Decommissioning Plan Addendum

Tulsa Facility
Tulsa, Oklahoma

Volume 2 of 2

Kaiser Aluminum & Chemical Corporation
Baton Rouge, Louisiana

Project Nos. 5427K and 5427M
May 2002
Revised May 2003

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Appendix A

Historical Site Assessment

Historical Site Assessment
Operational Area

Former Kaiser Aluminum Specialty Products Facility
Tulsa, Oklahoma

Kaiser Aluminum & Chemical Corporation
Tulsa, Oklahoma

Project No. 5427K
December 2001

Earth Sciences Consultants, Inc.

Providing Environmental Consulting Services Since 1979

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1.0 Introduction

This technical report was prepared by Earth Sciences Consultants, Inc. (Earth Sciences) on behalf of Kaiser Aluminum & Chemical Corporation (Kaiser) to present the results of an historical site assessment (HSA) performed for the former Kaiser Aluminum Specialty Products facility located in Tulsa, Oklahoma (Figure 1). The HSA focused on an approximate 3.5-acre land area of the facility known as the former "operational area." The former operational area is located to the north of 41st Street and south of the Union Pacific Railroad right-of-way (see Figure 2). Plant processes and operations occurred in this area. The former operational area currently houses several structures including the North Extrusion, Office, Maintenance, Warehouse, Crusher, and Crusher Addition buildings. The "land areas" of the former operational area consist mainly of paved concrete surfaces. The Flux Building, located to the northeast of the triangular parcel, is also included as part of the former operational area. The results of the HSA will be used to design characterization and/or decommissioning events for the former operational area of the facility.

1.1 Facility Operational Background

The subject facility, which was built by the Standard Magnesium Corporation (SMC) in the early to mid-1950s, currently is owned by Kaiser. Historical operations at the facility included the smelting of scrap magnesium alloy for the production of magnesium anodes. To facilitate these operations, SMC obtained a source materials license (C-4012) from the Atomic Energy Commission (AEC) in March 1958 to recycle magnesium alloy aircraft scrap with up to 4 percent natural thorium content. This license was renewed and amended several times, and was superceded by License No. STB-472 in 1961. In 1968, STB-472 was amended to also authorize possession and processing of uranium-bearing materials, but there is no record that uranium materials ever were received on site. Available site characterization data support this finding. Thorium alloy material comprised only a fraction of the total magnesium refined on site. Kaiser purchased the facility in 1964 and magnesium operations continued to around 1985. Aluminum replaced magnesium in smelting and anode manufacture, and the plant continued operating until the 1997-1998 time frame. However, the radiological license was terminated in 1971 by the AEC at

Kaiser's request. Magnesium-thorium alloy reprocessing had been halted at that time for more than a year.

The scrap magnesium alloy refining process consisted of placing the sheered material into large melting pots, heating the material until molten, and then siphoning off the pure magnesium. Impurities from the mixture, including thorium, separated from the magnesium and floated on the surface. This residue material was removed, allowed to cool, and crushed. The crushed material was returned to the heating pots for a second recovery process. Once refined, the metallic dross residue material was crushed and disposed on site in accordance with license conditions.

1.2 Historical Site Assessment

The HSA was performed using guidance outlined in the Multi – Agency Radiation Survey and Site Investigation Manual (MARSSIM). The conclusions presented in this HSA are a result of compiling and evaluating site information. The information sources used for the HSA are as follows:

- MARSSIM, 2000
- A Radiological Report, American Radiation Services, Inc. (ARS), 2000
- Local and Regional Environmental Data Report, Roberts/Schornick & Associates, Inc., 1996
- Decommissioning Plan, Tulsa Facility, Tulsa Oklahoma, June 2001, Earth Sciences
- Adjacent Land Remediation Plan (ALRP), Final Status Survey Report, Earth Sciences, 2001
- Proposed Characterization Plan, Decommissioned Facilities, Kaiser Aluminum & Chemical Corporation, Tulsa, Oklahoma, Earth Sciences, February 2001
- Historical Hydrological Impacts Shown on Aerial Photographs, A&M Engineering and Environmental Services (A&M Engineering), 1999
- Technical Document, Measurement of Thorium and Thoron Hazards (Appendix B)
- Arial photo progression review from 1950 to present
- Investigation on the basic plant process as well as site-specific process knowledge (Kaiser)
- Review of available site records
- Interviews with Mr. Robert Teel, Kaiser employee from 1963 to present

- Interviews with Mr. Bobby A. Holmes, Kaiser plant manager from 1982 to 1991
- Information gathered during the Additional Site Characterization Activities (ASCA), 2001, prepared by Earth Sciences

1.3 Report Structure

The format utilized for this report was provided by MARSSIM (Section 3, Page 3-26, Figure 3.2). The remainder of this document provides general background information on the facility, the approach that was used to gather historical information, and the results of the assessment of historical information that was gathered. Conclusions based upon the results of the investigation and review of historical information are also provided.

2.0 Purpose of the HSA

Extensive site characterization activities have been conducted since 1994 within a 14.0-acre land area of the facility known as the "pond parcel." These characterization activities have indicated the presence of residual radioactive material within a 10-acre portion of the pond parcel. The radioactive material identified within this portion of land is a thorium-bearing dross containing the isotopes thorium-232 (Th-232), thorium-230 (Th-230), and thorium-228 (Th-228). The impacted portion of the parcel contains the retention pond, former reserve pond area, and Flux Building area. The nonimpacted portion of the pond parcel contains a freshwater pond. A plan was prepared to address the decommissioning of the pond parcel land area. The decommissioning plan (DP) was submitted in June 2001 to the Nuclear Regulatory Commission (NRC) (Reference 1). The HSA focuses on the former operational area of the facility, which was not addressed in the June 2001 DP.

Over time, certain portions of the original SMC property were transferred to other entities. Consequently, some contamination existed on property adjacent to current Kaiser property boundaries. As a result, Kaiser prepared and submitted to the NRC an ALRP. This plan was approved by the NRC on April 4, 2000. Kaiser conducted off-site remediation activities from October 2000 through May 2001. Contamination of the adjacent properties was found to occur at the ground surface and to depths of up to 15 feet. The extent of the contamination was limited to the following properties: 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 the Red Man Pipe & Supply Company (Red Man) (formerly Premier) property. Contamination also was found along the north side of East 41st Street, between the roadway and the Crusher Addition Building. In addition, contamination was found south of Kaiser's Flux Building, outside the retention pond property fence, and on Kaiser property between the Flux Building and the Union Pacific Railroad property. Remediation was performed in these areas to achieve unrestricted release of the adjacent land areas. A final status survey report for the ALRP was submitted to the NRC in July 2001.

The most recent characterization effort (ASCA, October 2001 [Reference 2]) investigated parts of the former operational area of the facility. As previously mentioned, the former operational area is defined as the concrete surfaces and structures where plant processes and operations occurred. The areas are those that fall in the triangular parcel of land north of 41st Street and south of the railroad right-of-way. The Flux Building is included as part of the former operational area (Figure 2), since it is a related structure and will require appropriate classification according to MARSSIM (Reference 3). The HSA was conducted as the first step toward decommissioning the former operational area of the Kaiser facility. The objective was to compile as much historical information as possible for the site and, using (MARSSIM) guidelines, categorize the land areas and structures of the former operational area of the facility as either impacted or nonimpacted.

3.0 Property Identification

3.1 Site Location and Description

The former Kaiser Aluminum Specialty Products 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 (Figure 3). Currently, a 3-acre parcel south of 41st Street contains an active aluminum 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 3.5-acre parcel south of the railroad houses an active office building and several inactive operational structures. An approximate 14.0-acre pond parcel north of the railroad contains a freshwater pond, a retention pond, a former reserve pond area and the Flux Building area (Figure 3).

3.1.1 Site Topography and Stratigraphy

The site is located in the Northwest Oklahoma Cherokee Platform Physiographic Province, which is a region with low relief. Originally, the site topography ranged from elevations above 710 feet above mean sea level south of the tracks to below 690 feet at the retention pond and below 680 feet at the reserve pond. The current topography range of the site has not changed from the original calculations. This is illustrated in Figure 3.

3.2 Environmental Setting

Information contained in this section of the HSA was previously gathered for the DP. The information presented here was carried over from the appropriate sections of the DP. However, figures which illustrate the descriptions of the environmental setting were excluded from this report due to repetitiveness and length. If needed, the illustrations can be obtained from Reference 1.

3.2.1 Geology

In general, the site is underlain by Quaternary Age alluvial soil deposits. Large portions of the rocks that outcrop in northeastern Oklahoma are Pennsylvanian in age. The Pennsylvanian System is divided into five major series. These series, in descending order, are as follows:

- Virgilian Series (youngest rocks)
- Missourian Series
- Desmoinesian Series

- Atokan Series
- Morrowan Series (oldest rocks)

Figure 3-5 of the DP illustrates the general west-to-east cross section for Tulsa County.

Areal geology features a bedrock of mostly flatlying soft shales, interbedded with thin resistant beds of limestone and sandstone. The 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 Nowata 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 shale bedrock, which underlies much of the area, has been eroded along the original valley axis to average depths of 15 to 20 feet and locally to depths of 25 to 30 feet. Clay and silt sediments have some peat content, and localized thick organic peaty silt (Unit 4, A&M Engineering, July 1999) deposits are known from boreholes across the northern part of the retention pond.

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 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 (1995) when found in pond-bottom sediments.

Geologic and boring 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. The dross has been observed to run into drilled boreholes within or adjacent to the retention pond. Hammer blow counts for the soil surrounding and underlying the dross generally are low, in single digits, indicating minimal shear strength. Reasonable bearing strength is found in the shale bedrock and, to a lesser degree, in the clayey sand. Particle-size distributions for sand units indicate generally well-sorted sand with 5 to 20 percent fines and less than 10 percent gravel. For the clay units, more than 45 percent of the material passes through the No. 200 sieve; the sand fraction composes another 40 to 45 percent of the sediment. Atterberg tests on the fines indicate a low- to medium-plastic clay. More details on site geotechnical properties are presented in the Geotechnical Brief (Earth Sciences, 2000).

3.2.2 Surface Water Hydrology

The freshwater pond, Fulton Creek, and the retention pond dominate the site surface 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. With increasing urbanization, the flow into the pond and creek has changed to receive surface runoff and storm water from an area largely taken over by light industrial and commercial development. Downstream, Fulton Creek connects to Mingo Creek, Bird Creek, and the Verdigris River which ultimately empties into the Arkansas River. Mingo Creek basin waters have been designated by the Oklahoma Water Resources Bureau (OWRB) for beneficial use as an emergency water supply, fish and wildlife propagation, agriculture, industrial and municipal process and cooling waters, recreation, and aesthetics. Some flood control is provided within one-half mile downstream from Kaiser's property; however, none of the ponds or structures that are 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 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 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, permitted by the OWRB (Permit No. CW-72-131) as a nondischarging retention 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.

Surface runoff from Kaiser's former operational area, south of the railroad, is directed to the north beneath the railbed and through three culverts. In addition, surface runoff from the pond parcel is diverted either into the pond or off site through a ditch just north of the Flux Building and paved area.

These structures convey water toward the pond area, toward a ditch along the north edge of the paved area around the Flux Building, or to an off-site area south of the Flux Building. Adjacent to the Flux Building, surface flow is collected in a ditch which enters a pipe at the east fenceline. This pipe passes around the northwest corner of Specific Systems' property and enters a concrete-lined ditch, which connects with Fulton Creek upstream of a weir at the northeast corner of Kaiser property.

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 1.5 acres in area and reportedly up to 15 feet deep.

Figure 3 is a current topographic map of the site. Surface water typically leaves the facility moving north to Fulton Creek. From Fulton Creek, the flow proceeds east.

3.2.3 Groundwater Hydrology

The hydrogeologic setting was determined for Kaiser by A&M Engineering (July 1999), based on data from 23 boreholes and piezometers drilled in and adjacent to the pond parcel. Piezometers and monitoring wells were installed to monitor groundwater in shallow fine-grained sediments, in deeper sandy units comprising the basal part of the buried valley fill, and in deep stratigraphic holes drilled into the Nowata Shale unit. Groundwater elevation monitoring, hydraulic conductivity (slug) tests, and groundwater chemical analyses were performed. A hydrologic budget was estimated for surface and groundwater inflows and outflows of the site.

In general, groundwater flow is from west to east, along the axis of the buried stream valley. Groundwater was found to lie fairly close (within 3 to 5 feet) to the ground surface but was recognized to vary 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 is little evidence of downward migration between near-surface sediments into the Nowata Shale (see Figures 3-8 and 3-9 of the DP).

Water level data in wells and ponds were interpreted by A&M Engineering (July 1999) to indicate that the freshwater pond has 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 (A&M Engineering, 1998).

3.2.4 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.

The City of Tulsa lies along the Arkansas River at an elevation of about 700 feet above sea level. The surrounding terrain is gently rolling.

At Latitude 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°Fahrenheit (F), but last for a very short time. Temperatures of 100°F or higher often are experienced from late July to early September, but usually are accompanied by low relative humidity and a good southerly breeze. The fall season is long with a great number of pleasant sunny days and cool nights.

Rainfall is ample for most agricultural pursuits and is distributed favorably throughout the year. Spring is the wettest season, having an abundance of rain in the form of showers and thunderstorms. The steady rains of fall are a contrast to the spring and summer showers and provide a good supply of moisture and good conditions for growth of winter grains and pastures. The greatest amounts of snow are received in January and early March. Snow usually is light and remains on the ground only for brief periods.

The average date of the last 32°F temperature occurrence is late March and the average date of the first 32°F occurrence is early November. The average growing season is 216 days.

The Tulsa area occasionally is subjected to large hail and violent windstorms that occur mostly during spring and early summer, although occurrences have been noted throughout the year. Prevailing surface winds are southerly during most of the year. Heavy fogs are infrequent. Sunshine is abundant.

3.2.5 Wind

The predominant wind direction is from the south. The prevailing monthly wind speed varies from 9 to 12 knots. The highest 1-minute sustained wind speed was 52 miles per hour (mph). This occurred in April 1982. The highest peak gust was 70 mph, recorded in June 1992.

3.2.6 Temperature

Average annual temperature for the years 1948 through 1990 was 61°F. The daily average temperature varies from 83°F in July to 36°F in January. Monthly extremes vary from minus 8°F in December to 112°F in July.

3.2.7 Precipitation

Average annual precipitation is 38.9 inches of rainfall. The wettest year recorded during the period 1948 through 1990 was 69.9 inches of rainfall, while the driest year received 23.2 inches. May is the wettest month with an average of 5.6 inches of precipitation, while January is the driest month with an average of 1.6 inches of precipitation.

Storm events have an average duration of 9.2 hours. There is an average of 48 storm events per year. The average storm produces 0.744 inch of rainfall at an intensity of 0.11 inch per hour.

Annual snowfall averages 10 inches. Monthly snowfall exceeding 0.5 inch occurs in November, December, January, February, and March. Trace amounts (less than 0.5 inch and greater than 0.05 inch) occur in October and April. The remaining months typically are void of snowfall. Figure 3-4 of the DP depicts the monthly average snowfall for the years 1948 through 1990.

3.2.8 Relative Humidity

The average annual morning and afternoon relative humidities compiled from readings taken at 0600 hours and 1500 hours for the years 1948 through 1990 are 81 percent and 49 percent, respectively. Monthly averages vary from 85 percent in May, June, and September to 46 percent in April, August, and October.

3.2.9 Evapotranspiration

Average monthly potential evapotranspiration varies from 3 millimeters (mm) in January to 188 mm in July. During the months of February through May, the soil is at its maximum water-holding capacity and precipitation exceeds evapotranspiration. Therefore, a water surplus occurs during these 4 months.

During the June through September time frame, potential evapotranspiration exceeds actual evapotranspiration. This is due to the soil moisture content being below its maximum storage capacity, thereby limiting the water uptake of the vegetation. The amount of moisture removed from the soil by vegetation during this time frame is dependent upon the ratio of the actual soil moisture content to potential soil moisture content. In other words, actual evapotranspiration equals potential evapotranspiration, multiplied by the ratio of actual soil moisture content to potential soil moisture content. This exceedance of potential evapotranspiration to actual evapotranspiration results in a water deficit from June through September.

4.0 HSA Methodology

This section presents the areas of concern, regulatory guidance, and site assessment approach that was used to assess the operational area at the facility. The areas of concern have been categorized based on a review of historical operations and data generated during prior site activities. The site assessment approach has been extracted from MARSSIM, Chapter 3.

4.1 Approach and Rationale

The HSA was designed to obtain and review information about the potential distribution of residual radioactive material on the operational area of the site. The information was of two types: historical information regarding past operations at the facility and analytical data generated during past site characterization and remediation activities. The information was reviewed to support classification of land areas and structures as impacted or nonimpacted, in accordance with MARSSIM. The information reviewed is listed below.

- An investigation of the basic plant process as well as site-specific process knowledge (Kaiser)
- Review of available site records
- Aerial photo progression review from 1950 to present (Appendix A)
- Interviews with Mr. Robert Teel (Kaiser employee from 1963 to present)
- Interviews with Mr. Bobby A. Holmes (Kaiser plant manager from 1982 to 1991)
- Information gathered during the ALRP, Final Status Survey prepared by Earth Sciences (Reference 4)
- Information gathered during the ASCA prepared by Earth Sciences (Reference 2)

Information regarding initial building construction, additions, and/or deconstruction was reviewed to aid in the assessment. An aerial photograph progression review was performed to provide an understanding of plant design and redesign. Also, interviews of former facility employees were conducted to clarify the facility's operational history.

The information gathered was evaluated and cross referenced to develop a conceptual model of the operational area during the time period of magnesium-thorium alloy reprocessing. The conceptual model was used to classify the structures and land areas of the former operational area.

4.2 Boundaries of the Site

The former operational area of facility, with the exception of the Flux Building, is bounded to the north by the Union Pacific Railroad, to the south by 41st Street, to the east by a small parcel of Kaiser property, and to the west by the Smalley Equipment property. The railroad right-of-way, 41st Street right-of-way, and small parcel of Kaiser property located to the east of the former operational area were addressed during the ALRP.

4.3 Documents Reviewed

Documents reviewed for the HSA of the operational area of the Kaiser facility include the following:

- A Radiological Report, ARS, 2000 (Appendix B)
- Local and Regional Environmental Data Report, Roberts/Schornick & Associates, Inc., 1996 (Reference 6)
- DP, Tulsa Facility, Tulsa, Oklahoma, Earth Sciences, 2001 (Reference 1)
- ALRP, Final Status Survey Report, Earth Sciences, 2001 (Reference 4)
- Technical Document, Measurement of Thorium and Thoron Hazards (Appendix B)
- Historical Hydrological Impacts Shown on Aerial Photographs, A&M Engineering, 1999 (Reference 7)

4.4 Property Inspections

Property inspections included the following:

- Earth Sciences' oversight of the ALRP from October 2000 through May 2001. During the ALRP, information was obtained on the subsurface conditions of the site and characteristics of the residual radioactive material on site.
- Earth Sciences' oversight of the additional site characterization event in May 2001. The additional site characterization was conducted to provide further information on subsurface conditions beneath certain structures within the former operational area.
- Earth Sciences' site reconnaissance in October 2001. Details of the facility layout, and building configurations, construction, and current conditions were obtained during the site reconnaissance.

4.5 Employee Interviews

Mr. Teel has worked at the facility from 1963 to present. His interview provided knowledge of plant processes related to magnesium-thorium alloy recovery operations. Interviews with Mr. Teel provided information on which buildings were used during the recovery process and waste management activities of thorium-bearing materials.

Mr. Holmes worked at the facility from 1982 to 1991 as the plant manager. His interview provided supporting information on historical plant processes and facility design.

5.0 History and Current Usage

5.1 License History and Land Use

The Kaiser plant in Tulsa, Oklahoma was built by 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, was 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. Available site characterization data support this finding.

The AEC license was terminated in 1971 by the AEC, at Kaiser's request. Magnesium-thorium alloy reprocessing had been halted at that time for more than a year.

The scrap magnesium alloy refining process consisted of placing the sheered material into large melting pots, heating the material until molten, and then siphoning off the pure magnesium. Impurities from the mixture, including thorium, separated from the magnesium and floated on the surface. This residue material was removed, allowed to cool, and crushed. The crushed material was returned to the heating pots for a second recovery process. Once refined, the metallic dross residue material was crushed and disposed on site in accordance with license conditions.

Structures known to have been used to process thorium-bearing materials included the Smelter Building, the Crusher Building, and the Slag Storage Building. The smelting of magnesium alloy for purification occurred in the Smelter Building. The Smelter Building was demolished in October 2000, following completion of survey activities which indicated no contamination within the building. Operations conducted within the Crusher Building included the crushing of the dross/slag residue material from the smelting operations. The Crusher Building was razed and rebuilt in the early 1970s to accommodate aluminum smelting operations at the facility. The current structure identified as the Crusher Building was not used to process thoriated material. The Slag Storage Building, constructed circa 1964, was used for the storage of dross/slag residue materials prior to the second magnesium recovery step. The building was removed in 1977.

Extensive characterization activities conducted since 1994 have established that Th-228, Th-230, and Th-232 are present in dross/soil residues on the Kaiser property. No elevated uranium has been detected. Th-228 and Th-232 have been determined to be in secular equilibrium. In addition, a ratio of Th-230 to (Th-228 + Th-232)/2 of 3.5 has been calculated from characterization data.

5.2 Current Land Use

No licensed activities are currently conducted at the site, nor have any licensed activities been conducted since 1971. The site is currently inactive with the exception of site management (Office Building) and intermittent facility maintenance activities. Figure 4 is a 1995 aerial photograph depicting land uses within the area during that period. Figure 5 provides a current zoning map of the facility and areas of interest. As shown, 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.

5.3 Adjacent Land Use

The adjacent properties are zoned as stated above (Industrial Moderate District and Industrial Light District). Current growth projections, property demands, and property location do not indicate that this zoning status will change. However, the immediate adjacent property which was once part of the original SMC property was found to contain low levels of contamination. This contamination was detected by the NRC in 1993. The extent of the contamination was limited to the following properties: 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 the Red Man (formerly Premier) property. Contamination also was found along the north side of East 41st Street, between the roadway and the Crusher Addition Building. In addition, contamination was found south of Kaiser's Flux Building, outside the retention pond property fence, and on Kaiser property between the Flux Building and the Union Pacific Railroad property.

Kaiser prepared and submitted to the NRC an ALRP. This plan was approved by the NRC on April 4, 2000. Kaiser conducted off-site remediation activities from October 2000 through May 2001. Remediation was performed to achieve unrestricted release of the adjacent land areas. The Final Report for the ALRP is currently being reviewed and is expected to be accepted in the near future.

6.0 Findings

6.1 Potential Contaminants

Extensive characterization activities conducted since 1994 have established that Th-228, Th-230, and Th-232 are present in dross/soil residues on the Kaiser property. No elevated uranium has been detected. Th-228 and Th-232 have been determined to be in secular equilibrium. In addition, a ratio of Th-230 to (Th-228 + Th-232)/2 of 3.5 has been calculated from characterization data.

6.2 Potential Contaminated Areas

The facility was built in the early to mid-1950s by SMC. Licensed operations involving the recovery of magnesium-thorium alloy began in 1958 and continued through 1970. Plant operations continued until the 1997-1998 time frame. Characterizations for the site began in the mid-1990s, followed by remediation of the adjacent land areas in late 2000 and early 2001. This established time frame for facility construction and licensed operations was used to develop a conceptual model for the initial classification of the former operation area.

The following criteria were used in the model to classify areas as nonimpacted.

Nonimpacted Land Areas

- Land areas beneath buildings and concrete paving constructed prior to the initiation of licensed operations (1958)

Nonimpacted Structures

- Structures constructed following license termination in 1971
- Structures not involved with the reprocessing of magnesium-thorium alloy

As previously mentioned, the former operational area currently houses several structures including the North Extrusion, Office, Maintenance, Warehouse, Crusher, Crusher Addition, and Flux Buildings. The "land areas" of the former operational area consist mainly of land beneath paved concrete surfaces. Each of these structures and the land areas are discussed in the following sections.

6.2.1 Structures

None of the current site structures located within the former operational area were involved with the reprocessing of magnesium-thorium alloy. However, the Flux Building has been identified as an area of concern. The identification of this structure as an area of concern is not due to historical plant processes, but because it has been utilized as a storage and packaging area for radioactive materials (samples) during the ALRP, as well as prior characterization events.

6.2.2 Land Areas

Modifications to site facilities (buildings, parking lots, driveways, etc.) may have resulted in the covering of residual radioactive material beneath several currently paved surface and building floor areas. These areas of concern include the land areas beneath the Maintenance Building, the Crusher Building, the Crusher Building Addition, the North Extrusion Building, the Warehouse Building, and the former Smelter Building No. 5, as well as concrete paved areas completed post-1958. Residual radioactive material beneath these structures, if present, is not expected at great depths.

6.3 Impacted Areas

An impacted area, as defined by MARSSIM, is an area with the possibility of containing residual radioactivity in excess of natural background or fallout levels. Residual radioactivity is defined as radioactivity in structures, materials, soils, groundwater, and other media at the site resulting from activities under the cognizant organization's control. Residual radioactivity also includes radioactive materials remaining at the site as a result of routine or accidental release of radioactive material at the site and previous burials at the site. The following sections present the initial classifications of the land areas and current structures for the operational area at the facility.

6.3.1 Impacted Land Areas

Land areas within the operational area which fall into this category include the following:

- Areas covered by concrete post-1958
- Area beneath the former Smelter Building No. 5
- Area beneath the Crusher Addition Building
- Area beneath the Crusher Building
- Area beneath the North Extrusion Building
- Area beneath the Warehouse Building
- Area beneath the Maintenance Building

6.3.1.1 Land Areas Covered by Concrete Post-1958

Available records indicate that the land areas between structures were graded and paved with concrete post-1958. As a result, the grading and paving activities conducted during this period may have covered residual radioactive materials.

Sampling of the subsurface materials beneath the concrete pavement at several locations during the ASCA revealed the presence of residual radioactive material. Figure 6 illustrates the change in building size and presents ACSA sample locations with associated Th-232 activity concentrations.

6.3.1.2 Land Area Beneath the Crusher Addition Building

The Crusher Addition Building was constructed circa 1977 in the area immediately south of the Crusher Building. As previously mentioned, the Crusher Addition Building was constructed over the area which once housed a large sheering machine. The sheering machine was used to chop large pieces of scrap magnesium alloy into more manageable sizes for melting. The land area beneath this building could contain residual radioactive material from the shearing process. Site inspections conducted by Earth Sciences also indicated that the area was graded to accommodate the construction of the building.

6.3.1.3 Land Area Beneath the Crusher Building

Available information indicates that the Original Crusher Building was expanded sometime between 1958 and 1964. This building renovation may have resulted in the covering of residual radioactive material beneath the building floor expansion area. Sampling of the subsurface materials beneath the building floor during the ASCA revealed the presence of residual radioactive material. Figure 6 illustrates the change in building size and presents ACSA sample locations with associated Th-232 activity concentrations.

Crusher Building Dimension Changes Between 1958 and 1964	
1958	85 feet by 55 feet
1964	130-feet-by-65-feet addition added to the north and east of the original structure.

6.3.1.4 Land Area Beneath the North Extrusion Building

Available information indicates that the North Extrusion Building was expanded sometime between 1958 and 1964. This building renovation may have resulted in the covering of residual radioactive material beneath the building floor expansion area. The addition was approximately 105 feet by 150 feet. In addition, site characterization activities conducted in the vicinity of the building suggest that this once low-lying area had been partially filled with on-site material. Figure 7 presents a comparison of the North Extrusion Building area for the years of 1958 and 1964.

North Extrusion Building Dimension Changes Between 1958 and 1964	
1958	110 feet by 60 feet
1964	100-feet-by-145-feet addition added to the north of original structure.

6.3.1.5 Land Area beneath the Warehouse Building

Available information indicates that the Warehouse Building was expanded sometime between 1958 and 1964. This building renovation may have resulted in the covering of residual radioactive material beneath the building floor expansion area. Sampling of the subsurface materials beneath the building floor during the ASCA revealed the presence of residual radioactive material. Figure 6 illustrates the change in building size and presents ACSA sample locations with associated Th-232 activity concentrations.

Warehouse Building Dimension Changes Between 1958 and 1964	
1958	West Complex 100 feet by 55 feet , East Complex 110 feet by 35 feet
1964	One Complex 250 feet by 55 feet

6.3.1.6 Land Area Beneath the Maintenance Building

Available information indicates that the Maintenance Building was expanded sometime between 1958 and 1964. This building renovation may have resulted in the covering of residual radioactive material beneath the building floor expansion area. Figure 6 illustrates the change in building size. Samples taken during the ASCA revealed residual radioactive material within close proximity of the building's footprint.

Maintenance Building Dimension Changes Between 1958 and 1964	
1958	Original Complex 132 feet by 45 feet
1964	With Addition of Scale House, 132 feet by 65 feet

6.3.1.7 Land Area Beneath the Former Smelting Building No. 5

Available information indicates that the Smelter Building No. 5 was constructed sometime between 1960 and 1961. This building's construction may have resulted in the covering of residual radioactive material beneath the building floor area. Figure 6 presents an approximate location of the building.

6.3.2 Impacted Structures

The only current structure located within the former operational area which falls into this category is the Flux Building. The Flux Building was classified as impacted due to the utilization of the building as a sample storage and packing facility during characterization events and the ALRP. However, the potential for residual radioactive material in this building is minimal.

6.4 Nonimpacted Structures

A nonimpacted area, as defined by MARSSIM, is an area with no reasonable possibility of containing residual radioactivity in excess of natural background or fallout levels. Residual radioactivity includes radioactive materials remaining at a site as a result of routine or accidental release of radioactive material at the site and previous burials at the site. Current structures within the former operational area classified as nonimpacted include the following:

- Maintenance Building
- Office Building
- Warehouse Building
- Crusher Building
- Crusher Addition Building
- North Extrusion Building

6.4.1 Maintenance Building

Although currently referred to as the Maintenance Building, this structure's original function was for the manufacturing and packaging of underground anodes. Maintenance activities for the plant were moved to this area around 1985. Neither of these activities required the handling or storage of radioactive materials. Current activities in this area are minimal and are concentrated solely around the maintenance of the facilities.

6.4.2 Office Building

The Office Building is an original facility structure separate from the operational buildings. Available records indicate that this building has been utilized for administrative purposes exclusively.

6.4.3 Warehouse Building

The Warehouse Building has been renovated several times including a major renovation between 1958 and 1964. Available information indicates that area was once used for maintenance, but has been the central location for the warehousing of finished products.

6.4.4 Crusher and Crusher Addition Buildings

The structures currently identified as the Crusher Building and the Crusher Addition Building were rebuilt after thorium-magnesium alloy processing had ceased at the facility. These structures were used for the aluminum smelting operations exclusively.

6.4.5 North Extrusion Building

The North Extrusion Building was not at any time part of the magnesium refining process. The building was constructed circa 1961 and used for anode extrusion and storage of pure magnesium billets.

6.5 Potential Contaminated Media

Potential contaminated media within the former operational area of the facility includes the following:

- shallow subsurface materials located beneath existing concrete paved areas;
- shallow subsurface materials located beneath current building footprints; and
- structural surfaces of the Flux Building.

7.0 Conclusions

Two separate conceptual models were developed for the initial classification of the former operational area, one for the land areas, and the one for current structures. Land areas were classified using the following criteria:

- Land area usage related to magnesium-thorium alloy processing.
- Potential for residual radioactive material to have been covered by building expansion.
- Potential for residual radioactive material to have been covered by concrete paving events conducted post-1958.

The areas identified through these screening methods are illustrated in Figure 8. The impacted land areas are as follows:

- Areas covered by concrete post-1958
- Area beneath the former Smelting Building No. 5
- Area beneath the Crusher Addition Building
- Area beneath the Crusher Building
- Area beneath the North Extrusion Building
- Area beneath the Warehouse Building
- Area beneath the Maintenance Building

The second conceptual model focused on the current structures within the former operational area. These structures were screened using the following criteria:

- Historical building usage related to magnesium-thorium alloy processing
- Current building usage related to radioactive materials management.

The structures identified through these screening methods are illustrated in Figure 9. None of the current site structures located within the former operational area were involved with the reprocessing of magnesium-thorium alloy. The Flux Building was classified as impacted due to the utilization of the building as a sample storage and packing facility during characterization events and the ALRP.

8.0 References

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