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UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of Kerr-McGee Corporation Kerr-McGee Building Oklahoma City, Oklahoma	)	Amendment to Source Material License SUB-1010

AEC REGULATORY STAFF'S PROPOSED
FINDINGS OF FACT AND CONCLUSIONS OF LAW
IN THE FORM OF A PROPOSED INITIAL DECISION

The AEC Regulatory Staff ("the Staff") requests pursuant to 10 CFR 2.754 of the Commission's "Rules of Practice" that the following proposed findings of fact and conclusions of law in the form of a proposed initial decision be adopted by the Atomic Safety and Licensing Board in this proceeding.

I. PRELIMINARY STATEMENT

1. The Kerr-McGee Corporation ("the Licensee") is a Delaware Corporation having its principal office in Oklahoma City, Oklahoma. The Licensee is the holder of Source Material License SUB-1010, issued by the Atomic Energy Commission ("the Commission"), which authorizes the purification and conversion of yellow cake to uranium hexafluoride at its Sequoyah Facility near Gore, Oklahoma. On May 10, 1972, the Licensee filed an application with the Commission to amend License No. SUB-1010 for authorization to utilize deep well disposal of low level liquid radioactive wastes

generated from its solvent extraction uranium purification process. A prior application for such disposal had been denied by the Staff in October of 1970, but the Licensee was permitted to withdraw the application without prejudice.

2. On September 29, 1973, the Staff denied the May 10, 1972 application after determining that issuance of the license amendment would not conform with the requirements set forth in 10 CFR 40.32(c) and (d) because:

"(1) Existing information is not adequate to demonstrate the presence, location, or nature of the faults that are purported to provide barriers to movement of fluid from the disposal formation, nor is there adequate information to demonstrate that known faults will act as barriers to such movement during continued operation of the proposed well.

(2) The complexity of the geologic formation is such that there is no assurance as to the migration paths of the radioactive wastes and the brines which would be displaced.

(3) The complexity of the geologic and hydrologic system effectively precludes emergency recovery of the injected radioactive waste."

3. After consideration of additional information submitted by the Licensee, the Staff reaffirmed the denial referenced in paragraph 2 on March 14, 1973. On April 5, 1973, the Licensee requested a hearing on the denial.

4. On July 16, 1973, the Commission published a "Notice of Hearing" in the FEDERAL REGISTER (38 F.R. 18921) which directed the

presiding Hearing Board to consider and decide whether, pursuant to the Atomic Energy Act of 1954, as amended ("the Act"), and in accordance with 10 CFR 40.32(c) and (d):

"(1) The Licensee's equipment, facilities and procedures proposed for use pursuant to the requested amendment are adequate to protect health and minimize danger, life or property, and

(2) The issuance of the amendment will be inimical to the health and safety of the public."

The Notice further provided that if the Board makes an affirmative finding with respect to Item 1 above and a negative finding with respect to Item 2, the Licensee's application is to be remanded to the AEC Deputy Director for Fuels and Materials for such further action on environmental matters as may be required by 10 CFR 40.32(e).

5. The Hearing Board designated to preside at this proceeding held a prehearing conference in Washington, D.C. on Tuesday, August 14, 1973 pursuant to its Notice and Order of July 19, 1973 (38 F.R. 19853). After consideration of a "Petition to Require Publication of Proper Notice of Hearing" submitted on behalf of the Natural Resources Defense Council, the Board issued a "Prehearing Conference Order and Notice of Extension of Time to Intervene" on August 14,

1973 (38 F.R. 22175) inviting interested persons to file petitions for leave to intervene pursuant to 10 CFR 2.714 within 30 days from date of the Order's publication in the FEDERAL REGISTER. The Board also requested that the Licensee and the Staff frame a joint statement of the issues. Pursuant to this request, the Licensee and the Staff filed with the Board on September 21, 1973, a "Joint Statement of Proposed Issues" proposing the following issues for consideration in the proceeding:

a. Whether the Webbers Falls fault exists and, if it does, at what distance is it located northeast of the proposed disposal well?

b. Whether the South fault exists and, if it does, at what distance is it located southwest of the proposed disposal well?

c. Whether additional faults exist within the disposal formation (fault block) that may act as either barriers to fluid movement within the fault block or conduits for fluid movement within the formation.

d. Whether the nature of the faults comprising the fault block are such that the faults will act as barriers to fluid movement under increasing fluid pressure.

e. Whether the five disposal zones composing the Arbuckle Formation can be assumed to be homogeneous, isotropic, and constant in thickness, porosity, and permeability, thereby permitting the calculation of the movement of the disposed waste fluid from the well bore.

f. Whether a three dimensional analysis of geohydrologic problems by the finite difference method, based on test data obtained from a single well, can accurately predict the nature and performance of the injection horizons.

g. Whether monitoring by pressure testing at the well head is adequate to detect fluid movement, or whether there is a need for direct monitoring of the recipient formation.

h. Whether in the event of a demonstrated leak in the retention reservoir or fault block the waste fluid can be recovered.

6. No petitions for leave to intervene having been filed, the Board held an evidentiary hearing in Washington, D.C. on October 15 and 16, 1973 at which time the Licensee and the Staff presented evidence with respect to the issues referenced in paragraph 5.

II. FINDINGS OF FACT

ISSUE 1: WHETHER THE WEBBERS FALLS FAULT EXISTS AND, IF IT DOES, AT WHAT DISTANCE IS IT LOCATED NORTHEAST OF THE PROPOSED WELL?

1-1 The Licensee's reservoir studies, reservoir modeling, geological studies, and application of deductive reasoning do not adequately demonstrate the existence of a fault acting as a hydrologic boundary at a distance of approximately 1200 feet northeast of the disposal well. The Licensee testified that, based on water injection testing data and pressure fall-off measurements, a boundary exists in Layer No. 5 of the disposal reservoir approximately 1200 feet northeast of the well. This conclusion was based on data indicating a strong counter-flow from

Layer No. 5 together with the fact that Layer No. 5 accepted progressively smaller volumes of water during the injection tests. (K-M Exh. 38 p. 15).

1-2 The Staff took the position that these tests were inconclusive in establishing the existence of a boundary since in cases where reservoir boundaries are determined from injection and pressure fall-off tests, it is generally assumed that the reservoir is a one-layer homogeneous system. The Arbuckle reservoir, however, consists of five distinct layers, and only a single injection test was performed. Separate injection tests were not performed for each of the five layers to independently determine the existence or non-existence of boundaries for the individual layers. (Staff Exh. C, p. 5).

1-3 The Licensee testified that it had constructed a numeric reservoir model using test data consisting of initial static reservoir pressure, injection rate schedules, pressure fall-off time periods, injection fluid properties, certain boundary distances revealed by geological and pressure fall-off data and values of effective permeability, porosity and thickness of each layer. Combinations of data were varied until a "best fit" between the calculated and observed pressure fall-off curves was achieved. The

model which best matched the observed pressure fall-off data was a reservoir with five significant layers - three of which were bounded on all sides and Layers 3 and 4 bounded on the top, bottom and three sides with the fourth side determined not to be less than 28,414 feet from the well. (K-M Exh. 1A,pp. 1, 3, 4, and figures 1 and 3).

1-4 In order to achieve a "best fit" pressure curve referenced in paragraph 1-3, thirty-two separate computer runs had to be made, which, in the Staff's judgement, indicated difficulty in making proper adjustments to obtain desirable results. The Staff asserted that other combinations of the input data could have been introduced and achieved similar calculated pressure curves and that, therefore, the Licensee's reservoir model is neither unique nor dispositive of the performance characteristics of the reservoir. (Staff Exh. C, p. 5).

1-5 Although the Licensee testified that a "best fit" had been achieved, there is a significant difference between the measured pressure fall-off curve and the calculated pressure fall-off curve. The calculated points do not fall-off as rapidly as the measured points during the

first 60 hours of pressure fall-off. After 60 hours of pressure fall-off, the calculated points fall-off more rapidly than the measured points. According to the Staff, the significance of this difference, if any, can only be ascertained by further injection testing. (Tr. 351-352).

1-6 The Licensee's geographical studies show no topographical features which conclusively establish the existence of a fault at the point predicted by the reservoir studies and the numeric model. The surface features which the Licensee interpreted in its testimony as indicating a fault consist of a straight stream course, a precipitous bluff, a bend in the Illinois River, and anomalous "Round Mountains" northwest and southeast of the disposal well. (K-M Exh. 3A [Exhs. CD and CE]). The Licensee testified further, however, that none of these features are conclusive points evidencing the existence of the fault; they are only circumstantial evidence. (Tr. 103).

1-7 The Staff raised the point, and the Licensee concurred, that where relatively major faults are found, smaller features having the same direction as the major features are also usually found. (Tr. 81). Such smaller features usually consist of joints, fractures, and small faults.

(Tr. 81). The Licensee's photogeologic analysis of the surface of the disposal formation shows numerous additional faults, both actual and inferred, in the area between the Carlile School Fault and the Marble City Fault. (K-M Exh. 3A [Exh. CF]). In an area where two faults intersect, such as the area where the Carlile School Fault and the Webbers Falls Fault are shown to intersect on the Licensee's Exhibit 3A (Exh. CB), it is probable that one would find additional smaller faults. (Tr. 80-81). The Licensee's photogeologic analysis of the surface of the disposal formation, however, shows no additional faults in the vicinity of the Carlile School and Webbers Falls Faults intersection.

1-8 The Licensee's testimony and interpretation of the subsurface geology indicates only that a fault may exist within two miles northeast of the disposal well. (K-M Exh. 3A [Exh. CD and CE], Tr. 101-102). The Wapanucka Limestone does not appear on the surface within six miles of the disposal well when it should emerge at approximately two miles from the well assuming the regional dip is about 200 feet per mile. Such an

anomaly only indicates the possibility of a fault somewhere between the disposal well and the point where the Wapanucka Limestone should outcrop, which is a distance of approximately two miles.

1-9 Based on the foregoing, the Board finds that there is inadequate evidence to conclude that the Webbers Falls fault exists. Even if the fault does exist, there is inadequate evidence demonstrating its location of approximately 1,200 feet northeast of the disposal well.

ISSUE 2: WHETHER THE SOUTH FAULT EXISTS AND, IF IT DOES, AT WHAT DISTANCE IS IT LOCATED SOUTHWEST OF THE PROPOSED DISPOSAL WELL?

2-1 The Licensee's reservoir studies, numeric reservoir modeling, geological studies, and application of deductive reasoning do not conclusively establish the existence of a fault acting as a hydrological boundary in Layers 3 and 4 at a distance of approximately 29,000 feet southwest of the well. The Licensee testified that data from its injection testing showed water continuing to move at a distance of approximately 29,000 feet southwest of the well in Layers 3 and 4, indicating that no boundary had been reached. (Tr. 157). Based on the

numeric model, however, the Licensee testified that there must be an undetected fault somewhere beyond the 29,500 foot point southwest of the well because when the barriers were assumed to be permeable to varying degrees, appreciable differences arose in the shape of the calculated "best-fit" pressure fall-off curve. (Tr. 157). This testimony is somewhat inconsistent with the subsequent testimony of the Licensee that it only varied the permeability of the east boundary (Webbers Falls Fault). (Tr. 361). It is also inconsistent with the Licensee's statement in K-M Exhibit 1A at page 4 where it was stated that the South Fault could be removed entirely from the numeric model without significantly affecting the pressure curve match.

2-2 The Licensee also testified that its geological studies showed certain subsurface and topographical features which were only suggestive, but not directly indicative, of the existence of a fault. (K-M Exh. 3A, p. 14). The Licensee admitted that the existence and location of a fault based on these features are matters of interpretation of the data and, in the Staff's judgement, the Licensee's interpretation of the data is not necessarily the only interpretation available. (Tr. 76).

2-3 Aside from subsurface and topographical features, one basis used by the Licensee for establishing the existence and location of the fau't is that it precisely fits the pressure data determined and derived from the reservoir studies and the numeric model. (K-M Exh. 3A, p. 14). However, as indicated in paragraph 2-1, neither the study nor the model demonstrated the existence of a fault at that location. They only indicated that there may be a fault somewhere beyond that point.

2-4 The Board finds that there is inadequate evidence to conclude that the South Fault exists. The fault's existence and location is based solely on an interpretation of surface conditions which is neither unique nor dispositive of the existence of the fault.

ISSUE 3: WHETHER ADDITIONAL FAULTS EXIST WITHIN THE DISPOSAL FORMATION (FAULT BLOCK) THAT MAY ACT AS EITHER BARRIERS TO FLUID MOVEMENT WITHIN THE FAULT BLOCK OR CONDUITS FOR FLUID MOVEMENT WITHIN THE FORMATION

3-1 The Licensee's photogeologic interpretation of the disposal formation shows an inferred fault branching off to the west of the Carlile School Fault and shows 2

parallel inferred faults running northwest and perpendicular to the Carlile School Fault. (K-M Exh. 3A [Exh. 3F]). While the Licensee testified that field studies indicate that the 2 parallel faults perpendicular to the Carlile School Fault may be lines of vegetation rather than faults, there is testimony by the Licensee, based on the same field studies, establishing the existence of a fault branching off to the west of the Carlile School Fault within the disposal formation. (Tr. 79-80, 103-105).

3-2 Under cross-examination by the Staff, the Licensee agreed that faults are commonly thought of as vertical channels permitting migration of fluids from reservoirs to the surface and that they are also significant in that they offer possible paths for preferential lateral movement of fluid. (Tr. 82-85). The Licensee also concurred that while faults may form a boundary plane of a pool of gas or oil, this is more commonly due to higher fluid potentials within the channels and updip across the fault than it is to the fact that the fault is tightly sealed. There was also agreement on the fact that faults serve as channelways for mineralizing solutions and that they form and drain petroleum reservoirs. (Tr. 83, 86-87).

3-3 Based on the evidence presented, the Board finds that at least three additional faults have been inferred within the disposal formation and that it is common for faults to serve as pathways to fluid migration.

ISSUE 4: WHETHER THE NATURE OF THE FAULTS COMPRISING THE FAULT BLOCK ARE SUCH THAT THE FAULTS WILL ACT AS BARRIERS TO FLUID MOVEMENT UNDER INCREASING FLUID PRESSURE

4-1 The Licensee's reservoir studies and numeric model indicated that the boundaries comprising the disposal formation would not leak under increasing fluid pressure. The studies further indicated that a leakage equivalent to a tenth of a millidarcy could be detected at the well head, but not one equivalent to a hundreth of a millidarcy.

4-2 In calculating detectable leakage, the Licensee stated that it assumed that only the east boundary (Webbers Falls Fault) was permeable (leaking). (Tr. 361). The other three more distant boundaries were assumed to be impermeable (not leaking). (Tr. 361). No calculations were performed assuming the east boundary to be impermeable and assuming varying permeabilities in the other three boundaries. (Tr.

249). Thus, the calculation for detectable leakage equivalent to a tenth of a millidarcy is applicable only to the east boundary. The Licensee indicated that it could make no additional calculations for detectable leakage at the other three boundaries without performing further reservoir studies. (Tr. 248).

4-3 When the east boundary was assumed to be permeable (leaking), the Licensee indicated that no readjustment of that boundary location was made to achieve a closer fit with the measured data. (Tr. 240). Such a readjustment of the east boundary location might have achieved a better match of the pressure curves which would have indicated that the boundary - originally assumed to be impermeable - was actually permeable. (Tr. 240, 344). The Staff testified that had leakage at the east boundary first been assumed and the computer then used to locate boundaries producing the best fit to the measured data, the boundary would have been located at a point other than the location of the boundary calculated for the impermeable (no leak) case, although the input parameters could be varied to produce the impermeable case boundary. (Tr. 344-346).

4-4 With respect to the sensitivity of the numeric model to boundary leakage (K-M Exh. 1A, figure 14), the Staff's position is that little significance can be attached to the difference between the pressure fall-off curves for the measured pressure case and the calculated east boundary leakage case (permeability (k) = 0.1 md) since there is already a substantial divergence between the pressure curve for the calculated, best-fit impermeable boundary case and the measured pressure case. (Tr. 348). In addition, the divergence between the pressure fall-off curve for the calculated east boundary leakage case (k = 0.1 md) and the calculated best-fit impermeable boundary case is insufficient, in the Staff's judgement, to conclude that the model is sensitive to leakage of 0.1 millidarcy. (Tr. 348).

4-5 The record shows that if sufficient pressure were built up within the disposal formation, a fault could be ruptured allowing escape of the raffinate wastewater. (Tr. 163, 228). Sufficient pressure build-up for fault rupturing could result from additional injection into the formation from another disposal well. (Tr. 229-230). The Licensee neither owns nor controls all of the surface area over the disposal formation such that someone else

at some later date could drill another injection well into the disposal formation. (Tr. 229-230).

4-6 Based on the foregoing, the Board finds that the Licensee has not adequately demonstrated that the faults comprising the fault block, both actual and inferred, will act as barriers to fluid movement. The Board further finds that additional injection tests are necessary to determine if the three faults other than the east boundary leak and at what rate leakage, if it occurs, would be detectable.

ISSUE 5: WHETHER THE FIVE DISPOSAL ZONES COMPOSING THE ARBUCKLE FORMATION CAN BE ASSUMED TO BE HOMOGENEOUS, ISOTROPIC, AND CONSTANT IN THICKNESS, POROSITY, AND PERMEABILITY, THEREBY PERMITTING THE CALCULATION OF THE MOVEMENT OF THE DISPOSED WASTE FLUID FROM THE WELL BORE

5-1 The porosity and permeability parameters used in the Licensee's numeric model are based only on in-hole measurements from the disposal well. (Staff Exh. C, p. 3). According to the Staff's testimony, these measurements represent an area of only a few inches to a few feet around the well and, thus, they cannot be considered representative of the entire disposal reservoir, which extends hundreds or thousands of feet from the injection well. (Staff Exh. C, p. 3; K-M Exh. 1A, figure 1). There is further testimony by the Staff that in a limestone

aquifer such as the Arbuckle reservoir, it is not uncommon for permeability to vary by several orders of magnitude in a short distance, and similarly, it is not uncommon for porosity to vary by factors of 2 to 5 in a small area. (Staff Exh. C, p. 3). It is, therefore, unrealistic to assume homogeneous distribution of these properties in each of the five layers of the disposal formation. If permeability were highly anisotropic (direction-oriented) or heterogeneous, it is possible that the wastewater would move along a preferred path much further than the 900 feet calculated by the Licensee. (Staff Exh. C, p. 3).

5-2 The record shows that the Licensee did not take the phenomenon of hydrodynamic dispersion into account in calculating the eventual distance of fluid migration. (Tr. 173-181). This phenomenon, which occurs when concentration gradients are set up between the different salinities of the displacing and the displaced fluids, will result in fluid movements of a greater distance than those which the Licensee calculated. (Tr. 173-181, 326-327). An increase of 300 feet over that calculated by the Licensee would not be unreasonable. This distance would increase even more in the presence of large differences between permeabilities in narrow zones. (Tr. 327).

5-3 As an example of the inability to accurately calculate fluid migration in limestone formations, the Staff presented testimony on four wells drilled into Knox Dolomite at New Johnsonville, Tennessee for disposal of acid wastewater. This dolomite formation is of the same age and geologic character as the Arbuckle Formation. Extensive logging and testing of the wells were carried out, including radioactive tracer injectivity tests and straddle packer testing of all the potential injection zones. In each well, several zones were identified as being the most probable receptors of waste. After five years of operation, one of the wells showed that most of the wastewater entered only a single, very narrow interval since it was found that the water travelled much further than it possibly could have if it had entered the several zones originally identified by the testing program. In fact, the difference between the calculated fluid migration distance and the actual distance of movement over the five year period was over 2,200 feet. (Staff Exh. B, pp. 10-11; Tr. 328).

5-4 Based on the evidence presented, the Board finds that there is reason to believe that the wastewater will migrate further than the 900 feet calculated by the Licensee. The Board further finds that the wastewater may move in a preferred direction rather than radially away from the well bore because of the characteristic heterogeneous permeability of dolomite-limestone formations.

ISSUE 6: WHETHER A THREE DIMENSIONAL ANALYSIS OF GEOHYDROLOGIC PROBLEMS BY THE FINITE DIFFERENCE METHOD, BASED ON TEST DATA OBTAINED FROM A SINGLE WELL, CAN ACCURATELY PREDICT THE NATURE AND PERFORMANCE OF THE INJECTION HORIZONS

6-1 The Staff agreed that if properly used, numeric models utilizing the mathematical technique of finite differences to approximate the solutions to equations are valid, accurate tools for reservoir studies. Although the injection testing and numeric modeling procedures used by the Licensee were valid, accepted techniques, the Staff asserted that there was an insufficient geological data input into the numeric model to make it reliable in describing the performance characteristics of the disposal reservoir. (Staff Exh. B, p. 9). Input data from only a single well were used in the model, which was then adjusted and readjusted to yield results comparable to

the limited measured data obtained from actual tests performed on the injection well. The entire disposal formation was then assumed to be similar to the model. (Staff Exh. C, p. 3). However, the disposal formation is a complex, five-layered, limestone-dolomite reservoir and such reservoirs are characteristically quite heterogeneous (Staff Exh. B, p. 9; K-M Exh. 1A). Because of this heterogeneity, the Staff believes that there are probably significant variations in porosity and permeability within layers which could result in fluid moving in a preferred linear direction rather than radially from the well bore (Staff Exh. B, p. 9; Tr. 181). Because of these variations, data from a single well cannot be considered representative of the entire disposal reservoir and, therefore, a numeric model based only on such data cannot be considered realistic or reliable. (Staff Exh. C, p. 3).

6-2 The Board finds that because of the characteristic heterogeneity of the Arbuckle Formation, data derived from a single well cannot be considered representative of the subsurface geological conditions for an area extending hundreds or thousands of feet in all directions from the well-bore. A fortiori, such data cannot reasonably be

used to construct a reliable numeric model for predicting fluid performance within the disposal formation.

ISSUE 7: WHETHER MONITORING BY PRESSURE TESTING AT THE WELL HEAD IS ADEQUATE TO DETECT FLUID MOVEMENT, OR WHETHER THERE IS A NEED FOR DIRECT MONITORING OF THE RECIPEINT FORMATION

7-1 The Licensee's proposed monitoring procedures consist of direct pressure testing at the well-head and weekly and monthly analyses of water samples taken from area surface waters and subsurface wells (K-M Exh. 3E, p. 2). This monitoring would be conducted during the period of injection and for some unspecified time thereafter (Tr. 227). The Licensee testified that these procedures were adequate in part because of the sensitivity of the numeric model in detecting leakage. However, as stated in paragraph 4-2, the model is only sensitive to leakage of 0.1 millidarcy - or 40 barrels of fluid per day - at the east boundary. Inadequate data were available to calculate detectable leakage at the other three more distant boundaries. Thus, it is possible that leakage could occur at any one of these three boundaries without being detected by the pressure testing at the well-head. In addition, leakage could

occur in the form of ponding on the land surface, which may or may not be detected in the weekly and monthly water sampling.

7-2 The record shows that another, more reliable monitoring alternative is available to the Licensee. (Staff Exh. B, letter of 12/22/72). This alternative consists of drilling a second well to the top of the Arbuckle Formation and casing to the top of the Simpson Formation approximately 500 feet north by northeast of the well in order to detect any vertical leakage. (Staff Exh. B, p. 12; Tr. 338-341). This well would detect any increasing fluid pressure in the Simpson Formation resulting from vertical leakage of wastewater (Tr. 338-341). It further consists of confirming the existence of the Webbers Falls Fault by additional drilling and, if the fault is found to exist, drilling a second monitoring well approximately 2,000 feet southwest of the well.

ISSUE 8: WHETHER IN THE EVENT OF A DEMONSTRATED LEAK IN THE RETENTION RESERVOIR OR FAULT BLOCK THE WASTE FLUID CAN BE RECOVERED

8-1 The Licensee testified that it did not intend to recover any of the injected wastewater except in the event of a demonstrated accident or leak. (Tr. 222-224). The Licensee

further testified that should recovery become necessary, only 85 percent of the wastewater could be recovered by pumping out a volume of water equal to that injected. (Tr. 223-224). In any event, the record shows that none of the uranium or the thorium can be recovered because they precipitate out of the wastewater after neutralization in the formation. (Tr. 222-224).

8-2 The Board finds that the Licensee's 85 percent recovery estimate is unrealistically high due to greater than predicted mixing of the wastewater with the formation water (Tr. 222-224). Due to this mixing phenomenon, the Licensee would have to pump out a much greater volume of water than was injected to recover even 85 percent of the injected wastewater. Should such recovery ever become necessary, the Licensee has not demonstrated that it has sufficient surface storage capacity to retain the wastewater.

ADDITIONAL ISSUE: WHETHER RELEASE OR ESCAPE OF THE RAFFINATE WASTEWATER FROM THE DISPOSAL FORMATION WOULD POSE A RADIOLOGICAL HEALTH AND SAFETY HAZARD

9-1 Although not an issue framed in the Party's "Joint Statement of Proposed Issues," both Licensee and the Staff presented testimony concerning the radiological health and safety

aspects of disposing of the raffinate wastewater via the deep well. The Licensee's application of May 10, 1972 (K-M Exh. 1) requested permission to dispose of Ra-226 via the deep well up to the average concentration of 2.1×10^{-5} uCi/ml. This concentration is approximately 700 times the value of 3×10^{-8} uCi/ml established by Appendix B to 10 CFR Part 20 as the maximum permissible concentration of Ra-226 which may be released to an unrestricted area. (Staff Exh. A, pp. 5-6). The Licensee testified that the concentration of Ra-226 should be considered as an upper limit and that typical analysis of the raffinate wastestream indicated a Ra-226 concentration of only 340×10^{-8} uCi/ml, which is approximately 100 times the limit set in Appendix B (K-M Exh. 3E, Figure 1; Tr. 208-213). The reason given by the Licensee, however, for requesting a concentration limit 7 times higher than concentrations indicated by typical analyses was to account for variations in the extraction process and variations in the sources of feed material - sources over which the Licensee has no control. (Tr. 210, 232).

9-2 The Licensee testified that the worst possible accident would be a release of raffinate wastewater with a Ra-226 concentration of 340×10^{-8} uCi/ml into either the Arkansas

or Illinois River. (K-M Exh. 3D, figure 2). The Licensee further testified that such a release would not pose a radiological health and safety hazard because the Ra-226 would be diluted downstream to concentrations below maximum permissible limits. (K-M Exh. 3D, p. 8). However, the Licensee indicated that at the point of discharge into the river, there would be a plume of raffinate effluent extending downstream which would have a higher concentration of Ra-226 than the ultimate dilution concentrations. (Tr. 131).

9-3 Although the typical concentration of Ra-226 in the raffinate stream is 340 x 10^{-8} uCi/ml, the Licensee testified that it was requesting permission to dispose of Ra-226 in concentrations up to 2.1 x 10^{-5} uCi/ml which is approximately 7 times the typical concentration. (Tr. 219-220). The Licensee further testified that if the higher concentration limit were used in the assessment of concentrations resulting from the injection of r ıate into the Illinois and Arkansas Rivers contained in Figure 2 of the Licensee's Exhibit 3D, the values contained in the column headed "Raffinate" should be multiplied by a factor of 7. (Tr. 129-130). For accidental escape into the Illinois River, this multiplication would result in contentration values for the "Min/Record (1 day only 9-16-59)" and the "Min/Record/1971" of 49 x 10^{-8} uCi/ml respectively.

9-4 The Licensee testified that it would be possible for the raffinate wastewater to seep into shallow subsurface wells in such a manner so that Ra-226 concentrations would reach the maximum permissible concentrations without detection by potential human recipients. (Tr. 125, 138). The Licensee further testified under cross-examination that in considering the genetic effects of radiation exposure, one should apply the so-called linear concept, i.e., it must be assumed that radiation exposures are cumulative in effect. (Tr. 122-123).

9-5 Based on the foregoing, the Board finds that release of the raffinate wastewater either into surface or subsurface waters may result in human exposure to Ra-226, which has a half-life of approximately 1600 years, in concentrations greater than maximum permissible limits prescribed for the general population in Appendix B to 10 CFR Part 20.

III. CONCLUSIONS OF LAW

Based upon the foregoing Findings of Fact which are supported by reliable, probative, and substantial evidence as required by the Administrative Procedure Act and the Commission's Rules of Practice, and upon consideration of the entire evidentiary record in this proceeding, the Board concludes as follows with respect to the issues

concerning the requirements of the Atomic Energy Act of 1954, as amended, and 10 CFR 40.32(c) and (d):

1. The Licensee's equipment, facilities, and procedures proposed for use pursuant to the requested amendment are inadequate to protect health and minimize danger to life or property.

2. The issuance of the amendment would be inimical to the health and safety of the public.

IV. ORDER

WHEREFORE, IT IS ORDERED, in accordance with the Atomic Energy Act of 1954, as amended, and the Commission's Rules and Regulations, that the May 10, 1972 application to amend Source Material License No. SUB-1010 is hereby denied.

IT IS FURTHER ORDERED, in accordance with Sections 2.760, 2.762, 2.764, 2.785, and 2.786 of the Commission's Rules of Practice, that this Initial Decision shall be effective immediately and shall constitute the final action of the Commission forty-five (45) days after the date of issuance hereof, subject to any review pursuant to the Rules of Practice. Exceptions to this Initial Decision and supporting

briefs may be filed by any party within seven (7) days after the service of this Initial Decision. Within fifteen (15) days thereafter (20 days in the case of the Regulatory Staff) any party filing such exceptions shall file a brief in support of such exceptions. Within fifteen (15) days after service of the brief of appellant (20 days in the case of the Regulatory Staff) any other party may file a brief in support of, or in opposition to, the exception.

Respectfully submitted,

Roy E. Kinsey, Jr.
Counsel for AEC Regulatory Staff

James P. Murray, Jr.
Chief Rulemaking and Enforcement
Counsel

Dated at Bethesda, Maryland
this 11th day of December, 1973.

UNITED STATES OF AMERICA
ATOMIC ENERGY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of Kerr-McGee Corporation Kerr-McGee Building Oklahoma City, Oklahoma	Amendment to Source Material License SUB-1010

CERTIFICATE OF SERVICE

I hereby certify that copies of "AEC Regulatory Staff's Proposed Findings of Fact and Conclusions of Law in the Form of a Proposed Initial Decision" dated December 11, 1973 in the captioned matter have been served on the following by hand delivery or by deposit in the United States mail, first class or air mail, this 11th day of December, 1973:

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