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May 3, 2002

40-8857

Mr. Rick Weller – Project Manager
Division of Fuel Cycle Safety and Safeguards
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20850

RE: Gas Hills License Application
MILDOS

Dear Mr. Weller:

Per our recent phone conversations regarding the dose estimates generated from the MILDOS assessment material in Volume 5 of the Gas Hills License Application, please find three (3) copies of revised pages 11, 11a, 12, and 14. Hopefully, this revised information will clarify the results of the MILDOS modeling included in Section 3.0.

If you need any additional information, don't hesitate to contact me.

Sincerely,

W.F. Kearney
Manager-Health, Safety
& Environmental Affairs

WFK/ksj

attachments

cc: File GH-9

NMSSo1 Public.



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3.0 RESULTS

The results for individual receptors per the MILDOS dose assessment are summarized in Tables 3.1 and 3.2. The results are given in detail in the MILDOS outputs attached (Attachments 2 and 3). The concentrations, as a fraction of the Effluent Concentration Limit (ECL) for radon, are given in detail in Attachment 4, and were computed separately using spreadsheets. The Effluent Limit Concentration for radon with daughters in equilibrium, given in Appendix B, Table 2 of 10 CFR 20, is 0.1 pCi/L. The concentration limit for radon with no daughters present is 10 pCi/L. The concentration limit for radon decay products, based on a factor of 300 reduction from the derived air concentration for occupational exposure, is 0.0011 Working Level (WL). Radon decay product concentrations at the sixteen boundary locations and the three occupied receptors were below 0.0011 WL. All estimated concentrations of radon, adjusted for radioactive decay equilibrium, at the site boundaries and human receptors, were less than 0.1 pCi/L (1×10^{-4} pCi/m³) as shown in Table 3.2.

The “equilibrium adjusted radon concentrations” in Table 3.2 are values calculated from the location-by-location concentrations of radon decay products as given in the MILDOS output. The relationship between radon and its decay product concentrations varies for each location in this table, since decay product equilibrium with radon is a function of time. The dose due to radon is related to the radon decay product concentration. Therefore, 10 CFR 20.1302 allows for adjustment of effluent concentration limits to account for decay product equilibrium. When decay product equilibrium varies with location, as it does here, it is more convenient to calculate equivalent radon concentrations, rather than to adjust the concentration limit at each location. The equilibrium equivalent radon concentration in pCi/L was calculated by multiplying WL (as estimated using MILDOS) by a factor of 100.

Individual Receptor Dose: The estimated annual doses at each receptor location are given in Table 3.2b. The doses were calculated using the dose conversion factor of 400 mrem per working level month (WLM) from ICRP 65 “Protection Against Radon-222 at Home and at Work” (ICRP 1994). The exposure in WLM was calculated as follows:

$$\text{WLM} = ([\text{Rn-222 eq}][8760 \text{ h/y}][\text{OF}])/([170 \text{ WLh/WLM}][100 \text{ pCi/l-WL}])$$

Where: Rn-222 eq = equilibrium adjusted radon-222 concentration in pCi/L

OF = occupancy factor = 0.8

WL = radon decay product concentration

WLM = radon decay product exposure

Example: East Boundary for 2000

$$[\text{Rn-222 eq}] = 0.041 \text{ pCi/L}$$

$$\text{Annual Exposure} = ([0.041 \text{ pCi/L}][8760 \text{ h/y}][0.8])/([170 \text{ WLh/WLM}][100 \text{ pCi/L-WL}])$$

$$\text{Annual Exposure} = 0.017 \text{ WLM/y}$$

$$\text{Annual Dose} = [0.017 \text{ WLM/y}][400 \text{ mrem/WLM}] = 7 \text{ mrem/y}$$

The maximum estimated annual dose from inhalation of radon decay products at the site boundary is 7 mrem per year. If the annual dose is estimated assuming the effluent concentration limit of 0.1 pCi per liter is equivalent to an annual dose of 50 mrem, the maximum estimated annual dose at the site boundary would be 22 mrem per year.

Population Dose: MILDOS calculates population dose by summing the estimated doses for the population centroids shown in Table 2.1. The attached MILDOS output tables list Total Effective Population Dose Equivalent in person-rem, calculated for both of the release sources considered in this report and for the seven MILDOS time steps used in this study. The results, summed from both output tables for the population within 80 km of the site, are as follows:

Time Step:	1	2	3	4	5	6	7
Person-rem/yr	.14	.19	.2	.29	.13	.05	.024

Approximately 99.7% of this population lives beyond 40 km from the site.

Table 3.1 Estimated Radon Daughter Concentrations (WL) as a Fraction of the Effluent Concentration Limit at Boundaries and Receptors

Receptor	1998	2000	2002	2004	2006	2008	2010	2012
N Boundary	0.034	0.042	0.051	0.058	0.032	0.013	0.007	0.008
NNE Boundary	0.101	0.141	0.118	0.154	0.099	0.045	0.019	0.012
NE Boundary	0.087	0.130	0.115	0.142	0.090	0.031	0.014	0.011
ENE Boundary	0.156	0.238	0.198	0.244	0.159	0.062	0.028	0.021
E boundary	0.246	0.373	0.288	0.386	0.256	0.096	0.039	0.014
ESE Boundary	0.140	0.219	0.192	0.225	0.138	0.032	0.013	0.006
SE boundary	0.112	0.157	0.154	0.161	0.090	0.022	0.009	0.006
SSE boundary	0.192	0.266	0.233	0.273	0.166	0.059	0.024	0.012
S boundary	0.169	0.229	0.211	0.201	0.113	0.038	0.016	0.009
SSW Boundary	0.196	0.262	0.251	0.229	0.126	0.053	0.022	0.010
SW Boundary	0.048	0.062	0.163	0.105	0.027	0.010	0.004	0.003
WSW Boundary	0.051	0.066	0.089	0.106	0.056	0.022	0.010	0.006
W Boundary	0.183	0.250	0.203	0.269	0.177	0.092	0.037	0.017
WNW Boundary	0.042	0.053	0.068	0.074	0.042	0.021	0.012	0.017
NW Boundary	0.037	0.049	0.056	0.060	0.034	0.017	0.007	0.005
NNW Boundary	0.030	0.040	0.046	0.048	0.027	0.013	0.005	0.003
Nearest Res.	0.006	0.008	0.009	0.011	0.006	0.002	0.001	*
Waltman	0.002	0.002	0.002	0.003	0.002	*	*	*
Jeffrey City	0.002	0.003	0.003	0.004	0.002	*	*	*

* Less than 0.001

Table 3.2b Estimated Annual Dose from Radon at Boundaries and Receptors (mrem/y)

Receptor	1998	2000	2002	2004	2006	2008	2010
N Boundary	0.6	0.8	0.9	1	0.6	0.2	0.1
NNE Boundary	2	3	2	3	2	0.8	0.3
NE Boundary	2	2	2	3	2	0.6	0.2
ENE Boundary	3	4	4	4	3	1	0.5
E Boundary	4	7	5	7	5	2	0.7
ESE Boundary	2	4	3	4	2	0.6	0.2
SE Boundary	2	3	3	3	2	0.4	0.2
SSE Boundary	3	5	4	5	3	1	0.4
S Boundary	3	4	4	4	2	0.7	0.3
SSW Boundary	4	5	5	4	2	0.9	0.4
SW Boundary	0.9	1	3	2	0.5	0.2	<0.1
WSW Boundary	0.9	1	2	2	1	0.4	0.2
W Boundary	3	5	4	5	3	2	0.7
WNW Boundary	0.8	1	1	1	0.8	0.4	0.2
NW Boundary	0.7	0.9	1	1	0.6	0.3	0.1
NNW Boundary	0.5	0.7	0.8	0.9	0.5	0.2	0.1
Nearest Res.	0.1	0.1	0.2	0.2	0.1	<0.1	<0.1
Waltman	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Jeffrey City	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

4.0 REFERENCES

International Commission on Radiological Protection (ICRP). 1994. Protection Against

Radon-222 at Home and at Work. ICRP Publication 65. Pergamon (Elsevier Science Inc.). Tarrytown, NY.

Nuclear Regulatory Commission. 1984. Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations. NUREG/CR-4088. Office of Nuclear Regulatory Research. Nuclear Regulatory Commission. 1987. Methods for Estimating Radioactive and Toxic Airborne Source Terms for Uranium Milling Operations. Regulatory guide 3.59.

Nuclear Regulatory Commission. 1980. Final Generic Environmental Impact Statement on Uranium Milling, Volume III. NUREG-0706. Office of Nuclear Material Safety and Safeguards.

Power Resources Inc. Gas Hills Project Operations Plan. December 1996.