DECOMMISSIONING PLAN DEPLETED URANIUM MANUFACTURING FACILITY

D.E. Bernhardt
Rogers and Associates Engineering Corporation
P.O. Box 330
Salt Lake City, Utah 84110-0330

J.D. Pittmann, S.V. Prewett
Aerojet Ordnance Tennessee, Inc.
P.O. Box 399
Jonesboro, Tennessee 37659

ABSTRACT

Aerojet Ordnance Tennessee, Inc. (Aerojet) is decommissioning its California depleted uranium (DU) manufacturing facility. Aerojet has conducted manufacturing and research and development activities at the facility since 1977 under a State of California Source Materials License. The decontamination is being performed by a contractor selected for technical competence through competitive bid. Since the facility will be released for uncontrolled use it will be decontaminated to levels as low as reasonably achievable (ALARA).

In order to fully apply the principles of ALARA, and ensure the decontamination is in full compliance with appropriate guides, Aerojet has retained Rogers and Associates Engineering Corporation (RAE) to assist in the decommissioning. RAE has assisted in characterizing the facility and preparing contract bid documents and technical specifications to obtain a qualified decontamination contractor. RAE will monitor the decontamination work effort to assure the contractor's performance complies with the contract specifications and the decontamination plan. The specifications require a thorough cleaning and decontamination of the facility, not just sufficient cleaning to meet the numeric radiation cleanup criteria.

INTRODUCTION

Aerojet Ordnance Tennessee, Incorporated (Aerojet) has closed its California depleted uranium (DU) manufacturing facility -- and is in the process of decommissioning the facility. Aerojet has conducted manufacturing and research and development activities at the facility since 1977 under a State of California Radioactive Materials License. The principal activity has been production of GAU-8 penetrators from DU rod stock. The radioactive operations have been limited to the use of DU. The building is a commercial warehouse type structure built in 1967. Manufacturing activities ceased in mid May of 1986 and manufacturing machines and support equipment were removed in early 1987.

This paper discusses the planning and initiation of decontamination of the facility. The program objective is to terminate the Aerojet Radioactive Materials License for the facility, obtain approval for uncontrolled use of the facility, and return it to the lease holder. An underlining objective to facilitate attaining these program objectives is to apply the principles of as low as reasonably achievable (ALARA). Aerojet retained Rogers and Associates Engineering Corporation (RAE) to assist in the planning and management of the decontamination program. The program activities have included:

- Characterizing the facility and the associated contamination.
- Preparation of a Decontamination Plan, including specifying cleanup criteria, and meeting with the State of California.
- Developing detailed technical specifications and bid documents for selecting a contractor to perform the decontamination tasks and certify the facility meets the release criteria.
- Submit requests for proposals to qualified contractors for bid.

CHARACTERIZATION OF FACILITY

Aerojet initiated activities for possible closure and decontamination of its California depleted uranium manufacturing facility in 1985. One of the initial actions was retaining RAE to assist in characterizing the facility, estimating the required tasks and costs for decontamination. Ford Bacon and Davis Engineering assisted RAE in identifying and preparing an inventory of the facility features (e.g., quantities of above grade and subslab piping, surface areas of building support structure, lineal footage of joints and cracks in the floor slab, etc.) and costs of decontamination.

Facility

The general layout of the property and building is shown in Fig. 1. The facility is a 5,800 m^2 masonry commercial structure located in a commercial zoned area. The inside of the facility is divided into about a 4,000 m^2 open shop area and about 1,800 m^2 of offices, laboratories, storage, etc. The inside walls are non-load-bearing walls. The structure is covered by a flat roof supported by laminated wood trusses which are supported by pipe columns. The basic building ceiling height is about 8 m and the enclosed areas have 2.4 m ceilings. The floor is concrete slab on grade with sawed control joints at about 8 m spacing.

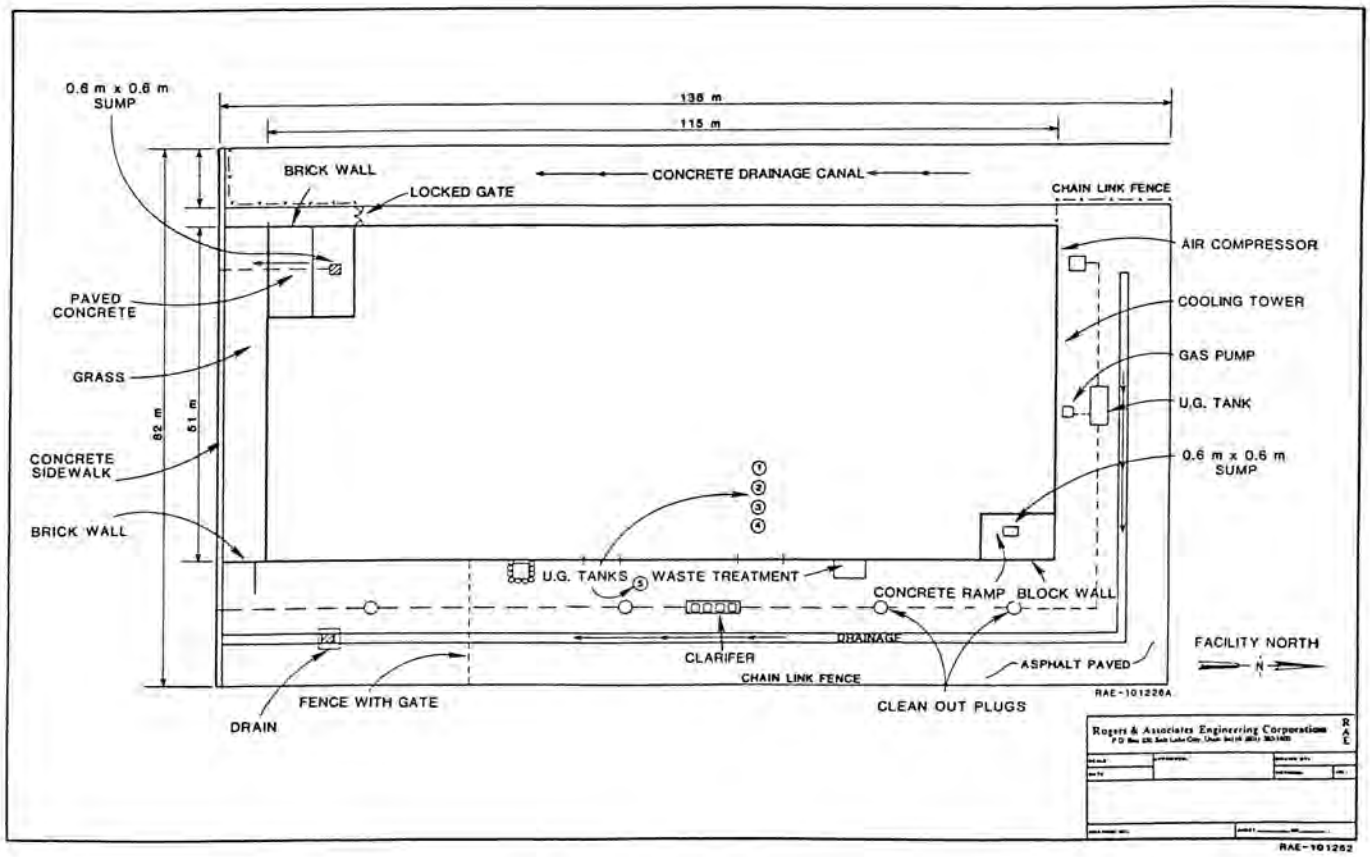

Fig. 1. Aerojet Compton Site

The outside areas of the property, except for a small area with grass in the front, are covered with about 8 cm of asphalt. The two truck docks (i.e., northeast corner in rear and southwest in the front) are paved with concrete. There is an open concrete lined storm channel to the west, a railroad siding to the north, and a commercial building to the east. The property is generally enclosed with a chain link fence. The total property is about 10,000 m^2 (2.6 acres).

The primary structural items of interest on the outside of the plant building are:

- Four stage clarifier prior to the main sanitary sewer connection on the east side of the facility.
- Surface drain in the east parking area, which discharges to the street.
- After burner, for the evaporator effluent, located on the east side of the facility.
- Air compressor shed, which is isolated from the main facility to the northwest of the facility.
- Cooling tower located adjacent to north end of the facility.
- Waste water tank under east parking lot.
- Gasoline tank and pump, not used by Aerojet.

Due to unknown activities on the site before Aerojets operations, activities on neighboring properties, or unknown chemical spills, Aerojet deemed it prudent to take soil samples from the railroad siding to the north and have them analyzed for the U.S. Environmental Protection Agency (EPA) priority pollutants. The sampling was performed by RAE and the analyses by EAL Corporation of Richmond, California. Essentially the only detectable pollutants were phthalates. The phthalates are esters of phthalic acid with various alcohols. They are relatively common pollutants in the environment at the concentrations observed. Phthalates are used in the plastics industry, are an additive for motor oils and high vacuum pump working fluids, and are general combustion product.

Even though the concentrations of phthalates in the soil samples were relatively innocuous, it was judged prudent to remove the material, and about 0.2 m^3 of surface soil was removed and disposed of as hazardous waste.

There are piping and four waste water tanks under the slab in the building. The tanks have been used for storing and processing contaminated waste water and will be removed. There is over 1,000 m of piping and electrical conduit in the ceiling area. The piping includes compressed air, fire sprinkler, and machine cooling water systems. The non-essential piping and conduit will be removed. The facility is shown in Fig. 2.

Much of the inner structure of the building is contaminated with dust containing DU oxide. The relative amount of contamination ranges from small

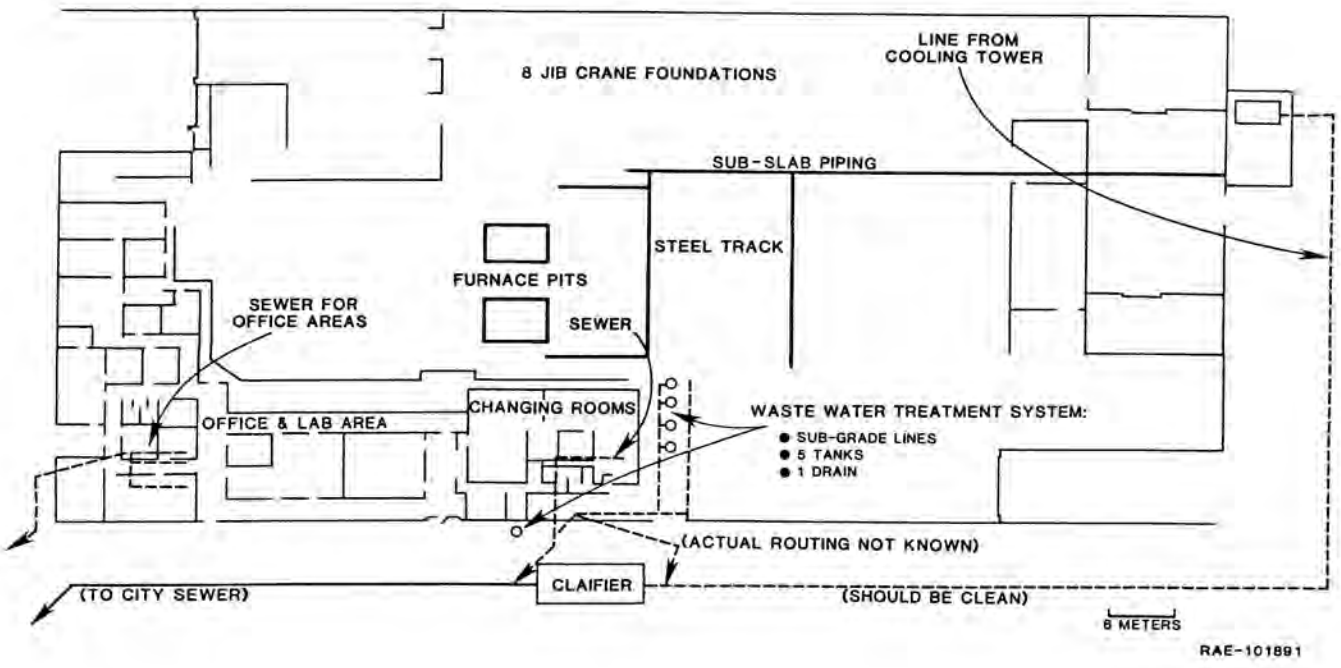

Fig. 2. Compton Sub-Grade Sewers.

amounts (below unrestricted release limits) in the unrestricted areas to more significant amounts in the ceiling area of the shop and the shop concrete floor which has DU oxide in pits, cracks, and control joints.

The facility floor is 10-cm concrete, slab on grade. The ceiling support columns are located at the intersection of control joints. There are two primary cracks in the concrete floor, both of which are associated with the operation of swagers. Also, there are a number of joints associated with subslab piping, tanks, and machine footings. About 600 anchor bolts in the slab are distributed throughout the shop. These will be removed. There are also eight jib crane foundations in the floor. The jib crane foundations are about 2.4 x 2.4 x 2.4 m concrete blocks with a 0.5 m diameter pipe in the center. Because of the uncertainties and the difficulties of fully monitoring beneath the jib cranes they will be removed.

There are two subgrade concrete pits in the central area of the shop. These contained steel lined oil sumps and were part of the vacuum heat treat furnaces.

The office and lab areas have nominal 2.4-m ceilings. The attic areas are not closed off from the shop. Hence, there is dust with some DU oxide in the attic areas. The ceilings are generally tiled ceilings on rafters, some suspended.

The roof is flat with a wood substructure and asphalt tar paper surface. There are numerous penetrations on the roof and runoff down pipes on all four corners of the roof. There are 53 roof turbine ventilators, 6 evaporative coolers, and 6 air conditioners.

General Radiological Characterization

Routine monitoring is performed throughout the facility for contamination control, worker protection, and to show compliance with the operating license. Additional monitoring has been performed to provide a background baseline, to assist in the development of specifications for a contract to decontaminate the facility, and to estimate the required level-of-effort and costs for decontaminating the facility.

The monitoring included survey instrument measurements with pancake probes (beta/gamma contamination), collecting and analyzing smears, and analysis of sediment samples from pipes and sumps. Monitoring was performed both on existing surfaces and after selected experimental cleaning operations to characterize the relative fixation of contamination. Measurements were generally taken in areas expected to have the highest levels of contamination.

Measurements were taken on the floors in several areas of the shop. Recently cleaned floors measured around 3,000 dpm/100 cm^2 (dpm -- disintegrations per min or 1/60 Bq). Small pits in the concrete surface, even after normal floor scrubbing, indicated levels of contamination above 15,000 dpm per 100 cm^2. Scrubbing, use of stripable paint, and a Turco acid wash reduced the contamination for some areas, but values were still above 15,000 dpm/100 cm^2.

Joints and cracks were also above the release criteria after washing. Simple chipping or scraping

did not reduce them significantly. Using a chipping hammer on a control joint reduced the level of contamination to about 100 cpm for a 15 cm^2 thin window pancake probe.

Areas of rough floor, cracks, joints, anchor bolts, etc., all indicate contamination which is very difficult to remove without chipping the concrete.

Several cores were drilled through the slab and the cores were monitored and the soil under the slab was sampled and analyzed. The cores were taken from control joints, cracks in the floor from operation of a swager, and expansion joints where expansion joint material was used. Soil beneath the control joints and the cracks had total concentrations of U-238 in the surface 15 cm of about 0.4 Bq/g (10 pCi/g) or less. The concentrations of U-238 in the soil beneath the expansion joints was about 4 Bq/g (100 pCi/g) or more.

The total contamination on the cardboard insulation in the ceiling area of the shop was generally less than 3,000 dpm/100 cm^2 and most of the measured areas were only a fraction of this value. The removable contamination for 10 of 11 swipes was less than 1,000 dpm/100 cm^2. Dry or moist wiping also reduced the level of contamination. The surface contamination on the trusses and beams ranged from nominal total values of about 3,000 dpm/100 cm^2 to about 15,000 dpm/100 cm^2. Vacuuming and wiping the structural materials removed much of the contamination.

Several areas of the masonry walls and wallboard walls in the shop were monitored in their present state and after cleaning. An effort was made to select the most soiled sections of walls. Generally it was found that a moist wipe reduced the contamination on the walls to below 5,000 dpm/100 cm^2.

Smear and sediment samples from two truck dock sumps, subslab piping, sewers, and the cooling tower sump have indicated small amounts of depleted uranium. Most of these items have been scheduled for excavation and removal.

DECONTAMINATION PLAN

A Decontamination Plan(1) has been prepared to orient corporate management and obtain concurrence from the licensing agency (State of California) for the decontamination of the facility. Furthermore, the preparation of this plan assisted the project participants in organizing the decontamination project activities, provided an impetus for making program decisions, and assisting in providing documentation for the project. The Decontamination Plan provided the following information:

- Characterization of facility
- Radiological cleanup criteria
- General specifications for decontamination; e.g., proposed cleaning techniques, what items would be cleaned, what items would be removed, etc.
- Management structure for the project
- Quality assurance program

The Decontamination Plan was submitted to the State of California, the licensing agency, to obtain conceptual approval of the program. The State has accepted the plan subject to acceptance of the specific decontamination techniques to be used by the selected contractor. The final approval of the Decontamination Plan and specific decontamination techniques will be accomplished through an approved license amendment or acceptance and use of a contractors license.

The Decontamination Plan focused on the cleanup criteria for release of the facility and the quality assurance program for demonstrating the adequacy of the cleanup. A basic feature of the quality assurance program is the retention of an independent third part to provide full-time monitoring of the decontamination activities and work and provide final radiological certification monitoring -- after the decontamination contractor has certified the facility has been decontaminated. RAE will have a senior health physicist and an engineer on site full-time to provide these functions as the Owner's Representative.

Radiological Cleanup Criteria

The proposed cleanup criteria are based on State of California, U.S. EPA, and U.S. Nuclear Regulatory Commission (NRC) guides and standards. Priority is placed on the State of California guides and the EPA and NRC guides are only used to supplement the state guides. The criteria for decontamination of the facility, including limits for surface contamination and dispersed activity, limit external radiation exposure to less than 0.10 mSv per year, above natural background.

The radiological cleanup criteria are taken from "California Guidelines for Limits," DECON-1(2) and the NRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors"(3). The specifically applicable criteria are:

- Removable contamination, determined by smearing with a dry filter: 1,000 dpm/100 cm^2.
- Average total contamination, based on a maximum area of 1 m^2: 5,000 dpm/100 cm^2.
- Maximum total contamination, based on an area of not more than 100 cm^2: 15,000 dpm/100 cm^2.

The cleanup will be based on reducing contamination levels to ALARA. The basic cleaning procedures specified willl be fully applied, even if the initial contamination is below the above numeric values. The calibration factor for a 15 cm^2 thin window pancake probe will be based on appropriate efficiency and geometry factors. The proposed conservative factor is about 22 dpm per 100 cm^2: cpm. The monitoring on the floors and lower walls will be based on 1 m grids with at least three recorded measurements and smears per square meter. The monitoring effort for upper walls and ceiling areas will be reduced with the possible application of attributes type sampling and statistics. There will be a recorded measurement and smear from each 3 m length of the exterior surface of in-place pipe.

The net residual external gamma exposure rate will be less than 0.10 mSv/yr, based on State of California criteria. The verification of this criteria will be based on gamma exposure rate measurements, and converting measurements of soil and surface measurements to gamma exposure rates.

Several agencies have issued guides or standards for concentrations of radionuclides dispersed in soil or other materials. The guidelines most applicable to the Compton facility are the Nuclear Regulatory Commission (NRC) guides for thorium and uranium from past operations(4), the U.S. Department of Energy

(DOE) guides for the release of sites(5), and U.S. Environmental Protection Agency guidance. The NRC and DOE guides(4,5), for completely unrestricted concentrations in soil, can generally be related to the EPA guidance for uranium mill tailings, 40CFR192(6) or for transuranic material in soil(7). These criteria have been discussed and evaluated by Bernhardt et al.(8).

The facility will be decontaminated to allow complete unrestricted use of the site. Even though the facility is a commercial building in a commercial area, the criterion of NRC for full unrestricted use will be applied. These criterion consider the possibility of future used of the land for farming or residential use(8). The criterion will be 1.3 Bq/g (35 pCi/g) of U-238 (based on isotopic composition of DU). The criterion will be applied for average depth intervals of 15 cm and areas of 100 m^2, as stipulated by the EPA in 40CFR192(6). Smaller areas will be used under joints in the slab.

The basic decontamination criteria are:

- Surface contamination, 5,000 dpm/100 cm^2
- Dispersed activity in soil, 1.3 Bq/g
- External whole-body gamma exposure, 0.10 mSv/year (10 mrem)

The external whole-body gamma dose from surface contamination of 5,000 dpm/100 cm^2 of DU is about 0.01 mSv/year (1 mrem) based on 100 percent occupancy time and dose parameters from references 9 and 10. The external gamma dose from 1.3 Bq/g (35 pCi/g) of DU in soil is about 0.02 mSv/year (2 mrem), based on 100 percent occupancy time and dose parameters from Refs. 4 and 9. The external gamma exposure from DU in soil underneath the concrete slab would be much less than 2 mrem/year. Furthermore, the gamma exposure from uranium is from relatively low energy photons.

The basic decontamination criteria and associated external gamma whole-body doses are given in Table I. It is evident that the soil and surface contamination criteria are more limiting for this situation than the external gamma dose.

TABLE I

Decontamination Criteria and Associated Whole-Body Doses

Criteria	Value	Dose (mSv/year)
Surface Contamination	5,000 dpm	0.01
Dispersed Contamination (Reduced for shielding)	1.3 Bq/g (35 pCi/g)	0.01
External Gamma	0.10 mSv	0.10

DECONTAMINATION SPECIFICATIONS AND BIDS

Specifications for the decontamination work have been broken down into detailed tasks. These tasks specify such items as:

- Clean a section of pipe
- Remove jib crane foundations
- Remove roof ventilators
- Remove tanks
- Clean/chip out a section of floor control joints
- Clean lights
- Remove insulation

The contract specifications require fully completing specified items, not just performance to meet the cleanup criteria. The specifications also require a thorough cleaning of areas that presently meet the cleanup or release criteria. Hence, the detailed performance of the specifications, which will be monitored by the Owner's Representative, will require decontamination not only to the release criteria, but to levels of ALARA.

Specifications for the first phase of decontamination work, removal of government installed equipment were issued to eleven bidders in October 1986. Four bids were received, and are presently being evaluated.

Specifications for the final phase of decontamination were issued to 15 bidders in December 1986. Bids are due in February 1987.

SUMMARY

Aerojet is decontaminating its California facility. The planned decontamination is based on removal of selected facilities and a comprehensive cleaning of the remainder of the facility. The facility will be cleaned through the application of the principles of ALARA to comply with appropriate State and Federal criteria which have been identified in the Decontamination Report. A basic principal of both the ALARA and the quality assurance (QA) programs has been the retention of an independent third party to assist in program planning, prepare contract specifications, and monitor and certify the decontamination.

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