June 8, 2003

Mr. Bill Vinzant
Project Manager, KACC
Kaiser Aluminum & Chemical Corporation
9141 Interline Avenue, Suite 1A
Baton Rouge, LA 70809

SUBJECT: APPROVAL OF THE PHASE 2 DECOMMISSIONING PLAN FOR THE TULSA FACILITY

Dear Mr. Vinzant:

The U.S. Nuclear Regulatory Commission (NRC) received the final Kaiser Aluminum and Chemical Corporation (Kaiser), Decommissioning Plan (DP) and Addendum for the Tulsa Facility, Tulsa, Oklahoma, dated May 2003. We have determined that the information provided in the DP and Addendum is acceptable.

NRC has prepared the enclosed Safety Evaluation Report and, on June 6, 2003, published the enclosed Finding of No Significant Impact in the Federal Register. Kaiser is authorized to commence remediation in accordance with the approved DP and Addendum.

If you have any comments or questions concerning this letter, please contact John Buckley at (301) 415-6607.

Sincerely,

/RA/
Daniel M. Gillen, Chief
Decommissioning Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Docket No. 040-2377
License No. STB-472 (Terminated)

Enclosures: 1. Safety Evaluation Report
2. Finding of No Significant Impact

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SAFETY EVALUATION REPORT

OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS

RELATED TO THE APPROVAL OF THE DECOMMISSIONING PLAN FOR

KAISER ALUMINUM & CHEMICAL CORPORATION

TULSA FACILITY

DOCKET NO. 40-2377

LICENSE NO. STB-472 (TERMINATED)

1.0 Executive Summary

The Kaiser Aluminum and Chemical Corporation (Kaiser) facility processed magnesium-thorium alloy from 1958 through 1970. Kaiser's Atomic Energy Commission (AEC) license was terminated in 1971.

In November 1993, the U.S. Nuclear Regulatory Commission (NRC) inspected the Kaiser site as part of the Terminated License Review Project and found residual contamination at levels exceeding the NRC's criteria for unrestricted release. NRC notified Kaiser that its facility was put on the Site Decommissioning Management Plan (SDMP) list in August 1994.

Site characterization studies determined that contamination was present on Kaiser property and adjacent properties. Kaiser prepared and submitted the Adjacent Land Remediation Plan (Ref. 1) in 1999. This plan was approved by the NRC on April 4, 2000. Kaiser conducted off-site remediation activities from October 2000, through May 2001. Field surveys were performed to guide remediation activities that, in this case, primarily involved excavating affected soil and moving it onto Kaiser's property. A final status survey (FSS) was performed following completion of remediation/excavation in each discrete affected survey grid to demonstrate that radiological conditions of the off-site areas satisfy the criteria for unrestricted release. In March 2002, NRC informed Kaiser that the adjacent land areas met NRC's criteria for unrestricted release.

In June 2001, Kaiser submitted a decommissioning plan (DP) to describe remediation activities for the pond parcel of its facility. An addendum to the DP, addressing remediation activities for the operational area, was submitted in May 2002. As a result of NRC requests for additional information, Kaiser submitted a revised DP and Addendum for NRC review and approval on May 14, 2003 (Ref. 2 & Ref. 3). This Safety Evaluation Report (SER) documents the staff's review of the May 14, 2003, submittals. Much of the information presented in this report is taken directly from the DP and/or Addendum.

Enclosure 1

2.0 Facility Operating History

2.1 License Number/Status/Authorized Activities

Kaiser does not have a license at this site. No licensed activities are currently conducted at this site, nor have any licensed activities been conducted at the site since 1971.

2.2 License History

The Kaiser plant in Tulsa, Oklahoma was built by the Standard Magnesium Corporation (SMC) in the early to mid-1950s to manufacture magnesium products. Kaiser purchased the facility in 1964. SMC received a source materials license (C-4012) from the AEC in March 1958, to receive possession and title to magnesium-thorium alloy with up to 4 percent thorium content for processing. The quantity of material SMC, and later Kaiser, were authorized to possess at one time was amended from time to time, but generally was limited to 30,000 pounds of magnesium-thorium alloy containing no more than 4 percent thorium. Scrap magnesium-thorium alloy was smelted along with other magnesium materials to recover the magnesium. Thorium alloy material comprised a small fraction of the total magnesium refined on site.

License C-4012 was superceded by License STB-472 in November 1961. License STB-472 was amended in June 1968, to add uranium to the list of authorized materials, but there is no record that uranium-bearing materials were ever received on site.

The AEC license was terminated in 1971, by the AEC at Kaiser's request. At the time, Kaiser stated that it had not processed magnesium-thorium alloy in the past year. After it stopped processing magnesium-thorium, Kaiser continued to process magnesium at the site until approximately 1985.

2.3 Previous Decommissioning Activities

The Kaiser facility was placed on the SDMP in 1994, after NRC detected surface contamination on, and adjacent to, the Kaiser property in 1993. Kaiser conducted characterizations of the pond area and areas adjacent to the south and east property boundaries. Contamination of the adjacent properties was found to occur at the ground surface and to reach depths of up to 15 feet. The extent of the contamination was limited to the: Union Pacific Railroad right-of-way, northwest corner of Specific Systems (formerly Unarco) property, along Fulton Creek on the Beejay, Inc. property, north of the north extrusion building, north of the Smalley Equipment property, and adjacent to the Red Man (formerly Premier) property. Contamination also was found along the north side of East 41st Street, between the roadway and the Kaiser building; south of Kaiser's flux building, outside the retention pond property fence, and on Kaiser property between the building and the Union Pacific Railroad property.

Kaiser conducted off-site remediation activities from October 2000, through May 2001. Remediation activities primarily involved excavating affected soil and moving it onto Kaiser's property. An FSS was performed following completion of remediation/excavation in each survey unit to demonstrate that post-remediation radiological conditions satisfied the SDMP Action Plan criteria for unrestricted release as specified in the Phase 1 DP. Following successful remediation, excavations were backfilled.

During the course of the adjacent land remediation project, a buried spillway structure was uncovered southwest of the retention pond. Although the spillway lies primarily on the pond parcel, its southern extremity extends onto the Union Pacific Railroad right-of-way. Decommissioning of the entire buried structure is included in the current decommissioning effort.

In March 2002, NRC informed Kaiser that the adjacent land areas met NRC's criteria for unrestricted release.

2.3 Spills

No spills or uncontrolled releases of chemical or radiological materials are known to have occurred at this site.

2.4 Prior On-site Burials

Most of the dross present on site is contained within the retention and reserve ponds. During operations, dross was hauled to the parcel and dumped into the ponds. It appears that other low spots in this parcel also received waste material including the spillway area adjacent to the railroad right-of-way. Distribution of dross deeper in the subsurface correlates reasonably well with the older pond limits.

Aerial photograph interpretations and observations made during the adjacent land remediation indicated that thorium-bearing material may be present under certain buildings as well as some concrete-covered areas in the operational area of the facility. A Historical Site Assessment (HSA) and subsequent characterization survey confirmed that select land areas in the operational area will require some remediation. A more detailed description of these areas is provided in Section 4 of this SER.

The NRC staff has reviewed the information in the "Facility Operating History" section of the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 2 ("Facility Operating History"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information to aid the NRC staff in evaluating the licensee's determination of the radiological status of the facility and the licensee's planned decommissioning activities, to ensure that the decommissioning can be conducted in accordance with NRC requirements.

3.0 Facility Description

3.1 Site Location and Description

The Kaiser facility is located at 7311 East 41st Street in Tulsa, Oklahoma. It is situated in Tulsa County, Oklahoma, about 5 miles southeast of the downtown center of the City of Tulsa. The site initially occupied approximately 23 acres of land on both sides of 41st Street. Currently, a 3 acre parcel south of 41st Street contains an active extrusion and fabrication facility. North of East 41st Street are several parcels of land previously devoted to refining, processing, and waste disposal functions. This acreage is split by the Union Pacific Railroad right-of-way. An approximate 4 acre parcel south of the railroad, known as the operational area, houses inactive crusher, smelter, packaging, and warehouse facilities and active office space. An approximate 14 acre pond parcel north of the railroad contains a retention pond, the flux building, a former freshwater pond area, and a segment of Fulton Creek. Some acreage along the east side of the pond parcel was sold to others in the 1960s before Kaiser purchased the facility.

The remediation area is bounded by the south fence line, the freshwater pond embankment on the west, Fulton Creek ditch on the north, the east fence line, and the northern and western edges of the flux building and paved area. The areas to be remediated include a portion of the 4-acre operational area south of the railroad, and a large portion of the 14 acre pond parcel located north of the railroad. The pond parcel is divided into three parts--the nonimpacted former freshwater pond to the west 4 acres, the affected retention pond/reserve pond area to the east approximately 9 acres, and the area containing the flux building and paved area approximately 1 acre.

3.2 Population Distribution

The Kaiser facility is located within the corporate limits of the City of Tulsa. In 1993, Tulsa had a population of 384,397, and the County of Tulsa had a population of 526,410.

In March 1996, demographic and population features were evaluated within an area defined by a square measuring 4 kilometers on each side (Area) with the facility at the center (Ref. 4). This Area encompasses a radius of approximately 3 kilometers. Population information from the United States Census Bureau for the year 1990 was obtained for the applicable census tracts and block groups within the Area. In 1990, a total of 23,929 persons were living in residential structures within the Area. Additionally, approximately 3,473 business entities were in operation within the Area.

3.3 Current/Future Land Use

The facility actually lies within two separate zones--Industrial Moderate District (the area between the railroad and East 41st Street) and Industrial Light District (the area north of the railroad). Zoning within the vicinity of the plant is not expected to change. Therefore, future use of the site is expected to be restricted to commercial or light industrial use.

3.4 Meteorology and Climatology

Meteorological and climatological data for the facility were obtained from the Oklahoma Climatological Survey and the National Climate Data Center. A general description of Tulsa's climate follows.

At a latitude of 36°, Tulsa is far enough north to escape long periods of heat in summer, yet far enough south to miss extreme winter cold. The influence of warm moist air from the Gulf of Mexico is often noted, due to the high humidity, but the climate is essentially continental, characterized by rapid changes in temperature. Generally, winter months are mild. Temperatures occasionally fall below 0°F, but last for a very short time. Temperatures of 100°F or higher often are experienced from late July to early September. Rainfall is ample for most agricultural pursuits and is distributed favorably throughout the year.

3.5 Geology and Seismology

3.5.1 Geology

Section 3.6 of the DP provides a detailed description of the geology and seismology of the area. In general, the site is underlain by Quaternary Age alluvial soil deposits. Areal geology features a bedrock of mostly flat lying soft shales, interbedded with thin resistant beds of limestone and sandstone. The Kaiser retention pond parcel is located in an area overlying a buried stream valley filled with recently deposited sediments. Borehole data indicate that the pond parcel is situated over a series of stream-deposited clayey silty sands that directly overlie the Shale bedrock. In turn, the sand units are covered by silty to sandy clays which, together with clayey fill material, form the surface features of the site.

The clay to silt sand unit (Unit 1) is a stream channel fill that ranges from 0 to 10 feet in thickness with the thickest areas under the east end of the retention pond. The silt to sandy clay unit (Unit 2) ranges from 5 to 15 feet in thickness with the thickest section under the former freshwater pond. Along the axis of the stream valley, the top of the clayey sand layer is at a near-uniform elevation of 682 feet (ground elevation on the retention pond peninsula is approximately 696 feet) with changes in thickness due to fill in previously existing topography on the eroded shale. The silt clay unit directly overlies the sand and reaches an elevation of 692 feet. Fill (Unit 3) and dross (Unit 5) fill in low spots on this unit. Dross is present in deposits that range in thickness from inches to 10 plus feet. This dross material possesses a characteristic metallic gray color in sand to gravel particle sizes when found in sediments and was described as sludge by ARS (Ref. 5) when found in pond-bottom sediments.

Geologic and borehole log descriptions indicate that the dross, clay, and sand units possess little shear strength. The dross, when saturated with groundwater as exists under ponded water conditions, has little mechanical strength.

3.5.2 Regional Geologic Structures and Tectonics

The geologic and tectonic history of Oklahoma is basically characterized by marine sedimentation, which periodically was interrupted by episodes of uplift, gentle folding, and erosion, which was followed subsequently by renewed sedimentation.

The tectonic activity in this area is associated with the final uplift of the Ozark and Ouachita Mountains. The remnants of this activity across Tulsa County are northeast- to southwest-trending folds, adjustment flexures, and some faults.

Other than these few inactive structural features, the local structural geology of Tulsa County mainly consists of rock formations that gently dip or slope slightly north of west at a rate of 30 to 50 feet per mile.

3.5.3 Seismology

Very little seismic activity has occurred in and around Tulsa County. Historically, there have been five earthquakes in Tulsa County. These earthquakes were of very low intensity and were instrumentally recorded and not felt. There has never been a recorded earthquake within the corporate boundaries of the City of Tulsa.

3.6 Surface Water Hydrology

The former freshwater pond, Fulton Creek, and the retention pond dominate the site surface water hydrology. The 274-acre Fulton Creek drainage basin upstream of the retention pond is located to the southwest, west, and northwest of the Kaiser facility. Downstream, Fulton Creek connects to Mingo Creek, Bird Creek, and the Verdigris River which ultimately empty into the Arkansas River. Mingo Creek basin waters have been designated by the Oklahoma Water Resources Bureau for beneficial use as emergency water supply, fish and wildlife propagation, agriculture, industrial and municipal process and cooling waters, recreational, and aesthetics. Some flood control is provided within one-half mile downstream from Kaiser's property; however, none of the ponds or structures on Kaiser property are designated as part of this system.

On-site features associated with the Fulton Creek drainage include the embankment that forms the eastern edge of the former freshwater pond and the excavated ditch carrying Fulton Creek along the northern edge of Kaiser's pond parcel. A deteriorating concrete weir at the northeast corner of the former freshwater pond controls flow into Fulton Creek. At the east edge of the property line, another deteriorating concrete weir is used to control flow exiting the property. Both weirs are reported to pass water beneath the structures, making measurements of discharge quantities unreliable. In addition, three concrete weirs are present on Kaiser property along Fulton Creek and create small ponds. Discharge varies with season and local precipitation events.

The retention pond covers approximately 8 acres and is bounded on the north and east by embankments and higher ground elsewhere. The pond formerly received both industrial process cooling water and solid dross wastes. Liquid wastewater from plant operations was carried to the retention pond through an underground pipe and a pumping station.

The reserve pond was excavated and diked at the northeast corner of the site. It was put into service in 1964, operated to post-1967, and was backfilled circa 1972. This pond was approximately 1 acre in area and reported up to 15 feet deep.

3.7 Groundwater Hydrology

In general, groundwater flow is from west to the east, along the axis of the buried stream valley. Groundwater is found close (within 3 to 5 feet) to the ground surface but the elevation varies considerably in response to short- and long-term precipitation patterns. Groundwater is suspected to occur both in shallow perched/mounded conditions and in deeper unconfined to semiconfined conditions. Groundwater elevations in piezometer pairs in deep and shallow aquifers/sediments may differ at locations around the pond by 0.1 foot to 5 feet. Downward vertical groundwater flow through the upper fine-grained units into the lower sandy units was reported. There was little evidence of downward migration between near-surface sediments into the Nowata Shale.

Water level data in wells and ponds were interpreted by A&M Engineering (Ref. 6) to indicate that the former freshwater pond had a relatively insignificant impact on the groundwater table. This was attributed to the impermeability of the embankment dam and, to a lesser degree, to silting of the pond bottom and controlled outflow through a weir from the pond into Fulton Creek. Retention pond and downstream groundwater elevations were observed to correlate closely during seasonal climate changes. Elevation changes of water in the Fulton Creek ditch were observed to correlate well with both retention pond levels and levels in deeper sand units, suggesting a link between them (Ref. 6). However, infiltration through the former freshwater pond into the subsurface was suspected of contributing to the locally high groundwater regime beneath the retention pond [Earth Sciences Consultants, Inc., August 2000 (Ref.7)].

3.8 Natural Resources

There are no known natural resources located at or near the site. Water for industrial, agricultural, and potable uses in the area of the site is supplied by the municipality. There are no known industrial or agricultural users of surface water from the immediate area of the Kaiser facility.

3.9 Ecology/Endangered Species

Information obtained from the U.S. Fish & Wildlife Services, Oklahoma Wildlife Conservation, and the Oklahoma Biological Survey and National Heritage Inventory indicates that while the ecology, endangered species, and threatened species in the Tulsa area are diverse, there are no known species inhabiting or requiring the support of the area encompassed by the Kaiser Tulsa plant or adjacent industrial properties. Additionally, the excavation and/or placement of fill associated with the unnamed tributary of Mingo Creek (Fulton Creek) will have no affect on federally listed endangered or threatened species or habitat critical for the survival of such species.

The NRC staff has reviewed the information in the “Facility Description” section of the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 3 (“Facility Description”). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information to allow the NRC staff to: evaluate the licensee’s estimation of doses to on- and off-site population during and at the completion of decommissioning; evaluate the licensees estimation of the impacts of the proposed decommissioning activities on the site, and its surrounding areas; and evaluate the licensees estimation of the impacts of the environment on the site.

4.0 Radiological Status of Facility

4.1 Contaminated Structures

Presently, none of the original buildings in which magnesium-thorium alloy processing occurred exist on site. With the exception of the Flux Building, there are no buildings in the former operations area of the facility classified as impacted.

Other buildings are not known to have involved operations involving thorium materials. From about 1977 until plant shutdown, the crusher building was used for the smelting of aluminum, whereas previously it was used to grind cooled dross masses for a second magnesium recovery step and/or prior to disposal as a waste product. Instrument surveys of the Crusher Building indicate no contamination is present in the building. The smelter building was demolished in October 2000, after a survey of the structure indicated no contamination.

The NRC staff has reviewed the information in the "Radiological Status of Facility" section of the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 4 ("Radiological Status of Facility"). Based on this review, the NRC staff has determined that Kaiser has described the types and activity of radioactive material contamination at its facility sufficiently to allow the NRC staff to evaluate the potential safety issues associated with remediating the facility, whether the remediation activities and radiation control measures proposed by the licensee or responsible party are appropriate for the type of radioactive material present at the facility, whether the licensee's or responsible party's waste management practices are appropriate, given the amount of contaminated material that will need to be removed or remediated.

4.2 Contaminated Systems and Equipment

Smelting of magnesium-thorium alloy was discontinued before 1971. Subsequently, non-thoriated magnesium and then aluminum were smelted at the plant. Instrument scans indicate that no contaminated systems or equipment exists at the facility.

A limited amount of subsurface piping and associated culverts exist within the former operational area of the facility. Information gathered during the HSA does not indicate the use of subsurface piping for the conveyance of radioactive material. Kaiser has committed to confirm the radiological status of the subsurface piping systems during remediation and before the conduct of FSS.

4.3 Surface and subsurface Soil Contamination

A site characterization investigation was conducted at the Kaiser facility in Tulsa, Oklahoma to characterize soils and sludges in the Retention and Reserve Pond areas.

Affected material volumes in the Retention and Reserve Pond areas were estimated to be 4,007,909 ft^3 of material greater than 10 pCi/g Th-228 + Th-232, and 5,059,614 ft^3 of soil with Th-232 + Th-228 concentrations greater than 6 pCi/g. Therefore, with the addition of the 285,000 ft^3 of material that was stockpiled on-site during the Adjacent Land Area Remediation project, the total approximate volume of material with thorium concentration greater than 6 pCi/g is 5,345,000 ft^3.

Due to modifications of on-site buildings/structures during operations, surface and subsurface soil contamination also exists beneath concrete paved surfaces and building floor areas in the operations area. Residual radioactive material exists in the following areas: (1) beneath a significant portion of the Flux Building structure; (2) beneath the northern portion of the concrete pad which was once used as a slag storage area; (3) beneath the north portion of the Crusher Building structure and the paved area north/northeast of the Crusher Building; (4) beneath the concrete paving area located west of the Maintenance Building; and (5) beneath a portion of the concrete area inside of the Warehouse Building. Kaiser estimates that approximately 60,000 ft^3 of material will be excavated from the former operations area.

4.4 Surface Water

The freshwater pond, Fulton Creek, and the retention pond dominate the site surface water, as discussed in Section 3.6 of this DP. Concentrations of radioactive material in these water bodies is significantly less than the limits set forth in 10 CFR Part 20, Appendix B.

4.5 Groundwater

Under Kaiser contract, Earth Sciences conducted an evaluation of groundwater quality conditions based upon data collected over a period of 14 consecutive quarters from September 1999 to December 2002. Analytical parameters included both inorganics and radionuclides (Ra-226, Ra-228, Th-228, Th-230, and Th-232).

During the first two events, filtering of samples was delayed until after samples were received at the analytical laboratory. Results from these two events indicated that EPA drinking water maximum contaminant levels (MCL) for both the combined Ra-226 and Ra-228 and gross alpha particle activities were exceeded in the source area only. Exceedances in the source area occur in wells screened in the waste and, therefore, the samples are pore water--not groundwater. Analytical results were compared to the MCLs, as they are a known regulatory standard. However, it should be noted that the site groundwater is not likely to ever be a drinking water source. Only combined Ra-226 and Ra-228 exceeded the MCLs beyond the source area (December 1999). However, during both events, the only significant exceedances of the MCLs were limited to the source area and to one monitoring well in the northeast area for combined Ra-226 and Ra-228.

Field filtering was incorporated into the third through fourteenth sampling events to produce analytical results that were more characteristic of actual groundwater conditions by minimizing the potential for chemical change of the samples before laboratory filtration/analysis. Radiological groundwater quality data collected during the third and fourth quarters of 2002 were compared to MCLs based on the EPA drinking water standards. Specific MCLs do not exist for Th-228, Th-230 and Th-232. However, since thorium is an alpha emitter, Kaiser used the MCL for gross alpha particle activity (including Ra-226 but excluding radon and uranium) which is 15 pCi/l. Therefore, in evaluating if the gross alpha particle activity MCL is exceeded, the combined totals for Ra-226, Th-228, Th-230, and Th-232 were considered for each water sample. Analytical results from these two events indicated that the MCLs for combined Ra-226 and Ra-228 and gross alpha activity (inferred from the Th and Ra isotopic analysis) were not exceeded in any of the sampled on-site monitoring locations. In addition, reported radiological parameter concentrations at the side-gradient and down-gradient monitoring wells were consistent with those reported at the up-gradient locations.

5.0 Dose Modeling Evaluations

Kaiser performed dose modeling evaluations consistent with NRC guidance presented in draft NUREG-1549, "Decision Methods for Dose Assessment to Comply with Radiological Criteria for

License Termination" (Ref. 8). Dose assessments were used to evaluate a number of decommissioning alternatives.

Kaiser determined that generic screening using the DandD model was not appropriate because of the large volume of material which extends to an average depth of 15 ft below grade. Instead, Kaiser utilized site specific parameter values to calculate the derived concentration guideline level ($DCGL_w$) using RESRAD, Version 6.0. Parameter values were obtained from historical and recent characterization data.

Based on its dose assessment, Kaiser selected a decommissioning approach that would achieve unrestricted release of the facility.

5.2 Unrestricted Release using Site-Specific Information

Source Term

The nuclides of interest at the site are Th-228, Th-230 and Th-232. Model input concentrations for all principal radionuclides were computed from weighted averages that took into account depth intervals of observed concentrations on site, as well as combined volumes of on-site and stockpiled material stored on site. Contamination at the site is present in the soil, at the surface and at depth. The contamination is spread non-homogeneously across the site.

In its preliminary dose assessment, Kaiser considered material above the $DCGL_{ws}$ to represent the volume of contaminated material. The dominant exposure pathways in the dose assessment were direct gamma and plant uptake of Th-232. Consequently, Kaiser adjusted the single-radionuclide $DCGL_w$ for Th-232 (3.45 pCi/g) to 3 pCi/g to account for the other radionuclides present at the site.

Critical Group, Scenarios and Pathway Identification and Selection

Kaiser evaluated the residential farmer and residential gardener scenarios using RESRAD. Kaiser states that the use of the most conservative scenario, residential farmer, accounts for potential uncertainties in land use over the next 1000 years.

Kaiser selected the residential farmer as the critical group. Model parameters for the residential farmer were consistent with the recommended RESRAD defaults in NUREG/CR-5512 (Ref. 9).

Conceptual Model

Kaiser has developed conceptual models for the residential farmer and residential gardener scenarios, and these detail the pathways modeled and important exposure factors. The conceptual models are consistent with the site, the scenarios, and the models used to calculate the dose. The conceptual model adequately describes the pathways involved in the exposure scenario.

Calculations and Input Parameters

Kaiser used the RESRAD Version 6.0 code to analyze the conceptual site model. Deterministic simulations were performed to estimate the dose to the critical group after remediation. Kaiser used conservative default parameters and site specific parameters (when available) to model the site.

Uncertainty Analysis

For its dose assessment, Kaiser performed a sensitivity analysis on the parameters used to describe the physical properties associated with the contaminated zone, the saturated zone and contaminant transport. Sensitivity analyses were not performed on behavioral or metabolic parameters since default values from guidance documents were used.

Kaiser determined that the parameters impacting the drinking water and external gamma pathways had the largest impact on dose. The dose assessment concludes that the dose to the residential farmer and residential gardener are total effective dose equivalents (TEDEs) of less than 0.3 mrem/yr each. These dose estimates occur at 1000 years and are well below the 25 mrem/yr dose limit.

The staff has reviewed the dose modeling analyses included in the Kaiser Phase 2 DP using Standard Review Plan 5.2. The staff concludes that the dose estimate calculated is appropriate for the decommissioning option and exposure scenario assumed. In addition, this dose estimate provides reasonable assurance that the dose criterion in 10 CFR 20.1402 will be met. This conclusion is based on the modeling effort performed by the staff in initially developing the default screening analysis.

6.0 Alternatives Considered and Rationale for Chosen Alternative

6.1 Alternatives Considered

Kaiser first considered taking no action to remediate the site but found it to be unacceptable. Subsequently, Kaiser considered a number of other possible options before arriving at the chosen alternative. Environmental, technical, and economic factors were considered. Kaiser has concluded that the selected remedial action to achieve unrestricted release strikes the best overall balance. No adverse impact on low-income/minority groups will result from the proposed action.

6.2 Rationale for Chosen Alternative

This alternative entails removing thorium-bearing material with concentrations greater than 31.1 pCi/g Th-232 (above-criteria material) and disposal of this material at a permitted facility. On average, excavated above-criteria material meets the definition of exempt material. Material with concentrations less than 31.1 pCi/g Th-232 will be backfilled in the excavation. Approximately 4,000,000 ft^3 of clean fill will be used to cover the below-criteria materials to bring the excavation to grade. Dose analysis for the resident farmer scenario demonstrated that unrestricted release dose criteria could be achieved with a maximum total estimated dose of 0.276 mrem/yr. Due to the industrialized setting and the absence of residences in the immediate vicinity of the site, no impacts are expected for local minority or low-income populations. Local land values and aesthetics will not change as a result of implementation of this alternative. Although this alternative will entail significant community relations and multi-agency liaison, it is expected to be favored by the community.

This alternative was chosen because it achieves the best balance of the evaluation criteria considered. It is protective of human health and the environment, complies with NRC regulatory requirements, affords a permanent remedy without the need for institutional controls, utilizes proven technology, and is economically viable.

7.0 ALARA Analysis

Kaiser conducted an analysis to demonstrate that the residual radioactivity remaining on-site following decommissioning activities will be reduced to a level that is "as low as is reasonably achievable" (ALARA). The ALARA analysis uses a cost-benefit approach to demonstrate that removing material below the cutoff criteria of 31.1 pCi/g is not cost effective.

In the analysis, Kaiser used the present-worth equation presented in NUREG 1727, Appendix D, (Ref. 10) [formerly Draft Regulatory Guide 4006 (Ref. 11)] which takes into consideration the fraction of residual radioactivity physically removed by additional remedial action, to reduce the dose below the dose that would result from the planned decommissioning activities. Using the RESRAD dose model resident farmer scenario, the planned action was found to result in a peak dose to an average member of the critical group (resident farmer) that does not exceed 0.276 mrem/yr. Kaiser assumed zero mrem/yr as the lower dose that could be achieved by removal of material below the 31.1 pCi/g cutoff limit, resulting in a maximum net averted dose of 0.276 mrem/year. This net averted dose was used in the present-worth equation.

Using 0.276 mrem/yr as the net averted dose overstates the potential benefit that could be achieved since the analysis assumes that this dose would be averted throughout the 1,000-year period considered. More likely, the peak dose would occur only in year 1,000.

The results of the ALARA analysis indicate that there is no advantage in removing more material than proposed in the planned action. Removal of only 5.6 cubic yards of material below the 31.1 pCi/g cutoff limit would equal the monetary value of the benefit associated with reducing the dose to zero. Given that much greater quantities of material would have to be removed to reduce the dose to zero, the cost of incremental dose reduction far exceeds any benefit. Therefore, the staff agrees that the planned action is ALARA.

8.0 Planned Decommissioning Activities

8.1 Contaminated Structures

The Kaiser facility has the following seven structures included in the former operational area; North Extrusion Building, Office Building, Maintenance Building, Warehouse, Crusher Building, Crusher Building addition, and the Flux Building. The Flux Building is the only structure classified as impacted, because it was, and is currently, used to process and store soil samples. The remaining six buildings were classified as unimpacted. Upon completion of decommissioning activities at the site, the Flux Building will be surveyed as a Class 1 survey unit.

8.2 Contaminated Systems and Equipment

There are no known contaminated systems, or equipment on site. A limited amount of subsurface piping and associated culverts exist within the former operational area of the facility. Information gathered during the HSA does not indicate the use of subsurface piping for the conveyance of radioactive material. Kaiser has committed to confirm the radiological status of the subsurface piping systems during remediation.

8.3 Soil

The planned remediation requires identifying material with concentrations of Th-232 above 31.1 pCi/g, excavating, and segregating it on site. Above-criteria material will be shipped to a facility permitted to receive the material. Below-criteria material will be returned to the excavation and covered over with cleanfill.

Standard construction equipment will be used to perform decommissioning operations. This equipment will include, but not be limited to, the following:

- Backhoes
- Scrapers
- Excavators
- Bulldozers
- Loaders
- Dump trucks
- Water trucks
- Pickup trucks

In addition, a specialized automated soil sorting/segregation system may be used. Alternatively, soil segregation may be accomplished by manual scanning. Kaiser has committed to conduct the material segregation activities under the direction of an Health Physics Technician (HPT) in a manner that will limit personnel exposure and off-site migration.

The site will be excavated to depths up to 15 to 20 feet with an average depth estimated at 15 feet across most of the retention and reserve ponds. All excavation activities will be conducted in accordance with Occupational Safety and Health Administration safety guidelines. In general, excavation walls will be sloped back. In areas where the excavation abuts the property line, special vertical excavation support, such as sheet piling, may be required to separate the work from the previously completed adjacent land remediation.

Health Physics support will be used to monitor the excavated material, the material left in place, workers safety, equipment, and loaded cars/containers leaving the site.

Above-criteria material destined for off-site disposal will be transported to the disposal site in intermodal containers on flat cars or trucks. Alternatively, gondola cars may be used. Loading will be accomplished by a front-end loader or a more elaborate conveyer belt system. The material will be dried prior to shipping to the extent needed to prevent development of free water during transportation.

Once the site is remediated to established levels, it will be cleared through a Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) (Ref. 12) directed final status survey. This will be conducted in stages where certain survey areas or units will be cleared and backfilled as excavation occurs in other areas. Prior to backfilling, the NRC may conduct inspections or confirmatory surveys.

Below-criteria material will be returned to the excavation. Approximately 4,000,000 ft^3 of clean fill will be added to backfill excavations. The thickness of clean fill will average 10 feet. Backfill will be placed in 8-inch loose lifts and suitably compacted. Kaiser has committed to conduct backfilling under the direction of a qualified technician or engineer in a manner that will limit personnel exposure and off-site migration.

The site will be graded so that drainage is from east to west, so that surface water discharge from the site is attenuated. The site also will be vegetated to minimize soil erosion.

Kaiser will complete the decommissioning with the assistance of contractors, and consultants. Kaiser is committed to maintaining occupational exposures within the requirements of 10 CFR Part 20 and ALARA during all operations involving the management of radioactive materials. Decommissioning activities will be conducted in accordance with written approved procedures as outlined in the DP. Dust emission controls and air monitoring will be maintained. HPT support will be used to monitor the material removed, the material left in place, as well as workers, equipment, and loaded cars/containers leaving the site.

8.4 Surface and Groundwater

Kaiser has committed to manage water in accordance with applicable NRC/EPA, state, and local laws, regulations, and permit requirements.

8.5 Schedules

With approval of the DP, Kaiser will undertake preparation of designs and specifications. Subsequently, a construction contractor will be selected. Kaiser may choose to develop performance specifications and require the contractor to develop design details, or opt to develop detailed designs/specifications. In either case, preconstruction activities are expected to take approximately 9 months.

Construction activities will not be conducted during the months of December through February because of inclement weather conditions. Remediation will begin following completion of the design/contractor selection tasks and extend over a period of approximately 3 years.

The NRC staff has reviewed the decommissioning activities described in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 8 (Planned Decommissioning Activities). Based on this review the NRC staff has determined that Kaiser has provided sufficient information to allow the NRC staff to evaluate the licensee's planned decommissioning activities to ensure that the decommissioning can be conducted in accordance with NRC requirements.

9.0 Project Management and Organization

9.1 Decommissioning Management Organization

Section 9 of the DP presents the project management and organizational structure that will be used during decommissioning. The Kaiser Project Manager (PM) will have overall responsibility for planning and management of decommissioning activities. Planning and management of on-site activities will be the responsibility of the Kaiser Site Administrator (SA). The DP also provides adequate position descriptions for the following key individuals responsible for the management, safety, and quality of decommissioning activities: (1) Health Physics Advisor/Radiation Safety Officer; (2) Quality Assurance Coordinator; (3) Data Manager; (4) Contractor PM; (5) Contractor Quality Control Supervisor; (6) Contractor Lead Health Physics Technician; (7) Contractor Site Supervisor; and (8) Contractor Health and Safety Supervisor.

9.2 Decommissioning Task Management

In the DP, Kaiser commits to developing and implementing written plans and procedures to control decommissioning activities. At a minimum, Kaiser will develop; (1) an engineering design, (2) a Health and Safety Plan, (3) an Erosion and Sedimentation (E&S) Plan, (4) a Contractor Work Plan, (5) Quality Assurance/Quality Control (QA/QC) Plan, and (6) a Final Status Survey Plan.

An engineering design will be completed and construction specifications will be developed so that the DP can be implemented. Specifications may be performance specifications or may be based upon detailed engineering designs.

The decommissioning contractor will develop and implement a Health & Safety (H&S) Plan for its activities. This plan will conform with Kaiser's H&S Plan.

An E&S Plan will be completed for the project. The goal of the E&S Plan is to minimize off-site transport of sediment.

The decommissioning contractor will submit a work plan that will outline and describe the sequence of construction activities. The work plan will be reviewed and approved by Kaiser and will be used to manage contractor activities throughout the project.

A QA/QC Plan will be established for the site. The QA/QC Plan will be used in conjunction with the Final Status Survey Plan to ensure that decommissioning goals are achieved. In addition to radiological concerns, the QA/QC Plan will address civil engineering and site restoration issues.

A Final Status Survey Plan will be completed for the decommissioning activities. The purpose of the Final Status Survey Plan will be to demonstrate that remaining thorium levels are at or below the release criteria established in this DP.

9.3 Decommissioning Management Positions and Qualifications

The DP provides adequate descriptions of the duties, reporting responsibilities, and minimum qualifications for each management position responsible for decommissioning activities.

9.4 Training

In the DP, Kaiser commits to implement a training program which includes general radiation safety training/monitoring, site orientation, site-specific training, and training verification and documentation. The training program meets NRC requirements and was found to be adequate to protect worker health and safety during the conduct of decommissioning activities.

9.5 Contractor Support

Kaiser will utilize contractors to conduct decommissioning activities at the site in accordance with written plans and procedures. However, the Kaiser PM retains overall responsibility for planning and management of decommissioning activities.

The NRC staff has reviewed the description of the decommissioning project management organization, position descriptions, management and safety position qualification requirements and the manner in which Kaiser will use contractors during the decommissioning of its facility according to the NMSS Decommissioning Standard Review Plan, Section 9 ("Decommissioning Management Organization"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information to allow the NRC staff to evaluate the licensee's decommissioning project management organization and structure to determine if the decommissioning can be conducted safely and in accordance with NRC requirements.

10.0 Radiation Safety and Health Program

10.1 Radiation Safety Controls and Monitoring for Workers

In the DP, Kaiser has committed to monitor worker exposures to external radiation and airborne radioactivity to confirm the effectiveness of radioactive material control practices during work activities. Kaiser will use the experience and survey results obtained during Phase 1 remediation activities in planning and implementing similar safety measures for Phase 2. Kaiser's implementation of the radiation safety program will be the subject of NRC in-process inspections.

10.1.1 Workplace Air Sampling Program

In areas where there is the potential for air concentrations to exceed 10 percent of the DAC, personal and/or area air samples will be collected to evaluate worker exposure. Dust will be collected on filters using standard industrial hygiene methods. Personal sampling pumps will be attached to a representative number of workers. The pumps used to collect airborne dusts are to be calibrated to a flow between 1.2 and 2.0 liters per minute with cassettes loaded with mixed cellulose ester filters in line. The alpha activity of the dusts captured on the filters will be determined.

Kaiser will use the following process to assess compliance with Regulatory Guide 8.25:

(1) Examine characterization survey(s) for thorium concentration in soil where work will be performed that will disturb soil or create dust.

(2) If the Th-232 + Th-228 is less than 200 pCi/g soil, perform occasional air sampling near the dust source. If the Th-232 + Th-228 concentration is 200 pCi/g soil or greater, perform continuous, stationary air sampling near the dust source while workers are present.

(3) Collect air samples using portable air samplers with particulate filter medium.

(4) After thoron and daughter decay, measure radioactivity by alpha counting.

(5) Compare with 10 CFR Part 20, Appendix B, Table 1, derived air concentration (DAC) limit, 2×10^{-12}mCi/ml = 1 DAC, assumed for Th-228, Th-230, or Th-232.

If the analytical results for the air samples exceed ten percent of the DAC limit, the Radiation Safety Officer (RSO) will be alerted and respiratory protection such as supplied air or particulate masks may be provided for any workers in the affected area.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 10.1.1 (Air Sampling Program). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information on when air samples will be taken in work areas, the types of air sample equipment to be used and where they will be located in work areas, calibration of flow meters, minimum detectable activities (MDA) of equipment to be used for analyses of radionuclides collected during air sampling, action levels for airborne radioactivity (and corrective actions to be taken when these levels are exceeded) to allow the NRC staff to conclude that the licensee's air sampling program will comply with 10 CFR 20.1204, 20.1501(a)-(b), 20.1502(b), 20.1703(a)(3)(I)-(ii), and Regulatory Guide 8.25.

10.1.2 Respiratory Protection Program

Respiratory protection is not specified in the H&S Plan. Kaiser has committed to evacuate the area of concern if conditions develop where supplied air would be necessary. If personnel are required to work in an area where Level C or Level B protection is necessary, Kaiser has committed to revise the H&S Plan before work is started in such areas.

All site personnel who may utilize respiratory protection devices will be trained in their use and must have received a medical examination to determine their ability to wear a respirator before starting work. Each person who uses a respirator must be fit tested within the previous year in the size and type of respirator actually in use. Documentation of the fit testing and training provided by subcontractors will be presented to the site H&S Supervisor before work commences.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 10.1.2 (Respiratory

Protection Program). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information to implement an acceptable respiratory protection program so as to allow the NRC staff to conclude that the licensee's program will comply with 10 CFR 20.1101(b), and 10 CFR 20.1701 to 20.1704 and Appendix A of 10 CFR Part 20.

10.1.3 Internal Exposure Determination

In areas where air monitoring predicts the potential to exceed 10 percent of the DAC, bioassay may be required for workers. Urine, feces, and/or whole body counts for the appropriate isotopes of thorium may be used to evaluate internal exposure of workers. Prior to beginning work in an area where bioassay is required, workers will submit bioassay samples for baseline or prior exposure determinations.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 10.1.3 ("Internal Exposure Determination"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information on methods to calculate internal dose of a worker based upon measurements from air samples or bioassay samples to allow the NRC staff to conclude that the licensee's program to determine internal exposure will comply with 10 CFR 20.1101(b), 20.1201(a)(1), (d) and (e), 20.1204 and 20.1502(b).

10.1.4 External Exposure Determination

External exposure control will be accomplished by establishing limits and action levels for personnel occupationally exposed to radiation, and controlling sources of radiation and access to areas containing radioactive material. Beta-Gamma radiation surveys will be taken periodically during the course of activities at the work site. These surveys will be performed in accordance with the approved plans and procedures that will be in place prior to the decommissioning of the site.

Dosimeters will be provided to site personnel to determine the cumulative gamma radiation exposure to personnel over the period of the dosimetry. Dosimetry will be analyzed at bimonthly intervals. Written dosimetry reports of exposure will be issued annually to each person issued a dosimeter.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 10.1.4 ("External Exposure Determination"). Based upon this review, the NRC staff has determined that Kaiser has provided sufficient information on methods to measure or calculate the external dose of a worker to allow the NRC staff to conclude that the licensee's program to determine external exposure will comply with the requirements of 10 CFR 20.1101(b), 20.1201(c), 20.1203, 20.1501(a)(2)(i) and (c), 20.1502(a), and 20.1601.

10.1.5 Summation of Internal and External Exposures

Kaiser will sum the total measured and/or calculated external and internal doses and will report as TEDE in accordance with 10 CFR 20.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 10.1.5 ("Summation of Internal and External Exposures"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information to conclude that the licensee's program for summation of internal and external exposures will comply with 10 CFR 20.1202 and 20.1208(c)(1) and (2), and 20.2106.

10.1.6 Contamination Control Program

Kaiser has a contamination control program which consists of contractor control measures, temporary operational work zones, site personnel requirements, and decontamination requirements for personnel and equipment.

The establishment of permanent site zones is not anticipated, however, temporary operation zones may be established as part of the site activities. Areas where sampling activities are occurring or contamination is anticipated, or known to exist, will have access restrictions. However, the DP does provide the requirements for establishing permanent work zones, in case they are necessary.

With regard to site personnel requirements, no person may enter a designated work area without the complement of personal protection equipment (PPE) specified by the H&S Officer, or RSO, for that area. PPE selections are based on the work to be performed and the hazards present.

Any restricted areas designated by the H&S Supervisor, or RSO, will be clearly marked in the field. The restrictions and requirements will be posted and/or verbally communicated to persons on the site. Temporary control zone and contamination reduction areas are to be established for work areas that present a significant risk of exposure to hazards such as high levels of contamination and/or dust-generating operations. A control zone will be established around areas of significant contamination to prevent the spread of contaminated materials. These areas require decontamination procedures for persons or equipment leaving the control zone.

The control zone and contamination reduction area are to be delineated by appropriate physical barriers. Temporary control zone and contamination reduction areas will be marked in the field using flagging tape or temporary construction fencing with appropriate signs. Temporary control zone or contamination reduction area barriers will remain in place until the work in the zone is completed or until the potentially hazardous conditions that caused an area to be designated as an control zone are eliminated. The decision to establish or eliminate a control zone or to modify required PPE, environmental monitoring, or other operational requirements will be made by the H&S Officer.

Support zone/clean areas are to consist of areas of the site which are not contaminated and are not being used for the contamination reduction area. Effort will be undertaken to prevent the contamination of clean areas and the support zone/clean area. Personnel and equipment that enter the support zone/clean area after having been in the control zone or contamination reduction area will be decontaminated.

Decontamination of personnel and equipment at the Kaiser site will be conducted to reduce the risk of off-site migration of contaminants and to prevent cross contamination of areas within the site boundaries. Decontamination is one of the primary means used to prevent or reduce the potential for ingestion of radionuclides. Decontamination of equipment may be performed between tasks to reduce the potential for cross contamination of areas and/or samples. Personnel decontamination is to be conducted when workers leave contaminated work areas and enter clean areas.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 10.1.6 ("Summation of Internal and External Exposures"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information to control contamination on skin, on protective and personal clothing, on fixed and removable contamination on work surfaces, on transport vehicles, on equipment (including ventilation hoods), and on packages to allow the NRC staff to conclude that the licensee's contamination control program will comply with 20.1501(a), 20.1702, 20.1906 (b), (d); and (f) of 10 CFR Part 20. The staff has verified that the information summarized under "Evaluation Criteria" above is included in the licensee's description of the methodology used to control contamination at the facility.

10.1.7 Instrumentation Program

Kaiser has committed to use the following types of Instrumentation to aid in the monitoring of the H&S Plan: Low Volume, High Volume, lapel samplers, and 0.8-micron cellulose filters or other appropriate filters. The equipment will be calibrated and routine pre-operational checks performed in accordance with approved plans and procedures.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 10.1.7 ("Summation of Internal and External Exposures"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information on the sensitivity and the calibration of instruments and equipment to be used to make quantitative measurements of ionizing radiation during surveys to allow the NRC staff to conclude that the licensee's instrumentation program will comply with 10 CFR 20.1501(b) and (c).

10.2 Health Physics Audits and Record-Keeping Program

In Section 13 of the DP, Kaiser commits to a documented audit and surveillance program designed to provide assurance that quality-related activities meet applicable requirements. Audits and surveillances will be documented and records will be kept as part of the Kaiser project file. Kaiser commits to conducting an audit within three weeks of the start of remediation activities and annually thereafter.

The NRC staff has reviewed the description of the audit and record keeping program which Kaiser will utilize during the decommissioning of its facility according to the NMSS Decommissioning Standard Review Plan, Section 10.3 ("Health Physics Audit, Inspection and Record-Keeping Program"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information to allow the NRC staff to evaluate the licensee's executive management and RSO audit and record keeping program to determine if the decommissioning can be conducted safely and in accordance with NRC requirements.

11.0 Environmental Monitoring Program

11.1 Environmental ALARA Evaluation Program

Kaiser has committed to conduct an environmental monitoring and control program to ensure that effluent concentrations of radioactive material in the water and air are ALARA in accordance with NRC guidance. The environmental monitoring program will include management of surface- and ground-water encountered in excavations, as well as monitoring for airborne particulates. The environmental monitoring and control program will also ensure that effluent concentrations in unrestricted areas are maintained below the limits listed in 10 CFR 20, Appendix B, Tables 2 and 3. Implementation of the environmental monitoring program will be the subject of NRC inspections and independent surveys, including sample collection and anlysis.

11.2 Effluent Monitoring Program

As discussed in Section 4.5 of the DP, the thorium oxide contained in the dross material is insoluble in water. Further, experience gained during remediation of the adjacent land areas indicates that the dross material does not become airborne easily. Regardless, Kaiser has developed an effluent monitoring program to demonstrate that releases from the site are below the limits set forth in 10 CFR Part 20, Appendix B.

Kaiser will contain and sample storm-water and ground-water collected within excavations. If the contained water has activity concentration levels below the limits specified in 10 CFR Part 20, Appendix B, the water may be released to surface drainage or the sanitary sewer system, as applicable (per the restrictions set forth by the City of Tulsa, and NRC criteria in Part 20.2003).

The RSO will determine the frequency of air monitor sampling at the site. Kaiser will establish up to 4 monitoring stations to evaluate off-site releases. Air filters will be analyzed on-site for gross alpha and sent to the laboratory for analysis.

11.3 Effluent Control Program

Kaiser has committed to control effluents released from the site. Surface water will be managed by: (1) maintenance and restoration of existing drainage ways; (2) minimization of water contacting contaminated material; (3) control and diversion of storm water around remediation areas; (4) pumping water in contact with contaminated material into a holding area; (5) minimization of soil erosion; and (6) protection of water quality in downstream watercourses.

Kaiser has also committed to conduct airborne radioactivity monitoring using fixed station, high flow air samplers. Kaiser will use continuous air sampling near occupied buildings if air particulate samples collected near the remediation activities indicate that long-term air concentration may exceed 0.5 of the maximum acceptable airborne concentration for members of the public.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Decommissioning Standard Review Plan, Section 11 ("Environmental Monitoring and Control Program"). Based on this review, the NRC staff has determined that Kaiser has provided sufficient information for the staff to conclude that the licensee's program will comply with 10 CFR Part 20.

12.0 Radioactive Waste Management Program

12.1 Solid Radioactive Waste

Remediation activities at the site will result in two types of solid waste: (1) Dry Active Waste (DAW); and (2) thorium-containing soil/dross. DAW consists mainly of paper and plastic goods. This material will be collected so that it is easily characterized for processing and disposal. Contaminated DAW will be disposed of at a licensed waste processing or disposal facility. DAW that is non-contaminated will be disposed as non-radioactive waste at an appropriate facility after appropriate characterization and NRC approval.

As discussed in Section 4.3 of this report, Kaiser estimates that there is approximately 5,345,000 ft^3 of soil/dross containing greater than 6 pCi/g thorium in the pond area. In addition, Kaiser estimates that approximately 60,000 ft^3 of material will be excavated from the former operations area.

Excavated material will be stockpiled in a handling/processing/storage area constructed on the western part of the property. The material will be segregated into the following four categories: (1) contaminated soil above the $DCGL_w$ (3.0 pCi/g Th-232) or DCCL (31.1 pCi/g Th-232) value for the processing and retention pond areas respectively; (2) backfill soil containing radioactivity above the $DCGL_w$ but below the DCCL value; (3) suspect contaminated soil which requires additional characterization; and (4) debris or non-soil material.

Above criteria material will be loaded into truck, railcars or storage containers. Containers awaiting shipment will be stored in a designated storage area. Above criteria material will be disposed of at a licensed disposal facility. Below criteria material will be used as backfill as described in Section 8 of this report.

12.2 Liquid Radioactive Waste

Liquid radioactive waste generated during decommissioning may include collected infiltration water and decontamination process fluid. Kaiser has committed to minimize the volume of liquid waste generated during remediation. Infiltration water will be collected and managed in accordance with local, state, and federal laws. Infiltration water collected during Phase 1 remediation had an average concentration of 1.2 pCi/l Th-232, which is well below the 30.0 pCi/l release standard provided in Part 20, Table 2 concentration limits.

12.3 Mixed Waste

No mixed waste is expected as a result of remediation activities. However, Kaiser has committed to inform the NRC in the event that mixed waste is discovered during remediation activities.

The NRC staff has reviewed Kaiser’s descriptions of the radioactive waste management program according to the NMSS Decommissioning Standard Review Plan, Section 12 (“Radioactive Waste Management Program”). Based on this review, the NRC staff has determined that Kaiser's programs for the management of radioactive waste generated during decommissioning operations ensure that the waste will be managed in accordance with NRC requirements and in a manner that is protective of the public health and safety.

13.0 Quality Assurance Program

13.1 Organization

Section 13 of the DP describes the organization responsible for the development and implementation of the QA program. As described in Section 9 of this report, the Kaiser PM will have overall responsibility for planning and management of decommissioning activities. The Kaiser PM is responsible for ensuring that the remediation activities meet the QA requirements. Planning and management of on-site activities will be the responsibility of the Kaiser SA. A contractor will serve as the Quality Assurance Coordinator (QAC). The QAC will report directly to the Kaiser SA. The QAC has the delegated responsibility and authority to assure that QA objectives are met. The QAC has the authority to suspend work until any issue can be resolved by the Kaiser SA. However, the QAC is not authorized to revoke, alter, or waive any requirements of the DP.

13.2 Quality Assurance Program

Kaiser will implement a QA Program to limit the introduction of error into analytical data. The QA Program covers all aspects of data collection, including field surveys, soil sampling, sample custody, and laboratory analyses, through the preparation of the documentation of the results.

13.3 Document Control

In Section 13 of the DP, Kaiser describes adequate controls for the preparation, review, approval, distribution, and revisions of QA records. QA records include: (1) Kaiser site specific plans and procedures; (2) contractor site specific plans and procedures; (3) FSS data and reports; (4) non-conformance and corrective action reports; (5) audit and surveillance reports; (6) survey instrument records; (7) personnel radiation exposure records; (8) effluent and environmental monitoring data; (9) radiological data and survey reports; (10) training records; and (11) safe work permits and ALARA documentation.

13.4 Control of Measuring and Test Equipment

Kaiser's plans for controlling measuring and test equipment (M&TE) are presented in Section 13.5 of the DP. Kaiser states that all counting systems and instruments will be used in accordance with approved procedures. Daily source and instrument checks will be conducted on counting systems and instruments before use. In addition, at a minimum, ambient background will be determined each day that an analysis is performed. Kaiser commits to calibrate M&TE with a National Institute of Standards and Technology (NIST) traceable source at intervals not exceeding 12 months.

13.5 Corrective Action

Kaiser has committed to take corrective actions in accordance with an approved procedure. All non-conformances and deficiencies will be investigated by the QAC. The QAC is responsible for reporting non-conformances and deficiencies to the SA. The SA is responsible for resolving minor non-conformances and deficiencies. Major deficiencies and non-conformances will be resolved by the Kaiser Project Manager. All corrective actions will be documented.

13.6 Quality Assurance Records

In Section 13.6 of the DP, Kaiser commits to maintain records to confirm that actions essential to meeting quality objectives were performed. Records, log books, or forms used to document field activities (plans, technical procedures, survey results, analytical data, and survey data) will be retained and managed as quality records. In addition, audit reports, nonconformance reports and corrective action reports will also be maintained as quality records. Kaiser will maintain records subject to this plan such that they can be retrieved for verification. Written instructions will designate documents that must be retained as quality records and maintained on site.

13.7 Audits and Surveillances

Kaiser has committed to conduct quality assessments to provide added assurance that quality-related activities meet applicable requirements. These assessments will evaluate whether technical and regulatory requirements are met as well as procedural conformance.

Quality assessment methods may include: audits, surveillances, readiness reviews, data quality evaluations, management reviews and technical reviews. At a minimum, Kaiser will conduct a complete program review at least annually. Quality assessments will be conducted in accordance with written procedures.

The QAC will determine the assessment methods and schedules. Personnel conducting the assessments will have access to managers, documents, and records during the assessment. Deficiencies will be reported in accordance with the corrective action process presented in Section 13.5 of the DP.

The NRC staff has reviewed Kaiser’s Quality Assurance Program according to the NMSS Decommissioning Standard Review Plan, Section 13 (“QA Program”). Based on this review, the NRC staff has determined that Kaiser's QA program is sufficient to ensure that information submitted to support the decommissioning of its facility should be of sufficient quality to allow the staff to determine if the licensee’s planned decommissioning activities can be conducted in accordance with NRC requirements.

14.0 Facility Radiation Surveys

14.1 Release Criteria

In its DP, Kaiser is proposing to remediate the site in accordance with 10 CFR 20.1402, Radiological Criteria for Unrestricted Use. The site will be suitable for release for unrestricted use if the residual radioactivity distinguishable from background results in a TEDE to an average member of the critical group that does not exceed 25 mrem/yr and the residual radioactivity has been reduced to levels that are ALARA.

Kaiser performed dose modeling analyses to estimate the TEDE to the average member of the critical group (that group reasonably expected to receive the greatest exposure to residual radioactivity for any applicable circumstances). The concentration of residual radioactivity (per radionuclide) distinguishable from background that, if distributed uniformly throughout a survey unit, results in a TEDE of 25 mrem in 1 year to an average member of the critical group is the single-radionuclide $DCGL_W$. Preliminary $DCGL_W$ values for the radionuclides of concern at the Kaiser site were calculated using the guidance provided in NUREG-1549. In order to account for the presence of multiple radionuclides, the Unity Rule was applied, and $DCGL_W$ values adjusted as shown in the following table.

$DCGL_W$ Values

Radionuclide	Single Radionuclide $DCGL_W$ (pCi/g)	Ratio to Th-232 Assuming Equilibration	Average Concentration with Th-232 at Single Rad $DCGL_W$ (pCi/g)	Adjusted $DCGL_W$ to Meet Unity Rule (pCi/g)
Pb-210	1.751	0.043	0.15	0.12
Ra-226	5.9	0.082	0.28	0.24
Ra-228	4.3	1	3.4	3
Th-228	3.4	1	3.4	3
Th-230	102	3.5	12	10
Th-232	3.4	1	3.4	3

In developing the remedial action plan, Kaiser derived a cutoff concentration level (DCCL) of 31.1 pCi/g Th-232. This value represents the dividing line concentration between material which must be exported to an off-site disposal facility and material which can remain on site under an unrestricted release scenario. The average concentration of below-criteria material remaining on site is termed herein as the Average Derived Concentration Level ($ADCL_W$). Based upon dose evaluations, the $ADCL_W$, rounded to 7 pCi/g Th-232, results in a postremediation TEDE well below 1 mrem/yr. This $ADCL_W$ is the release criterion for material returned to the excavation after separation of above-DCCL material.

The three important threshold concentration criteria and their significance are summarized in the table below.

Threshold Concentration Criteria

Parameter	Value (pCi/g Th-232)	Application
$DCGL_W$	3.0	Release criterion for soil stockpile/processing area
DCCL	31.1	Dividing line for off-site disposal of material
$ADCL_W$	7.0	Average concentration (release criterion) of material left on site as backfill

Table 14-3 in the DP presents area factors (based upon the MARSSIM guidance) to be used for elevated measurement comparisons (EMC) and to determine sampling requirements in situations where the scan instrument's minimum detectable concentration is greater than the appropriate $DCGL_W$ or $ADCL_W$. The appropriate $DCLG_{EMC}$ and $ADCL_{EMC}$ values are calculated by multiplying the appropriate $DCGL_W$ or $ADCL_W$ by the area factors presented in Table 14-3. $ADCL_{EMC}$ values estimated for the excavation area are presented in Table 14-4 of the DP. Those for the processing area (area where material will be separated into above- and below-criteria material) were estimated based on the $DCGL_W$ and are presented in Table 14-5 of the DP.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Standard Review Plan, Section 14.1 ("Release Criteria"). Based on this review, the NRC staff has determined that Kaiser has summarized the DCGL(s) and area factors used for survey design and for demonstrating compliance with the radiological criteria for license termination.

14.2 Characterization Surveys

Kaiser has conducted a series of radiological characterization surveys of the site from 1994 to 2001. In February of 1994, the site was divided into eight sections and a gamma walk-over survey was performed. Measurements were taken at 1 m above the ground every 15 feet. Background was established as 10 μR/hr, and readings of greater than twice background were observed in all eight sections of the site, including a maximum of 400 μR/hr. In addition, five 18-inch core boring samples, one background core boring, and four additional soil samples were taken from test excavations. Analytical results confirmed the presence of Th-228 in secular equilibrium with Th-232. Th-230 (from the natural uranium decay chain) also was identified. The Th-230 was 2.4 to 3.4 times the Th-232 activity.

In October of 1994, a more extensive characterization of the site was performed. Two hundred and fifty samples were systematically collected from 90 borehole locations. Samples were counted for 10 minutes with a shielded 2-inch-by-2-inch NaI (Tl) scintillator detector.

Sixty 200-ml subsamples were taken from the 250 field samples. Subsamples were analyzed using a density compensating gamma spectroscopy system for U-234, U-235, U-238, and

Th-232.   The results of the survey were total thorium (Th-232 + Th-228) pCi/g values ranging from below the minimum detectable activity (MDA) of 1 pCi/g to 425.6 pCi/g.

Alpha spectroscopy was performed on 11 of the samples and confirmed the previously established ratio of Th-232 to Th-230 in dross of between 1:2.4 and 1:3.4.   The 11 samples were selected from 60 sample results that fell in the 1 to 50 pCi/g total thorium range. The 11 samples represented 3 of the 4 main areas surveyed including the retention pond, the reserve pond, and the land area between the railroad and the retention pond. The ratios calculated from these data ranged from 1:0.62 to 1:3.15. These data were consistent with previous characterization survey results and were used to estimate volumes of contaminated material and to map contamination at depth.

Surface water samples from the retention pond and from Fulton Creek were collected and analyzed by gamma spectroscopy. Results were below the MDA value of approximately 1.0 pCi/l Th-232.

In 1999, 24 samples were selected (on site) to confirm the Th-232 to Th-230 ratio in the dross. The samples were selected based on geographical distribution and included both the retention and reserve ponds and a range of depths. The data approximate the ratio to be 1:3.5.

The HSA indicated that modifications to site facilities (buildings, parking lots, etc.) during operations may have resulted in the covering of thorium-bearing dross beneath several paved surfaces and building floor areas. The areas of concern included Slag Storage Building and adjacent paved area, the original crusher building and adjacent paved area, the Crusher Addition Building, the Flux Building and adjacent paved areas, the Warehouse Building, and the concrete paved area located to the west of the Maintenance Building. Another area of concern was the "trash pile." In 2000, Kaiser conducted site characterization surveys to identify additional radioactive material beneath these areas.

Kaiser excavated seven exploratory trenches to characterize the "trash pile." Five of the seven trenches revealed the presence of a significant amount of debris material (concrete, scrap steel, rebar, wood, plastic, wire, cables and rubber belts) intermixed with soil and dross. This material was found to be nonhazardous. Further, the characterization activities showed no evidence of organic compounds.

Characterization activities under site facilities and paved areas in the former operations area indicated the presence of radioactive material: (1) beneath a significant portion of the Flux Building structure; (2) beneath the northern portion of the concrete pad which was once used a a slag storage area; (3) beneath north portion of the Crusher Building structure and beneath the paved are north/northeast of the building; (4) beneath the concrete paving area located west of the Maintenance Building; and (5) a portion of the concrete area inside the Warehouse Building. Characterization did not reveal the presence of radioactive material beneath the Crusher Building addition. However, a subsurface concrete layer prevented adequate subsurface characterization of this area.

14.3 Remedial Action Support Surveys

Kaiser will conduct remedial action support surveys while remediation is being conducted. These surveys will be used to determine when a survey unit is ready for the final status survey. The remedial action surveys will rely principally on direct radiation measurement using gamma-sensitive instrumentation. The determination of a survey unit's readiness for a final status survey will rely on the on-site knowledge of the area (i.e., kriging information and area classification) and the results from the survey instrumentation.

During remediation, excavated material will be characterized into one of the following four categories based on physical description and/or radiological survey:

- Contaminated Soil (or soil-like material) – Soil above the $DCGL_W$ or DCCL value for the processing and retention pond areas respectively.

- Acceptable Backfill Soil (or soil-like material) – Soil containing radioactivity above the $DCGL_W$ but below the DCCL value.

- Suspect Contaminated Soil – Soil which requires additional characterization for the determination of whether it is below the $DCGL_W$ or DCCL value.

- Debris – Nonsoil material that is oversized (e.g., concrete fragments, bricks, and construction debris).

Debris will be segregated from soil to the extent practical by visual inspection, surveyed to ensure that removable contamination is absent, dispositioned as structural material, and disposed of as waste. Based on survey instrument DCCL, $DCGL_W$, and $ADCL_W$ values, survey instrumentation threshold values will be determined. The lower bound threshold is the value below which surveyed soil is acceptable backfill soil. The upper bound threshold is the value above which surveyed soil is contaminated soil. The two threshold values will be conservatively set based on empirical data (e.g., the lower bound threshold value will be set at the average net counts per minute value corresponding to the $DCGL_W$ less one standard deviation and the upper bound threshold will be set at the average plus one standard deviation) to ensure that soil is acceptable backfill or that soil is contaminated. Soil surveyed with results between the two threshold values will be stockpiled as suspect contaminated soil and will be sampled for laboratory analysis to determine if the soil is acceptable backfill or contaminated and requiring proper disposal.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according to the NMSS Standard Review Plan, Section 14.2 ("Characterization Surveys"). This review has determined that the radiological characterization of the site, area, or building is adequate to permit planning for a remediation that will be effective and will not endanger the remediation workers, to demonstrate that it is unlikely that significant quantities of residual radioactivity has not gone undetected, and to provide information that will be used to design the final status survey.

14.4 Final Status Survey Design

The FSS is performed after an area has been fully characterized, remediation has been completed, and the licensee believes that the area is ready to be released for unrestricted use. The purpose of the FSS is to demonstrate that each area, as defined by survey classifications, meets the radiological criteria for license termination. The FSS design entails an iterative process that requires appropriate site classification - based on the potential residual radionuclide concentration levels relative to the DCGLs - and formal planning using data quality objectives (DQOs).

Section 14.4 of the DP, "Final Status Survey Design," presents the framework through which the FSS will be planned, designed, and implemented. To evaluate the FSS design the following relevant sections were also evaluated: Section 14.5 - “Use of a Surrogate Radionuclide;” Section 14.6 - “Establishing Background”; Section 14.7 - “Area Classifications”; Section 14.8 - “Selection of Survey Units”; Section 14.9 - “Field Instrumentation”; Section 14.10 - “Laboratory Analysis”; Section 14.11 - “Sampling and Measurement Technique”; Section 14.12 - "Final Status Survey Implementation”; and Section 14.13 - “Data Evaluation.”

NRC will be conducting performance-based, in-process inspections throughout the various stages of decommissioning activities. The purpose of the inspections is to verify the implementation of the commitments made by Kaiser and to review the procedures, methodology, equipment, training and qualifications, and QA and QC measures.

Kaiser used site characterization data, together with process knowledge and operational and routine surveillance survey records, as the principal means for initially classifying site areas as impacted or non-impacted. The freshwater pond area is the only area with in the pond parcel that was determined to be not impacted. However, since Kaiser will use the freshwater pond area for material processing during decommissioning, Kaiser also designated this area as impacted for purposes of classification and survey. The proposed survey unit sizing and classification process were found to be consistent with NRC guidance provided in NUREG-1575 (Ref. 11).

The DP describes information and parameters that will be applied in developing DQOs, as defined in MARSSIM. The elements of the DQOs include: the null hypothesis (i.e., the survey unit does not meet the release criteria); decision errors; selection of an appropriate statistical test; limits on decision errors; scan coverage as a function of survey unit classification; variables for calculating sample size and sampling density for each survey unit; sampling locations and reference grid system for buildings and grounds; survey design process; and establishing background radiation levels in selected reference areas. The variables used to calculate sample size are the DCGL, lower boundary of the gray region (LBGR), and estimates of the variability of the contaminants in a survey unit (commonly referred to as “sigma”). The statistical tests discussed in NUREG-1575 are the Wilcoxon Rank Sum (WRS) test and the Sign test. Typically, the WRS test is selected when the radionuclides of concern are present in background, or gross measurements are made. The WRS test also requires the identification of appropriate background reference areas from which the same samples or measurements were collected, as was done within the survey unit. The reference area data are adjusted for the DCGL, and then the two data sets are compared to demonstrate compliance with the release criteria. Alternatively, the Sign test may be selected if the radionuclides of concern are not present in the background, or are present at a small fraction of the DCGL. Section 14.4.2 of the DP address this process. The DP states that since the radionuclides of interest occur naturally in background, the survey unit net radiological conditions will be compared to the specified DCGLs or ADCLs using the WRS test.

The input parameters for sample size calculations include the DCGL; the LBGR (which generally provides an estimate of the mean concentration in the survey unit, but may be adjusted to optimize the design); and an estimate of the radionuclide variability. These parameters, together with decision errors, are used to calculate the required number of statistical samples. For initial planning purposes, Kaiser has set the LBGR at 50 percent of the DCGL, and established default decision errors at 0.05 for both Type I and II errors. The principal decision error of concern to NRC, for survey design inputs, is the Type I or α error. This error occurs when a survey unit is determined to meet the release criteria when in fact it does not. The default value of 0.05 for the Type I or α error used by Kaiser is acceptable. In Section 14.4.2, Kaiser determines that the minimum number of samples for survey units is 9. This number includes a factor to increase the number of samples by 20 percent as recommended by MARSSIM. The approach and statistical survey planning discussed in the DP are found to be acceptable.

DP Section 14.4.2 presents the site coordinate and reference system that will be used during the conduct of FSS'. Kaiser has committed to collect a minimum number of samples in each survey unit regardless of the survey unit classification. A random-start triangular grid pattern will be used. The start point will be selected by a random point generator, and sample points will be located by use of a global positioning system. The proposed approach is deemed appropriate.

The selection of survey instrumentation (ratemeters and detectors), calibration, and survey methods are discussed in Section 14.9, of the DP. The selection process will ensure that the instrumentation used for the FSS' will respond adequately to the types of radiations being emitted by the various radionuclides of concern; is sufficiently sensitive to detect these radionuclides, or gross activity, at levels within appropriate fractions of the DCGLs; and is calibrated in a manner that accounts for the expected or known radionuclide mix, expected radiation emission energies of the mixture, surface efficiencies, and how the contaminants are physically distributed in the media. The list of instrumentation and the basis for instrumentation detection efficiencies are deemed appropriate for the radionuclides of interest.

In Section 14.5 of the DP Kaiser discusses its plan to use Th-232 as a surrogate radionuclide to demonstrate compliance for all radionuclides and to guide remediation activities. Characterization activities have verified that the primary radionuclides of concern at the site are isotopes of thorium. Th-228 and Th-232 were found to be in secular equilibrium. Th-230, a part of the natural uranium decay chain, is also present even though no uranium was ever found on-site. Characterization established that the Th-230 activity is 3.5 times greater than the Th-232 activity. Since not all of the radionuclides can be identified by real time gamma surveys or gamma spectroscopy, Kaiser will use Th-232 decay products as a surrogate. A review of these sections of the DP indicates that the proposed approach is acceptable.

The conduct of routine operational checks and calibration procedures is discussed in DP Section 13.4.2. Kaiser will use NIST traceable calibration sources that are similar in energy to the primary radionuclides of concern. Instrument response checks will be performed before use, each day. Should a response check fail the +/- 2σ criteria, the instrument will be rechecked and ultimately removed from service. For laboratory instrumentation, responses will be monitored using control charts and appropriate radioactive standards. A review of these sections of the DP indicates that the proposed approaches are acceptable.

The method for conducting FSS' is contained in Sections 14.11 and 14.12 of the DP. Section 14.11 discusses sampling and measurement techniques to be used during FSS', including: methods for performing surface scans; direct measurements; and soil sampling. Section 14.12 discusses FSS implementation. Surveys will be conducted with gamma sensitive instruments.

Methods for surface scans recognize the importance of surface-to-detector distance and scan speeds to achieve an adequate scan sensitivity.   For direct-fixed measurements, counting time will be based on the background count rate and the required sensitivity. For open land, the surface scan method specifies holding the detector within a few inches of the surface, maintaining a scan speed of 0.5 m (1.6 ft) per second.

The scan coverage is based on survey unit classification, with Class 1 survey units receiving 100 percent scan coverage, Class 2 receiving coverages of 10 to 100 percent, and Class 3 receiving up to 10 percent. Surface activity measurements and soil and bulk-material samples are currently proposed to be performed at locations defined using the MARSSIM test. Kaiser has stated that measurement/sampling locations are to be determined based on a random-start triangular grid pattern for Classes 1 and 2 survey units. These proposed methodologies for surveys are acceptable and generally follow NRC guidance.

Section 14.13 presents the approach that will be used to develop investigational levels; the process to investigate areas that have been found to contain elevated levels of activity above the DCGL of the applicable investigational levels; and the actions to be taken once it has been confirmed that an action level has been exceeded. The section outlines the process steps of preliminary data review, data evaluation and conversion, comparison of survey results with investigation levels. A measurement that exceeds the investigation level may indicate that the survey unit is improperly classified, or that the survey instrument failed. When an investigation level is exceeded, Kaiser will conduct an investigation to determine the need for survey unit reclassification, further remediation, and/or resurvey. The DP stipulates (Section 14.7.3) that if the licensee elects to reduce a survey unit's classification (e.g., from Class 1 to Classes 2), NRC approval will be obtained.

Section 14.14 of the DP provides a brief description of the FSS documentation and report contents. The FSS report will include: (1) an overview of the survey results; (2) a discussion of any changes made in the survey from what was proposed in the DP; (3) a discussion about the number of samples taken for each survey unit; and (4) survey results for each survey unit.

The NRC staff has reviewed the information in the Kaiser Phase 2 Decommissioning Plan according the NMSS Standard Review Plan, Section 14.3. Based on this review, the NRC staff has determined that Kaiser's final status survey design is adequate to demonstrate compliance with radiological criteria for license termination. Implementation of the FSS program will be verified through NRC inspections and confirmatory surveys.

15.0 Financial Assurance

Kaiser is not a licensee, and therefore, not required to have financial assurance.

16. Acronyms

AEC - Atomic Energy Commission
ALARA - As Low As Is Reasonably Achievable
ADCL - Average Derived Concentration Level
DAC - Derived Air Concentration
DAW- Dry Active Waste
DCCL- Derived Cutoff Concentration Levels
DCGL- derived concentration guideline level
DP - Decommissioning Plan
DQO - Data Quality Objective
E & S - Environmental Health and Safety
EMC - Elevated Measurement Comparisons
FSS - Final Status Survey
ft^3 - Cubic Feet
H & S - Health and Safety
HPT - Health Physics Technician
HSA - Historic Site Assessment
LBGR - Lower Boundary of the Grey Region
MARSSIM - Multi-Agency Radiation Survey and Site Investigation Manual
M & TE - Measuring and Test Equipment
MCL - maximum contaminant levels
MDA - Minimum Detectable Activity
mrem/yr - millirem per year
NIST - National Institute of Standards and Technology
NRC - Nuclear Regulatory Commission
pCi/l - picocuries per liter
pCi/g - picocuries per gram
PM - Project Manager
PPE - Personal Protection Equipment
QA/QC - Quality Assurance/Quality Control
QAC - Quality Assurance Coordinator
SA -Site Administrator
SDMP - Site Decommissioning Management Plan
SER - Safety Evaluation Report
SMC - Standard Magnesium Corporation
TEDE - Total Effective Dose Equivalent
uR/hr - microRad per hour
WRS - Wilcoxon Rank Sum test

17.0 References

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3. Kaiser Aluminum and Chemical Corporation, May 2003, Decommissioning Plan Addendum for the Tulsa Facility, Tulsa, Oklahoma.

4. Roberts/Schornick & Associates, March 20, 1996, Local and Regional Environmental Data Report, Kaiser Aluminum Specialty Products.

5. Advanced Recovery Systems/Nuclear Fuel Services, Inc., April 25, 1995, Kaiser Aluminum Specialty Products, Field Characterization Report, Tulsa, Oklahoma.

6. A & M Engineering and Environmental Services, Inc., July 1999, Hydrologic and Geologic Investigation, Kaiser Aluminum Specialty products.

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11. Nuclear Regulatory Commission, August 1998, Draft Regulatory Guide DG-4006: Demonstrating Compliance with the Radiological Criteria for License Termination.

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[7590-01-P]

NUCLEAR REGULATORY COMMISSION

[Docket No. 40-2377]

ENVIRONMENTAL ASSESSMENT AND FINDING OF NO SIGNIFICANT IMPACT RELATED TO THE APPROVAL OF THE DECOMMISSIONING PLAN FOR KAISER ALUMINUM & CHEMICAL CORPORATION, TULSA FACILITY, TULSA, OKLAHOMA

I. Introduction

The U.S. Nuclear Regulatory Commission (NRC) is considering approval of the Decommissioning Plan (DP) for Kaiser Aluminum & Chemical Corporation (Kaiser), Tulsa Facility, Tulsa, Oklahoma (Ref. 1), and DP Addendum (Ref. 2) submitted to NRC on May 25, 2001, and May 9, 2002, respectively. Kaiser is obligated to remediate the Tulsa, Oklahoma facility to meet the release criteria established in 10 CFR Part 20, Subpart E. Kaiser has proposed a decommissioning approach that will achieve unrestricted release of the site.

II. Environmental Assessment

Introduction

On March 7, 1958, the Atomic Energy Commission (AEC) issued Source Material License No. C-4012 to Standard Magnesium Corporation (Standard Magnesium), a Division of Kaiser Chemical Company, for possession of magnesium-thorium alloy. Standard Magnesium purchased magnesium-thorium scrap metal for reclaiming purposes. The end product from Standard Magnesium's manufacturing process was magnesium anodes used for cathodic protection on items such as tanks and pipelines. NRC License No. STB-472 superceded License No. C-4012 on November 22, 1961. On June 5, 1968, License No. STB-472 was amended to include the possession of uranium, so that Standard Magnesium could process magnesium slag containing uranium. It does not appear that uranium was ever received or processed on site. On March 16, 1971, License No. STB-472 was terminated at the licensee's request.

In 1991, Oak Ridge National Laboratory (ORNL) was contracted, by NRC, to review and evaluate all nuclear material licenses terminated by NRC or its predecessor agencies since inception of material regulation in the late 1940s. One of the objectives of this review was to identify sites with a potential for meaningful residual contamination, based on information in the license documentation. ORNL identified the Kaiser site as having the potential for residual contamination. On November 17, 1993, an NRC inspector surveyed the Kaiser facility to assess the potential for residual contamination at the site. The inspector found contamination on the surface, indicating that waste magnesium-thorium slag was improperly disposed of in the past. Off-site residual thorium contamination was first identified during a subsequent NRC inspection conducted on June 29, 1994. The off-site thorium contamination is due to slag dumping in areas to the east and south of the current Kaiser property boundary, on property which belonged to Standard Magnesium during licensed operations. NRC notified Kaiser on August 19, 1994, that the site had been added to the Site Decommissioning Management Plan (SDMP). Kaiser has agreed to conduct remediation activities in accordance with current regulations and release limits, even though it is not currently a licensee.

A detailed discussion of the contamination present at the site is presented in Chapter 4 of the DP, and Chapter 4 of the DP Addendum.

Purpose and Need For Proposed Action

The Kaiser property contains thorium contaminated dross/soil. This property was owned and operated by Kaiser's predecessor, Standard Magnesium. Standard Magnesium extracted magnesium from magnesium thorium alloys. The thorium-bearing slag was disposed of on-site and onto, what is now, land adjacent to the Kaiser property. Kaiser has completed remediation of the adjacent property and is now proposing plans to remediate its property.

Extensive site characterization studies conducted by Kaiser (Ref. 3 and Ref. 4), indicate that Th-228, Th-230 and Th-232 are present in dross/soil on the Kaiser property. In 1995, an investigation was performed to characterize soils and sludges in the Retention and Reserve Pond areas containing thorium with respect to criteria used by the NRC for release of sites for unrestricted use, as set forth in the NRC Branch Technical Position, Disposal or On-Site Storage of Residual Thorium or Uranium Wastes From Past Operations (Ref. 5). From the characterization data, affected material volumes were estimated by performing kriging calculations. The estimate from the kriging calculations yielded a total volume of 113,504 cubic meters (m^3) [4,007,909 cubic feet (ft^3)] of material with Th-232 + Th-228 concentrations greater than 370 milli Becquerels per gram (mBq/g) [10 picocuries per gram (pCi/g)], and a volume of 143,288 m^3 (5,059,614 ft^3) of material with concentrations greater than 222 mBq/g (6 pCi/g). With the addition of stockpiled soils, (8071 m^3 (285,000 ft^3) of material moved on-site during the Adjacent Land Area Remediation project), the kriging estimate for the total volume of affected soil in the Retention Pond and Reserve Pond areas is 151,370 m^3 (5,345,000 ft^3). The thorium concentration for on-site material ranges from approximately 74 mBq/g to 15.4 Bq/g (2 pCi/g to 416 pCi/g) for Th-232 + Th-228.

In the DP, Kaiser identified the potential for radioactive material under concrete paved surfaces and building floor areas in the operations area. Subsequently, Kaiser submitted a report on additional site characterization activities conducted to identify radioactive material located beneath structures in the operations area (Ref. 4). Kaiser has determined that modifications of on-site buildings/structures during operations resulted in surface and subsurface soil contamination beneath concrete paved surfaces and building floor areas in the operations area. Residual radioactive material exists in the following areas: (1) beneath a significant portion of the Flux Building structure; (2) beneath the northern portion of the concrete pad which was once used as a slag storage area; (3) beneath the north portion of the Crusher Building structure and the paved area north/northeast of the Crusher Building; (4) beneath the concrete paving area located west of the Maintenance Building; and (5) beneath a portion of the concrete area inside of the Warehouse Building. Kaiser estimates that approximately 1699 m^3 (60,000 ft^3) of material will be excavated during decommissioning activities in the former operational area.

The purpose of the proposed action is to reduce residual radioactivity at the Kaiser facility to a level that permits release of the property for unrestricted use. NRC is fulfilling its responsibilities under the Atomic Energy Act to make a decision on a proposed action for decommissioning that ensures protection of the public health and safety of the environment.

The Proposed Action

Kaiser is proposing to remediate its facility to meet the unrestricted release criteria of 10 CFR Part 20, Subpart E, by identifying, excavating, and disposing material with Th-232 concentrations greater than 1151 mBq/g (31.1 pCi/g). Specifically, Kaiser proposes to conduct excavation activities in four phases:

Phase 1 - remove material stockpiled from the adjacent land remediation. Materials from the existing stockpile will be transported to a new storage area and sorted. Materials above 1151 mBq/g (31.1 pCi/g) will be shipped to a disposal site licensed to receive the material.

Phase 2 - excavate material from the former operational area and transport to the pond parcel. Material with Th-232 concentrations greater than 1151 mBq/g (31.1 pCi/g) will be segregated and shipped to a disposal site licensed to receive the material. Material below criteria will be placed in the pond parcel as backfill.

Phase 3 - excavate and transport material from the reserve pond area to the stockpile area for processing. Material above 1151 mBq/g (31.1pCi/g) will be shipped to a disposal site licensed to receive the material. Below-criteria material will be returned to the excavation.

Phase 4 - excavate material from the retention pond area and former spillway. Material will be transported to the stockpile area and processed/disposed as in previous phases. It is estimated that approximately 170,592 m^3 (6,028,000 ft^3) of material will be excavated during decommissioning activities. Of this volume, 33,984 m^3 (1,200,000 ft^3) will have Th-232 concentration greater than 1151 mBq/g (31.1 pCi/g), and will require off-site disposal.

A detailed discussion of the proposed decommissioning activities at the site is presented in Chapter 8 of the DP, and Chapter 8 of the DP Addendum.

Alternatives to the Proposed Action

The proposed remediation approach allows Kaiser to meet NRC's requirements for unrestricted release of the site, uses proven technology, and is protective of human health and the environment. However, there are two alternatives to the proposed action of excavating and disposing of above- criteria material at a licensed disposal facility; (1) to take no action, and (2) to excavate contaminated material such that the site would be suitable for restricted release. The no-action alternative is not acceptable because soil contains thorium at levels which would cause a dose exceeding NRC's limits presented in 10 CFR 20.1402 (25 mrem/yr (25mSv/yr) plus ALARA). Kaiser does not consider the restricted release alternative to be advantageous at this time for environmental, technical and economic reasons. Therefore, these alternatives are not considered further in this EA.

The Affected Environment and Environmental Impacts

The Kaiser facility is located at 7311 East 41st Street in Tulsa, Oklahoma. It is situated in Tulsa County, Oklahoma, about 5 miles southeast of the downtown center of the City of Tulsa. The site initially occupied approximately 23 acres of land on both sides of 41st Street. The remediation area is bounded by the south fence line, the freshwater pond embankment on the west, Fulton Creek ditch on the north, the east fence line, and the northern and western edges of the flux building and paved area. The areas to be remediated include a portion of the 4-acre operational area south of the railroad, and a large portion of the 14-acre pond parcel located north of the railroad. The pond parcel is divided into three parts--the unaffected freshwater pond to the west (approximately 4 acres), the affected retention pond/reserve pond area to the east (approximately 9 acres), and the area containing the flux building and paved area (approximately 1 acre).

Remediation of the Kaiser property could result in both radiological and non-radiological environmental impacts. Radiological environmental impacts that could result from the remediation of the facility include exposure, inhalation, and ingestion hazards to workers and the public. These hazards could occur during excavation, transport, or backfilling of the contaminated soil.

Potential radiological impacts during excavation and backfilling include: (1) exposure; (2) inhalation and ingestion to workers; and (3) inhalation and ingestion to the public. Kaiser has committed to perform work activities in accordance with the Health & Safety Plan (HSP) (Chapter 10 of the DP), and the Environmental Health and Safety Plan (EHSP) (Appendix E of the DP).

Worker doses due to direct exposure to the contaminated soil are expected to be small. Site characterization revealed that 95 percent of the material contains less than 1850 Bq/kg (50 pCi/g) thorium. Since worker exposure time will be short, and thorium concentrations are relatively low, Kaiser estimates that doses due to direct contact with soil will be less than 1 millisievert per year (mSv/yr) [100 millirem per year (mrem/yr)].

Inhalation and ingestion impacts will be minimized to the workers and public by controlling airborne material levels. Kaiser has determined that in order to reach 10 percent of the derived air concentration (DAC) limit, the soil must exceed 7.4 Bq/g (200 pCi/g) Th-232 + Th-228. Based on characterization information, Kaiser has a good database to identify where soil exceeds 7.4 Bq/g (200 pCi/g) Th-232 + Th-228. If the Th-232 + Th-228 is less than

7.4 Bq/g (200 pCi/g) soil, Kaiser will perform occasional air sampling near the dust source. If the soil exceeds 7.4 Bq/g (200 pCi/g) Th-232 + Th-228 where airborne dust from nearby soil might reach 0.1 DAC, Kaiser will perform continuous, stationary air sampling near the dust source while workers are present.

Air sampling will also be conducted at work area boundaries to evaluate off-site releases. Action will be taken if radioactivity levels exceed 50 percent of the regulatory limit at the work area boundary.

Kaiser's DP includes controls for keeping radiation exposures to workers, and the public, "as low as is reasonably achievable" (ALARA). These controls include implementing: (1) the HSP and EHSP; (2) radiation worker training; (3) a respiratory protection program; (4) safety work permit procedures; and (5) radioactive material storage and handling procedures. In addition, Kaiser presented an ALARA analysis (Chapter 7 of the DP) which compared dose and cost of the planned action with the cost benefits of incremental soil removal to further reduce the dose. The analysis demonstrates that removal of additional soil/dross is not cost beneficial.

The potential for radiological impacts during transportation is limited. Spillage during transportation is the only credible scenario for workers receiving a potential dose. Since any spills could be immediately recovered, doses due to direct exposure will be minimal. The potential exists for contaminated material to become airborne during loading, unloading, or as a result of accidental spills. In the DP, Kaiser commits to using a controlled material handling/processing/storage area to package waste for disposal. Packaging will include Department of Transportation and disposal facility approved containers. After packaging, waste will be transferred to a secured on-site storage area or loaded directly for shipping. Potential radiological impacts to workers and the public due to airborne material will be controlled as described above.

Potential radiological impacts resulting from the stockpiling of the contaminated soil on Kaiser property include doses to the public from airborne material and precipitation runoff. In the DP, Kaiser commits to minimize the spread of contamination by lining the stockpile area with a high density polyethylene liner, or equivalent. In addition, berms or ditches will be constructed at the stockpile perimeter to control precipitation falling on the stockpile. Kaiser has committed to minimize storm water contact with stockpiled soil. Contact may be minimized by: (1) diverting water around remediation and stockpile areas; (2) covering stockpiles; or (3) performing work during dry season.

The potential for groundwater contamination at the site is minimal. Site characterization sampling at the site indicates that the vertical migration of the thorium is limited. Sampling revealed that thorium concentrations dropped quickly in undisturbed soil.

Potential non-radiological impacts include; increased traffic from transportation of waste, esthetic degradation, and economic impacts. Waste will be transported by either rail or truck. Kaiser estimates that approximately 33,984 m^3 (1,200,000 ft^3) of material will be generated for off-site disposal. This volume of material will require less than 1000 rail cars, which will be spread over a three year time period. Therefore, the impact from transportation should be insignificant.

The Kaiser facility is located in an area which is completely developed with no pre-settlement vegetation existing. Land use within a one mile radius from the site is a mixture of commercial, industrial, and residential. Commercial or industrial properties in the area include Union Pacific Railroad (right-of-way), Specific Systems, Beejay Inc., Smalley Equipment, and Red Man. Kaiser has committed to restore the site following remediation. Restoration will include; placement of vegetative cover, seeding and mulching, permanent surface water controls, and permanent erosion and sedimentation controls. U.S. Fish and Wildlife Service has determined that the proposed action will not have an adverse impact on threatened and endangered species. The Oklahoma Historical Society informed Kaiser that there are no historic properties affected by the project. The Oklahoma Archeological Survey has stated that no archeological sites are listed as occurring within the project area and no archeological materials are likely to be encountered. Further, the Creek Nation of Oklahoma informed Kaiser, that there are no religious or sacred sites within the project area that will be affected by the undertaking of this project. Therefore, the esthetic impact from decommissioning activities should be insignificant.

The residential population within a 3 km (1.9 miles) radius of the site is approximately 24,000. Additionally, in 1990, there were approximately 3500 business entities with in the same area. The facility lies within two separate zones; the Industrial Moderate District and Industrial Light District. Zoning within the vicinity of the facility is not expected to change. According to Chapter 15.0 of the DP, less than 15 workers will be required to perform decommissioning activities. Due to the small number of workers required for decommissioning, and the short duration of the project, this effort should have minimal socioeconomic impact on the community.

Air quality and noise impacts will result from excavation and transport of waste. Kaiser will use appropriate dust control measures during excavation. These activities will be sporadic in nature and relatively short in duration; and, therefore, will have minimal impact on the surrounding community and environment.

NRC has found no other activities in the area that could result in cumulative impacts.

Agencies and Persons Consulted

NRC staff provided a draft of the EA to Oklahoma Department of Environmental Quality (ODEQ) for review. By facsimile dated May 30, 2003, ODEQ informed NRC that it had no comments on the draft EA.

NRC contacted the U.S. Fish and Wildlife Service to ensure that the proposed action will not have an adverse impact on threatened and endangered species. Mr. Ken Frazier informed the NRC on April 16, 2003, that the proposed action will have no impact on threatened and endangered species.

Prior to approval of the Kaiser Phase 1 DP, NRC contacted the Oklahoma Historical Society to determine if the proposed action would have any adverse impacts on sacred or historical properties near the Kaiser site. The Oklahoma Historical Society informed Kaiser, by letter dated August 31, 1999, that there are no historic properties affected by the project.

The Oklahoma Archeological Survey informed NRC, by letter dated August 6, 1999, that no archeological sites are listed as occurring within the project area and no archeological materials are likely to be encountered.

The Creek Nation of Oklahoma informed Kaiser, by letter dated August 5, 1999, that there are no religious or sacred sites within the project area that will be affected by the undertaking of this project.

Conclusions

Kaiser has committed to perform remediation activities in accordance with an acceptable DP. NRC staff believes the DP provides adequate controls to keep potential doses to workers and the public from direct exposure, airborne material, and released effluents, ALARA.

NRC staff also believes that the remediation alternative proposed by Kaiser minimizes the potential dose to members of the public, and other environmental impacts. Potential doses to members of the public will be minimized by removing contaminated soil from Kaiser property and making the site suitable for unrestricted release. The proposed remediation alternative also minimizes the potential environmental impacts. Kaiser will excavate and dispose of soil with Th-232 concentrations greater than 1151 mBq/g (31.1 pCi/g), thereby removing a significant source of contamination from the local environment. Therefore, the potential environmental impact from the proposed action is insignificant.

List of Preparers

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References

1. Kaiser Aluminum and Chemical Corporation, “Decommissioning Plan,” June 2001.
2. Kaiser Aluminum and Chemical Corporation, “Decommissioning Plan Addendum,” May 2002.
3. Advanced Recovery Systems/Nuclear Fuel Services, Inc., Kaiser Aluminum Specialty Products, “Field Characterization Report,” April 18, 1995.
4. Kaiser Aluminum and Chemical Corporation, “Additional Site Characterization Activities,” November 2001.
5. NRC, Branch Technical Position, “Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations,” 1981.

III. Finding of No Significant Impact

Pursuant to 10 CFR Part 51, NRC has prepared this EA related to the approval of Kaiser’s DP. On the basis of this EA, NRC staff has concluded that there are no significant environmental impacts on the quality of the human environment. Accordingly, the staff has determined that preparation of an Environmental Impact Statement is not warranted.

IV. Further Information

The licensee's request for the proposed action and other related documents to this proposed action are available for public inspection and copying for a fee at NRC's Public Document Room at NRC Headquarters, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852. These documents, along with most others referenced in the EA, are available for public review through ADAMS, the NRC's electronic reading room, at: http://www.nrc.gov/reading-rm/adams.html.

Any questions with respect to this action should be referred to John Buckley, Decommissioning Branch, Mailstop T-7F19, Division of Waste Management, Office of Nuclear Materials Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001. Telephone: (301) 415-6607.

Dated at Rockville, Maryland, this ______ day of May, 2003.

For the Nuclear Regulatory Commission,

Daniel M. Gillen, Chief
Decommissioning Branch
Division of Waste Management
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