Decommissioning Plan for the Newfield Facility

Submitted by:

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TABLE OF CONTENTS

DEFINITIONS

AAF - Baghouse dust collector formerly located adjacent to Building D111

ACO - Administrative Consent Order

Action level - The numerical value that will cause the decision maker to choose one of the alternative actions It may be a regulatory threshold standard (e g , Maximum Contaminant Level for drinking water), a dose - or risk-based concentration level (e.g., DCGL), or a reference-based standard See investigation level.

Activity - See radioactivity.

AEA - Atomic Energy Act

ALARA (acronym for As Low As Reasonably Achievable) - A basic concept of radiation protection which specifies that exposure to ionizing radiation and releases of radioactive materials should be managed to reduce collective doses as far below regulatory limits as is reasonably achievable considering economic, technological, and societal factors, among others Reducing exposure at a site to ALARA strikes a balance between what is possible through additional planning and management, remediation, and the use of additional resources to achieve a lower collective dose level. A determination of ALARA is a site-specific analysis that is open to interpretation, because it depends on approaches or circumstances that may differ between regulatory agencies. An ALARA recommendation should not be interpreted as a set limit or level.

ALI - Annual Level of Intake

Alpha particle - A positively charged particle emitted by some radioactive materials undergoing radioactive decay.

ANSI - American National Standards Institute

Area - A general term referring to any portion of a site, up to and including the entire site

Area factor (Am) - A factor used to adjust $DCGL_W$ to estimate $DCGL_{EMC}$ and the minimum detectable concentration for scanning surveys in Class 1 survey units—$DCGL_{EMC} = DCGL_W \cdot Am$. Am is the magnitude by which the residual radioactivity in a small area of elevated activity can exceed the $DCGL_W$ while maintaining compliance with the release criterion

Area of elevated activity - An area over which residual radioactivity exceeds a specified value $DCGL_{EMC}$.

Arithmetic mean - The average value obtained when the sum of individual values is divided by the number of values.

Arithmetic standard deviation - A statistic used to quantify the variability of a set of data. It is calculated in the following manner. 1) subtracting the arithmetic mean from each data value individually, 2) squaring the differences, 3) summing the squares of the differences, 4) dividing the sum of the squared differences by the total number of data values less one, and 5) taking the square root of the quotient. The calculation process produces the Root Mean Square Deviation (RMSD).

Assessment - The evaluation process used to measure the performance or effectiveness of a system and its elements. As used in MARSSIM, assessment is an all-inclusive term used to denote any of the following· audit, performance evaluation, management systems review, peer review, inspection, or surveillance.

Background radiation - Radiation from cosmic sources, naturally occurring radioactive material, including radon (except as a decay product of source or special nuclear material), and global fallout as it exists in the environment from the testing of nuclear explosive devices or from nuclear accidents like Chernobyl which contribute to background radiation and are not under the control of the cognizant organization. Background radiation does not include radiation from source, byproduct, or special nuclear materials regulated by the cognizant Federal or State agency Different definitions may exist for this term. The definition provided in regulations or regulatory program being used for a site release should always be used if it differs from the definition provided here.

Becquerel (Bq) - The International System (SI) unit of activity equal to one nuclear transformation (disintegration) per second. 1 Bq = 2.7×10^{-11} Curies (Ci) = 27.03 picocuries (pCi)

Beta particle - An electron emitted from the nucleus during radioactive decay.

Byproduct material - Any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.

Calibration - Comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments

CDE (committed dose equivalent) - The dose equivalent calculated to be received by a tissue or organ over a 50-year period after the intake into the body. It dose not include contributions from radiation sources external to the body. CDE is expressed in units of Sv or rem.

CEDE (committed effective dose equivalent) - The sum of the committed dose equivalent to various tissues in the body, each multiplied by the appropriate weighting factor (Wt). CEDE is expressed in units of Sv or rem See TEDE.

Chain of custody - An unbroken trail of accountability that ensures the physical security of samples, data, and records

Characterization survey - A type of survey that includes facility or site sampling, monitoring, and analysis activities to determine the extent and nature of contamination. Characterization surveys provide the basis for acquiring necessary technical information to develop, analyze, and select appropriate cleanup techniques.

CIH - Certified Industrial Hygienist

Class 1 area - An area that is projected to require a Class 1 final status survey.

Class 1 survey - A type of final status survey that applies to areas with the highest potential for contamination, and meet the following criteria (1) impacted; (2) potential for delivering a dose above the release criterion; (3) potential for small areas of elevated activity, and (4) insufficient evidence to support reclassification as Class 2 or Class 3

Class 2 area - An area that is projected to require a Class 2 final status survey

Class 2 survey - A type of final status survey that applies to areas that meet the following criteria: (1) impacted, (2) low potential for delivering a dose above the release criterion, and (3) little or no potential for small areas of elevated activity

Class 3 area - An area that is projected to require a Class 3 final status survey.

Class 3 survey - A type of final status survey that applies to areas that meet the following criteria (1) impacted, (2) little or no potential for delivering a dose above the release criterion; and (3) little or no potential for small areas of elevated activity

Classification - The act or result of separating areas or survey units into one of three designated classes - Class 1 area, Class 2 area, or Class 3 area

Cleanup - Actions taken to deal with a release or threatened release of hazardous substances that could affect public health or the environment. The term is often used broadly to describe various Superfund response actions or phases of remedial responses, such as remedial investigation/ feasibility study. Cleanup is sometimes used interchangeably with the terms remedial action, response action, or corrective action.

Cleanup standard - A numerical limit set by a regulatory agency as a requirement for releasing a site after cleanup See release criterion.

Cleanup (survey) unit - A geographical area of specified size and shape defined for the purpose of survey design and compliance testing.

Composite sample - A sample formed by collecting several samples and combining them (or selected portions of them) into a new sample which is then thoroughly mixed.

Confidence interval - A range of values for which there is a specified probability (e.g., 80%, 90%, 95%) that this set contains the true value of an estimated parameter.

Confirmatory survey - A type of survey that includes limited independent (third-party) measurements, sampling, and analyses to verify the findings of a final status survey.

Contamination - The presence of residual radioactivity in excess of levels which are acceptable for release of a site or facility for unrestricted use.

Control chart - A graphic representation of a process, showing plotted values of some statistic gathered from that characteristic, and one or two control limits. It has two basic uses: 1) as a judgement to determine if a process was in control, and 2) as an aid in achieving and maintaining statistical control.

Core sample - A soil sample taken by core drilling.

Corrective action - An action taken to eliminate the causes of an existing nonconformance, deficiency, or other undesirable situation in order to prevent recurrence.

Criterion - See release criterion.

Critical level (Lc) - A fixed value of the test statistic corresponding to a given probability level, as determined from the sampling distribution of the test statistic. Lc is the level at which there is a statistical probability (with a predetermined confidence) of correctly identifying a background value as "greater than background."

Critical value - The value of a statistic (t) corresponding to a given significance level as determined from its sampling distribution; e.g., if Pr (t > to) = 0 05, to is the critical value of t at the 5 percent level

Curie (Ci) - The customary unit of radioactivity. One curie (Ci) is equal to 37 billion disintegrations per second (3.7 x 10^{10} dps = 3.7 x 10^{10} Bq), which is approximately equal to the decay rate of one gram of 226 Ra Fractions of a curie, e g picocurie (pCi) or 10^{-12} Ci and microcurie (µCi) or 10 -6 Ci, are levels typically encountered in decommissioning

D102 - Building number D102

D111 - Building number D111

DAC - Derived Air Concentration

DCGL (derived concentration guideline level) - A derived, radionuclide-specific activity concentration within a survey unit corresponding to the release criterion. The DCGL is based on the spatial distribution of the contaminant and hence is derived differently for the nonparametric statistical test (DCGLW) and the Elevated Measurement Comparison (DCGLEMC). DCGLs are derived from activity/dose relationships through various exposure pathway scenarios

Decay - See radioactive decay.

Decommissioning - The process of removing a facility or site from operation, followed by decontamination, and license termination (or termination of authorization for operation) if appropriate. The objective of decommissioning is to reduce the residual radioactivity in structures, materials, soils, groundwater, and other media at the site so that the concentration of each radionuclide contaminant that contributes to residual radioactivity is indistinguishable from the background radiation concentration for that radionuclide.

Decontamination - The removal of radiological contaminants from, or their neutralization on, a person, object or area to within levels established by governing regulatory agencies Decontamination is sometimes used interchangeably with remediation, remedial action, and cleanup

DEIS - Draft Environmental Impact Statement

Derived concentration guideline level - See DCGL

Detection limit - The net response level that can be expected to be seen with a detector with a fixed level of certainty

Detection sensitivity - The minimum level of ability to identify the presence of radiation or radioactivity.

Direct measurement - Radioactivity measurement obtained by placing the detector near the surface or media being surveyed. An indication of the resulting radioactivity level is read out directly.

Distribution coefficient (Kd) - The ratio of elemental (i e , radionuclide) concentration in soil to that in water in a soil-water system at equilibrium. Kd is generally measured in terms of gram weights of soil and volumes of water (g/cm 3 or g/ml)

Dose commitment - The dose that an organ or tissue would receive during a specified period of time (e.g., 50 or 70 years) as a result of intake (as by ingestion or inhalation) of one or more radionuclides from a given release.

Dose equivalent (dose) - A quantity that expresses all radiations on a common scale for calculating the effective absorbed dose This quantity is the product of absorbed dose (rads) multiplied by a quality factor and any other modifying factors Dose is measured in Sv or rem.

Effective probe area - The physical probe area corrected for the amount of the probe area covered by a protective screen.

Elevated area - See area of elevated activity.

Elevated measurement - A measurement that exceeds a specified value $DCGL_{EMC}$.

Elevated Measurement Comparison (EMC) - This comparison is used in conjunction with the Wilcoxon test to determine if there are any measurements that exceed a specified value DCGLEMC .

Exposure pathway - The route by which radioactivity travels through the environment to eventually cause radiation exposure to a person or group.

Exposure rate - The amount of ionization produced per unit time in air by X-rays or gamma rays. The unit of exposure rate is Roentgens/hour (R/h); for decommissioning activities the typical units are microRoentgens per hour (µR/h), i.e., 10 -6 R/h.

External radiation - Radiation from a source outside the body

FEMA - Federal Emergency Management Agency

Field Sampling Plan - As defined for Superfund in the Code of Federal Regulations 40 CFR 300 430, a document which describes the number, type, and location of samples and the type of analyses to be performed. It is part of the Sampling and Analysis Plan

Final status survey - Measurements and sampling to describe the radiological conditions of a site, following completion of decontamination activities (if any) in preparation for release.

Flex-Kleen - Baghouse dust collector formerly located adjacent to Building D111

FSS - final status survey

Gamma radiation - Penetrating high-energy, short-wavelength electromagnetic radiation (similar to X-rays) emitted during radioactive decay. Gamma rays are very penetrating and require dense materials (such as lead or steel) for shielding.

GET - General Employee Training

Graded approach - The process of basing the level of application of managerial controls applied to an item or work according to the intended use of the results and the degree of confidence needed in the quality of the results.

Grid - A network of parallel horizontal and vertical lines forming squares on a map that may be overlaid on a property parcel for the purpose of identification of exact locations.

Grid block - A square defined by two adjacent vertical and two adjacent horizontal reference grid lines.

H_D - deep dose equivalent

Half-life (t1/2) - The time required for one-half of the atoms of a particular radionuclide present to disintegrate

HASP - Health and Safety Plan

Historical Site Assessment (HSA) - A detailed investigation to collect existing information, primarily historical, on a site and its surroundings.

Hot measurement - See elevated measurement.

Hot spot - See area of elevated activity.

HP - Health Physicist or Health Physics

HSP - Health and Safety Plan

HSO - Health and Safety Officer

Hypothesis - An assumption about a property or characteristic of a set of data under study The goal of statistical inference is to decide which of two complementary hypotheses is likely to be true. The null hypothesis (H_0) describes what is assumed to be the true state of nature and the alternative hypothesis (H_a) describes the opposite situation.

Impacted area - Any area that is not classified as non-impacted. Areas with a possibility of containing residual radioactivity in excess of natural background or fallout levels

Independent assessment - An assessment performed by a qualified individual, group, or organization that is not part of the organization directly performing and accountable for the work being assessed

Indistinguishable from background - The term indistinguishable from background means that the detectable concentration distribution of a radionuclide is not statistically different from the background concentration distribution of that radionuclide in the vicinity of the site or, in the case of structures, in similar materials using adequate measurement technology, survey, and statistical techniques

Infiltration rate - The rate at which a quantity of a hazardous substance moves from one environmental medium to another—e g , the rate at which a quantity of a radionuclide moves from a source into and through a volume of soil or solution

Inspection - An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic

Inventory - Total residual quantity of formerly licensed radioactive material at a site

Investigation level - A derived media-specific, radionuclide-specific concentration or activity level of radioactivity that - 1) is based on the release criterion, and 2) triggers a response, such as further investigation or cleanup, if exceeded See action level

Less-than data - Measurements that are less than the minimum detectable concentration

License - A license issued under the regulations in parts 30 through 35, 39, 40, 60, 61, 70 or part 72 of 10 CFR.

Licensee - The holder of a license

License termination - Discontinuation of a license, the eventual conclusion to decommissioning.

Lower limit of detection (L_D) - The smallest amount of radiation or radioactivity that statistically yields a net result above the method background. The critical detection level, L_C , is the lower bound of the 95% detection interval defined for L_D and is the level at which there is a 5% chance of calling a background value "greater than background." This value should be used when actually counting samples or making direct radiation measurements Any response above this level should be considered as above background, i e , a net positive result. This will ensure 95% detection capability for L_D . A 95% confidence interval should be calculated for all responses greater than L_C .

MARSSIM - Multi-Agency Radiation Survey and Site Investigation Manual

MDA - Minimum detectable activity

MDC - Minimum detectable concentration

Measurement - For the purpose of MARSSIM, it is used interchangeably to mean: 1) the act of using a detector to determine the level or quantity of radioactivity on a surface or in a sample of material removed from a media being evaluated, or 2) the quantity obtained by the act of measuring

Millirem - one thousandth of a rem

Minimum detectable concentration (MDC) - The minimum detectable concentration (MDC) is the a priori activity level that a specific instrument and technique can be expected to detect 95% of the time. When stating the detection capability of an instrument, this value should be used. The MDC is the detection limit, LD, multiplied by an appropriate conversion factor to give units of activity

Minimum detectable count rate (MDCR) - The minimum detectable count rate (MDCR) is the a priori count rate that a specific instrument and technique can be expected to detect

Missing or unusable data - Data (measurements) that are mislabeled, lost, or do not meet quality control standards Less-than data are not considered to be missing or unusable data

MSHA - Mine Safety and Health Administration

NCDC - National Climate Data Center

NEPA - National Environmental Policy Act

NIOSH - National Institute for Occupational Safety and Health

NIST - National Institute of Standards and Technology

NJDEP - New Jersey Department of Environmental Protection

NOAA - National Oceanic and Atmospheric Administration

Non-impacted area - Areas where there is no reasonable possibility (extremely low probability) of residual contamination. Non-impacted areas are typically located off-site and may be used as background reference areas

Normal (gaussian) distribution - A family of bell shaped distributions described by the mean and variance

NVLAP - National Voluntary Laboratory Accreditation Program

O&M - operation and maintenance

Organization - a company, corporation, firm, government unit, enterprise, facility, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration

OSHA - Occupational Safety and Health Administration

pCi/g - picocuries per gram

PM - Project Manager

Precision - A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation

Process - A combination of people, machine and equipment, methods, and the environment in which they operate to produce a given product or service

Professional judgement - An expression of opinion, based on technical knowledge and professional experience, assumptions, algorithms, and definitions, as stated by an expert in response to technical problems

Pyrochlore - concentrated ore containing columbium (niobium)

QA - Quality Assurance

QAO - Quality Assurance Officer

QAPP - Quality Assurance Project Plan

QA/QC - Quality Assurance/Quality Control

QC - Quality Control

QIP - Quality Implementing Procedure

Qualified data - Any data that have been modified or adjusted as part of statistical or mathematical evaluation, data validation, or data verification operations

Quality - The totality of features and characteristics of a product or service that bear on its ability to meet the stated or implied needs and expectations of the user

Quality assurance (QA) - An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer

Quality control (QC) - The overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer, operational techniques and activities that are used to fulfill requirements for quality

RAB - Restoration Advisory Board

Radiation survey - Measurements of radiation levels associated with a site together with appropriate documentation and data evaluation

Radioactive decay - The spontaneous transformation of an unstable atom into one or more different nuclides accompanied by either the emission of energy and/or particles from the nucleus, nuclear capture or ejection of orbital electrons, or fission Unstable atoms decay into a more stable state, eventually reaching a form that does not decay further or has a very long half-life

Radioactivity - The mean number of nuclear transformations occurring in a given quantity of radioactive material per unit time The International System (SI) unit of radioactivity is the Becquerel (Bq) The customary unit is the Curie (Ci)

Radiological survey - Measurements of radiation levels and radioactivity associated with a site together with appropriate documentation and data evaluation

Radioluminescence - Light produced by the absorption of energy from ionizing radiation

Radionuclide - An unstable nuclide that undergoes radioactive decay

Random error - The deviation of an observed value from the true value is called the error of observation. If the error of observation behaves like a random variable (i.e , its value occurs as though chosen at random from a probability distribution of such errors) it is called a random error

Regulation - A rule, law, order, or direction from federal or state governments regulating action or conduct. Regulations concerning radioisotopes in the environment in the United States are shared by the Environmental Protection Agency (EPA), the U.S. Nuclear Regulatory Commission (NRC), the U.S. Department of Energy (DOE), and many State governments Federal regulations and certain directives issued by the U.S. Department of Defense(DOD) are enforced within the DOD

Release criterion - A regulatory limit expressed in terms of dose or risk

Rem (radiation equivalent man) - The conventional unit of dose equivalent. The corresponding International System (SI) unit is the Sievert (Sv): 1 Sv = 100 rem

Remedial action - Those actions that are consistent with a permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of a hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health or welfare or the environment

Remediation - Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a Superfund site

Removable activity - Surface activity that is readily removable by wiping the surface with moderate pressure and can be assessed with standard radiation detectors. It is usually expressed in units of dpm/100 cm 2

Removal - The cleanup or removal of released hazardous substances, or pollutants or contaminants which may present an imminent and substantial danger; such actions as may be necessary taken in the event of the threat of release of hazardous substances into the environment; such actions as may be necessary to monitor, assess, and evaluate the threat of release of hazardous substances; the removal and disposal of material, or the taking of other such actions as may be necessary to prevent, minimize or mitigate damage to the public health or welfare or the environment

Representative measurement - A measurement that is selected using a procedure in such a way that it, in combination with other representative measurements, will give an accurate representation of the phenomenon being studied

Representativeness - A measure of the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Reproducibility - The precision, usually expressed as a standard deviation, that measures the variability among the results of measurement of the same sample at different laboratories

Residual radioactivity - Radioactivity in structures, materials, soils, groundwater, and other media at a site resulting from activities under the cognizant organization's control. This includes radioactivity from all sources used by the cognizant organization, but excludes background radioactivity as specified by the applicable regulation or standard. It also includes radioactive materials remaining at the site as a result of routine or accidental releases of radioactive material at the site and previous burials at the site, even if those burials were made in accordance with the provisions of 10 CFR Part 20

RESRAD - computer code used to determine residual radioactivity in the environment

Restricted use - A designation following remediation requiring radiological controls

RI/FS - Remedial Investigation and Feasibility Study

RSO - Radiation Safety Officer

RSP - Radiation Safety Procedure

RWP - Radiation Work Permit

RWT - Radiation Worker Training

Sample - (As used in MARSSIM) A part or selection from a medium located in a survey unit or reference area that represents the quality or quantity of a given parameter or nature of the whole area or unit; a portion serving as a specimen

Sample - (As used in statistics) A set of individual samples or measurements drawn from a population whose properties are studied to gain information about the entire population

Scanning - An evaluation technique performed by moving a detection device over a surface at a specified speed and distance above the surface to detect radiation

Site - Any installation, facility, or discrete, physically separate parcel of land, or any building or structure or portion thereof, that is being considered for survey and investigation

SMC - Shieldalloy Metallurgical Corporation

Soil activity (soil concentration) - The level of radioactivity present in soil and expressed in units of activity per soil mass (typically Bq/kg or pCi/g)

Source material - Uranium and/or Thorium other than that classified as special nuclear material

Source term - All residual radioactivity remaining at the site, including material released during normal operations, inadvertent releases, or accidents, and that which may have been buried at the site in accordance with 10 CFR Part 20

Standard operating procedure (SOP) - A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and that is officially approved as the method for performing certain routine or repetitive tasks

Subsurface soil sample - A soil sample that reflects the modeling assumptions used to develop the DCGL for subsurface soil activity An example would be soil taken deeper than 15 cm below the soil surface to support surveys performed to demonstrate compliance with 40 CFR 192

Surface contamination - Residual radioactivity found on building or equipment surfaces and expressed in units of activity per surface area (Bq/m^2 or dpm/100 cm^2)

Surface soil sample - A soil sample that reflects the modeling assumptions used to develop the DCGL for surface soil activity. An example would be soil taken from the first 15 cm of surface soil to support surveys performed to demonstrate compliance with 40 CFR 192

Surveillance (quality) - Continual or frequent monitoring and verification of the status of an entity and the analysis of records to ensure that specified requirements are being fulfilled

Survey - A systematic evaluation and documentation of radiological measurements with a correctly calibrated instrument or instruments that meet the sensitivity required by the objective of the evaluation

Survey plan - A plan for determining the radiological characteristics of a site

TDS - Total Dissolved Solids

TEDE (total effective dose equivalent) - The sum of the effective dose equivalent (for external exposure) and the committed effective dose equivalent (for internal exposure). TEDE is expressed in units of Sv or rem. See CEDE

TLD - thermoluminescent dosimeter

TODE - total organ dose equivalent

traceability - The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughput the project back to the requirements for quality for the project

Unrestricted area - Any area where access is not controlled by a licensee for purposes of protection of individuals from exposure to radiation and radioactive materials—including areas used for residential purposes

Unrestricted release - Release of a site from regulatory control without requirements for future radiological restrictions Also known as unrestricted use

USEPA - United States Environmental Protection Agency

USNRC - United States Nuclear Regulatory Commission

Weighting factor (Wt) - The fraction of the overall health risk, resulting from uniform, whole-body radiation, attributable to specific tissue. The dose equivalent to tissue is multiplied by the appropriate weighting factor to obtain the effective dose equivalent to the tissue.

Wilcoxon Rank Sum (WRS) test - A nonparametric statistical test used to determine compliance with the release criterion when the radionuclide of concern is present in background.

1 EXECUTIVE SUMMARY

1.1 Introduction

This Decommissioning Plan (Plan) describes the radiological remedial actions that will be implemented in order to permit release of the Shieldalloy Metallurgical Corporation (SMC) facility at Newfield, New Jersey. Once the release criteria have been met and documented, SMC will request termination of radioactive materials license number SMB-743. However, the decommissioning objective is to terminate the license under "restricted use" conditions, therefore this plan also contains conditions and actions that will be taken in order to maintain radiation exposures to the public as low as is reasonably achievable. Included herein are the background information, assessments, and commitments to support the license termination request.

1.2 Site Description

Shieldalloy Metallurgical Corporation (SMC) operates a manufacturing facility located at 12 West Boulevard in Newfield, New Jersey. During the ferrocolumbium manufacturing process, the facility generated slag, dross, and baghouse dust.

The primary portion of the site, consisting of the manufacturing facilities and their support areas, covers 67.7 acres. An additional 19.8 acres of farmland, located approximately 2,000 feet southwest of the primary site in Vineland, Cumberland County, New Jersey, are also owned by SMC.

1.3 Summary of Licensed Activities

The USNRC radioactive materials license (USNRC License No. SMB-743) authorizes possession of up to 303,050 kilograms of thorium in any chemical/physical form, and up to 45,000 kilograms of uranium in any chemical or physical form. As of August 28, 2002, SMC was at 96.8% of the thorium limit and 87.6% of the uranium limit.

One of the materials received, used and stored by SMC contains radioactive material which is classified as "source material" pursuant to Title 10, Code of Federal Regulations, Part 40. This material is called pyrochlore, a concentrated ore containing columbium (niobium). Pyrochlore contains greater than 0.05% of natural uranium and natural thorium. Therefore, it is licensable by the U. S. Nuclear Regulatory Commission (USNRC).

The majority of the licensed radioactive material inventory at the plant currently consists of the slag from the D-111 production department and dust from the D-111 baghouses. After processing of consumable pyrochlore ore and other feed materials for ferrocolumbium and other metallurgical operations, greater than 99% of the radioactive species remains in the slag and, to a much lesser extent, in the baghouse dust.

1.4 Nature and Extent of Contamination

Subsurface soil contamination, in the form of ferrocolumbium slag, is present in the Storage Yard, and at a number of locations throughout the Newfield plant where slag was used as fill. Ferrocolumbium standard slag, ferrocolumbium high-ratio slag, and columbium nickel slag generated from the D111 and D102 smelting operations consist of solid, non-combustible material with the consistency of vitrified rock. All three slag types were maintained separately from the others at their respective points of generation and are transported in trucks from D111 and D 102 to the Storage Yard. There are approximately 20,000 cubic meters of ferrocolumbium slag (high ratio and standard) in the Storage Yard. In addition, baghouse dust was transported by truck to the Storage Yard. Approximately 20,000 cubic meters of baghouse dust are currently in the Storage Yard.

The only areas within the Newfield plant property lines where residual radioactivity exists in surface soils, other than in the Storage Yard, are the concrete pads that housed the former AAF and Flex-Kleen Baghouses. In addition, residual radioactivity was identified in the Hudson's Branch watershed in the late 1980's. The Hudson's Branch, an intermittent, slow-moving tributary of Burnt Mill Branch in the Maurice River Basin, is the predominant surface water body in the vicinity of the plant. It borders the southern boundary of the property, where it flows from east to west.

The only buildings that contained systems and equipment for processing source material were D-111, the Flex-Kleen Baghouse, the AAF Baghouse, and D-102/112. The AAF Baghouse was demolished and released for unrestricted use in calendar year 2001. The Flex-Kleen Baghouse, D-111 and D-102/112 were decommissioned in calendar year 2002, and the final status survey report is soon to be submitted to the USNRC. Consequently, there are no longer any contaminated systems or equipment to be addressed in the site-wide decommissioning effort.

1.5 Selected Decommissioning Objective

Prior to terminating License No. SMB-743, SMC intends to move all residual radioactive materials at the Newfield Facility to the Storage Yard, which is located on the eastern boundary of the plant. There it will be graded, topped with the excavated soils from elsewhere on the plant, capped in place, and subject to long-term maintenance and monitoring. This *in situ* decommissioning methodology has already received federal and state (Ohio) regulatory acceptance at a site that performed similar operations, and with similar quantities/forms of residual radioactive materials.[1,2]

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[1] U. S. Nuclear Regulatory Commission, NUREG-1543, "Environmental Impact Statement; Decommissioning of the Shieldalloy Metallurgical Corporation Newfield, Ohio Facility", July, 1996.

[2] PTI Environmental Services, "Remedial Investigation and Feasibility Study at the Shieldalloy Metallurgical Corporation Site in Newfield, Ohio", September, 1996.

After all on-site activities are complete, a final status survey will be performed, the results of which will be documented in a comprehensive report. Included therein will be a demonstration that the site, at the end of the decommissioning process, meets the decommissioning objective.

The residual radioactivity at the Newfield facility consists, entirely, of natural uranium (^{238}U plus progeny) and natural thorium (^{232}Th plus progeny). The media of concern are building surfaces and soil. Based upon the requirements specified in 65 FR 114 and NUREG/CR-5512, Derived Concentration Guideline Levels (DCGLs) were determined which are equivalent to the applicable release criteria of less than 100 millirem per year to members of the public. Specifically, the DCGL established for ^{238}U plus progeny is less than 29 picocuries per gram (pCi/g) for soil and less than 78 disintegrations per minute (alpha) per 100 square centimeters (dpm (α)/100 cm^2). The DCGL established for ^{232}Th plus progeny is less than 44 pCi/g in soil and less than 24 dpm (α)/100 cm^2.

1.6 Summary of Radiation Dose Analysis

The DCGLs were derived using the USNRC guidance in 65 FR 114 and NUREG/CR-5512. The corresponding dose for these DCGLs was determined to be less than 100 millirem per year to members of the public.

1.7 Summary of ALARA Analysis

SMC's goal for this decommissioning effort is to contain the slag, contaminated soil and baghouse dust in a pile equipped with an engineered cap such that the potential exposures of members of the public to radiation and radioactive materials is minimized. The manner in which the cap is designed, constructed and maintained, will allow it to last for more than 1,000 years. It will also be suitable to divert surface water and minimize the erosion of contaminated materials and the spread of contamination. SMC intends to implement restrictions to reduce potential exposures, including deed restrictions related to the use of the property and intrusive activities. Furthermore, the cap will satisfy the requirements established by the New Jersey Department of Environmental Protection and be suitable to reduce radiation exposures to below the radiation dose limit.

Removing the contaminated material from the site will result in the fewest long-term environmental effects, although the cost is astronomical. (The estimated cost of off-site disposal was calculated to be approximately \$102-112 million versus approximately \$3.0 million for the on-site disposal options.) The off-site disposal option also has some potentially significant ramifications on air quality and noise that would demand mitigation. Furthermore, the off-site disposal alternative would result in higher potential for worker injuries than would the on-site disposal alternative. That is why, after weighing the costs and benefits of the proposed action and considering reasonable alternatives, the USNRC recommended implementation of the on-site disposal alternatives, along with some additional mitigating actions as described in DEIS. The same conclusions are applicable to SMC's Newfield site, thus the in-situ stabilization and disposal option would be considered to be as low as reasonably achievable (ALARA).

1.8 Restrictions Used to Limit Radiation Doses

After remediation activities are complete, a deed notice will be filed with Gloucester County that prohibits or in some way restricts agricultural, residential, and industrial activities on the restricted release areas of the site. At this time, there are no plans for re-development of the restricted release areas after license termination, other than to complete and maintain a wildlife preserve with nature trails. The final decision(s) on this issue will be made prior to license termination.

SMC intends to retain title to the property until such time as all remaining plant operations cease. At that time, SMC intends to turn portions of the property over to the Borough of Newfield, to Gloucester County, or to the State of New Jersey, along with all funds designated for long-term (1000-year) maintenance of the restricted release area as a wildlife sanctuary. The final decision(s) on the title recipient and areas to be transferred will be made prior to license termination.

1.9 Summary of Public Participation Activities

SMC will solicit local input as it plans and implements its cleanup and management of the residual radioactivity at the site. SMC will establish a Restoration Advisory Board (RAB) as a voluntary advisory group. The RAB members include individuals from state and county regulatory agencies, as well as residents from the county. All of the RAB meetings will be open to the public, and SMC will solicit comments from the general public in addition to the RAB members at the RAB meetings.

1.10 Proposed Initiation and Completion Dates

The duration of regulatory review of this decommissioning plan, and exchange of additional information solicited by the USNRC, is unknown at this time. However, full implementation of the Plan will be completed within two years after its approval by the USNRC.

1.11 Request for License Amendment

SMC requests that the license be amended to incorporate this decommissioning plan as provided in the following sections.

INTRODUCTION

Shieldalloy Metallurgical Corporation (SMC) operates a manufacturing facility in Newfield, New Jersey. This facility manufactures or has manufactured specialty steel and super alloy additives, primary aluminum master alloys, metal carbides, powdered metals, and optical surfacing products. Raw materials used at the facility included ores which contain oxides of columbium (niobium), vanadium, aluminum metal, titanium metal, strontium metal, zirconium metal, and fluoride (titanium and boron) salts. During the manufacturing process, slag, dross, and baghouse dust were generated.

One of the materials received, used and stored by SMC contains radioactive material which is classified as "source material" pursuant to Title 10, Code of Federal Regulations, Part 40. This material is called pyrochlore, a concentrated ore containing columbium (niobium). Pyrochlore contains greater than 0.05% of natural uranium and natural thorium. Therefore, it is licensable by the U. S. Nuclear Regulatory Commission (USNRC).

SMC currently holds USNRC License No. SMB-743 which allows possession, use, storage, transfer and disposal of source material ancillary to metallurgical operations. The most recent amendment of SMB-743 was issued on October 9, 2001, and the license expiration date is October 20, 2002.

In anticipation of license expiration, SMC has prepared this decommissioning plan. When fully implemented, it will permit the Newfield site, in its entirety, to be released for restricted use. At that time, License No. SMB-743 may be terminated. Included herein are the following sections:

- Chapter 1 - *Executive Summary,* provides an overview of the installation and operating history, and results of analyses; also states SMC's request for license termination with restrictions.
- Chapter 2 - *Facility Operating History*, describes the facility's operating history, including licensed activities performed since the date of initial regulatory authorization.
- Chapter 3 - *Facility Description*, details the site location, land use, socioeconomics, and existing environmental conditions.
- Chapter 4 - *Radiological Status of the Facility*, describes the radiological status of the facility, with emphasis on the Storage Yard.
- Chapter 5 - *Dose Modeling Evaluations*, details and summarizes the dose modeling.

- Chapter 6 - *Alternatives Considered and Rationale for the Chosen Alternative*, presents the alternatives for license termination and the rationale for the selected alternative.

- Chapter 7 - *ALARA Analysis*, presents the ALARA analysis and includes the benefits and costs of decontamination of the manufacturing area and construction of an engineered cap in the Storage Yard.

- Chapter 8 - *Planned Decommissioning Activities*, describes the approach to be implemented in order to decommission the facility for license termination.

- Chapter 9 - *Project Management and Organization*, describes the project management and organization, including the role and responsibilities of key organizations and personnel.

- Chapter 10 - *Radiation Safety and Health Program During License Termination*, describes the radiation safety and health program that will remain in place throughout the decommissioning process.

- Chapter 11 - *Environmental Monitoring and Control Program*, addresses the way in which the environment will be protected from decommissioning-related emissions.

- Chapter 12 - *Radioactive Waste Management Program*, identifies the type, amount and disposition of radioactive materials associated with this decommissioning program.

- Chapter 13 - *Quality Assurance Program*, describes the elements of quality and the quality control measures to be implemented during decommissioning.

- Chapter 14 - *Facility Radiation Surveys*, describes the way that the radiological conditions at the site after decommissioning is complete will be measured and documented.

- Chapter 15 - *Financial Assurance*, provides SMC's plan for ensuring funding is available to support implementation of this Plan during its execution and for the specified time period after restricted release.

- Chapter 16 - *Restricted Use*, provides the rationale and basis for license termination under restricted conditions as described in 10 CFR 20.1402.

Each of the chapters is organized similar to the checklist found in Appendix A of NUREG-1727. This organization was selected in order to facilitate regulatory review of SMC's decommissioning plan. In addition, the lines on each page are numbered to provide a ready point of reference for reviewers.

2 FACILITY OPERATING HISTORY

2.1 License Status

The majority of the licensed radioactive material inventory at the Newfield plant consists of slag from the D-111 production department, and dust from the D-111 baghouses. After processing of consumable pyrochlore ore and other feed materials for ferrocolumbium and other metallurgical operations, greater than 99% of the radioactive species remained in the slag and, to a much lesser extent, in the baghouse dust.[3]

License No. SMB-743 authorizes possession of up to 303,050 kilograms of thorium in any chemical/physical form, and up to 45,000 kilograms of uranium in any chemical or physical form. As of August 28, 2002, SMC was at 96.8% of the thorium limit and 87.6% of the uranium limit.

2.2 License History

SMC currently holds USNRC License No. SMB-743 which allows possession, use, storage, transfer and disposal of source material ancillary to metallurgical operations. The most recent amendment of SMB-743 was issued on October 9, 2001, and the license expiration date is October 20, 2002.

2.3 Previous Decommissioning Activities

2.3.1 Haul Road

The Haul Road was, at one time, a county right-of-way that ran through SMC's Newfield plant. Over the years, the south portion of Haul Road was surfaced with crushed slag from SMC operations. Although the Haul Road was never used to perform principle activities authorized by License No. SMB-743, it was nonetheless included in site characterization efforts that took place in 1988 and in 1991.[4,5] These surveys showed that the contact exposure rates in and near the Haul Road were only slightly discernible from background, and that the slag used to form the road bed was not characteristic of licensed material (i.e., ferrocolumbium slag).[6]

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[3] IT Corporation, "Assessment of Environmental Radiological Conditions at the Newfield Facility", IT Corporation Report No. IT/NS-92-106, April 1, 1992.

[4] Oak Ridge Associated Universities, "Radiological Survey of the Shieldalloy Metallurgical Corporation, Newfield, New Jersey", Report No. ORAU 88/G-79, July, 1988.

[5] IT Corporation, "Assessment of Environmental Radiological Conditions at the Newfield Facility", Report No. IT/NS-92-106, April 2, 1992.

[6] Exposure rates in and near the Haul Road generally ranged from background to 26 microR per hour, with a maximum exposure rate of 90 microR per hour. The contact exposure rate from ferrocolumbium slag is in the vicinity of 1,000 to 2,000 microR per hour.

The radioactive materials identified within the Haul Road were excavated and relocated to the Storage Yard. A final status survey was performed and documented in the fourth quarter of 1998.[7]

2.3.2 AAF Baghouse

Ferrocolumbium production was performed within a single building (D-111) equipped with an operator control room, mechanical booms and heavy equipment handlers, storage containers, scales, a variety of melting pots, two furnaces, other miscellaneous items, and a dust collection system comprised of two interconnected emission control units with high-efficiency baghouses. One of the emission control units was an American Air Filter baghouse, termed the "AAF Baghouse".

Because of improvements made to the air handling system in the immediate vicinity of the smelting operation, and because maintenance performed on a baghouse that operated in tandem with the AAF Baghouse improved its efficiency, in early 1999, SMC determined that it was no longer necessary to operate two emission control systems. Therefore, the decision was made to decommission the AAF Baghouse.

During the remedial action, which occurred between May 17 and June 17, 1999, the AAF Baghouse was disassembled. Structural components and materials that were generated during the demolition were surveyed to determine whether they could be released for unrestricted use (i.e., without regard for radiological constituents). Those items that did not meet the applicable release criteria were decontaminated and re-surveyed, or controlled as licensed material. A final status survey report was prepared, and the area, with the exception of the concrete pad, was released for unrestricted use in a license amendment.[8] The AAF concrete pad remains in place, and is addressed further in Chapter 5, below.

2.3.3 Building D203(G)

One area at the Newfield plant where source material was temporarily stored pending shipment or use is D203(G), also known as "G-Warehouse". G-Warehouse consisted, primarily, of open floor space to facilitate forklift movement, and a series of storage bays. However, operational and programmatic changes resulted in source materials being stored at locations within the SMC controlled area other than G-Warehouse. Because SMC no longer needed G-Warehouse to perform the primary activities authorized under License No. SMB-743, it was decommissioned.

Routine radiological surveillance of this area demonstrated that it was relatively free of residual radioactivity. Therefore, no remedial actions were necessary. In October of 2000, a final status

[7] Integrated Environmental Management, Inc., Report No. 94005/G-17172, "Final Status Survey of Haul Road", October 1998.

[8] Integrated Environmental Management, Inc., Report No. 94005/G-20187, "Demolition and Final Survey of the AAF Baghouse", November 2000,

survey of G-Warehouse was performed and documented.[9] The building was subsequently released for unrestricted use in a license amendment.

2.3.4 Building D203(A)

Another area where source material was received and temporarily stored pending shipment or use in D203(A), also known as "A-Warehouse". This building was constructed with a concrete slab floor and sheet metal siding and roof, and consisted, primarily, of open floor space to facilitate forklift movement, and a series of storage bays. When SMC no longer needed A-Warehouse to perform the primary activities authorized under License No. SMB-743, it was decommissioned.

Routine radiological surveillance of A-Warehouse indicated that it had become contaminated during use as a temporary storage location for radioactive materials awaiting shipment. The necessary remedial actions were performed, and a final status survey was conducted and documented.[10] The building was subsequently released for unrestricted use in a license amendment.

2.3.5 East End of the Storage Yard

The east end of the Storage Yard was used, at one time, to store ferrovanadium slag. However, placement of those materials often resulted in mixing with ferrocolumbium slag. Eventually, the two slag types were segregated, and the ferrovanadium slag pile was sold for beneficial re-use. The footprint of the pile was then excavated to remove all any remaining ferrocolumbium slag, with the excavated materials segregated within a single pile of soil/slag within the Storage Yard.

Soil sampling and walkover gamma surveys of the excavated area were performed and documented n 1999.[11] The soil sampling results were negative for residual radioactivity above the applicable release criteria, and the USNRC released the area for re-forestation.[12] On the other hand, the ambient exposure rates in the area, as a result of its proximity to the ferrocolumbium slag piles, were too high to permit measurement of residual radioactivity in non-sampled areas.

2.3.6 Building D111, D102 and D112

As part of a commitment made by SMC to the USNRC to continue on-going efforts to reduce the number and size of the existing restricted areas within the facility, in July of 2002, SMC began the

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[9] Integrated Environmental Management, Inc. Report No. 94005/G-16171, "Final Status Survey of G-Warehouse", November 2000.

[10] Integrated Environmental Management, Inc. Report No. 94005/G-16171, "Final Status Survey Report for 'A' Warehouse", October 1998,

[11] Integrated Environmental Management, Inc., IEM Report No. 94005/G-18198, "Soil Sampling/Survey of Storage Yard After Remediation", January 2000.

[12] Olivier, J. A., U. S. Nuclear Regulatory Commission, to D. R. Smith, "Former Storage Yard Area to be Reforested (TAC No L31310)", April 6, 2000.

decommissioning of the D111 Production Department, and the D102/D112 Production Department from that listing.[13] All work was performed in full compliance with the requirements of License No. SMB-743, and was approved, in advance, by the USNRC.

As of September 1, 2002, the work on this project is still on-going. However, when all remedial actions are complete, SMC will perform and document a final status survey that follows the guidance in NUREG-1575, "Multi-Agency Radiation Survey and Site Investigation Manual" (MARSSIM), and will enclose a copy of the final status survey report in an application to remove the three buildings from the listing of permanent restricted areas that currently appears on License No. SMB-743.

Because that application will be submitted to the USNRC shortly after the submission of this decommissioning plan, an immediate amendment to the Plan would be necessary. Therefore, for the remainder of this report, it will be assumed that Buildings D111, D102 and D112 were addressed in a *completed* decommissioning activity, and that they are no longer considered to be a permanent restricted area on License No. SMB-743.

2.3.7 Non-radiological Activities

Environmental investigations have been ongoing at the Newfield site since 1972, when the first hydrologic investigation was conducted to evaluate the source of hexavalent chromium, which had been detected in a nearby municipal water supply well. In addition, a series of subsequent ground water and surface water studies were conducted to evaluate potential environmental impacts associated with SMC facility operations. Under the October 1988 Administrative Consent Order (ACO) with NJDEP, SMC contracted the design and installation of a 400 gallon per minute groundwater pump and treat system to control off-site migration of hexavalent chromium. As a result of the October 1988 ACO and further discussions with the NJDEP, SMC commenced with the removal of all of the materials from the Storage Yard that were not regulated by the USNRC. The only materials that in the Storage Yard today are those that are under the USNRC's jurisdiction.

A remedial investigation/ feasibility study (RI/FS) was also initiated under the ACO to fully characterize and evaluate potential non-NRC environmental impacts associated with the site. The 1988 ACO had noted NJDEP's and SMC's disagreement regarding the hazardous waste status of chromium slag piles and solid waste status of other slags, dross and baghouse dusts stored at the facility. The ACO stated that the chromium slag pile area and general slag area had not been fully investigated and required that investigation and remediation of soil and ground water contamination at and emanating from these areas be performed during the RI/FS. The 1988 ACO also acknowledged that the site was regulated by the USNRC and, therefore, certain activities conducted pursuant to the ACO could require the approval of the USNRC in addition to the approval of the NJDEP.

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[13] Written communication from D. R. Smith, (Shieldalloy Metallurgical Corporation) to T. S. Sherr (U. S. Nuclear Regulatory Commission), "Intent to Terminate Source Material License No. SMB-743", August 27, 2001.

The RI report was completed in 1992, and several focused feasibility studies and supplemental investigations have been completed since then. A Record of Decision (ROD) was signed on September 24, 1996 which addresses the ground water remedial action.

In 1995, a series of six former wastewater treatment lagoons (designated as B-1, B-2, B-3, B-5, B-11 and B-12) were remediated and closed. The contents of the lagoons consisted of water and settled sludge containing metals (primarily chromium), generated from treatment, storage and settling/polishing stages of the treatment process. Remediation of these lagoons entailed the following primary activities:[14]

- Characterization of the sludge in each lagoon;
- Removal, treatment and discharge of standing water from each of the units;
- Demolition of associated pump houses, valve pits and piping with disposal of all generated wastes;
- Solidification, excavation and off-site disposal of the accumulated sludge, lagoon liner, and impacted underlying bedding material and soils;
- Collection and chemical analysis of confirmatory soil samples from each lagoon;
- Supplemental excavation and disposal of impacted soils located beneath portions of the lagoons; and
- Backfilling and restoration of final grade.

In 1994, a lagoon characterization investigation was conducted for three additional former wastewater treatment lagoons (B6, B7 and B8). The objectives of the investigation were to characterize the lagoons' contents, with respect to quantity and composition. Closure involved the treatment and removal of lagoon surface water, excavation and disposal of sludge, removal and off-site disposal of lagoon liners and contaminated soils, and backfilling and grading of the lagoon excavations. Approximately 2.5 million gallons of chromium hydroxide sludge were removed, dewatered and disposed as part of this remedial action, the details of which were captured in a 1999 report.[15]

[14]TRC Environmental Corporation, Closure Report, Surface Impoundments BB1, B2, B3, B5, B11 and B12, Liner and Contaminated Soil Removal and Disposal, dated April 1996 (revised August 2000)

[15]TRC Environmental Corporation, Closure Report, Surface Impoundments B6, B7 and B8, Liner and Contaminated Soil Removal and Disposal, April 1999.

2.4 Spills

No radiological spills have been reported over the history of the license. Non-radiological incidents are described in Section 8.4, below.

2.5 Prior On-site Burials

No burial of radioactive material, other than that described in Section 4.4, below, has been reported over the history of the license.

3 FACILITY DESCRIPTION

3.1 Site Location and Description

SMC's Newfield facility is located in the town of Newfield, Gloucester County, New Jersey. (A site location map is provided in Figure 18.1.) The primary portion of the site, consisting of the manufacturing facilities and their support areas, covers 67.7 acres. An additional 19.8 acres of farmland, located approximately 2,000 feet southwest of the primary site in Vineland, Cumberland County, New Jersey, are also owned by SMC.[16]

The primary site is bounded to the north by Conrail lines and to the west by East Boulevard. Woods, residential homes, and small businesses are present to the east of the site. The southern property line is bounded by the Hudson Branch and associated wetlands, just north of residences located along Weymouth Road. An unnamed pond is located in this portion of the Hudson Branch.[17] The majority of the site is surrounded by secure steel-wire fencing, except for a small portion of the property along the western property boundary which contains the facility parking lot. A detailed map depicting site boundaries and physical features of the plant is provided in Figure 18.2.

The topography of the Newfield Area is relatively flat, and the SMC facility is located on a slight topographic high (approximately 100 feet above mean sea level), with the ground surface generally sloping to the west-southwest, toward the Hudson Branch. The facility is comprised of three primary areas: (1) Manufacturing Area; (2) Undeveloped Plant Property (including the former Lagoon Area); and (3) Storage Yard, each of which is described as follows:

- Manufacturing Area - This area is characterized by presence of plant operations, offices, loading docks, and other facilities associated with former and present production operations (refer to Figure 18.2). The majority of this area is covered by buildings, other structures, asphalt or concrete. Much of this area has been evaluated with respect to potential environmental concerns including the former Manpro-Vibra Degreasing Unit; the Railroad Siding Area; the Department 102 Area; several areas associated with former underground storage tanks; and the Building 101(B) Glass Stack Area. Operations within the Manufacturing Area have been curtailed, with only limited manufacturing operations presently being performed on-site. Portions of the Manufacturing Area have been investigated, and several areas will be subject to remediation to address identified environmental impacts. In addition, this area also contains the Wastewater Treatment Facility, housed in Building 216 in the

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[16] This property has not been impacted by licensed operations other than as described herein.

[17] The Hudson Branch is a tributary to Burnt Mill Pond, from which the Burnt Mill Branch flows to the Maurice River. The Hudson Branch is an intermittent, slow-moving surface water body which flows from east to west adjacent to the site

southwestern corner of the site, which was installed to treat groundwater contaminated with hexavalent chromium and volatile organic compounds (VOCs). Treated groundwater is discharged to the adjacent Hudson Branch, subject to the requirements of a NJPDES Discharge to Surface Water Permit.

- Undeveloped Property - This area consists of several undeveloped strips of property, the majority of which extends along the southern portion of the property, and includes areas east and west of the Manufacturing Area. No buildings or other significant structures are present in this area. The extent of this area is depicted in Figure 18.2. Areas of potential concern that have been evaluated in this portion of the site include the Former Material Storage Area, the Drum Storage Area, the Former Chromium Button Storage Area, and the Tank T12 Chromium Wastewater Spill Area (site of a 1990 wastewater spill).

- Former Lagoon Area - This area occupied the central portion of the site and consisted of up to nine wastewater treatment lagoons. An unlined lagoon used to hold untreated process wastewater during the 1960s, was subsequently replaced with the nine smaller lined lagoons in which wastewater was treated for discharge. Over time, the wastewater treatment process was modified, and the lagoons were gradually phased out and closed. Final characterization, remediation, and closure of these lagoons were performed in the 1990s. Discussion of these closure activities was provided previously in Chapter 3, above.[18]

- Storage Yard - This area, which comprises about eight (8) acres of the eastern portion of the site, has historically been used to store by-product materials generated as a result of former manufacturing processes. A defined portion of this area has been designated a restricted area in License No. SMB-743. Currently, the Storage Yard contains a number of segregated piles, the layout of which is shown in Figure 18.3. A breakdown of the volumes of the various regulated material types is provided in Table 17.1.

3.2 Population Distribution

The property owned by SMC is located in part in three different communities and two counties; the Borough of Newfield, the City of Vineland, Franklin Township, and Gloucester and Cumberland Counties. Population distribution information is not available by town in Newfield or Franklin Township, therefore a comprehensive demographic listing was created by county. Current population information for the counties surrounding the site was obtained from the U.S. Census

[18] The former Lagoon Area is a relatively flat, open portion of the site and is predominantly covered by grass. Portions of this area are also presently used for temporary storage of equipment and non-regulated materials. Other portions of the Undeveloped Property portion of the facility are generally open and vegetated with grass and/or small shrubs and trees.

Bureau website. The City of Vineland maintains its own website, which includes projected population growth. These data are included in Table 17.2.[19]

3.3 Current/Future Land Use

Current land use in the general vicinity of the site has been determined through review of Master Plans and Zoning maps from the local municipalities, and contact with municipal officials. Specifically, the vicinity of the SMC site within a one-mile radius encompasses several municipal entities: Borough of Newfield, City of Vineland, and Township of Franklin. The site itself is zoned for heavy industry. Figure 18.4 depicts specific land uses within a one-mile radius, based on the following sources:

- Borough of Newfield Master Land Use Plan, February 1979;
- City of Vineland Master Plan, January 1992;
- City of Vineland Zone Map, January 1996; and
- Township of Franklin Zoning Map, April 2001.

Recent contact with municipal representatives indicates that land use planning has not changed substantially since the preparation of these documents. Figure 18.4 shows distribution of residential, business (i.e., commercial and industrial), and cultivation (i.e., agricultural) and woodlands. As can be seen from this figure, much of the region to the east of the site is zoned for residential use while much of that to the west/southwest is agricultural and/or undeveloped. Based upon the available information, no specific planned changes in future land use could be determined.

3.4 Meteorology and Climatology

The Philadelphia International Airport was chosen as a climatologically representative site. Philadelphia, like the Newfield, NJ site, is inland while other airports in the region are coastal and show coastal influences (e.g. sea breezes) that do not typically affect Newfield.

In the 2001 Local Climatological Data-Annual Summary with Comparative Data for Philadelphia, the National Oceanic and Atmospheric Association (NOAA) describes the climate of the region as being moderate:

> "The Appalachian Mountains to the west and the Atlantic Ocean to the east have a moderating effect on climate. Periods of very high or very low temperatures seldom last for more than three or four days. Temperatures below zero or above 100 degrees are a rarity. On occasion, the area becomes engulfed with maritime air during the

[19] Neither Newfield nor Franklin had projections on population growth, and a statistic for the entire state was not included because it would not necessarily be representative of these smaller communities.

summer months, and high humidity adds to the discomfort of seasonable warm temperatures.

Precipitation is fairly evenly distributed throughout the year with maximum amounts during the late summer months. . . . Single storms of 10 inches or more occur about every five years."

National Climate Data Center (NCDC) data were obtained for the years 1972 through 2001. These demonstrate an average annual temperature of 54.7 degrees Fahrenheit, and average annual precipitation of 40.81 inches, and an average amount of snowfall of 19.9 inches. The average annual relative humidity in the afternoon is 55 percent.

3.4.1 Winds

In the *Local Climatological Data-Annual Summary with Comparative Data,* NOAA states that: "The prevailing wind direction for the summer months is from the southwest, while northwesterly winds prevail during the winter. The annual prevailing direction is from the west-southwest. Destructive velocities are comparatively rare and occur mostly in gustiness during summer thunderstorms. High winds occurring in the winter months, as a rule, come with the advance of cold air after the passage of a deep low pressure system. Only rarely have hurricanes in the vicinity caused widespread damage, primarily because of flooding."

The following data from NCDC is based on climatological normals from 1961-1990. The mean annual wind speed is 9.6 miles per hour and the prevailing wind direction is 230 degrees (west-southwest). The maximum 2-minute wind speed of 51 miles per hour at 300 degrees (west-northwest) occurred in June 1998. The maximum 5-second wind speed of 71 miles per hour also occurred in June 1998, from the west-northwest.

3.4.2 Precipitation

The annual average amount of precipitation in the region of the Newfield facility is 41.41 inches. The normal amount of snowfall is 23.2 inches. The normals are based on NCDC data from 1961-1990. The average monthly precipitation is based on data from 1972-2001 and ranges from 2.68 inches in October to 4.25 inches in August.

Thunderstorms occur an average of 27.1 days each year. Snowfall greater than one inch occurs on an average of 6.4 days per year. The mean number of days with heavy fog (visibility less than or equal to ¼ mile) is 21.2.

The site is near the county lines of Gloucester to the east and Cumberland to the west therefore, storm data for both counties was obtained from NCDC. The period of record for the data is January 1, 1972 to April 30, 2002. In Gloucester County 4 tornadoes and 1 funnel cloud were reported during that time period. In Cumberland County 9 tornadoes and 1 tropical storm were reported for the same period.

3.4.3 Air Quality

The nearest Class I air quality area is the Brigantine Wilderness Area, located approximately 31 miles to the east of Newfield. The rest of the state is considered a Class II PSD (Prevention of Significant Deterioration) area. Cumberland and Gloucester Counties are classified as severe nonattainment areas for ozone, although the area is in attainment for all other National Ambient Air Quality Standards.

3.5 Geology and Seismology

3.5.1 Geologic Characteristics of the Site and Surrounding Area[20]

The Newfield site is located in the Atlantic Coastal Plain physiographic province. It is underlain by a thick sequence of unconsolidated materials, comprised of several distinct formations, which overly unconformably on bedrock.

Bedrock below the site consists of a banded, micaceous schist or gneiss of the Wissihickon Formation of Precambrian age. The formation primarily contains mica, quartz, feldspar, and chlorite, and the formation has numerous fractures and joints and folding of individual layers. This formation outcrops northwest of and outside of Gloucester County and, based upon average dip, the top of the formation is projected to be at a depth of over 2,000 feet below grade in the Newfield area. Relative to the overlying unconsolidated materials, the bedrock is not expected to be a significant water supply resource in the area both due to depth and comparatively low yield.

The unconsolidated materials underlie much of southern New Jersey and dip and thicken to the southeast. Therefore, the formations thin to the northwest and further thicken to the southeast of the site area. The Middle to Lower Cretaceous sediments are primarily continental deposits consisting of alternating layers of clay, silt, sand and gravel. The Upper Cretaceous and most Tertiary sediments were deposited in beach and shelf environments, and tend to be finer grained than continental deposits. Very fine grained sediments are recognized as transgressive marine deposits, which formed during major incursions of the sea. Coarsening-upward deposits that overlie the fine-grained units are recognized as marine regressions, deposited in inner-shelf, near-shore or beach environments as the ocean was retreating. The formations typically outcrop in sequential bands striking northeast-southwest, with the earliest deposits outcropping further to the west, near the Delaware River.

The deepest among the sequence of unconsolidated deposits are the Upper Cretaceous Raritan and Magothy Formations. Below the site area, the combined formation thickness is expected to be 500 feet or more. The Raritan Formation is composed of quartzose sand, clay, and some gravel; the Magothy Formation consists of beds of dark-gray to black clays alternating with micaceous fine sand. These formations represent a significant aquifer system in parts of Gloucester County,

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[20] "Special Report 30: Water Resources and Geology of Gloucester County, New Jersey", NJDCED, Hardt, W.F, and Hilton, G.S., 1969 and "Generalized Structural Contour Maps of the New Jersey Coastal Plain", Report 4, NJGS, Richards, H.G., Olmsted, F.H., and Ruhle, J.L., undated.

particularly to the northwest, closer to the outcrop area, but the water may be brackish below the site area.

The Raritan and Magothy Formations are overlain unconformably by Upper Cretaceous sediments of the Merchantville Formation. This is overlain, in turn, by the Woodbury Clay, the Englishtown Formation, the Marshalltown Formation, the Wenonah Formation, the Mount Laurel Sand, and the Navesink Formation.

The Merchantville Formation is described as a glauconitic micaceous silt or quartzose or glauconitic sandy clay (the composition varies within the county), and the thickness ranges from 45 to 70 feet. This formation is a minor aquifer within the county and, together with the overlying Woodbury Clay, acts as an aquaclude.

The Woodbury Clay is a dark blue to black clay (with some white sand streaks and marine fossils in some areas). The Woodbury Clay thickness in Gloucester County ranges up to 80 feet.

The Woodbury Clay is overlain unconformably by the Englishtown Formation, which is described as a fine-to-coarse-grained quartzose sand with local lenses of clay and occasional lignite, mica, and glauconite. In some areas the sand grades into clay and is indistinguishable from the overlying and underlying units. Fossil assemblages suggest both continental and marine origins. The Englishtown Formation is a minor aquifer in Gloucester County.

The Marshalltown Formation consists of a dark-green to black clay, sandy clay, and silt, with mica and glauconite in some areas. Marine fossils have been found in the formation. The formation acts as a confining layer for the underlying Englishtown Formation. The top of the Marshalltown Formation is expected to be at an elevation of approximately 800 feet below mean sea level in the Newfield area, or approximately 900 feet below grade level.

The Wenonah Formation conformably overlies the Marshalltown Formation. The Wenonah Formation and the Mount Laurel Sand are similar in composition and are mapped as a single unit in Gloucester County, although the Mount Laurel Sand is the predominant formation. The unit is composed of medium-to-coarse-grained quartz sands with varying percentages of glauconite.

The Navesink Formation conformably overlies the irregular surface of the Mount Laurel Sand and the Wenonah Formation. The formation consists of glauconitic sand and clay mixed with quartz sands, and can be clayey at the surface and pebbly at the base. The Navesink Formation and the overlying Hornerstown Sand function as confining layers.

The Navesink Formation is overlain unconformably by the Tertiary age Hornerstown Sand which is, in turn, overlain by Tertiary sediments of the Vincentown Formation, the Manasquan Formation, the Kirkwood Formation, and the Cohansey Sand.

The Hornerstown Formation is composed of clay and sand and can have significant percentages of glauconite. As noted above, this formation, along with the Navesink Formation, functions as a confining layer. The top of the Hornerstown Sand is at an approximate elevation of 600 feet below mean sea level in the Newfield area or approximately 700 feet below grade.

The Vincentown Formation can occur as a quartz sand with glauconite or a limey sandstone with shell fossils. It ranges up to 55 feet in thickness in Gloucester County. The Manasquan Formation is similar in composition to the Vincentown Formation, so is difficult to distinguish. The Manasquan sand can contain a high percentage of glauconite, and acts as a confining layer for the Vincentown Formation.

The Kirkwood Formation consists of clay, silt, and very-fine-to-coarse quartzose micaceous sand and represents only a minor aquifer in the county. The Kirkwood ranges in thickness from 50 to 100 feet.

The Cohansey Sand is composed of fine-to-coarse quartz sand, lenses of clay, and lenses of gravel and is approximately 130 feet thick in the Newfield area. Grain size varies both vertically and laterally, which is consistent with deposition within a coastal environment. The Cohansey Sand is the second most productive aquifer in the county. The Cohansey Sand below the site is composed of coarse sands and little to trace silt in the upper 40 feet, and generally finer sand and some silt, with some clay and silt stringers in the lower 60 to 80 feet. Discontinuous silt and clay lenses, up to 6 feet in thickness, were encountered. The Kirkwood Formation, described as a gray silt and clay layer, was encountered at a depth of 120 feet below grade in one of the well borings.

The Pleistocene Bridgeton Formation unconformably overlies the Cohansey Sand and is overlain by other sediments of Pleistocene age, including the Pensauken and Cape May Formations. The Pensauken and Cape May Formations, although present in parts of Gloucester County, are not expected to be present in the site area.

The Bridgeton Formation is composed of fine-to-very coarse quartz sand and gravel possibly of glacial or interglacial origins. The Bridgeton Formation reveals itself at the SMC site as a brown sand. Its thickness ranges from 0 feet in the vicinity of well SC-17D to 28 feet in the vicinity of well SC-12D (see Appendix 19.1). In the area of the site it is expected to be hydraulically connected to the underlying Cohansey Sand. Ground water in the Bridgeton Formation is expected to be under water table conditions.

Erosion, deposition, cutting, and filling have altered the landscape in and around the site area. Such actions may expose the Cohansey Sand at the surface where the Bridgeton Formation has been removed. Reworked sediments of the Bridgeton Formation and the Cohansey Sand may be present in stream valleys and floodplains.

3.5.2 Tectonic History

The Newfield site is located above a thick sequence of unconsolidated sediments which lie unconformably upon Precambrian age bedrock. To the north and west of the site lies the Newark Basin which was an active post-Devonian age rift zone. The Ramapo fault and the associated fault zone lie at the approximate western edge of the rift zone, approximately 80 miles north of the site area. The Newark Basin is filled with sedimentary and igneous rock of Triassic and Jurassic ages, including sandstone, siltstone, shale, conglomerates, basalts and diabases. Thrust faults to the north of Philadelphia (possibly a Precambrian suture zone) separate the Newark Basin sediments from the Precambrian bedrock which underlies the site. The attached geologic map of the Newark Quadrangle presents the underlying bedrock structural geology that might influence the tectonics of the site area.

According to NJGS Report 31, "New Jersey is not especially prone to earthquakes and has had no major earthquakes within the last several hundred years."[21] New Jersey is 2,000 miles from the Mid-Atlantic Ridge, the nearest plate boundary. Historical earthquakes felt in New Jersey are caused by fault movements within the North American tectonic plate (not at the plate boundary). The reference cites three general areas of seismic activity that can be felt by seismographs in New Jersey, these include:

- Several northeast-trending faults in north-central New Jersey and New York, of which, the Ramapo fault is the most active. The Ramapo fault is approximately 80 miles north of the site.

- In the Delaware Valley between Trenton and Wilmington and in the Wilmington area. Trenton and Wilmington are 50 miles north and 30 miles west from the site, respectively, and the valley trends northeast-southwest approximately 25 miles northwest of the site.

- Subsidence in the Raritan Bay, which has caused tremors in that area. The Raritan Bay is approximately 80 miles to the northeast of the site.

3.5.3 Regional Tectonic Map

New Jersey is 2,000 miles from the Mid-Atlantic Ridge, the nearest plate boundary. Appendix 19.1 shows the epicenters of earthquakes recorded or felt in New Jersey.[22] Appendix 19.1 summarizes those earthquakes with magnitude of 3 or greater or Mercalli intensity of IV or greater centered within 200 miles of the site which were felt in New Jersey.

[21]"Catalog of New Jersey Earthquakes through 1990", NJGS Report 31, 1992; "Geologic Map of the Newark 1 x 2 degree Quadrangle, New Jersey, Pennsylvania, and New York", USGS MI Map I-1715, Lyttle, P.T., and Epstein, J.B., 1987.

[22]Copied from "Catalog of New Jersey Earthquakes through 1990", NJGS Report 31, 1992.

3.5.4 Structural Geology

The Newfield plant area is characterized by a thick sequence of unconsolidated materials which overly unconformably on bedrock at a depth of over 2,000 feet below grade. The unconsolidated materials underlie the entire county and dip and thicken to the southeast. Figures in Appendix 19.1 depict the sedimentary sequence.[23]

3.5.5 Crustal Tilting, Subsidence, Karst Terrain, Landslides, and Erosion

Metamorphic and igneous bedrock is present below the Newfield site at considerable depth (see 3.5.1, above). Subsidence, either due to collapse of karst terrain or fault movement related to underlying bedrock is not believed to be a significant concern in the area.

The surficial materials in the vicinity of the site consist of sands, silts, and gravels (Bridgeton Formation and Cohansey Sand). Relief on the site and in the immediate vicinity of the site is slight. Excluding the slag piles, relief depicted on the USGS 7.5-minute topographic map of the area (Newfield Quadrangle, 1994) is on the order of 20 feet or less across the entire site (between 85 and 105 ft NGVD 1929). Local land surface highs are depicted at 130 ft NGVD 1929 (3,000 feet north of the site) and 140 ft NGVD 1929 3,000 feet east-southeast of the site. Because of the low relief and low seismic potential in the area, landslides are not believed to be a significant concern in the site area.

The site is located near the source of the Hudson Branch, the small stream which crosses the southeastern corner of the property. The sandy surficial materials and low relief would be expected to allow infiltration of precipitation in undeveloped areas surrounding the site, consequently, the potential for stormwater movement to cause erosion of surficial materials appears to be slight. After the site is decommissioned and buildings are removed, the overall area of impermeable surface may be reduced, decreasing runoff from the site during and immediately following storm events.

With respect to off-site stormwater crossing the site via the Hudson Branch, the site is located in the upper portion of the drainage area. The 100-year flood zone mapped by the Federal Emergency Management Agency (FEMA) includes a cross section of 100 to 120 feet across the Hudson Branch near the site.[24]

[23] Copied from "Special Report 30: Water Resources and Geology of Gloucester County, New Jersey", NJDCED, Hardt, W.F, and Hilton, G.S., 1969; "Generalized Structural Contour Maps of the New Jersey Coastal Plain", Report 4, NJGS, Richards, H.G., Olmsted, F.H., and Ruhle, J.L., undated.

[24] "Remedial Investigation Technical Report", TRC Environmental Consultants, Inc., 1992; "Flood Insurance Rate Map and Street Index, Borough of Newfield, New Jersey", FEMA, 1982.

3.5.6 Geologic Characteristics (Surface and Subsurface)

The dominant subsurface geologic characteristic of the site is the large sequence of unconsolidated materials which underlie the site. This dominant feature influences landform, drainage, and water supply availability.

3.5.7 Geomorphology

The deposits of the Bridgeton Formation, possibly of glacial or interglacial origins, rest unconformably on the Cohansey Sand. Surface drainage across these sands during deposition and post-deposition has carved small stream valleys throughout the area, possibly exposing the Cohansey Sand in the stream valleys.

3.5.8 Faults

The nearest mapped fault of seismic significance is the Ramapo fault, located approximately 80 miles to the north of the site. The locations of faults mapped in bedrock to the north and west of the site are documented.[25]

3.5.9 Deformation

Published descriptions of the Precambrian Wissaihickon Formation, which underlies the Newfield site at a depth of over 2,000 feet, indicate that nearer the outcrop area the formation contains fractures, joints, crumpling, and folding. Future deformation of bedrock or the unconsolidated sequence above bedrock at this site is not a significant concern due to the low anticipated seismic potential and the considerable sequence of unconsolidated materials underlying the site and between the site and the bedrock surface.

3.5.10 Man-Made Geologic Features

Fill material has likely been placed along roadways and stream crossings, and the landform at the site and that of surrounding properties may have been modified by cutting and filling.

To the northeast, and bordering the SMC property, is the former Newfield municipal landfill. Aerial photographs from 1962-1986 identify a landfill, which at its largest covered 1.2 acres (estimated on the basis of those photographs. The USGS topographic map of the area does not show any significant change in relief which would suggest the presence of a landfill.

3.5.11 Seismicity

The seismic potential of the area is considered to be low, as described previously. Appendix 19.1 contains a listing of historical earthquakes.

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[25] "Geologic Map of the Newark 1 x 2 degree Quadrangle, New Jersey, Pennsylvania, and New York", USGS MI Map I-1715, Lyttle, P.T., and Epstein, J.B , 1987.

3.6 Surface Water Hydrology

3.6.1 Site Drainage and Fluvial Features

During periods of increased precipitation, the Hudson Branch originates as far as 300 feet east of the site. At present, under normal conditions, the "headwaters" of the Hudson Branch are located approximately 300 feet, from the toe of the Storage Yard, in a marsh area in the southeast corner of the SMC property (see Figures 18.2and 18.8). The Hudson Branch flows westward through portions of the property and along the southern property boundary.

Historically the site included three permitted discharge outfalls. Outfall 001 historically included discharges of remediated ground water and treated stormwater, stormwater from a portion of the Borough ofNewfield north of the SMC site, and non-contact cooling water (which was later rerouted to Outfall 002). Outfall 002 historically included discharges of stormwater and non-contact cooling water. Outfall 003 included discharges from an employee parking lot and industrial areas (laboratory and maintenance department).

Modifications made to site drainage, however, have resulted in the presence of only two stormwater outfalls associated with discharges from the SMC facility, of which only one qualifies as a permitted outfall. Former Outfall 001 still conveys stormwater from off-site Borough ofNewfield sources into the Hudson Branch but does not include any facility-generated waters or stormwater. A 36-inch diameter pipe from Newfield Borough enters the SMC facility at the northern property line, crosses the SMC facility from north-to-south, and discharges into the Hudson Branch at this former outfall location. Existing Outfall 002 now conveys a combination of stormwater, non-contact cooling water, and treated water from the on-site ground water treatment system. A small man-made ponded area has been constructed immediately upstream of this outfall. Flows are recorded at an H-flume located at the outfall. While facility stormwater is still discharged at former Outfall 003, activities within the drainage area have been modified such that there is no longer a potential for industrial stormwater impacts.

The Hudson Branch joins the Burnt Mill Branch approximately 6,500 feet southwest of the site. An approximately 15-acre pond (Burnt Mill Pond) has formed at the confluence of the Hudson Branch and Burnt Mill Branch . The Burnt Mill Branch joins the Maurice River an additional 9,000 feet southwest of Burnt Mill Pond.

The historical configuration of the Hudson Branch and tributaries in the immediate site area has changed since the development of the site. A review of historic aerial photographs indicates the characteristics of the Hudson Branch during the period when the facility was used for glass manufacturing (based on a 1940 aerial photograph), and changes in the characteristics of the Hudson Branch as the site was further developed (based on 1951, 1962, 1965, 1974, 1977 and 1986 aerial photographs). The 1940 aerial photograph shows the Hudson Branch as originating in the same area east of the facility, although it appears that drainage from an area east of the facility but north of the railroad track may contribute to the Hudson Branch headwaters. The existing ponded area south of the facility is not apparent in the 1940 photograph. The 1940 aerial photograph also indicates the presence of a drainageway which enters the Hudson Branch near the location of current Outfall 002. The drainageway extends to the north-northeast through mostly undeveloped land that is currently the center of SMC's production area. The drainageway continues to the railroad tracks along the northern edge of the facility and it appears that drainage from an area north of the railroad tracks (as far north as Catawba Avenue) may also contribute to this drainageway.[26]

The upstream drainage area of the Hudson Branch (upstream of a point adjacent to the slag piles on site) is estimated at 0.55 square miles, of which approximately 95% of the area is only sparsely undeveloped. Ground water discharge is the source of the Hudson Branch in times of no or low precipitation. In addition, the outfalls reportedly represent a major portion of the flow of the Hudson Branch in the vicinity of the site. The initial results of a 1993 study indicated that there is no hydraulic connection between the Hudson Branch and the Maurice River during low-flow conditions; in fact, during the study the flow in the Hudson Branch steadily decreased until there was no measurable flow immediately upstream of Burnt Mill Pond.[27]

When the level of the Hudson Branch rises in response to precipitation, the surface water may discharge to the adjacent aquifers in some areas. Runoff during storm events at the site has been observed to cause flooding of the Hudson Branch in a marsh area at the southwest corner of the site, approximately 900 feet downstream of the slag piles.

The channel of the Hudson Branch on site and adjacent to the site varies in size and ranges from 10 to 20 feet wide and one to three feet deep. During typical flow conditions, the Hudson Branch channel is approximately 300 feet from the slag piles.

3.6.2 Water Resources Data

There are no stream gaging stations on the Hudson Branch or the Burnt Mill Branch downstream of the site. The closest downstream gaging station is located on the Maurice River at Norma, New Jersey, approximately 9,000 feet downstream of the confluence of the Burnt Mill Branch and the Maurice River (4 miles southwest of the site).

3.6.3 Topographic Maps

A copy of information available on the USGS Newfield Quadrangle (photo revised 1994), as reprinted from CD ROM, is shown in Appendix 19.1.

3.6.4 Surface Water Bodies

See Section 3.6.1 above.

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[26] "Remedial Investigation Technical Report", TRC Environmental Consultants, Inc., 1992; Draft Final Feasibility Study Report, TRC Environmental Corporation, April 1995.

[27] "Evaluation of Fate and Transport of Chromium and Total Dissolved Solids in the Hudson Branch-Burnt Mill Branch Tributaries to Maurice River", Environmental Resources Management, Inc., November 6, 1995

3.6.5 Water Control Structures and Diversions

There are no known surface water diversions in the Hudson Branch or the Burnt Mill Branch downstream of the site. The same is true upstream of the convergence with the Maurice River.

Ground water is the primary source of domestic, agricultural, community, and municipal water supplies in the area of the site. Public wells are in the range of 150 to 200 feet deep (probably within the Bridgeton/Cohansey Formation); the depths of private wells vary. Ground water would appear to provide a good quality and reliable quantity of water at an economical depth, whereas it is assumed that surface water is a less reliable source.

The maps in Appendix 19.1 show the locations of water-supply wells within one mile of the site (as of 1994 and additional research conducted in 2001) and the area of a water-supply well restriction area located downgradient of SMC as of 1986.[23] The 2001 survey identified 13 water wells with permitted daily withdrawals of 100,000 gallons or more per day within a one-mile radius search area, which included the site (five of which are owned by SMC). Two wells within the area were listed as owned by the Borough of Newfield and were confirmed to be in use at the time of the survey. The nearest City of Vineland municipal well is outside of the search area, approximately 1.5 miles west of the center of the search area. The table included in Appendix 19.1 lists the addresses of well permits in the one-mile radius search area.

3.6.6 Flow Duration Data

There is no stream flow gaging station on the Hudson Branch, although flow rates in the Hudson Branch have been characterized by a number of studies. There are a number of limitations and apparent inconsistencies in the data, probably owing to seasonal variations in recharge/discharge relationships, local withdrawals, precipitation, etc.

Woodward-Moorhouse & Associates, Inc. (WMAI) conducted a study in 1974, before ground water extraction and treatment was initiated. They reported flows of 225 gpm near Outfall 001, 290 gpm at the culvert under West Boulevard and 360 gpm just upstream of West Arbor Avenue.

Stream flow rates were measured as part of Dan Raviv Associates, Inc. (DRAI) studies conducted in November 1983, June 1988 and April 1989.[24] These studies were all conducted during the period that ground water extraction and treatment was occurring at a rate of approximately 80 gpm. Therein, it was reported that Outfall 001 discharge rates were in the range of 250 to 350 gpm and Outfall 002 discharge rates were approximately 50 gpm during this period. The stream flow rates (in gpm) measured during this period are summarized in Table 17.3.

[23] Personal communication w/Paul Horner, City of Vineland Water-Sewer-Utility Department on 08/09/02; and TRC file information.

[24] "Modification of Surface Water Discharge Permit", Dan Raviv Associates, Inc., August 1988.

DRAI interpreted the WMAI results and the results presented above, in combination with field observations and ground water quality information, as indicating that the upper segment of the stream (Segment 1), from the headwaters of the Hudson Branch to just upstream of Outfall 001, is intermittent. Segment 2, which continues from Segment 1 to West Boulevard, was characterized as an area in which the stream recharges the ground water or there is a significant difference in the stream gradient and storage compared to other segments of the stream. The second explanation is described as being more probable, since no indication of stream loss (i.e., mounding) was observed in the water levels of nearby monitoring wells. Segment 3 continues downstream from West Boulevard to prior to sampling station 8, with this portion of the stream described as a "gaining" segment (i.e., there is a contribution from ground water to the stream). Segment 4, continuing downstream from sampling station 8 to West Arbor Avenue, is described as an area in which stream recharge and ground water discharge appear to be in equilibrium. [DRAI, 1988a and DRAI, 1990]

While the descriptions presented above have been referenced in subsequent environmental reports, there are other factors which must be considered in their utilization. These are:

- The data do not support the conclusions as unequivocally as they are stated in the reports. For example, while the 1983 and 1988 data indicate a reduction in flow between West Boulevard and Weymouth Road, the 1989 data indicate a 920 gpm increase in flow over this segment. Furthermore, the 1988 data from West Boulevard to sampling station 8 indicate an overall decrease in flow in this stretch which is described by DRAI as a "gaining" segment.

- The data indicate the potential for errors in flow estimates. Again, the 1989 data for the segment between West Boulevard and Weymouth Road indicate a 920 gpm increase in flow over a distance of approximately 500 feet. There are no known direct discharges to the stream within this segment and it is highly unlikely that ground water would be discharging to the stream at such a rate. Therefore, it is likely that an inaccurate estimation of stream flow velocity or stream cross-sectional area is responsible for the suspect results. Other errors in such calculations could impact other estimated flow rates and result in inaccuracies in the hydrologic evaluation of the stream.

- The evaluation did not account for the potential impacts of precipitation events on flow rates, nor did it consider ground water table elevations immediately adjacent to the stream. Existing monitoring wells are not located immediately adjacent to the stream and may not be screened over a sufficiently shallow interval to reflect the true water table elevation.

- The data reflect surface water flow characteristics during a period when the treatment system was operating at a rate of 80 gpm and outfall flows totaled 300 to 400 gpm. This data may not reflect current conditions where ground water is being extracted at a greater rate and outfall discharges are likely to exceed the 1988 rates, based on the treatment of ground water (and its subsequent discharge into the Hudson Branch) at approximately 400 gpm.

Studies conducted by DRAI from August 1991 through May 1992 provided monthly flow rate information for the Hudson Branch. These studies were conducted during a period when the ground water treatment system was operating at a typical rate of 200 gpm. The flow rates measured in the Hudson Branch were significantly reduced from those estimated in previous studies. Flows measured at Weymouth Road (sampling station 4) and at sampling station 8 were less than 25 gpm for all monthly measurements except for those made in February 1992. Again, the flow data did not unequivocally support DRAI's previous interpretation of the inter-relationship between ground water and surface water.[25]

A 1995 study conducted by Environmental Resources Management, Inc. included the collection of flow measurements at nine locations on the Hudson Branch, Burnt Mill Branch and Maurice River during a low-flow period (autumn 1993) and a high-flow period (spring 1995).[26] As with previous studies, flow measurements were collected by measuring flow depth and velocity. The flow rate was then determined by multiplying the velocity by the estimated cross section. The ground water treatment rate during the study period approximated 400 gpm.

During the autumn 1993 portion of the study, the flow in Hudson Branch decreased from Outfall 001 to the confluence with Burnt Mill Pond, with no measurable flow immediately upstream of Burnt Mill Pond. Reductions in flow were consistently measured both from Outfall 001 to Weymouth Road and from Weymouth Road to ERM's downstream sampling station 8 (which was located in the same general area as DRAI's sampling station 8).

During the spring 1995 study, variable flow rates in upstream portions of Hudson Branch were measured. Periods of relatively constant flow, periods of steady flow decreases and one period of steady increases in flow were observed. For the portion of the stream between Outfall 001 and Weymouth Road, reductions in flow rate were observed during every monitoring event but one. For the portion of the stream between Weymouth Road and sampling station 8, flow reductions were measured during four events, flow increases were measured during three events, and relatively constant flows (i.e, within a range of plus or minus 10 gpm) were measured during three events. In the area immediately upstream of Burnt Mill Pond, measurable rates of flow were present during the first half of the spring 1995 portion of the study, but flow was not measurable during the second half of the study period.

[25] Dan Raviv Associates, Inc., 1991.

[26] "Evaluation of Fate and Transport of Chromium and Total Dissolved Solids in the Hudson Branch – Burnt Mill Branch Tributaries to Maurice River", Environmental Resources Management, Inc., November 1995.

An evaluation of the flow rates estimated during the ERM study in combination with the analytical parameters (i.e., chromium and TDS concentrations) further demonstrate that a more complicated situation is present with respect to the ground water discharge/surface water recharge areas along the Hudson Branch. Areas which may exhibit surface water gain during some times of the year may exhibit surface water loss during others. Areas of surface water loss would be expected to exhibit a loss of flow, with no significant change in chromium or TDS concentration. However, contradictory indications were often observed, such as a measured reduction in surface water flow in combination with an increase in chromium levels.[27]

As described in Section 3.6.1, modifications have been made to site drainage since these Hudson Branch studies were conducted. While no net change in total discharge volume has resulted from these modifications, the individual outfall locations at which the discharges occur, specifically with respect to Outfalls 001 and 002, have changed.

3.6.7 Aerial Photography of the Site

An aerial photograph of the site showing the approximate 100-year floodplain of the Hudson Branch, generated from Federal Emergency Management Agency (FEMA) publications, is included in Appendix 19.1. That figure also shows the separation between the slag piles and the Hudson Branch.

3.6.8 Existing and Planned Surface Water Uses

There are no known or planned surface water diversions in the Hudson Branch or the Burnt Mill Branch downstream of the site and upstream of the convergence with the Maurice River.[28]

3.6.9 100-Year Floodplain

Appendix 19.1, generated from Federal Emergency Management Agency (FEMA) publications, contains the predicted extent of the 100-year flood plain at the SMC site.

3.6.10 Man-Made Changes

The SMC site and the town of Newfield, which is located adjacent to the site and to the north, are partially covered with impermeable materials (buildings and pavement) which would result in increased runoff as compared to undeveloped land. The topographic map of the area (see Appendix 9.1) indicates a likely drainage divide north of the center of the town so that drainage would be directed to both the Mill Branch (north) and the Hudson Branch (south).

Development of the site caused some modification of drainage features at and near the site. Other man-made changes which may influence the surface water flow include: roadway runoff during storm events, culverts below roadways which may restrict flow in significant flood events, and non-

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[27] Draft Final Feasibility Study Report, TRC Environmental Corporation, April 1995.

[28] Personal communication w/Paul Horner, City of Vineland Water-Sewer-Utility Department.

stormwater discharges (such as the non-contact cooling water and associated discharges from the SMC site) into the Hudson Branch which add to the base flow of the stream.

3.7 Groundwater Hydrology

3.7.1 Saturated Zone

The Cohansey Sand is the major geologic formation identified in the wells drilled below the site. The Cohansey Sand dips southeast about 11 feet per mile and is about 130 feet thick at Newfield, New Jersey. It is a water table aquifer with depths to ground water ranging from 4 feet in the southern portion of the site to 16 feet in the northern portion. The Cohansey Sand below the site is composed of coarse sands and little to trace silt in the upper 40 feet, and generally finer sand and some silt, with some clay and silt stringers in the lower 60 to 80 feet. Discontinuous silt and clay lenses, up to 6 feet in thickness, were encountered. The Kirkwood Formation, described as a gray silt and clay layer, was encountered at a depth of 120 feet below grade in one of the well borings.

3.7.2 Monitoring Wells

Tabular summaries of the SMC monitoring wells located at and surrounding the site are shown in Tables 17.5 And 17.6. A monitoring well location map (Figure 18.5) and representative ground water level elevation contour maps (Appendix 19.1) are also included.

3.7.3 Ground Water Flow Directions and Velocities

The ground water flow directions in both the water table and lower Cohansey Sand closely correspond to the general topography of the site, which slopes towards the southwest. A downward hydraulic gradient was observed at most of the well clusters across the site. Due to the smaller grain size and increased percentage of silt and clay, the transmissivity of the lower Cohansey Sand is lower than in the upper Cohansey Sand. The average linear shallow ground water flow velocity was calculated at approximately 1 to 3 feet per day.[29]

3.7.4 Unsaturated Zone

Test boring and monitoring well drilling at the site identified primarily fine to coarse sands and gravels in the unsaturated zone at the site; these sediments are likely to be representative of the Bridgeton Formation. The thickness of the unsaturated zone ranges from 0 feet at the Hudson Branch to approximately 17 feet below the northwest portion of the site. The depth to ground water ranges between approximately eight and 15 feet below grade in the vicinity of the slag piles.

3.7.5 Monitor Stations

Figure 18.5 depicts the groundwater monitoring well locations that are present on the Newfield site.

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[29] "Ground Water Remedial Alternatives", Dan Raviv Associates, Inc., 1988; "Remedial Investigation Technical Report", TRC Environmental Consultants, Inc., 1992.

3.7.6 Physical Parameters

The hydraulic characteristics for the Cohansey Sand at the SMC site were determined in previous investigations and are summarized in Tables 17.7 and 17.8. These investigations have determined separate transmissivities and specific yield values for both the shallow (water table) and deep (lower Cohansey Sand). These values were averaged from four aquifer tests performed for SMC, as well as from two tests conducted during development the Newfield supply well adjacent to the site (to the northwest):[30,31] Vertical hydraulic conductivities of 0.006 to 3 gpd/ft^2 were calculated at locations across the site.[32]

3.7.7 Numerical Analysis Techniques

Numerous investigations and on-site and off-site hydraulic tests have been performed over the past 30 years associated with the investigation and remediation of ground water contaminated with chromium and volatile organic compounds. The information from the report, "Summary of Geohydrologic Information Collected Since January 1988" (Dan Raviv Associates, Inc., April 1990), shown in the attachments summarizes those results and the data analysis. Computer modeling of the ground water flow system was performed and documented in the report, "Ground Water Remediation Alternatives" by Dan Raviv Associates, Inc. (January 1988).

3.7.8 Distribution of Radionuclides

Several quarterly radiological ground water sampling events were performed from December 1988 through January 1990 utilizing the following onsite monitoring wells: W3 (representative of background conditions), and W2, SC11, SC12, and SC13 (representative of conditions in the vicinity of the Storage Yard), and A (generally downgradient of the Storage Yard and near the downgradient property line. The purpose of the radiochemical sampling was to determine if thorium and uranium, which occurs naturally in some of the raw materials used at the facility, and thus in some of the slag, had impacted ground water. As thorium and uranium decay naturally, energy is released in the form of alpha and beta emissions, measured in picocuries per liter (pCi/l). Both filtered and unfiltered ground water samples were analyzed to determine the influence of suspended versus dissolved solids on ground water quality.

Screening levels established by the USEPA for acceptable concentrations for community drinking water systems are 5 and 50 pCi/l for gross alpha and gross beta, respectively. The highest level of gross alpha was 10 pCi/l and was found at monitoring wells SC12 and SC13 in the vicinity of the slag piles. The highest level of gross beta was 530 pCi/l at SC13. In addition, there were

[30] Woodward-Moorhouse & Associates, Inc , "Preliminary Report Groundwater Contamination Study Phase II", September 12, 1974.

[31] Roy F. Weston, Inc., "Hydrogeologic Investigation of Ground Water Contamination" Interim Report, February 1972.

[32] "Evaluation of Remediation Alternatives", Dan Raviv Associates, Inc., January 1988; "Remedial Investigation Technical Report", TRC Environmental Consultants, Inc., 1992.

exceedences of the gross alpha screening levels found at SC11, while W2, W3, and A were consistently below the screening levels for both gross alpha and beta. Wells SC11 and SC12 exhibited exceedences of the screening level for gross beta, although these results were lower than at SC13. Greater concentrations of gross alpha or beta were not consistently found in the unfiltered samples, as compared to the filtered samples. Therefore, the suspended sediment in the ground water does not contain significant levels of gross alpha or beta. (It should be noted that the method detection limits for gross alpha and beta analysis varied depending on the amount of suspended solids in each sample, and the error range generally increased as the detection of analytes increased.)

The results of this investigation indicate the presence of radionuclides in the wells in the immediate vicinity of the Storage Yard. However, those wells to the west and downstream of the Storage Yard are below the USEPA screening levels.[33]

3.8 Natural Resources

3.8.1 Potable, Agricultural, or Industrial Ground or Surface Waters

Ground water is used for local water supply by municipal and private wells. The attached maps show the locations of water-supply wells within one mile of the site (as of 1994). There are no known or planned surface water diversions along the Hudson Branch or Burnt Mill Branch downstream of the site and upstream of the Maurice River for water supply or other purposes.

3.8.2 Economic, Marginally Economic, or Sub-economic Known or Identified Natural Resources[34]

According to Daniel Dombrowski of the New Jersey Geologic Survey, there are no known mineral, fuel, hydrocarbon, or other natural resources in the area surrounding the site, with the possible exception of sand or gravel. (Personal communication, 7/29/02). This information is validated in addition by the Geologic Map of New Jersey, which identifies the formations surrounding the site as layers of gravel, sand, silt, and clay. This geologic formation, referred to as the Coastal Plain, "has been mined in the past for bog iron, glass sand, ceramic and brick titanium.... The mineral glauconite for use in fertilizer, and titanium....Today the Coastal Plain sediments continue to supply glass sand, and are extensively mined for construction material. The sand formations are productive aquifers and important ground water reservoirs."[35] Specific listings of mineral resources were not available.

3.8.3 Mineral, Fuel, and Hydrocarbon Resources Near and Surrounding the Site

There are no mineral, fuel, or hydrocarbon resources in the area other than sand and gravel. Mining of sand and gravel beyond the property boundaries in the future should not affect the dose estimates.

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[33] "Quarterly Radiochemical Ground Water Sampling;" reports from 1988 – 1990, Dan Raviv Associates, Inc.

[34] As defined in U.S. Geological Survey Circular 831

[35] From USGS website, www.usgs.gov/

3.9 Ecology/Endangered Species

3.9.1 Commercially or Recreationally Important Invertebrate Species Known to Occur within 5 km of the Site

An inquiry has been made to the Office of Natural Lands Management for a search of the Natural Heritage Database for information on commercially- or recreationally-important species in the vicinity of the Newfield site.[36] The inquiry included the location of the SMC property, its Plane Coordinates, and a USGS quadmap showing the outline of the premises.

3.9.2 Commercially Important Floral Species Known to Occur within 5 km of the Site

According to Jim Johnson, Cumberland County, NJ Agricultural Extension Agent, no native species in New Jersey are harvested for commercial use.

3.9.3 Commercially or Recreationally Important Vertebrate Animals Known to Occur within 5 km of the Site

Refer to Section 3.9.1. Farm animals, domestic animals, and game animals may be present in the vicinity of the site.

3.9.4 Estimates of Relative Abundance of Both Commercially and Recreationally Important Game and Non-game Vertebrates

Refer to Section 3.9.1. No specific information regarding the relative abundance of commercially and recreationally important game and on-game vertebrates could be determined that the time of this Plan's development.

3.9.5 A List of All Endangered Species at or within 5 km of the Site

In 1994, an endangered and threatened plant species survey and stressed vegetation survey were conducted by Amy S. Greene Environmental Consultants, Inc. as part of the remedial investigations for the site. This investigation included a field-based survey as well as database research through NJDEP's Office of Lands Management, Natural Heritage Program. Results of those activities indicated that although habitats specific to several species of concern existed in the vicinity of the site, no specimens of the listed species were identified on the site. A copy of the final report is provided in Appendix 19.1.

More recently, in preparation for this Decommissioning Plan, an updated report of endangered and threatened species was requested from the Natural Heritage Program. The Landscape Project database (Version 1.0) search results show that suitable habitat patches of emergent wetland, forest, and forest wetland occur on the SMC site, however, it identified no records for rare or endangered plants, animals, or natural communities in those habitat areas. A copy of the letter report which presents the result of the research is provided in Appendix 19.1. The report includes list of rare species from records in the Natural Heritage Data Base in the general vicinity of the site, as well as

[36] Office of Natural Lands Management, Natural Heritage Program, PO Box 404, 22 South Clinton Avenue, Trenton, NJ 08625-0404.

lists of rare species and natural communities that have been documented from Gloucester and Cumberland Counties.

4 RADIOLOGICAL STATUS OF THE FACILITY

4.1 Contaminated Structures

The Newfield plant is divided into three functional areas, plus administration facilities. These are the manufacturing area, the Storage Yard, and other undeveloped plant property. The following are brief description of each functional area:

- Manufacturing Area - This area contains a number of operations facilities, offices, and loading docks. For the most part, the area is covered with buildings and asphalt or concrete pavement. Included are the Railroad Siding Area, Department 111 (ferrocolumbium operation), Department 102 (former aluminothermic reduction operation), Department 112 (crushing operations), Department 107 (induction melting) Department 101 (metal grinding operations), Department 115 (aluminum master alloys), Department 116/118 (metal powder compaction operations), Department 203 (warehouse operations), and Department 204 (maintenance operations).[37,38]

- Storage Yard - This area is located on the eastern portion of the property, and is used to store materials generated during manufacturing operations. Slag generated during the ore processing procedures is stored in this area, as is baghouse dust and excavated soils.

- Other Undeveloped Plant Property - This area is located along the southern plant property boundary, and includes all undeveloped and unused areas of the plant.

By far the preponderance of the Newfield site has either never been impacted by licensed operations, or has already been free-released. The former includes the visitor center, administrative offices, Department 107, Department 101, Department 115, Department 116/118, Department 203, and Department 204, all of which have never housed licensed materials. The following is a listing of those structures or facilities that were, at one time, impacted by licensed operations, but that have since been remediated, as necessary, with final status surveys performed and documented, and the facilities subsequently released for unrestricted use: A-Warehouse; G-Warehouse; AAF Baghouse (with the exception of the concrete pad); and the ferrovanadium slag sorting area in the Storage Yard

[37] Department 111 and Department 102 process the radioactive materials for this operation.

[38] At one time, D-116 processed polishing compounds and other materials that are exempt from licensing pursuant to 10 CFR 40.13. Although these materials contained thorium and uranium, the cost of characterization, remediation and final status survey of D-116 is not included in this Plan because it was never a radiologically restricted area, and because the operations therein were exempt from the regulations in 10 CFR 40.

(recently re-forested).[39,40,41,42] Finally, D-111, and D-102/112 were recently decommissioned, and a final status survey is planned for calendar year 2002, a copy of which will be submitted to the USNRC. Section 2.3, above, contains additional information about all previously-decommissioned structures.

There are over 20 buildings on the property, and their construction is either steel or wood frame or concrete block. Only three of them are currently designated as restricted areas, meaning source material was stored/used there at one time. These are D-117 (Cave), D-202 (Laboratory) and D-Warehouse. Figure 18.6 shows the location and size of the three restricted areas.

Ambient gamma exposure rates in background locations have been performed as part of a number of different surveillance operations (e.g., final status surveys of A-Warehouse, G-Warehouse etc.), including the compliance surveys performed and documented each quarter. The following subsections summarize the measured levels.

4.1.3.1 Ambient Gamma

Data acquired with a Bicron Microrem meter at a height of approximately one (1) meter above a ground or floor surface, indicate ambient gamma background dose rates in buildings ranging from seven (7) to eight (8) microrem per hour.[43]

4.1.4.2 Surface Contamination

Alpha backgrounds ranging from zero (0) to two (2) counts per minute were obtained using hand-held instruments. Background alpha activities using a large area floor monitors ranged from eight (8) to thirteen (13) counts per minute. Background beta results for the large area floor monitors ranged from 900 to 1080 counts per minute.

In all three of the restricted areas (D-117, D-202 and D-Warehouse), routine surveillance data acquired each calendar quarter confirm that there is no residual radioactivity in these areas.

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[39] Shieldalloy Metallurgical Corporation, License Amendment Application to remove D203A (known as "A-Warehouse") from listing of permanent restricted areas, submitted on January 28, 1999. Amendment issued on July 20, 1999.

[40] Shieldalloy Metallurgical Corporation, "License Amendment Application to Remove Bldg. D203(G), also known as "G-Warehouse" from the listing of permanent restricted areas, submitted March 30, 2001.

[41] Shieldalloy Metallurgical Corporation, "License Amendment Application to Remove AAF Baghouse from the listing of permanent restricted areas, submitted January 30, 2000.

[42] Integrated Environmental Management, Inc., Report No. 94005/G-18198, "Soil Sampling/Survey of Storage Yard After Remediation", submitted to Shieldalloy Metallurgical Corporation, January 20, 2000.

[43] A Microrem meter provides a tissue-equivalent response allowing a readout in microrem per hour (μrem/hr),

Nonetheless, their final radiological status as compared to the site-specific release criteria will be included in the final status survey report for this decommissioning effort.

Quarterly walkthroughs of the D202 laboratory (upper level) showed general area dose rates of approximately six (6) microrem/hr, even in the vicinity of energized x-ray analysis equipment. Dose rates on the lower level ranged from 6 to 7 microrem/hr (the majority of a separate storage room containing a locked safe housing radioactive materials), with a maximum of 40 microrem/hr at one foot from the aforementioned safe. General area dose rates in Building D117 (i.e., the "Cave") were 6 to 7 microrem/hr. All of these ambient dose rates, with the exception of those near the safe, are consistent with the background data set.

4.2 Contaminated Systems and Equipment

The only buildings that contained systems and equipment for processing source material were D-111, the Flex-Kleen Baghouse, the AAF Baghouse, and D-102/112. The AAF Baghouse was demolished and released for unrestricted use in CY 2001. The Flex-Kleen Baghouse, D-111 and D-102/112 were decommissioned in CY 2002, and the final status survey report is soon to be submitted to the USNRC. Consequently, there are no longer any contaminated systems or equipment to be addressed in the site-wide decommissioning effort.

4.3 Surface Soil Contamination

The only areas within the Newfield plant property lines where residual radioactivity exists in surface soils, other than in the Storage Yard, are the concrete pads that housed the former AAF and Flex-Kleen Baghouses.[44] In addition, residual radioactivity was identified in the Hudson's Branch watershed in the late 1980's.[45] The Hudson's Branch, an intermittent, slow-moving tributary of Burnt Mill Branch in the Maurice River Basin, is the predominant surface water body in the vicinity of the plant. It borders the southern boundary of the property, where it flows from east to west.[46]

Ambient gamma exposure rates in background locations have been performed as part of a number of different surveillance operations (e.g., final status surveys of Haul Road, ferrovanadium slag sorting area, etc.), including the compliance surveys performed and documented each quarter. The values recorded are instrument- and geometry-dependent. However, data acquired with a Bicron Microrem meter at a height of approximately one (1) meter above a ground indicates background dose rates ranging from eight (8) to 15 microrem per hour in outdoor areas.[47]

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[44] Section 4.4, below, describes the radioactive materials present in the Storage Yard.

[45] "Baseline Radiological Risk Assessment for the Hudson's Branch Watershed", IT Corporation Report No. IT/NS-92-116, submitted to Shieldalloy Metallurgical Corporation, Newfield, New Jersey, November 3, 1992.

[46] The Hudson's Branch flows from northeast to southwest after it leaves the SMC property.

[47] A Microrem meter provides a tissue-equivalent response allowing a readout in microrem per hour (μrem/hr),

Background soil samples have been collected and analyzed by a variety of organizations and methodologies over the years. Table 17.6 is a compendium of background soil concentrations of uranium and thorium isotopes acquired during three measurement campaigns.

On and around the concrete pad that remained after demolition of the AAF Baghouse, the only radionuclides of concern are thorium and uranium, with progeny in general equilibrium. From the final status survey report for the AAF Baghouse decommissioning, the concrete pad was shown to contain up to 19,800 dpm/100 cm^2 of residual beta activity.[48] During the most recent quarterly compliance surveillance effort, a maximum of 1868 dpm/100 cm^2 of alpha activity from direct frisks was noted. Smears of the pad are negative for the presence of removable alpha or beta activity, meaning the measured residual radioactivity is affixed to the pad.

The radionuclide concentration in the Hudson's Branch was summarized in a 1992 risk assessment report.[49] There it was shown that the presence of those materials, which were uranium and thorium plus progeny, presented an insignificant radiological risk to members of the public. A scale drawing and map showing the Hudson's Branch Watershed, with ambient exposure rates, is included herein as Figure 18.7. Figure 18.8 shows the location of soil sampling, along with a graphical representation of the results.

4.4 Subsurface Soil Contamination

Subsurface soil contamination, in the form of ferrocolumbium slag, is present in the Storage Yard, and at a number of locations throughout the Newfield plant where slag was used as fill. The dimensions of these locations were described in detail in a 1992 report.[50]

Ferrocolumbium standard slag, ferrocolumbium high-ratio slag, and columbium nickel slag generated from the D111 and D102 smelting operations consist of solid, non-combustible material with the consistency of vitrified rock. All three slag types were maintained separately from the others at their respective points of generation and are transported in trucks from D111 and D 102 to the Storage Yard. There are approximately 20,000 cubic meters of ferrocolumbium slag (high ratio and standard) in the Storage Yard. In addition, baghouse dust was transported by truck to the

[48] Integrated Environmental Management, Inc. Report No. 94005/G-20187, "Demolition and Final Survey of the AAF Baghouse", submitted to Shieldalloy Metallurgical Corporation on January 7, 2000.

[49] "Baseline Radiological Risk Assessment for the Hudson's Branch Watershed", IT Corporation Report No. IT/NS-92-116, submitted to Shieldalloy Metallurgical Corporation, Newfield, New Jersey, November 3, 1992.

[50] Berger, C. D., A. Chance, K. Wiggins and H. Prichard, "Assessment of Environmental Radiological Conditions at the Newfield Facility", IT Corporation Report No. IT/NS-92-106, submitted to Shieldalloy Metallurgical Corporation, Newfield, New Jersey, April 1, 1992.

Storage Yard. Approximately 20,000 cubic meters of baghouse dust are currently in the Storage Yard.[51,52]

Ambient gamma exposure rates in background locations have been performed as part of a number of different surveillance operations (e.g., final status surveys of Haul Road, ferrovanadium slag sorting area, etc.), including the compliance surveys performed and documented each quarter. The values recorded are instrument- and geometry-dependent. However, data acquired with a Bicron Microrem meter at a height of approximately one (1) meter above the ground surface indicates a background dose rate range of eight (8) to 15 microrem per hour.[53] Background soil samples have been collected and analyzed by a variety of methodologies over the years (see Table 17.6).

There are approximately 23 curies each of uranium and thorium in the form of slag and baghouse dust in the Storage Yard. The concentration of each in the slag is approximately 400 pCi/gram. In the baghouse dust, the concentrations are less than 10 pCi/g each.

The physical form of the slag in the Storage Yard slag (glass-like rock) does not permit the radioactive elements to leach out into the regional water supply or local wetlands. Leachability studies performed on samples of the slag support this conclusion.[54] Also, the surface of the baghouse dust pile forms a "crust" when it encounters moisture, which serves to deter fugitive dust emissions. The radiation exposure rates in this area range from background to 0.2 milliR per hour, with the maximum measured exposure rate being due north of the Storage Yard, approximately 30 feet from the slag piles.

The Storage Yard also contains less than 6,500 m³ of soil excavated during a previous remedial action. In addition, there are other deposits throughout the plant that may be returned to the Storage Yard as part of the decommissioning process. The following is a description of all of these materials:

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[51] Historically, dusts generated from both ferrocolumbium production and un-recycled dusts from ferrovanadium production were not segregated. Currently, however, the ferrovanadium contribution to the collected dusts is negligible.

[52] From the volumetric information obtained from an October, 1991 fly-over of the Newfield site, the Storage Yard contained 16,800 m³ of standard slag and 1040 m³ of high-ratio slag at that time, for a total of 17,840 m³ (Shieldalloy Metallurgical Corporation, "Applicant's Environmental Report for the Newfield, New Jersey Facility", October 1, 1992). The volume of slag produced during ferrocolumbium operations performed after the 1991 fly-over and before the date of this report was added to this total in order to estimate the present-day volume of slag in the Storage Yard

[53] A Microrem meter provides a tissue-equivalent response allowing a readout in microrem per hour (μrem/hr),

[54] Teledyne Isotopes, "Report of Leachability Studies for Shieldalloy Metallurgical Corporation", Teledyne Isotopes, Westwood, New Jersey, 1992.

- Haul Road - The Haul Road was, at one time, a county right-of-way that ran through SMC's Newfield plant. Over the years, the south portion of the road was surfaced with crushed slag from SMC operations. Characterization efforts that took place in 1988 and 1991 showed that the contact exposure rates in and near the road were only slightly discernible from background, that the contaminants therein were natural uranium and natural thorium, and that the slag used to form the road bed was not characteristic of licensed material (i.e., ferrocolumbium slag).[55,56,57] In September of 1998, approximately 6,500 m^3 of predominantly soil, with some residual slag, was scraped from the road transferred to the Storage Yard. This soil is assumed to contain approximately 0.2 curies of uranium, and thorium.[58] A final status survey of the remediated area demonstrated that the Haul Road may be released for unrestricted use (i.e., without regard for radiological constituents).[59]

- Slag Used as Fill - The remaining areas on the property where fill slag may exist (i.e., the southwest fence line and in the T12 Tank Area) are not designated "Restricted Areas" since the ambient exposure rates in these areas currently range from background to only a few tens of microR per hour.[60] While the mass of fill slag has not been well-characterized, the lateral extent of elevated surface exposure rates identified in a previous site characterization effort (i.e., approximately 8,000 m^2)

[55] Oak Ridge Associated Universities, "Radiological Survey of the Shieldalloy Metallurgical Corporation, Newfield, New Jersey", Report No. ORAU 88/G-79, July, 1988.

[56] IT Corporation, "Assessment of Environmental Radiological Conditions at the Newfield Facility", Report No. IT/NS-92-106, April 2, 1992.

[57] Exposure rates in and near the road generally ranged from background to 26 microR per hour, with a maximum exposure rate of 90 microR per hour directly over slag pieces. If these are compared to the contact exposure rate from ferrocolumbium slag, which is in the vicinity of 1,000 to 2,000 microR per hour, it is clear that the slag in the road was the result of a different operation.

[58] If the source material content of ferrocolumbium slag (i.e., 400 pCi per gram each of thorium and uranium) is multiplied by the ratio of the maximum contact exposure rates for the materials excavated from the road and ferrocolumbium slag, a reasonable estimate of the source material concentration in the excavated soils is 18 pCi per gram. Assuming a soil density of 1.6 grams per cm^3, and a total soil volume of 6,500 m^3, the curie content of the excavated soils is about 0.2 curies each of uranium and thorium.

[59] Integrated Environmental Management, Inc. Report No. 94005/G-17172, "Final Status Survey of Haul Road", June 22, 1999.

[60] IT Corporation, "Assessment of Environmental Radiological Conditions at the Newfield Facility", IT Corporation Report No. IT/NS-92-106, April 1, 1992.

gives a reasonable estimate the spatial extent of residual radioactivity therein.[61] A conservative assumption of uniform thickness (i.e., one meter) over this entire area results in an estimate of 8,000 m^3 of fill slag on the property, containing approximately 4.2 curies each of uranium and thorium.[62]

The slag and baghouse dust contained within the Storage Yard have been placed directly upon the ground surface. Because the leach rate of radionuclides from these materials is low, sub-surface activity beyond a nominal depth of 30 cm, attributable mainly to slag burial, is unlikely. In those areas on the property where slag was used as fill, the maximum depth of deposition can be reasonably assumed to be one (1) meter or less.[63]

4.5 Surface Water

From many years of sample collection and analysis, it can be shown that the surface water collected from the vicinity of the Newfield site does not exhibit elevated (above background) radionuclide concentrations.[64]

4.6 Groundwater

The radionuclide content of groundwater collected from the vicinity of the Newfield site is described in Section 3.7.8, above. In general, no elevated levels of radionuclides have been identified.

[61] Berger, C. D., A. Chance, K. Wiggins and H. Prichard, "Assessment of Environmental Radiological Conditions at the Newfield Facility", IT Corporation Report No. IT/NS-92-106, submitted to Shieldalloy Metallurgical Corporation, Newfield, New Jersey, April 1, 1992.

[62] Assuming a source material concentration of 400 pCi per gram each of thorium and uranium in the slag, a slag density of 1.3 grams per cubic centimeter, and a total slag volume of 8,000 m^3, the curie content of the slag used as fill is approximately 8.4 curies each of uranium and thorium.

[63] However, it is important to note that, in order to main the structural integrity of the areas where slag was used as fill, the radionuclide distribution and depth have not yet been well-characterized.

[64] TRC Environmental Consultants, Inc., "Remedial Investigation Technical Report", Project No. 7650-N51, Windsor Connecticut, April, 1992.

5 DOSE MODELING EVALUATIONS

5.1 Unrestricted Release

SMC is requesting that License No. SMB-743 be terminated under restricted release conditions. A description of the dose potential associated with this request, by all applicable exposure scenarios (pathways) is presented in the following subsection.

5.2 Restricted Release Using Site-specific Criteria

5.2.1 Acceptable Dose Limit

The primary purpose of the USNRC requirements on disposal of materials with radiological constituents is to ensure that the radiation dose limits for members of the general public are met. At issue, however, is the dose limit, below which, negligible risk, if any, would be incurred. The USNRC promulgated a radiation dose limit to define negligible risk, and published the following regulation:[65]

> "A site will be considered acceptable for license termination under restricted conditions if: . . . (e) Residual radioactivity at the site has been reduced so that if the institutional controls were no longer in effect, there is reasonable assurance that the TEDE from residual radioactivity distinguishable from background to the average member of the critical group is as low as reasonably achievable and would not exceed either– (e)(1) 100 mrem (1 mSv) per year; or (e)(2) 500 mrem (5 mSv) per year provided the licensee–, . . ."

For the decommissioning of the SMC site, a dose objective of 100 millirem above background is applicable and is used as the basis for demonstrating that the site may be released for restricted use.

5.2.2 Assessment Methodology

If the SMC site is decommissioned as described herein, the question then becomes "what kind of radiation dose might a person incur as a result, and would that dose exceed the 100 millirem objective?" Because the magnitude of a specific person's radiation dose is dependent not only on the amount of radioactivity present but also on the person's time and motion relative to the location of the radioactivity, person-specific doses can be difficult to assess. However, it is possible to perform a dose assessment that establishes a conservative estimate of exposure (i.e., one that is well above the average case) by assuming a constant and continuous presence at the site.

For this assessment, it was assumed that the "agricultural farm family" scenario is applicable. In this scenario, a hypothetical family is assumed to move into a house adjacent to the capped slag pile after

[65] US Nuclear Regulatory Commission, *Criteria For License Termination Under Restricted Conditions*, Title 10 CFR 20.1403, July 21, 1997.

the SMC materials have been placed. For this scenario, it is assumed that a fictitious family builds a home and raises all of the crops and livestock for family consumption on the property. These fictitious family members may thus incur a radiation dose by all of the following pathways:

- Inhalation of re-suspended radioactivity;
- Ingestion of food from crops grown in the location of the residual radioactivity;
- Ingestion of milk from livestock that grazes in the location of the residual radioactivity;
- Ingestion of meat from livestock that grazes in the location of the residual radioactivity;
- Ingestion of fish from an on-site pond contaminated by water percolating through the residual radioactivity; and
- Ingestion of water from a well on the property that is contaminated by water percolating through the residual radioactivity.

The reason for selecting the agricultural farm family scenario for this dose assessment is that exposure of permanent residents is long-term in nature, generally involves a greater number of exposure pathways than for non-residents, and results in a high, or conservative, estimate of potential radiation dose.

The storage pile is shaped in such a way as to eliminate the likelihood that a house or residence may be build on the top of the pile. The pile, as shown in Figure 18.9, is narrow at the top and exhibits a 3:1 ratio for the side walls. There is insufficient area to construct a house directly on the pile and consequently the direct gamma radiation pathway, as calculated by RESRAD is eliminated for the purposes of the radiation dose estimate. Radiation dose estimates from the direct radiation pathway are estimated to be less than 10 microrem per hour (<0.01 mrem/hr) above background. The radiation dose estimate assumed residents living in a house built near the covered storage pile, within 20 feet. The shielding abilities of the soil cover were not included in the calculation. The direct exposure pathway is considered to be conservative given the deed restrictions and the prohibition of building a residence immediately near the storage pile.

A computer code, RESRAD Version 6.2, was used to model radionuclide fate and transport, and to assess the radiation dose incurred by the hypothetical family members from the residual radioactivity that would exist after the cap is installed.[66] This code provides the radiation dose expected to be received by the hypothetical farm family member beginning from the time of site closure and extending into the future (i.e., 1000 years). It takes into account potential uses of the site and potential migration of radioactive materials through the environment over time through both natural processes and human activities that could be expected to alter the patterns or rates of constituent movement. In general, the dose assessment process consists of two steps:

- Development of representations of site physical conditions and potentially exposed populations, and expression of these representations in mathematical terms; and

- Use of a mathematical model with input from the representations and/or technical literature to estimate future exposures and radiation doses (TEDE) as a function of time.

5.2.3 Input parameters

The computer model RESRAD includes default parameters for each of the pathways that are used by the code to complete the calculations. These default parameters were evaluated and compared to the site specific conditions that exist at the Newfield site. Many of the default parameters were found to be representative and used in the calculations. Selected parameters were changed in the model to match site conditions; these parameters are described in the sections that follow and listed in Table 17.6 through 17.13 The key parameters that were changed in the calculations were the partition coefficients (K_d).

5.2.3.1 Soil Liquid Partition Coefficients

Partition coefficients were changed from the RESRAD defaults to reflect the types of soil that exist below the Newfield site for the elements of interest in the slag[67]. The default coefficients provided by RESRAD, assume a different type of soil and consequently may underestimate the potential for migration. Table 17.9 summarizes the K_d coefficients that were used in the dose calculation for this assessment.

5.2.3.2 Multilayered Engineered Cap

A cap will be constructed over the Storage Yard. The cap is designed to divert rainwater from mixing with the materials placed under the cap, and to serve as a substantial attenuator of direct radiation exposure in close proximity to the cap. A cross-section of the multi-layered cap is presented in Figure 18.10.

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[66] Yu, C, Zielen, A.J, et al, User's Manual for RESRAD Version 6, ANL/EAD-4, Argonne National Laboratory, Argonne, Illinois, July, 2001.

[67] Shappard and Thibault, Default Soil Solid/Liquid Partition Coefficients, K_dS, for Four Major Soil types: A compendium, Health Physics Journal, Volume 59, Number 4, October 1990.

The final graded and compacted pile will be covered with a compacted soil barrier at least 1 meter (approximately 39 inches) in thickness. The soil cap will consist of thirty-three (33) inches of a compacted suitable soil layer topped with a six (6) inch thick final vegetative soil layer, and seeded with suitable low maintenance and drought resistant grasses. The cap will include a geotextile membrane which will divert all rainwater and surface water. The input parameters for the RESRAD model were modified to include the features of the impermeable cover. Specifically, the erosion rate was eliminated and the water runoff coefficient was changed to 1 (100% runoff).

The soil cap system shall have a maximum projected erosion rate of five tons per acre per year and shall have a slope of between five percent and twenty-five percent, or some greater slope based on stability analyses. The final cap slopes will generally be thirty-three percent.

The barrier layer of the final cover will be keyed approximately four (4) feet into the surrounding soils at the toe of the slope of the final cover. Crushed stone riprap will be placed along the toe of the slope, as indicated in Figure 18.10.

5.2.3.3 Radon

The exposure pathway for potential exposure to radon gas was eliminated in this assessment. The USNRC documented their concurrence with this approach in the Statement of Consideration for the License Termination Rule:[68]

> "Following the approach taken in the proposed rule, this final rule includes radiological criteria for residual radioactivity that is distinguishable from background. Because of natural transport of radon gas in outdoor areas due to diffusion and air currents, doses from exposure to radon in outside areas due to radium in the soil are negligible... Therefore, in implementing the final rule, licensees will not be expected to demonstrate that radon from licensed activities is indistinguishable from background on a site-specific basis..."

5.3 Results

In spite of the inherent conservatism built into this analysis, it is clear that the maximally-exposed annual radiation dose from all pathways is less than 10 millirem per year. In fact, the maximum radiation dose (TEDE) calculated for a hypothetical farm family member who lives adjacent to the storage pile less than 1 millirem per year, which occurs only after the decay products equilibrate after 1,000 years. The impact of groundwater pathway is minimized by the use of a geotextile membrane to eliminate the potential of surface water commingling with the slag and creating a potentially contaminated leachate. The output of the RESRAD code is provided in Appendix 19.2.

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[68] U.S.Nuclear Regulatory Commission, *Radiological Criteria for License Termination*, Federal Register, Volume 62, Number 139, July 21, 1997.

6 DECOMMISSIONING ALTERNATIVES AND RATIONALE

SMC is committed to implement conservative radiological protection practices, and intends to be consistent with federal requirements that licensed radioactive materials be handled and released in a manner that ensures that exposures are as low as is reasonably achievable (ALARA) taking into account economic and societal factors.[69] Because the goal of decommissioning the Newfield site is to ensure that members of the general population do not incur radiation doses in excess of 100 millirem per year after the license is terminated, these two objectives (i.e., the dose limit contained in 10 CFR 20.1402 and the ALARA provisions) form the basis for the level of effort necessary for decommissioning.

SMC has proposed to stabilize and cap the radioactive materials as described in Chapter 8, below. A second alternative is to ship the contents of the Storage Yard to the Envirocare Low Level Waste disposal facility in Utah. The no-action alternative is to leave the Storage Yard contents in their current configuration and take only those actions necessary to control erosion or correct problems that may develop. An additional alternative, sale for reuse of the slag and baghouse dust in the Storage Yard, is possible, but at this time its feasibility is not certain.

6.1 Alternatives Considered

6.1.1 On-site Stabilization and Disposal Alternative

Radioactively contaminated materials at the Newfield site will be consolidated into a single pile within the Storage Yard (see Figures 18.14 and 18.15). This alternative would involve stabilizing, capping, and grading the Storage Yards on the site. The capping and grading would be designed to provide long-term protection against wind and water erosion, to minimize groundwater contamination, and to reduce the radiation dose to an individual who gains access to the piles. The cap for the pile would be of multiple-layer construction designed to minimize vertical infiltration. of water through the covered area and to provide adequate radiation shielding and an intruder barrier.

The maximum elevation of the capped pile would be about nine (9) meters (30 ft) at its highest point, and the volume of slag, baghouse dust and other materials would be about 57,000 m^3 (75,000 yd^3). Transportation of the cap materials for the Storage Yard would require about 3,800 dump truck loads, assuming 15 m^3 (20-yd^3) capacity dump trucks are used. The cap for the Storage Yard would be of multiple-layer construction designed to provide adequate radiation shielding and an intruder barrier.

The time duration for capping the Storage Yard is approximately seven (7) months, which is most likely to take place during a May-to-October construction season. Approximately 12 to 24 workers would be needed to carry out on-site capping activities. The labor categories would include

[69] Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation".

construction foreman, truck drivers, heavy equipment operators, and general laborers. A grader would be used to maintain the haul roads and a water truck would be used as needed to suppress windblown dust.

Following capping, institutional controls including access restrictions, maintenance, monitoring (visual inspections, radiation surveys, and groundwater and surface water sampling), and legal restrictions against future residence construction farming or business re-development on the restricted release area would be implemented. Maintenance would include mowing the vegetation on the cap and repairing any cracks that might appear in the cap.

6.1.2 Off-site Disposal Alternative

Under the off-site disposal alternative, radioactive contamination would be removed from the site and disposed of at the Envirocare of Utah, Inc., facility near Clive, Utah. Radioactive contamination on the site would be reduced to levels considered acceptable for release for unrestricted use. The acceptable level for natural thorium (^{232}Th in secular equilibrium with ^{228}Th and decay products) is 10 pCi/g and for natural uranium (^{238}U in secular equilibrium with ^{234}U and decay products) is 10 pCi/g provided the total activity (natural uranium and natural thorium) is less than 10 pCi/g. The total amount of material that would be disposed of off site would be approximately 134,000 tons from the Storage Yard. Approximately 1,500 covered railroad cars, each with an 80-metric-ton (90-ton) capacity, would be used for the off-site transport of material from both piles. A staging area would be established in the vicinity of the Storage Yard to serve as a temporary stockpile and loading area for the slag.

Construction of an additional railroad spur might be needed to accommodate temporary storage and loading of railroad cars. Additional site preparation activities would include adding approximately 150 linear meters (500 ft) of gravel road to the existing facility road network to accommodate the truck traffic between the Storage Yard and the staging area.

Removal of the material from the Storage Yard would take place in four main phases that to some degree would occur concurrently: (1) moving the slag and soil from the Storage Yard to the staging area located near the Storage Yard; (2) crushing the slag to meet the size requirements of the off-site facility, if necessary; (3) loading the slag from the staging area into the railcars; and (4) transporting and disposing of the slag at the off-site facility.

A front-end loader would be used to load the slag into trucks at the Storage Yard. It is assumed the slag would be hauled to the staging area in 15-m^3 (20-yd^3) dump trucks. A bulldozer would be used to loosen the Storage Yard material and move it toward the loader. The stockpiled slag would be crushed, if necessary, and then loaded into railcars using a front-end loader. A small locomotive would be required to shift railcars around as they are loaded. After the slag is removed from the Storage Yard, the area would be graded. It is assumed that a 0.3-m (l-ft) layer of topsoil would then be placed onto the area.

The estimated time to complete the actions for this alternative is approximately two (2) years assuming Envirocare is able to receive 15 railcars per day and the work can be conducted five (5) months each year.

6.1.3 No-action Alternative

The no-action alternative would be to retain the site in its current configuration without any additional processing or stabilization. The piles in the Storage Yard would remain in their present condition and location. Only those actions required to correct problems that occur (e.g., erosional damage to the Storage Yard cap) would be taken. This alternative may not meet the interests of the public, the State of New Jersey, or of SMC. Consideration of the no-action alternative is required by the regulations implementing NEPA in order to provide a baseline for comparison with the other alternatives.

Under this alternative, the only increase in the number of workers at the SMC property would be 2 to 4 people monitoring the site on an intermittent basis. Implementation of the no- action alternative would only require expenditure of those funds needed to monitor the materials, report on the results of that monitoring, and take undefined corrective actions should problems occur. The materials in the Storage Yard would not be decommissioned and SMC's license for possession of source material would not be terminated.

6.1.4 Sale of Slag for Beneficial Re-use

Sale for reuse is being pursued by SMC for the slag in the Storage Yard. This possible alternative involves the use of the slag as a conditioner in the production of steel. The constituents of the slag, including its aluminum and calcium content, make it valuable as a slag conditioner. In this case, the slag would be crushed on-site and sold to slag conditioner suppliers for resale to steel mills as an additive to the steel-making process to remove impurities in the final product. The crushed slag might be blended with other materials by companies that supply slag conditioners or they may supply it to the steel industry as is.

The on-site processing of slag for reuse would involve removing the slag from the excavation, accessing different strata within the pile for uniformity, removing metallic inclusions and other material that could damage the crushing machinery , crushing and sizing the slag, and creation of approximately 1,000 ton lots for shipment to customers. Radiation screening would take place before crushing and before shipment from Newfield. Chemical and isotopic analysis would also be obtained for each lot prior to preparation for shipment. Because analyses show that the slag contains only about 0.03 percent uranium and thorium by weight, and based upon initial radiological dose analyses, off-site and on-site exposures scenarios show very low exposure levels.

The feasibility of reuse of the slag as a conditioner is unknown. The uncertainties are both institutional and technical. The latter includes the need for steel makers to determine the acceptability of the slag as a slag conditioner, which will require extensive trials, and which in turn will determine the availability and size of the commercial market. The institutional uncertainties include the need for beneficial reuse approval by the NJDEP.[70] The USNRC must confirm that use of the slag conditioner will not subject steel mills to USNRC specific licensing requirements. If this assumption is not correct, it would make the feasibility of this option questionable, since steel mills might be reluctant to obtain an USNRC license to possess the material.

In order to allow the use of this material by steel mills without a specific license, dose assessments will need to be conducted that include consideration of the various exposure scenarios to the public and to workers who might be exposed to the slag. The scenarios and the assumptions associated with them would need to be developed and justified, and then accepted by USNRC. Thus, additional work is necessary before this option can be considered as viable.

6.2 Rationale for Chosen Alternative

A site in another state with residual radioactivity that is similar in radiological and physical form to that found at the Newfield facility, had its characterization results incorporated into a Draft Environmental Impact Statement (DEIS) prepared by the USNRC, and into a Remedial Investigation and Feasibility Study (RI/FS) prepared by the licensee.[71,72] Both of these documents concluded that the proposed decommissioning methodology of in-situ stabilization and disposal would have no significant impact on the environment, and that additional action under NEPA would not be necessary.[73]

The regulatory decision on the preferred decommissioning alternative for this out-of-state site is equally applicable to SMC's Newfield facility. Therefore, SMC has elected to implement the on-site stabilization and disposal method for decommissioning because it maximizes the radiological protection of people and the environment, minimizes risks to workers and members of the public, maintains radiation exposures ALARA when economic and societal issues are taken into account, and it is consistent with an option deemed acceptable previously by the USNRC.

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[70] NJDEP, Division of Solid Waste.

[71] U. S. Nuclear Regulatory Commission, NUREG-1543, "Environmental Impact Statement; Decommissioning of the Shieldalloy Metallurgical Corporation Cambridge, Ohio Facility", July, 1996.

[72] PTI Environmental Services, "Remedial Investigation and Feasibility Study at the Shieldalloy Metallurgical Corporation Site in Cambridge, Ohio", September, 1996.

[73] 63 FR 64976, 1998.

7 ALARA ANALYSIS

SMC's goal for this decommissioning effort is to contain the slag, contaminated soil and baghouse dust in a pile equipped with an engineered cap such that the potential exposures of members of the public to radiation and radioactive materials is minimized. The manner in which the cap is designed, constructed and maintained, will allow it to last for more than 1,000 years. It will also be suitable to divert surface water and minimize the erosion of contaminated materials and the spread of contamination. SMC intends to implement restrictions to reduce potential exposures, including deed restrictions related to the use of the property and intrusive activities. Furthermore, the cap will satisfy the requirements established by the New Jersey Department of Environmental Protection and be suitable to reduce radiation exposures to below the radiation dose limit.

A summary of economical impacts of the proposed action and alternatives were evaluated by the USNRC in the Draft Environmental Impact Statement prepared for the SMC site in Cambridge, Ohio.[74] The site at Cambridge used the same base materials and operated in a similar manner as the site in New Jersey. Based upon analyses presented in this document, the USNRC concluded that: (1) the environmental impacts of the on-site disposal alternatives are not significant, if mitigative measures are carried out; and (2) there is no obviously superior alternative.

Two other alternatives that were considered feasible were evaluated as well. These were: (1) disposing of the contaminated material off site at the Envirocare facility in Clive, Utah; and (2) taking no-action. The potential long-term human health effects from taking no-action prior to license termination are greater than those associated with the off-site disposal option. Therefore, some remedial action is appropriate and required in order to meet the USNRC's license termination criteria, or level of acceptable risk.

Removing the contaminated material from the site will result in the fewest long-term environmental effects, although the cost is astronomical. (The estimated cost of off-site disposal was calculated to be approximately $102-112 million versus approximately $3.0 million for the on-site disposal options.) The off-site disposal option also has some potentially significant ramifications on air quality and noise that would demand mitigation. Furthermore, the off-site disposal alternative would result in higher potential for worker injuries than would the on-site disposal alternative. That is why, after weighing the costs and benefits of the proposed action and considering reasonable alternatives, the USNRC recommended implementation of the on-site disposal alternatives at the SMC Cambridge, Ohio site, along with some additional mitigating actions as described in DEIS. The same conclusions are applicable to SMC's Newfield site, thus the in-situ stabilization and disposal option would be considered ALARA.

[74] U.S. Nuclear Regulatory Commission, Draft Environmental Impact Statement, *Decommissioning of the Shieldalloy Metallurgical Corporation Newfield, Ohio Facility*, NUREG 1543, Draft, July, 1996.

8 PLANNED DECOMMISSIONING ACTIVITIES

This chapter contains the description of SMC's approach for decommissioning of the remaining restricted areas at the Newfield site. It also contains a schedule for completion of those activities. As described previously, the decommissioning program will involve the following general steps:

- Finalization of decommissioning work plan and procedures, which will cover the detail and procedures, including the final design and technical specifications, health and safety plans (HASPs), construction issues, and performance and documentation of the Final Status Survey.
- Consolidation, stabilization, grading, and preparation of the regulated material within the Storage Yard;
- Characterization of those portions of the Storage Yard surrounding the final storage area's footprint; construction of the final cap and associated infrastructure (e.g., drainage systems); and
- Performance of the Final Status Survey of the soil excavation areas and the completed capped area to confirm the absence of residual radiological activity above the site-specific criteria.

A detailed description of the planned closure activities, in accordance with the USNRC decommissioning guidance titled *Consolidated NMSS Decommissioning Guidance*, and a schedule for these activities, are presented in the following subsections. In addition to those areas of the facility that will be subjected to active decommissioning processes (e.g., excavation, cap construction, etc.), several additional areas that were formerly associated with radiological source material but no longer exhibit residual activity will be subjected to Final Status Survey assessment as part of this site-wide decommissioning effort.

8.1 Contaminated Structures

As described in Section 2.3, above, residual activity was present in building materials and/or equipment associated with several Newfield site structures. These included Building D-111 and associated (Flex-Kleen and AAF) air handling systems, and the D102-112 Production Department facilities. Associated building and equipment decontamination, demolition, and disposal activities have already been completed. Non-licensed material that has been generated as part of these activities has been recycled or disposed off-site; licensed materials have been stockpiled in the Storage Yard.

As a result of the recent decommissioning actions associated with contaminated structures on-site, approximately 2,630 cubic meters of USNRC-regulated material is assumed to be incorporated into the Storage Yard closure program. This material is located in the southern part of the Storage Yard, as depicted in Figure 18.3. No additional decommissioning activities are thus necessary in order to address contaminated structures.

8.2 Contaminated Systems And Equipment

As described in Section 2.3, decommissioning activities have been performed to address other identified portions of the Newfield facility that exhibit radiological activity. Contaminated systems and equipment have been managed as part of the contaminated building program, including Building D-111 and its two air handling systems, and the D102-112 Production Department facilities. As a result of those recent decommissioning actions, approximately 110 cubic meters of contaminated materials, in the form of baghouse dust, was generated and placed into the Storage Yard. Based upon the findings of routine surveillance activities and previous radiological site characterizations, as well as historical process knowledge, no additional facilities with residual radioactivity remain at the site.

8.3 Soil

The focus of this Plan is the consolidation, capping and management of remaining process slag, baghouse dust, radiologically-impacted soils and USNRC-regulated materials into the existing Storage Yard. For purposes of this Plan, all of these materials will be categorized as "soil". Site materials exhibiting radiological activity above applicable release criteria will be incorporated into the capped landfill area. The following sequence of steps will be performed to address the management and final disposition of soil materials on-site which exhibit radiological activity above established background levels:

- Installation of erosion and sedimentation control systems to prevent off-site migration of regulated materials during construction activities and the control of run-on into the work areas;
- Dust control;
- Preparation of final capped disposal area (grading, compaction, drainage, etc.);
- Consolidation of regulated materials (slag, baghouse dust, soils, stockpiled decontamination/demolition regulated material) beneath the planned cap;
- Sampling and radiological analysis of surface soils surrounding the capped area, within the Storage Yard, followed by excavation and consolidation of additional regulated soils, if required;
- Final grading, compaction, and cap installation;

- Performance of Final Status Survey of the entire Storage Yard (consisting of capped and surrounding areas; and

- Establishment of O&M and monitoring programs.

Specific activities associated with the first four of these steps, including sequence and methods, are described individually below. The Final Status Survey and long-term monitoring and maintenance of the site are discussed in detail in Chapters 11 and 16, below.

The final design and specifications for the cap will be developed in accordance with USNRC requirements, as summarized in Title 10 Code of Federal Regulations, Section 61.52, with the final plans and specifications provided in a subsequent submission, and will include the following design elements:

- Final contour plan;
- Cap system design details;
- Slope stability analysis;
- Description and availability of final cover material;
- QA/QC Plan for cap construction;
- Detailed description of erosion control measures;
- Post-closure monitoring plan;
- Surface water management system design;
- Contingency plans for differential settling;
- Construction Quality Assurance Plan;
- Performance Standard Verification Plan; and
- Operation and Maintenance Plan.

Primary design considerations include: (1) physical characteristics of the stockpiled regulated materials (size, density); (2) volumes of the material piles; and (3) relative location of the material piles. The cap will be designed and constructed in order to minimize material relocation, while establishing a stable storage system. Specific design considerations include provision for the following:

- Provide required radiological shielding through installation of calculated soil cap thickness;
- Facilitate drainage off of cap and away from unit;
- Ensure long-term cap slope stability through appropriate design and construction;
- Install erosion controls for implementation during construction and for long-term cap maintenance;
- Provide dust control during cap construction;
- Minimize need for waste material handling (loading, transfer, and installation) to lower construction costs and simplify logistics;
- Utilize baghouse dust, soil and finer slag material as subgrade preparation for the soil cap, over the larger size slag material;
- Minimize requirements for off-site cover material to lower construction costs;
- Minimize surface area of cap while meeting requisite slope stability and other key design objectives to simplify long-term maintenance and lower overall program costs; and
- Use low maintenance vegetative cover materials.

8.3.1 Cap Construction

Construction of the cap will be initiated through consolidation of the collected/stockpiled regulated materials and preparation of the final subgrade for cap construction. Surface drainage systems will be constructed, which will direct surface runoff from the cap away from the capped material. Cap preparation will also involve the physical movement of slag, baghouse dust, and other materials using standard construction equipment (front-end loaders, bulldozers, dump trucks) such that effective consolidation and compaction is achieved.

Due to the large size and rough texture of the resident ferrocolumbium slag, it is anticipated that the finer-grained slag, soils and baghouse dust will be used to prepare the cap subgrade by filling the larger void spaces among the slag matrix. Final decisions as to the location of the various materials within the constructed capped unit will be made by SMC's Contractor based upon field conditions and final cap design considerations.

During consolidation of the various regulated materials into a single pile, comprehensive health and safety protocols will be followed to avoid exposing workers and nearby resident to site contaminants, and to prevent migration of contaminants into the surrounding environment. Water and/or other appropriate dust-control media will be used during all material movement activities. Continuous monitoring of the access and haul roads will be performed and appropriate dust control activities will be performed to minimize vehicle-induced fugitive dust generation. Material loading and unloading activities will also be monitored and controlled in a similar fashion. Further, real-time dust monitoring and radiological monitoring will be performed by SMC's Contractor to ensure exposures to radiological contaminants as well as other constituents of potential concern (i.e., metals) do not occur as a result of materials handling activities.[75] These actions, combined with the fact that the closest residence is more than 28 meters from the SMC property boundary, will ensure radiological and safety conditions that cannot be distinguished from those prior to the start of work will be maintained.

8.3.2 Adjacent Soil Characterization

As part of the regulated material consolidation process into a single pile, supplemental radiological surface soil characterization will be conducted within the Storage Yard by SMC's contractor to determine whether soils outside of the footprint of the storage cap are impacted by radiological contaminants of potential concern. Historical storage of licensed materials in this area could have caused the co-mingling with the underlying site surface soils. These potentially-impacted shallow surface soils may therefore be required to be consolidated in the capped pile.

Following removal of all of the licensed material beyond the areal extent of the final planned capped pile, soil sampling and radiological surveys will be conducted to determine the extent of any possible additional licensed material. Actual number, location, and depth of samples will be determined following completion of all initial consolidation activities, however sampling will involve the collection of a statistically significant number and distribution of shallow surface soil samples, which will be subjected to analysis for radiological constituents.

Upon receipt of the shallow surface soil characterization results, SMC's environmental Contractor(s) will make a determination as to which soils shall be placed beneath the cap. Soils exhibiting radiological activity above the release criteria for soil excavation will be transferred to the Storage Yard for capping. SMC may place other inert (unlicensed) soils beneath the cap to prepare the cap subgrade, to shape the site surrounding the cap or to isolate other soil materials regulated by NJDEP.

8.3.3 Cap Completion

Upon final consolidation of materials, the final cap will be constructed on the prepared subgrade in order to achieve the design criteria described in Section 5.0 of this Plan. The cap has been designed

[75] In the event that exposure levels above established site-specific health and safety action levels are identified, additional dust control activities (e.g , increased application of water or other control medium or use of different/supplemental controls systems) will be implemented.

in accordance with USNRC specifications. On this basis, the final graded and compacted impoundment will be covered with a one-meter-thick compacted soil shield barrier. Thickness of the soil barrier layer was calculated using a RESRAD computer model, and demonstrates that the potential for radiation exposures to from all exposure pathways over the next 1,000 years is less than 100 millirem per year (see Chapter 5, above). The cap in its entirety will consist of a geotextile membrane for water diversion, and one (1) meter of compacted suitable soil, topped with a six-inch thick final vegetative soil layer that is then seeded with suitable low maintenance and drought resistant grasses.

Surface drainage from the top surface of the capped pile will be collected near the top of the side slopes via open drain swales and directed down the side slopes in erosion control-lined downchute open channels. The discharge from the downchutes will be directed away from the pile and either allowed to spread and disperse or it will be directed via open channels or pipe to a suitable stormwater outfall location. Final cover soil material will be secured from a certified off-site source, and will be of appropriate grain size and quality to be stable and augment the overlying vegetative soil layer. Proposed location and dimensions of the final cap are depicted in Figure 18.9; details of design elements are provided in Figure 18.10.

Due to the long-term nature of the planned materials storage program, the size of the capped area, and the future secure nature of the area, SMC intends to evaluate the final storage area as a potential wildlife preserve. Such an application will enhance the aesthetic appearance of the area, provide an undisturbed refuge for local wildlife, and provide a secondary value for the property. To that end, the final cap design process will include a detailed ecological evaluation of the local flora and fauna, as well as the identification of appropriate plant species and other physical features that may be implemented into the final cap restoration. In addition to increased habitat value, the establishment of permanent vegetation also serves to protect the surface from soil erosion and remove water from the cover soils via evapotranspiration.

Given the current conditions that exist on the site, a successional old-field community is proposed in order to provide long-term stabilization of the cap and minimize future maintenance requirements, while promoting rehabitation by indigenous species, as well as migrating birds. The vegetation selected for the restricted release area should include a mixture of herbaceous and shrub species. Upland areas may be planted with a mix of perennial species during the growing season to establish permanent vegetative stabilization. Perennials develop a strong sturdy root structure that generally inhibits the growth of volunteer woody vegetation that may affect the integrity of the cap. The seed mix selected for the area may include grass and legume species including annual rye grass (Lolium spp.), birdsfoot trefoil (Lotus corniculatus), red clover (Trifolium pratense), and vetch (Vicia spp.). Shrub species selected for the area may include juniper (Juniperus communis) and staghorn sumac (Rhus typhina). A monitoring plan would be recommended to ensure successful establishment of selected plant species on the capped area. The final planting scheme would be prepared in close cooperation with the final engineering design of the cap.

8.3.4 Final Status Survey

Following completion of all material consolidation and capping activities, SMC's Contractor will conduct a Final Status Survey of the disturbed areas and capped unit. The survey will follow protocols and methods established in the *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)*. The primary purpose of the Final Status Survey will be the confirmation that the former radiologically-controlled and/or impacted areas of the site associated with controlled by-product material used on-site (stored or used as fill) meet the established exposure criteria for the site. Detailed discussion of the Final Status Survey is provided in Chapter 11.

8.3.5 SMC Commitment Statement

SMC is committed to implementation of conservative radiological protection practices, and intends to be consistent with federal requirements that licensed radioactive materials be handled and released in a manner that ensures that exposures are as low as reasonably achievable (ALARA), taking into account economic and societal factors. Because the goal of decommissioning at the Newfield site is to ensure that members of the general population do not incur radiation doses in excess of 100 millirem per year after the license is terminated, these two objectives (i.e., the dose limit contained in 10 CFR 20.1402 and the ALARA provisions) form the basis for the level of effort necessary for decommissioning of this facility.

8.4 Ground Water

As described in Chapter 4, previous investigations at the site, including evaluations in the vicinity of the Storage Yard, yielded no radiological impacts above USEPA screening levels in downgradient ground water. Non-radiological contaminants (e.g., metals and/or volatile organic compounds) were detected in ground water and have been further evaluated and addressed under the NJDEP RI/FS process. Results of previous investigations are presented in the report titled *Remedial Investigation Technical Report*, dated 1992. Based on the absence of exceedances of radiological action levels in downgradient ground water, no decommissioning actions are planned to address the ground water. However, the planned decommissioning program will be designed and implemented in order to prevent discharges of radiological and/or chemical constituents to these environmental receptors through effective erosion and sedimentation controls, materials and equipment management, and proper completion of the designed cap. Future effectiveness of this storage unit will be evaluated through installation of long-term monitoring program; specifications of the O&M and monitoring of this unit are provided in Chapter 16 of this Plan.

8.5 Decommissioning Schedule

The projected schedule for the Newfield Decommissioning program is shown in Figure 18.12. This schedule presents the estimated time that will be required to perform the full closure process, from finalization of the project Work Plan through submission of the Construction Completion Report and receipt of final USNRC approval. The primary tasks depicted on the schedule consist of the following activities:

- Work Plan Development;

- Final Design;
- Bidding and Award;
- Implementation of Decommissioning Activities;
- Cap Construction; and
- Construction Completion Report and Certification.

The presented schedule, which depicts the relative sequence of tasks and the projected time frame for each task/subtask, has been based upon a number of general assumptions, including time requirements for the review and approval of submittals to the USNRC. SMC acknowledges that this schedule may change substantially based on USNRC input, final design requirements, site-specific conditions, etc. In the event that the schedule as provided in this Plan cannot be maintained, as the project moves forward, SMC will develop and submit an updated schedule to the USNRC.

9 PROJECT MANAGEMENT AND ORGANIZATION

9.1 Decommissioning Management Organization

SMC will maintain primary responsibility for all site activities conducted under the requirements of License No. SMB-1507. The point of contact between applicable regulatory authorities and SMC will be the SMC Radiation Safety Officer.

Figure 18.13 shows the organizational structure of the project. This streamlined arrangement serves to minimize administrative functions, keeps overhead costs to a practical minimum, provides maximum flexibility for resource allocation, and facilitates SMC oversight of all decommissioning operations. The following subsections contain brief descriptions of the remainder of the decommissioning organization.[76]

9.2 Decommissioning Task Management

Radiation Work Permits (RWPs) will be used for the administrative control of personnel entering or working in areas that have radiological hazards present. Work techniques will be specified in such a manner that the exposure for all personnel, individually and collectively, are maintained ALARA. RWPs will not replace work procedures, but will act as a supplement to procedures. Radiation work practices will be considered when procedures are developed for work which will take place in a radiologically controlled area.

Project RWPs will describe the job to be performed, define protective clothing and equipment to be used, and personnel monitoring requirements. RWPs will also specify any special instructions or precautions pertinent to radiation hazards in the area including listing the radiological hazards present, area dose rates and the presence and intensity of hot spots, loose surface radioactivity, and other hazards as appropriate. The radiation safety organization will ensure that radiation, surface radioactivity and airborne surveys are performed as required to define and document the radiological conditions for each job.

RWPs for jobs with low dose commitments will be approved at the HP technician or HP supervisory level while RWPs for jobs with potentially high dose commitment or significant radiological hazards will be approved by the RSO. Examples of topics covered by implementing procedures for the Radiation Work Permits are:

- Requirements, classifications and scope for RWPs;
- Initiating, preparing and using RWPs;

[76] A single individual may serve one or more roles during implementation of the work plan. Likewise, each role described herein may be fulfilled by more than one individual. Those individuals specifically assigned to each role will be named and their qualifications presented in the work plans.

- Extending expiration dates of an RWP; and
- Terminating RWPs.

9.3 Decommissioning Management Positions and Qualifications

9.3.1 Radiation Safety Officer

The RSO will have an Associate's degree (or equivalent), and should have completed course work and/or have experience with the following: Principles and practices of radiation protection; Radioactivity measurements, monitoring techniques, and the use of instruments; Mathematics and calculations basic to the use and measurement of radioactivity; Biological effects of radiation; Safety practices applicable to protection from the radiation, chemical toxicity, and other properties of the radioactive materials in use at SMC facilities; Conducting radiological surveys and evaluating results; Evaluating radioactive material processing facilities for proper operations from a radiological safety standpoint; and Familiarity with applicable USNRC, USEPA, and OSHA regulations, as well as the terms and conditions of any licenses and permits issued to SMC by these agencies.

The Radiation Safety Officer (RSO) is an individual who, by virtue of qualifications and experience, has been given the authority to implement the Radiation Protection Program Plan on the site. The RSO is qualified to direct the use of radioactive material for its intended purpose in a manner that protects health and minimizes danger to life or property. The RSO is responsible for recognizing potential radiological hazards, developing a radiation safety program to protect against these hazards, training workers in safe work practices, and supervising day-to-day radiation safety operations.

The RSO is responsible for recommending the type and quantity of staff and resources necessary for full implementation of the SMC Radiation Protection Program Plan. The RSO has the responsibility and authority to terminate any work activities that do or may violate regulatory requirements for radiological protection pursuant to "Stop Work Authority".

9.3.2 Other Management Positions

9.3.2.1 Decommissioning Contractor

SMC will retain a Decommissioning Contractor to implement this Plan subject to SMC's direction and control. The Decommissioning Contractor, to be selected by SMC after USNRC approval of the Plan, will prepare the final work plans, pre-qualify and select all subcontractors, monitor subcontractor performance, perform and document Final Status Surveys, facilitate communications with federal and state regulatory authorities, and provide on-site project management and site-specific health and safety support (radiological, industrial hygiene, and industrial safety support) during the construction phase. To fulfill this role, the Decommissioning Contractor will have demonstrated experience in facility decommissioning, industrial safety/surveillance, radiological safety/surveillance, license/regulatory interactions, negotiations and compliance demonstration, developing technical bases for radiological operations, and preparing standard operating procedures to implement these technical bases.

9.3.2.2 Project Manager

The Decommissioning Contractor will designate an individual to serve as the Project Manager. The Project Manager will be responsible for the following:

- Verifying that the personnel used by each subcontractor are provided with the proper radiation protection, industrial safety training and possess the requisite knowledge of the details of the job assignment;
- Observing work in progress to verify adherence to the radiological and industrial safety rules and procedures;
- Recommending changes to operational and radiological protection practices to the subcontractors;
- Enforcing compliance with SMC site rules and license requirements;
- Reviewing reports and results provided by subcontractors; and
- Establishing and maintaining a records management system to verify that project documents, such as correspondence, procedures, drawings, specifications, contract documents, changes to documents, and inspection records are controlled.

9.3.2.3 Site Health and Safety Officer

Reporting to the Project Manager will be the Site Health and Safety Officer (Site HSO). This individual will be present at the Newfield facility for the duration of all on-site work, and is to be knowledgeable in the following radiation protection and industrial safety subjects:

- Principles and practices of radiation protection;
- Radioactivity measurements, monitoring techniques, and the use of instruments;
- Mathematics and calculations basic to the use and measurement of radioactivity;
- Biological effects of radiation;
- Safety practices applicable to protection from radiation, chemical toxicity, and other properties of the materials that may be encountered during the decommissioning;
- Conducting radiological surveys and evaluating results;
- Evaluating and implementing the final work plans for proper operations from a radiological safety standpoint;

- Applicable USNRC, USEPA, and OSHA regulations, as well as the terms and conditions of any licenses and permits issued by regulatory agencies to SMC; and

- The requirements contained in USNRC License No. SMB-1507.

The responsibilities of the Site HSO will include, but are not limited to the following:

- Establishing the health and safety program requirements for field activities

- Verifying that the subcontractors implement the requirements of the industrial safety and radiation protection program adequately

- Reviewing the results of surveys, sampling, and environmental monitoring to identify trends and potential for personnel exposure

- Evaluating the effectiveness of engineering and administrative control including the requirements for personnel protective equipment

- Developing new safety protocols and procedures necessary for new field activities

- Providing internal review and approval for work related documents

- Auditing key aspects of the safety and health program

- Making recommendations to the Project Manager regarding the control of existing and potential industrial, chemical and radiological hazards

- Stopping work if conditions indicate the potential for unnecessary radiation exposure to site personnel or members of the public, or for unsafe working conditions.

9.3.2.4 Quality Assurance Officer

The Decommissioning Contractor will also assign a Quality Assurance Officer (QAO) for the project. The QAO will perform the following:

- Technical assistance and peer review of all deliverables;

- Prepare and review the QAPP;

- Coordinate with analytical laboratories, as necessary;

- Oversee subcontractor QA activities to ensure compliance with the QAPPs;

- Track laboratory submittals and sample analyses and verify delivery of data, as necessary;
- Coordinate validation of analytical data;
- Monitor the on-site activities; and
- Prepare and submit QA reports, as required.

9.4 Training

All employees, contractors, and visitors with unescorted access to the facility will be trained in regard to the type and magnitude of the radiological hazards they might face. All personnel performing the on-site work described in this Plan will be trained pursuant to 29 CFR 1910.120. The following subsections briefly describe the various training programs that will be implemented as part of this Plan.

9.4.1 Visitor Training

Visitors to the work zone will be trained by reading and signing a briefing form. The briefing form will contain information about the hazards present in the work zone, and the requirement that all visitors be escorted while in the work zone.

9.4.2 General Employee Training

General Employee Training in Radiation Protection (GET) will be administered to all project employees with the potential to receive in excess of 100 millirem TEDE while performing work at the SMC plant. GET, provided to the start of work on this decommissioning effort, will consist of an oral presentation by the Site HSO, hand-out of materials, and completion of a form acknowledging receipt of training. GET will address the following topics:

- The type and form of radioactive material present at the facility.
- The location of USNRC and SMC radiation protection policies and procedures.
- Employee and management responsibilities for radiation safety.
- Identification of radiation postings and barriers.
- Protective equipment and procedures.
- Work zone setup and decontamination procedures;
- Emergency procedures; and

- How to contact SMC and project radiation safety staff.

A self-graded exam to test employee proficiency in the class topics shall be administered. A passing score of 68% is required.

9.4.3 Radiation Worker Training

Radiation Worker Training (RWT) will be administered to all employees with the potential to receive in excess of 500 millirem TEDE while participating in this decommissioning effort. RWT will address the following topics:

- Radioactivity and radioactive decay.
- Characteristics of ionizing radiation.
- Man-made radiation sources.
- Acute effects of exposure to radiation.
- Risks associated with occupational radiation exposures.
- Special considerations in the exposure of women of reproductive age.
- Dose-equivalent limits.
- Modes of exposure - internal and external.
- Dose-equivalent determinations.
- Basic protective measures - time, distance, shielding.
- Specific procedures for maintaining exposures as low as reasonably achievable (ALARA).
- Radiation survey instrumentation - calibration, use and limitations.
- Radiation monitoring programs and procedures.
- Contamination control, including protective clothing, equipment and work place design.
- Personnel decontamination.

- Emergency procedures.
- Warning signs, labels, and alarms.
- Responsibilities of employees and management.
- How to contact SMC and project radiation safety staff.

RWT will consist of a classroom lecture and procedure review, a two-hour practical demonstration, a question/answer period, and a handout. The duration of training is approximately six (6) hours. A self-graded exam to test employee proficiency in the class topics shall be administered. A passing score of 70% is required.

9.4.4 Tailgate Safety Training

Tailgate safety meetings will be conducted at the beginning of each work shift, whenever significant changes are made in job scope or whenever new personnel arrive at the job site. The meetings will present health and safety procedures and issues for the day, any unique hazards associated with an activity and review any significant topics from previous activities. The information discussed will be recorded, which will serve as confirmation that the information was presented to those persons whose signatures are on the form.

9.4.5 Training Records

A form will be developed to demonstrate that training commitments are being met. The form will capture the following information: the facility, date, time, task number, type of work, hazardous/radioactive materials used, protective clothing/equipment, chemical hazards, radiological hazards, physical hazards, emergency procedures, hospital/clinic, phone, paramedic phone, hospital address, special equipment and any other safety topics that may be relevant.

9.5 Contractor Support

The efforts of the Decommissioning Contractor will be focused on nuclear, health and safety, regulatory compliance, and project management manners. Specialty services necessary to complete all aspects of this Plan (e.g., engineering design, construction, labor, analytical, etc.) may be subcontracted to firms with appropriate skills and experience. As part of the contract arrangement, each subcontractor will designate a Task Manager and, as necessary, a health and safety and/or QA contact. At all times, however, the Decommissioning Contractor will remain responsible for the quality, type and level of service provided by all subcontractors.

10 HEALTH AND SAFETY PROGRAM

SMC is committed to completing the decommissioning action described herein in a manner that protects workers, the surrounding environment and the public. Consequently, comprehensive health and safety requirements and access controls will be specified in the final work plans. These Health and Safety Plans (HSPs) will remain in effect during all on-site decommissioning activities. SMC will also verify there is sufficient documentation to demonstrate the effectiveness of the health and safety program.

On-site health and safety will be monitored by the Site HSO, operating under the direction of the SMC Radiation Safety Officer, and pursuant to the requirements of License No. SMB-743. As necessary, the Site HSO will provide tailgate safety training, implement the surveillance and individual monitoring programs, perform release surveys for personnel and equipment during decommissioning operations, and maintain all health and safety records generated during the decommissioning efforts.

The Decommissioning Contractor's operations, and those of all subcontractors, will be governed by procedures that meet the requirements of 10 CFR 19 and 20, and the commitments in License No. SMB-743. At a minimum, the Decommissioning Contractor will maintain the following procedures, with their technical basis, at the site for regulatory inspection:

- Radiation Protection Program Plan
- Health and Safety Program Plan
- Control of Health and Safety Procedures
- Radiation Protection Records
- Training and Qualifications of Radiation Protection and Safety Personnel
- Training in Radiation, Chemical and Industrial Safety
- Instrumentation
- Contamination Control
- Exposure Control
- Radiological Areas and Posting

- Control of Radioactive Waste
- Stop Work Authority
- Tailgate Safety Training

Uncontrolled copies of these procedures, as applicable, will be continually present at the job site. Deviations from the procedures will be permitted only as described in the approved exemption criteria.

Each member of the project team will assume certain health and safety responsibilities. These will include, but are not limited to, the following:

- The Site HSO is responsible for the implementation of the HSP, and recommending changes to the plans to the SMC Radiation Safety Officer (RSO).

- The RSO is responsible for providing oversight for implementation of the Work Plan and making changes to reflect field situations that were not anticipated during the plan's initial development. Changes in the HSP can only be made with the concurrence of the SMC Radiation Safety Officer.

- The designated health and safety contact for each subcontractor is responsible for verifying field implementation of the HSP's provisions. This includes communicating site requirements to all personnel on the job, field supervision, and consultation with the Site HSO regarding appropriate changes to this decommissioning plan.

- All on-site project team members are responsible for understanding and complying with all site health and safety requirements, including proper maintenance of health and safety equipment and facilities. This understanding will be documented by signature prior to any team member being authorized to work on decommissioning operations.

SMC is responsible for providing a work-place environment in which employees, visitors and contractors are adequately protected from hazards, including the hazards associated with exposure to radiation and radioactive material. While the exposures associated with the planned decommissioning operations are low, all exposures are assumed to entail some risk to the employee. Therefore, SMC has adopted the following three principles to govern all decommissioning work activities with the potential for exposure to radiation or radioactive materials:

- No activity or operation will be conducted unless its performance will produce a net positive benefit.

- All radiation exposures will be kept as low as reasonably achievable (ALARA) considering economic and societal costs.

- No individual will receive radiation doses in excess of federal limits.

The ALARA requirement will be communicated to all subcontractors at the outset of this project. Each individual must understand their responsibilities to reduce their radiation exposure. Methods to be used to achieve exposure reduction will be reviewed during GET and Tailgate Safety Training. Monitoring and surveillance information will be summarized and reviewed by the work force on a planned and periodic basis. Requirements to implement the ALARA program at the SMC facility are described in SMC Radiation Safety Procedure No. RSP-005.[77]

10.1 Radiation Safety Controls and Monitoring for Workers

Radiation, airborne radioactivity and contamination surveys during decommissioning will be conducted in accordance with approved procedure(s) as listed above. The purposes of these surveys will be to:

- protect the health and safety of workers

- protect the health and safety of the general public, and

- demonstrate compliance with applicable license, federal and state requirements, as well as decommissioning plan commitments.

Radiation safety personnel assigned to the project will verify the validity of posted radiological warning signs during the conduct of these surveys. Surveys will be conducted in accordance with procedures utilizing survey instrumentation and equipment suitable for the nature and range of hazards anticipated. Equipment and instrumentation will be calibrated and, where applicable, operationally tested prior to use in accordance with procedural requirements. Routine surveys are conducted at a specified frequency to ensure that contamination and radiation levels in unrestricted areas do not exceed license, federal, state or site limits. HP staff will also perform surveys during decommissioning whenever work activities create a potential to impact radiological conditions.

Control levels have been established for this decommissioning action. Based upon knowledge of the radiological constituents present at the site and existing exposure rates, it is expected that maximum individual personnel exposures will not exceed 300 millirem TEDE over the life of the project. Surveillance will be performed by the Decommissioning Contractor to verify that exposures are minimized and within acceptable guidelines.

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[77] Shieldalloy Metallurgical Corporation, *ALARA Program*, RSP-005.

As required in 10 CFR 20.1502, the need for individual monitoring for internal and external exposures will be determined and documented prior to the start of work based on existing data. However, because the exposure potential is expected to be less than 500 millirem TEDE, individual monitoring for on-site personnel may not be required. Nonetheless, and at the discretion of the Site HSO, individual monitoring may be implemented.

10.1.1 Air Sampling Program

The air sampling program for the campaign will generally consist of samples collected in a work location occupied by workers, and drawn from the area that is most representative of the air that the worker breathes.[78] Sampling head placement will not, however, be placed in such a manner to interfere with the work or normal movements of the worker.

In the selection of air sampling equipment, equipment that is appropriate for its intended use will be chosen. The type of sampling that is desired will determine the appropriate collection media (e.g., glass fiber, cellulose, membrane, quartz, etc.) required to collect the contaminant. When air sampling is to be performed, consideration will be given to sampling frequencies and changes. The frequency of changes will be determined based on the radiological and physical condition of the work location, worker stay times and type of air sampling performed.

Some air sampling will be performed to achieve a baseline value, as soon as operations begin and routinely thereafter, and after any significant changes in operating conditions. Sampling durations will be determined prior to the start of sample collection based on how routinely or non-routinely the area is occupied, the likelihood of exceeding a predetermined percentage of a DAC or DAC-hour exposure, the length of time required by the operating activity and any other conditions as warranted. The minimum detectable concentration (MDC) is also a determining factor for sampling duration and will be evaluated prior to sample collection. MDC will be based on 10% of the specified DAC.

Following air sample collection, the filter media will be counted with sufficient time (typically one minute) to achieve the MDA for the specific type of radioactivity. After the count, the activity of the air sample will be calculated and compared to the specific DAC value of the radionuclide being sampled. An action level will be based on not exceeding 10% of the applicable ALI and DAC regulatory values listed in 10 CFR 20, Appendix B, Table 1. Measurement results will be reported in units of concentration.

Samplers will be charged, calibrated, deployed and retrieved by the Site HSO (or designee). Filters will be collected on a daily basis and held for decay for 24 hours. They will then be counted in-house for determination of gross alpha activity. Any filters with gross alpha activity significantly

[78] Stationary air monitors may be used to evaluate exposures to the public and workers, determine and track airborne radiological conditions, verify effectiveness of engineering and process controls, to promptly detect any loss of control of airborne material and to satisfy regulatory requirements. These devices, along with the breathing zone sampling, will be used as input to respiratory protection decisions and the internal dose assessment program.

in excess of background (e.g., three times background) will be forwarded, by overnight carrier, to a commercial analytical laboratory for determination of the presence of thorium and uranium isotopes. The laboratory will establish the minimum detectable activity for specific isotopes; the results will be reviewed to establish a consistent ratio between the gross alpha results measured in the field and the isotopic specific activities recorded by the analytical laboratory. Records of the breathing zone sampling program will be maintained on standardized forms. A "Chain of Custody Form" will be completed for all laboratory transfers.

10.1.2 Respiratory Protection Program

In controlling the concentrations of radioactive materials in air, the use of process controls, engineering controls or administrative procedures will be used. Examples may include the use of stay times, exhaust ventilation, diversion of air flow, dust suppression, fixative coatings, or some combination of methods. The use of respiratory protection will only be implemented if these methods are deemed ineffective at controlling intakes of radioactivity by workers.

In the event that respiratory protection is implemented by the Site HSO, the program will require use of National Institute for Occupational Safety and Health/Mine Safety and Health Administration (NIOSH/MSHA) certified equipment, and procedures that comply with 10 CFR 20, Subpart H. The Project Manager, the RSO and the HSO will concur on the need and on the procedural requirements prior to implementing a respiratory protection program.

NIOSH/MSHA approved air purifying respirators include full face piece assemblies with air purifying elements to provide respiratory protection against hazardous vapors, gases, and/or particulate matter to individuals in airborne radioactive materials areas. Individuals may be required to use continuous or constant flow full-face airline respirators for work in areas with actual or potential airborne radioactivity . The RSO will also ensure that the respiratory protection program meets the requirements of 10 CFR Part 20, subpart H.

When respiratory protection equipment requires cleaning, the filter cartridges will be removed. The respirator will be cleaned and sanitized after every use with a cleaner/sanitizer and then rinsed thoroughly in plain warm water in accordance with HP procedures.

Respiratory protective equipment will be kept in proper working order. When any respirator shows evidence of excessive wear or has failed inspection, it will be repaired or replaced.. Respiratory protective equipment that is not in use will be stored in a clean dry location.

10.1.3 Internal Exposure Determination

A combination of indirect bioassay and breathing zone air sampling may be used to determine internal exposures incurred by decommissioning workers while on site. The indirect bioassay program would consist of baseline, termination, and routine monitoring at a frequency sufficient to assess Committed Effective Dose Equivalents equal to a fraction of the ALI. In addition, "special" or "diagnostic" sampling will be implemented in the event air sample data and/or process knowledge warrants stricter control and monitoring. All samples will be analyzed by a laboratory that meets the performance criteria in ANSI N13.30.

The RSO (or designee) will determine the validity of bioassay and air monitoring results prior to their inclusion in the internal dose assessment process. The RSO will typically evaluate the following items to ascertain the validity of monitoring results:

- sample collection errors
- radiation background interference during counting
- calibration errors
- computer software errors
- errors due to counting geometry
- statistical errors.

Only valid bioassay or air monitoring results, as determined by the RSO, will be used for assessment of internal radiation dose. If the data are not valid: the RSO will document the basis for that conclusion and include the documentation in the individual's dosimetry record. The RSO will also estimate the internal dose to the individual via other means and include the estimate in the individual's exposure history. The RSO will identify the route of entry (i.e., inhalation, ingestion, etc.), as the most likely route based upon current knowledge of exposure conditions. The lung clearance class for intake by inhalation will be selected based upon current knowledge of the chemical form and/or particle size.

The committed effective dose equivalent (stochastic) incurred by workers will be estimated by:

$$CEDE_T\ (millirem) = \frac{Intake}{ALI_S} \times 5{,}000$$

where T = the organ or tissue of interest, Intake = the activity taken into the body as determined from bioassay measurements, and ALI = the stochastic Annual Limit on Intake for the radionuclide of interest.

10.1.4 External Exposure Determination

Monitoring for radiation exposures from sources that are outside of the body (external exposure monitoring), if warranted, will be conducted in accordance with applicable SMC Radiation Safety Procedures. Monitoring may, as determined by the RSO, be extended to visitors or others, depending upon the extent of the radiological hazards present in the work areas to be entered.

However, individual-monitoring devices will only be provided to individuals with the potential to meet or exceed 500 mrem effective dose equivalent in a calendar year.

Individual monitoring devices, at a minimum will consist of a whole body thermoluminescent dosimeter (TLD) or equivalent (e.g., optical dosimeter, etc.). The TLDs will be ordered from a vendor that has been approved in advance by the Decommissioning Contractor, and whose program has met the requirements of ANSI N13.11. In addition, the vendor must demonstrate accreditation by National Voluntary Laboratory Accreditation Program (NVLAP).[71]

A number of additional external exposure control methods will be implemented during this decommissioning efforts, such as RSO review and validation of all monitoring results and the application of "time", "distance" and "shielding" in the workplace. In all cases, however, they will be consistent with the requirements and procedures described in applicable SMC Radiation Safety Procedures.

10.1.5 Summation of Internal and External Exposures

Internal and external radiation exposures will be assessed at least each quarter during the decommissioning project. The total organ dose equivalent (TODE) is computed by summing the deep dose equivalent (H_D) from external sources, as determined from external radiation monitoring, and the committed dose equivalent (CDE), as determined from internal radiation monitoring.[72] The total effective dose equivalent (TEDE) is determined by summing the committed effective dose equivalent (CEDE) from sources internal to the body, and the H_D.

10.1.6 Contamination Control Program

The procedures for access to contaminated areas will address the responsibilities of all personnel permitted access, contamination limits, posting, labeling and tagging requirements, protective clothing requirements of each level of contamination encountered, entry and exit requirements, measurement methodologies, decontamination of personnel and training requirements, as described in RSP-009.[73] Routine surveys will be performed throughout the campaign, with each planned in advance with regard to the specific radiation type, predetermined radiation levels, location where radiation is expected and any other special condition warranting a survey.

[71] The use of extremity monitoring or multiple dosimetry are not applicable to this work because uniform exposures are expected. The use of alarming dosimeters will not be required at this site because of process knowledge, previous site surveys and general area dose rates demonstrate they are unnecessary. Furthermore, external dose from airborne radioactive material is not a viable exposure pathway at this site. Therefore, these issues will not be discussed further in this Plan.

[72] If external radiation monitoring is not performed, $H_D = 0$.

[73] Shieldalloy Metallurgical Corporation, *Contamination Control*, RSP-009.

The initial level of protection for the intrusive tasks of this decommissioning operation (i.e., where residual radioactivity may be encountered) will be hard hats, tyvek or cloth coveralls, safety glasses with side shields, steel-toed boots, and gloves. Upgrading or downgrading of the level of protection will be based on ambient conditions as work proceeds. The Site HSO will notify the RSO if it is deemed necessary to upgrade to a higher level of protection.

To assure radioactive materials remain under the control of SMC, each worker involved in this decommissioning effort and working in a contaminated area will be frisked using calibrated, hand held instruments prior to leaving the contaminated work area. Equipment and materials will be frisked and decontaminated, as necessary, prior to exiting the controlled area. Records of release surveys will be maintained on standardized forms and maps. Release criteria will be consistent with those contained in RSP-001.

10.1.7 Instrumentation Program

Radiation survey equipment and instrumentation suitable for detecting and quantifying the radiological hazards to workers and the public will be present on-site throughout the remediation and final release surveys. The selection of equipment and instrumentation to be utilized will be based upon knowledge of the radiological contaminants, concentrations, chemical forms and chemical behaviors that are expected to exist as demonstrated during radiological characterization, and as known from process knowledge of the working history of the SMC site. Equipment and instrumentation selection will also takes into account the working conditions. contamination levels and source terms that are reasonably expected to be encountered during the performance of decommissioning work, as presented in this Plan. In all cases, the program will be consistent with the requirements in RSP-008.[74]

All instruments will be calibrated and maintained according to applicable Radiation Safety Procedures and ANSI Standard N323-1978.[75] All instruments will be calibrated using radiation sources which are traceable to the National Institute of Standards and Technology (NIST). Each ratemeter will be calibrated with a specific detector. All instruments will be calibrated using radiation sources which are traceable to NIST.

Each instrument will be response checked using a reference source and have pre-operational checks performed on a daily basis or as needed. Pre-operational checks will include battery function, high voltage, response to reference source, reset button function, audible response function if applicable, physical condition, current calibration and response to background radiation. These results will be documented and any instruments failing any of the pre-operational checks will be tagged and taken out of service.

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[74] Shieldalloy Metallurgical Corporation, *Instrumentation and Surveillance*, RSP-008.

[75] American National Standards Institute, *Radiation Protection Instrumentation Test and Calibration* ANSI -N323-1978, 1978

10.2 Nuclear Criticality Safety

The licensed radioactive materials present at the Newfield facility are natural uranium and natural thorium, with progeny in equilibrium. The Uranium-235 concentration in the materials is less than 1% by weight, meaning it does not meet the definition of Special Nuclear Material found in 10 CFR 70.4. Because the materials cannot trigger or sustain a critical reaction, nuclear criticality safety measures are not necessary.

10.3 Health Physics Audits, Inspections and Recordkeeping

During the implementation of this Plan, at least one assessment of the effectiveness of this health and safety plan will be performed by an individual who is Certified by the American Board of Health Physics in the comprehensive practice of health physics. Informal assessments and inspections will be completed by the Site HSO on a daily basis, with unexpected, non-conforming, ir unusual items and situations documented, along with their resolution.

10.4 Public Health and Safety Requirements

The safety of the public is a priority during this decommissioning project. SMC is committed to minimizing the likelihood that the public health and safety will be compromised or impacted during the project. Therefore, access to active construction areas will be limited to authorized construction personnel. Fences will be used to eliminate the likelihood of members of the public (e.g. children) inadvertently intruding on the site. If deemed necessary, security guards will be employed to monitor temporary locations where the fence is deemed to be insufficient for protection.

The spread of contamination off site will be minimized by surveying persons and equipment before leaving the controlled area and verify that no radioactive contamination remains on the clothing or equipment surfaces above the limits established by the project plans. Airborne dust and debris will be minimized by the use of wet methods during intrusive work.

10.5 General Health and Safety Requirements

General health and safety requirements for this decommissioning effort will be designed to meet the requirements of the OSHA Construction Standard (29 CFR 1926), applicable USNRC regulations, and other specific requirements established by SMC. The requirements will remain in effect throughout the campaign. However, changes to the health and safety plan (HSP) may be made by the Site HSO to accommodate static or dynamic conditions. The following issues will be addressed in a site-specific HSP, prepared by an individual who is Certified by the American Board of Industrial Hygiene:

- Facility or site description including availability of resources such as roads, water supply, electricity and telephone service;

- Description of the known hazards and an evaluation of the risks associated with the incident and with each activity conducted;

- Listing of key personnel (including the site safety and health officer) and alternates responsible for site safety, response operations, and for protection of public health;
- Delineation of work area, including a map;
- Description of levels of protection to be worn by personnel in the work area;
- Description of the medical monitoring program;
- Standard operating procedures for verifying the proper use and maintenance of personal protective equipment;
- Procedures to control site access;
- Description of decontamination procedures for personnel and equipment;
- Site emergency procedures and availability of emergency medical care for injuries, radiological and toxicological insults;
- Procedures for monitoring fugitive emissions, including frequency and type of monitoring, monitoring techniques, and equipment calibration and maintenance; and
- Procedures for protecting workers from weather-related problems.

A copy of the HSP, as approved by the CIH and the RSO, will be maintained on-site for the duration of the decommissioning effort, and its provisions will be captured in applicable training programs.

10.5.1 Site/Area Access Control

The Site HSO will enter the work area before any work begins in order to verify that work zones have been appropriately established. The daily site entry procedure will include the following:

- Determine the wind direction and stay apprized of it throughout the day, identifying the direction during the tailgate safety meetings and whenever activities with the potential to create airborne dust are performed;
- Confirm the proper placement of emergency information and operational status of equipment.
- Visually scan for signs of actual or potential life or health threatening hazards;
- Note the physical conditions of the site and determine potential exposure pathways;

- Identify new boundaries of the work zones; and
- Document site activities in a "Field Activity Daily Log", including observations related to field conditions and the site, and samples collected.

In general, access to the work area will be limited to the Decommissioning Contractor and subcontractor personnel.

10.5.2 Medical Monitoring Program

All personnel involved in on-site remedial activities participate in a medical and health monitoring program. This program will follow the general guidelines established by OSHA in 29 CFR 1910.120. Unscheduled medical examinations may be conducted at the request of an employee or SMC's occupational physician after a suspected exposure is reported or measured.

Any team member who develops a lost-time illness or sustains a lost-time injury during production operations will be re-examined by a physician. The physician must certify that the employee is fit to return to work before further participation in the decommissioning effort.

10.5.3 Emergency Procedures

This section of the Plan establishes the means by which decommissioning operations will be conducted without adverse impacts on worker health and safety. In the event of an accident or other emergency situation, appropriate measures will be taken in order to reduce the impact on worker health and safety.

Minor accidents will be investigated by the subcontractor and reported to the Site HSO. The actions necessary to correct the situation will be documented. The work area will have a first aid kit to handle minor incidents. Should there be an incident that cannot be handled by the subcontractor (e.g., a major accident, fire, or chemical release), then the RSO will be informed of the location and type of incident, and the need for assistance. The Site HSO will notify the RSO of all first aid cases so that the potential for radionuclide uptake through wounds can be assessed.

A list of emergency response telephone numbers will be compiled and distributed during tailgate safety training. Prior to the start of each day's work activities, the nearest SMC telephone will identified for use during an emergency, and a radio will be worn by the Site HSO, which will be compatible with the communications systems used by the subcontractors. The list of emergency phone numbers will be readily available on site, along with directions to the nearest hospital.

11 ENVIRONMENTAL MONITORING AND CONTROL PROGRAM

11.1 Environmental ALARA Evaluation

The management of SMC is committed to reducing exposures to radioactive materials and direct radiation to as low as reasonably achievable (ALARA). Exposures should be reduced to ALARA to SMC employees, contractors assigned to implement the decommissioning plan as well as emissions to the environment and ultimately the members of the public living near the Newfield facility. Potential pathways for exposure exist during the construction of the engineered cap and intrusive work where the slag and baghouse dust is excavated. Engineering and administrative controls will be implemented during the construction phase in order to minimize exposures.

The principle source of exposure is contaminated airborne dust impacting the inhalation and ingestion pathways. The slags at the facility are all solid, non-combustible material with the consistency of vitrified rock. Testing performed on the slag shows that the radioactivity does not leach with exposure to ambient conditions.[76] The baghouse dust forms a "crust" when it encounters moisture, which serves to deter fugitive dust emissions. To the extent practical, excavated soil will be wetted to reduce the generation of airborne dust. SMC has established a goal to evaluate the effectiveness of the wetting process; contaminated airborne dust should be reduced to concentrations at least 10% of the USNRC limits for offsite discharge.[77] As described in Chapter 10, air monitoring will be performed to measure the presence of contaminated dust, both near the employee's work areas as well as the perimeter of the Storage Yard. Air sampling stations will be established as described in Section 10.1. The analytical results for the perimeter air samples will be compared to the limits specified in the USNRC regulations for discharge to the environment.

Employees working directly with contaminated soil or the baghouse dust will wear personal protective clothing to reduce the spread of radioactive contamination. Portable, calibrated radiation survey instruments will be used to verify that the employees are free of surface contamination before leaving the restricted area and the facility at the end of the work shift. A description of the contamination control program is provided in Section10.1.

The RSO will review the results of the air sampling program periodically and prepare a summary for SMC management. The report will summarize the air sampling results, applicable limits and identify any trends relating to elevated results. If necessary, the RSO will modify the field practices and verify that the changes were adequate to reduce airborne dust concentrations to ALARA. Any sample that exceeds 10% of the USNRC airborne limit will be reviewed by the RSO within 24 hours

[76] Teledyne Isotopes, *Report of Leachability Studies for Shieldalloy Metallurgical Corporation*, Teledyne Isotopes, Westwood, New Jersey, 1992.

[77] US Nuclear Regulatory Commission, Standards for Protection Against Radiation, Title 10 Code of Federal Regulations, Part 20, Appendix B.

after it is identified. An investigation will be documented and the source of the elevated readings will be identified and evaluated.

11.2 Effluent Monitoring Program

The primary effluent discharges during the decommissioning process are assumed to be airborne in nature and could consist of dust from the excavation of material, dumping of material, shaping and pushing of the slag and other regulated and non-regulated materials during capping operations, vehicle/equipment movement, and the surface grinding of contaminated concrete. The locations where potential effluent discharges could occur include the Storage Yard where the baghouse dust and various slags are currently stored and where the planned engineered cap will be installed. In addition, the temporary haul roads used for transport of radioactive materials to the engineered cap location, sites where slag used as fill are excavated, and residual concrete pads or surfaces that will be decontaminated are other potential sources.

Area air samples will be taken in locations that are representative of actual effluent releases. A sufficient number of samplers will be positioned downwind of in progress work locations to ensure that samples collected are representative of actual releases. Air sampler positioning will be evaluated frequently to accommodate for shifts in the prevailing wind direction and the locations of dust generating operations.

Air samples will be collected as described in Section 10.1of this Plan, which covers topics such as air sampler and filter selection, sampling durations and frequencies, sampler calibration, action levels for airborne activity. The calculation of the sample MDA will be completed in accordance with SMC Radiation Safety Procedure RSP-008, Instrumentation and Surveillance.

Environmental air samples will be collected at the following frequencies: Before operations with radioactive materials begin to determine a baseline value for airborne activity, as soon as decommissioning operations begin and routinely thereafter, and after any significant change in operating conditions. Air samples will especially be collected during any dust generating operations. The frequency of sample collection will be determined based on the radiological and physical conditions present at the work location and the type of air sampling being performed. Consideration will be given to more frequent filter changeouts during high dust conditions.

Air sampling results will be recorded on standard survey forms that will include information such as sample location and number, date and time of sample, volume sampled, air sampler and filter used, and calculated airborne concentrations. Sampling information will be made a part of the final status survey report. Filters which exceed set parameters will be held and recounted after an appropriate length of time and/or forwarded to a commercial analytical laboratory for further analysis. The decommissioning project manager will inform the RSO of the initial data of samples that exceed action levels and subsequent re-analysis information.

Sample collection and analysis will be conducted using approved procedures as described in Section 10.1 of this procedure. Elements of the quality assurance program are provided in Section 13 of this Plan.

11.3 Effluent Control Program

The source of effluent discharges to the environment for the decommissioning project is the materials that have the potential to become airborne during the various operations described in Chapter 8, above. Measures that will be instituted to minimize the release of airborne materials to the environment may include continual application of water spray to excavation areas, to materials in the engineered cap area during shaping and compaction of the pile, and during the dumping of materials from vehicles/equipment. Dust suppressant materials such as calcium chloride, may be used on temporary haul roads used to move materials around the facility. The discharge of liquids to the environment will be eliminated during the decommissioning project through the use of a silt fence backed up with staked hay bales around the perimeter of the entire engineered cap area, thereby preventing sediment from leaving the work site. Surface runoff water outside the silt fence will be collected via perimeter drainage swales to prevent run-on from entering the work site. These drainage swales would be designed to discharge away from the work area to prevent the erosion of the radionuclide-bearing materials.

Actions to be taken in the event an action level is exceeded include stoppage of the suspect work activity if it is still ongoing, the conduct of additional air, radiation, and contamination surveys as applicable, notification of the RSO, preparation of dose estimates for workers and the general public due to the release, and corrective measures to prevent future releases.

12 RADIOACTIVE WASTE MANAGEMENT PROGRAM

12.1 Solid Radioactive Waste

The types of solid materials associated with the decommissioning process include ferrocolumbium standard slag, ferrocolumbium high-ratio slag, and columbium nickel slag generated from the D111 and D102 smelting operations; baghouse dust from prior operations in D111; soil containing ferrocolumbium slag, and concrete dust from the surface removal of contaminated concrete baghouse and building structures. Each of the slags are solid, non-combustible materials with the consistency of vitrified rock. The estimated volume of each of the material types are listed in Table 17.1.

The entire volume of these materials will be contained within the capped area of the property. It is anticipated that no residual radioactivity will be shipped off site for disposal and no temporary storage of materials will be required. Excavated materials that do not meet the applicable release criteria will be transported directly to the Storage Yard for disposal under the engineered cap.

Excavated materials and radioactive materials currently in the Storage Yard will be sprayed with a water spray to minimize dust generation during operations such as excavation, shaping and pushing of piles, dumping of materials from vehicles/equipment, etc. Concrete removed (scabbled) from the surface of the AAF and Flex-Kleen Baghouse pads, and other materials collected from building surfaces using high efficiency filtered vacuums, will be transported to the Storage Yard prior to the installation of the engineered cap.

12.2 Liquid Radioactive Waste

No radioactive liquids are anticipated to be generated during the decommissioning process. Water spray used to minimize dust generation is assumed to be included (consumed) with the capping process for the solid materials.

12.3 Mixed (Radioactive and Hazardous) Waste

No solid or liquid mixed wastes are expected to be generated during the decommissioning process.

13 QUALITY ASSURANCE PROGRAM

Decommissioning activities will be performed in a manner to ensure the results are accurate and that uncertainties have been adequately considered. The quality assurance program will operate in all stages of decommissioning through the final survey, validation of the data. and the interpretation of the results to verify that this has occurred.

13.1 Organization

Persons responsible for ensuring that the quality assurance program has been established and verifying that activities affecting quality have been correctly performed will have sufficient authority, access to work areas and organizational freedom to:

- identify quality problems;
- initiate, recommend or provide solutions to quality problems through designated channels;
- verify implementation of solutions; and
- ensure that further decommissioning activities are controlled until proper disposition of a nonconformance or deficiency has occurred.

Such persons or organizations will have direct access to responsible management at a level where appropriate action can be taken. Such persons or organizations will report to a management level such that required authority and organizational freedom are provided, including sufficient independence from cost and schedule considerations.

The following key positions, the decommissioning project manager, radiation safety officer and health physics technicians have the authority and responsibility to implement the elements of the quality assurance program.

13.1.1 Decommissioning Project Manager

Overall control and authority for radiation protection at SMC will rest with the Decommissioning Project Manager (PM). The responsibility of the PM will include, but is not limited to, the following:

- Establish the procedures to decommission the site and submit changes to the decommissioning plan to the USNRC. The PM may not implement the changes until approved by the USNRC in writing;

- Assure that the capability of radiation protection services are sufficient to meet the requirements of this decommissioning plan and applicable state or federal regulations.

13.1.2 Radiation Safety Officer (RSO)

The RSO will be responsible for recommending the type and quantity of staff and resources necessary for full implementation of the Radiation Protection Program Plan. The RSO is designated by the USNRC in writing and may not be changed without the written approval of the USNRC and amendment of the radioactive materials license.

The RSO will have the responsibility and authority to terminate any work activities that do or may violate regulatory or SMC requirements for radiological protection. Specific work activities will be permitted to proceed to a safe condition after implementation of the stop-work order. Stop-work orders will be lifted after the initiating conditions have been alleviated.

13.1.3 Health Physics Technicians

The RSO may designate authority for implementing certain aspects of the radiation protection program to SMC or contract Health Physics Technicians. The responsibilities and authority of Health Physics Technicians may include the following:

- Ascertain compliance with rules and regulations, site-specific license conditions, and the guidelines approved and specified by the RSO;

- Provide technical support for some or all aspects of radiation protection, including field operations;

- Monitor and maintain equipment associated with the use, storage and/or disposal of radioactive material;

- Provide consultation on all aspects of radiation protection to personnel at all levels of responsibility;

- Administer and coordinate the distribution of personnel and area dosimeters on an as-needed basis;

- Maintain personnel/area monitoring records, notify personnel and management of exposures approaching maximum permissible limits, recommend appropriate corrective action, and evaluate exposures reported by contract dosimetry services;

- Perform other monitoring/surveillance tasks as directed by the RSO.

13.2 Quality Assurance Program

For execution of decommissioning activities at the SMC Project, a Quality Assurance Project Plan (QAPP), consistent with applicable guidelines will be developed. The QAPP will be reviewed and approved by SMC prior to its implementation. The objective of the QAPP is to ensure confidence in the sampling, analysis, interpretation and use of radiological data generated during the decommissioning project.

The QAPP will ensure collection of reliable data by serving as the instrument of control for field and analytical activities associated with the project. Stated within the QAPP are the quality assurance policies, quality control criteria, and reporting requirements that must be followed by all site and contractor personnel when carrying out their assigned responsibilities on this project. The QAPP describes the functional activities and quality assurance/quality control {QA/QC) protocols necessary to collect data of adequate quality.

13.2.1 Procedures

Supporting Quality Implementing Procedures (QIPs) will provide step-by-step details for complying with project QA requirements. The final radiological survey, including development of sampling plans, direct measurements, sample analysis, instrument calibration, daily functional checks of instruments, and sampling methods will be performed according to written procedures. These written procedures will be reviewed and approved by the SMC project manager.

13.2.2 Subcontractor Services

The activities to be conducted during decommissioning will require the services of a decommissioning contractor and various specialty subcontractors such as a qualified drilling contractor or a licensed surveyor. Contractor activities will be under the direct supervision of SMC personnel in accordance with the QAPP. Subcontractor activities will be under the direct supervision of the decommissioning contractor personnel, also in accordance with the QAPP .

13.2.3 Laboratory Services

For off-site sample analysis, a qualified laboratory recommended by the decommissioning contractor and approved by SMC will perform those radiological analytical laboratory services for the project. The laboratory will be responsible for all bench level QA/QC, data reduction, data reporting, and analytical performance monitoring. Laboratory accuracy will be evaluated by the analysis of blank and spiked samples. Sample handling protocols, analytical procedures, and reporting procedures employed by the analytical laboratory will be described in the laboratory's Quality Assurance Plan.

The off-site laboratory will be responsible for assuring that all appropriate laboratory personnel are thoroughly familiar with the Quality Assurance Project Plan and good laboratory practices, and that all appropriate laboratory personnel meet the requisite qualifications for their positions within the laboratory. The laboratory Director, or his equivalent/representative, will review and approve all reports. The Director will also be responsible for assuring laboratory personnel have appropriate training to perform assigned responsibilities, and for daily management of the laboratory and its staff.

The off-site laboratory will have a QA designee who will be responsible for assuring that the QA/QC requirements of the QAPP, the laboratory Quality Assurance Plan, and its associated operating procedures are strictly followed. The QA designee will be responsible for review of data, alerting the SMC decommissioning Project Manager and the Contractor Project Manager of the need for corrective action (when necessary), performing internal audits as specified by the QAPP, and maintenance of the QC records. The QA designee will also be responsible for preparing project specific QA/QC plans, as necessary .

13.2.4 Surveys and Sampling Activities

Trained individuals following written procedures will perform surveys using properly calibrated instruments. The custody of samples will be tracked from collection to analysis. Final survey data will be retained until the radioactive materials is terminated by the USNRC. The designated sampler or analytical laboratory will collect a split sample when desired by the USNRC to obtain samples that are duplicates of those to be analyzed. When this operation is performed, the procedure for obtaining duplicate samples will be followed.

QC hold points will be utilized as necessary to ensure quality of surveys and sampling. Hold points will also be used to ensure that debris is moved only after QA has verified that the proper sampling and survey information for the debris in question has been obtained.

13.3 Document Control

Data will be recorded and documented in a data management system. Entries will include the location of the survey or sampling point on the appropriate building grid. Data management personnel will also ensure that chain-of-custody and data management procedures are followed for decommissioning-related samples. The decommissioning contractor's procedures for proper handling, shipping and storage of samples will be used.

Both direct measurements and analytical results will be documented. The results for each survey measurement or sample and its grid block location, will be listed in tabular form *(i.e.,* result versus sample or survey location).

Data will be recorded in an orderly and verifiable way and reviewed for accuracy and consistency. Every step of the decommissioning process, from training personnel to calculating and interpreting the data, will be documented in a way that lends itself to audit. Records of training to demonstrate qualification will also be maintained.

13.4 Control of Measuring and Test Equipment

Procedures for calibration, maintenance, accountability , operation and quality control of radiation detection instruments implement the guidelines established in American National Standard Institute

(ANSI) standard ANSI N323-1978 and ANSI N42.17A-1989.[78,79] Proper maintenance of equipment varies, but maintenance information and use limitations are provided in the vendor documentation. Measuring and analyzing equipment will be tested and calibrated before initial use and will be recalibrated if maintenance or modifications could invalidate earlier calibrations. Field and laboratory equipment, specifically used for obtaining final radiological survey data, will be calibrated based on standards traceable to NIST.

Minimum frequencies for calibrating equipment will be established and documented. Measuring equipment will be tested at least once on each day the equipment is used. Test results will be recorded in tabular or graphic form and compared to predetermined, acceptable performance ranges. Equipment that does not conform to the performance criteria will be promptly removed from service until the deficiencies can be resolved.

13.5 Corrective Action

Audits and surveillances will be conducted during the course of the decommissioning project. Observations will be investigated and corrections will be made as necessary. The observation and the proposed corrective actions will be documented and reviewed by the project manager and the radiation safety officer. The corrective action will be documented and the concurrence by the project manager and the radiation safety officer will be documented in writing. The person or department responsible for implementing the corrective action will be assigned and a schedule will be established to implement the change. After the finding is closed out, a surveillance will be conducted within thirty (30) days to verify that the problem has been alleviated. Significant conditions adverse to quality, the cause of the conditions, and the corrective action taken to preclude repetition will be documented and reported to immediate management and upper levels of management for review and assessment.

13.6 Quality Assurance Records

13.6.1 Laboratory Data

Data reduction, QC review, and reporting will be the responsibility of the analytical laboratory. Data reduction includes all automated and manual processes for reducing or organizing raw data generated by the laboratory. The laboratory will provide a data package for each set of analyses that will include a copy of the raw data in electronic format, and any other information needed to check and recalculate the analytical results.

[78] American National Standards Institute, *Radiation Protection Instrumentation and Calibration*, ANSI N323-1978, September, 1977.

[79] American National Standards Institute, *Performance Specifications for Health Physics Instrumentation - Portable Instrumentation for Use in Normal Environmental Conditions*, ANSI N42.17A-1989, November, 1988.

Once a data package is received from the laboratory, the analytical results and pertinent QA/QC data will be compiled onto standardized data formats. The data packages will serve as basic reference sheets for data validation, as well as for project data use.

13.6.2 Field Survey Data

The generation, handling, computations, evaluation and reporting of final radiological survey data will be as specified in the decommissioning contractor's procedures. Included in these procedures will be a system for data review and validation to ensure consistency, thoroughness and acceptability. Qualified health and safety, operations, and/or engineering personnel will review and evaluate survey data.

13.6.3 Data Evaluation

Prior to releasing data for use by project staff, selected data will undergo data evaluation based on intended end use of the data. Data points chosen for evaluation will be examined to determine compliance with QA requirements and other factors that determine the quality of the data. Data taken during a characterization survey will be subjected to quality verification before use as final status survey (FSS) data. Data taken during a prior survey, e.g., characterization survey, may be usable as FSS data provided the data are subjected to quality verification and satisfy data quality objectives.

If sample data are rejected or data omissions are identified during the data validation, this data will be evaluated to judge the impact on the project. Other corrective action may include re-sampling and analyzing, evaluating and amending sampling and analytical procedures and accepting data acknowledging the level of uncertainty .

In the event final status survey data are processed by computer, the application program and each modification thereof will be verified to perform as intended before its initial use. A knowledgeable person will verify that the algorithms are as intended and will compare an instance of computer-generated result and an independently derived result of the same process. SMC will document the application program, including its algorithms and a listing or copy of the program.

13.6.4 Sample Chain-of-custody

One of the most important aspects of sample management is to ensure that the integrity of the sample is maintained; that is, that there is an accurate record of sample collection, transport, analysis, and disposal. This ensures that samples are neither lost nor tampered with and that the sample analyzed in the laboratory is actually and verifiably the sample taken from a specific location in the field.

Sample custody will be assigned to one individual at a time. This will prevent confusion of responsibility. Custody is maintained when (1) the sample is under direct surveillance by the assigned individual, (2) the sample is maintained in a tamper-free container, or (3) the sample is within a controlled-access facility .

The individual responsible for sample collection will initiate a chain-of -custody record using a standard form provided by the decommissioning contractor. A copy of this form will accompany the samples throughout transportation and analyses; and any breach in custody or evidence of tampering will be documented.

13.7 Audits and Surveillances

Periodic audits will be performed to verify that decommissioning activities comply with established procedures and other aspects of the QAPP and to evaluate the overall effectiveness of the QA program. SMC and Contractor Quality Assurance personnel will verify that qualified personnel are used to conduct audits to ensure that the applicable procedures are being properly implemented. The audits will be conducted on at least a quarterly basis, in accordance with written guidelines or checklists. Health and safety personnel will also conduct semiannual audits in their area of concern. External program audits may also be used at the discretion of either SMC or contractor management. Audit results will be reported to both SMC and contractor management in writing, and actions to resolve identified deficiencies will be tracked and appropriately documented.

14 FACILITY RADIATION SURVEYS

14.1 Release Criteria

The residual radioactivity at the Newfield facility consists, entirely, of natural uranium (238U plus progeny) and natural thorium (232Th plus progeny). The media of concern are building surfaces and soil. Based upon the requirements specified in 65 FR 114 and NUREG/CR-5512, Derived Concentration Guideline Levels (DCGLs), which are equivalent to the applicable release criteria, were determined for restricted release conditions as follows:[80,81]

$$DCGL_R = C_T \times 100\ mrem \div 25\ mrem$$

where $DCGL_R$ = the DCGL for restricted release, and C_T = the concentration given in the applicable table of NUREG/CR-5512. Table 17.12 contains a summary of results.

To facilitate the performance of field measurements, in light of the presence of more than one radionuclide, gross activity DCGLs for each medium were determined as follows:[82]

$$DCGL_{gross} = \frac{1}{\frac{f_{238U+C}}{DCGL_{238U+C}} + \frac{f_{232Th+C}}{DCGL_{232Th+C}}}$$

where f = the relative fraction of the total activity contributed by the radionuclide. Assuming f = 0.5 for both radionuclides, Table 17.13 is a summary of those results. Although Class 1 survey units are present at the Newfield site, in order to interject an element of conservatism into the decommissioning effort, only wide-area DCGLs, using the values shown in Tables 17.12 and 17.13 are applicable.

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[80] Federal Register, Volume 65, No. 114, page 37186, June 13, 2002.

[81] Beyeler, W. E., et al., "Residual Radioactive Contamination From Decommissioning; Parameter Analysis; Draft Report for Comment", NUREG/CR-5512, Vol. 3, U. S. Nuclear Regulatory Commission, October, 1999, Tables 5.19 and 6.91.

[82] MARSSIM, Equation 4-4.

14.2 Characterization Surveys

14.2.1 Measurement Description

A comprehensive site-wide survey for the presence of radioactivity at the Newfield facility was conducted in 1991. The purpose of the survey was to assess the overall radiological conditions at the site. The findings were captured in a final report that was published in 1992.[83]

Data acquisition for this effort was consistent with a measurement/sampling plan that was approved by the USNRC and the NJDEP in advance of deployment to the site. Pressurized ion chamber (PIC) measurements were performed at 20 meter intervals along the boundary of the site to characterize the whole body exposure rate at the boundary fence. The PIC has a relatively "flat" energy response over the energy range of interest for the effort (e.g.150 keV to 2600 keV) and therefore, its measurements directly reflect the ambient whole body exposure rate at the point of measurement. In addition, ambient radiation surveys using gamma scintillation survey meters were performed at each intersection of an established grid pattern. These measurement results, after application of a "count rate to exposure rate" conversion factor, were used to determine ambient exposure rates throughout pertinent areas of the SMC property and adjacent areas of interest.

An assessment of the amount of residual radioactivity in soil and sediment was performed by performing a walkover survey with gamma scintillation survey meters positioned near the ground surface. The entire Newfield property was gridded for these measurements, as well as certain locations immediately adjacent to the property boundary. These measurement results were used to identify locations with potentially elevated concentrations of radioactive materials. No walkover surveys were conducted in the vicinity of the slag piles in the Storage Yard due to the elevated background readings in this area. Instead, soil samples were collected in these areas and analyzed for radioactivity.

Finally, since surface drainage in the vicinity of the plant is toward the south into the Hudson's Branch watershed, water and sediment samples were collected at various locations in the Hudson's Branch. In addition, samples of surface water runoff were collected during a storm event in locations exhibiting evidence of erosion. The radioanalytical results of these samples were used to provide additional information on the potential for radiological contamination which might be present in the vicinity of the Hudson's Branch.

14.2.2 Field Instruments, Methods and Detection Sensitivities

The measurement locations of interest on the property were identified by establishing a 10 meter grid system. The gridded area included the majority of the property within the legal boundaries of the site as well as certain surrounding property. The off-site portion of the grid extended approximately 30 meters beyond the fence lines. The types of instruments used for the two radiological surveys included a PIC and portable gamma scintillation survey meters. Ambient exposure rates in the

[83] IT Corporation, Report No. IT/NS-92-106, "Assessment of Environmental Radiological Conditions at the Newfield Facility", April 1992.

vicinity of the slag piles and at the perimeter of the property were measured with a PIC. Acquisition of ambient exposure rate data using PICs is time consuming and somewhat unwieldy. Therefore, portable survey instruments were used to obtain "count rates" at a height of one meter above the ground at the same locations as the PIC measurements. These values were used to develop a "count rate to exposure rate" conversion factor for use in converting portable survey instrument readings into ambient gamma exposure rates.

Portable instrument surveys were then conducted at every grid intersections with the exception of paved areas of the plant and in the vicinity of the slag piles. The grid point measurements were performed with the probe of a gamma scintillation detector positioned at a height of one meter above the ground surface. The "one meter height" count rates were then converted into ambient gamma exposure rates through application of the conversion factor.

Walkover surveys were conducted to obtain additional information on the extent of soil contamination. These surveys were performed in all accessible grid blocks, with the exception of the paved area of the plant and in the vicinity of the slag piles by walking in 10 meter parallel paths while slowly swinging a gamma scintillation detector in a three to four foot span parallel to the ground (approximately 10 cm from the ground surface).

14.2.3 Laboratory Instruments, Methods and Detection Sensitivities

Soil samples collected during the measurement campaign were transported to a commercial analytical laboratory and were analyzed by gamma spectroscopy (radium-226, radium-228, bismuth-214, lead-214, and other gamma-emitters). The concentration of uranium-238 and thorium-232 in the samples were determined by isotopic analysis (alpha spectroscopy).

Water samples also went to an offsite commercial laboratory where they were filtered into suspended and dissolved fractions. Each water sample was analyzed for dissolved and suspended gross alpha and beta activity. Isotopic analysis was performed if the gross alpha activity exceeded a 1976 EPA screening level (applicable at the time) of 15 pCi/liter or if the gross beta activity exceeded the screening level of 50 pCi/liter. The isotopic analyses included gamma spectroscopy and alpha spectroscopy for uranium-238 and thorium-232. For the dissolved fractions, radon de-emanation was used to determine the radium-226 concentration, and beta-gamma coincidence counting was used to determine the radium-228 concentration.

14.2.4 Survey Results

Appendix 19.3 shows the radionuclide concentrations measured during the site-wide characterization. The maximum measured exposure rate at the property fence line was 0.13 milliR per hour. Walkover survey results indicated elevated count rates on the eastern-most boundary of the property, although the soil sampling results from the same area show little difference from measured background concentrations. Both survey and sampling data show surface deposits present in the general vicinity of the former Flex-Kleen and AAF Baghouses, and elevated count rates identified to the south of the property were attributed to the flow of surface water running from the Storage Yard towards the south.

14.2.5 Maps and Drawings Showing Non-impacted/Impacted Areas

Figure 18.3 contains site drawings with analytical results, on a "per radionuclide" basis. The areas of the Newfield facility that are considered to be unimpacted are consistent with those locations with radionuclide concentrations or exposure rates that are indistinguishable from background.

14.2.6 Adequacy of Characterization Survey

Since the 1991 site-wide characterization effort was completed, routine surveillance activities in and around all restricted areas have been performed once per calendar quarter. These data and the surveillance summaries confirm that no significant quantities of residual radioactivity have migrated past the restricted areas.

All areas and surfaces within the Newfield facility have been surveyed or sampled as part of the 1991 characterization effort, routine quarterly surveillance efforts, or as part of a facility-specific decommissioning effort.

14.3 Remedial Action Support Surveys

No remedial action support surveys will be performed as part of this decommissioning effort. Therefore, no field screening procedures are being incorporated into this decommissioning plan.

14.4 Final Status Survey Design

14.4.1 Overview

Once all remedial actions are complete, the Final Status Survey will be performed, the data acquired will be validated, and a Final Status Survey Report will be prepared and submitted with SMC's application to terminate License No. SMB-743. The objective of the Final Status Survey is to collect sufficient information to demonstrate, to a reasonable degree of statistical certainty, that the radiological parameters at the site do not exceed the established DCGLs, and that the license termination criterion for restricted release has been met. The assigned survey units represent the fundamental elements for compliance demonstration using the statistical tests.

14.4.2 Classification of Areas

All of the areas at the Newfield facility do not have the same potential for residual contamination. Therefore, not all will require the same level of survey coverage in order to evaluate its radiological character. For the purposes of this Plan, SMC has classified the areas at the Newfield site into three categories, Class 1, Class 2, and Class 3 (see Figure 18.14).

Class 1 areas have the greatest potential for contamination and therefore receive the highest degree of survey effort for the final status survey using a graded approach, followed by Class 2, and then by Class 3. Class 1 areas are those that have (or had prior to remediation) a potential for radioactive contamination or known contamination above the DCGL. Class 1 areas at the Newfield site include those known to contain slag or previously were covered by slag. The area encompassing the Storage Yard, and extending outward a distance of 50 feet will be considered a Class 1 area as well as the location of residual slag identified during prior characterizations and the sites where buildings D102/112, D111, the AAF Baghouse and the Flex-Kleen Baghouse were located.

Class 2 areas are those that have a potential for radioactive contamination or known contamination, but are not expected to exceed the DCGL. Class 2 areas at the Newfield site include those that may be potentially contaminated as a result of excavation or other intrusive work during the construction of the caps and site preparation activities. Other Class 2 areas include the laboratory building, shipping and receiving areas/warehouses, and D117 (the "cave"). In addition, locations susceptible to fugitive dust during decommissioning actions are also classified as Class 2 areas.

Class 3 areas are those that are not expected to contain any residual radioactivity or are expected to contain levels of residual radioactivity at a small fraction of the DCGL based on site operating history and previous radiation surveys. Class 3 areas at the Newfield site will include all areas that are not classified as Class 1 or Class 2.

14.4.3 Background Reference Areas

In order to evaluate gross alpha or beta activity on surfaces, a surface of similar construction will be used. The administration building (D201,"Link Building") will be used for background information for drywall surfaces. The Personnel Building (D201) and its immediate will be used to acquire cinder block, asphalt, concrete and soil background data. In addition, the background data sets described in Section 4.1.4, above, will also be used.

14.4.4 Statistical Tests

Because the radionuclides of concern at the Newfield facility exist in the natural background, all measurement results acquired during the Final Status Survey will be compared to the aforementioned DCGLs, using the Wilcoxon Rank Sum Test and the Quantile Test as described in Section 5 of NUREG-1505. If an area exhibits residual radioactivity in excess of the applicable criterion, that area will either be marked for additional remedial action, or technical/regulatory justification for no further action will be prepared and included in the Final Status Survey report. If additional remediation is necessary, follow-up measurements will be performed to demonstrate their effectiveness.

14.4.5 Scanning Instrument Description

All instrumentation used for the Final Status Survey, including scanning measurements, will be appropriate for the type of radiation expected, of sufficient sensitivity and accuracy to detect the radioactive materials of interest, and of sufficient quantity to support planned activities. The following instruments (or equivalent substitutions) will be used to meet these requirements:

- Bicron MicroRem tissue-equivalent meter (ambient gamma surveys)

- Ludlum Model 2241 scaler/ratemeter with a Model 44-10 sodium iodide gamma scintillation detector (gamma walkover surveys)

- Ludlum Model 2224 scaler/ratemeter with Ludlum Model 43-89 dual alpha/beta (contamination surveys of surfaces)

- Ludlum Model 239-1F floor monitor with Ludlum Model 2221 scaler/ratemeter and Ludlum Model 43-37 gas proportional probe (contamination scanning of floors).

Instrument use, calibration and operational checks will be performed pursuant to RSP-008, "Instrumentation and Surveillance". The sensitivity for each medium and radionuclide will be determined prior to the start of the measurement campaign, with the results documented in the final status survey report.

14.4.6 In-situ Measurement Instrumentation Description

No in-situ measurements of radionuclide concentration in soils or other solid materials will be made during this decommissioning effort. Instead, samples will be collected and forwarded to a commercial analytical laboratory for analysis.

14.4.7 Analytical Instrument Description

Prior to submitting any samples to a commercial analytical laboratory, a letter of specification will be written. Included will be the necessary measurement result(s) and relevant detection sensitivity. At that time, the laboratory will be asked to declare the analytical method and the measurement devices they intend to use in order to meet SMC's specifications.

Each commercial laboratory that provides analytical results as part of this decommissioning plan will be asked to provide a copy of their quality assurance documents, including quality assurance procedures designed to ensure the necessary calibrations and detection sensitivity requirements are met.

14.4.8 Sample Collection

Surface soil samples will be collected with a clean, stainless steel scoop or spoon that is decontaminated between uses. Samples will be placed into appropriately-sized containers that have been provided by the analytical laboratory. Each will be labeled with a unique sample number.

All sampling activities will be recorded on field logs and will include individual sample information such as date/time of sample, sample location, and sample number. Collected samples will remain in the custody of sampling personnel or locked in a controlled, limited access location until they are packaged for shipment to the commercial laboratory. A sample Chain of Custody/Request for Analysis form will be completed for all samples and will accompany the sample shipment to the analytical laboratory. Field screening of the samples will be performed to approximate the total radioactivity present and ensure the sample shipment conforms to applicable Department of Transportation shipping regulations.

14.5 Final Status Survey Report

Much of the information contained in the Final Status Survey report will be available from other decommissioning documents compiled by and retained by SMC. However, to the extent practicable, the Final Status Survey report will be a stand-alone document with the amount of information incorporated by reference kept to a minimum. The report will be independently reviewed and will be approved by designated personnel capable of evaluating all aspects of the report prior to its release. The following is a listing of required report elements:

- Site description
- Site conditions at the time of the survey
- Survey objectives
- Derived Concentration Guide Levels
- Classification of areas
- Selection of instruments and survey techniques
- Survey plan and procedures
- Determination of background
- Scanning survey measurements
- Discrete samples
- Detection sensitivity
- Sample collection and analysis
- Data interpretation

Additionally, the following construction-related items will be included in the report as well:

- A brief description of the outstanding construction items from the prefinal inspection and an indication that the items were satisfactorily resolved;

- A synopsis of the work defined in the final work plan and Final Design, and certification that this work was performed;

- An explanation of any changes to the work defined in the final work plan and Final Design, including as-built drawings of the constructed facilities, and why the changes were necessary or beneficial for the project;

- Certification that the decommissioning activities are complete and constructed caps or component of the caps are operational and functional.

Additionally, the Final Status Survey report will contain the following:

- a discussion of any changes that were made in the final status survey from what was proposed in the Plan or other prior submittals.

- a description of the method by which the number of samples was determined for each survey unit;

- a summary of the values used to determine the numbers of sample and a justification for these values;

Furthermore, the survey results reported for each survey unit will include, as applicable:

- the number of samples taken for the survey unit;

- a map or drawing of the survey unit showing the reference system and random start systematic sample locations for Class 1 and 2 survey units and random locations shown for Class 3 survey units and reference areas;

- the measured sample concentrations;

- the statistical evaluation of the measured concentrations;

- judgmental and miscellaneous sample data sets reported separately from the those samples collected for performing the statistical evaluation;

- a discussion of anomalous data including any areas of elevated direct radiation detected during scanning that exceeded the investigation level or measurement

- locations in excess of $DCGL_W$.

- a statement that a given survey unit satisfied the DCGLw and the elevated measurement comparison if any sample points exceeded the DCGLw.

Finally, the Final Status Survey report will contain the following, as necessary:

- a description of any changes in initial survey unit assumptions relative to the extent of residual radioactivity

- if a survey unit fails, a description of the investigation conducted to ascertain the reason for the failure and a discussion of the impact that the failure has on the conclusion that the facility is ready for final radiological surveys; and

- if a survey unit fails, a discussion of the impact that the reason for the failure has on other survey unit information.