Entergy

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%

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.

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

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	15,400	5.98	0.18	Non-Discharge Canal	2.2E-03	9.0E-03
	Sr-90	30		3.6E-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	55,000	3.4	0.37	Non-Discharge Canal	1.3E-03	5.8E-03
	Sr-90	30		2.0E-04			
	Ni-63	55		3.7E-04			
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	**0.73**	**Total Dose**	**3.6E-03**	**1.5E-02**
			Sr-90 Ci	**0.00056**	**Limit**	**3**	**10**
			Ni-63 Ci	**0.00037**	**% of Limit**	**0.12%**	**0.15%**

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	15,400	30	0	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	55,000	30	55	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)					**15,400**	N/A	**1,560**	For GW from U1, use the highest value from MW 49, or 50, as representative of the concentration of GW going to the river in the Unit 1 area.
H-3 Ci/yr					**0.18**	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
Ni-63 pCi/L					**0**	N/A	0	
Ni-63 Ci/yr					**0.00E+00**	N/A	0	The volume used would be that from Unit 1.
Unit 2 - East		2.81	100%	0%	0.00	2.81	N/A	651 pCi/l for East and West - direct to Hudson River
Unit 2 - Middle		7.91	75%	25%	1.98	N/A	5.9	2900 pCi/l for Middle- goes to Discharge Canal
Unit 2 - West		8.46	100%	0%	0.00	8.46	N/A	651 pCi/l for East and West - direct to Hudson River
Unit 2 - Total	1.39	19.18			3.37	11.3	5.9	
H-3 (pCi/L) E/W					**55,000**	**651**	N/A	For GW, MW-111 or MW-36/37.
H-3 (pCi/L) Mid						N/A	**2,900**	
H-3 Ci/yr E/W					**0.37**	**0.015**	**0.034**	
H-3 Ci/yr Mid						N/A	0	
H-3 Ci/yr Total					**0.37**	N/A	0	
Sr-90 pCi/L					**30**	N/A	0	
Sr-90 Ci/yr					**2.01E-04**	N/A	0	
Ni-63 pCi/L					**55**	N/A	0	
Ni-63 Ci/yr					**3.69E-04**	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
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**	**0.73**	
Total Sr-90 Activity in Release Path Ci)	**3.4E-04**	**5.6E-04**	
Total Ni-63 Activity in Release Path Ci)	**6.7E-04**	**3.7E-04**	**Percent of annual dose limit**
Whole Body Dose (mrem/yr)	**2.1E-03**	**3.6E-03**	**0.12%**
Adult Bone Dose (mrem/yr)	**9.7E-03**	**1.5E-02**	**0.15%**

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.

December 2006

IPEC Summary for Storm & Ground Water releases (H-3, Ni-63, Sr-90, Cs-137)

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*
Cs-137	7.50E-04	1.03E-03	6.72E-04	0.00E+00	3.48E-04	1.16E-04	1.98E-05	*3.57E+02*
totals	1.19E-02	1.13E-03	3.13E-03	9.00E-06	3.57E-04	1.25E-04	3.30E-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
all isotopes	1.19E-02	1.13E-03	3.13E-03	9.19E-06	3.57E-04	1.25E-04	3.30E-04	*see above*

% Annual Limit	*0.119*	*0.011*	*0.104*	*0.0001*	*0.0036*	*0.0012*	*0.003*