UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
611 RYAN PLAZA DRIVE, SUITE 400
ARLINGTON, TEXAS 76011-4005

September 28, 2004

Mr. Russell H. Jones, Project Manager
Kerr-McGee Corporation
Kerr-McGee Technical Center
P.O. Box 25861
Oklahoma City, Oklahoma 73125

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION

Dear Mr. Jones,

This refers to the decommissioning activities underway at your Kerr-McGee Corporation, Kerr-McGee Technical Center (KMTC), located near Oklahoma City, Oklahoma. The approved decommissioning plan submitted to the Nuclear Regulatory Commission, for this activity included derived concentration guideline levels (DCGLs) for the unrestricted release of soil and building surfaces at KMTC based on ICRP-72 dose conversion factors. KMTC submitted a final status survey report (FSSR) for the Outdoor Survey Units on September 2003, which contained buried and exposed piping. KMTC requested use of building surface DCGLs for the unrestricted release of piping (e.g., laboratory drains and pipes contaminated with uranium and thorium). The NRC staff response indicated that building surface DCGLs could not be arbitrarily used for buried and embedded piping. Therefore, KMTC submitted specific modeling in the form of two (2) Technical Memorandums (04-02 and 04-03) for the piping on April 15, 2004, as part of the FSSR Indoor Survey Units.

<u>KMTC Approaches for Modeling of Piping and Dose Calculations</u>

KMTC used the “Monte Carlo N Particle, MCNP” software, developed by Los Alamos National Laboratory Version 4c code to simulate radiological characteristics and geometry of the pipes and to determine the detection capabilities of the instrumentation proposed for site characterization and the FSSR. In this context, KMTC used the MCNP code to relate sodium iodide (NaI) detector count rate data to activity and to determine minimum detectable concentrations from the simulated background counts for each piping configuration. Using MCNP, the KMTC assumed specific piping geometries, a detector configuration, structure, and geometrical relationships to the piping, and use of three constructed blocks of concrete to represent wall and floor for simulation of background. KMTC assumed that the pipe was 30 cm above the concrete floor and the detector was placed parallel to the floor and 1 m away from the opposite wall and 15 cm away from the side wall. KMTC established activity density (pCi/g) assigned to background materials and contamination activity levels (DCGLs) to exposed and embedded pipes inner surfaces. These DCGLs were established for each of the single radionuclides Ra-226, Th-232, U-238, and the mixture of the three radionuclides using the “Unity Rule.” The background count rate for glass and plastic pipes of diameters 1", 2", and 4" were established. The DCGLs were applied for each configuration and the MCNP model was run to calculate the detector efficiency for each configuration. Using this approach, the count rates at the DCGLs for different configurations of plastic and glass piping were derived.

In addition to using the MCNP code, KMTC also conducted several runs of Microshield Version 5 code to calculate the exposure rate for each radionuclide and radionuclide mixture using different piping configuration. For example, the total exposure rate for a 4" diameter pipe was calculated to be 3.072 E-01 mR/hr. Further, KMTC developed a building renovation scenario to determine the potential dose to individuals from the embedded piping. The scenario assumed demolition and removal of the piping, in which the exposure pathways included external gamma and inhalation of re-suspended material. Using this scenario, KMTC assumed a unit uniform contamination (1 dpm/100 cm^2) on all buried surfaces, 30 years of radionuclide ingrowth, and a thickness of contamination of 1/32" (0.0008m). The annual external exposure period to the contaminated material was assumed to be 50 hours. Microshield, version 5.03 was used to model external exposure using three exposure scenarios:

- <u>Pipe source</u>: an individual is assumed to be exposed to a contaminated pipe 20 meters in length with the exposure point 1m away from the midpoint of the pipe;
- <u>Volumetric source</u>: the exhumed piping and excavation tank material is assumed to be uniformly crushed and dispersed into a volume of 10 m^3 with an area of 100 m^2 (area of the sediment tank and the limestone pit). The tank/pit walls and floors are assumed to be 6" of concrete and the exposure point is assumed to be 1 m away from the crushed volume; and
- <u>Slab source</u>: the total surface area of the stockpiled material is 100 m^2 with all contamination on the surface layer and the exposure point is the center of the disk.

Microshield code was also used to derive conversion factors to convert the calculated dose rate to an estimated dose assuming a rotational geometry. For example, to convert 1 dpm/100 cm^2 into mSv/hr, a factor of 4.57E-11 was derived for a slab source of U-238 to U-234 isotopes. For the inhalation exposure calculation, KMTC used a unit surface contamination of 1 dpm/100 cm^2, a contaminated surface area of 100 m^2, and assumed that 3.2E-05 fraction of the material is released (assuming a resuspension factor of 4E-02 m^{-1} and a thickness of contamination of 0.0008 m). The total time spent breathing the suspended material is assumed to be 3 seconds for each mechanical disturbance. Assuming there will be 20 mechanical disturbances, this results in a total annual exposure inhalation time of 60 seconds. The suspended contamination is assumed to be contained in a volume of 200 m^3. The DCFs for each isotope were those of ICRP 1995. For example, using a slab geometry, the calculated exposure per unit concentration for uranium (e.g., 1 dpm/100 cm^2) was derived as 5.51 E-06 (mrem/yr)/(1dpm/100 cm^2). Finally, the external and internal dose contributions are combined to compare with the unrestricted release limit of 25 mrem/y.

With respect to your modeling approach to the buried and embedded piping, we have identified the following requests for additional information:

1. Although use of the MCNP code can accurately model the photon interaction rate in the NaI detector, the simulation cannot accurately predict the output of the detection system resulting from this interaction rate. The simulation therefore appears to have assumed a specific relationship between the interaction rate in the crystal and the count rate of the system. The staff finds such an assumption as insufficiently reliable, and therefore the results from this simulation is lacking an adequate technical basis for the intended purpose.

Further work, or an alternative approach, to establish an acceptable relationship between contamination levels in the pipe and the detector count rate is therefore required.

2. The Microshield runs and output data provided in Attachment C (C-1 through C-17, pages 214-247) indicate a source dimension of 65.0 cm. This source is assumed to be the length of the pipe. However, on page 251, for calculation of exposure using a pipe source, an individual is assumed to be exposed to a 20 m length of contaminated pipe. Please explain or reconcile.

3. The Microshield runs and output data provided in Attachment C (C-1 through C-17, pages 214-247) indicate results of total exposure rates for different piping configurations and for different radionuclides and mixtures. These exposure rates were reported in the range of 1 E- 03 to 4.5 E-01 mR/hr. The report did not provide a direct conversion of these exposure rates to dose using a realistic exposure time of an average member of the critical group. It is unclear how these derived exposure rates were used in the dose calculations or in deriving the DCGLs. Please explain.

4. The source input values of Microshield runs in Attachment C (C-1 through C-17, pages 214-247) were provided as total radioactive source inventory (e.g., curies) and surface concentration $\mu Ci/cm^2$. Please provide information on assumptions or data for deriving radionuclide source inventory and surface area contamination.

5. For the building renovation scenario, the external exposure to contaminated material was assumed to be 50 hours. Please provide the rationale for selecting this occupancy time, taking into consideration the much longer occupancy period for the building occupancy scenario.

6. For calculation of the inhalation exposure, the KMTC assumed that inhalation of radioactive contamination only occurs during 20 mechanical disturbances, where each disturbance lasts only for 3 seconds. In a typical building occupancy scenario, it is assumed that the inhalation time is the same as the indoor or outdoor exposure time corresponding to the indoor/outdoor occupancy time. In other words, it is assumed that mechanical disturbances of the source occur during individual occupancy. Please provide further explanation for using a total of one minute per year for the total mechanical disturbance time of the source.

7. The reference, ICRP 1995, provided for the DCFs on pages 260 and 262 should include the ICRP series number or a complete reference.

Please provide a response to these items so that we can complete our review. If there are any questions, concerning this request for additional information, please contact me or Rachel Browder at (817) 276-6552.

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Sincerely,

/RA/

D. Blair Spitzberg, Ph.D., Chief,
Fuel Cycle Decommissioning Branch

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