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KERR-McGEE CHEMICAL LLC
KERR- McGEE CENTER • P.O. BOX 25861 • OKLAHOMA CITY, OKLAHOMA 73125

December 14, 2001

D. Blair Spitzberg, Ph.D., Chief
Fuel Cycle Decommissioning Branch
United States Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

Re: Docket No. 040-08006; License No. SUB-986
Kerr-McGee Corporation LLC (KMCLLC) Technical Center
Responses to NRC Region IV Decommissioning Plan Review Comments

Dear Dr. Spitzberg:

I am writing in response to your comments regarding the KMCLLC Technical Center Decommissioning Plan (D Plan). We appreciate your technical review and submit these responses to comments for your consideration and application toward approval of the D Plan. We also understand from Rachel Carr of your staff that additional comments may be forthcoming. As such, we have not included change pages with this submittal, but will provide these pages once all agency comments have been received and addressed. Our specific responses to your comments on the D Plan are provided in Attachment 1.

We also request the addition of a new section (3.3.2.1) to the D Plan regarding the Limestone Pit located east of the parking lot in Soil Survey Units 19 and 20. This section describes replacement of the pit in the event that it needs to be removed during the decommissioning process. The new Section 3.3.2.1 is provided in Attachment 2.

In addition to the items described above, we are providing a revised version of Attachment 2 to Appendix E in the D Plan. During our review, we noticed that the original version of this attachment was an earlier draft and did not include certain technical information that might assist your staff in it's performance of a comprehensive review. Specifically, The Unit Conversion Factor (cpm/pCi/g) is shown in the new attachment. This is the source for the unit conversion factors shown in Table 1 of Appendix E. Also, minor adjustments were made to the geometry model to more accurately reflect field conditions. The revised version of the Appendix E attachment is provided as Attachment 3.

Finally, retirements and a recent reorganization within the Kerr-McGee Safety and Environmental Affairs Division necessitate changes to the Technical Center decommissioning organization. Russell Jones will now serve at the Project Manager and

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will report to Mike Logan who is the Director of Remediation. In addition, Jeff Ostmeyer, Senior Staff Compliance Specialist who reports to Tom Knight, will provide audit assistance. Attachment 4 contains the revised organization chart for the Technical Center decommissioning project.

Thank you for your assistance with these issues. Please feel free to contact me if there are any additional questions or concerns.

Sincerely yours,

Russell H. Jones
Project Manager
Kerr-McGee Corporation

Attachments

Kerr-McGee Corporation L.L.C. (KMCLLC) Technical Center
Responses to NRC Region IV Decommissioning Plan Review Comments

NRC Comment #1:
Section 2.2.2.2, Laboratories Where Source Materials Were Used, documents that smear surveys conducted prior to the 1985 expansion of the west wings of your facility verified that the smearable alpha surface activity was less that 200 dpm/100cm^2. NRC inspections conducted between 1985 and 1995 did not document a review of these surveys. Please submit the data from these surveys for our review.

In addition, please provide information regarding any release of materials to the environment, surface soil regrading, and any soil samples that might have been taken in this area prior to the expansion.

KMCLLC Response:
The 1985 expansion of the west wings of the facility was initiated in August of 1984 and completed in May of 1995 and thus the 1984 NRC inspection may contain documentation of these surveys. KMCLLC does not have a copy of the 1984 NRC inspection report. Appendix 1 contains the bi-monthly radiation monitoring records for August, October and December of 1984 and for February and May, 1985. These bi-monthly radiation-monitoring records document that the smearable alpha surface activity was less than 200 dpm/100cm^2. In addition, the exterior west wall of the Technical Center that existed prior to the 1985 expansion of the west wings is still in place as it existed prior to the 1985 expansion.

A review performed of available records and files did not identify any information regarding any release of materials to the environment, surface soil re-grading, or any soil samples that might have been taken in this area prior to the west wing expansion.

NRC Comment #2:
Section 2.2.2.4.2, Sample Preparation Facility, states that the sample prep room was enclosed and contained a ventilating hood. Section 2.3.1.5, Air/Hood Vents Cleaned, states that you do not expect to find accumulations of source material in the lab hood system. Please clarify whether your final status survey plan includes (1) dismantling and surveying the ventilation system in the sample preparation facility, and (2) surveying the roof of the sample preparation facility.

KMCLLC Response:
The final status survey plan includes surveying the ventilation system in the sample preparation facility and surveying the roof of the sample preparation facility. Radiological measurements will be taken in the immediate vicinity of any roof ventilation stacks when they originate in an affected lab to document any potential residual contamination. Measurements will consist of scan surveys and bias surveys at the point of intake and discharge and along roof drainage flow paths from the ventilation area using instrumentation such as a Ludlum 2224 with 43-89 probe or equivalent. The Table

3.6 building surfaces release criteria will be applied to these measurements. Smear samples will also be collected as an indicator of removable activity at accessible discharge point openings. Further investigation will be performed if the surveys indicate the presence of residual activity above the release criteria. For clarification, the first sentence of Section 2.3.1.5 in the Decommissioning Plan (D Plan) will be revised as follows: "Although the *existing* laboratory hood systems were monitored...".

NRC Comment #3:
Figure 2.4, highlights the locations to be surveyed. Provide the classification for the bathroom area (buffer zone) between Class 1 Sample Prep (P-2) room and Class 2 Pilot Plant room and your justification for this classification.

KMCLLC Response:
The men's changing room is located between rooms P-1 and P-2 as depicted in Figure 2.4 of the D Plan. This room allows for access from both SU 106 and SU 107 and could have been a pathway between them for personnel working in both areas. Accordingly, this room will be added to Figure 2.4 as an affected room and has been added to the Class 2 Survey Unit (SU) # 106. Revised D Plan pages will reflect:

- Addition of room G-1 to Table 2.1.
- Addition of room G-1 to Table 3.4 as part of SU 106.
- Revision to Table 3.4 to reflect more current surface area data and the division of Room P-2 (Sample Prep Room) between SU106 and SU107.
- Revisions to Figure 2.4 and Drawing TECHCNTR 006 to include Room G-1 and the addition of the room in SU106

Justification for classification of room G-1 is as follows:

- Characterization data indicated negligible smearable activity (i.e., less than 3 dpm/100 cm^2 alpha and beta);
- Direct alpha measurements ranged from 0 to 40 dpm/100cm^2;
- Direct beta-gamma measurements ranged from 0 to 1879 dpm/100cm^2 including matrix background (the elevated beta-gamma is primarily due to tiles containing naturally occurring materials, as evidenced by the micro-R meter exposure rates in the room);
- Exposure rate measurements ranged from 10 to 16 μR/h including background (9 μR/h).

In summary, all measurements indicate minimal if any impact from licensed activities. The men's change room will therefore receive a Class 2 survey.

NRC Comment #4:
Section 2.3.1.4, Sewer/Drain Lines, states that the drain traps in the designated use laboratories will be inspected and surveyed for residual contamination. Please provide information regarding the survey, including what surveys will be conducted, the survey instruments(s) that will be used and the calculated MDC for the survey.

KMCLLC Response:
Drain traps are considered fixed equipment since they are rigidly mounted to the room surfaces. FC 83-23 is used as guidance for the conduct of these surveys. The survey of the sewer/drain lines will be conducted using a combination of beta scans and bias direct beta measurements. The instrument used will be the Ludlum 2224 with a 43-89 probe, or equivalent.

The following description from a final status survey design for the KMCLLC Technical Center is provided for additional clarification of the survey requirements for drains:

"Surveyors should use process knowledge, existing data, and health physics 'good practices' to cover specific areas where contamination is likely to be found, especially in and around items of fixed equipment.

Bias survey measurements should be taken on all affected fixed equipment identified in the appendix for the specific survey unit. To the extent practical, internal access points for pipes, tanks, ducts and similar equipment will receive a survey by either direct measurement, beta scan, or NaI scan to determine the potential for internal radioactivity. The degree of effort required to obtain access to the interior is left to the judgment of the surveyor. The following should be used as guidance for measuring internal surfaces:

> The radioactivity on the interior surfaces of pipes, drain lines, or ductwork shall be determined by making measurements at all traps and other appropriate access points, provided that contamination at these locations is likely to be representative of contamination on the interior.

In practice, direct beta measurements on the top of the drain (in the sink) would be measured. A NaI measurement from the exterior of the trap would be used as a qualitative indicator of any high levels of contamination. Positive indications of elevated contamination levels either from the exterior direct bias measurement points or the NaI would result in removal of the trap for further measurements and action. Swipes can be obtained on the interior surfaces of a removed trap as a further indicator of elevated activity.

MDCs for beta measurements on glass or metal surfaces would be approximately 120 bpm/100 cm^2 (assuming a one (1) minute count). Swipes would be measured by a Tennelec 5100 and would have the MDA as stated in Table 5.1 of the KMTC D Plan."

NRC Comment #5:
Section 2.4.5, Groundwater Impacts From Licensed Activities, indicates that the down gradient wells were plugged and abandoned as a result of the excavation activities in December 2000, and that the last data from the down gradient wells (1,7,8) were collected in February 2000. Section 2.4.8, Shallow Groundwater Impacts From Excavation Activities, states that a small groundwater seep in the northwest corner of the excavation pit was identified with a total uranium concentration of approximately 1270 pCi/l, and that ongoing analysis of water samples shows a decline in total uranium

concentrations. Please comment on apparent migration of uranium and the elevated uranium concentrations in the excavation pit and the seep water (IFI 40-8006/0101-01)

KMCLLC Response:
As stated, elevated concentrations of uranium in groundwater were measured in the test pit excavation. Since submittal of the D Plan, the field analyses that were performed at the Cimarron facility have been modified based upon outside laboratory comparisons with General Engineering Laboratory in Charleston, SC. Thus, the initially reported total uranium value of 1270 pCi/L has been corrected to 2541 pCi/L.

As stated in the D Plan, all soils containing residual activity above the proposed subsurface soil $DCGL_w$ (110 pCi/g) were removed. During the 10 months the excavation remained open, water was removed on a regular frequency from the pit. Initially, an average of greater than one thousand gallons of water were generated daily from the pit. In time, as the area surrounding the pit was de-watered, recharge to the pit declined, so that when pumping ceased in August, 2001, the pit was only capable of making approximately 100 gallons of water per day or less.

Uranium concentrations in the seep located at the West end of the excavation continued to show a general decline until the seep was covered by soil which slumped from the side walls of the excavation from heavy rainfall in April, 2001. Pumping of the excavation continued, with periodic composite sample collection and analysis, until the excavation was backfilled to surface grade during August, 2001. Just prior to the time of backfill, independent laboratory analysis of three samples by General Engineering Laboratory (samples collected April 27, June 28, and August 1, 2001), and two samples by Severn-Trent Labs-Richland (samples collected June 28 and August 1, 2001) indicated concentrations below the proposed DCGL for groundwater. The samples collected just prior to backfill of the excavation indicated concentrations in the range of 80 pCi/L from each of the two independent laboratories.

We believe that the regular removal of water from the pit (which decreased in time from an average of over one thousand gallons per day the first few months to a few hundred gallons per week at the end) as recharge lessened effectively de-watered the area around the excavation. The removal of approximately 440,000 gallons of water from the pit during that time effectively remediated the site, as evidenced by consecutive analyses (verified by two independent labs) of collected water samples with uranium concentrations of less than the DCGL. The combination of decreasing concentration and volume of water entering the excavation suggests that the remaining residual activity in the interstitial pore spaces of soils surrounding the test pits has been substantially reduced and that it is below the groundwater DCGL as presented in the D Plan.

NRC Comment #6:
Section 3.2.2.1, Background in Building Materials or Equipment, includes Table 3.1 which provides a summary of background radioactivity for matrix specific materials which were measured in unaffected areas of your facility. Please provide information regarding the following:

- The locations where matrix samples were collected
- The instrument(s) used for the analysis
- The type of radiation (e.g. β/γ) measured
- The efficiency of the instrument(s) used

KMCLLC Response:
We have modified Table 3.1 to include brick as a sample matrix. In addition, Table 3.1 has been revised to provide the locations for the matrix sample measurements. Table 3.2 is added to the D Plan to provide information regarding the instruments used in the analysis, type of radiation measured, and typical instrument efficiencies. The revised Table 3.1 and Table 3.2 are reproduced below. The remaining tables and pages in Section 3 of the D Plan will be renumbered when all comments have been resolved through the issuance of change pages to the D Plan.

Table 3.1
Background Reference Data and Thresholds for Building Surfaces

Matrix Code	Matrix Material	Number of Data Points	Average Background ($dpm/100cm^2$)	Sigma ($dpm/100cm^2$)	Background Threshold* ($dpm/100cm^2$)	Location
B	Brick	15	2496	240	2976	F&D – Chaseway between F & D Wings
C	Concrete	15	610	201	1012	Stock Room 15, Maintenance Shop, & Battery Material Storage Area
CB	Concrete Block	15	1683	187	2056	Stock Room 24
CTP	Countertop	15	540	390	1320	Rooms D3, E17, & F6
CTX	Celotex Tile	10	969	117	1203	Room F19
FT	Formica Tops	15	272	144	560	Room E1
GB	Gypsum Board	15	106	213	533	Rooms F6, D3, & D7
PL	Plaster	15	471	359	1190	Rooms D3, D10, & D7
VT	Vinyl Tile	15	306	180	665	Rooms F6, F10, & F14

*Mean value plus two times standard deviation (sigma)

Table 3.2
Instruments used for Matrix Background Measurements

Instrument	Serial #	Radiation Measured	Effective Area (cm^2)	Efficiency (dpm/cpm)
L2224 / L43-89	114616	β/γ	110	0.14-0.17
L2224 / L43-89	114606	β/γ	110	0.15
L2360 / L43-89	138250	β/γ	110	0.13

NRC Comment #7:
Table 3.4, Soil Characterization Data, provides data which includes contributions from natural background. Please comment on the elevated background values for natural thorium in the area locations annotated as "N of Pits" and E Drainage." In addition, please comment on the elevated background values for uranium in the area location annotated as "E Drainage."

The area location annotated as "TSSL Drain Area," appears to have the highest value measured by a NaI instrument Please provide justification for not collecting samples in this area.

KMCLLC Response:
Review of characterization data for Soil Survey Unit (SSU) 2 and 16-20 indicates that additional data have been collected since submittal of the D Plan. In addition, a transcription error was identified regarding the maximum thorium concentration for SSU 2 as the data indicate that natural thorium is present at levels characteristic of natural background. Natural thorium measurements in the East drainage area SSU 17 may be due to runoff from other areas, or may be present due to spillage or storage of materials, since the the areal extent of the elevated soils appears limited. Elevated measurements in SSU 19 and 20 are most likely due to cleanout, overflow or spillage from the limestone pit. Updated data for the SSU of interest are presented in the revision to D Plan Table 3.5 (previously Table 3.4) which is provided below.

The TSSL Drain Area (SSU 6) contains a drain line that originated in the TSSL Building Exposure Lab (Room T-1, SU 109). This line exits the lab near the northwest corner where it enters SSU 6, and proceeds toward the west in SSU 5. Samples have been collected in the area and are awaiting analysis. Both SSU 5 and SSU 6 are Class 1 survey units and will receive appropriate surveys in accordance with the D Plan.

Table 3.5[1]
Soil Characterization Data

				Total U(pCi/g)		Nat Th(pCi/g)		Ra-226(pCi/g)			
Area Location	*# Samples*	*SSU[2]*	*Class*	*Max*	*Mean*	*Max*	*Mean*	*Max*	*Mean*	NaI $_{Max}$ (cpm)	µR $_{Max}$ (µR/hour)
U Test Pits	32	01	1	3.0	1.1	2.8	2.1	0.8	0.6		
N of Pits	84	02	1	53.1	2.5	3.4	1.9	7.8	0.8	12,200	34
S of Pits	1	03	1	1.1	1.1	2.8	2.8	0.7	0.7		15
Buffer	2	04	2	2.6	2.4	2.8	2.8	0.9	0.8	5,000	
Drain Line	6	05	1	10.2	2.9	3.1	2.7	1.2	0.8	5,000	
TSSL Drain Area	0	06	1							79,000	180
Access Rd	0	07	1							18,000	31
Yard	0	08	1								
Yard	0	09	1								16
Buffer	0	10	2								
Storage Area	0	11	1							30,000	80
Storage Area	0	12	1							56,000	70
Storage Area	0	13	1								16

Storage Area	0	14	1								16
N/E of bldg	0	15	2							6,700	18
E. Drainage	50	16	1	15.3	3.2	2.4	1.9	13.1	1.3	7,000	N/A
E. Drainage	2	17	1	261	183	8.1	6.1	54.4	37.1	35,000	135
E. Drainage	2	18	1	21.6	14.4	2.5	2.2	4.3	3.3	9,000	22
E. Drainage	80	19	1	36.4	2.8	32.6	3.8	2.5	0.8	17,000	22
E. Drainage	26	20	1	13.0	1.6	5.7	2.3	1.2	0.6	12,000	24
E. Pond	8	21	1	2.1	1.2	2.9	2.5	0.9	0.7	5,200	17
E. Pond	12	22	1	1.9	1.2	2.8	2.6	0.9	0.7	5,100	15
E. Pond	0	23	1								15
Buffer	0	24	2								

[1] *Concentrations and data given in this table include the contribution from natural background.*

[2] *SSU – Soil Survey Unit*

NRC Comment #8:

Section 3.4.3, On-site Storage, states that waste will be stored in a designated "access restricted" location. Please clarify whether this waste storage location is onsite. If radioactive waste will be stored onsite, clarify whether this waste will be stored onsite until license termination.

KMCLLC Response:

The waste storage location is onsite. Most of the waste generated as a result of the Test Pit excavation and cleanup was shipped offsite to the Envirocare facility in Utah. However, a small amount of waste in one rolloff container is currently being stored onsite. On-site waste storage will most likely be utilized throughout the decommissioning process until license termination.

NRC Comment #9:

Table 5.1, Cimarron/Technical Center Radiation Monitoring Instruments, provides typical efficiency and confidence levels for instruments used during decommissioning. This is satisfactory for preliminary work. However, for the final status survey, the efficiencies and confidence levels will have to be calculated for the specific measurements. Section 6.7 of NUREG-1575, Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), stipulates that it is important to use actual background count rate values and detection efficiencies when determining counting and scanning parameters, particularly during final status and verification surveys. Please revise Table 5.1 to include actual instrument efficiencies and confidence levels.

KMCLLC Response:

The instrument efficiencies listed in Table 5.1 are typical measurements for instruments when calibrated in accordance with applicable Cimarron procedures. Table 5.1 is intended as a summary reference. The actual background count rate values and efficiencies used with each measurement performed for final status surveys are recorded in the survey records and in the database where they are used to convert from counts to appropriate units of interest. These records are available for onsite inspection by the NRC.

NRC Comment #10:
Section 6.3, Data Quality Objectives, Item Number 7, states that the MDC for scans should be less than the $DCGL_{EMC}$. However, Section 5.5.2.6 of MARSSIM states, that for Class 2 or Class 3 areas, neither measurements above the $DCGL_w$ nor areas of elevated activity are expected, because the survey design for Class 2 or Class 3 survey units is not driven by the EMC. Therefore, the MDC for scans for Class 2 and Class 3 areas should be less that the $DCGL_w$. Please revise the DP to reflect the intent of MARSSIM.

KMCLLC Response:
Section 5.5.2.6 of MARSSIM, in that same paragraph, goes on to state that "Because the survey design for Class 2 and Class 3 survey units is not driven by the EMC, the scanning MDC might exceed the $DCGL_w$. In this case, any indication of residual radioactivity during the scan would warrant further investigation." The DQO in Section 6.3 of the D Plan will be revised to state the following: "The MDC for scans for Class 2 and Class 3 areas should be less than the $DCGL_w$. While Kerr-McGee's goal during decommissioning is to obtain a scan MDC that is as low as reasonably achievable, it may not always be possible to obtain an MDC less than the $DCGL_w$. In accordance with MARSSIM guidance, any indication of residual radioactivity will be identified for further investigation."

NRC Comment #11:
Section 6.4.7, Determine the Data Collection Requirements for Statistical Tests, states that the design process may be redesigned utilizing more suitable values for α, β and LBGR, if the required number of measurements determined for a survey unit exceed "reasonable bounds." The null hypothesis states that the residual contamination in the survey unit is greater than the $DCGL_w$. The Type II Error is made when the null hypothesis is not rejected when it is false and the initial value for beta equals 0.05. The Type II error rate is the error rate of concern by the NRC, because it directly effects the release criteria. Therefore, the beta value (β=0.05) can not be adjusted without justification and approval by the NRC. Please provide a commitment that the beta value will not be changed without the NRC's approval.

Section 6.4.7 also states "If the $DCGL_{EMC}$ is lower that the MDC, the spacing of the grid samples will be accordingly." Please clarify this sentence.

KMCLLC Response:
The D Plan will be revised to state in Section 6.4.7 that the DQO Type II error rate of 0.05 will not be adjusted without justification and approval from the NRC.

In addition to the above commitment, Section 6.4.7 of the D Plan will be revised as follows: "If the $DCGL_{EMC}$ is lower than the MDC, the spacing of the grid samples (L) will be *reduced* accordingly." The remainder of this paragraph in the D Plan provides further details as to how the grid spacing will be reduced.

NRC Comment #12:
Section 6.4.9, Specify Required Level of Beta/Gamma Scan Measurements, states that on soil surfaces beta/gamma scans will be performed using sodium iodide detectors. Please provide the energy peak for determining the presence of uranium and thorium in soils. If the DCGL is based on thorium, please provide the gamma peak for which the beta/gamma scan is based.

Note that, in accordance with Section 4.3.2 of MARSSIM, when using one radionuclide to measure the presence of others, a sufficient number of measurements, spatially separated throughout the survey unit, should be made to establish a "consistent" ratio. Additionally, when the ratios are determined using final status survey data, MARSSIM recommends that at least 10 percent of measurements (both direct measurements and samples) include analyses for all radionuclides of concern. Section 5.5.3 of MARSSIM also cautions that scanning for alpha emitters or low-energy beta emitters for land area survey units is generally not considered effective because of problems with attenuation and media interferences.

KMCLLC Response:
We first acknowledge a typographical error in that our NaI scans will measure gamma radioactivity only, not beta/gamma. Gamma scans will be performed using 3" by 0.5" NaI(Tl) detectors in the "window out" mode. This configuration will count any gamma that has sufficient energy to penetrate the detector holder and impart energy within the detector volume. Therefore, neither specific peaks nor surrogate radionuclide analyses are used in the scan measurements. Instead, the entire spectrum is integrated and used to determine the possible presence of residual activity.

Scans of outdoor areas present a challenge due to the fact that neither beta nor alpha surveys can be effectively utilized as is the case for indoor areas. In order to derive the MDC for outdoor scans, calculations were made based upon an assumed homogeneous contamination of outdoor areas as is detailed in Appendix E of the D Plan. Using the Microshield® computer code, each gamma in the Uranium and Thorium decay series was accounted for and the probability that a given gamma would contribute to the total counts measured by a NaI(Tl) detector was calculated. Using a series of concentric rings, an estimate of total counts was derived that approximates an infinite plane source. Appendix E in the D Plan provides the fluence rates for each energy increment for the Uranium and Thorium decay series of interest. Table 1 in Appendix E of the D Plan gives the unit conversion factor to convert NaI count rate data to radionuclide concentrations. Correlation of the count rate data and actual sample concentration data is presented in Figure 1 of Appendix E. The correlation will be expanded upon as field data are accumulated in order to further justify the scanning methods.

NRC Comment #13:
Section 6.4.9 also states that for Class 2 areas, surface scans will be performed on at least 10 percent of structure surfaces and/or fixed equipment and soil surfaces. Generally floors will receive 15 percent surface scans or greater, walls and ceilings will receive less that 10 percent.

However, Chapter 5 of MARSSIM indicates that for Class 2 survey units surface scans are performed over 10 to 100 percent of structure surfaces, with upper wall surfaces and ceiling receiving surface scans over 10-50 percent. For soil surfaces, scans are performed over 10 – 100 percent of open land surfaces. Please revise your DP to include surface scans of not less than 10 percent of upper wall surfaces and ceilings. Optionally, you may provide a justification for the reduced scanning in Class 2 survey areas.

KMCLLC Response:
In Section 6.4.9 the paragraph titled Class 2 Areas will be revised as follows:
Class 2 Areas. Surface scans will be performed on at least 10% of structure surfaces and/or fixed equipment, and soil surfaces. (Generally, floors will receive 15% surface scans or greater but walls and ceilings will receive no less than 10% surface scans.)

NRC Comment #14:
Section 6.4.10, Specify Contingency Action, discusses the contingency actions in the event the scan threshold is exceeded. The contingency action is acceptable. However, Section 5.5.3 of MARSSIM states that for any survey area which exceeds the investigation level, the area should be reclassified and documented as such in the final status survey report. Please revise your DP to include the investigation of any measurements which exceed the investigation levels and the documentation, in the final status survey report, of any actions taken.

KMCLLC Response:
The last sentence of the last paragraph in Section 6.4.10 of the D Plan will be replaced with the following:
"When direct readings confirm that radioactivity exceeding the $DCGL_w$ exists in a class 2 or 3 survey unit, the elevated area will be reclassified as Class 1 and the FSSP will be adjusted to reflect the change. Survey unit areas in the vicinity of the elevated area will also be evaluated to determine if any additional measurements are needed and whether reclassification is necessary. The survey designer and/or analyst will provide direction regarding additional characterization and/or remediation requirements. The actions taken and the evaluation of the final results will be documented in the Final Status Survey Report."

NRC Comment #15:
Section 6.5, Final Status Survey Instrumentation, states that source response checks are performed on a daily basis for all instruments being utilized for Final Status Survey work. However, MARSSIM recommends that a response check should be performed twice daily when in use. Please revise your DP to include that a response check for survey equipment be performed twice daily when in use. Optionally, you may provide a justification to perform source checks as described in your DP.

KMCLLC Response:
We believe that daily source checks are justified when instruments are used for surveys. If an instrument fails a source check, all data collected prior to the source check, up to and including the last satisfactory source check, will be reviewed. Acceptance of the

questionable data will hinge upon whether the instrument failure would result in over-reporting or under-reporting. While either case might result in discarding the data, the case of under-reporting is more critical since it could affect decisions with health and safety implications. In all cases where the source check failure could result in under-reporting, data will be further scrutinized and quality control measurements will be used as necessary to assist the evaluator in the decision to either accept or reject data.

Section 6.5 of the D Plan will be revised to reflect this commitment.

NRC Comment #16:
Section 6.6.1, Review and Approval of the Survey Design, states that all final status survey plans will be reviewed and approved prior to being implemented. Please provide clarification regarding who is responsible for the review and approval of the plans.

KMCLLC Response:
Final status survey plans are drafted by NEXTEP Environmental, Inc. and reviewed and approved by representatives of Kerr-McGee. Each FSSP will be signed by the Project Manager, the Cimarron Radiation Safety Officer, and the NEXTEP Environmental Technical Director to certify that an adequate review has been completed within each organization and the document is acceptable to both. This commitment will be reflected in a revision to Section 6.6.1 of the D Plan.

NRC Comment #17:
Section 6.6.1, also states that the final status survey plans should verify that the scan MDC is less than the $DCGL_{EMC}$. However, for Class 2 and Class 3 scans, the MDC should be less than $DCGL_w$. Please revise your DP to reflect the appropriate DCGL for Class 2 and Class 3 survey areas.

KMCLLC Response:
Section 5.5.2.6 of MARSSIM, in that same paragraph, goes on to state that "Because the survey design for Class 2 and Class 3 survey units is not driven by the EMC, the scanning MDC might exceed the $DCGL_w$. In this case, any indication of residual radioactivity during the scan would warrant further investigation." While Kerr-McGee's goal during decommissioning is to obtain a scan MDC as low as reasonably achievable, it may not always be possible to obtain an MDC less than the $DCGL_w$. In this instance and in accordance with MARSSIM guidance, any indication of residual radioactivity will be identified for further investigation.

Section 6.6.1 of the D Plan will be revised to reflect this commitment.

Appendix 1

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO File
FROM W. J. Robertson

DATE August 15, 1984
SUBJECT Bimonthly Radiation Monitoring

A radiation survey was conducted at the Technical Center August 13, 1984. Alpha and gamma radiation was measured for areas where radioactive material is or has been used.

Surface alpha contamination action levels at the Technical Center are 1,000 dpm fixed and 200 dpm smearable per 100 cm^2. If the reading is >200 dpm per 100 cm^2, the surface may be wiped for determination of smearable activity, or the surface may be cleaned as part of the survey. For gamma, the standard currently used by Nuclear Regulatory Commission inspectors is <2 mr/hr at "18" inches from the radiation source. This level of radiation is satisfactory for an unrestricted area.

The radiation inspection instruments are checked against standards prior to each inspection. The E-120 was calibrated July 30, 1984. The alpha PAC-3G was calibrated April 12, 1984.

Survey Results:

Alpha Radiation

Areas checked were less than 200 dpm/100 cm^2.

Gamma Radiation

Location	γ mr/hr	
C-13	0.1	Samples in N.W. hood
C-5	0.6	Sample cabinet and Radon cells
C-1	0.02	
E-2	0.02	
E-8	0.02	
E-10	0.02	
E-12	0.20	Samples in hood and closet
F-4	0.4	Floor safe, standards
Sample Prep (W. Whse)	0.02	
Sample Prep (TSSL)	0.02	Samples on east wall
E-14	0.02	
N.W. Bldg.	0.2	Waste stored in building

The proper signs are posted appropriately per NRC regulations.

W. J. Robertson

W. J. Robertson

WJR/cmt
TIC: Project No. 951

KERR-McGEE CORPORATION

INTERNAL CORRESPONDENCE

TO File | DATE October 5, 1984

FROM W. J. Robertson | SUBJECT Bimonthly Radiation Monitoring

A radiation survey was conducted at the Technical Center October 5, 1984. Alpha and gamma radiation was measured for areas where radioactive material is or has been used.

Surface alpha contamination action levels at the Technical Center are 1,000 dpm fixed and 200 dpm smearable per 100 cm^2. If the reading is >200 dpm per 100 cm^2, the surface may be wiped for determination of smearable activity, or the surface may be cleaned as part of the survey. For gamma, the standard currently used by Nuclear Regulatory Commission inspectors is <2 mr/hr at "18" inches from the radiation source. This level of radiation is satisfactory for an unrestricted area.

The radiation inspection instruments are checked against standards prior to each inspection. The E-120 was calibrated July 30, 1984. The alpha PAC-3G was calibrated April 12, 1984.

Survey Results:

Alpha Radiation

Areas checked were less than 200 dpm/100 cm^2.

Gamma Radiation

Location	γ mr/hr	
C-13	0.1	Samples in N.W. hood
C-5	0.6	Sample cabinet and Radon cells
C-1	0.02	
E-2	0.02	
E-8	0.02	
E-10	0.02	
E-12	0.20	Samples in hood and closet
F-4	0.4	Floor safe, standards
Sample Prep (W. Whse)	0.02	
Sample Prep (TSSL)	0.02	Samples on east wall
E-14	0.02	

The proper signs are posted appropriately per NRC regulations.

W. J. Robertson

W. J. Robertson

WJR/ln

TIC: Project No. 951

TECHNOLOGY DIVISION

KM-514-11-B

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO File

FROM W. J. Robertson

DATE December 31, 1984

SUBJECT Bimonthly Radiation Monitoring

A radiation survey was conducted at the Technical Center December 28, 1984. Alpha and gamma radiation was measured for areas where radioactive material is or has been used.

Surface alpha contamination action levels at the Technical Center are 1,000 dpm fixed and 200 dpm smearable per 100 cm^2. If the reading is >200 dpm per 100 cm^2, the surface may be wiped for determination of smearable activity, or the surface may be cleaned as part of the survey. For gamma, the standard currently used by Nuclear Regulatory Commission inspectors is <2 mr/hr at "18" inches from the radiation source. This level of radiation is satisfactory for an unrestricted area.

The radiation inspection instruments are checked against standards prior to each inspection. The E-120 was calibrated July 30, 1984. The alpha PAC-3G was calibrated November 21, 1984.

Survey Results:

Alpha Radiation

Areas checked were less than 200 dpm/100 cm^2.

Gamma Radiation

Location	γ mr/hr	
C-13	0.1	Samples in N.W. hood
C-5	0.6	Sample cabinet and Radon cells
C-1	0.02	
E-2	0.02	
E-8	0.02	
E-10	0.02	
E-12	0.20	Samples in hood and closet
F-4	0.4	Floor safe, standards
Sample Prep (W. Whse)	0.02	
Sample Prep (TSSL)	0.02	Samples on east wall
E-14	0.02	

The proper signs are posted appropriately per NRC regulations.

W. J. Robertson
W. J. Robertson

WJR/ps
TIC: Project No. 951

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO File

FROM W. J. Robertson

DATE February 5, 1985

SUBJECT Bimonthly Radiation Monitoring

A radiation survey was conducted at the Technical Center February 5, 1985. Alpha and gamma radiation was measured for areas where radioactive material is or has been used.

Surface alpha contamination action levels at the Technical Center are 1,000 dpm fixed and 200 dpm smearable per 100 cm^2. If the reading is >200 dpm per 100 cm^2, the surface may be wiped for determination of smearable activity, or the surface may be cleaned as part of the survey. For gamma, the standard currently used by Nuclear Regulatory Commission inspectors is <2 mr/hr at "18" inches from the radiation source. This level of radiation is satisfactory for an unrestricted area.

The radiation inspection instruments are checked against standards prior to each inspection. The E-120 was calibrated July 30, 1984. The alpha PAC-3G was calibrated November 21, 1984.

Survey Results:

Alpha Radiation

Areas checked were less than 200 dpm/100 cm^2.

Gamma Radiation

Location	γ mr/hr	
C-13	0.1	Samples in hoods
C-5	0.6	Sample cabinet and Randon cells
C-1	0.02	
E-2	0.02	
E-8	0.02	
E-10	0.02	
E-12	0.20	Samples in hood and closet
F-4	0.4	Floor safe, standards
Sample Prep (W. Whse)	0.02	
Sample Prep (TSS)	0.02	Samples on east wall
E-14	0.02	
Pilot Plant	1.0	Density gauge

The proper signs are posted appropriately per NRC regulations.

The following radiation generators were surveyed on January 22-24, 1985, with the E-120: Siemans XRD, Siemans XRF, Norelco EM, and Micromerities size analysis. No radiation was detectable above background with this instrument.

W. J. Robertson

W. J. Robertson

ps

TIC: Project No. 951

KERR-McGEE CORPORATION
INTERNAL CORRESPONDENCE

TO File
FROM W. J. Robertson

DATE May 2, 1985
SUBJECT Bimonthly Radiation Monitoring

A radiation survey was conducted at the Technical Center April 29, 1985. Alpha and gamma radiation was measured for areas where radioactive material is or has been used.

Surface alpha contamination action levels at the Technical Center are 1,000 dpm fixed and 200 dpm smearable per 100 cm^2. If the reading is >200 dpm per 100 cm^2, the surface may be wiped for determination of smearable activity, or the surface may be cleaned as part of the survey. For gamma, the standard currently used by Nuclear Regulatory Commission inspectors is <2 mr/hr at "18" inches from the radiation source. This level of radiation is satisfactory for an unrestricted area.

The radiation inspection instruments are checked against standards prior to each inspection. The E-120 was calibrated March 26, 1985. The alpha PAC-3G was calibrated November 21, 1984.

Survey Results:

Alpha Radiation

Areas checked were less than 200 dpm/100 cm^2.

Gamma Radiation

Location	γ mr/hr	
C-13	0.2	Samples in lab
C-1	0.02	
E-8	0.02	
E-10	0.02	
E-12	0.20	Samples in hood and closet
Sample Prep (W. Whse)	0.02	
Sample Prep (TSSL)	0.02	Samples on east wall
E-14	0.02	
E-22	0.02	
E-24	0.02	
E-26	0.5	Radioactive materials storage
Pilot Plant	1.0	Density gauge

The proper signs are posted appropriately per NRC regulations.

During this period, the Analytical Department vacated rooms C-5, E-2, and F-4. Radioactive materials are now stored in E-26 and will be used in E-22 and E-24. These rooms are properly posted. Materials stored in E-26 are kept in a locked safe. Gamma survey shows 0.5 mr/hr at 18 inches from the front of the safe. Dose rate at the corridor wall adjacent to the safe is one mr/hr. Dose rate at the outside (north) wall is 0.6 mr/hr. These dose rates are satisfactory for an unrestricted area.

W. J. Robertson

W. J. Robertson

ps

TIC: Project No. 951

Attachment 2

3.3.2.1 Limestone Pit and Chemical Drains

Elevated characterization measurements were observed in the vicinity of the limestone pit east of the building located in Soil Survey Units (SSU) 19 and 20. If it becomes necessary to remove the limestone pit materials, a replacement treatment pit will be constructed in an area determined to be free of residual radioactivity above the release criteria, or in an unaffected area, and connected to the chemical drains leading to the current pit. Discharge from the new pit will be to the sanitary sewer lines downstream from the current pit. Any drain lines connections or replacements will involve appropriate surveys to assure that residual activity is identified, if present, and disposed in accordance with the criteria in the license and/or D Plan.

First Approximation for Th Nat

Energy increment	Na Mass attenuation coefficient (cm²/g)	I Mass attenuation coefficient (cm²/g)	NaI mass attenuation coefficients (cm²/g)	Mean free path (cm)	Fluence rate at detector (photons/cm²/s)	Detector thickness (g/cm²)	Detector counts (photons/cm²/s)	Detector Area (cm²)	CPM
0.020	2.057	25.430	21.845	0.012	-	4.661	-	46.0	-
0.030	0.720	8.561	7.358	0.037	-	4.661	-	46.0	-
0.040	0.397	22.100	18.771	0.015	0.045	4.661	0.045	46.0	125
0.050	0.280	12.320	10.473	0.026	-	4.661	-	46.0	-
0.060	0.227	7.579	6.451	0.042	0.109	4.661	0.109	46.0	301
0.080	0.180	3.510	2.999	0.091	11.670	4.661	11.670	46.0	32,209
0.100	0.159	1.942	1.668	0.163	2.496	4.661	2.495	46.0	6,886
0.150	0.134	0.698	0.611	0.446	1.788	4.661	1.684	46.0	4,649
0.200	0.120	0.366	0.329	0.829	23.680	4.661	18.558	46.0	51,221
0.300	0.103	0.177	0.166	1.644	11.610	4.661	6.247	46.0	17,242
0.400	0.092	0.122	0.117	2.326	1.062	4.661	0.447	46.0	1,233
0.500	0.084	0.097	0.095	2.869	6.207	4.661	2.220	46.0	6,127
0.600	0.077	0.083	0.082	3.313	14.250	4.661	4.537	46.0	12,523
0.800	0.068	0.067	0.068	4.034	14.590	4.661	3.941	46.0	10,876
1.000	0.061	0.058	0.059	4.633	27.450	4.661	6.581	46.0	18,163
1.500	0.050	0.046	0.047	5.802	6.614	4.661	1.300	46.0	3,589
2.000	0.043	0.041	0.041	6.569	0.155	4.661	0.027	46.0	75
3.000	0.035	0.037	0.037	7.403	19.330	4.661	3.047	46.0	8,411
				First approximation	**141.056**		**62.910**		**173,631**

Repeat analysis of NaI probe detectability by breaking the soil contamination into concentric rings.

	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	NaI mass attenuation coefficients (cm²/g)
	5.00	15.60	26.10	36.70	47.20	57.80	68.30	100.00	
Theta	28.00	64.00	76.50	81.00	83.20	84.60	85.50	86.60	
Photon path length through detector	1.42	2.89	4.00	4.00	4.00	4.00	4.00	4.00	

Energy increment	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	NaI mass attenuation coefficients (cm²/g)
0.020								-	21.845
0.030								-	7.358
0.040	0.011	0.032	0.038	0.041	0.043	0.043	0.044	0.045	18.771
0.050								-	10.473
0.060	0.020	0.071	0.090	0.098	0.010	0.105	0.106	0.109	6.451
0.080	1.712	6.950	9.300	10.030	11.083	11.160	11.360	11.670	2.999
0.100	0.317	1.383	1.929	2.171	2.297	2.373	2.424	2.496	1.668
0.150	0.193	0.896	1.312	1.156	1.621	1.684	1.725	1.788	0.611
0.200	2.401	11.320	16.890	19.770	21.290	22.190	22.780	23.680	0.329
0.300	1.110	5.275	8.006	9.501	10.310	10.810	11.120	11.610	0.166
0.400	0.098	0.468	0.716	0.857	0.935	0.983	1.014	1.062	0.117
0.500	0.562	2.678	4.119	4.954	5.428	5.727	5.913	6.207	0.095
0.600	1.267	6.041	9.324	11.260	12.380	13.100	13.540	14.250	0.082
0.800	1.261	6.019	9.343	11.360	12.550	13.330	13.820	14.590	0.068
1.000	2.317	11.070	17.260	21.080	23.380	24.930	25.890	27.450	0.059
1.500	0.532	2.555	4.016	4.950	5.530	5.939	6.193	6.614	0.047
2.000	0.012	0.058	0.092	0.011	0.128	0.138	0.145	0.155	0.041
3.000	1.428	6.935	11.050	13.810	15.610	16.980	17.830	19.330	0.037
	13.2	61.8	93.5	111.0	122.6	129.5	133.9	141.1	Source activity (photons/sec)

counts per energy increment per concentric ring (cm)

Energy increment	5	15.6	26.1	36.7	47.2	57.8	68.3	100	CPS per 100 pCi/g	Unit Conversion (cpm/pCi/g)
0.020	-	-	-	-	-	-	-	-	-	**1,141.747**
0.030	-	-	-	-	-	-	-	-	-	
0.040	0.457	0.562	0.106	0.047	0.022	0.012	0.008	0.013	1.227	
0.050	-	-	-	-	-	-	-	-	-	
0.060	0.819	1.387	0.307	0.134	(1.313)	1.322	0.021	0.035	2.712	
0.080	69.507	142.997	38.540	12.191	15.795	1.078	2.660	3.844	286.613	
0.100	12.880	29.094	8.954	4.041	1.890	1.064	0.678	0.893	59.495	
0.150	7.515	19.160	6.822	(2.605)	6.974	0.882	0.545	0.781	40.074	
0.200	79.863	236.104	90.613	47.709	22.617	12.499	7.784	11.070	508.258	
0.300	26.053	94.210	40.856	22.775	11.070	6.385	3.761	5.543	210.652	
0.400	1.822	7.189	3.340	1.929	0.963	0.556	0.335	0.489	16.622	
0.500	8.904	36.738	17.771	10.486	5.346	3.148	1.860	2.741	86.995	
0.600	17.921	76.011	37.743	22.665	11.777	7.066	4.102	6.172	183.457	
0.800	15.183	66.593	34.291	21.188	11.228	6.869	4.099	6.006	165.457	
1.000	24.816	111.153	58.699	36.888	19.949	12.548	7.383	11.185	282.620	
1.500	4.684	21.724	11.935	7.770	4.334	2.852	1.683	2.600	57.583	
2.000	0.095	0.449	0.253	(0.613)	0.797	0.065	0.039	0.061	1.145	
3.000	275.519	858.972	376.329	221.304	158.648	114.146	103.259	151.433	1,902.911	**Second approximation**
Source activity (photons/sec)	8,917	86,310	243,200	479,500	795,400	1,191,000	1,665,000	3,567,000	3,570,000	
	0.03090	0.01110	0.00240						0.00053	
			0.00155							

First Approximation for Th-230+

Energy increment	Na Mass attenuation coefficient (cm²/g)	I Mass attenuation coefficient (cm²/g)	NaI mass attenuation coefficients (cm²/g)	Mean free path (cm)	Fluence rate at detector (photons/cm²/s)	Detector thickness (g/cm²)	Detector counts (photons/cm²/s)	Detector Area (cm²)	CPM
0.020	2.057	25.430	21.845	0.012	0.000	4.661	0.000	46.000	0.013
0.030	0.720	8.561	7.358	0.037	0.000	4.661	0.000	46.000	0.022
0.040	0.397	22.100	18.771	0.015	0.000	4.661	0.000	46.000	0.132
0.050	0.280	12.320	10.473	0.026	0.417	4.661	0.417	46.000	1,150.920
0.060	0.227	7.579	6.451	0.042	0.059	4.661	0.059	46.000	162.454
0.080	0.180	3.510	2.999	0.091	6.418	4.661	6.418	46.000	17,713.665
0.100	0.159	1.942	1.668	0.163	0.075	4.661	0.075	46.000	207.161
0.150	0.134	0.698	0.611	0.446	0.049	4.661	0.046	46.000	127.643
0.200	0.120	0.366	0.329	0.829	4.814	4.661	3.773	46.000	10,412.818
0.300	0.103	0.177	0.166	1.644	9.381	4.661	5.048	46.000	13,932.091
0.400	0.092	0.122	0.117	2.326	17.330	4.661	7.290	46.000	20,121.157
0.500	0.084	0.097	0.095	2.869	0.811	4.661	0.290	46.000	800.987
0.600	0.077	0.083	0.082	3.313	22.010	4.661	7.008	46.000	19,342.983
0.800	0.068	0.067	0.068	4.034	4.399	4.661	1.188	46.000	3,279.307
1.000	0.061	0.058	0.059	4.633	14.840	4.661	3.558	46.000	9,819.372
1.500	0.050	0.046	0.047	5.802	9.472	4.661	1.862	46.000	5,139.334
2.000	0.043	0.041	0.041	6.569	13.890	4.661	2.442	46.000	6,739.638
3.000	0.035	0.037	0.037	7.403	-	4.661	-	46.000	-
			First approximation	40	104		39		108,950

Repeat analysis of NaI probe detectability by breaking the soil contamination into concentric rings.

	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	
	5.00	15.60	26.10	36.70	47.20	57.80	68.30	100.00	
Theta	28.00	64.00	76.50	81.00	83.20	84.60	85.50	86.60	
Photon path length through detector	1.42	2.89	4.00	4.00	4.00	4.00	4.00	4.00	
Energy increment	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	Fluence rate (photons/cm²/s)	NaI mass attenuation coefficients (cm²/g)
0.020	-							0.000	21.845
0.030	-							0.000	7.358
0.040	-							0.000	18.771
0.050	0.090	0.284	0.349	0.377	0.392	0.401	0.407	0.417	10.473
0.060	0.011	0.038	0.049	0.053	0.055	0.056	0.057	0.059	6.451
0.080	0.942	3.822	5.113	5.662	5.956	6.134	6.247	6.418	2.999
0.100	0.010	0.042	0.058	0.065	0.069	0.071	0.073	0.075	1.668
0.150	0.005	0.025	0.036	0.042	0.045	0.046	0.047	0.049	0.611
0.200	0.488	2.301	3.434	4.019	4.327	4.511	4.630	4.814	0.329
0.300	0.897	4.263	6.470	7.677	8.334	8.731	8.984	9.381	0.166
0.400	1.601	7.637	11.690	13.980	15.260	16.050	16.540	17.330	0.117
0.500	0.073	0.350	0.538	0.648	0.710	0.749	0.773	0.811	0.095
0.600	1.958	9.333	14.410	17.400	19.130	20.230	20.920	22.010	0.082
0.800	0.380	1.814	2.816	3.423	3.782	4.018	4.164	4.399	0.068
1.000	1.253	5.989	9.334	11.400	12.650	13.480	14.000	14.840	0.059
1.500	0.762	3.659	5.751	7.088	7.920	8.506	8.869	9.472	0.047
2.000	1.077	5.197	8.217	10.190	11.450	12.360	12.930	13.890	0.041
3.000	-	-	-	-	-	-	-	-	0.037
	10	45	68	82	90	95	99	104	Source activity (photons/sec)

counts per energy increment per concentric ring (cm)

Energy increment	5	15.6	26.1	36.7	47.2	57.8	68.3	100	CPS per 100 pCi/g	Unit Conversion (cpm/pCi/g)
0.020	-	-	-	-	-	-	-	0.000	0.000	844.480
0.030	-	-	-	-	-	-	-	0.000	0.000	
0.040	-	-	-	-	-	-	-	0.001	0.001	
0.050	3.644	5.311	1.063	0.469	0.225	0.129	0.080	0.119	11.040	
0.060	0.442	0.749	0.172	0.066	0.035	0.019	0.012	0.018	1.514	
0.080	38.225	78.638	21.172	9.168	4.410	2.492	1.503	2.120	157.729	
0.100	0.387	0.875	0.270	0.122	0.057	0.032	0.020	0.027	1.790	
0.150	0.206	0.526	0.187	0.093	0.043	0.024	0.015	0.021	1.117	
0.200	16.239	47.989	18.432	9.691	4.583	2.555	1.570	2.263	103.321	
0.300	21.054	76.137	33.017	18.387	8.990	5.070	3.069	4.491	170.215	
0.400	29.680	117.398	54.559	31.390	15.760	9.078	5.349	8.041	271.255	
0.500	1.164	4.803	2.322	1.373	0.698	0.411	0.243	0.359	11.372	
0.600	27.695	117.424	58.368	35.004	18.191	10.796	6.433	9.475	283.386	
0.800	4.578	20.067	10.337	6.376	3.387	2.078	1.221	1.833	49.878	
1.000	13.420	60.142	31.720	19.950	10.842	6.719	3.999	6.023	152.815	
1.500	6.709	31.110	17.090	11.122	6.217	4.087	2.405	3.725	82.464	
2.000	8.495	40.141	22.589	15.028	8.620	5.811	3.458	5.429	109.570	
3.000	176.939	616.909	297.399	194.939	129.257	107.100	97.678	143.945	1,407.466	Second approximation
Source activity (photons/sec)	8,917	86,310	243,200	479,500	795,400	1,191,000	1,665,000	3,567,000	3,570,000	
	0.019842896	0.007971118	0.001895587						0.0003942	
			0.00122							

First Approximation for U through U-234

Energy increment	Na Mass attenuation coefficient (cm²/g)	I Mass attenuation coefficient (cm²/g)	NaI mass attenuation coefficients (cm²/g)	Mean free path (cm)	Fluence rate at detector (photons/cm²/s)	Detector thickness (g/cm²)	Detector counts (photons/cm²/s)	Detector Area (cm²)	CPM
0.020	2.057	25.430	21.845	0.012	0.000	4.661	0.000	46.000	0.019
0.030	0.720	8.561	7.358	0.037	0.000	4.661	0.000	46.000	0.104
0.040	0.397	22.100	18.771	0.015	0.010	4.661	0.010	46.000	26.427
0.050	0.280	12.320	10.473	0.026	0.006	4.661	0.006	46.000	16.764
0.060	0.227	7.579	6.451	0.042	0.338	4.661	0.338	46.000	933.432
0.080	0.180	3.510	2.999	0.091	0.097	4.661	0.097	46.000	267.747
0.100	0.159	1.942	1.668	0.163	1.188	4.661	1.188	46.000	3,277.504
0.150	0.134	0.698	0.611	0.446	0.192	4.661	0.180	46.000	497.934
0.200	0.120	0.366	0.329	0.829	0.632	4.661	0.495	46.000	1,366.601
0.300	0.103	0.177	0.166	1.644	0.084	4.661	0.045	46.000	124.588
0.400	0.092	0.122	0.117	2.326	0.004	4.661	0.002	46.000	4.636
0.500	0.084	0.097	0.095	2.869	0.003	4.661	0.001	46.000	3.261
0.600	0.077	0.083	0.082	3.313	0.014	4.661	0.004	46.000	11.934
0.800	0.068	0.067	0.068	4.034	0.077	4.661	0.021	46.000	57.379
1.000	0.061	0.058	0.059	4.633	0.251	4.661	0.060	46.000	166.149
1.500	0.050	0.046	0.047	5.802	0.006	4.661	0.001	46.000	3.017
2.000	0.043	0.041	0.041	6.569	0.001	4.661	0.000	46.000	0.363
3.000	0.035	0.037	0.037	7.403	-	4.661	-	46.000	-
			First approximation	40.25	2.90		2.45		6,757.86

Repeat analysis of NaI probe detectability by breaking the soil contamination into concentric rings.

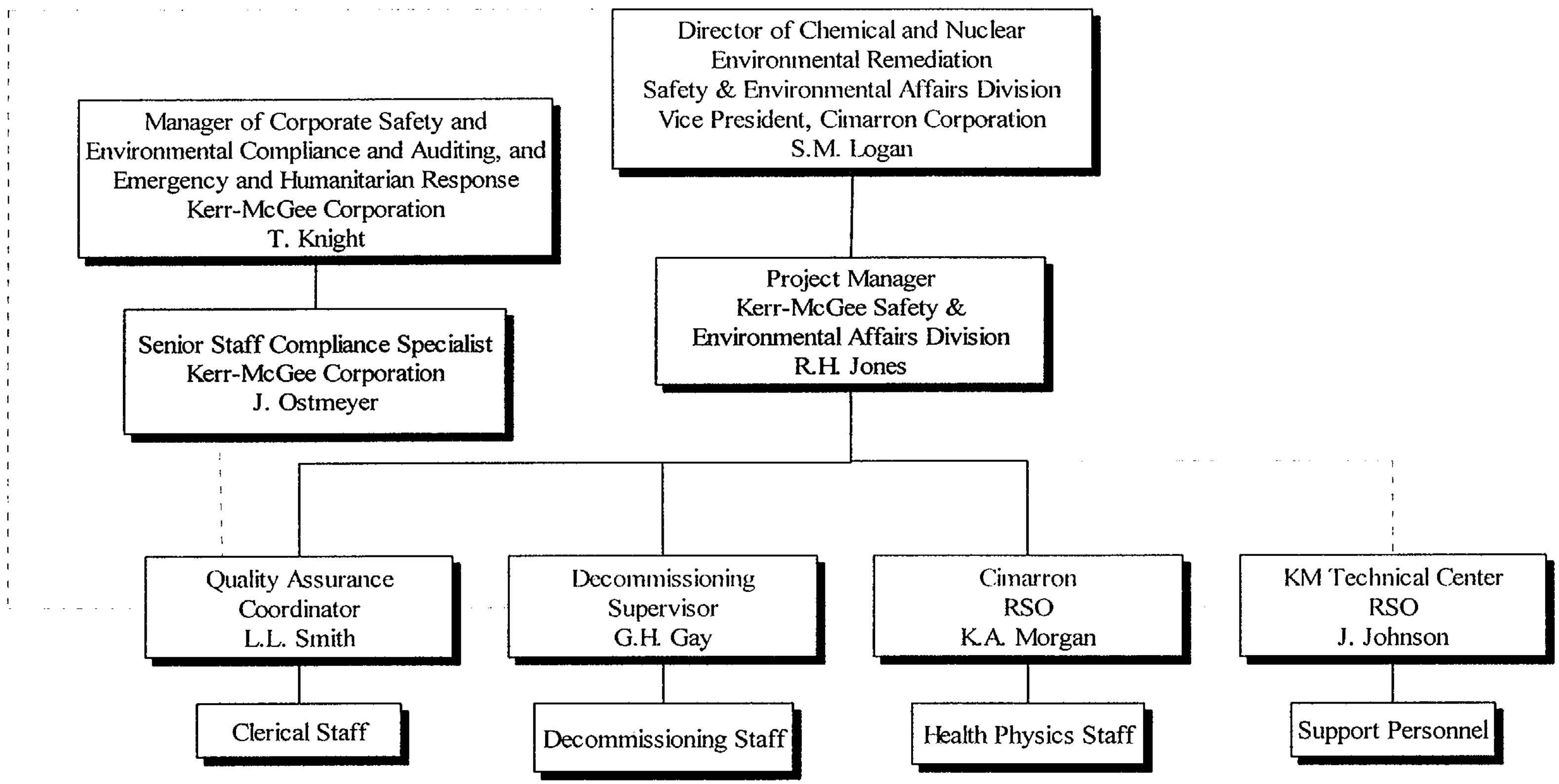
	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	Radius to:	
	5.00	15.60	26.10	36.70	47.20	57.80	68.30	100.00	
Theta	28.00	64.00	76.50	81.00	83.20	84.60	85.50	86.60	
Photon path length through detector	1.42	2.89	4.00	4.00	4.00	4.00	4.00	4.00	
Energy increment	**Fluence rate (photons/cm²/s)**	**Fluence rate (photons/cm²/s)**	**Fluence rate (photons/cm²/s)**	**Fluence rate (photons/cm²/s)**	**Fluence rate (photons/cm²/s)**	**Fluence rate (photons/cm²/s)**	**Fluence rate (photons/cm²/s)**	**Fluence rate (photons/cm²/s)**	**NaI mass attenuation coefficients (cm²/g)**
0.020	-							0.000	21.845
0.030								0.000	7.358
0.040								0.010	18.771
0.050								0.006	10.473
0.060	0.063	0.220	0.278	0.303	0.317	0.326	0.330	0.338	6.451
0.080	0.014	0.058	0.077	0.086	0.090	0.093	0.095	0.097	2.999
0.100	0.151	0.658	0.919	1.034	1.093	1.130	1.154	1.188	1.668
0.150	0.021	0.096	0.141	0.162	0.174	0.180	0.185	0.192	0.611
0.200	0.064	0.302	0.451	0.527	0.568	0.592	0.608	0.632	0.329
0.300	0.008	0.038	0.058	0.069	0.075	0.078	0.080	0.084	0.166
0.400	0.000	0.002	0.003	0.003	0.004	0.004	0.004	0.004	0.117
0.500	0.000	0.001	0.002	0.003	0.003	0.003	0.003	0.003	0.095
0.600	0.001	0.006	0.009	0.011	0.012	0.012	0.013	0.014	0.082
0.800	0.007	0.032	0.049	0.060	0.066	0.070	0.073	0.077	0.068
1.000	0.021	0.101	0.158	0.193	0.214	0.228	0.237	0.251	0.059
1.500	0.000	0.002	0.003	0.004	0.005	0.005	0.005	0.006	0.047
2.000	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.041
3.000								-	0.037
	0.35	1.52	2.15	2.46	2.62	2.72	2.79	2.90	Source activity (photons/sec)

counts per energy increment per concentric ring (cm)

Energy increment	5.000	15.600	26.100	36.700	47.200	57.800	68.300	100.000	CPS per 100 pCi/g	Unit Conversion (cpm/pCi/g)
0.020	-	-	-	-	-	-	-	0.000	0.000	37.703
0.030	-	-	-	-	-	-	-	0.000	0.000	
0.040	-	-	-	-	-	-	-	0.119	0.119	
0.050	-	-	-	-	-	-	-	0.075	0.075	
0.060	2.541	4.308	0.951	0.416	0.201	0.136	0.044	0.105	8.702	
0.080	0.579	1.189	0.321	0.139	0.067	0.038	0.023	0.031	2.385	
0.100	6.134	13.849	4.267	1.927	0.885	0.518	0.319	0.422	28.321	
0.150	0.805	2.052	0.730	0.366	0.168	0.094	0.059	0.084	4.358	
0.200	2.131	6.296	2.421	1.271	0.603	0.335	0.206	0.298	13.559	
0.300	0.188	0.681	0.295	0.164	0.080	0.045	0.027	0.040	1.522	
0.400	0.007	0.027	0.013	0.007	0.004	0.002	0.001	0.002	0.063	
0.500	0.005	0.020	0.009	0.006	0.003	0.002	0.001	0.001	0.046	
0.600	0.017	0.072	0.036	0.022	0.011	0.007	0.004	0.006	0.175	
0.800	0.080	0.351	0.181	0.112	0.059	0.036	0.021	0.032	0.873	
1.000	0.227	1.017	0.537	0.338	0.183	0.114	0.068	0.102	2.586	
1.500	0.004	0.018	0.010	0.007	0.004	0.002	0.001	0.002	0.048	
2.000	0.000	0.002	0.001	0.001	0.000	0.000	0.000	0.000	0.006	
3.000	17.717	45.484	35.872	41.474	49.468	59.129	69.074	101.320	62.838	Second approximation
	8,917	86,310	243,200	479,500	795,400	1,191,000	1,665,000	3,567,000	3,570,000	
	0.00199	0.00059	0.00023						0.00002	
			0.00015							

Figure 4.1

Kerr-McGee Corporation
Safety & Environmental Affairs Division
(KM Technical Center Decommissioning Organization)



KERR-McGEE CHEMICAL LLC.

FIGURE 4.1

KM Technical Center Decommissioning Organization

PREPARED BY: DF	DWN BY: DF
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