From: "Tortorelli, James" <James.Tortorelli@Honeywell.com>
To: <MGR@NRC.GOV>
Date: 3/28/06 2:58PM
Subject: Dose Questions

Mike:

Attached is the report with answers to your questions on off-site dose rates. The calculation sheets that back up the results in this report are in a 75MB file. If you need them, let me know if you want a CD, paper or electronic copy and how best to transmit the electronic copy.

Jim Tortorelli
Regulatory Affairs Manager
Honeywell Metropolis Works

CC: "Patterson, Charles" <Sean.Patterson@Honeywell.com>, "Stokes, Robert C" <Robert.Stokes2@Honeywell.com>, "Litinski, Lidia I" <Lidia.Litinski@Honeywell.com>, "Edwards, David" <David.Edwards4@Honeywell.com>, "Mays, Darren" <Darren.Mays@Honeywell.com>

Mail Envelope Properties (44299558.F7F : 11 : 8063)

Subject:	Dose Questions
Creation Date:	3/28/06 2:57PM
From:	"Tortorelli, James" <James.Tortorelli@Honeywell.com>
Created By:	James.Tortorelli@Honeywell.com

Recipients

nrc.gov
twf4_po.TWFN_DO
MGR (Michael Raddatz)

Honeywell.com
Darren.Mays CC (Darren Mays)
David.Edwards4 CC (David Edwards)
Lidia.Litinski CC (Lidia I Litinski)
Robert.Stokes2 CC (Robert C Stokes)
Sean.Patterson CC (Charles Patterson)

Post Office	**Route**
twf4_po.TWFN_DO	nrc.gov
	Honeywell.com

Files	**Size**	**Date & Time**
MESSAGE	362	03/28/06 02:57PM
TEXT.htm	2131	
Offsite_dose_calcs_3_23.doc	652288	
Mime.822	897639	

Options

Expiration Date:	None
Priority:	Standard
Reply Requested:	No
Return Notification:	None
Concealed Subject:	No
Security:	Standard

NRC Questions:

1. *What versions of GENII and XOQDOQ are you using? Please justify the use of the statement that appears in ER Page 212 "The methodology, data, and assumptions used in the dose assessments were provided in Appendix A of the 1995 EA".*

   Response:
   The ER statement was based on referencing the methodology, data and results of the 1995 EA. These calculations were not updated for the ER since the radionuclide releases from and population surrounding the Honeywell MTW facility had not changed significantly. In response to this question, the offsite dose consequences of gaseous and aqueous releases were reevaluated. This new analysis uses GENII-NESHAPS Version 2.0 and FRAMES Version 1.6.

   The new version of the GENII software, GENII Version 2.0, was developed by the U.S. Environmental Protection Agency in 2002 to incorporate improved transport models, exposure options, dose and risk estimation, and user interfaces. The GENII-NESHAPS Edition is specifically designed to improve compliance with 40 CFR 61, Subparts H and I. EPA plans to approve the model for this purpose through a rulemaking beginning in 2006. GENII-NESHAPS incorporates the internal dosimetry models recommended by the International Commission on Radiological Protection in ICRP 56-72 and the radiological risk estimating procedures of Federal Guidance Report 13 into updated versions of existing environmental pathway analysis models.

   FRAMES (Framework for Risk Analysis Multimedia Environmental Systems), Version 1.6, is a software platform developed by PNNL for selecting and implementing environmental software models for risk assessment and management problems. The newest version of FRAMES, Version 1.6, includes the newest MEPAS (Multimedia Environmental Pollutant Assessment System) and GENII modules.

2. *Specifically what bounds today's calculations with the 1995 data? Is your position that (as stated on Page 216) that "Process operations, production levels, and air effluent emissions have not changed substantially since preparation of the EA for the 1995 License Renewal." On page 25 of the ER you state that. "Comparison of the air monitoring results from 2000 to 2003 with those reported in the previous license renewal (for the period 1989 to 1993) indicate that uranium concentrations in air have increased while radium and thorium concentrations in air have remained about the same."*

   Response:
   The statement on page 216 of the ER is correct; process operations, production levels, and air emissions have not changed substantially since the 1995 EA preparation. To quantify the impact of any changes in air emissions or population distribution, the offsite dose to the maximally exposed individual and the population were reevaluated.

   The Honeywell Metropolis facility releases radioactive material to the atmosphere through 52 monitored release points and reports measurements of the activity released to the NRC on a semi-annual basis. The annual release rates for the past 5 years are provided in Section 6.1 of the MTW ER. The calculations use the uranium isotopic distribution that was presented during the 1995 License Renewal. The isotopic distribution by activity was 49 percent U-234, 49 percent U-238, and 2 percent U-235. Relatively small amounts of thorium-230 and radium-226 are also released from the Metropolis facility.

The gaseous release data for the last five years is provided in Table 2.1-3 (as amended by correspondence in January 2006) of the Environmental Report, Renewal of Source Material License SUB-526, Docket 40-3392 as follows:

Discharge Direction, Stack Height, Flow and Annual Uranium Emissions For The Years 2000 – 2004

ER Table 2.1-3

Stack No.	Description	Discharge Direction	Height (m)	Flow (m^3/min)	Uranium emissions (ci/yr)				
					2000	2001	2002	2003	2004
1-1	Wet oxide dust collector	V	30	143	1.55E-03	2.43E-03	7.71E-04	2.84E-04	6.73E-05
1-2	Dry oxide dust collector	H	32	75	2.77E-03	6.59E-03	3.52E-03	9.27E-05	4.49E-05
1-3	Drum cleaner dust collector	V	12	122	1.76E-04	2.51E-04	1.51E-04	1.86E-04	2.79E-04
1-4	Oxide vacuum cleaner	H	30	12	2.54E-05	1.04E-04	2.69E-04	2.22E-04	1.55E-04
1-7	UF4 vacuum cleaner	H	4	21	1.31E-04	1.81E-04	1.41E-03	2.33E-04	2.50E-04
1-10	"B" UF, dust collector	V	30	12	1.46E-03	1.89E-04	9.10E-05	2.94E-03	3.27E-03
1-11	Dust collector for secondary DC	V	12	167	7.57E-05	5.83E-06	6.45E-07	8.45E-09	0.00E+00
1-12	Ash vacuum cleaner	H	26	73	8.41E-03	1.19E-02	9.01E-03	2.94E-03	5.37E-03
1-12	Ash dust collector	H	26	73	3.24E-03	1.42E-03	1.36E-03	2.26E-04	1.40E-04
1-13	"A" fluorination coke box	V	32	5	1.03E-02	1.37E-02	3.13E-02	2.25E-02	1.09E-02
1-14	"B" fluorination coke box	V	32	5	2.44E-02	1.14E-02	4.29E-02	4.11E-02	1.36E-02
1-46	"A" UF4 dust collector	V	30	30	6.65E-05	5.50E-03	7.80E-04	7.07E-04	6.77E-05
1-48	H2S incinerator stack	V	47	184	1.62E-04	2.05E-03	1.22E-04	6.37E-05	8.16E-05
1-54	Drum invertor dust collector	V	6	436	1.72E-03	2.94E-03	9.83E-03	4.52E-03	3.74E-04
3-2	U-recovery dust collector	V	12	13	1.34E-05	1.98E-05	7.92E-06	1.50E-08	2.44E-08
4-2	Pond mud calciner	V	9	93	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
17-1	Sampling plant dust collector	V	7	214	1.32E-04	5.31E-05	3.93E-05	3.83E-05	4.03E-05
17-2	Sampling plant vacuum cleaner	H	4	14	7.04E-06	4.79E-06	2.41E-06	2.17E-06	1.42E-06
1-15	"A" reductor blower	H	23	28	5.69E-04	4.19E-04	2.73E-04	2.71E-04	1.43E-04
1-16	"B" reductor blower	H	23	28	1.57E-03	4.62E-04	4.55E-04	2.66E-04	1.70E-03
1-17	"A" top hydrofluorinator blower	H	14	188	4.16E-03	5.17E-03	5.09E-03	3.84E-03	2.61E-03
1-18	"A" bottom hydrofluorinator blower	H	4	188	2.93E-07	1.74E-06	2.31E-05	4.42E-06	1.29E-05
1-19	"B" top hydrofluorinator blower	H	12	28	4.70E-04	3.56E-04	1.66E-04	1.94E-04	2.95E-04
1-20	"B" bottom hydrofluorinator blower	H	14	28	2.61E-04	3.48E-04	4.52E-04	1.45E-04	2.51E-04
1-21	"A" fluorinator blower	H	9	120	5.85E-04	2.46E-04	5.91E-04	3.08E-04	2.21E-04
1-22	"B" fluorinator blower	H	9	120	3.22E-04	3.59E-04	0.00E+00	0.00E+00	4.05E-04
1-26	Ore prep multifloor exhaust	V	18	400	2.95E-06	3.89E-05	2.51E-04	9.26E-04	0.00E+00
1-27	Exhaust fan 1st floor south	H	5	651	3.36E-04	4.64E-04	2.20E-04	1.74E-04	1.62E-04
1-28	Exhaust fan 1st floor west	H	5	651	3.51E-03	1.84E-03	4.56E-03	2.23E-03	2.90E-03
1-29	Exhaust fan 2nd floor south	H	9	651	5.06E-03	4.31E-03	4.08E-03	5.16E-04	1.32E-03
1-30	Exhaust fan 3rd floor south	H	14	651	4.77E-03	4.13E-03	4.80E-03	2.18E-03	3.26E-03

Stack No.	Description	Discharge Direction	Height (m)	Flow (m^3/min)	Uranium emissions (ci/yr)				
					2000	2001	2002	2003	2004
1-31	Exhaust fan 3rd floor west	H	14	651	3.85E-03	4.06E-03	3.75E-03	5.57E-04	1.43E-03
1-32	Exhaust fan 3rd floor south	H	14	651	2.81E-03	9.05E-04	3.63E-03	1.34E-03	2.55E-03
1-33	Exhaust fan 3rd floor north	H	14	651	3.65E-03	8.10E-04	3.40E-05	0.00E+00	1.34E-05
1-34	Exhaust fan 4th floor south	H	18	651	4.48E-03	4.98E-03	5.94E-03	8.05E-04	9.83E-04
1-35	Exhaust fan 4th floor west	H	18	651	3.95E-03	5.16E-03	5.45E-03	1.55E-03	2.29E-03
1-36	Exhaust fan 4th floor south	H	18	651	4.40E-03	4.83E-03	5.05E-03	2.36E-03	3.68E-03
1-37	Exhaust fan 5th floor south	H	23	651	1.80E-03	1.01E-03	2.89E-03	1.92E-03	1.51E-03
1-38	Exhaust fan 5th floor west	H	23	651	3.54E-03	3.82E-03	2.79E-03	1.70E-03	1.99E-03
1-39	Exhaust fan 5th floor south	H	23	651	3.34E-03	3.76E-03	1.86E-03	1.97E-03	2.05E-03
1-41	Exhaust fan overhead no. 2	V	27	708	4.07E-03	4.47E-03	2.82E-03	3.18E-04	4.25E-05
1-42	Exhaust fan overhead no. 3	V	27	708	1.11E-03	3.95E-03	3.03E-03	3.16E-03	2.03E-03
1-43	Exhaust fan overhead no. 4	V	27	708	4.97E-03	5.50E-03	3.60E-03	2.36E-03	2.24E-03
1-45	NH_3 dissociator vent	V	18	356	3.14E-03	2.38E-03	3.04E-03	2.16E-03	1.79E-03
1-47	"C" fluorinator blower	H	9	120	1.82E-04	5.06E-04	9.65E-05	4.57E-04	1.40E-03
1-49	Distillation multifloor exhaust	H	4	1132	1.14E-03	1.10E-03	1.17E-03	1.15E-03	1.50E-03
1-50	"A" reductor off-gas	H	20	21	3.35E-05	3.22E-05	2.41E-05	2.61E-05	3.91E-05
1-51	"B" reductor off-gas	H	20	34	5.61E-05	5.22E-05	3.61E-05	4.05E-05	1.47E-04
1-55	Exhaust fan 3rd floor north	H	14	242	5.99E-04	7.58E-04	8.41E-04	1.99E-04	5.31E-04
1-56	Exhaust fan distillation 1st floor north	H	7	747	8.15E-04	5.54E-04	8.27E-04	5.30E-04	6.00E-04
1-57	Sampling plant vacuum cleaner	H	3	149	9.58E-04	1.07E-03	1.03E-03	3.87E-04	3.59E-04
17-58	Exhaust fan 3rd floor east	H	4	214	3.38E-04	6.82E-04	4.34E-06	0.00E+00	0.00E+00

From the above data, the average yearly Uranium emission is **1.22E-01** (Ci/yr). The Isotopic releases are determined below.

	Release Fraction	Uranium Emission (Ci/yr)
U-234	49%	5.96E-02
U-235	2%	2.43E-03
U-238	49%	5.96E-02

Releases of Th-230 and Ra-226 were not included in the dose calculation due to their insignificant dose impact. In addition, the GENII code (at least the FRAMES version) does not allow selection of appropriate lung inhalation factors for these isotopes or their progeny. In the GENII code input, all daughter products of U-234, U-235, and U-238 are assumed to be in secular equilibrium with the parent.

As seen above, the releases are a mix of horizontal and vertical orientations. The majority (95%) of the release is attributed to the following vents.

Vent	Description	Discharge Direction	Height (m)	Flow (m^3/min)
1-14	"B" fluorination coke box	V	32	5
1-13	"A" fluorination coke box	V	32	5
1-12	Ash vacuum cleaner	H	26	73
1-29	Exhaust fan 2nd floor south	H	9	651
1-43	Exhaust fan overhead no. 4	V	27	708
1-30	Exhaust fan 3rd floor south	H	14	651
1-34	Exhaust fan 4th floor south	H	18	651
1-36	Exhaust fan 4th floor south	H	18	651
1-17	"A" top hydrofluorinator blower	H	14	188
1-41	Exhaust fan overhead no. 2	V	27	708
1-35	Exhaust fan 4th floor west	H	18	651
1-31	Exhaust fan 3rd floor west	H	14	651
1-33	Exhaust fan 3rd floor north	H	14	651
1-38	Exhaust fan 5th floor west	H	23	651
1-28	Exhaust fan 1st floor west	H	5	651
1-39	Exhaust fan 5th floor south	H	23	651
1-12	Ash dust collector	H	26	73
1-45	NH_3 dissociator vent	V	18	356
1-32	Exhaust fan 3rd floor south	H	14	651
1-2	Dry oxide dust collector	H	32	75
1-37	Exhaust fan 5th floor south	H	23	651
1-54	Drum invertor dust collector	V	6	436
1-16	"B" reductor blower	H	23	28
1-1	Wet oxide dust collector	V	30	143
1-10	"B" UF, dust collector	V	30	12
1-49	Distillation multifloor exhaust	H	4	1132
1-42	Exhaust fan overhead no. 3	V	27	708

The average release height for the above vents is 20 meters and the building height is assumed to be 20 meters. This has no impact on the offsite dose consequences since the plume rise option is not selected in the GENII code input (i.e., vertical velocity = 0.0 m^3/sec). Other vent data used in the GENII input is as follows:

Exit Temperature assumed to be = 66°C (~150°F)
Exit Area assumed to be = 10 m^2
Ambient Temperature assumed to be = 20°C (68°F)

The solubility Class for all Uranium isotopes and daughter products is assumed to be Class Y (slow) as recommended in the GENII code manual. In the GENII code, the ICRP Class Y materials are represented by the newer ICRP "Slow" clearance class.

The maximally exposed individual is located at the nearest residence, which was 564 meters (1,850 feet) north-northeast of the Metropolis facility. The maximally exposed individual does not have a home garden; however, this ingestion pathway is included in the dose assessment.

The meteorological data used is from the database of STAR files (STability ARray (STAR) format) provided for the GENII Version 2 development by Mr. Barry Parks, US Department of Energy. The STAR file used is for Paducah, Ky. The Paducah data for the years of 60/1-64/12, is in file "PAH0479". This file is acceptable, absent site data, since there have been no major changes in the region of the MTW site which would affect the regional meteorological conditions. The Joint Frequency Distribution contained in this file is as follows:

Direction	Stability Class	1-3 knot	3-6 knot	6-10 knot	10-16 knot	17-21 knot	21+ knots
N	A	0.00022	0.00007	0	0	0	0
NNE	A	0.00032	0.00055	0	0	0	0
NE	A	0.0005	0.00075	0	0	0	0
ENE	A	0.00029	0.00048	0	0	0	0
E	A	0.00049	0.00048	0	0	0	0
ESE	A	0.00042	0.00055	0	0	0	0
SE	A	0.00054	0.00014	0	0	0	0
SSE	A	0.00022	0.00007	0	0	0	0
S	A	0.00041	0.00075	0	0	0	0
SSW	A	0.00003	0.00007	0	0	0	0
SW	A	0.00017	0.00041	0	0	0	0
WSW	A	0.00036	0.00041	0	0	0	0
W	A	0.0005	0.00027	0	0	0	0
WNW	A	0.00027	0.00041	0	0	0	0
NW	A	0.00069	0.00027	0	0	0	0
NNW	A	0.00025	0.00014	0	0	0	0
N	B	0.00205	0.00158	0.00096	0	0	0
NNE	B	0.00147	0.00158	0.00116	0	0	0
NE	B	0.00136	0.00336	0.00212	0	0	0
ENE	B	0.00129	0.00212	0.00103	0	0	0
E	B	0.00237	0.00322	0.00069	0	0	0
ESE	B	0.0023	0.00212	0.00075	0	0	0

Direction	Stability Class	1-3 knot	3-6 knot	6-10 knot	10-16 knot	17-21 knot	21+ knots
SE	B	0.00135	0.00206	0.00041	0	0	0
SSE	B	0.00121	0.00199	0.00055	0	0	0
S	B	0.00171	0.00308	0.00116	0	0	0
SSW	B	0.00121	0.00212	0.00212	0	0	0
SW	B	0.0016	0.00377	0.00212	0	0	0
WSW	B	0.00048	0.00206	0.0011	0	0	0
W	B	0.00095	0.0013	0.00096	0	0	0
WNW	B	0.00085	0.00089	0.00082	0	0	0
NW	B	0.00122	0.00103	0.00041	0	0	0
NNW	B	0.00064	0.00096	0.00082	0	0	0
N	C	0.00105	0.00116	0.00411	0.00048	0	0
NNE	C	0.00091	0.0013	0.00459	0.00034	0	0
NE	C	0.00198	0.00226	0.00418	0.00021	0	0
ENE	C	0.00115	0.00171	0.00349	0.00034	0	0
E	C	0.00186	0.00164	0.00363	0	0	0
ESE	C	0.00165	0.0013	0.0024	0.00007	0	0
SE	C	0.00123	0.00116	0.00151	0.00007	0	0
SSE	C	0.00084	0.00082	0.00144	0.00021	0	0
S	C	0.00189	0.00281	0.0048	0.00062	0	0
SSW	C	0.00193	0.00212	0.00904	0.00219	0.00027	0
SW	C	0.00211	0.00158	0.01048	0.00158	0.00021	0
WSW	C	0.00049	0.00089	0.0048	0.00082	0	0
W	C	0.00093	0.00055	0.00219	0.00062	0	0
WNW	C	0.00089	0.00096	0.00253	0.00021	0	0
NW	C	0.00151	0.00116	0.00253	0.00027	0.00007	0
NNW	C	0.00074	0.00055	0.00343	0.00048	0	0
N	D	0.00199	0.00507	0.01404	0.01206	0.00123	0.00007
NNE	D	0.002	0.00514	0.01233	0.00897	0.00041	0.00007
NE	D	0.00255	0.00781	0.0111	0.00281	0	0.00007
ENE	D	0.00127	0.00548	0.00712	0.00226	0.00014	0
E	D	0.00283	0.00569	0.00527	0.00233	0	0
ESE	D	0.00183	0.005	0.00507	0.00082	0	0
SE	D	0.00223	0.00329	0.00322	0.00082	0	0
SSE	D	0.00111	0.00349	0.00897	0.00356	0.00014	0
S	D	0.00228	0.00562	0.0187	0.01349	0.00089	0.00007
SSW	D	0.00163	0.00596	0.0263	0.03637	0.00301	0.00021
SW	D	0.00184	0.00575	0.01754	0.01891	0.00164	0.00027
WSW	D	0.00081	0.00295	0.00726	0.00891	0.00151	0.00007
W	D	0.00056	0.00212	0.00452	0.00575	0.00048	0
WNW	D	0.00072	0.00219	0.00651	0.00891	0.00116	0
NW	D	0.00129	0.00247	0.00849	0.01425	0.00151	0
NNW	D	0.00081	0.00295	0.00952	0.01699	0.00158	0
N	E	0	0.00253	0.00575	0	0	0
NNE	E	0	0.00212	0.00301	0	0	0
NE	E	0	0.00301	0.00219	0	0	0
ENE	E	0	0.00233	0.00089	0	0	0
E	E	0	0.00308	0.00089	0	0	0

Direction	Stability Class	1-3 knot	3-6 knot	6-10 knot	10-16 knot	17-21 knot	21+ knots
ESE	E	0	0.00329	0.00062	0	0	0
SE	E	0	0.00329	0.00034	0	0	0
SSE	E	0	0.00329	0.00274	0	0	0
S	E	0	0.00555	0.01055	0	0	0
SSW	E	0	0.00452	0.01788	0	0	0
SW	E	0	0.00349	0.01069	0	0	0
WSW	E	0	0.00171	0.0026	0	0	0
W	E	0	0.00116	0.00164	0	0	0
WNW	E	0	0.00069	0.00192	0	0	0
NW	E	0	0.00123	0.00432	0	0	0
NNW	E	0	0.00089	0.00507	0	0	0
N	F	0.00938	0.00527	0	0	0	0
NNE	F	0.00956	0.00486	0	0	0	0
NE	F	0.01137	0.00562	0	0	0	0
ENE	F	0.00568	0.00281	0	0	0	0
E	F	0.01013	0.00301	0	0	0	0
ESE	F	0.00875	0.0037	0	0	0	0
SE	F	0.01244	0.00466	0	0	0	0
SSE	F	0.01102	0.00445	0	0	0	0
S	F	0.02254	0.01329	0	0	0	0
SSW	F	0.01333	0.01075	0	0	0	0
SW	F	0.01932	0.01034	0	0	0	0
WSW	F	0.00748	0.00555	0	0	0	0
W	F	0.00728	0.00377	0	0	0	0
WNW	F	0.00525	0.00336	0	0	0	0
NW	F	0.00519	0.00377	0	0	0	0
NNW	F	0.00438	0.0026	0	0	0	0

Based on the above site-specific input data the maximum individual doses were calculated with GENII-NESHAPS, Version 2.0. For other data and parameters (e.g., consumption rates, inhalation rates, dose conversion factors, etc.), the GENII defaults were used. All offsite doses and cancer risks are based on the accumulated dose and risk for the 99-year interval following the one-year release. The maximum individual pathway doses and cancer risks are given below:

	Summation for all Radionuclides			
	cancer incidence	cancer fatalities	Dose Sv	Dose mRem
Exposure Route and Pathway	(Total)	(Total)	(Effective)	(Effective)
TOTAL	4.33E-07	4.02E-07	**5.68E-06**	**5.68E-01**
external (total)	1.69E-08	1.21E-08	3.84E-07	3.84E-02
Air	2.24E-13	1.87E-13	3.73E-12	3.73E-07
Ground	1.69E-08	1.21E-08	3.84E-07	3.84E-02
inhalation (total)	3.97E-07	3.79E-07	4.99E-06	4.99E-01
Air	9.95E-08	9.45E-08	1.25E-06	1.25E-01
Indoor air	2.98E-07	2.84E-07	3.74E-06	3.74E-01
Soil	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ingestion (total)	1.84E-08	1.16E-08	3.05E-07	3.05E-02
Leafy vegetables	5.31E-09	3.32E-09	8.56E-08	8.56E-03
Meat	1.42E-09	9.02E-10	2.51E-08	2.51E-03
Milk	1.14E-09	7.30E-10	2.13E-08	2.13E-03
Root vegetables	1.05E-08	6.62E-09	1.73E-07	1.73E-02

The organ doses for the maximally exposed individual are:

MAXIMUM EXPOSED INDIVIDUAL		
ORGAN	MAX. Dose (Sv)	MAX. Dose (mrem)
Adrenals	3.31E-07	3.31E-02
Bld Wall	3.44E-07	3.44E-02
B Surface	5.39E-06	5.39E-01
Brain	3.35E-07	3.35E-02
Breasts	3.91E-07	3.91E-02
Esophagus	3.18E-07	3.18E-02
St Wall	3.54E-07	3.54E-02
SI Wall	3.58E-07	3.58E-02
ULI Wall	4.91E-07	4.91E-02
LLI Wall	7.87E-07	7.87E-02
Kidneys	1.97E-06	1.97E-01
Liver	8.43E-07	8.43E-02
Lungs	4.17E-05	**4.17E+00**
Muscle	3.81E-07	3.81E-02
Ovaries	3.33E-07	3.33E-02
Pancreas	3.26E-07	3.26E-02
R Marrow	6.94E-07	6.94E-02
Skin	1.99E-05	1.99E+00
Spleen	3.45E-07	3.45E-02
Testes	3.90E-07	3.90E-02
Thymus	3.40E-07	3.40E-02
Thyroid	3.59E-07	**3.59E-02**
Uterus	3.33E-07	3.33E-02
Effective	5.68E-06	5.68E-01

The atmospheric doses resulting from atmospheric emissions from the Honeywell MTW facility are well within the applicable regulatory limits. The radiation dose to the maximally exposed individual (564m, NNE) is 0.570 mrem per year. This radiation dose is less than the effective dose limit of 10 mrem per year established by the EPA in 40CFR Part 61.92 and less than the EPA limit of 25 mrem per year to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations as established in 40 CFR 190.10. The lung dose of 4.17 mrem per year is less than the 40 CFR 190 dose limit and the thyroid dose is an insignificant fraction of the 75 mrem per year limit given in 40 CFR 190. The effective dose of 0.570 mrem per year is also less than the NRC limit of 100 mrem per year established in 10 CFR 20.

3. *I need a justifying and bounding statement to show that it is logical that the airborne dose remains the same. In 1999 the population was 471,410 and collective dose was 4.3 person/rem. Current values indicate an increase in population and dose.*

Response:
The population collective dose was reevaluated based on the release data given above and the projected population distribution. The population distribution is obtained from the ER, Tables 3.10-8 and 3.10-9. However these tables only provided a projected 2015 population distribution for the 0-5 mile distances. Since the projected 2015 population for distances 10-50 miles is not given in the ER, the projected population increase for 2015 for distances 1-5 miles was used to project the population distribution for distances of 10-50 miles. The data used in the GENII input is:

2015 population based on a 5% increase from 2000 data

		Distance from site (miles)									
Direction	Year	0-1	1-2	2-3	3-4	4-5	5-10	0-20	20-30	0-40	40-50
N-NE	2015	25	56	49	50	109	374	680	886	8415	17745
NE	2015	35	164	210	77	65	313	1437	3017	2217	3783
E-NE	2015	39	132	77	123	60	376	356	2245	6672	4781
East	2015	150	442	126	161	138	506	1058	1884	5315	10247
E-SE	2015	286	2097	764	138	70	1688	2700	8363	6554	2874
S-E	2015	3	1193	2200	3	8	13989	26943	8885	14012	7362
S-SE	2015	1	32	11	41	127	6286	13503	5983	10836	24060
South	2015	0	8	41	99	272	2590	3204	6287	12404	10604
S-SW	2015	0	15	28	69	270	1633	2032	2636	3887	5887
SW	2015	0	0	11	7	6	1813	1523	3156	1168	5797
N-SW	2015	0	2	4	5	19	545	3173	5173	6300	15055
West	2015	1	0	2	5	7	390	1099	4476	2818	16433
W-NW	2015	2	3	20	30	56	638	984	4026	2103	45036
NW	2015	2	3	106	99	84	360	1623	2044	13403	12004
N-NW	2015	13	100	142	106	81	118	2338	3288	15829	57318
North	2015	29	64	84	60	48	176	3854	2172	5327	12628

The resulting population dose within 50 miles (80467 m) of the MTW site are given below:

	POPULATION GROUP AGE RANGE 0 TO 70 YEARS										
	POPULATION EFFECTIVE DOSE BY DISTANCE AND DIRECTION (PERSON-SV)										
Direction		**Distance (m)**									
Compass	**Degrees**	**1609**	**3219**	**4828**	**6437**	**8047**	**16090**	**32190**	**48280**	**64370**	**80470**
NNE	23	1.00E-03	2.60E-04	1.20E-04	8.40E-05	1.30E-04	1.70E-04	1.10E-04	7.90E-05	4.60E-04	6.40E-04
NE	45	1.10E-03	6.30E-04	4.60E-04	1.10E-04	7.10E-05	1.30E-04	2.30E-04	2.50E-04	1.10E-04	1.20E-04
ENE	68	5.10E-04	2.10E-04	7.00E-05	7.50E-05	2.70E-05	6.60E-05	2.30E-05	7.80E-05	1.40E-04	6.50E-05
E	90	1.20E-03	4.50E-04	7.20E-05	6.20E-05	3.90E-05	5.70E-05	4.50E-05	4.20E-05	7.10E-05	8.80E-05
ESE	113	2.90E-03	2.50E-03	5.00E-04	6.10E-05	2.30E-05	2.10E-04	1.30E-04	2.10E-04	9.70E-05	2.80E-05
SE	135	3.90E-05	1.70E-03	1.80E-03	1.60E-06	3.10E-06	2.10E-03	1.50E-03	2.60E-04	2.50E-04	8.70E-05
SSE	158	1.50E-05	5.10E-05	9.70E-06	2.40E-05	5.30E-05	9.80E-04	7.90E-04	1.90E-04	2.10E-04	3.10E-04
S	180	0.00E+00	1.70E-05	4.70E-05	7.50E-05	1.50E-04	5.50E-04	2.50E-04	2.60E-04	3.20E-04	1.80E-04
SSW	203	0.00E+00	4.30E-05	4.70E-05	7.90E-05	2.30E-04	5.50E-04	2.60E-04	1.70E-04	1.50E-04	1.40E-04
SW	225	0.00E+00	0.00E+00	1.10E-05	4.80E-06	3.00E-06	3.60E-04	1.20E-04	1.30E-04	3.00E-05	9.80E-05
WSW	248	0.00E+00	2.20E-06	2.40E-06	2.00E-06	5.60E-06	6.40E-05	1.50E-04	1.30E-04	9.90E-05	1.60E-04
W	270	1.00E-05	0.00E+00	1.20E-06	2.00E-06	2.00E-06	4.50E-05	5.00E-05	1.10E-04	4.40E-05	1.80E-04
WNW	293	2.30E-05	4.10E-06	1.60E-05	1.60E-05	2.30E-05	1.10E-04	6.20E-05	1.30E-04	4.00E-05	5.50E-04
NW	315	1.50E-05	3.00E-06	6.10E-05	3.90E-05	2.40E-05	4.30E-05	7.40E-05	4.80E-05	1.90E-04	1.10E-04
NNW	338	1.40E-04	1.30E-04	1.10E-04	5.30E-05	3.00E-05	1.70E-05	1.30E-04	9.40E-05	2.70E-04	6.50E-04
N	360	8.30E-04	2.40E-04	1.80E-04	8.50E-05	5.00E-05	7.10E-05	5.80E-04	1.70E-04	2.50E-04	3.90E-04
	POPULATION EFFECTIVE DOSE BY DISTANCE AND DIRECTION (PERSON-Rem)										
Direction		**Distance (m)**									
Compass	**Degrees**	**1609**	**3219**	**4828**	**6437**	**8047**	**16090**	**32190**	**48280**	**64370**	**80470**
NNE	23	1.00E-01	2.60E-02	1.20E-02	8.40E-03	1.30E-02	1.70E-02	1.10E-02	7.90E-03	4.60E-02	6.40E-02
NE	45	1.10E-01	6.30E-02	4.60E-02	1.10E-02	7.10E-03	1.30E-02	2.30E-02	2.50E-02	1.10E-02	1.20E-02
ENE	68	5.10E-02	2.10E-02	7.00E-03	7.50E-03	2.70E-03	6.60E-03	2.30E-03	7.80E-03	1.40E-02	6.50E-03
E	90	1.20E-01	4.50E-02	7.20E-03	6.20E-03	3.90E-03	5.70E-03	4.50E-03	4.20E-03	7.10E-03	8.80E-03
ESE	113	2.90E-01	2.50E-01	5.00E-02	6.10E-03	2.30E-03	2.10E-02	1.30E-02	2.10E-02	9.70E-03	2.80E-03
SE	135	3.90E-03	1.70E-01	1.80E-01	1.60E-04	3.10E-04	2.10E-01	1.50E-01	2.60E-02	2.50E-02	8.70E-03
SSE	158	1.50E-03	5.10E-03	9.70E-04	2.40E-03	5.30E-03	9.80E-02	7.90E-02	1.90E-02	2.10E-02	3.10E-02
S	180	0.00E+00	1.70E-03	4.70E-03	7.50E-03	1.50E-02	5.50E-02	2.50E-02	2.60E-02	3.20E-02	1.80E-02
SSW	203	0.00E+00	4.30E-03	4.70E-03	7.90E-03	2.30E-02	5.50E-02	2.60E-02	1.70E-02	1.50E-02	1.40E-02
SW	225	0.00E+00	0.00E+00	1.10E-03	4.80E-04	3.00E-04	3.60E-02	1.20E-02	1.30E-02	3.00E-03	9.80E-03
WSW	248	0.00E+00	2.20E-04	2.40E-04	2.00E-04	5.60E-04	6.40E-03	1.50E-02	1.30E-02	9.90E-03	1.60E-02
W	270	1.00E-03	0.00E+00	1.20E-04	2.00E-04	2.00E-04	4.50E-03	5.00E-03	1.10E-02	4.40E-03	1.80E-02
WNW	293	2.30E-03	4.10E-04	1.60E-03	1.60E-03	2.30E-03	1.10E-02	6.20E-03	1.30E-02	4.00E-03	5.50E-02
NW	315	1.50E-03	3.00E-04	6.10E-03	3.90E-03	2.40E-03	4.30E-03	7.40E-03	4.80E-03	1.90E-02	1.10E-02
NNW	338	1.40E-02	1.30E-02	1.10E-02	5.30E-03	3.00E-03	1.70E-03	1.30E-02	9.40E-03	2.70E-02	6.50E-02
N	360	8.30E-02	2.40E-02	1.80E-02	8.50E-03	5.00E-03	7.10E-03	5.80E-02	1.70E-02	2.50E-02	3.90E-02
	Total Population dose =			**3.81**	Person-Rem/yr						

The collective radiation dose to the 50-mile population of about 517,000 people surrounding the Honeywell MTW facility is estimated to be 3.81 person-rem/yr. Based on an average background radiation dose of approximately 0.360 rem per year for individuals in the United States (NCRP Report No. 93), this same population would receive a collective background radiation dose of 186,000 person-rem/yr. The collective radiation dose associated with atmospheric releases from the Honeywell MTW facility is a small percentage of the radiation dose from background.

4. *Why doesn't the dose increase correlate more closely with the population increase?*

   The population dose will increase in direct proportion to the increase in population if all other data and parameters remain unchanged. Since the original analysis given in the NRC EA, the radiation dosimetry has changed which, considered alone, will reduce the offsite doses. The current radiation dosimetry is based on ICRP Publications 60 and 72, as provided in the supporting documents for Federal Guidance Reports 12 and 13.

   The GENII-NESHAPS code incorporates the internal dosimetry models recommended by ICRP 56-72 and the radiological risk estimating procedures of Federal Guidance Report 13 into updated versions of existing environmental pathway analysis models.

   Based on the changes in models and radiation dosimetry, the results of the current analysis can not be compared directly with the earlier analyses.

5. *Give me a basic calculation method that demonstrates that your aqueous discharge at <1ppm uranium will result in a dose of less than one mrem to the citizens of Joppa.*

   The pathways considered in the aqueous release pathway are: ingestion, shoreline exposure, boating exposure, and water submersion. The ingestion pathway includes drinking water and fish consumption. Shoreline exposure consists of exposure to contaminated sediments along the riverbank. The water submersion pathway considered swimming.

   The radiation doses from aqueous releases of radionuclides is estimated using the current quantity of radionuclides released from the Metropolis facility and the FRAMES computer code. The evaluation of offsite individual and population doses used the FRAMES WCF Surface Water Module, the MEPAS (Multimedia Environmental Pollutant Assessment System) 5.0 Exposure Pathway Module, the MEPAS 5.0 receptor Intake Module, and the MEPAS 5.0 Health Impacts Module. Except for site-specific input, the default parameters in the FRAMES code were used.

   The nearest individual receptor is assumed to be in Joppa, Illinois, 8 kilometers (5 Miles) downstream. Exposure at this location was limited to the maximum individual since the city of Joppa does not use the Ohio River for drinking water

   The nearest downstream public drinking water intake is located in Cairo, Illinois, about 51 kilometers (32 miles) away. The population of Cairo, Illinois was: 3,632, (year 2000) and the estimated population in July 2004 is 3,434 (-5.5% change) http://www.city-data.com/city/Cairo-Illinois.html

The population of Cairo has been in decline every decade since the 1920's—in 1920: 15,203; in 1940: 14,407; 1950: 12,123. At the Cairo High School Graduation in 1990, the school principal advised the graduating class to leave town, as Cairo had nothing to offer them. http://en.wikipedia.org/wiki/Cairo,_Illinois. The Cairo population used in NRC's SER was **4,846**. Since this bounds the current and projected population of Cairo, this value was used in the analysis.

For this location, average ingestion rate of drinking water as identified in Regulatory Guide 1.109 was used. For other parameters, the FRAMES default data was used. These values are summarized in the following Table. Food crops are not typically irrigated in this area; therefore, this pathway was not evaluated.

Parameters Used in Dose Analysis

Maximally Exposed Individual		
Parameter	Value[1]	Value used in Analysis
Ingestion Rate of Drinking Water	730 L/yr	730 L/yr
Ingestion rate of Freshwater Fish	21 kg/yr	0.054 kg/day (19.7 kg/yr)
Time Spent Swimming	88 hr/yr	730 hr/yr
Shoreline Exposure	12 hr/yr	1825 hr/yr

Population		
	Value[1]	Value used in Analysis
Ingestion Rate of Drinking Water	370 L/yr	370 L/yr
Ingestion rate of Freshwater Fish	6.9 kg/yr	0.054 kg/day (19.7 kg/yr)
Time Spent Swimming	88 hr/yr	730 hr/yr
Shoreline Exposure	8.3 hr/yr	1825 hr/yr

[1]Reference: Regulatory Guide 1.109, Revision 1.

The liquid releases used in the NRC's EA were based on releases from the plant to the Ohio River from 1989 through 1993. These releases were assumed to be 49 percent U-238, 49 percent U-234, and 2 percent U-235. The current Honeywell MTW releases are given below:

	Honeywell MTW Releases[1]				
	2001	2002	2003	2004	2005
U-nat (Ci)	0.62	0.33	0.32	0.27	0.31
RA-226 (Ci)	8.21E-03	3.47E-03	4.19E-03	4.29E-03	5.27E-03
Th-230 (Ci)	1.47E-03	9.15E-03	8.25E-03	8.71E-03	2.41E-03

	Average Release		
	Ci/yr	Ci/L	Ci/ml
U-234 (49%)	0.1813	7.66531E-16	7.6653E-19
U-235 (2%)	0.0074	3.1287E-17	3.1287E-20
U-238 (49%)	0.1813	7.66531E-16	7.6653E-19

[1]Data from: Patterson, Charles @ Honeywell MTW, **Sent:** Monday, March 20, 2006 3:20 PM

Daughter products of the above radioisotopes are conservatively assumed to be the same activity and release rate as the parent. The calculated doses for the maximum individual located in Joppa are:

Maximum Individual Dose

	Dose (Whole Body)	
Exposure Route and Pathway	**Sv**	**mRem**
TOTAL	4.22E-09	**4.22E-04**
external (total)	2.45E-13	2.45E-08
Boating	3.88E-16	3.88E-11
Shoreline	2.43E-13	2.43E-08
Swimming	7.78E-16	7.78E-11
ingestion (total)	4.22E-09	4.22E-04
Fish	8.33E-10	8.33E-05
Swimming	3.08E-10	3.08E-05
Water	3.08E-09	3.08E-04
dermal (total)	0.00E+00	0.00E+00
Shoreline	0.00E+00	0.00E+00
Swimming	0.00E+00	0.00E+00

The population doses calculated for Cairo are equal to the minimal individual dose * total population.

Cairo Population Dose
Liquid Release

	Dose (Whole Body)	
Exposure Route and Pathway	**Sv**	**mRem**
TOTAL	2.71E-09	**2.71E-04**
external (total)	2.45E-13	2.45E-08
Boating	3.88E-16	3.88E-11
Shoreline	2.43E-13	2.43E-08
Swimming	7.78E-16	7.78E-11
ingestion (total)	2.71E-09	2.71E-04
Fish	8.33E-10	8.33E-05
Swimming	3.08E-10	3.08E-05
Water	1.57E-09	**1.57E-04**
dermal (total)	0.00E+00	0.00E+00
Shoreline	0.00E+00	0.00E+00
Swimming	0.00E+00	0.00E+00
Population =	4846	
Population Dose (person-rem) =	**1.32E-03**	

As shown by the above results, the drinking water pathway is the largest contributor to the total dose, 1.57/2.71 = 58%. Shoreline exposure, swimming, and boating produced negligible radiation doses.

The radiation dose due to the maximally exposed individual due to aqueous releases is estimated to be 0.0004 mrem per year. This estimated dose is far less than the NRC limit of 100 mRem per year (10 CFR 20) and is also far less than the EPA limit of 25 mRem per year in 40 CFR 190. The estimated maximum individual dose of 0.0004 mRem is also far less than the EPA drinking water standard of 4 mRem per year (40 CFR Part 141). The collective radiation dose to the population of Cairo, Illinois (4846 people) from aqueous releases is estimated to be 0.0013 person-rem per year. Based on an average background radiation dose of 0.360 rem per year for individuals in the U.S. (NCRP Report No. 93), this same population would receive about 1,745 person-rem per year. The radiation dose from aqueous releases from the Honeywell MTW facility is a very small percentage of the collective dose from background.