



South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

November 9, 2009  
U7-C-STP-NRC-090196

U. S. Nuclear Regulatory Commission  
Attention: Document Control Desk  
One White Flint North  
11555 Rockville Pike  
Rockville, MD 20852-2738

South Texas Project  
Units 3 and 4  
Docket Nos. 52-012 and 52-013  
Supplemental Response to Request for Additional Information

Attached is the supplemental response to the NRC staff question in Request for Additional Information (RAI) Letter 204 related to Combined License Application (COLA) Part 2, Tier 2, Section 12.2. This response supplements the response originally provided in letter U7-C-STP-NRC-090155, submitted on September 22, 2009. This letter completes the response to Letter 204.

The Attachment provides response to the RAI question below:

RAI 12.02-7

The indicated change to the COLA will be included in the next routine revision of the COLA submitted after NRC acceptance of the RAI response.

There are no commitments in this letter.

If you have any questions regarding this response, please contact me at (361) 972-7136 or Bill Mookhoek at (361) 972-7274.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on 11/9/09

Scott Head  
Manager, Regulatory Affairs  
South Texas Project Units 3 & 4

SCS

Attachment:  
Question 12.02-7 Supplemental Response

STI 32572383

DOA1  
NRW

cc: w/o attachment except\*  
(paper copy)

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**RAI 12.02-7****QUESTION:**

Please provide detailed information to enable the staff to validate and verify the estimated doses cited in FSAR section 12.2.2.2 with respect to the dose objectives of Appendix I to 10 CFR Part 50 and the dose limits in 10 CFR 20.1301(e); please revise the FSAR to include this information, or justify its exclusion. The information should include the following:

- a complete description of how the applicant derived all the values listed in Table 12.2-21, including all assumptions made
- citations to any reference material used (for documents not publicly available please provide a copy for staff's use)
- detailed breakdown of individual doses by pathway and organ
- detailed breakdown of population doses by pathway and organ

**RESPONSE:**

- *A complete description of how the applicant derived all the values listed in Table 12.2-21, including all assumptions made*

STP is responding to this question by addressing both gaseous releases (FSAR Table 12.2-21) and liquid releases (DCD Table 12.2-23).

**Gaseous**

The values in Table 12.2-21, provided here as Table 12.02-7-1, are gaseous pathway doses from all pathways at the offsite Maximally Exposed Individual (MEI) location (whether or not those pathways exist at that location or not) from one-unit ABWR operation. They are taken directly from the GASPAR output. Doses for all pathways and receptors calculated by the code are presented in the table.

RAI response 2.3.4-5 (revised July 30, 2009), Table 2.3S-26 gives the distances from the release points to sensitive offsite receptors surrounding the plant in each of 16 wind directions. The exposures to each age group from all pathways viable at those locations were calculated. The maximum exposure was found to occur to a child at 3505 meters WSW of the Unit 4 release point. All pathways except those of cow and goat milk ingestion (there are no milk animals located within 5-miles of the plant) are viable at that location. The last row of Table 12.2-21 gives the total dose from all viable pathways (i.e., child dose for plume, ground, vegetable, meat and inhalation).

One exception to the maximum organ dose exposure location was found. The maximum exposure to the thyroid was found to occur to a child at 4884 meters NNW of the Unit 4 release point. The thyroid doses listed in Table 12.2-21 are calculated for the latter location. Again; all pathways, except those of cow and goat milk ingestion, are viable and included in the total dose in the last row of the table.

ER Section 5.4, especially sub-sections 5.4.1.2 and 5.4.2.2, further discusses the gaseous pathway dose calculations. See also the tables in that chapter, especially Tables 5.4-2, 3 and 4. Also, Table 5.4-6 corresponds to Table 12.2-21 except that the former is for two-unit operation.

ER Table 5.4-7 is a “Comparison of Annual Maximally Exposed Individual Doses with 10CFR50, Appendix I Criteria”. ER Table 5.4-8 is a Comparison of Maximally Exposed Individual Doses with 10 CFR 20.1301(e), which references 40 CFR 190 Criteria.

### Liquid

The liquid pathway table, analogous to Table 12.2-21, is attached here as Table 12.02-7-2. DCD Table 12.2-23 presents the total MEI liquid pathway doses, as given in the last row of Table 12.02-7-2. The maximally exposed (from liquid releases) individual is a teenager using Little Robbins Slough; the bone dose liquid pathway MEI is a child at the same location. ER Section 5.4, especially sub-sections 5.4.1.1 and 5.4.2.1, further discusses the liquid pathway dose calculations. See also the tables in that chapter, especially Tables 5.4-1 and 5. Table 12.02-7-2 expands ER Table 5.4-5 (and FSAR Table 12.2-23) to include pathway doses to various age groups.

- *citations to any reference material used (for documents not publicly available please provide a copy for staff's use)*

All citations are given in ER Section 5.4.6 (References) and are noted in the sections and tables described above. A new reference section has been added to FSAR Section 12.2.

- *Detailed breakdown of individual doses by pathway and organ*

Table 12.2-21 gives the detailed breakdown of individual doses by pathway and organ for gaseous releases. The contents of that table are repeated in the attached Table 12.02-7-1 with only the viable site pathways shown. Pathway viability is discussed in the first bullet of this response. Table 12.02-7-2 is the analogous table for liquid releases.

- *Detailed breakdown of population doses by pathway and organ*

Attached Tables 12.02-7-3 and 12.02-7-4 give the detailed breakdown of population doses by pathway and organ from gaseous and liquid pathways. As shown in the latter table, the liquid pathway population dose has two components, exposure from the Colorado River and exposure from Matagorda Bay.

**Table 12.02-7-1**  
**Gaseous Pathway Doses for Maximally Exposed Individual[1] One Unit**  
**(millirem per year)**

<b>PATHWAY</b>	<b>T.BODY</b>	<b>GI-TRACT</b>	<b>BONE</b>	<b>LIVER</b>	<b>KIDNEY</b>	<b>THYROID</b>	<b>LUNG</b>	<b>SKIN</b>
						<b>[3]</b>		
<b>PLUME</b>	1.67E-01	1.67E-01	1.67E-01	1.67E-01	1.67E-01	8.63E-02	1.70E-01	4.62E-01
<b>GROUND</b>	2.36E-02	2.36E-02	2.36E-02	2.36E-02	2.36E-02	2.84E-02	2.36E-02	2.77E-02
<b>VEGETABLE</b>								
ADULT[2]	4.09E-02	4.04E-02	1.76E-01	4.41E-02	4.02E-02	8.30E-01	3.43E-02	3.35E-02
TEEN[2]	6.15E-02	6.10E-02	2.84E-01	7.00E-02	6.40E-02	1.06E+00	5.55E-02	5.40E-02
CHILD	1.38E-01	1.35E-01	6.80E-01	1.56E-01	1.45E-01	1.99E+00	1.31E-01	1.29E-01
<b>MEAT</b>								
ADULT	1.33E-02	1.80E-02	6.15E-02	1.38E-02	1.32E-02	3.99E-02	1.25E-02	1.23E-02
TEEN	1.09E-02	1.36E-02	5.21E-02	1.15E-02	1.10E-02	2.97E-02	1.05E-02	1.04E-02
CHILD	2.00E-02	2.11E-02	9.80E-02	2.09E-02	2.02E-02	4.67E-02	1.96E-02	1.94E-02
<b>INHAL</b>								
ADULT	1.62E-03	2.14E-03	8.15E-04	2.41E-03	3.06E-03	7.45E-02	3.67E-03	1.03E-03
TEEN	1.75E-03	2.33E-03	1.13E-03	2.92E-03	3.80E-03	9.75E-02	5.05E-03	1.04E-03
CHILD	1.67E-03	1.77E-03	1.51E-03	2.71E-03	3.46E-03	1.21E-01	4.25E-03	9.20E-04
INFANT	1.04E-03	9.55E-04	1.13E-03	2.10E-03	2.17E-03	1.10E-01	3.06E-03	5.30E-04
<b>SUM OF PATH- WAYS (CHILD)</b>	3.50E-01	3.48E-01	9.74E-01	3.69E-01	3.58E-01	2.27E+00	3.49E-01	6.39E-01

[1] Maximally exposed individual for total body and all organs except thyroid is child resident, 2.18 miles WSW of new units.

[2] Adult, teen and infant doses are presented as additional information.

[3] Maximally exposed individual for thyroid: Child resident 3.03 miles NNW.

Ground level releases assumed.

Source: GASPAR II calculated pathway doses for locations indicated in footnotes [1] and [3]

**Table 12.02-7-2**  
**Liquid Pathway Doses for Maximally Exposed Individual[1] One Unit**  
**(millirem per year)**

<b>PATHWAY</b>	<b>SKIN</b>	<b>BONE</b>	<b>LIVER</b>	<b>TOTAL BODY</b>	<b>THYROID</b>	<b>KIDNEY</b>	<b>LUNG</b>	<b>GI-LLI</b>
<b>ADULT</b>								
<b>[2]</b>								
FISH	0.00E+00	8.30E-04	1.14E-04	8.60E-05	2.93E-05	3.95E-05	3.03E-05	3.51E-04
SHORELINE	3.79E-05	3.23E-05	3.23E-05	3.23E-05	3.23E-05	3.23E-05	3.23E-05	3.23E-05
TOTAL	3.79E-05	8.62E-04	1.46E-04	1.18E-04	6.15E-05	7.17E-05	6.26E-05	3.83E-04
<b>TEENAGER</b>								
FISH	0.00E+00	8.65E-04	1.12E-04	8.25E-05	2.29E-05	3.29E-05	2.50E-05	2.54E-04
SHORELINE	2.12E-04	1.80E-04	1.80E-04	1.80E-04	1.80E-04	1.80E-04	1.80E-04	1.80E-04
TOTAL	2.12E-04	1.05E-03	2.92E-04	2.63E-04	2.03E-04	2.13E-04	2.05E-04	4.34E-04
<b>CHILD</b>								
FISH	0.00E+00	1.11E-03	1.00E-04	8.95E-05	1.95E-05	2.66E-05	2.09E-05	1.02E-04
SHORELINE	4.43E-05	3.76E-05	3.76E-05	3.76E-05	3.76E-05	3.76E-05	3.76E-05	3.76E-05
TOTAL	4.43E-05	1.15E-03	1.38E-04	1.27E-04	5.71E-05	6.42E-05	5.85E-05	1.39E-04
<b>MEI[3]</b>	2.12E-04	1.15E-03	2.92E-04	2.63E-04	2.03E-04	2.13E-04	2.05E-04	4.34E-04

[1] Little Robbins Slough

[2] Infant doses are zero and not included in table.

[3] Maximally liquid pathway exposed individual is teenager except child for bone dose.

Source: LADTAP II calculated pathway doses for locations indicated in footnote [1]

**Table 12.02-7-3**  
**Gaseous Pathway Population Doses[1] One Unit**  
**(person-rem per year)**

<b>PATHWAY</b>	<b>T.BODY</b>	<b>GI- TRACT</b>	<b>BONE</b>	<b>LIVER</b>	<b>KIDNEY</b>	<b>THYROID</b>	<b>LUNG</b>	<b>SKIN</b>
<b>PLUME</b>	5.61E-02	5.61E-02	5.61E-02	5.61E-02	5.61E-02	5.61E-02	5.93E-02	2.28E-01
<b>GROUND</b>	5.64E-02	5.64E-02	5.64E-02	5.64E-02	5.64E-02	5.64E-02	5.64E-02	6.62E-02
<b>INHAL</b>	5.18E-03	6.28E-03	2.34E-03	7.06E-03	8.52E-03	4.51E-01	1.14E-02	3.74E-03
<b>VEGET</b>	2.85E-02	2.74E-02	1.32E-01	3.12E-02	2.75E-02	3.25E-02	2.61E-02	2.55E-02
<b>COW MILK</b>	4.98E-03	4.12E-03	2.04E-02	6.32E-03	5.43E-03	1.66E-01	3.92E-03	3.74E-03
<b>MEAT</b>	1.38E-01	1.79E-01	6.51E-01	1.44E-01	1.38E-01	4.22E-01	1.30E-01	1.29E-01
<b>TOTAL</b>	2.90E-01	3.29E-01	9.18E-01	3.02E-01	2.92E-01	1.19E+00	2.87E-01	4.57E-01

[1] Population within 50-miles

Ground level releases assumed.

Source: GASPAR II calculated pathway doses

**Table 12.02-7-4**  
**Liquid Pathway Population Doses One Unit**  
**(person-rem per year)**

<b>PATHWAY</b>	<b>BONE</b>	<b>LIVER</b>	<b>TOTAL BODY</b>	<b>THYROID</b>	<b>KIDNEY</b>	<b>LUNG</b>	<b>GI-LLI</b>	<b>SKIN</b>
<b>COLORADO RIVER</b>								
FISH	1.08E-04	9.75E-05	5.30E-05	1.58E-06	2.86E-05	1.77E-05	4.79E-05	0.00E+00
INVERTEBRATE	2.17E-08	1.55E-08	8.10E-09	1.65E-10	3.21E-09	4.90E-09	3.78E-08	0.00E+00
SHORELINE	0.00E+00	0.00E+00	1.36E-03	1.36E-03	0.00E+00	0.00E+00	0.00E+00	1.59E-03
SWIMMING	0.00E+00	0.00E+00	3.68E-06	3.68E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BOATING	0.00E+00	0.00E+00	1.84E-06	1.84E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>MATAGORDA BAY</b>								
FISH	8.60E-07	6.75E-07	3.61E-07	1.60E-08	1.85E-07	1.43E-07	4.79E-07	0.00E+00
INVERTEBRATE	1.88E-04	1.26E-04	6.55E-05	1.54E-06	2.40E-05	4.30E-05	3.44E-04	0.00E+00
SHORELINE	0.00E+00	0.00E+00	2.61E-05	2.61E-05	0.00E+00	0.00E+00	0.00E+00	3.06E-05
SWIMMING	0.00E+00	0.00E+00	3.09E-08	3.09E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
BOATING	0.00E+00	0.00E+00	1.55E-08	1.55E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00
<b>TOTAL</b>	2.96E-04	2.24E-04	1.51E-03	1.39E-03	5.27E-05	6.08E-05	3.92E-04	1.62E-03



The following changes to the COLA will be made as a result of this response:

FSAR Section 12.2.2.2 add the following to the end of the section:

- Tables 12.2-24, 25, and 26 describe the parameters used in the airborne release dose assessment.

**[ER Tables 5.4-2, 3, and 4 are added as FSAR Tables 12.2-24, 25, and 26, references revised to FSAR #s]**

**Table 12.2-24**

**Gaseous Pathway Parameters**

Parameter	Value
Release Source Terms	Table 12.2-20
Population distribution	ER Table 2.5-2
Dispersion and deposition factors ( $\chi/q$ and $d/q$ ) [1]	Table 2.3S-27
50-Mile Milk Production (L/yr)	2.13E6 [2]
50-Mile Meat Production (kg/yr)	4.05E7 [2]
50-Mile Vegetable Production (kg/yr)	9.64E6 [2]

[1] Air concentration and deposition per unit release rate.

[2] Animal and vegetable production from 2002 National Census of Agriculture. Production converted to

food products using average conversion factors: 21,328 lb-milk/cow, 524 lb beef per cattle/calf, 92.2 lb pork/hog-pig, 61.1 lb meat/sheep, and 8,090 kg vegetables/acre

**Table 12.2-25**

**Gaseous Pathway Consumption Factors for Maximally Exposed Individual**

Consumption Factor	Annual Rate			
	Infant	Child	Teen	Adult
Milk consumption (L/yr) [1]	330	330	400	310
Meat consumption (kg/yr) [1]	0	41	65	110
Leafy vegetable consumption (kg/yr) [2]	0	26	42	64
Vegetable consumption (kg/yr) [2]	0	520	630	520

Source: Reference 12.2-1

[1] Cattle are assumed on pasture for 11 months of the year.

[2] Leafy vegetables are assumed grown in the MEI's garden for 11 months of the year; the garden is assumed to supply 76% of the other vegetables ingested annually.

**Table 12.2-26****Gaseous Pathway Receptor Locations**

<b>Receptor</b>	<b>Direction</b>	<b>Distance (miles)</b>
Site boundary	NNW	0.69
Maximally exposed individual (MEI), total body and all organs but thyroid	WSW	2.18
MEI, thyroid	NNW	3.03

Source: from GASPAR II (Reference 12.2-1) calculations of dose at nearby receptors (receptors given in Reference 12.2-2). Locations of maximum dose reported above.

FSAR Section 12.2.2.5 changes:

1. "The results of liquid releases, ~~assuming dilution factors described in Subsection 12.2.2.5.1,~~ are shown in the dose evaluation in Table 12.2-23.
2. Add to end of section "~~Table 12.2-27 describes the site-specific parameters used in the liquid release dose assessment.~~"

**[ER Table 5.4-1 is added as FSAR Table 12.2-27, references revised to FSAR #s]**

**Table 12.2-27 Liquid Pathway Parameters**

Parameter	Value
Release source terms	Table 12.2-22 [1]
Water body flow	600, 97800, 18.3 cubic feet per second [2]
Dilution factor for discharge	1 [3]
Transit time to receptor	1 hour [4]
Impoundment reconcentration model	None [5]
50-Mile population	514,003 [6]
50-Mile sport fishing, invertebrate catch	4.5E4, 1.8E6 kg/yr [7]
50-Mile shoreline usage	7.84E6 person-hours/yr [8]
50-Mile swimming, boating usage	3.92E6 person-hours/yr [9]
Fish consumption	21 kilograms per year [10]
Drinking water consumption	None [11]

[1] Table 12.2-22 gives single unit releases to the main cooling reservoir. Sources to the Colorado River, Matagorda Bay, and Little Robbins Slough are calculated by multiplying the values in Table 12.2-22 by the factors for each water body and nuclide in Table B4-1 of Reference 12.2-2.

[2] Dilution flow rate in Colorado River, Matagorda Bay, and Little Robbins Slough (Reference 12.2-3).

[3] Liquid discharge assumed fully mixed with annual average dilution flows.

[4] 1 hour assumed for transit time from reservoir discharge in all water bodies. This parameter is inconsequential because of residence time in the reservoir.

[5] Completely mixed model used for all water bodies. Reservoir characteristics built into Reference 12.2-2 Table B4-1 factors.

[6] Estimated 2060 population, ER Table 2.5-2.

[7] One-half of fish catch in each of Colorado River and Matagorda Bay. All invertebrate catch in Matagorda Bay (Reference 12.2-2)

[8] One-half at each of Colorado River and Matagorda Bay (Reference 12.2-2)

[9] Each of swimming and boating assumed one-half of shoreline usage.

[10] Adult MEI. 6.9 kilograms per year average (adult population) fish consumption (Reference 12.2-4)

[11] References 12.2-2 and 12.2-3

FSAR Section 12.2.2.5.1 changes:

1. Dilution flow rates in the Colorado River, Matagorda Bay and Little Robbins Slough used to evaluate the liquid pathway dose to the MEI, were obtained using information from the STP 2006 Offsite Dose Calculation Manual (ODCM). They were inputs to the LADTAP II computer program, as referenced in Table 12.2-27, footnotes 1, 2, and 3.
2. The liquid pathway doses to the MEI, assuming a dilution factor of only 10, are determined to be in Little Robbins Slough and are presented in Table 12.2-23.

FSAR Section 12.2.3.1 changes:

1. Using site-specific parameters, doses from the average annual liquid releases and the average annual airborne releases to the environment have been computed. The releases and doses and are shown in Tables 12.2-20 through 12.2-23. Tables 12.2-29 and 30 demonstrate that The average annual liquid and airborne releases are in compliance with 10 CFR 20 and 10 CFR 50 Appendix I.
2. [ER Tables 5.4-7 and 8 are added as FSAR Tables 12.2-29 and 30, references revised to FSAR #s]

**Table 12.2-29****Comparison of Annual Maximally Exposed Individual Doses with 10 CFR 50, Appendix I Criteria**

Type of Dose	Location	Annual Dose	
		ABWR (per unit)	Limit
Liquid effluent	Little Robbins Slough		
Total body (mrem) [5]		2.63E-4 [1]	3
Maximum organ – Bone (mrem)		1.15E-3 [7]	10
Gaseous effluent [2]	Site Boundary		
Gamma air (mrad) [6]		3.30	10
Beta air (mrad)		4.28	20
Total external body (mrem)		3.20	5
Skin (mrem)		7.25	15
Iodines and particulates [3] (gaseous effluents)			
Maximum organ – thyroid (mrem)	MEI	2.19 [4]	15

[1] Teenager using Little Robbins Slough.

[2] North-northwest Site Boundary. Ground level releases assumed.

[3] Includes Tritium and Carbon-14 terrestrial food chain dose (and inhalation dose for calculation ease and conservatism), consistent with Table 1 of Reference 12.2-5.

- [4] Child eating home grown meat and vegetables. Difference between Tables 12.2-28 and 12.2-29 thyroid dose is 0.087 millirem per unit from noble gases in the plume.
- [5] One-one thousandth of a rem (roentgen equivalent man). For gamma and beta exposure, one mrem = one mrad.
- [6] One-one thousandth of a rad (radiation absorbed dose), or 0.1 ergs per gram of biological mass.
- [7] Child using Little Robbins Slough.

Source: GASPAR II and LADTAP II calculated doses.

**Table 12.2-30****Comparison of Maximally Exposed Individual Doses with 10 CFR 20.1301(e) Criteria [1]  
(millirem per year)**

	Direct Radiatio	Units 3 and 4 (ABWR)			STP 1 & 2 (Existing) [5]			Site Total	Regulatory Limit
		Liquid [2]	Gaseous	Total	Liquid	Gaseous	Total		
Total body	5.0	0.00025	0.70 [3]	5.70	0.0042	0.0080	0.012	5.71	25
Thyroid	NA	0.00011	4.54 [4]	4.54	0.0041	0.0097	0.014	4.55	75
Other organ - bone	NA	0.0023	1.94 [3]	1.94	0.00077	0.0011	0.0019	1.94	25

[1] Compliance with 40 CFR 190 specified in 10 CFR 20.1301(e).

[2] Child using Little Robbins Slough for shoreline activities and fishing

[3] Residence with meat animal and vegetable garden, dose to child, 2.18 miles WSW of new units (MEI).

[4] Residence with meat animal and vegetable garden, dose to child, 3.03 miles NNW of new units (MEI).

[5] References 12.2-1, 12.2-3, and 12.2-4. Same receptors as STP 3 & 4.

NA = Not applicable

FSAR Add Reference Section:**References for FSAR Section 12.2**

12.2-1 NRC (U.S. Nuclear Regulatory Commission) 1987. *GASPAR II Technical Reference and User Guide*, NUREG/CR-4653, Office of Nuclear Reactor Regulation, Washington D.C., March.

12.2-2 STP (South Texas Project) 2007. *Offsite Dose Calculation Manual*, Revision 15, South Texas Project, STI32207439, October 1, 2007.

12.2-3 STP (South Texas Project) 2006. *2005 Radioactive Effluent Release Report*, South Texas Project Electric Generating Station, April 27, 2006.

12.2-4 NRC (U.S. Nuclear Regulatory Commission) 1986. *LADTAP II Technical Reference and User Guide*, NUREG/CR-4013, Office of Nuclear Reactor Regulation, Washington D.C., April.

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