Table of Contents

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

Page

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

Table of Contents
(Continued)

1.0 Executive Summary

This Decommissioning Plan (DP) has been prepared to describe remediation activities proposed for implementation at the Fansteel Inc. (Fansteel), Muskogee, Oklahoma facility located between Oklahoma State Route 165 and the west bank of the Arkansas River at River Mile 395. The Fansteel Muskogee plant is sited in an area zoned for industrial use. This industrial use restriction is expected to persist in the future in accordance with the updated Master Plan for industrial properties issued by the Port of Muskogee (Master Plan of Development for the Muskogee Port and Industrial Park, Muskogee City-County Port Authority, November 28, 1967). Implementation of this DP will make the site suitable for unrestricted release under an industrial use scenario.

1.1 Background

Fansteel's Muskogee plant produced tantalum and columbium metals. The Fansteel processing facility had been in operation for approximately 33 years until operations ceased in 1990. The raw materials used for tantalum and columbium production contained uranium and thorium as naturally occurring trace constituents. These radioactive species were present in the process raw materials at an approximate concentration of 0.1 percent uranium oxide and 0.25 percent thorium oxide. This concentration is sufficient to cause the ores and slags to be classified by the Nuclear Regulatory Commission (NRC) as source materials. Consequently, Fansteel operated under NRC License No. SMB-911 for the possession of source materials.

The ores and slags used for tantalum and columbium production were digested in a hydrofluoric acid (HF) solution. After the digestion step, a series of unit processes to separate the tantalum and columbium products was conducted. The byproduct of the separation steps (residues from the work in progress [WIP]) was disposed in Pond Nos. 2, 3, and 5. These ponds were called acidic ponds due to their acid constituent. Acidic and ammonia waters were stored in temporary holding Pond Nos. 1S and 1N respectively prior to treatment. Uranium and thorium in the raw materials were not extracted from the ores by the digestion process. The radioactive species remained in the residues from the WIP that were disposed in the East Plant Area. Process water, as well as the Pond No. 3 french drain supernatant, was treated and then passed on to Pond Nos. 6, 7, 8, and 9 for solids precipitation prior to passing through a National Pollutant Discharge Elimination System (NPDES) discharge outfall. These ponds are referred to as alkaline ponds. The residues from WIP disposed in the ponds as a result of the manufacturing process contain U_3O_8 and ThO_2 at similar concentrations either alone or in a calcium fluoride (CaF) precipitate matrix.

In June 1989, the west embankment of Pond No. 3 failed discharging supernatant from the pond into the surrounding area and ultimately into the Arkansas River. The discharge into the river was halted by the emergency construction of containment dikes. Fluids from ponds created by the temporary diking of supernatant were routed to the plant's water treatment system as directed by the NRC. Following treatment, this material was disposed in Pond Nos. 8 and 9. After its failure, Pond No. 3 did not receive the liquid residues from the WIP from ore/slag processing. Filter presses were put into operation to remove the solid wastes from the acidic process water stream before further processing. In addition, a groundwater interception trench installed east of Pond No. 3 is used to collect alluvial groundwater and minimize the potential for discharge of contaminated groundwater to the Arkansas River. Groundwater is collected in the trench and filtered through a filter press.

In 1993, a characterization survey was performed at the Fansteel Muskogee site to determine existing site conditions. Radiological survey activities were conducted over the interior and exterior of the site structures and the external open land areas of the Fansteel site. Buildings and equipment associated with the ore-processing activities include the Chemical "C" Building, the Chemical "A" Building, and the R&D Building. The Chemical "C" Building is contaminated throughout by radioactive ore residues. Isolated areas of radioactive contamination were also identified in some of the other site buildings.

Characterization surveys in 1993 identified the highest concentrations of radiological contaminants in Pond Nos. 2 and 3. The average concentration of radiological contaminants in Pond Nos. 2 and 3 ranges from 360 to 640 picocuries per gram (pCi/g) of U-238 and 360 to 440 pCi/g of Th-232. The average concentration of radiological contaminants in Pond Nos. 5 through 9 ranges from 14 to 53 pCi/g of U-238 and 2 to 26 pCi/g of Th-232. Survey data indicate that the Th-232 and U-238 are present with their radioactive progeny in secular equilibrium. The U-235 decay series is also present, because U-235 constitutes 0.7 percent by weight (approximately 2.3 percent by radioactivity) of naturally occurring uranium.

1.2 Dose Modeling

Dose modeling evaluations have been performed using RESRAD and RESRAD-Build computer code software to demonstrate compliance with the NRC final rule on "Radiological Criteria for License Termination," published in the Federal Register (FR) (62 FR 39058) which was incorporated as Subpart E to Title 10 Code of Federal Regulations (CFR) Part 20. The site will be considered acceptable for unrestricted use after decontamination has reduced the radioactivity levels as low as reasonably achievable (ALARA), and the residual radioactivity level will not result in a total effective dose equivalent (TEDE) exceeding 25 millirem per year (mrem/year) to an industrial worker.

The remediation ALARA analysis is an optimization technique to seek the proper balance of remediation costs and benefits to achieve a TEDE as far below 25 mrem as is reasonably. "Reasonably achievable" is judged by considering the state of technology and the economics of improvements in relation to all the benefits from these improvements.

Dose modeling has been used to calculate the concentration of radioactivity that if uniformly distributed throughout the site area would result in an annual TEDE of 25 mrem to an industrial worker at the site. These radionuclide-specific values are called Derived Concentration Guideline Levels ($DCGL_W$s) for relatively uniform distributions of residual radioactivity across a survey unit. RESRAD Version 6.21 has been used to derive the radionuclide-specific $DCGL_W$s for the residual radioactivity present in land areas at the time of the Fansteel site final status survey (FSS) and site release. RESRAD-Build Version 3.21 has been used to derive the radionuclide-specific $DCGL_W$s for the residual radioactivity present on building, structural, and component surfaces at the time of the Fansteel site FSS. Under the industrial worker scenario, the worker is assumed to spend 8 hours per day on the site. Of the 8 hours, 6 hours are spent indoors and the remaining 2 hours are spent outside.

External exposure to penetrating radiation, inhalation of soil dust (while outdoors and during building occupancy), and inadvertent ingestion of soil are the exposure pathways that were considered in deriving radionuclide-specific $DCGL_W$s for residual radioactivity in site soil. Exposure pathways considered in the derivation of radionuclide-specific $DCGL_W$s for residual radioactivity on building and component surfaces included direct external gamma exposure including submersion, inhalation of resuspended residual radioactivity, inadvertent ingestion of residual radioactivity from surface sources, and ingestion of deposited radioactivity resulting from resuspension. The computed $DCGL_W$s for residual radioactivity in soils and building surfaces is presented in Tables 1-1 and 1-2. Derivation of the $DCGL_W$ incorporated the unity rule to assure that cumulative doses from Th-232, U-238, U-235, and their radioactive progeny do not result in a total annual dose that exceeds 25 mrem to an industrial worker.

Table 1-1 Industrial Worker Scenario Individual Radionuclide Decay Chain $DCGL_W$s for Soils

Radionuclide and Entire Decay Chain in Equilibrium	Industrial Worker $DCGL_W$s at Time Zero (pCi/g)	Time of Maximum Dose (yrs)
U-238 – Uranium Chain	14.1	0
U-235 – Actinium Chain	37	0
Th-232 – Thorium Chain	10	0

Table 1-2 Industrial Worker Scenario Individual Radionuclide Decay Chain $DCGL_w$s for Building and Component Surfaces

Radionuclide Decay Chain $DCGL_w$	Industrial Worker $DCGL_w$s at Time Zero (dpm/100 cm^2)	Time of Maximum Dose (yrs)
U-238 – Uranium Chain	5,200	0
U-235 – Actinium Chain	840	0
Th-232 – Thorium Chain	3,160	0

The groundwater beneath the Muskogee site contains limited amounts of radioactive material attributed to historical operations at the site. Although on-site consumption of this groundwater is excluded from the industrial worker scenario, Fansteel will evaluate the necessity of including a groundwater ingestion dose component in the remediation alternative/option ALARA analyses.

1.3 Summary of Decommissioning Activities

Cleaning of building surfaces and facility components will be performed under controlled conditions in accordance with written procedures and restricted access. Decommissioning will include decontamination of buildings and components using appropriate solvents, cleaning solutions, high-power vacuum cleaners, pressure washers, vacuums, etc. It is expected that portions of the floor (10 percent) of the Chemical "A" and Chemical "C" buildings will have to be scabbled and disposed as low-level radioactive (LLR) waste. Portions of structures or building facilities and equipment that cannot be cleaned for unrestricted release will be size reduced for handling, shipping, and/or disposal purposes.

Radiologically impacted soils and residues from WIP are isolated to plant areas within and surrounding Pond Nos. 2, 3, 5, 6, 7, 8, and 9, and areas to the east of the Chemical "A" and Chemical "C" plant buildings. Soil contamination was also detected to the east of the wastewater treatment ponds and Pond No. 5, however, at levels typically lower than that exhibited in the areas of the site associated with manufacturing and ore processing. The total impacted land area to be remediated encompasses an estimated area of 180,000 square meters (m^2).

Approximately 16,000 tons (20 percent moisture content by weight) of residues from the WIP will be excavated from Pond Nos. 2 and 3 and shipped off site to a licensed uranium reclamation facility. An estimated 68,000 tons (20 percent moisture content) of impacted material will be excavated from the alkaline process water settling ponds which received CaF and process water from the Wastewater Treatment Plant (WWTP) (Pond Nos. 5, 6, 7, 8, and 9). Excavation and disposal of soil from the surrounding plant area and beneath the ponds will account for 15,855 tons (ambient moisture content). Above-criteria

soil will be transported (most likely by rail) to a licensed or permitted waste disposal facility(ies). The total quantity of soil and residue for off-site disposal is estimated to be approximately 99,855 tons.

The purpose of this DP is to decommission the facility safely and meet the NRC requirements for unrestricted use. Decontamination and excavation activities will be performed under controlled and monitored conditions with access restricted. Health Physics Technician (HPT) support will be used to monitor the soil and contaminated material removal; the surfaces and soil left in place; as well as workers, equipment, and loaded cars/containers leaving the site. Haul roads, drainage channels, culverts, berms, erosion and sedimentation (E&S) controls, and access controls will be constructed.

1.4 Summary of FSS Activities

A Final Status Survey Plan (FSSP) will be prepared in accordance with MARSSIM guidance to support remediation activities for the Fansteel site. A combination of scanning, direct measurements, and sampling for the radionuclides of concern and/or their progeny will be performed to ensure that remediation is complete. A nonparametric statistical test will be applied to the sampling data taken at distinct survey locations in each survey unit to determine whether the release criteria have been met. The nonparametric tests recommended in MARSSIM are the Wilcoxon Rank Sum (WRS) test and the Sign test.

Upon approval of this DP by the NRC, Fansteel will undertake preparation of designs and specifications. Subsequently, a construction contractor will be selected. Fansteel may choose to develop performance specifications and require the contractor to develop design details. Alternatively, Fansteel may 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. Therefore, remediation is anticipated to begin in March following completion of the design/contractor selection tasks and extend over a period of approximately 10 years. A detailed schedule will be prepared subsequent to NRC approval of the DP. This schedule will be updated as circumstances dictate.

Fansteel is seeking approval of this DP to authorize the activities described herein and NRC concurrence that if this plan is implemented as described, it will result in the property being suitable for unrestricted use. However, this remediation plan is premised on current knowledge of site conditions, regulatory

guidance, disposal, and reclamation market factors. Other alternatives to disposal such as reuse of CaF residues in the cement industry will be considered as the decommissioning project progresses.

w:\5427f\rpt\decomplan\chapter-1.doc