November 13, 2001

MEMORANDUM TO: Larry W. Camper, Chief
DCB/DWM/NMSS

FROM: Thomas Essig, Chief ***/RA by Sandra L. Wastler Acting For/***
EPAB/DWM/NMSS

SUBJECT: REVIEW AND APPROVAL OF PROPOSED DCGLs FOR KERR McGEE TECHNICAL CENTER (TAR 8096)

Richard Codell of the Performance Assessment Section (EPAB) has reviewed the Licensee's proposed DCGLs for the Kerr McGee Technical Center. He has concluded that most of the DCLGs and area factor calculations are acceptable, but there were two concerns about the use of possibly inappropriate dose factors and building air exchange rates that should be addressed before final approval. The bases of his conclusions are contained in the attached report. Please contact him with any questions.

Docket Number: 40-8006
License Number: SUB-986

Attachment: DCGLs Report Review

CONTACT: R. Codell, EPAB/DWM
(301) 415-8167

(EPAB-TAR-30)

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DISTRIBUTION: NMSS/DWM r/f EPAB r/f K. Kalman L. Camper
S. Moore

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OFC	DWM		DWM		DWM	
NAME	RBCodell:rmc/eab prfrd		SLWastler		THEssig	
DATE	11/ 07 /01		11/13 /01		11/ 13 /01	

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NRC Staff Review of Derived Concentration Guideline Levels for the Kerr McGee Technical Center, Oklahoma City, OK

Introduction

Kerr-McGee Corporation has submitted a Decommissioning Plan for its Technical Center located in Oklahoma City, OK, in which it requests unrestricted release of the site [Kerr-McGee, 2001]. Its license allows for 250 kg of natural uranium, 150 kg of natural thorium and 35 kg of depleted uranium. The NRC staff has evaluated its calculations of derived concentration guideline levels (DCGLs) and found them to be acceptable except for two questions regarding use of alternative dose factors and high indoor air turnover rates. The following text discusses the extent of the radioactive contamination of the site and buildings, the removal of contaminated soil, the cleaning of contaminated surfaces in buildings, and the derivation of the DCGLs.

Description of Site Contamination

Most of the radioactive material was contained in five in-ground vaults known as the “Calibration Test Pit” area, used to calibrate uranium prospecting instruments. The vaults consisted of 1.8 m (6 ft) diameter corrugated steel pipes 3.7 m (12 ft) long, placed vertically in the ground and sealed on the bottom by a steel plate. The top and bottom segments of the pipe contained clean sand. The middle 1.8 m (6 ft) section contained the source material. There was a 11.4 cm (4.5 inch) OD fiberglass pipe installed in the centerline of the steel pipe and used to lower the instruments for calibration. Five of the eight test pits contained source material consisting of U_3O_8. There was approximately 24 m^3 (32 cubic yards) of source material with an average U_3O_8 concentration of approximately 0.25 weight percent. There was approximately 132 kg (290 lb) of U_3O_8, mostly in the form of crushed ore and sand with yellowcake. Three other test pits at the site never contained source material.

Decontamination of the site will require the removal of source material from the uranium calibration test pits and disposal at a licensed disposal facility. Other areas of the site, including the grounds around the test pits and laboratory space within buildings used to prepare and analyze samples, may contain minor amounts of contamination that must be surveyed and possibly decontaminated for decommissioning.

Attachment

Groundwater Contamination

Water infiltrating the soil around the test pits and introduced by irrigation pipes mobilized some of the buried uranium and carried it into the groundwater. The soils near the test pits are well-drained and of low permeability. Although the water table is approximately 15 ft below the surface in the test pit vicinity, it is unlikely that this could be a source of drinking or irrigation water because of the low soil permeability. Since the site is within the limits of Oklahoma City, all residential and commercial users are required to be hooked up to the municipal drinking water service. There are productive groundwater zones beneath the site, but they are several hundreds of feet deep, separated by low-permeability soil and rock, and unlikely to be contaminated above action levels by infiltrating groundwater from the test pits.

The test pits have been excavated to remove the contaminated soil and the corrugated steel pipes. Initial measurements of water samples from the excavated pits were measured in the field to be as high as 670 pCi/l. More contaminated soil has been excavated from the site since those measurements and generally show that groundwater concentrations continue to decline.

There are eight groundwater monitoring wells in the soil surrounding the test pits. These wells have measured concentrations of total uranium of between 7 and 37 pCi/l, including background. Staff believes that the low concentration of uranium in these wells would be indicative of the level of uranium contamination in the groundwater in the event that shallow groundwater was used for human consumption, e.g., a dug well. These concentrations are significantly below the licensee's calculated DCGLs for groundwater.

Licensee's Calculations of DCGLs for Groundwater

The licensee performed a separate calculation of the release criteria for total uranium in groundwater and determined it to be 226 pCi/l for the resident farmer scenario. The exposure pathways were ingestion of groundwater, ingestion of soil, external exposure, ingestion of vegetables and ingestion of meat. Except for the direct ingestion of groundwater by humans and animals, all other pathways depend on the contamination of the soil by irrigation supplied by contaminated groundwater. Given that ample municipal water and productive groundwater zones are available at the site, and that the hydrologic conditions of the soil would preclude a large-scale production of groundwater from the shallow soil zone, this is a highly pessimistic calculation. Nevertheless, the licensee's calculations estimate that over 80 percent of the potential dose would come from direct ingestion of groundwater by human inhabitants. We concur in these estimates and expect that they are conservative for the purposes of determining groundwater release criteria. We also note that the release criteria of 226 pCi/l exceeds the measured concentrations in monitoring wells close to the test pits. Additional groundwater calculations are an integral part of the surface and subsurface soil DCGLs.

Licensee's Calculations of DCGLs for Surface Soil

The licensee calculated DCGLs for surface contamination of soils outside of buildings using the RESRAD code [Yu, *et al*, 2001] and started with the default scenario for a resident farmer but with some significant differences, described below:

1. Two unsaturated soil layers - The licensee noted that there were at least two distinct layers of soil in the unsaturated zone in the area of the test pits.

2. Site-specific coefficients in soil layers - The licensee used many default values of coefficients for transport from NUREG 5512 but based some of the coefficients for the four soil layers (contaminated zone, two unsaturated zones and one saturated zone) on site-specific information. The licensee performed a grain size and hydrometer analysis of soil above the saturated zone and used Kd values for clay from published literature and, as a result, classified the upper soil as a clay loam and the lower unsaturated soil as a silty clay. The choice of the distribution coefficients for these soils appears to be within reason for the site-specific study. Default Kd values from NUREG 5512 for all layers were used except for the lower unsaturated zone. Including these deviations from the default case is justified.

3. Area Factors - Area factors for DCGLs were determined by running the RESRAD code for areas between 10,000 and 1 m^2. The resulting curve appears to be correct and is somewhat more conservative than the recommended default area factors from RESRAD [Yu, *et al*, 2001].

4. Use of ICRP 72 ingestion dose factors - The licensee used ingestion dose conversion factors from ICRP 56+, as summarized in ICRP 72. Only ingestion dose factors were used in the licensee's evaluation, with the remaining dose factors chosen as the default in RESRAD.

Since some of the chain radionuclides could be out of equilibrium, the licensee produced separate dose factors for Th-232 plus progeny, total uranium through U-234, and Th-230 through Pb-210. Soil guidelines were then based on soil concentrations resulting in 25 millirem doses and the unity rule for mixtures of radionuclides. These results are shown in Table 1.

We concur in the licensee's use of site-specific values for the RESRAD evaluation but not with the use of the ICRP 72 dose factors. Although the ICRP 72 dose factors led to a slightly more conservative DCGL for Th-232 and progeny, they resulted in somewhat more optimistic DCGLs for Th-230 and considerably more optimistic DCGLs for natural uranium through U-234. Staff's results with default ingestion dose factors are compared to the licensee's results in Table 1. There are minor differences between the licensee and staff calculations using the same dose factors. These can be explained by the staff's use of RESRAD 6.1 and minor differences in default values other than ingestion dose factors.

The issue of using isolated dose factors from a different standard while leaving the other factors of the analysis as default values has been addressed by the Nuclear Regulatory Commission and is generally discouraged without ample justification.

Table 1 - Comparison of Surface Soil DCGLs

Radionuclides	Calculated Single Radionuclide Rates - mrem/yr/pCi/g Kerr-McGee	Calculated Single Radionuclide Rates - mrem/yr/pCi/g - NRC Staff
Th-232 + progeny	4.6	4.02
Nat. U to U-234	0.141	0.284
Th-230 + progeny	7.1	8.7

Subsurface Soil DCGLs

The licensee conducted a RESRAD analysis for subsurface contamination in the vicinity of the test pits to estimate soil guideline values for natural uranium. The subsurface contamination was considered to be at the bottom of the test pit, about 3.7 m (12 ft.) below ground. The licensee used the default dose factors in RESRAD, site-specific values of saturated hydraulic conductivity, and distribution coefficients based on soil types observed on site. Contamination was assumed to be restricted to a 50 m^2 area. A single radionuclide dose rate of 0.223 millirem/pCi/ gram total uranium was predicted. We concur in the licensee's calculations for subsurface soil DCGLs.

Indoor DCGLs

The licensee produced DCGLs for indoor surfaces and structures. As with the other calculations, DCGLs were derived for Th-232 and progeny, the uranium series through U-234 and Th-230 plus progeny. RESRAD-BUILD [Yu, *et al.*, 1994] was used to calculate DCGLs for indoor surfaces, with the default parameters except for: (1) air exchange rate, (2) room height, and (3) removable fraction. The choice of removable fraction was justified on the age of the facility and the fact that there has been no recent use of laboratory space for handling contaminated materials. We concur in this choice.

The licensee used an air exchange rate of 10/hour instead of the RESRAD-BUILD default value of 0.8/hr., with the explanation that the affected spaces are laboratories and have higher air exchange rates. Nevertheless, this choice of air exchange rate is near the upper limit of the distribution ranges recommended for RESRAD-BUILD. Since resuspension of particulates is by far the largest dose contributor to the indoor environment, the choice should be justified better, especially in terms of unrestricted release of the site, e.g., will it revert back to space other than laboratories? Staff has performed sensitivity studies with the air exchange rate and estimates that the chosen air turnover rate gives a dose two orders of magnitude smaller than the default value.

Area factors for DCGLs - The licensee decided that an ALARA approach would be used for indoor contamination because traditional calculations of area factors would allow high residual levels for small areas of elevated concentration. They will ensure that all residual indoor contamination will not exceed DCGLw by more than a factor of 3. We concur in this approach.

Conclusions and Recommendations

We have evaluated the licensee's calculations of DCGLs for contaminated surface soil, buried waste, groundwater and interior building surfaces and structures. We concur in all of the licensee's calculations with the following exceptions:

1. Use of ICRP-72 dose factors for ingestion.

2. Use of an air turnover rate of 10/hr for indoor DCGLs.

The licensee should further justify the use of these factors, or accept the default values used in current versions of RESRAD and RESRAD-BUILD.

References

Kerr-McGee, "Decommissioning Plan for the Kerr-McGee Chemical L.L.C. Technical Center," License No. SUB-986, Docket No. 040-08006, Kerr-McGee Chemical Corporation, Oklahoma City, OK, 73125, March 2001.

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Yu, C. and others, "RESRAD-BUILD: A computer model for analyzing the radiological doses resulting from the remediation and occupancy of buildings contaminated with radioactive material," ANL/EAD/LD-3, Environmental Assessment Division, Argonne National Laboratory, 9700 South Cass Ave, Argonne, IL, 60439, November 1994.