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TELEPHONE
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October 19, 1979

William A. Nixon
Division of Fuel Cycle
& Material Safety
Office of Nuclear Material
Safety & Safeguards
United States Nuclear
Regulatory Commission
Washington, D.C. 20505

Re: Kerr-McGee Chemical Corporation
West Chicago Facility

Dear Mr. Nixon:

The People of the State of Illinois, by William J. Scott, Attorney General of the State of Illinois submit the following comments on the proposed "Stabilization Plan" of the Kerr-McGee Chemical Corporation related to its activities in West Chicago, Illinois.

1. The Plan has not considered all reasonable alternatives to on-site disposal of the waste material. The Plan considers:

1. The three currently operating low-level waste sites;

2. Abandoned open pit mines, in particular two sites within 150 mile radius to our Chicago site; and

3. Argonne National Laboratories and the Fermilab.

The consideration of alternatives is inadequate for the following reasons:

A. Kerr-McGee does not consider all reasonable suitable sites within a 150 mile radius. Rather it has merely considered two such sites. Kerr-McGee seems to dismiss other open pit mines because of their recreation potential and tendency to fill up with water. Kerr-McGee incorrectly assumes that these conditions are true of all strip mines or even the majority of them. Further, even sites with water may be suitable if dewatering of the site is considered in the site preparation plan. Kerr-McGee must analyze all geologically suitable strip mine sites within a reasonable distance from its West Chicago facility.

B. Kerr-McGee has arbitrarily limited consideration of alternative sites (except for licensed low-level sites) to those within 150 miles. There are other suitable sites beyond 150 miles within a reasonable distance of the West Chicago facility which should be considered.

C. Kerr-McGee dismisses Argonne National Laboratories as a potential site on the basis of a letter received from the Department of Energy stating that Argonne would be unavailable. DOE is not intractable and if Argonne National Laboratories should prove to be the most superior site DOE may be willing to reconsider its position. Argonne National Laboratories should be analyzed for geological suitability.

D. Kerr-McGee has failed to consider the use of property already owned by the Company off of the West Chicago site.

E. Kerr-McGee's cost benefit summary is inadequate. It has compared only the comparative economic cost of the various sites and has not considered environmental, safety and irretrevable committment of resources.

2. If the material to be buried is of a hazardous nature (either radiologically or chemically) then on-site burial is unsuitable. The hydrology and the geology of the land are inappropriate for the burial of hazardous chemical or radioactive material. The geology of the site is not suitable for long term containment of leachable solid waste due to the relatively high permeability of the soil. The potential for migration and pollution of the groundwater is significant. Evidence of this is the former use of this site for the percolation ponds and the degradation of the groundwater quality in the area.

The water table is relatively high in certain areas of the site and contamination of this aquifer in the past has been significant. Further, the potential for future contamination exist. We are unable to assess the potential for future contamination resulting from the construction activities associated with the excavations, dredging and operations.

To compensate for this Kerr-McGee proposes to construct an artificial clay liner of 10 feet of clay under the material from the factory and a 2 foot artificial clay cap over the entire burial site. There is scant evidence about the suitability of artificial clay liners.

The use of a compacted clay liner as an engineering modification to the site is not acceptable because it is not a proven technology and cannot be relied upon for long term containment. There is no evidence to show that clay type soil may be recompacted to achieve a permeability coefficient of 10^{-8} cm/sec. Further, such a device is inconsistent with Illinois Environmental Protection Agency's internal standard which requires a ten foot liner of in situ clay like soil. This problem is particularly acute in view of the location of the Kerr-McGee site within a popular residential area.

However, on the basis of the Stabilization Plan and the meeting held between members of the Attorney General's staff and Kerr-McGee's technical step on October 12, 1979 it appears that Kerr-McGee does not base its plan upon the suitability of the clay liner. Rather, Kerr-McGee believes that the material to be buried is not of a hazardous nature based on leach tests they conducted.

There is insufficient data at the present in the Stabilization Report to be able to determine whether or not the material to be buried is or is not of a hazardous nature. The Stabilization Plan does not provide a comprehensive list of the materials proposed to be buried. Further, leachability tests have not been conducted on certain known elements such as fluorides and nitrates.

On the basis of our October 12 meeting Kerr-McGee has agreed to take certain steps to try to provide all the parties a list of what elements are contained in the material to be buried. Kerr-McGee technical staff would research their files and attempt to identify the raw materials used in their process operations and will attempt to do a material balance to identify those substances expected to be found in the waste streams of all the operations conducted at this plant. Tests may then have to be conducted on some of this material. Further. Kerr-McGee has committed itself to performing leachability tests on fluorides and nitrates and providing the parties with copies of the resulsts. An informed assessment may then be made regarding the suitability of on-site disposal.

3. The Stabilization Report is inadequate due to its failure to consider those sites within the West Chicago area where thorium has been deposited and which if it were disturbed would result in radioactive levels in excess of those 10 CFR, Part 20.

Argonne National Laboratories has identified some 75 thorium residual areas within West Chicago where thorium from Kerr-McGee's predecessor-in-interest has been deposited. Many of these sites, if disturbed, would contain radioactive levels in excess of those levels permitted by 10 CFR 20, Part 20. These sites pose both a present and a future health hazard to the citizens of West Chicago and Illinois.

Kerr-McGee's Stabilization Plan proposes only that it will exhume and safely dispose of one site which, without being disturbed, has levels of radiation in excess of 10 CFR Part 20. Kerr-McGee also indicates that it will provide space in its on-site burial ground, without accepting legal responsibility for the thorium residuals located at Reed Keppler Park, providing someone else will exhume the material transported to Kerr-McGee's burial site.

There can be no question that the material found at the 75 West Chicago residual sites in question are generated by Kerr-McGee predecessor-in-interest. Materials identical to the material at the Kerr-McGee site and there is no other generated in the area of the thorium tailings. This is a conclusion which is arrived at by researchers for Argonne National Laboratories in "Thorium Residuals in West Chicago, Illinois" (NUREG CR-0413).

Therefore, Kerr-McGee must propose as part of its Stabilization Plan a safe and adequate method of identifying, exhuming, transporting, storing and disposing of the thorium tailings at those sites in West Chicago which cannot meet the release criteria of the NRC regulations if disturbed.

In discussing this issue with Kerr-McGee officials at our meeting of October 12, 1979 they raised the question of whether the problem of thorium residuals can be considered in a separate plan. The Attorney General's Office has no objection to not including the Thorium Residual Plan in the Stabilization Plan so long as: (1) a Thorium Residual Plan is developed as expeditiously as possible and (2) the Stabilization Plan does not preclude any reasonable options for the disposing of thorium residual piles and approval for the plans be given concurrently.

4. The Stabilization Plan should demonstrate that it complies with regulations promulgated pursuant to the Resource Conservation Recovery Act and the Uranium Mill Tailings Act of 1979. In particular note proposed regulations on the Landfill Disposal of Solid Waste, 44 F.R. 18138 (3/26/79); Solid Waste Disposal Facilities Classification Guidelines, 43 F.R. 4942 (February 6, 1978); Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (U.S.E.P.A. Draft Guidelines) (September 12, 1978 and September 25, 1978) and Uranium Mill Tailings Licensing Criteria

Relating to Construction of Major Plants, 44 F.R. 50012, 50015 (September 7, 1979). Further, the U.S.E.P.A. definition of what is a hazardous waste as articulated in forthcoming regulations pursuant to Section 3001 of the Resource Conservation and Recovery Act will be critical to a final decision. The most recent estimate of the promulgation date of most of the Section 3001 regulations is April of 1980. See, "Administrator's Third Quarterly Report on the Status of Development of Regulations Under the Resource Conservation and Record Act of 1976" dated October 15, 1979 as submitted pursuant to court order in State of Illinois v. Costle, U.S. District Court for the District of Columbia (Civ. Act. 78-1689).

Very truly yours,

DEAN HANSELL
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Environmental Control Division
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Chicago, Illinois 60601
(312) 793-2491

DH:ss
cc: Burt Davis, NRC

7/19/79

Comments on Radiological Aspects of Kerr-McGee Stabilization Plan

Larry Jensen,
U.S. Environmental Protection Agency

1) THERE IS INSUFFICIENT TOPSOIL TO REDUCE RADON EMISSIONS TO RECOMMENDED LEVELS.

a) The Draft Generic Environmental Impact Statement on Uranium Milling (GEIS) recommends a radon-222 emission limit of 2 pCi/sec/m2 (Volume I, page 18). Dames and Moore has calculated the emission of radon-222 as 15.9 Ci/yr (page 5). This converts to 60.3 pCi/sec/m2 or 30 times the recommended level (see attachment, I). As a check, it was calculated that using Dames and Moore data and the procedure of the GEIS, Appendix P, the radon-222 emission level is 66 pCi/sec/m2 (see attachment, II). It appears that the recommended limits cannot be met as proposed.

b) The GEIS specifies that no less than 3m (10 ft.) of cover be placed over tailings (Volume I, page 22). Based upon the procedure of the GEIS, Appendix P, a top-soil cover of 18 feet must be laid over the clay cap to reduce the radon-222 levels to 2pCi/sec/m2 (see attachment, III).

2) THE RADIOLOGICAL STANDARDS FOR THE STABILIZED WASTE AVOID THE PRIMARY HAZARD ALPHA EMISSION.

The Kerr Mc Gee plan sets an external gamma radiation level of .05mR/hr over the stabilized waste site, based upon the Surgeon General's standards for Grand Junction, Colorado (page 7.8)

a) The GEIS rejects these standards as improper for tailings disposal "(The) Surgeon General limits were developed for a remedial action situation where options (were) limited as distinguished from the (tailings) situation...where the same constraints do not present themselves." (Volume I, page 18)

b. mR is an exposure unit reserved for x-rays and gamma rays. The primary problem here is alpha emission from radon gas. Monitoring should be directed at the primary hazard and this should be reflected in the units.

3) THE SAMPLING WELLS MAY BECOME RADON VENTS.

a) The two sampling wells at the west end of area 1 may become radon vents unless properly controlled. If radon buildup is to be assessed then perhaps more widely spearated wells would be desirable.

b) It is not clear whether sealed wells will penetrate the clay cap. If they do then a possible radon vent may be created.

4) CONTAMINATED TOPSOIL MAY BE USED AS COVER.

It appears that some contaminated excavation material and topsoil may be used over the clay cap as cover (Page 4.18, Area 1, (b) and Page 4.22, Disposal Site, (b)). In no case should clay or topsoil materials be used, either from onsite or offsite, when they will contribute to the radioactive emissions of the waste site.

5) RADIOACTIVE MATERIALS MAY BE LEACHED INTO WATER TABLE.

Figure 4.4 shows ore residue and building rubble placed directly on the surface. Tables 3.2.3c and 3.2.3d do not show that waste samples were tested for leachability of uranium, thorium, or radium. Unless some assurance can be produced that radioactive species will not be transported into the water table, all of this material should be placed within the clay liner also.

6) PROVISIONS FOR TEMPORARY STORAGE OF RADIOACTIVE MATERIALS NOT EXPLICIT.

Contaminated materials will be stored for shipment offsite or for onsite burial. It is not clear where they will be stored, how they will be protected, how they will be surveyed, and with what frequency they will be surveyed.

7) PROVISIONS FOR FUTURE SITE MAINTENANCE NOT EXPLICIT.

Maintenance of the site after disposal has been completed is not clearly set forth. Several questions remain including:

(1) Who will survey the site (at what intervals)?
(2) Who will check for erosion (and repair it)?
(3) Who will check for damage to the clay cap, including cracks and penetrations by animals and insects (and repair it)?
(4) Who will be responsible for site security?
(5) Further, who will be financially responsible for these tasks?

8) SUPERVISION OF THE RADIATION MONITORING PROGRAM

On page 4.36 it is stated a "qualified, registered professional soil engineer" will be employed to monitor clay compaction. It is not stated a "qualified, board certified professional health physicist" will be employed to supervise the radiation monitoring program. What provisions will be made in this regard?

9) DEFICIENCIES IN THE MONITORING PROGRAMS ARE PREVALENT

Section 5.7 states that 12 tons of dust contaminated with uranium, thorium and their daughter products will be generated during decommissioning and stabilization. A detailed plan to keep exposures as low as reasonably achievable for the occupational workforce and for the general public is not provided. Deficiencies in the plan as provided are evidenced by examples from section 7.5.2

(a) The Eberline RASP-1 is incorrectly identified as an air sampler. It is an alpha probe.
(b) The lapse time for gross alpha counting is not stated.
(c) The "appropriate locations" for the continuous air sampling are not specified.
(d) "Continuous" air sampling for the general public should be continuous, not just during working hours.
(e) Criteria for collecting "breathing zone" samples are not specified. "As needed" is vague.
(f) "Periodically" is too vague for the issuance of personnel air samplers.
(g) Assessment of internal exposure, through bioassay, is not mentioned.
(h) Quarterly samples of groundwater during implementation may be too infrequent.
(i) When groundwater samples exceed 10 CFR 20 limits, the place for reporting is not specified.
(j) No reference is made to the National Interim Primary Drinking Water Regulations with regard to groundwater samples, especially as they apply to radioactive constituents.
(k) No provision is made to sample surface water runoff into Kress Creek in spite of the fact it is stated in section 6.1.1.2 that "Radioactivity dispersal of mostly insoluable material would not likely be airborne but rather water-borne to sewers and runoff watercourses."
(l) It is vague to say that "Kerr McGee does not expect the implementation of the plan to increase the dose to the neighbors..." Specifics are in order.
(m) The above quote finishes "... from gamma radiation." This could be read that Kerr Mcgee expects increases in beta and/or alpha dose to its neighbors. The import of the restriction should be addressed.
(n) No attempt is made to measure for contaminated sediment.

10) MONITORING TO ASSESS INTERNAL EXPOSURE IS EXCLUDED

a) Section 7.5 limits monitoring to assessment of external dose rates. Since the primary radioactive hazards are alpha emitters, a strong program of internal dose assessment is in order. This should include bioassay.

b) Page 4.9-The Eberline E-120 with HP-190 probe is primarily a beta-gamma instrument. An alpha probe would be much more appropriate in light of the predominant contamination.

c) Section 7.5.3 states that in the post Phase III monitoring gamma scans will be made of the site. Since radon emissions are a larger problem alpha scans would be essential. A reporting process for anomalies should be stated.

11) DETAILS ON PLANS TO MEET APPLICABLE REGULATIONS AND REGULATORY GUIDES ARE WEAK

a) Details on meeting the requirements of 10 CFR 20 are missing. Specifically needed are:

(1) types and frequencies of surveys, including alpha
(2) provisions for personal monitoring, including bioassay
(3) provisions for protective clothing and masks
(4) provisions for physicals and mask fit tests
(5) provisions for records of surveys and radiation monitoring
(6) provisions for reporting to required agencies and to the individual
(7) provisions for specific actions when monitoring shows high levels of contamination or exposure becomes excessive

b) No references are made to applicable NRC Regulatory Guides.

c) No reference is made to the EPA National Interim Primary Drinking Water Regulations.

12) CONTROL OF LIQUID RADIATION WASTE

a) On pages 4.17 and 6.7 it is specified that a nozzle-fog system will be used to keep down airborne contamination. This will generate a liquid rad waste. What provisions will be made to control this secondary waste?

b) On page 6.7 it is specified that decontamination fluid will be reused. This will concentrate the rad waste. What provisions will be made to monitor the contamination and control the resulting exposure?

13) TOOL AND MACHINE DECONTAMINATION

On page 4.19 it is stated that a dragline will be used to excavate ponds 2 and 3. How will this dragline, and indeed all machines and tools, be decontaminated after use. Where will the waste go?

14) CONSEQUENCES OF A LARGE RELEASE

a) On page 6.4 the dose calculation was not weighted for the quantities of THO2 and U3O8 present. Rather than 10% of the dose for the GEIS accident, the dose should be the same (see attachment, IV).

b) If a large release occurred what provisions would be made for monitoring, dose assessment, and cleanup in the surrounding residential and commercial areas?

15) DAMES AND MOORE STUDY

a) Reference 1 is used extensively and yet, it is not available for review because it is a personal communication. This document should be made available.
b) It is not clear how the values in sections 2.1.2 and 2.2 are calculated. A more detailed description is necessary.
c) Why is the adult chosen as the critical person instead of a child? With the surrounding residential area this would seem more appropriate.
d) Page 2 - J has no units
- Ra should have units of pCi/m3
Page 19 - Does t=material thickness?
- In f(Ji) there is an unmatched parentheses
What is the correct form of the equation?

16) ADDITIONAL POINTS
a) Page 2.8 - Heading reads just Radiation. What type of radiation?
b) Page 5.3 - Dose rates have no units.
c) Unequivocal statements of no adverse impacts in such sections as 6.1.1.1, 8.4.1, 8.6.1, and 8.6.2 are unfounded and speculative.

ATTACHMENT

I AVERAGE ANNUAL RADON -222 FLUX, DAMES AND MOORE

Dames and Moore calculates the following flux, 15.9Ci/yr, from a tailings /sledge pile of area 600 feet x 150 feet. (page 5)

Convert this to pCi/sec/M2

$$15.9\ \frac{Ci}{yr} = 15.9\ \frac{Ci}{yr} \times 1E{+}12\ \frac{pCi}{Ci} \times \frac{1}{3.154E{+}7}\ \frac{yr}{sec} \times \frac{1}{600X150\ ft2} \times \frac{1}{.0929}\ \frac{ft2}{m2}$$

$$= 60.3 pCi/sec/m2$$

II AVERAGE ANNUAL RADON-222 FLUX, GEIS, APPENDIX P

Refer to attached Appendix P

Calculate Jo, using Dames and Moore data

(Ra) = CRa = 550 pCi/gm
ρ =1.75 gm/cm3
E = .2, residual material
λ = 2.1E-6 sec -1, Radon 222
Dt= 2.75E-2 cm2/sec, residual material
Pt = 1, apparently

Jo = 463 pCi/sec/m2

Calculate J, using Dames and Moore data

Jo= 463 pCi/sec/m2
λ = 2.1E-6 sec-1

Xclay = 2 ft. = 60.98 cm	x topsoil = 3 ft.=91.44 cm
Pclay = 1, apparently	P topsoil = 1, apparently
Dclay = 5E-3 cm2/sec	D topsoil = 3.6E-2 cm2/sec

J = 66 pCi/sec/m2

III TOPSOIL DEPTH TO REACH EMISSION OF 2 pCi/sec/m2

Solve for the topsoil thickness

$$J = Jo \exp\left(-\sum_{i=1}^{n} xi \cdot (\lambda Pi/Di)^{1/2}\right)$$

$$= Jo \exp\left(-Xclay \cdot (\lambda P\ clay/Dclay)^{1/2} - x\ topsoil \cdot (\lambda Ptopsoil/Dtopsoil)^{1/2}\right.$$

$$X\ topsoil = \frac{\ln Jo/J - Xclay \sqrt{Pclay/Dclay}}{\sqrt{Ptopsoil/Dtopsoil}}$$

1594 035

To achieve an emission level of J=2 pCi/sec/m2, use Dames and Moore data

Jo=463 pCi/sec/m2
λ=2.1E-6 sec-1, Radon - 222
Xclay=2ft.=60.96 cm
Pclay=1,apparently
Dclay=5E-3 cm 2/sec
Ptopsoil = 1, apparently
Dtopsoil=3.6E-2 cm 2/sec

IV DOSE FROM LARGE RELEASE AT WEST CHICAGO FACILITY.

The large release accident in the GEIS assumed that 15% of the available material was distributed (25,100 lbs.) giving a maximum dose committment of 8.3E-7 rem

Here we have

ThO2	1.425 E+6 lbs	) Table 3.2.2
U308	5.67E+4 lbs.	)

15% dispersal is

ThO2	2.1 E+5 lb
U308	8.5 E+3 lb

Thus using Kerr McGee approach (page 6.5)

	Fraction Of 25,100 lbs. U308	Fraction Of Specific Activity of U308	Fraction Of Lung Dose Of U308	Fraction Of Fraction Of U308
THO2	8	.01	10	.8
U308	.3	1	1	.3
				Total 1.1

Dose is approximately equal to GEIS accident case of about 8.3E-7 rem

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APPENDIX P. CALCULATION OF THICKNESSES OF REQUIRED COVER MATERIALS

Calculations of the thickness of cover materials required to attenuate the radon flux to near background levels will be based on the following equation (Ref. 1):

$$J = J_0 \exp - \sum_{i=1}^{n} x_i(\lambda P_i/D_i)^{\frac{1}{2}} \qquad (1)$$

where

J = radon flux from the surface after attenuation with various cover materials (pCi/m^2-sec)

J_0 = radon flux at the surface of the bare tailings pile (pCi of Rn-222/m^2-s)

λ = decay constant for Rn-222 (2.1×10^{-6}/s)

P_i = porosity or void fraction for cover material "i" (dimensionless)

D_i = effective bulk diffusion coefficient for radon in cover material "i" (cm^2/s)

x_i = thickness of cover material "i" (cm)

n = number of cover materials

The effective bulk diffusion coefficient (D) and the porosity (P) will be determined on a case-by-case basis. Although there will be some segregation of slimes from the sands in the tailings, the average concentration of Ra-226 expected to be present in the tailings will be used in calculation of thicknesses of cover materials required to meet the proposed limit. This assumption of homogeneity of tailings is considered more realistic and more implementable than alternative assumptions of segregation of sands and slimes. It is expected that in most cases, the tailings pile will be thick enough (i.e., greater than 3-4 meters in depth) to assume that the tailings are effectively of infinite thickness. Based on these assumptions, then, the radon flux at the surface of the bare source (J_0) is calculated by the following equation (Ref. 1):

$$J_0 = [Ra]\ \rho\ E\ (\lambda D_t/P_t)^{\frac{1}{2}} \qquad (2)$$

where

[Ra] = concentration of radium-226 in the tailings solids (pCi/gm)

ρ = density of the tailings solids (g/cm^3)

E = emanating power of tailings (dimensionless)

D_t = effective bulk diffusion coefficient for radon from the tailings solids (cm^2/s)

P_t = porosity or void fraction for tailings solids (dimensionless)

The values for computing J_0 will vary from mill to mill, depending upon the characteristics of the tailings produced.

An example is provided to illustrate the calculation of the thickness of overburden required in order to meet the proposed flux limit of 2 pCi/m^2-s:

Example

The following values will be assumed:

[Ra] = 450 pCi/g

ρ = 1.6 g/cm^3 for tailings

$E = 0.2$

$(D/P)_{tailings} = 1 \times 10^{-2}$ cm²/s

$(D/P)_{clay} = 1.0 \times 10^{-3}$ cm²/s

$(D/P)_{overburden} = 2.5 \times 10^{-2}$ cm²/s

$(D/P)_{topsoil} = 5.0 \times 10^{-2}$ cm²/s

Thickness of topsoil = 30 cm

The radon flux from the surface of the uncovered tailings is calculated by equation (2) as follows:

$$J_0 = (4.2 \text{ pCi/g})\ (1.6 \text{ g/cm}^3)\ (0.2)\ \sqrt{(2.1 \times 10^{-6}\ s^{-1})(1 \times 10^{-2}\ cm^2/s)\ (10^4\ \tfrac{cm^2}{m^2})}$$

$$= 209 \text{ pCi/m}^2\text{-s}$$

Equation (1) can be rearranged as follows to calculate the thickness of overburden needed to reduce the radon flux to the proposed limit of 2 pCi/m²s:

$$x_{overburden} = \frac{\frac{1}{\sqrt{\lambda}} \ln \frac{J_0}{J} - x\sqrt{P/D}_{clay} - x\sqrt{P/D}_{topsoil}}{\sqrt{P/D}_{overburden}}$$

$$= \frac{\frac{1}{\sqrt{2.1 \times 10^{-6}}} \ln \frac{209}{2} - 61\sqrt{1/10^{-3}}_{clay} - 30\sqrt{1/5 \times 10^{-2}}_{topsoil}}{\sqrt{1/2.5 \times 10^{-2}}_{overburden}}$$

$$= 181 \text{ cm}$$

Thus, given the soil parameters assumed in the example, 61 cm of clay, 181 cm of overburden, and 30 cm of topsoil should be sufficient to reduce the radon flux to the proposed limit. (Proposed minimum thickness requirements would require a slight addition of cover to provide a total thickness of 3 m cover). Note that, because limits apply to exhalation of radon from the tailings disposal area above background, the contribution to radon flux made by radium in cover materials is ignored in these calculations.

The methods described here for determining tailings cover thicknesses were selected to provide a simple, standardized approach to licensing. Site specific parameters, such as diffusion coefficients, must still be determined to apply these methods. The staff considers that the level of detail and sophistication involved with these methods is appropriate, given the variability and uncertainties existing for these parameters. However, in some cases, slight modification of these methods may be appropriate. For example, if the method of depositing tailings in the impoundment was done in such a way that sand fractions of tailings were deposited in thick layers above slime fractions, estimating flux from the bare tailings source (Jo) would warrant assumptions other than homogeneous mixing of the tailings.

Reference

1. "Characterization of Uranium Tailings Cover Material for Radon Flux Reduction," prepared by Ford, Bacon, Davis, Utah, Inc., for U.S. Nuclear Regulatory Commission, Draft Report FBDU-218, November 1978.

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

November 1, 1979

Mr. Luis Saguinsin
Building 11
Argonne, Illinois 60439

Dear Mr. Saguinsin:

Enclosed is an addendum to the original list of comments made by the Region V U.S. Environmental Protection Agency's Radiation Program on the radiological aspects of Kerr-McGee's Stabilization Plan for their West Chicago Facility. Please submit it with our original comments.

Sincerely yours,

Larry Jensen

Larry Jensen
Radiation Specialist

1594 039

Enclosure

Addendum to "Comments on Radiological Aspects of Kerr-McGee Stabilization Plan"

U.S. Environmental Protection Agency
Larry Jensen, Radiation Specialist

With regard to the Appendix II study prepared by Dames and Moore

1) WIND FREQUENCIES BY STABILITY CLASS FOR EACH SECTOR DO NOT SUM TO 100%

Airem 3 input data for wind frequencies by stability class for each sector are given on pages B-1, C-1, and D-1. In each case the total frequency is 33.33%, not 100%. It is not clear upon what basis this reduction is made. If this is an attempt to only calculate dose for an 8 hour working day as seems apparent from Section 7.5.2 (A) of the main text, then this is objectionable because dose for the surrounding community is being accumulated on a continuous basis. The tailings and sludge piles and also the capped disposal area are indeed continuous, not intermittent, emitters.

2) A POINT SOURCE IS ASSUMED FOR DOSE ESTIMATE CALCULATIONS

If the source were small or the affected individuals were far removed from the source an assumption of a point source might be valid. The smallest source is the tailings pile, 41 meters X 41 meters X 11 meters. This is not small. The nearest dose calculation begins at 150 meters. This is not far removed from the source. An area source computer program would be more appropriate. A variation of AIREM for a distributed source, AREAC (Area Source Radiological Emission Analysis Code) is available from the U.S. Environmental Protection Agency, Environmental Analysis Division, Washington D.C.

Illinois Institute of Natural Resources

State Geological Survey Division

Natural Resources Building
Urbana, IL 61801
217/344-1481

September 28, 1979

Mr. Jose Luis S. Saguinsin
Argonne National Laboratory
Building 11
Argonne, IL 60439

Dear Mr. Saguinsin:

This letter summarizes the comments of the Illinois State Geological Survey on the Kerr-McGee Stabilization Plan for the West Chicago site as requested by the US-NRC. Also included is a copy of a letter from the State Geological Survey to the Illinois Department of Public Health which summarized a review of a former site stabilization plan. Although additional work has satisfied some of our earlier concerns, such as the installation of monitoring wells, many other questions remain unanswered.

This is particularly true with regard to the installation of a clay liner and large mound of earth fill and the potential for the creation of a ground-water mound and the potential for the development of leachate springs. The remainder of the review deals with the chemical aspects of waste disposal.

Page	Paragraph	
i	(3)	The report states that "little material has migrated from the property...and no measureable radioactivity is escaping to the ground water."

Comment: Substantial migration of chemical wastes has occurred from the site into both shallow ground water and the underlying dolomite aquifer. Measure-able radioactivity has been consistently found in well B-2 as well as in soil samples from beneath the site.

v	(3)	The rationale for eliminating open-pit coal mines in Illinois was that they "tend to fill with water and are extensively used for recreational activities; and, there-fore, they are generally unsuitable for waste disposal."

Comment: Many strip mines have large areas which do not fill with water and, except for local clubs, only two areas owned by the state are being developed for recreational activities.

1.2 (3)
Comment: The existing monitoring wells are all finished in shallow sand and gravel (less than 35 feet). Perhaps a monitoring well sealed in the upper dolomite bedrock should be found nearby or installed.

Page Paragraph
2.18 (3)
Comment: Monitoring well B-5 which was drilled to the top of the dolomite aquifer and reportedly plugged back so a shallow well could be installed may not have been sufficiently sealed. This may allow for transport of contaminated ground water directly into the underlying bedrock down the borehole.

2.18 (5) The report states: "The original static water level for the aquifer was close to that for the glacial drift ...a "perched" water table aquifer in the glacial drift overlying a bedrock aquifer with a significantly lower fluid level...and an unsaturated upper section exists in the bedrock aquifer."

Comment: Although it is likely that water levels in the dolomite aquifer have declined as a result of pumping, it is highly improbable that geologically recent water levels in the dolomite were ever close to that for the glacial drift. The condition that exists is a natural result of the downward infiliation of precipitation and ground water through the fine grained glacial materials which overlie the bedrock. This is not a "perched" water table condition. The glacial aquifer is not isolated from the bedrock aquifer as evidenced by the extent of chemical pollution of ground water in the dolomite. The potential is definitely there for the downward flow of ground water and thus, contaminants; however, as the report concludes, the thick sequence of fine-grained materials probably restricts the total flux of ground water.

2.19 (1)
Comment: Although deteriorated or even open well casings probably exist in the vicinity of the site it is not likel y that this is the sole cause of ground-water contamination in the bedrock. The extent of pollutant loading undoubtedly allowed for natural migration of contaminants through permeable zones in the glacial drift to the bedrock.

2.19 (2);(Fig. 2.6.2)
Comment: The water levels used to construct Fig. 2.6.2 do not represent data from 1976 as stated. They were from well log records, which span more than 30 years, collected by the Illinois EPA.

2.21 (2)
Comment: Are there data to prove that the water table since 1975 has dropped below the elevation of the storm sewer? Since the storm sewer has continued to discharge water it is likely that it intersects the water table prior to discharging into Kress Creek.
Secondly, the report states that the analyses in Table 2.6.3b may reflect ground-water discharge to the sewer rather than surface runoff from the site. However, the ground water directly beneath the site which has discharged into the sewer has derived most of its contaminant load directly from the wastes on the site during infiltration.

Page Paragraph
2.22 (3)
Comment: The natural movement of ground water may help "flush out" dissolved solids; however, natural infiltration continues to leach wastes contributing additional contaminants to the ground-water system. Also, measureable radioisotopes have been found in ground water in the glacial drift.

3.23 (3)
Comment: The leachability and the hazardous nature of the 11,000 cubic feet of rare earth compounds stored in Building 19 should be addressed prior to final disposal.

3.24 (2)
Comment: Long-term leaching by infiltrating rain water has already resulted in both radioactive and metal contamination of shallow ground water. (See comments on leaching tests in attached material).

3.24 (3)
Comment: The data in Table 3.2.3a. do not indicate that ground-water quality is acceptable. Extensive chemical contamination is evident.

3.24 (4)
Comment: As subsequent analyses prove radioactive contamination in well B-2 was not "accidental;" and if it were, their methods would not prove it so.

4.2 (4)
Comment: Monitoring well B-2 should be overdrilled and plugged to ensure sealing.

4.22 (1)
Comment: Any permanent cover over the disposal areas will require periodic maintenance as a result of unavoidable settlement of the fill.

4.36 (2)
Comment: Although the use of montmorillonite based clays with a high exchange capacity for pollutant containment may be recognized, the clayey soils in the vicinity of West Chicago are not montmorillonite based; they are illite based with quite low exchange capacity.

4.38
Comment: Although the specifications call for a clay liner and cover with a permeability of less than 10^{-8}cm/sec, the results of the laboratory tests on samples of clay from the vicinity indicate that all have coefficients of permeability greater than 10^{-8}cm/sec, as much as 10 times greater (and these results are apparently for highly compacted samples).

4.41 (2)
Comment: The suitability for disposal of the radioactive wastes from Reed-Keppler Park in the unlined disposal area #3 should be addressed.

5.7 (2)
Comment: Ground-water quality may be gradually improving, but how does this imply that a stable condition has been established? Liquid discharges have ceased, but undoubtedly leaching has continued with a corresponding decrease in the pollutant land on the ground-water system.

5.7 (3)
Comment: The purpose of the cover and stabilization effort is to reduce, not prevent, potential impacts on ground-water quality. It should be recognized that infiltration will continue to slowly leach the waste materials although theoretically at lower rates.

7.2 (4)
Comment: Monitoring wells should monitor the shallowest sand and gravel aquifer if saturated.

7.3 (5)
Comment: The installation of a cover will reduce, not prevent, infiltration so the appearance of water in the encapsulated area may not indicate the failure of a specific portion of the cover. The quality of shallow ground water will also not serve as a good indicator of cover integrity. Continued leaching is to be expected even from the encapsulated area; however, the degree of contamination of shallow ground water precludes the recognizance of anything but very large additional releases of pollutants from the disposal area.

12.2 (5)
Comment: The Illinois State Geological Survey did not "look" for suitable alternative disposal sites.

If we can be of any further assistance please let us know.

Sincerely yours,

Thomas M. Johnson

Thomas M. Johnson
Assistant Geologist
Hydrogeology and Geophysics Section

REB:jwh

August 5, 1976

Mr. Gary Wright
Division of Radiological Health
Department of Public Health
535 West Jefferson Street
Springfield, Illinois 62761

Dear Mr. Wright:

This letter summarizes the Illinois State Geological Survey's review of Kerr-McGee Chemical Corp.'s proposal to dispose of thorium-bearing solid wastes at their plant site at West Chicago, in NW¼ NE¼ NE¼ Section 16, T. 39 N., R. 9 E., Du Page County. We have examined Kerr-McGee's report and data, the Illinois Environmental Protection Agency's field reports, geologic report, and analytical data on the site, and relevant data and reports in our own files.

We note that no hydrogeologic data are available on subsurface conditions at the disposal site. The nearest water wells whose logs give some indication of the nature of the glacial deposits overlying the Silurian bedrock are several hundreds of feet away from the site. Because the glacial deposits are quite variable at West Chicago and substantial beds of sand and gravel are encountered in many wells, we recommend that drilling be undertaken on the site and that the earth materials down to bedrock be carefully sampled to determine the sequence and nature of the unconsolidated deposits. The samples should be taken with a split-spoon and/or Shelby-tube sampler, analyzed for texture, origin, and other pertinent physical properties, and preserved for further examination by the Geological Survey. Several of the test holes should go to bedrock.

We consider that proof of the subsurface conditions is at least as critical at this site as it is at conventional sanitary landfill sites where subsurface exploration is required procedure.

Another hydrogeologic matter that concerns us is that there has been no consideration of the possible effects of regrading the site and creating a mound of earth fill, consisting largely of thorium waste. At other sites in Illinois where earth mounds have been created, ground-water mounds have commonly developed under them. Frequently springs of leachate appear on the flanks of the mound. We believe that the proposed operation at West Chicago raises the possibility that springs containing radionuclides and other metals will form at the surface. This possibility and the fact that the waste materials could have effects on the shallow ground-water reservoir suggest that monitoring of the site should also be a required part of the plan. At present there are no sampling points for ground water at the site.

Dr. Robert A. Griffin of our Geochemistry Section makes the following observations relative to Kerr-McGee's analysis of their waste-disposal plan.

> Kerr-McGee's basic premise is that thorium compounds are so insoluble that they will not go into solution in hazardous concentrations and will therefore not contaminate ground water. They conclude that mixing lime with the solids will maintain a high pH and reduce the quantity of radioactive materials leached from the solid waste materials.
>
> The solubility of ThO_2 at pH 3 is about 5×10^{-6} M (1.2 ppm) and goes to a minimum solubility above pH 6. Thus, ThO_2 has a low solubility but can't really be termed "insoluble." Thorium forms stable complexes with fluoride ion and with oxygen donor ligands. Therefore the presence of fluoride or organic compounds in the waste could significantly increase the solubility of the thorium compounds.
>
> The results of the leaching tests indicate that the wastes are a significant potential pollution hazard. The level of radioactivity leached from the solids is 100 - 10,000 times greater than is allowed in public water supplies, and the ground water 9 feet below the site contains more than 16 times the amount of radioactivity normally found in ground water.
>
> The interpretation of the data by Mr. Van De Steeg in his December 16, 1975 communication is oversimplified and inaccurate. The conclusion that "alkaline solutions leach less radium from the samples than neutral or acidic solutions" is not supported by the data. Over half the samples leached with the alkaline solution contained more radioactivity in their effluent than those leached with the neutral solution. One of the effluents from the alkaline leaching contained more and three other effluents about the same amount of radioactivity as obtained from the acid leaching solution.
>
> The second conclusion that "the presence of carbonates or bicarbonates increases the amount of radioactive materials leached" cannot be supported by the data presented for the reasons given above. I suggest that the pH and Na^+ ion content were important parameters that probably had more influence on the leaching than the carbonates.
>
> The third conclusion that "the principal radioactive materials in the leach effluents are thorium and thorium daughters other than radium-224" is also not supported by the data and is based on faulty logic. The similar radioactive content of the two leaching fractions could be due to fast leaching of slowly soluble compounds, i.e.,

non-equilibrium conditions in the columns. The March 24, 1976 isotope analysis of the composite leach solution also shows the conclusion to be false. No thorium at all was detected and the major isotopes found were Ra-224, Ra-226, U-238, and U-234.

Mr. Van De Steeg states that the volume of water leached through the columns is equal to about 10 years of rainfall in the Chicago area. However, if the materials are of as low a solubility as Kerr-McGee claims, rapid leaching with a large volume of water may actually dilute the concentration of radioactivity. The concentration of radioactivity leached by slow percolations with one year's equivalent of rainfall may actually be much greater than the values listed in the tables.

Due to the high pollution potential of these wastes, adequate safeguards should be taken before disposing of them on the land. The high molecular weight (232) and cationic nature of thorium indicate that it should be tightly and preferentially adsorbed by clay minerals from pure solutions, especially at pH values above 6. This implies that if an adequate thickness of calcareous clayey material were placed between the waste and the ground water, no contamination of the ground water should occur. However, thorium readily forms complexes with fluoride and organic compounds that will increase its mobility through clay materials. Therefore, mixing of the thorium and other wastes or any other soluble salts should be avoided. I would recommend that the thorium hydrate solids (sample 9 - process intermediates) not be disposed of at this site, but should be hauled to a more secure disposal facility.

If we can assist you further in the matter please let us know.

Sincerely yours,

Robert E. Bergstrom
Principal Geologist
Geological Group

cc: John S. Moore (Land Pollution Control, EPA)

bcc: R. A. Griffin

F
NRC BHDA

WU INFOMASTER 1-018858A304 10/31/79
ICS IPMWGWD WSH
00322 10-31 0524P EST
TWX 7108240415 NRC BHDA
4-057062S304 10/31/79
ICS IPMBNGZ CSP
3122931075 NL TDBN WEST CHICAGO IL 197 10-31 0350P CST
PYS UNITED STATES NUCLEAR REGULATORY COMMISSION, ATTN WILLIAM A NIXON
, DLR, DLR
DIV OF FULL CYCLE AND MATERIAL SAFETY
WASHINGTON DC 20555
REGARDING THORIUM RESIDUALS IN WEST CHICAGO ILLINOIS KERR-MCGEE
CHEMICAL CORP DECOMMISSIONING PLAN FOR ITS WEST CHICAGO ILLINOIS
FACILITY LICENSE STA. 583.
DEAR MR NIXON
THE MAYOR OF THE CITY OF WEST CHICAGO WAS RECENTLY NOTIFIED BY
TELEPHONE OF A MEETING TO BE HELD NOVEMBER 6 1979 IN ROCKVILLE
MARYLAND BETWEEN NRC AND KERR-MCGEE OFFICIALS, TO DISCUSS COMMENTS
MADE BY THE CITY, LOCAL, AND FEDERAL OFFICES.
THE CITY, BY ITS MAYOR, EUGENE RENNELS, REQUESTS THAT THIS TELEGRA
M INCLUDED AS FORMAL COMMENTS TO BE READ AT THE MEETING.
THE CITY OF WEST CHICAGO, ILLINOIS, DEMANDS:
(1) THAT ANY FUTURE NON-TECHNICAL MEETINGS BE HELD IN A CHICAGO AREA,
AS TENTATIVELY AGREED UPON AT OUR MEETING ON FEBRUARY 14, 1979 AT THE
O'HARE MARRIOTT IN CHICAGO ILLINOIS.
(2) THAT THE CITY PROTESTS ANY AGREEMENT ENTERED INTO WITHOUT
REPRESENTATION BY A WEST CHICAGO CITY OFFICIAL, AND THAT BUDGETARY
AND TIME CONSIDERATION PRECLUDE OUR ATTENDANCE AT THIS MEETING TODAY.
(3) THAT THE OBJECTIONS MADE TO THE KERR-MCGEE REPORT AT THE PRIOR
MEETINGS BE RAISED AGAIN, AND CONSIDERATION BE GIVEN TO WHETHER OR
NOT ANY PROGRESS HAS BEEN MADE CONCERNING THE OBJECTION RAISED BY
THIS CITY SINCE THE TIME OF THE LAST MEETING. SINCERELY,
A. EUGENE RENNELS MAYOR, WEST CHICAGO ILLINOIS
1724 EST

1741 EST

NRC BHDA