

From: "Sandike, Steven Richard" <SSandik@entergy.com>
To: <JRW1@nrc.gov>, "Mayer, Donald M" <DMayer1@entergy.com>, "Loope, Dennis" <dloope@entergy.com>, "Gray, Dara F" <DGray@entergy.com>, "Lavera, Ronald" <RLavera@entergy.com>, "Quinn, Dennis M" <dquinn91@entergy.com>, <dquinn@daq-inc.com>, "ADLER, JOESPH J" <adler@tlgservices.com>
Date: 4/24/06 3:40PM
Subject: Update IPEC ground water dose calc

We updated the concentrations with some new data, as described. Same model, for now.

<<Updated Dose Calc.pdf>>

Steve Sandike
Effluents / RMS
ENN Indian Point Energy Center
Buchanan, NY 10511-0308
phone: 914-736-8455
fax: 914-734-6010
email: ssandik@entergy.com

CC: "Wilson, Daniel" <DWilson@entergy.com>

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Indian Point NPP

Apr 24, 2006
IPEC-CHM-06-012

MEMORANDUM TO: D. WILSON - CHEMISTRY SUPERINTENDENT

FROM: S. SANDIKE - Sr. CHEMISTRY SPECIALIST

SUBJECT: UPDATED GROUND WATER DOSE EVALUATION - APRIL 2006

Based on the detection of Sr-90 in monitoring wells MW-37 and MW-50, a decision was made to evaluate whether the existing assessment of offsite dose was still appropriate. The assessment method is the same; that is, it uses a water balance method, where total rainfall in the Indian Point watershed area is partitioned between groundwater (GW) from infiltration, and storm water (SW). The assessment addresses the approximate flows of GW and SW into various areas of the site, based on physical size and locations of the reactor units.

The inputs to the assessment have changed in some cases. For example, tritium going through the Unit 2 area had been based on monitoring well data in the transformer yard (i.e., MW-111 and others). More recently, the wells along the riverfront area have been completed, and the values from wells MW-36, 37, 49, 50 and MW-52, are considered more relevant to the actual releases to the Hudson River. As a result of the more recent data, and the fact that Sr-90 was detected in the riverfront wells, the inputs to the assessment have changed. Details of this assessment are attached.

The resulting annual dose summary indicates very little change from the March 2006 assessment:

Parameter	March 2006 Eval	April 2006 Eval	Percent Limit
Total Body Dose	2.1E-3 mrem	2.5E-3 mrem	0.08%
Adult Bone Dose	9.7E-3 mrem	1.1E-2 mrem	0.11%

Doses are still approximately 0.1% percent of the applicable NRC effluents limits of 3 millirem per year (whole body) and 10 millirem per year (highest organ). The actual curies and doses will still, of course, be included in the annual effluent report. Our site hydrologist will also continue to pursue a more detailed method of determining precise flow through each effected well, and, when completed, this method will be incorporated into the dose model for ongoing application.

SS/ss

cc: D. Mayer D. Loope D. Gray R. Lavera D. Quinn J. Adler

Update on Assessment of Offsite Dose from Groundwater and Storm Water Pathways

Based on the detection of Sr-90 in monitoring wells MW-37 and MW-50, a decision was made to evaluate whether the existing assessment of offsite dose was still appropriate. The assessment method is the same; that is, it uses a water balance method, where total rainfall in the Indian Point watershed area is partitioned between groundwater (GW) from infiltration, and storm water (SW). The assessment addresses the approximate flows of GW and SW into various areas of the site, based on physical size and locations of the reactor units.

The inputs to the assessment have changed in some cases. For example, tritium going through the Unit 2 area had been based on monitoring well data in the transformer yard (i.e., MW-111 and others). More recently, the wells along the riverfront area have been completed, and the values from wells MW-36,37,49,50 and MW-52, are considered more relevant to the actual releases to the Hudson River. As a result of the more recent data, and the fact that Sr-90 was detected in the riverfront wells, the inputs to the assessment have changed. The current inputs are shown in Table 1, below. The "Calc Sheet" references in the "Comments" column refer to spreadsheets developed by Chemistry to calculate the offsite doses in different pathways:

Table 1

Inputs to Dose Assessment for Groundwater and Storm Water Discharges to River and to Discharge Canal

Unit	Water Type	Discharge Point	Dilution Volume (gal/day)	Near Term Dil. Factor	Release Rate (gpm)	H-3 (pCi/L)	Sr-90 (pCi/L)	Ni-63 (pCi/L)	Comments
Unit 1	Groundwater	River	1.11E+05	1.0	5.98	34,100	30	56.5	Calc Sheet A1-1
	Storm Water	River	1.11E+05	1.0	0	1,560	0	0	No Calc Sheet
	Storm Water	Discharge Canal	1.39E+06	5.0	3.57	1,560	0	0	Calc Sheet A1&3-2 added 3.57 + 36.19 together for one calc
Unit 2	Groundwater	River	1.11E+05	1.0	3.37	58,100	5	0	Calc Sheet A2-1
	Storm Water	River	1.11E+05	1.0	11.27	651	0	0	Calc Sheet A2-2
	Storm Water	Discharge Canal	1.39E+06	5.0	5.93	2,900	0	0	Calc Sheet A2-3
Unit 3	Groundwater	River	1.11E+05	1.0	7.82	620	0	0	Calc Sheet A3-1
	Storm Water	River	1.11E+05	1.0	0	1,560	0	0	No Calc Sheet
	Storm Water	Discharge Canal	1.39E+06	5.0	36.19	1,560	0	0	Calc Sheet A1&3-2 added 3.57 + 36.19 gpm together for one calc

The results summary is shown in Table 2, and indicates that the doses have marginally increased from the previous assessment, based on the Sr-90 detected in additional riverfront wells. Note that the doses are still approximately 0.1% percent of the applicable NRC effluents limits of 3 millirem per year (whole body) and 10 millirem per year (highest organ). Table 3 shows the comparison of the current assessment (April 2006) to the previous assessment (March 2006).

Table 2

Summary Dose Assessment from IPEC Groundwater and Stormwater

Water Source	Nuclide	pCi/liter	gpm	CI	Dilution Type	WB Dose (mrem)	Bone Dose mrem)
Unit 1 - Groundwater	H-3	34,100	5.98	0.41	Non-Discharge Canal	2.2E-03	1.0E-02
	Sr-90	30		3.6E-04			
	Ni-63	56.5		6.7E-04			
Unit 1 and Unit 3 - Storm Water	H-3	1,560	39.8	0.12	Discharge Canal	2.2E-08	-
Unit 2 Groundwater - Transformer Yard	H-3	58,100	3.4	0.39	Non-Discharge Canal	2.1E-04	8.4E-04
	Sr-90	5		3.4E-05			
	Ni-63	0		0.0E+00			
Unit 2 Storm Water - Zone B - East and West	H-3	651	11.3	1.5E-02	Non-Discharge Canal	1.6E-07	-
Unit 2 Storm Water - Zone C - Middle	H-3	2,900	5.9	3.4E-02	Discharge Canal	6.1E-09	-
Unit 3 Groundwater	H-3	620	7.82	9.6E-03	Non-Discharge Canal	1.08E-07	-
			H-3 CI	0.96	Total Dose	2.5E-03	1.1E-02
			Sr-90 CI	0.00039	Limit	3	10
			Ni-63 CI	0.00067	% of Limit	0.08%	0.11%

Table 3

Comparison of Offsite Dose Assessments

Parameter	March 2006 Eval.	April 2006 Eval.	% of Dose Limit
Total H-3 Activity in Release Path (Ci)	1.53	0.96	N/A
Total Sr-90 Activity in Release Path Ci)	3.4E-04	3.9E-04	N/A
Total Ni-63 Activity in Release Path Ci)	6.7E-04	6.7E-04	N/A
Whole Body Dose (mrem/yr)	2.1E-03	2.5E-03	0.08%
Adult Bone Dose (mrem/yr)	9.7E-03	1.1E-02	0.11%

Inputs to Dose Assessment for Groundwater and Storm Water Discharges to River and to Discharge Canal

Unit	Water Type	Discharge Point	Dilution Volume (gal/day)	Near Term Dil. Factor	Release Rate (gpm)	H-3 (pCi/L)	Sr-90 (pCi/L)	Ni-63 (pCi/L)	Comments
Unit 1	Groundwater	River	1.11E+05	1.0	5.98	34,100	30	56.5	Calc Sheet A1-1
	Storm Water	River	1.11E+05	1.0	0	1,560	0	0	No Calc Sheet
	Storm Water	Discharge Canal	1.39E+06	5.0	3.57	1,560	0	0	Calc Sheet A1&3-2 added 3.57 + 36.19 together for one calc
Unit 2	Groundwater	River	1.11E+05	1.0	3.37	58,100	5	0	Calc Sheet A2-1
	Storm Water	River	1.11E+05	1.0	11.27	651	0	0	Calc Sheet A2-2
	Storm Water	Discharge Canal	1.39E+06	5.0	5.93	2,900	0	0	Calc Sheet A2-3
Unit 3	Groundwater	River	1.11E+05	1.0	7.82	620	0	0	Calc Sheet A3-1
	Storm Water	River	1.11E+05	1.0	0	1,560	0	0	No Calc Sheet
	Storm Water	Discharge Canal	1.39E+06	5.0	36.19	1,560	0	0	Calc Sheet A1&3-2 added 3.57 + 36.19 gpm together for one calc

Unit	GW - gpm	SW - gpm	% SW to HR or DC	% SW to GW	Adjusted GW (to Hudson)	Adjusted SW (to Hudson)	Adjusted SW (to Dis. Canal)	Applicable sample locations
Unit 1	2.41	7.15	50%	50%	5.98	N/A	3.57	
H-3 Conc (pCi/L)					34,100	N/A	1,560	For GW from U1, use the highest value from MW 37, 49, or 50, as representative of the concentration of GW going to the river in the Unit 1 area. GZA (MB) stated that at the current level of understanding, the most likely source of water at MW-37 is from Unit 1, and MW-36 should be associated with Unit 2.
H-3 Ci/yr					0.41	N/A	0.011	
Sr-90 pCi/L					30	N/A	0	
Sr-90 Ci/yr					3.57E-04	N/A	0	For SW, manholes in Zones C, D, E (same as in previous evaluation)
Ni-63 pCi/L					56.5	N/A	0	Ni-63 based on highest level of 56.5 pCi/L at MW-37.
Ni-63 Ci/yr					6.73E-04	N/A	0	
Unit 2 - East		2.81	100%	0%	0.00	2.81	N/A	651 pCi/l for East and West - direct to Hudson River (same as previous evaluation)
Unit 2 - Middle		7.91	75%	25%	1.98	N/A	5.9	2900 pCi/l for Middle- goes to Discharge Canal (same as previous evaluation)
Unit 2 - West		8.46	100%	0%	0.00	8.46	N/A	651 pCi/l for East and West - direct to Hudson River (same as previous evaluation)
Unit 2 - Total	1.39	19.18			3.37	11.3	5.9	
H-3 (pCi/L) E/W					58,100	651	N/A	For GW, used MW-36 as the closest point to release. See notes on Unit 1, above.
H-3 (pCi/L) Mid						N/A	2,900	
H-3 Ci/yr E/W					0.39	0.015	0.034	
H-3 Ci/yr Mid						N/A	0	
H-3 Ci/yr Total					0.39	N/A	0	
Sr-90 pCi/L					5	N/A	0	Sr-90 based on highest level of 4.1 pCi/L at MW-36.
Sr-90 Ci/yr					3.35E-05	N/A	0	
Ni-63 pCi/L					0.0	N/A	0	Ni-63 not identified at MW-37 or transformer yard samples.
Ni-63 Ci/yr					0.00E+00	N/A	0	
Unit 3	3.80	40.21	90%	10%	7.8	N/A	36.2	
H-3 Conc (pCi/L)					620	N/A	1,560	GW- MW-38, 620 pCi/l. SW- 1,560 pCi/l (same as in previous evaluation).
H-3 Ci/yr					0.010	N/A	0.112	
Sr-90 pCi/L					0	N/A	0	
Sr-90 Ci/yr					0	N/A	0	

	Previous Eval.	4-24-06 Eval.	
Total H-3 Activity in Release Path (Ci)	1.53	0.96	
Total Sr-90 Activity in Release Path (Ci)	3.4E-04	3.9E-04	
Total Ni-63 Activity in Release Path (Ci)	6.7E-04	6.7E-04	Percent of annual dose limit
Whole Body Dose (mrem/yr)	2.1E-03	2.5E-03	0.08%
Adult Bone Dose (mrem/yr)	9.7E-03	1.1E-02	0.11%

Note: where 620 pCi/l was used, it was based on an average of the readings from MW-38, U3-1, U3-2, U3-3, U3-4, U3-T1, and U3-T2

Where 1560 pCi/l was used, it was based on an average of the results from storm sewer systems A, B, and C.

Where 651 pCi/l was used, it was based on an average of the results from MH-2

Where 2900 pCi/l was used, it was based on an average of the results from MH-4 and MH-4a.

IPEC Summary for Storm & Ground Water releases (H-3, Ni-63, Sr-90)

Adult mrem (most limiting)

Sum of IPEC monitoring well calculations for units 1, 2, & 3 (Areas 2, 3a, & 3b)

Doses, in mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI	uCi
H-3	0.00E+00	9.00E-06	9.00E-06	9.00E-06	9.00E-06	9.00E-06	9.00E-06	8.05E+05
Ni-63	1.33E-03	9.20E-05	4.45E-05	0.00E+00	0.00E+00	0.00E+00	1.92E-05	6.72E+02
Sr-90	9.79E-03	0.00E+00	2.40E-03	0.00E+00	0.00E+00	0.00E+00	2.82E-04	3.90E+02
totals	1.11E-02	1.01E-04	2.45E-03	9.00E-06	9.00E-06	9.00E-06	3.10E-04	8.06E+05

Storm Drain Water from Zone B, East/West Unit 2, near MH-2, going to river directly

Doses, in mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI	uCi
H-3	0.00E+00	1.63E-07	1.63E-07	1.63E-07	1.63E-07	1.63E-07	1.63E-07	1.46E+04

Storm Drain Water from Zones C and D/E (Central U2 & U1/U3) to Discharge Canal

Doses, in mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI	uCi
H-3	0.00E+00	2.82E-08	2.82E-08	2.82E-08	2.82E-08	2.82E-08	2.82E-08	1.58E+05

Totals:

Doses, in mrem

H-3 only	0.00E+00	9.19E-06	9.19E-06	9.19E-06	9.19E-06	9.19E-06	9.19E-06	9.77E+05
	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI	uCi/H-3
H-3, Ni-63, Sr-90	1.11E-02	1.01E-04	2.45E-03	9.19E-06	9.19E-06	9.19E-06	3.10E-04	see above

% Annual Limit	0.111	0.001	0.082	0.0001	0.0001	0.0001	0.003
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Storm Drain Zone B (MH-2 East & West Unit 2) to the Hudson River directly

Release Rate ml/day or 1.62E+04 gpd or 11.28 gpm

Duration of Release, in days Waste vol released = 5.93E+06 gal

Dilution flow gpm Dilution vol released = 5.83E+10 gal

Dil Factor 1.02E-04 (dilution data per IP-CHM-05-042 from Dr. John Hamawi)

ISOTOPE	Activity Released uCi/ml	10CFR20 EC'10 conc limit	PRE DILUTION CONC/MPC	POST DILUTION uCi/ml	POST DILUTION CONC/MPC	MICRO- CURIES RELEASED
H-3	6.51E-07	1.00E-02	6.51E-05	6.62E-11	6.62E-09	1.46E+04
MN-54		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58		2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60		3.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90		5.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134		9.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137		1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57		6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	6.51E-07	n/a	6.51E-05	6.62E-11	6.62E-09	1.46E+04

NUREG 0133 "Applicable Factor" for Near Field Dilution =

Adult Total Body mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.63E-07	1.63E-07	1.63E-07	1.63E-07	1.63E-07	1.63E-07
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	0.00E+00	1.63E-07	1.63E-07	1.63E-07	1.63E-07	1.63E-07	1.63E-07

**Central Unit 2 Storm Drain Releases to the Hudson River
via the Discharge Canal (Zone C)**

Release Rate ml/day or 8.54E+03 gpd or 5.93 gpm

Duration of Release, in days Waste vol released = 3.12E+06 gal

Dilution flow gpm Dilution vol released = 7.31E+11 gal

Dil Factor 4.27E-06 (dilution from actual 2005 data)

	Activity	10CFR20	PRE	POST	POST	MICRO-
ISOTOPE	Released	EC*10	DILUTION	DILUTION	DILUTION	CURIES
	uCi/ml	conc limit	CONC/MPG	uCi/ml	CONC/MPG	RELEASED
H-3 *	2.90E-06	1.00E-02	2.90E-04	1.24E-11	1.24E-09	3.42E+04
MN-54		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58		2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60		3.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90		5.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134		9.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137		1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57		6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	2.90E-06	n/a	2.90E-04	1.24E-11	1.24E-09	3.42E+04

* No gamma identified in storm drains, and 2.9E-6 was avg effluent H-3 in 2005 from MH-4a.

NUREG 0133 "Applicable Factor" for Near Field Dilution =

Adult Total Body mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	6.11E-09	6.11E-09	6.11E-09	6.11E-09	6.11E-09	6.11E-09
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	0.00E+00	6.11E-09	6.11E-09	6.11E-09	6.11E-09	6.11E-09	6.11E-09

Storm Drain Releases to the Hudson River via the Discharge Canal from Units 1 and 3 (Zones D and E)

Release Rate ml/day or 5.72E+04 gpd or 39.75 gpm

Duration of Release, in days Waste vol released = 2.09E+07 gal

Dilution flow gpm Dilution vol released = 7.31E+11 gal

Dil Factor 2.86E-05 (dilution from actual 2005 data)

ISOTOPE	Activity Released uCi/ml	10GFR20 EC*10 conc limit	PPE DILUTION CONC/MPC	POST DILUTION uCi/ml	POST DILUTION CONC/MPC	MICRO- CURIES RELEASED
H-3 *	1.56E-06	1.00E-02	1.56E-04	4.46E-11	4.46E-09	1.23E+05
MN-54		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58		2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60		3.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90		5.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134		9.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137		1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57		6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	1.56E-06	n/a	1.56E-04	4.46E-11	4.46E-09	1.23E+05

* No gamma identified in storm drains, and 1.56E-6 was average of effected Storm Drains in 2005

NUREG 0133 "Applicable Factor" for Near Field Dilution =

Adult Total Body mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	2.20E-08	2.20E-08	2.20E-08	2.20E-08	2.20E-08	2.20E-08
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	0.00E+00	2.20E-08	2.20E-08	2.20E-08	2.20E-08	2.20E-08	2.20E-08

IP3 Releases to Hudson River via Bedrock Pathway

(from the area near IP3 waterfront, as determined by samples from Monitoring Wells - Area 3b)

Release Rate 4.26E+07 ml/day or 1.13E+04 gpd or 7.82 gpm

Duration of Release, in days 365 Waste vol released = 4.11E+06 gal

Dilution flow 1.11E+05 gpm Dilution vol released = 5.83E+10 gal

Dil Factor 7.04E-05 (dilution data per IP-CHM-05-042 from Dr. John Hamawi)

	Activity	10CFR20	PRE	POST	POST	MICRO-
ISOTOPE	Released	EC*10	DILUTION	DILUTION	DILUTION	CURIES
	uCi/ml	conc limit	CONC/MPG	uCi/ml	CONC/MPG	RELEASED
H-3	6.20E-07	1.00E-02	6.20E-05	4.37E-11	4.37E-09	9.64E+03
MN-54		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58		2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60		3.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90		5.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134		9.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137		1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57		6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	6.20E-07	n/a	6.20E-05	4.37E-11	4.37E-09	9.64E+03

NUREG 0133 "Applicable Factor" for Near Field Dilution =

1.00E+00

Adult Total Body mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	0.00E+00	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07	1.08E-07

IP1 Releases to Hudson River via Bedrock Pathway

(from the area near IP1 waterfront, as determined by samples from Monitoring Wells - Area 3a)

Release Rate 3.26E+07 ml/day or 8.61E+03 gpd or 5.98 gpm

Duration of Release, in days 365 Waste vol released = 3.14E+06 gal

Dilution flow 1.11E+05 gpm Dilution vol released = 5.83E+10 gal

Dil Factor 5.39E-05 (dilution data per IP-CHM-05-042 from Dr. John Hamawi)

	Activity	10CFR20	PRE	POST	POST	MICRO-
ISOTOPE	Released	EC*10	DILUTION	DILUTION	DILUTION	CURIES
	uCi/ml	conc limit	CONC/MPG	uCi/ml	CONC/MPG	RELEASED
H-3	3.41E-05	1.00E-02	3.41E-03	1.84E-09	1.84E-07	4.06E+05
MN-54		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58		2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60		3.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	5.65E-08	1.00E-03	5.65E-05	3.04E-12	3.04E-09	6.72E+02
SR-90	3.00E-08	5.00E-06	6.00E-03	1.62E-12	3.23E-07	3.57E+02
SB-125		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134		9.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137		1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57		6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	3.42E-05	n/a	9.47E-03	1.84E-09	5.10E-07	4.07E+05

NUREG 0133 "Applicable Factor" for Near Field Dilution =

1.00E+00

Adult Total Body mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	4.54E-06	4.54E-06	4.54E-06	4.54E-06	4.54E-06	4.54E-06
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	1.33E-03	9.20E-05	4.45E-05	0.00E+00	0.00E+00	0.00E+00	1.92E-05
SR-90	8.95E-03	0.00E+00	2.19E-03	0.00E+00	0.00E+00	0.00E+00	2.58E-04
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	1.03E-02	9.65E-05	2.24E-03	4.54E-06	4.54E-06	4.54E-06	2.81E-04

IP2 Activity Releases to Hudson River via Bedrock Pathway

(from the area near IP2 transformer yard, as determined by samples from Monitoring Wells - Area 2)

Release Rate 1.84E+07 ml/day or 4.85E+03 gpd or 3.37 gpm

Duration of Release, in days 365 Waste vol released = 1.77E+06 gal

Dilution flow 1.11E+05 gpm Dilution vol released = 5.83E+10 gal

Dil Factor 3.03E-05 (dilution data per IP-CHM-05-042 from Dr. John Hamawi)

	Activity	100FR20	PRE	POST	POST	MICRO-
ISOTOPE	Released	EC*10	DILUTION	DILUTION	DILUTION	CURIES
	uCi/ml	conc limit	CONC/MPG	uCi/ml	CONC/MPG	RELEASED
H-3	5.81E-05	1.00E-02	5.81E-03	1.76E-09	1.76E-07	3.89E+05
MN-54		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55		1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58		2.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60		3.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	1.00E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	5.00E-09	5.00E-06	1.00E-03	1.52E-13	3.03E-08	3.35E+01
SB-125		3.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134		9.00E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137		1.00E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57		6.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	5.81E-05	n/a	6.81E-03	1.76E-09	2.07E-07	3.89E+05

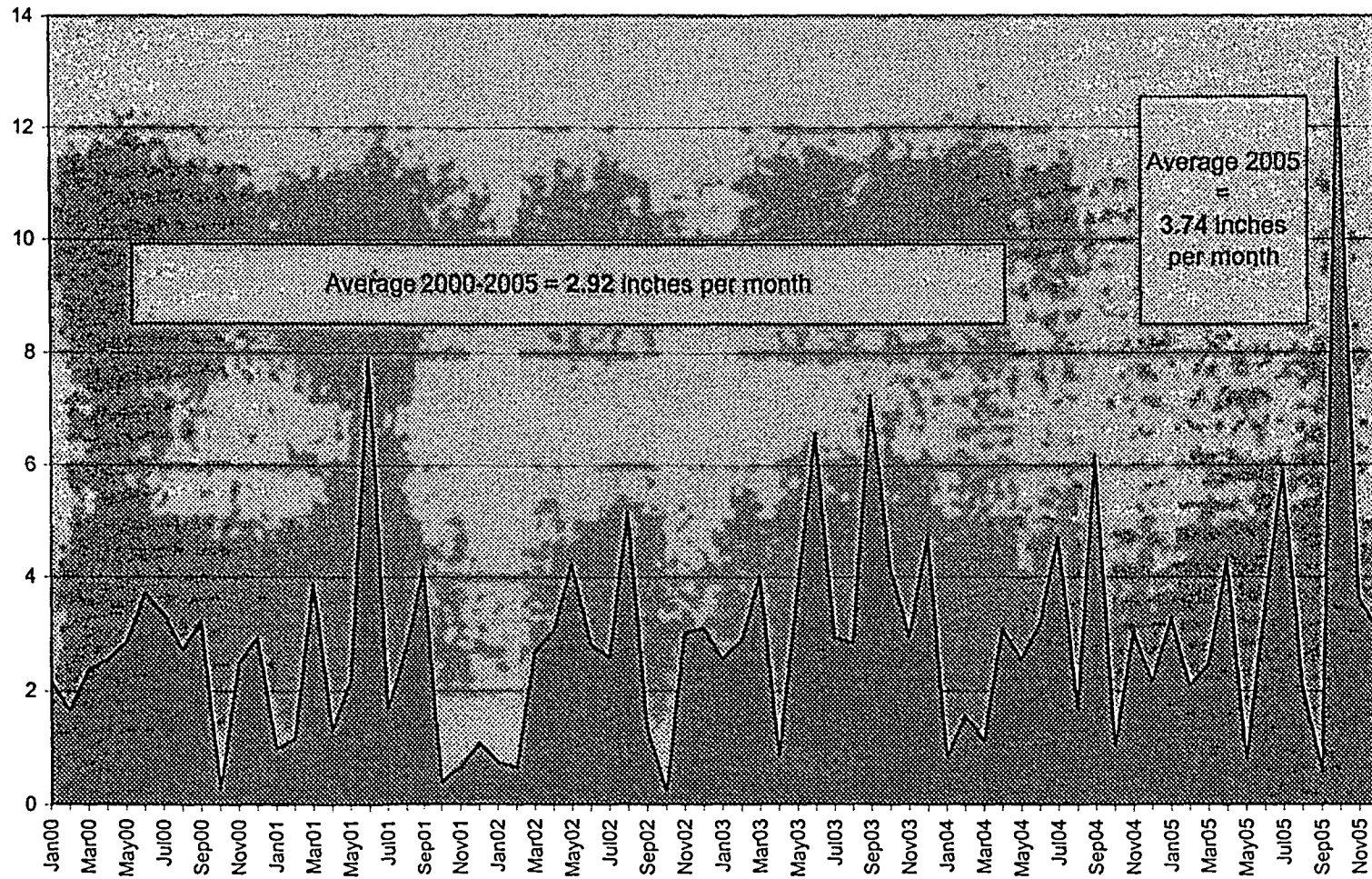
NUREG 0133 "Applicable Factor" for Near Field Dilution =

1.00E+00

Adult Total Body mrem

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GILLI
H-3	0.00E+00	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06	4.35E-06
MN-54	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FE-55	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-58	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-60	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NI-63	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
SR-90	8.40E-04	0.00E+00	2.06E-04	0.00E+00	0.00E+00	0.00E+00	2.42E-05
SB-125	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CS-137	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CO-57	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	8.40E-04	4.35E-06	2.10E-04	4.35E-06	4.35E-06	4.35E-06	2.85E-05

Precipitation (inches) at IPEC



Adult Dose Factors Only

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.82E-01	2.82E-01	2.82E-01	2.82E-01	2.82E-01	2.82E-01
MN-54	0.00E+00	5.43E+03	1.04E+03	0.00E+00	1.61E+03	0.00E+00	1.66E+04
FE-55	3.21E+04	2.21E+04	5.16E+03	0.00E+00	0.00E+00	1.24E+04	1.27E+04
CO-58	0.00E+00	5.15E+02	1.15E+03	0.00E+00	0.00E+00	0.00E+00	1.04E+04
CO-60	0.00E+00	1.48E+03	3.26E+03	0.00E+00	0.00E+00	0.00E+00	2.78E+04
NI-63	4.97E+04	3.45E+03	1.67E+03	0.00E+00	0.00E+00	0.00E+00	7.19E+02
SR-90	6.32E+05	0.00E+00	1.55E+05	0.00E+00	0.00E+00	0.00E+00	1.82E+04
SB-125	3.11E+02	3.47E+00	7.40E+01	3.16E-01	0.00E+00	2.40E+02	3.42E+03
CS-134	4.14E+04	9.84E+04	8.04E+04	0.00E+00	3.18E+04	1.06E+04	1.72E+03
CS-137	5.30E+04	7.25E+04	4.75E+04	0.00E+00	2.46E+04	8.18E+03	1.40E+03
CO-57	0.00E+00	1.21E+02	2.01E+02	0.00E+00	0.00E+00	0.00E+00	3.07E+03

Teen Dose Factors

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	2.17E-01	2.17E-01	2.17E-01	2.17E-01	2.17E-01	2.17E-01
MN-54	0.00E+00	5.33E+03	1.06E+03	0.00E+00	1.59E+03	0.00E+00	1.09E+04
FE-55	3.35E+04	2.37E+04	5.43E+03	0.00E+00	0.00E+00	1.51E+04	1.03E+04
CO-58	0.00E+00	5.10E+02	1.18E+03	0.00E+00	0.00E+00	0.00E+00	7.04E+03
CO-60	0.00E+00	1.48E+03	3.32E+03	0.00E+00	0.00E+00	0.00E+00	1.92E+04
NI-63	5.15E+04	3.64E+03	1.75E+03	0.00E+00	0.00E+00	0.00E+00	5.79E+02
SR-90	5.27E+05	0.00E+00	1.30E+05	0.00E+00	0.00E+00	0.00E+00	1.48E+04
SB-125	3.27E+02	3.58E+00	7.64E+01	3.11E-01	0.00E+00	2.85E+02	2.53E+03
CS-134	4.24E+04	9.97E+04	4.63E+04	0.00E+00	3.17E+04	1.21E+04	1.24E+03
CS-137	5.67E+04	7.54E+04	2.63E+04	0.00E+00	2.57E+04	9.97E+03	1.07E+04
CO-57	0.00E+00	1.25E+02	2.10E+02	0.00E+00	0.00E+00	0.00E+00	2.33E+03

Child Dose Factors

ISOTOPE	BONE	LIVER	TOT BODY	THYROID	KIDNEY	LUNG	GI-LLI
H-3	0.00E+00	1.81E-01	1.81E-01	1.81E-01	1.81E-01	1.81E-01	1.81E-01
MN-54	0.00E+00	4.20E+03	1.12E+03	0.00E+00	1.18E+03	0.00E+00	3.53E+03
FE-55	4.55E+04	2.42E+04	7.48E+03	0.00E+00	0.00E+00	1.37E+04	4.47E+03
CO-58	0.00E+00	4.20E+02	1.29E+03	0.00E+00	0.00E+00	0.00E+00	2.45E+03
CO-60	0.00E+00	1.23E+03	3.64E+03	0.00E+00	0.00E+00	0.00E+00	6.84E+03
NI-63	6.85E+04	3.67E+03	2.33E+03	0.00E+00	0.00E+00	0.00E+00	2.47E+02
SR-90	4.68E+05	0.00E+00	1.19E+05	0.00E+00	0.00E+00	0.00E+00	6.30E+03
SB-125	4.22E+02	3.25E+00	8.85E+01	3.91E-01	0.00E+00	2.35E+02	1.01E+03
CS-134	5.15E+04	8.44E+04	1.78E+04	0.00E+00	2.62E+04	9.39E+03	4.55E+02
CS-137	7.19E+04	6.88E+04	1.02E+04	0.00E+00	2.24E+04	8.07E+03	4.31E+02
CO-57	0.00E+00	1.15E+02	2.33E+02	0.00E+00	0.00E+00	0.00E+00	9.43E+02

We updated the concentrations with some new data, as described. Same model, for now.

<<Updated Dose Calc.pdf>>

Steve Sandike

Effluents / RMS

ENN Indian Point Energy Center

Buchanan, NY 10511-0308

phone: 914-736-8455

fax: 914-734-6010

email: ssandik@entergy.com