Docket 40-2061

PDR

40-2061

UNITED STATES
ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

REPLY TO ATTENTION OF:
5HAWM

AUG 1 1 1980

Mr. W. A. Nixon
Nuclear Regulatory Commission
Uranium Process Licensing Section
Uranium Fuel Licensing Branch
Division of Fuel Cycle & Material Safety
Washington, D.C. 20555

Dear Mr. Nixon:

On May 1, 1980, my staff was sent revisions to the Kerr-McGee Chemical Corporation Plan for Decommissioning and Stabilizing the West Chicago, Illinois, facilities. These revisions were produced as a result of comments submitted to the Nuclear Regulatory Commission (NRC) by various Federal and State of Illinois agencies on the original Plan distributed August 15, 1979. We have completed our review of the Revised Plan from a radiological perspective and have found that extensive comments are required. Our comments are detailed in the attachment to this letter and are directed towards two areas;

On the Revised Plan, we offer the following:

(1) the environmental sampling program for Kress Creek is not adequate to identify possible deleterious effects originating during the implementation phase of the Plan,

(2) no plans are set forth for internal dose assessment for occupational workers or for possibly contaminated members of the surrounding residential community during the implementation phase of the Plan,

(3) toxic, long-lived radioactive ore residue and building rubble is not isolated sufficiently after burial so as to preclude migration into subsurface water or emanation to the ambient air,

(4) the standards for stabilization should be site-specific to the West Chicago facility, recognizing the unique position of a radioactive waste site in a residential community.

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On the radon dose assessment (Appendix II), we offer the following:

> Revised dose projections prepared for Kerr-McGee, ore residue and sludge materials on the Waste Site are unrealistically assigned very high moisture concentrations thereby forcing a "best case" solution on the annual radon emmissions and on the dose projections for the general population. Because data for the dose calculations is not fixed in the literature EPA-Region V does not feel speculation on what are or are not proper numbers for dose projections is responsible when matters of public health are concerned. I therefore request that the Nuclear Regulatory Commission direct the Kerr-McGee Chemical Corp. to revise their radon dose projections based to the fullest extent possible on data specific to the West Chicago site.

Our agencies share a commitment in protecting the public health and the environment in the matter of the Kerr-McGee West Chicago Facility. Consequently, this Region will continue to provide whatever support is available to assure the timely resolution of this problem. The attached comments are directed toward strengthening the Revised Plan, and to revision of the radon dose projections, with site-specific data.

My Radiation Program staff will be happy to provide any further assistance you may wish in this matter. If you have any questions or wish to discuss our comments further please do not hesitate to call Pete Tedeschi or Larry Jensen at (312)353-2654 or 886-6175.

Sincerely yours,

John McGuire
Regional Administrator

Attachment

U. S. ENVIRONMENTAL PROTECTION AGENCY COMMENTS
ON THE REVISED PLAN FOR
THE DECOMMISSIONING AND STABILIZATION OF THE KERR-McGEE
WEST CHICAGO, ILLINOIS, RARE EARTH PROCESSING FACILITY

Comments on Revisions to the Revised Plan

A. Section 7.3.1 states that prior to implementation of the Plan a sample will be taken of the storm sewer outlet that discharges to Kress Creek. One sample is inadequate to characterize ambient levels. A definite program of sampling to establish the normal background pattern in all its fluctuations is essential. This should minimally span 4 months and include 3 to 4 storm events. Automated water sample takers would be extremely helpful in collecting storm runoff.

B. Section 7.3.1 states that during implementation of the Plan, the outlet to Kress Creek will be sampled at least quarterly, monthly during excavation and grading, and "promptly" after a heavy runoff. It is imperative that any further deleterious effects on Kress Creek due to implementing the Plan be detected in a timely fashion so that corrective action can be taken. This sparse sampling schedule is inadequate and should be replaced by a much tighter schedule. A weekly composite composed of daily samples is preferable.

C. Section 7.5 indicates the Plan has not been modified to include radiological monitoring for sources producing doses internal to the body. The uranium and thorium found in abundance on the waste site are alpha emitting radionuclides with the potential to create significant health effects. It is essential that no worker or member of the general public be allowed to accumulate a body burden as a result of breathing or ingesting materials from the waste site during implementation of the Plan. A definite plan for internal dose assessment should be set up before implementation.

D. Section 6.1.2.3 deals with a possible large release of radioactivity caused by a tornado. The assessment is based upon the procedure used in NUREG-0511. Two specific statements are made in this calculation by Kerr-McGee - the average specific activity for waste site materials is 6.3×10^{-9}* Ci/gm and the thorium constituent has a rem dose to the lung per curie which is about 10 times greater than the uranium concentrate used in the NUREG-0511 approach. Both of these statements need a basis or a reference.

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* 10^{-9}
10(-9)=10

E. In our original comments we objected to placing ore residue and building rubble directly on the ground surface outside the clay liner. The revised Plan proposes to neutralize the material with lime to retard migration into the soil, but still to leave it off the clay liner. Considering the toxic nature of these materials, their long half-lives and their potential to contaminate drinking water supplies, it is absolutely necessary to place these materials over a clay liner to retard their migration.

F. Additional points made to the original Plan went unanswered in the recent revision. Specifically,

(1) The revised Plan still intends to use 2 feet of clay and 3 feet of topsoil to cover the wastes. As noted in our original comments, NUREG-0511 recommends no less than 3 meters (10 feet) of cover over stabilized tailings. Upon what basis is the NUREG recommendation set aside?

(2) The revised Plan still adheres to the Surgeon General's Standards for Grand Junction, Colorado, as a basis for stabilization even though it was shown NUREG-0511 rejects these standards as improper for tailings disposal. West Chicago is unique in that 3.2 million pounds of ThO2 and 44,800 pounds of U3O8 is proposed to be buried within a community of 12,700 people. Site specific standards may be more applicable. Upon what basis are the Surgeon General's Standards retained?

Comments on Radon Dose Assessment-Appendix II

Kerr-McGee Nuclear Corporation had prepared for them by Dames & Moore a "Calculation of the Impact of Radon Releases Associated With the Decommissioning of the West Chicago, Monazite Sand Leaching Facility" (Revised Plan, Appendix II). Several specific comments follow:

A. The letter from W. J. Shelley, Director, Regulation and Control, Kerr-McGee Nuclear Corporation, to Irwin Spickler, Dames & Moore, March 4, 1980 (Revised Plan, Attachment I) directs that the following assumptions be made for the radon dose projections.

	Density	Moisture
Pile 1-Sediment	3.8 g/cc	40%
Pile 2-Tailings	2.7 g/cc	36.5%

These moisture levels have to be treated with suspicion for several reasons.

(1) In a telephone conversation with George France, Kerr-McGee Nuclear Corporation, May 14, 1980, it was learned by EPA - Region V that the moisture values were obtained by Kerr-McGee's Technical Center from waste site sample masses before and after drying. Data for the moisture determinations, including number of samples and time of year, were not included as part of the Revised Plan. It should be noted 40% moisture by mass is 72% moisture by volume using the given sediment density of 3.8 g/cc. This is tremendously high.

(2) NUREG/CR-1081, "Characterization of Uranium Tailings Cover Materials for Radon Flux Reduction," referenced by Dames & Moore in their dose projections, labels one covering material with 37.2% moisture as "mud". Visual inspections of the tailings and sediment piles have not shown them to have the appearance of mud.

(3) The study performed by Soil Testing Services, Inc., for Kerr-McGee entitled "Location and Evaluation of Impermeable Clay Sources, West Chicago, Illinois "(Revised Plan, Attachment III) showed in Table 1 only 1 of 14 clay samples taken in the West Chicago vicinity to have more than 30% moisture (34.3%). Eight samples had between 20% and 30% moisture. Two of the remaining 5 samples had less than 5% moisture. Thus, local clay samples do not appear to have nearly the high moisture levels attributed to the West Chicago tailings and sediments by Kerr-McGee.

B. As a direct consequence of assigning extremely high moisture levels to the waste materials, Dames & Moore selected extremely low values for the diffusion coefficients in their radon-222 flux rate calculations. The diffusion coefficients are related to the rate of migration of radon through the waste materials and are drastically reduced by moisture. In the Dames & Moore study a footnote to Table 2.1-1 states, "The diffusion coefficients were estimated from those quoted in the literature (10(-6) cm2/sec)* for materials with high moisture content (NUREG/CR-1081)." NUREG/CR-1081 assigns 10(-6) cm2/sec to "mud" (Table 5-10).

For soils from the uranium mining areas of the Powder River Basin and the Shirley Basin diffusion coefficients of 8.2x10(-5) cm2/sec to 2.3x10(-2) cm2/sec were measured. These are orders of magnitude less than those used by Dames & Moore.

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* Momeni, et. al., "Radiological Impact of Uranium Tailings and Alternatives for Their Management".

Further, Dames & Moore labels the tailings "sand" and assigns it a diffusion coefficient of 1.2x10(-5) cm2/sec. NUREG/CR-1081 assigns sand a diffusion coefficient of 5.4x10(-2) cm2/sec (Table 5-10). The net effect of low diffusion coefficients, a consequence of very high moisture levels, is to drastically reduce the projected radon fluxes.

C. Emanation coefficients were assigned to the tailings (.092) and the sediments (.20). The emanation coefficient measures the fraction of the radon present within the waste materials that enters the pore spaces. Emanation coefficients vary only slightly with ore moisture between 10%-80% saturation.* However, these coefficients vary considerably with source material. NUREG/CR-1081 shows emanation coefficients varying from .06 to .75 in 6 different uranium mining areas of the western United States. Momeni et. al.* state emanation coefficients range from 0.01-0.9 with an average of 0.25 for domestic uranium ores. The point to be made here is that the Dames & Moore study selects emanation coefficients on the low side of the range, thereby reducing the radon impact. NUREG-0511, NUREG/CR-1081 and Momeni, et. al. indicate that this variable is extremely site specific. For a proper dose projection it must be determined for the West Chicago site specifically.

D. Based upon cross-sections obtained from the "Existing Topographic Plan" supplied by Kerr-McGee with the Original Plan, surface areas and volumes of the tailings and sediment piles were estimated by EPA-Region V and compared to those found by Kerr-McGee. The area is crucial because it represents the surface available for radon emanation. The volume is critical because it sets the quantity of ThO2 and U3O8 available as radon source material. The shapes chosen were reasonable alternative shapes selected to substantiate Kerr-McGee's estimates.

The comparisons follow.

Tailings Pile

Area** (Square Feet)		Volume** (Cubic Feet)	
EPA-Region V Estimate	Kerr-McGee Estimate	EPA-Region V Estimate	Kerr-McGee Estimate
39,692	8,671	575,841	636,000

**Both EPA-Region V and Kerr-McGee assumed the pile shape was a frustrum of a right cone.

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* Momeni, et. al., "Radiological Impact of Uranium Tailings and Alternatives for Their Management".

Sediment Pile

Area (Square Feet)			Volume (Cubic Feet)		
EPA-Region V Estimate #1 *	EPA-Region V Estimate #2 **	Kerr-McGee Estimate ***	EPA-Region V Estimate #1 *	EPA-Region V Estimate #2 **	Kerr-McGee Estimate ***
21,635	19,246	9400	180,526	169,510	86,000

* Pile shape assumed one-half of a right cylinder, based upon perpendicular cross-sections from "Existing Topographic Plan" maps.

** Pile shape assumed one-half of each of two right cones, based upon perpendicular cross-sections from "Existing Topographic Plan" maps.

*** Pile shape assumed a spherical segment.

The estimates for the tailings pile are somewhat comparable but the sediment pile estimates are quite divergent. This divergence should be resolved for a good dose projection.

E. Dames & Moore assume weather reduction factors of 2/3 for radon-222 and 215/365 for radon-220 to account for the emanation retarding effects of snowfall and precipitation (Revised Plan, Appendix II, Section 2-1). No allowance is made for increased emanation during periods of high temperature and low barometric pressure. Use of a weather reduction factor without considering a weather enhancement factor is forcing a best case argument. Unless dominance of one weather factor over all others can be firmly established, no reliance upon any weather correction factors should be made.

F. For the calculation of particulate impact during the relocation phase for the tailings and sediment piles, the Dames & Moore study assumes that "50% of the dust emission rate is attributable to the tailings, the other 50% is attributable to the sludge." The division seems arbitrary. Using Kerr-McGee estimates from the table above in section D, it can be shown there is 636,000 cubic feet/28,671 cubic feet = 7.4 times more material in the tailings pile. Table 2.1-1 from the Dames & Moore study shows that the tailings have a specific activity for radium 226 of 1172 pCi/gm/277 pCi/gm = 4.23 times greater than for the sludge pile. Radium-226 is the parent radionuclide for the radon-222 daughter.

Based upon the pile volumes a better allocation of dust emissions would be (using Kerr-McGee estimates for the example)

$$\frac{636{,}000 \text{ cubic feet}}{636{,}000 \text{ cubic feet} + 86{,}000 \text{ cubic feet}} = 88\% \text{ Tailings Particulates (1172 pCi/gm)}$$

$$\frac{86{,}000 \text{ cubic feet}}{636{,}000 \text{ cubic feet} + 86{,}000 \text{ cubic feet}} = 12\% \text{ Sediment Particulates (277 pCi/gm)}$$

A proper dose assessment for particulates requires a proper distribution of source materials.

G. In spite of the directions given to Mr. Irwin Spickler of Dames & Moore by Mr. W. J. Shelley of Kerr-McGee Nuclear Corporation in the letter of March 4, 1980, (Revised Plan ,Attachment 1) to "Consider the source as an area source rather than a point source" the waste piles are still treated as point sources for the computer dose projections. AIREM III used by Dames & Moore has no provisions for extended area sources. AREAC, a variation of AIREM III for extended sources, considers the physical size of the source to be significant whenever a receptor is within 2.51 times the crosswind diameter of the source. A receptor at the waste site fence line can fall within this criteria.

	Largest crosswind diameter measured parallel to fence	Diameter x 2.51	Distance from pile centroid to nearest fence line
Tailings	250 ft.	630 ft.	130 ft.
Sediment	190 ft.	480 ft.	320 ft.

Since both waste piles satisfy the area source criteria it is imperative a non-point source dose projection be made.

H. For the stabilized waste materials, Dames and Moore solved a second order partial differential equation to obtain the surface radon-222 flux from the buried tailings under clay and topsoil covers. Four boundary conditions were used.

(1) Equal radon fluxes at the tailings-clay and clay-topsoil interfaces.

(2) Equal radon concentrations at the tailings-clay and clay-topsoil interfaces.

(3) Zero radon concentration at the topsoil-ambient air interface.

(4) Infinitely thick tailings.

Condition 3 is highly questionable. The purpose of the entire calculation was to calculate a surface radon flux. By condition 3 there is a surface flux but no surface concentration of radon. With this dubious assumption the stabilized waste radon flux value is not valid.

I. The main Plan text designates ThO2 and U3O8 weights present in the ore residue pile (tailings) and the sediment pile west of Building 18 (sediments) (Revised Plan, Table 3.2.2(b)). Source materials in Ponds 1,2, and 3 are also tabulated. Compared to the quantity of source material in the ore residue, the following quantities of ThO2 and U3O8 are present in each site.

	ThO2 Ratio *	U3O8 Ratio **
Ore residue pile	1	1
Sediment pile	2.23	2.13
Pond 1	2.02***	2.34***
Pond 2	.44	.51
Pond 3	1.1	1.36

* 1 unit = 464,300 pounds ThO2(Kerr-McGee estimate)
** 1 unit = 6100 pounds U3O8 (Keer-McGee estimate)
*** Pond 1 covered with 80,000 cubic feet of fill.

Radon calculations are made for only the tailings and sediment piles although the ponds contain considerable source material. This should be rectified by calculating the corresponding radon fluxes and making the dose projections for the ponds.

J. Dames & Moore states that 50% of the tailings pile will be moved for regrading (Revised Plan, Appendix II, Section 2.1.2) thereby releasing half the trapped radioactive gases. In the main text it is stated all of the ore residue and sediment will be neutralized with lime before burial (Revised Plan, page 4.19a). This second statement seems to require moving all of the tailings pile. All of the gases would then be released. Consequently, for a proper dose projection, it should be assumed all of the radon in both the tailings and sediment piles will be released upon regrading.

K. The Dames & Moore study assumes that the release heights for radon from both the tailings and sediment piles in their present state is 8 meters. (Appendix II, Section 3.1). This height is approximately the maximum height of the tailings pile, 22 feet, read from the "Existing Topographic Plan" map furnished with the original Plan, but is overstated for the sediment pile, maximum height 18 feet. Since radon is a heavy gas (Density = 9.73 gm/l, Handbook of Chemistry and Physics, 56th Edition) overestimated emission heights would tend to decrease the ground level concentrations in the nearest populated areas.

Clarifications Needed In Appendix II

(1) Section 2.1.2 - A one time radon-222 release of 0.3 Ci is computed for regrading the tailings pile. By the methods of NUREG-0511 (pages G-4, G-11) the term computes to 26.7 Ci.

(2) Section 2.1.3 - The radium-226 content of clay is listed as 0.49 (units missing). Table 3, Attachment II, gives the same variable as 0.87 pCi/gm.

(3) Section 2.1. - The values given for the radium-226 levels in topsoil and clay have no units.

(4) Table 2.1-1- Footnote ** computes the bulk density for tailings and sediments based upon moisture levels provided in Mr. Shelley's March 4, 1980, letter (Revised Plan, Attachment 1). This calculation mistakenly assumes the moisture levels are volume ratios not mass ratios. The bulk densities are in error.

(5) Table 2.2-1 - Two sets of activity emissions are listed for Th-232. What do these represent?

(6) Section 3.1 - For the purposes of the computer dose projection, Dames & Moore was directed by W. J. Shelley to use O'Hare Airport data. This is not confirmed in the text. The wind rose shown on page 2.4 of the main text (Revised Plan) is labeled 1/60-12/64. This would be very old data if it was used for the computer dose projection. To clarify, the site and time span for the wind frequency/wind speed data used in AIREM III needs to be stated.

(7) Section 3.1 - AIREM III source terms are modified by a factor of 0.164. It is not clear how the reduction factor was obtained.

(8) Table 3.1-1 - A lung dose conversion factor for radon-222 is listed as 0.318 E+5 (mrem-m3/Ci-sec). Based upon a period of 1 year (3.154 x 10(+7) seconds) this is 1003 mrem/(pCi/1). NUREG-0511 uses a dose conversion factor of 625 mrem/(pCi/1). Why is there such a divergence?

(9) Appendix A - Numerous omissions appear in the equations of this section. A fully corrected copy would be appreciated.

(10) Several definitions of diffusion coefficient exist in the literature, including effective diffusion coefficient (De), diffusion coefficient (D) and diffusion coefficient (De/p) (p=porosity). A clarification on the specific diffusion coefficient used in this dose projection is needed.

Justifications Needed In Appendix II

(1) Section 2.1.2 - For the purpose of calculating the radon release during the one-time regrading of the tailings pile, it is stated, "The pore space of the material is approximately 50%." No substantiation is given.

(2) Section 2.2 - For particulate emissions during relocation of the tailings and sludge materials it is stated, "The dust emission rate...is for particles 20um all (of) which are capable of migrating offsite." What determined the 20um cutoff? Why are particles 20um excluded?

(3) Appendix A - For the purpose of calculating the radon flux from the stablized wastes the tailings and clay and topsoil covers are assumed to be infinitely thick. "J1, J2, J3 = The calculated surface fluxes for the materials if they were 'infinite' in thickness." This needs a basis, especially for the clay and topsoil covers.

References Needed In Appendix II

Section 2.1.3 - Loamy topsoil bulk density
Effective diffusion coefficients - topsoil, clay
Emanation coefficients - topsoil, clay

Conclusions Concerning Appendix II

It should be firmly established at this point that the revised radon dose projections prepared for Kerr-McGee Chemical Corp. are flawed and are biased to minimize the radon impact. Specifically:

(1) Moisture levels specified to the contractor were so high as to characterize the wastes as comparable to mud thereby forcing down certain key coefficients in the dose equations. The result was a drastically reduced dose projection.

(2) Without any site-specific basis, emanation coefficients were arbitrarily assigned on the low end on a wide range of values given in the literature. Again, the result was to force down radon emanations.

(3) Estimates of the volume and area of the waste piles appear to be low -- for the sediment pile, very low -- thereby reducing the quantity of source material present and the surface available for emanation, respectively.

(4) Arbitrary assignment of particulate emission fractions during the relocation phase severely downplays the impact of the high specific activity tailings pile.

(5) In spite of specific directions given to the contractor by Kerr-McGee Nuclear Corporation, the contractor, Dames & Moore did not consider the physical extent of the waste piles in their dose projections.

(6) A boundary condition of zero surface radon concentration, in spite of a surface radon flux, was assumed in solving for the radon flux for the stabilized site. This dubious assumption calls the entire calculation into question.

(7) Radon calculations were made for only the tailings and sediment piles, even though Ponds 1, 2, and 3 contain comparable amounts of source material.

(8) Radon releases during regrading of the tailings pile were reduced to half by assuming only half the pile would be moved. This is incorrect because all of the pile must be moved to neutralize it with lime. The radon source term for this calculation must be doubled.

(9) Overestimates of emission heights for the tailings and sludge piles decreased the ground-level concentrations of radon for close receptors.

In addition, numerous questions remain as to the methods for certain calculations, the format of equations, the sources for several pieces of data and the bases upon which key assumptions are made.

It cannot be stated that, even in its revised form, a creditable radon dose projection has been performed for the West Chicago Facility.

To this end we request that the Nuclear Regulatory Commission direct that the Kerr-McGee Chemical Corp. further revise their "Calculation of the Impact of Radon Releases Associated With the Decommissioning of the West Chicago Monazite Sand Leaching Facility," based to the fullest extent possible on data specific to the West Chicago site. Radon flux and dose projections should include Ponds 1, 2, and 3 in addition to the tailings and sediment piles. Consideration should be taken of the extensive critique offered herein by the U. S. Environmental Protection Agency Region V. We would expect site-specific data to include specifically but not solely the effective diffusion coefficients, the emanation coefficients, the moisture contents, bulk densities, and porosities for the tailings, sediment, clay and topsoil involved.

If inhomogeneities are expected or encountered when these measurements are made, then a sufficient number of multiple determinations should be made so as to adequately characterize the variables.