The disposal site(s) would be selected in coordination with the USACE to avoid sensitive areas (e.g., wetlands or waterways), to maximize the effectiveness of water quality BMPs, and to ensure adequate disposal area for the life of the VCS facility. Long-term data for the region suggests a sedimentation rate of 1.23 feet per 100 years. Using that sedimentation rate and based on the expected size of the intake canal and forebay, the estimated volume of dredged spoils is approximately 4100 ft^3 per year. Note that although this spoils quantity represents an estimated annual average, RWMU system dredging and maintenance activities would be performed as needed based on operating experience. The implemented BMPs could include the installation of silt fence or vegetative filter strips, the use of filter bags or other decanting techniques, and/or the placement of disposal areas to promote the return of managed dewatering runoff to the source water body (i.e., rather than another water body that could have different water quality characteristics). Considering that dredging and disposal activities would be conducted in accordance with applicable permits and regulations, utilizing BMPs for site selection and water quality protection, the impacts associated with the disposal of dredge spoils would be SMALL.

<u>References</u>:

R. W. Beck 2006. *Solid Waste Collections Analysis, Final Report, City of Victoria, Texas*, Prepared by R.W. Beck, November 2006. Available at: http://www.victoriatx.org/environmental/pdfs/solidwastecollectionfinal.pdf.

EPA 2010. U.S. Environmental Protection Agency, *State Detail Analysis, The National Biennial RCRA Hazardous waste Report (based on 2009 Data)*, 2010. Available at: http://www.epa.gov/waste/inforesources/data/br09/state09.pdf

Penn State undated. Penn State, College of Agricultural Services, *Land Application of Sewage Sludge in Pennsylvania, What is sewage sludge and what can be done with it?,* Available at : http://extension.psu.edu/cmeg/facts/sewage-sludge.pdf

TCEQ 2011. Texas Commission on Environmental Quality, Municipal Solid Waste in Texas: A Year in Review, FY2010 Data Summary and Analysis. AS-197/11, October 2011. Available at http://www.tceq.texas.gov/assets/public/comm_exec/pubs/as/187_11.pdf.

TNRCC 2000. Texas Natural Resource Conservation Commission, Permit No. HW-50052-0001 for Texas Ecologists, Inc., Permit issued February 8, 2000.

<u>Associated ESPA Revisions:</u>

There are no ER changes associated with this response.

ATTACHMENT 17

SUMMARY OF REGULATORY COMMITMENTS (Sheet 1 of 2)

(Exelon Letter to USNRC No. NP-12-0028, dated July 13, 2012)

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
ER Subsection 4.5.1 will be updated in a future ESPA revision to include the commitment to confirm that Unit 1 would be operational first and would therefore be a radiation source for Unit 2. [RAI 6505 HP-1 Response]	March 31, 2013	Yes	No
ER Tables 5.4-1, 5.4-4, 5.4-6, 5.4-7, and 5.4-8 will be revised in a future revision of the ESPA. [RAI 6506 HP-5.4.1-1 Response]	March 31, 2013	Yes	No
The last paragraph of ER Subsection 5.4.2.2 and ER Tables 5.4-3, 5.4-5, 5.4-6, and 5.4-7 will be revised in a future revision to the ESPA to reflect updated gaseous pathway doses to the MEI. [RAI 6506 HP-5.4.1-8 Response]	March 31, 2013	Yes	No
ER Table 5.4-7 will be revised in a future ESPA revision to reflect the correct MEI doses. [RAI HP-5.4.3-2 (6506) Response]	March 31, 2013	Yes	No
ER Subsection 6.2.2.1 will be updated in a future ESPA revision to include the following commitment: "Exelon will develop a leakage monitoring program for discharge blowdown piping at the COL stage of the project." [RAI 6508 HP-6.2-1Response]	March 31, 2013	Yes	No
ER Subsection 5.4.2.1, ER Table 5.4-1, and SSAR Tables 11.2.3-1 and 11.2.3-3 will be revised as shown. [RAI 6454 RW 3.5-2 Response]	March 31, 2013	Yes	No

SUMMARY OF REGULATORY COMMITMENTS (Sheet 2 of 2)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
The ESP evaluation to determine site suitability is based on the bounding LLW volume and activity identified in ER Section 3.5.4. When Exelon selects a reactor design at the COL stage, then the design specific radioactive waste information will be considered. If the PPE values are not bounded a reevaluation will be performed. [RAI 6454 RW 3.5-3 Response]	COL stage of project	Yes	No
The data available for the mPower reactor will not support an evaluation of radioactive waste related impacts. Should Exelon select the mPower technology for the VCS, an evaluation will be provided as part of the COL application [RAI 6454 RW 3.5-3 Response]	COL stage of project	Yes	No
Exelon would implement corporate initiatives such as those described in the NRW 3.6-1 (6530) response to minimize waste management impacts for VCS. [RAI 6530 NRW 3.6-1 Response]	COL stage of project	Yes	No