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WASTE PIT 6 EXPOSED MATERIAL REMOVAL ACTION WORK PLAN FEED MATERIALS PRODUCTION CENTER

DOCUMENT DATE 00/00/00

908 [redacted]

WASTE PIT 6 EXPOSED MATERIAL

REMOVAL ACTION

WORK PLAN

FEED MATERIALS PRODUCTION CENTER

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For

The United States Department of Energy
Oak Ridge Operations Office

TABLE OF CONTENTS

	EXECUTIVE SUMMARY	1
I.	INTRODUCTION	2
II.	BACKGROUND	2
III.	SUPPORT ACTIVITIES	3
IV.	REMOVAL ACTION IMPLEMENTATION	4
V.	SAMPLING AND ANALYSIS	6
VI.	QUALITY ASSURANCE	8
VII.	HEALTH AND SAFETY PLAN	8
VIII.	ATTACHMENTS	9

EXECUTIVE SUMMARY

The Department of Energy (DOE) has conducted a Removal Site Evaluation (RSE) under authorities delegated to the agency under Section 104 of the Comprehensive Environmental Responsibility, Compensation and Liability Act (CERCLA), through Executive Order 12580. The RSE was performed to determine whether the conditions present at Waste Pit 6 warrant a removal action under CERCLA, consistent with Section 300.410 of the National Contingency Plan (NCP). Based upon the information in the RSE, DOE has determined that a removal action is appropriate and has issued an Action Memorandum. The objective of the removal action is to implement interim actions to mitigate the continuing release of contaminants from Waste Pit 6 until final remediation.

This document provides a work plan describing this removal action.

The removal action will use a crane with a clamshell attachment to remove the exposed waste pit material and redistribute the material into deeper portions of the waste pits. The material will be below the water cover after completion of the action, and an ongoing maintenance program will ensure that all waste pit material remains under water.

I. INTRODUCTION

This document provides a work plan describing a proposed removal action with the objective of mitigating the continuing release of contaminants from Waste Pit 6 until final remediation under Operable Unit No. 1. The proposed action is initiated by DOE under authorities delegated to it under Section 104 of CERCLA, through Executive Order 12580.

II. BACKGROUND

Waste Pit 6 contains an estimated 9,000 cubic yards of green salt, slag, process residues, and asbestos. The 32,400 square foot surface area is covered with up to two feet of water with the exception of 4,800 square feet of material.

The exposed material is available for wind erosion and dispersal resulting in a significant contribution (88 percent) to the calculated offsite radiation exposure received by the offsite population. Based on the RSE, "Waste Pit 6 Exposed Material," a removal action is recommended to mitigate the release caused by the exposed material.

There are three related activities planned for Waste Pit 6.

1. Obtain samples for treatability studies.

2. Develop a Standard Operating Procedure (SOP) to inspect and maintain the desired water cover over the contents of Waste Pit 6.

3. Install Air Monitoring Stations (AMS) to monitor airborne radionuclide concentrations.

An evaluation of methods to mitigate the releases was completed and the preferred method of redistributing the exposed material below the water cover was chosen. A schedule for the major actions can be found in Attachment A.

This removal action will:

1. Use a combination of engineering controls, specific work practices, and personal protective equipment to protect the field workers.

2. Use a crane with a clamshell attachment to remove the exposed material and redistribute the material to deeper portions of the waste pit.

The removal action will eliminate future airborne fugitive emissions and will have no impact on the status of the Remedial Investigation/Feasibility Study (RI/FS) or final remedial action.

III. SUPPORT ACTIVITIES

1. Operable Unit 1 Manager has responsibility for all activities concerning this removal action through normal management organization structure. These activities will include, but not be limited to, tasks described on the attached schedule. This removal action will be completed prior to initiating the final remedial action for Operable Unit 1. The removal action will contribute to the efficient performance of the final remediation to the extent practicable. All design and construction activities associated with the removal action will be reviewed, and approved, by the Operable Unit 1 Manager to assure consistency with the final remedial program.

2. All personnel are responsible and accountable for verbatim compliance with this removal action work plan, any applicable procedures, and all FMPC safety policies.

3. Workers are responsible for the following:

   3.1 Maintaining line of sight contact with at least one other person while in the exclusion zone.

   3.2 Promptly informing supervision of any abnormality or unforeseen situations that may occur during the removal action.

4. Industrial Hygiene Technicians (IHTs) and Radiological Safety Technicians (RSTs) are responsible for the following:

   4.1 Performing and documenting the required surveys and air monitoring.

   4.2 Promptly notifying the health and safety officer and supervision of monitoring results.

5. Supervisor is responsible for the following:

   5.1 Promptly notifying the Assistant Emergency Duty Officer (AEDO) of abnormal or unforeseen situations.

   5.2 Maintaining a daily log of operations.

   5.3 Generating and maintaining an approved access list for the exclusion area.

   5.4 Conducting daily pre-shift briefings for planned activities.

   5.5 Maintaining a copy of all checklists required by the work plan or the task specific health and safety plan.

III. SUPPORT ACTIVITIES (Continued)

6. Health & Safety Officer is responsible for verifying compliance with the task specific health and safety plan.

IV. REMOVAL ACTION WORK IMPLEMENTATION

GENERAL

1. A daily log of operations shall be maintained and must include the following:

   1.1 Date and time of operations.

   1.2 Initial conditions at startup, including meteorological data.

   1.3 Names of all personnel accessing the area and duration of the access.

   1.4 Operations performed.

   1.5 Any abnormal or unforeseen conditions.

   1.6 Verification that all required checklists are complete, and no defective equipment is in service.

2. A daily pre-shift briefing shall be conducted as required by the task specific health and safety plan.

3. At the completion of daily operations, the clamshell bucket shall be sprayed off over the pit and lowered into the drip containment until the next material movement. The containment will be on solid ground with only minimal distance to the open pit.

4. No personnel shall be within five feet of the sloped portion of the pit liner.

5. The drip containment for storage of the clamshell shall be a standard white metal box (six-pack), which shall be visually inspected daily and the inspection documented in the daily log.

PROCEDURES

NOTE: Issue or verify an active work permit and perform any required initial monitoring.

1. Verify that the exclusion area and decontamination zone barriers and postings meet the requirements of the task specific health and safety plan.

PROCEDURES (Continued)

2. Set up and inspect the crane in accordance with the checklist (Attachment B).

3. Don all protective clothing.

4. Start all monitoring equipment, including personal samplers.

5. The material movement will be performed with the crane located on the south and west sides of Waste Pit 6. Attachment C shows the orientation of equipment.

   5.1 A low-flow water fog shall be applied to the area during all material movement.

NOTE: Operators shall communicate with the spotter to assure that they are not interfering with the vision of any operator.

   5.2 The clamshell will be opened and lowered on the southwestern-most portion of the exposed material.

   5.3 When in contact, the clamshell is closed and raised only enough to allow movement to the east and to a deeper portion of the pit.

   5.4 The clamshell is to be lowered to the water line and the material released.

NOTE: At no time shall the mark on the clam be allowed below the water line.

   5.5 Repeat 5.1 through 5.4 as required.

   5.6 Verify that all material is covered.

6. The following shall be performed when operations are discontinued.

   6.1 Raise the clamshell over the pit to a position convenient for spraying off the bulk material.

   6.2 Spray off clumped material on the clamshell with hose.

   6.3 Move the clamshell into the drip containment.

   6.4 Secure the crane.

7. At the completion of the removal action, the following shall be completed:

PROCEDURES (Continued)

7.1 The clamshell shall be monitored for loose surface contamination, and be decontaminated to be less than 200 dpm/100 cm^2 alpha and 1000 dpm/100 cm^2 beta gamma.

7.2 The drip containment must be decontaminated (by water washdown), or disposed of as waste.

7.3 All equipment within the exclusion area shall be monitored for radioactive loose contamination and be decontaminated as required to be less than 200 dpm/100 cm^2 alpha and 1000 dpm/100 cm^2 beta gamma.

7.4 The Supervisor and Health and Safety Officer shall, together with IRS&T personnel, verify that: a) all work to be accomplished is complete, b) required surveys are complete, c) all equipment meets contamination limits, and d) all waste (PPE) is packaged correctly.

7.5 Remove all barriers.

7.6 Determine the highest elevation of pit contents.

7.7 Adjust and maintain the desired water cover on the pit and institute inspections in accordance with SOP for Pit 6 operations. (SOP is in development.)

V. SAMPLING AND ANALYSIS

An extensive sampling and monitoring program is part of the removal action. Monitoring will be completed to meet the following objectives:

1. Provide quantified results of particulate radionuclide emissions before, during, and after the removal action to evaluate the effectiveness of the action.

2. Provide real time monitoring to immediately assess the adequacy of the worker protective methods employed during the removal action.

3. Provide quantified analysis for each contaminant found in the waste pit material.

Standards for radioactive particulate emission from 40 CFR are 10 mrem equivalent dose and asbestos emissions from OAC-3745-20-07 dictate that no visible emissions occur. All other contaminants are governed under OAC 3745-15-07 as nuisance fugitive emission, and no specific emission rates are dictated.

V. SAMPLING AND ANALYSIS (Continued)

The primary control method to reduce airborne emission will be to constantly apply a water spray during excavation to keep the excavation area thoroughly wetted. Secondary measures include operator training and control, and minimizing the mechanical disturbance of the material by the use of short movements.

The following contaminants are contained in the Waste Pit 6 material and are available for wind erosion and fugitive airborne emissions: radioactive material, arsenic, asbestos, silver, lead, magnesium fluoride, mercury, and 1,1,2,2 tetrachloroethane.

Radioactive particulate emissions resulted in 4.6 mrem equivalent dose to the nearest neighbor for the entire year of 1989. Given the short duration of this action, only slight impact is expected from fugitive emissions.

Asbestos emissions are not expected to occur during the removal action.

To accomplish objectives 2 and 3, the table below presents the hazards to be monitored, sampling method and type, sample location, and frequency of monitoring.

Hazard Monitored	Sampling Method	Analysis	Frequency	Location
Uranium	Filter sampling[3]	Counts on filter and activity	Continuous	- Breathing zone - Various[2]
Asbestos	Filter sampling[4]	Optical particle counters per NIOSH 7400 method	Continuous	Breathing zone
Arsenic, lead, silver, & magnesium fluoride	Filter sampling[4]	Atomic absorption analysis per NIOSH 7300 method	Continuous	Breathing zone Boundary[2]
1,1,2,2-Tetrachloroethane	Photo ionization[5]	HNu-101 photo-ionization instrument calibrated with 100 ppm. isoketylene prior to use	Prior to movement, hourly, & upon completion	Boundary [2]
External Radiation	TLD	Direct	Continuous	Personal
Internal Radiation	Urinalysis	Florescence	Annual	NA
External Contamination	NA	Direct scintillation	Exiting	Decon zone
Total Particulates	Photometer	MIE-RAM-1	Continuous	Various as per evolution near work stations

1= Direct reading dosimeter not required at the dose rates around the waste pit.
2= Refer to Attachment "C".
3= 8x10-inch backed glass fiber Whatman EPM 1000 filter
4= 0.8 micron mixed cellulose ester filter
5= Portable IR (MIRAN 1B) or GC equipment may be used to augment the broad spectrum analysis.

V. SAMPLING AND ANALYSIS (Continued)

To accomplish objective 1, two high volume air samplers will be installed at the specified locations (Attachment C-1). The locations are based on predominant wind directions. The filters will be analyzed by IT Analytical Services in accordance with their local analysis procedures and IT AS-QAM, Rev. 1 (2/1/88) for gross beta, total uranium, and spectroscopy for any other radionuclides that may be present. Eight-hour samples will be taken prior to the removal action, continuously during operations, and for a 3-week period following the completion of the operation. Permanent air monitoring stations will be installed during the CY-1991 to enhance the current FMPC air monitoring program. Sampling procedures, chain of custody, and sample handling protocol are contained in Attachment E.

Meteorological data (temperature,wind speed, and direction) shall be recorded on all air sample data sheets.
The results of all analysis will be documented in a final report and will be forwarded to the RI/FS contractor for evaluation and possible inclusion into the Remedial Investigation Report.

VI. QUALITY ASSURANCE

The overall quality assurance program at the FMPC is described in the site Quality Assurance Plan, FMPC 2139. The Quality Assurance Plan is based on the criteria specified in ASME NQA-1, Federal EPA Guideline QAMS-005/80 and DOE Orders 5700.6 and 5400.1. Specific quality assurance requirements will be incorporated into written and approved procedures and into personnel training. The WMCO Quality Department will conduct surveillance and inspections and/or audits to verify compliance throughout the execution of this removal action.

VII. HEALTH AND SAFETY PLAN

The work to be performed will be consistent with the Health and Safety Plan prepared for this removal action. The plan identifies, evaluates, and controls all identified safety and health hazards. In addition, it provides for emergency response for hazardous operations. The plan is consistent with 29 CFR 1910.120 and the FMPC Site Health and Safety Plan. Safety documentation will be prepared according to FMPC-2116 Topical Manual "Implementing FMPC Policies and Procedures for System Safety Analysis." FMPC-2116 has been prepared to implement DOE Order 5481.1B, "Safety Analysis and Review System" and DOE/OR-901, "Guidance for Preparation of Safety Analysis Reports."

VIII. ATTACHMENTS

A. Schedule

B: Crane operation checklist

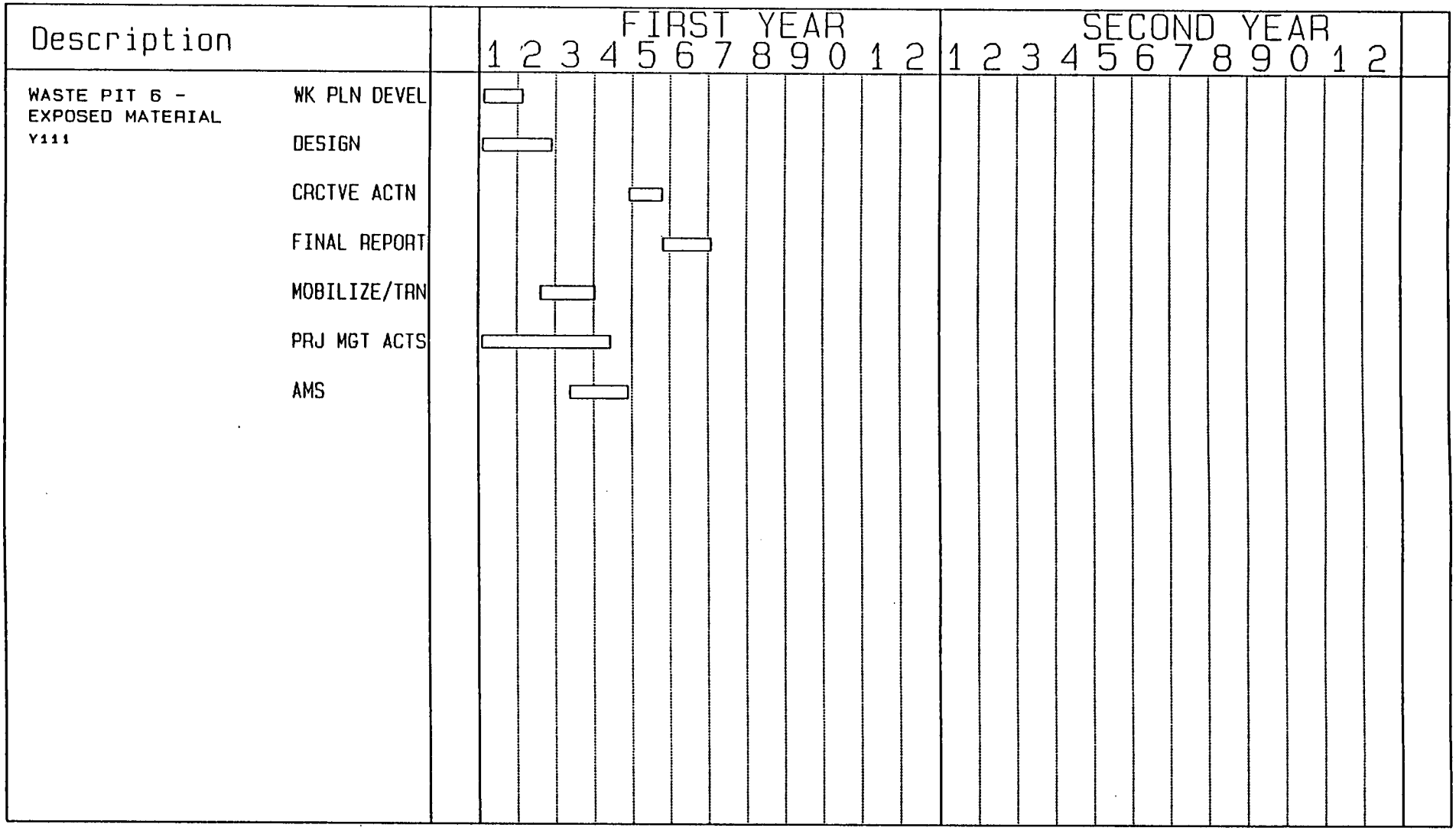
C: Crane placement and orientation

D: Health and Safety Plan

E: Sampling Supplement

WASTE PIT 6 EXPOSED MATERIALS REMOVAL ACTION SCHEDULE

FMPC



Time zero equals October 19, 1990

ATTACHMENT A

908

12

CRANE DAILY USE CHECKSHEET

Crane # _____ Operator _____ Date _____

Engine Oil _____

Radiator Water _____

Fuel Level _____

Tire Condition _____

Hours Meter _____

Gauges & Instruments _____

Limit Switches _____

Hook _____

Safety Latch _____

Horn _____

Steering _____

Brakes _____

Parking Brakes _____

Hydraulic Controls _____

Damage & Leaks _____

Hoist Cables _____

Lifting Devices _____

(2nd Power Train if Applicable)
Drive Engine Oil _____ Drive Engine Water _____

Comments: _____

_____

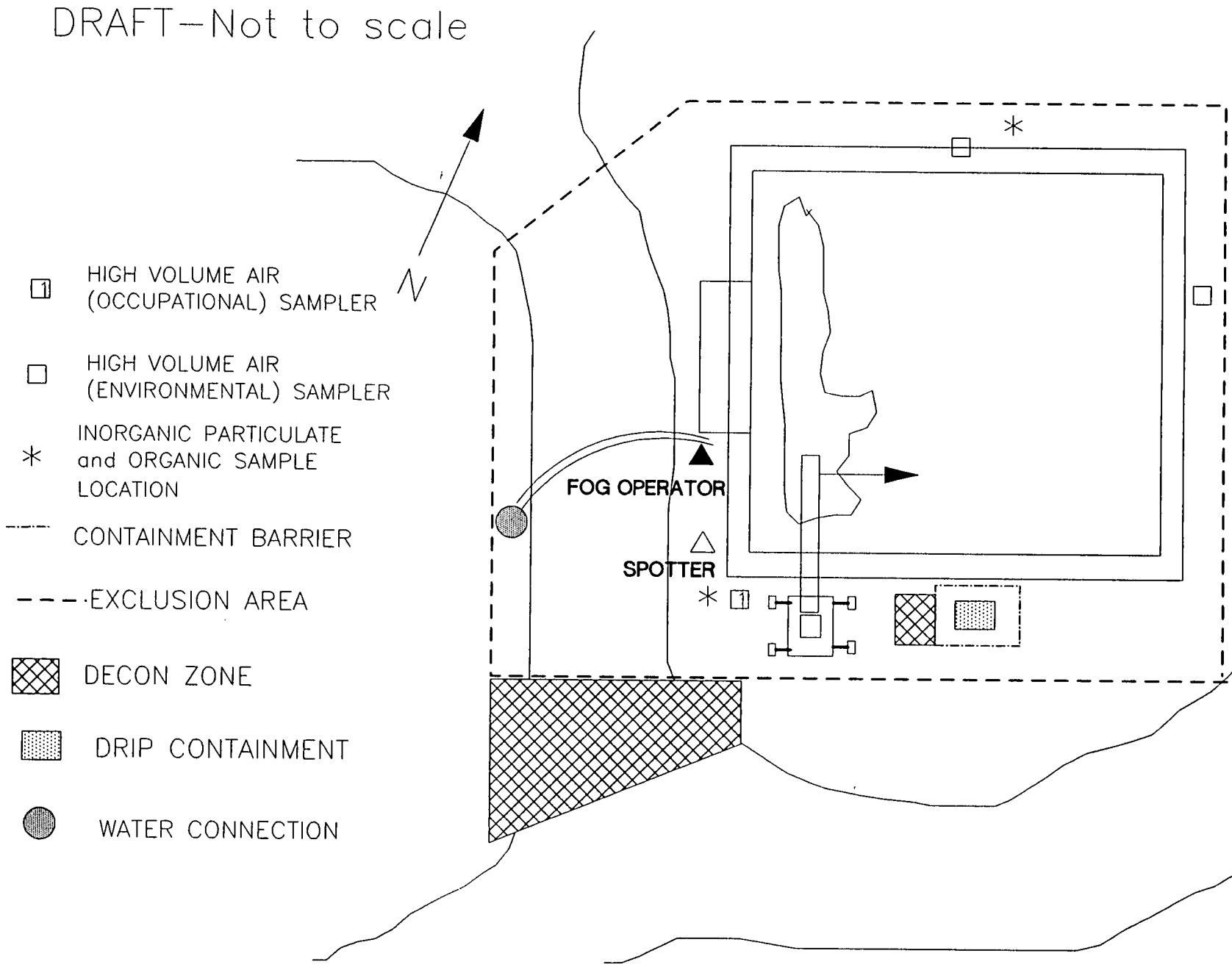
_____

_____

_____

Attachment C-1

EQUIPMENT and SAMPLE LOCATION LAYOUT 1



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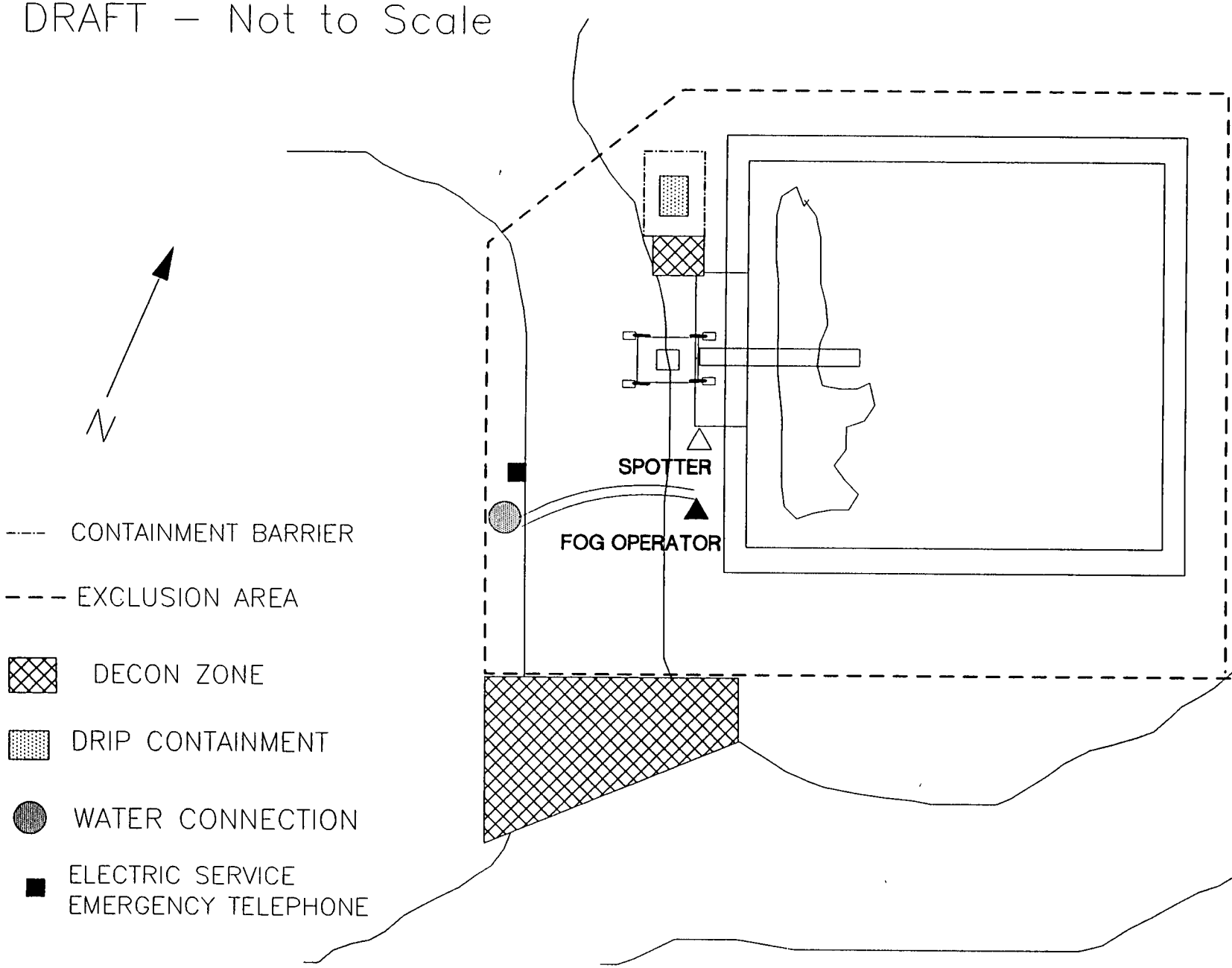


ATTACHMENT C–2

Equipment Layout 2

ATTACHMENT D

WASTE PIT 6 EXPOSED MATERIAL

REMOVAL ACTION

HEALTH AND SAFETY PLAN

FEED MATERIALS PRODUCTION CENTER

November 1990

Approvals:

I. W. Diggs, Manager
Operable Unit 1
WMCO

S. W. Coyle, Manager
Environmental Management
WMCO

For **J. J. Volpe, Vice President**
Industrial, Radiological Safety & Training
WMCO

TABLE OF CONTENTS

1.0 Introduction/History	1
2.0 Site Characterization and Analysis	1
3.0 Site Control	3
4.0 Hazard Assessment	4
5.0 Training	4
6.0 Medical Surveillance	9
7.0 Engineering Controls/Work Practices/Personal Protective Clothing	11
8.0 Monitoring	13
9.0 Safety equipment	15
10.0 Decontamination	16
11.0 Contingency Plan	16
12.0 Amendments	19

1.0 INTRODUCTION/HISTORY

1.1 This task specific Health and Safety Plan is for a removal action to mitigate the release of material from Waste Pit 6. The purpose of this document is to:

1.1.1 Fulfill the requirements of 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response."

1.1.2 Provide an understandable and effective tool for the field personnel to perform the task in the most safe and effective manner.

1.2 The most appropriate method to mitigate the release from Waste Pit 6 has been determined to be redistribution of the exposed material below the existing water cover. An onsite crane with a clamshell attachment will be used in a combination lift and drag approach to spread the exposed material to the center of the waste pit and below the water cover.

2.0 SITE CHARACTERIZATION AND ANALYSIS

2.1 Waste Pit 6 was constructed in 1979 and waste materials were added to the pit until 1985. The pit remains open with the majority of the surface area covered by water that collects from rainfall. The water levels remain relatively constant with the occasional need to pump excess to the surge lagoon after in-place precipitation of solids.

2.2 Waste Pit 6 has a 32,400 square foot surface area and has a 24-foot depth. The pit contains an estimated 9,000 cubic yards of green salt (uranium tetrafluoride), filter cake, slag, process residues, and asbestos. The pit contains an estimated 1.9 million pounds of uranium. Approximately 4,800 square feet of the contents are exposed to weather, making them available for wind erosion, and are a major contributor to the airborne dose received by the maximally exposed offsite individual from all sources of radiation at the FMPC.

2.3 Figure 1 shows accessibility and the location of Waste Pit 6 within the FMPC.

2.4 The Characterization and Investigation Study (CIS) for the FMPC included sampling and analysis of the contents of Waste Pit 6. Table 1 is a summary from this report.

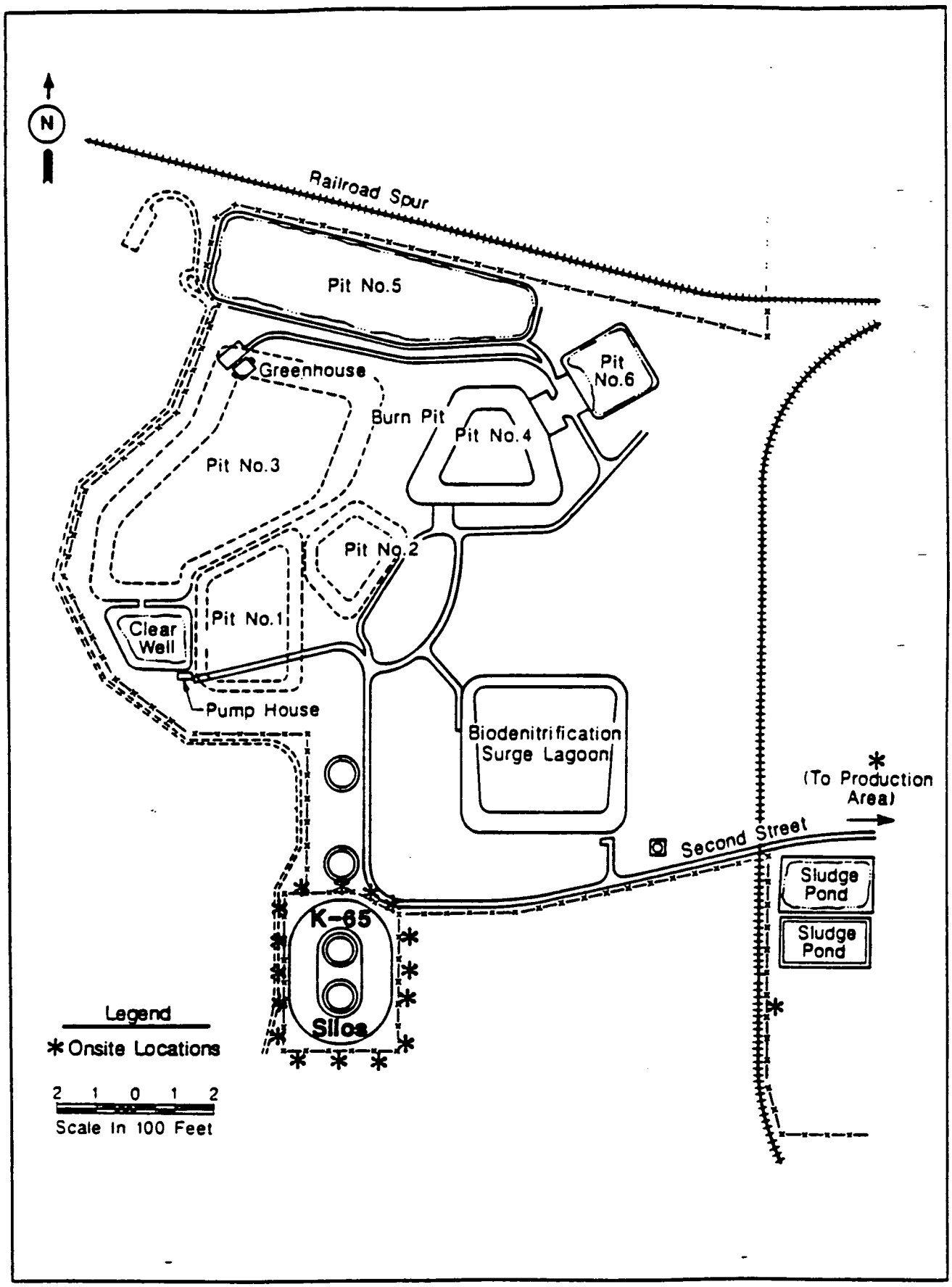

N
Railroad Spur
Pit No.5
Greenhouse
Pit No.6
Burn Pit
Pit No.4
Pit No.3
Pit No.2
Pit No.1
Clear Well
Pump House
Biodenitrification Surge Lagoon
(To Production Area)
Second Street
Sludge Pond
Sludge Pond
K-65
Silos
Legend
* Onsite Locations
2 1 0 1 2
Scale In 100 Feet

FIGURE 1

TABLE 1

WASTE PIT 6 CHARACTERISTICS

Description	Quantities and Units
Area	32,400 ft^2 (0.75 acres)
Contents: Depleted slag, scrap green salt, process residues, filter cake, and asbestos	9,000 yd^3
Surface water	485,000 gallons
Geotechnical data:	
Dry density	101.2 lb/ft^3
Specific gravity	2.87
Moisture content[a]	25.4 percent
Material consistency: Saturated, soft, coarse to fine, sand-sized, and clay-sized materials	
Radioactive material concentrations	
Radium-226	16 to 30 pCi/g
Uranium-235	350 to 1,750 pCi/g
Uranium-238	12,500 to 18,700 pCi/g
Thorium-230	14 to 41 pCi/g
Thorium-232	0.2 to 1.2 pCi/g
Technetium-99	84 to 164 pCi/g
Organics	
Listed hazardous materials	
1.1.2.2-tetrachloroethane (U209)	Maximum concentration 29,000 ppb
All other organics	Below quantification level
HSL semivolatiles	The concentration level for all HSL semivolatiles analyzed was below quantification level.
HSL inorganics	
Aluminum	4,730 mg/kg
Calcium	22,190 mg/kg
Iron	2,750 mg/kg
Magnesium	32,101 mg/kg
Lead	5 to 60 mg/kg
Silver	158 mg/kg
Arsenic	7.61 mg/kg
Mercury	0.03 to 0.07 mg/kg
Hazardous materials/wastes	All samples tested were within the established limits for corrosivity, reactivity, ignitability, and EP Toxicity.

[a] By percent of dry weight

3.0 SITE CONTROL

3.1 The removal action is anticipated to take one to two weeks of field work. The exposed waste pit material will be moved below the existing water line with a clamshell attachment on a crane. The equipment necessary is onsite, in working order, and operated by WMCO employees on a routine basis. Prior to use in the waste pit, the attachment will be cleaned and repainted to facilitate post-operation decontamination. Figures 2 and 3 demonstrate the orientation of the crane for the two stages of the action and shows the travel paths for the clamshell.

3.2 There are two major uncertainties in the assessment of hazards: the effect of mechanical disturbance on the numerical modeling that has been performed on the pit emissions, and the heterogeneous mixture of the waste material in the pit, but no action level is anticipated to be exceeded. Due to the uncertainties, air purifying respiratory protection will be required in addition to the engineering controls and work practices during material movement.

3.3 Arsenic and silver are the most restrictive airborne chemical hazards due to the concentrations of the contaminants in the waste material and action limits. A real time total particulate monitor shall be used during all operations. To correlate the measurements from the total particulate monitor to the individual chemical contaminates the following assumptions will be made:

3.3.1 A conservative assumption is that the concentration of $MgFl_2$ will be at the measured level.

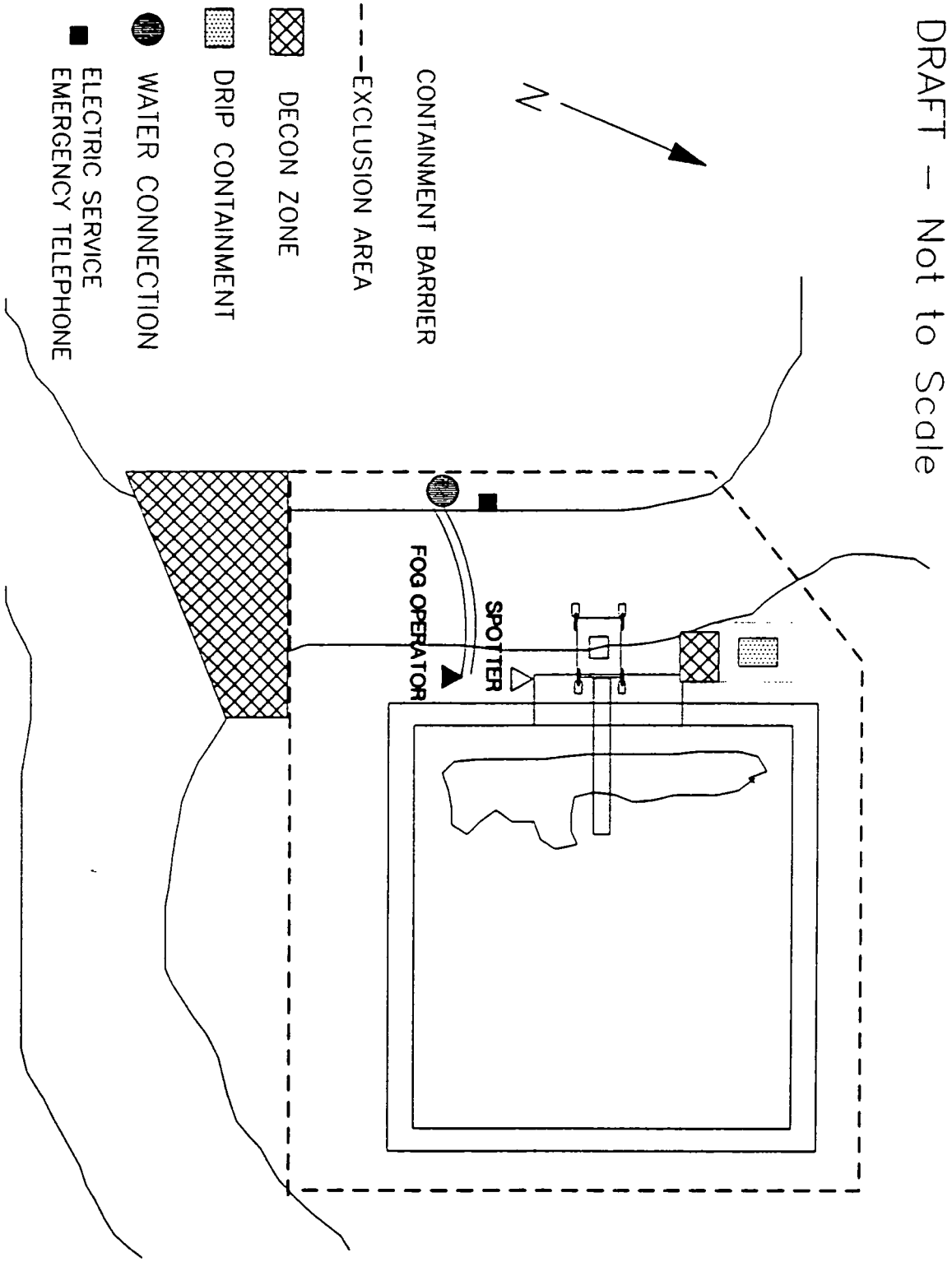
3.3.2 Concentration of the other chemical contaminants will be assumed to be a very conservative 10 percent of the total particulate concentration.

3.4 For inhalation hazards, if any action level multiplied by the protection factor of a half-face air purifying respirator(s) is exceeded (listed in Table 5), work shall be stopped, and the Supervisor, Health and Safety Officer, and members of IRS&T shall review the analysis and assess whether the personal protective equipment is adequate and document all actions in the daily log.

3.5 For direct and physical hazards, work shall be stopped, and the Supervisor, Health and Safety Officer, and members of IRS&T shall review the analysis and assess whether the personal protective equipment is adequate and document all actions in the daily log.

3.6 For loose surface contamination, if any action level is exceeded, decontamination shall take place as per Section 8.0, "Decontamination."

3.7 All portable electrical equipment will be protected by GFCI.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N
CONTAINMENT BARRIER
EXCLUSION AREA
DECON ZONE
DRIP CONTAINMENT
WATER CONNECTION
ELECTRIC SERVICE
EMERGENCY TELEPHONE
SPOTTER
FOG OPERATOR

FIGURE III

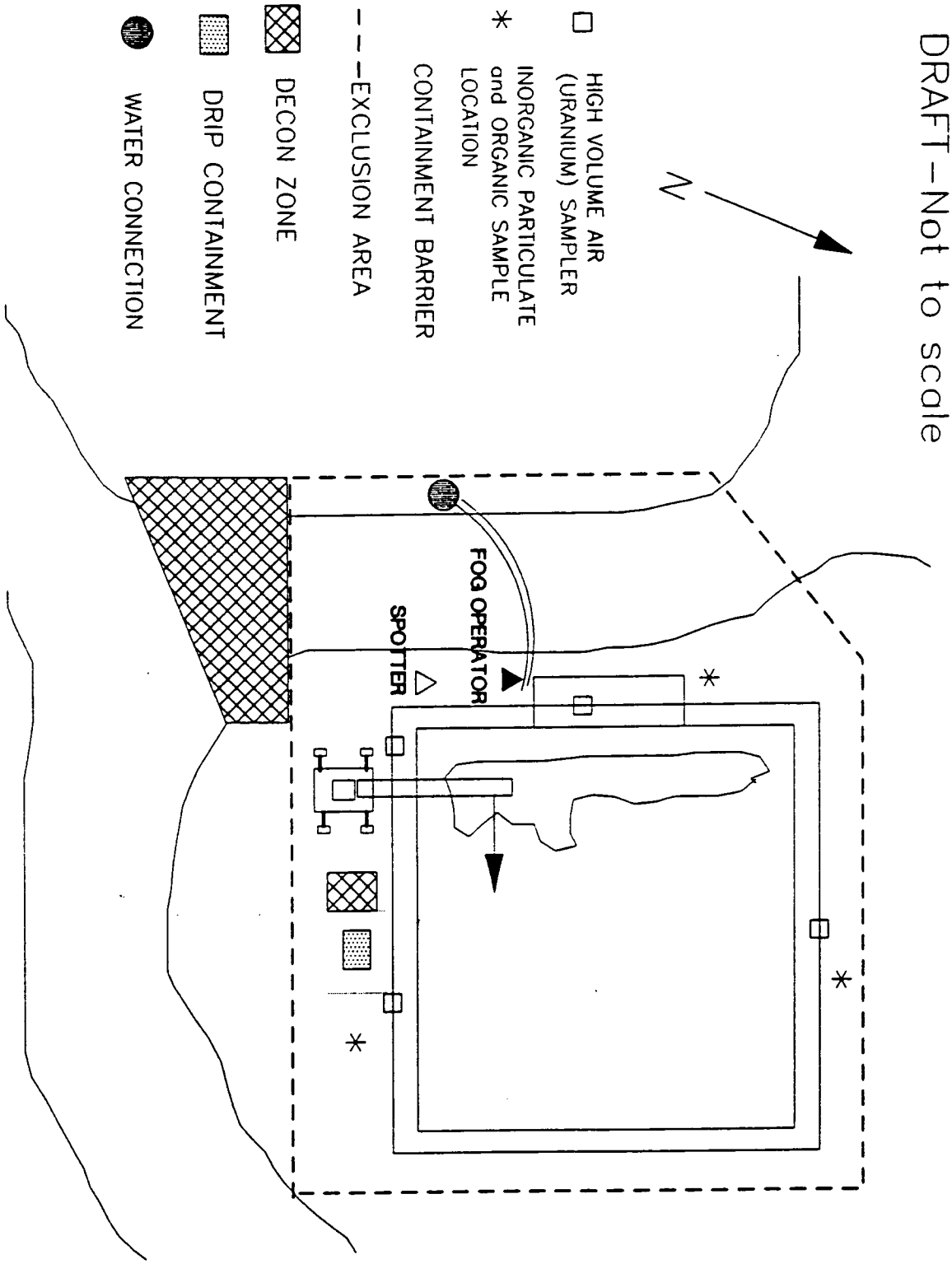
DRAFT–Not to scale
N
HIGH VOLUME AIR (URANIUM) SAMPLER
INORGANIC PARTICULATE and ORGANIC SAMPLE LOCATION
CONTAINMENT BARRIER
EXCLUSION AREA
DECON ZONE
DRIP CONTAINMENT
WATER CONNECTION
FOG OPERATOR
SPOTTER

FIGURE II

3.0 **SITE CONTROL** (Continued)

3.8 There will be no confined space entry.

3.9 During operations, there will be a supervisor, crane operator, spotter, two operators, and an IRS&T representative in and around the work area.

3.10 S. M. Ferguson, Radiation Safety Supervisor, or his designee, will perform the duties of the Health and Safety Officer.

4.0 **HAZARD ASSESSMENT**

4.1 Table 2 presents an assessment of the anticipated hazards that may be encountered during the removal action.

4.2 Exposure symptoms for chemical hazards are described in the following paragraphs. The symptoms mentioned below normally deal with handling materials in higher concentrations than handled by this task.

4.2.1 Asbestos

Health Risks: Exposures to high dust levels cause a pneumonoconiosis called asbestosis. Exposures to low levels (especially in smokers) increases the risk of lung cancer.

Exposure Routes: Inhalation

First Aid: None

4.2.2 Uranium

Health Risks: High level exposures to soluble uranium compounds causes respiratory irritation and are toxic to the kidneys. Lower level chronic exposures may increase the incidence of cancers of the lungs, lymph system, hemopoietic system.

Exposure Routes: Broken Skin and respiratory tract

First Aid: **Inhalation** - Remove person to fresh air. Start bioassay procedures (urinalysis) to quantify dose. **Broken Skin** - Remove contaminated clothing. Clean affected area. Check cleaned skin with frisker to ensure complete uranium removal.

4.0 HAZARD ASSESSMENT (Continued)

4.2.3 Magnesium Fluoride (as total fluoride)

Health Risks: Chronic exposures can result in thickening of bones and joints (fluorosis).

Exposure Routes: Inhalation of dust

First Aid: Remove person to fresh air. Provide urinalysis for fluoride at end of shift and at start of following shift.

4.2.4 Lead, Inorganic

Health Risks: Chronic exposure produces symptoms which are non-specific: decreased physical fitness, fatigue, sleep disturbance, headache, aching bones and muscles, constipation, abdominal cramps, decreased appetite. Continued exposure results in anemia, colic, "wrist drop" (a sign of peripheral neuropathy), kidney damage with azotemia.

Exposure Routes: Inhalation of dust. Inadvertent ingestion of dust.

First Aid: If a person is suspected of lead exposure exceeding the OSHA action level for more than 30 days per year, collect whole blood sample per OSHA 29 CFR 1910.1025, "Lead." If sample result exceeds 50 μg Pb/dL whole blood, remove person from further exposure as required by OSHA.

4.2.5 Arsenic

Health Effects: There are two kinds of health effects.

chronic: classified as a human carcenigen by IARC.

acute:

Skin - Trivalent arsenic is corrosive to the skin, with the moist mucous membranes being the most sensitive.

Inhalation - Inhalation is the most common cause of chronic poisoning in the industrial situation. This condition is divided into three phases:

First phase: Symptoms are centered around the digestive system (i.e., nausea, vomiting, and diarrhea).

Second phase: Symptoms are respiratory tract centered (i.e., membrane sensitivity, hoarseness, and nasal lesions).

4.0 **HAZARD ASSESSMENT** (Continued)

Third phase: Symptoms are centered around the nervous system (i.e., loss of feeling in hands and feet).

Exposure Routes: Skin contact for some compounds can occur, but the most common exposure is from inhalation or inadvertent ingestion of dust.

First Aid: Remove person to fresh air. Seek medical help immediately.

4.2.6 1,1,2,2-Tetrachloroethane

Health Risks: Early effects brought on by tetrachloroethane narcotic action include tremors, headache, a prickling sensation and numbness of limbs, and excessive sweating. Later symptoms may be jaundice, mental confusion, stupor or delirium, hematemesis, convulsions, and purpuric rashes.

Exposure Routes: Inhalation of dust. Inadvertent ingestion of dust.

First Aid: Remove person to fresh air. Seek medical help immediately.

4.2.7 Mercury

Health Risks: Chronic exposures may lead to nervous system disorders such as fine tremors (twitching) in hands and face, loss of memory, and despondent behavior.

Exposure Route: Inhalation of fumes. Skin absorption.

First Aid: Remove person to fresh air. Seek medical attention immediately.

TABLE 2

Contaminant/Hazard	Route of Entry	Exposure Limit	Action Level	Assessment	
				Release Rate[1]	
Organics 1,1,2,2 - tetrachlorethane	inhalation/skin	7mg/m³ (skin) (ACGIH) 1 ppm	3.5 mg/m³ 0.5 ppm	NA	The action level will not be approached based on 3 factors: 1) Quantified measurements in a stagnant air environment in Plant 6, where concentrations of trichloroethylene in water were 310 ppm, the highest airborne concentrations noted were 1.7 ppm. 2) Large air exchange rates exist for outdoor work as compared to the stagnant air. 3) 1,1,2,2 is less volatile than trichloroethylene, based on vapor pressure.
Physical Heat stress	NA		80°F Dry bulb	NA	Work will be accomplished during late Fall and Winter seasons.
Cold stress	NA		20° F	NA	Wind chill must be included. Additional layers of clothing and rest periods in warm area may be required. Operator attention must be used to prevent the fog operators from getting wet.
Noise	NA	85 dba	85 dba	NA	Standard heavy equipment practices will be employed.
Crane Operation/Electrical Shock	NA		NA	NA	Maintain 15 feet distance from energized lines.
Slips/Trips and Falls	NA		NA	NA	Fog spray in freezing temperatures may lead to ice on surfaces. Surfaces where operators will be are fairly level and porous. Operator care is the primary method to avoid ice.

TABLE 2

Contaminant/Hazard	Route of Entry	Exposure Limit	Action Level	Assessment	
				Release Rate[1]	
Inorganics					
Arsenic	inhalation absorption	.01 mg/m³	0.005 mg/m³	3 mg/hr	The action level will not be approached. 1) The most restrictive contaminant is $MgFl_2$ if all particulate contaminants are released proportionally. 2) Large volume exchange exists for outdoor work. 3) Given an enclosed workspace (~1200 m³) only eight volume exchanges per hour would be necessary for reductions below the $MgFl_2$ action levels. Uncertainties: - heterogeneous nature of material - effect of mechanical disturbance. - quantification of the stabilizing effect of fog application.
Mercury	inhalation	.1 mg/m³	0.05 mg/m³	.03 mg/hr	
Lead	inhalation	.05 mg/m³	0.03 mg/m³	22 mg/hr	
Silver	inhalation	.01 mg/m³	0.005 mg/m³	59 mg/hr	
Magnesium Fluoride[2]	inhalation/skin	2.5 mg(F⁻)/m³	1.3 mg(F⁻)/m³	12 g/hr	
Asbestos	inhalation	0.2 Fibers/cc	0.1 Fibers/cc	NA	
Radiological Airborne					
Uranium	inhalation	$2x10^{-11}$ μCi/ml	$5x10^{-12}$ μCi/ml	10.3 μCi/hr	Uranium is the most limiting radionuclide due to its much greater proportion in the waste material.
External exposure					The highest penetrating dose rates at the pit perimeter are 0.5 mr/hr and 1.7 mr/hr at 30 cm from material surface.
Whole body	penetrating	5 rem/year	150 mrem/wk		
	skin	50 rem/year	300 mrem/wk		The highest non-penetrating dose rates 30 cm from the material surface are 92 mr/hr.
Contamination					
Loose surface	inhalation ingestion		200 dpm/100 cm² 1000 dpm/100 cm² 5000 dpm/100 cm²* 50000 dpm/100 cm²*		

1 = Based on 1989 environmental monitoring report with releases occurring 14 percent (1225 hours) of the year. Total yearly release was 455 kg of particulate using numerical models.

* = Drip containment area during operations.

2 = Limit for total fluorides.

28

908

5.0 TRAINING

5.1 All WMCO personnel assigned to this work shall, as a minimum, meet the following training requirements. All training is to be documented. Documentation of understanding consists of tests, checklists, task demonstration, etc.

5.1.1 Review this health and safety plan for this work including site specified hazards and procedures

5.1.2 WMCO radiation safety training

5.1.3 WMCO respirator training and fit test (annual)

5.1.4 40-hour OSHA training

5.1.5 8-hour annual refresher training (each year)

5.1.6 8-hour supervisory training (for supervisors)

5.1.7 24-hour supervised field experience

5.1.8 Review of all pertinent SOPs and MSDSs for this plan

5.1.9 Review of hazards posed by arsenic in pit sludge as required by 29 CFR 1910.1018 - OSHA Arsenic Standard

5.1.10 Crane inspection and certification training (heavy equipment operators)

5.1.11 General safety

5.1.12 Nuclear criticality safety

5.2 A start-of-shift briefing, which must be documented, shall be conducted prior to the start of each day's work. The Health and Safety Officer shall be present at the briefing. The meeting shall cover the following applicable subjects specific to the task:

5.2.1 Task organization

5.2.2 Work operations

5.2.3 Decontamination

5.0 **TRAINING** (Continued)

5.2.4 Physical stress

5.2.5 Communications

5.2.6 General Safety

5.2.7 Housekeeping

5.2.8 Personal Protection Equipment (PPE)

5.2.9 Monitoring tests and results

5.2.10 Material Safety Data Sheets (MSDS)

5.2.11 Hazard communications

5.2.12 Emergency procedures/notifications

5.2.13 All monitoring data

5.2.14 SOPs

6.0 **MEDICAL SURVEILLANCE**

6.1 In accordance with 29 CFR 1910.120 OSHA requirements, all site personnel are required to participate in a medical monitoring program which includes:

6.1.1 A baseline medical examination

6.1.2 Annual medical examination

6.1.3 Medical examinations may be required after exposures

6.1.4 Respirator clearance for respirator users (annual)

6.2 Prior to the start of work, individuals involved in this project shall be identified by name and badge number. Each individual shall be subject to a medical surveillance approval by the Director of Medical Services. The approval statement shall certify that each individual is medically qualified to perform the work and is physically fit to wear PPE.

7.0 ENGINEERING CONTROLS/WORK PRACTICES/PERSONAL PROTECTIVE CLOTHING

7.1 It is WMCO's philosophy to prevent the spread of contamination, protect workers and the environment with engineering controls and work practices (where feasible) before resorting to the use of personal protective equipment.

7.2 To prevent breaching the liner, the following will be performed:

7.2.1 Clamshell will be cleaned and painted to facilitate post-action decontamination.

7.2.2 The body of the clamshell and the lower six inches will be painted contrasting colors.

7.2.3 The clamshell will not be allowed to go more than 6 inches below the water surface. The rubber liner is 18 inches below the water line at the closest location where excavation is required.

7.3 The engineering controls and work practices to be used in the redistribution of the material in Waste Pit 6 are presented in Table 3.

TABLE 3

	HAZARD				
	PHYSICAL	AIRBORNE RADIATION	AIRBORNE CHEMICAL	DIRECT RADIATION	DIRECT CHEMICAL
All material movements to be performed remotely by the use of a crane and clamshell		*	*	*	*
Low volume water fog will be applied to the excavation area, suppressing airborne emissions.		*	*		
A physical barrier will be established 5 feet from the sloping portion of the pit. No personnel will be allowed beyond the barrier.	*	*	*	*	*
Eating, drinking, and smoking are prohibited in the waste pit area.	*	*	*	*	*
The supervisor maintains access control to the exclusion area. During idle periods, the personnel will retreat to the decontamination zone.	*	*	*	*	*

1 = Includes ingestion, absorption, and penetrating hazards.

7.0 ENGINEERING CONTROLS/WORK PRACTICES/PERSONAL PROTECTIVE CLOTHING (Continued)

7.4 Personal Protective Equipment

TABLE 4

	Crane Operator	Spotter	Fog Operator	Containment Operations	Inspection Personnel
coveralls	Process [1] Warm weather gear[4]	Process [1] Warm weather gear[4]	Process [1] Warm weather gear[4]	Process [1] Warm weather gear[5] Saranex Tyvek[2]	Process [1] Warm weather gear[4]
gloves	NA	NA	leather[1]	inner glove[2] nitrile[2]	NA
shoes	safety shoes[1]	safety shoes[1]	safety shoes[1]	safety shoes[1] Latex boots	safety shoes[1]
head	safety glasses[1] hearing protection[4]	safety glasses[1] hearing protection[4]	safety glasses[1] hearing protection[4]	NA hearing protection[4]	safety glasses[1] hearing protection[4]
Respiratory	3	3	3	3	3

1 = minimum requirement
2 = splash protection
3 = as per Table 5
4 = as required

TABLE 5

MEASUREMENT	LEVEL	RESPIRATORY PROTECTION
Radioactivity	$\leq 2.5 \times 10^{-11}$ µci/ml $\leq 2.5 \times 10^{-10}$ µci/ml	[1]Half-face, air purifying respirator (APR) [1]Full-face, (APR)
Organic Vapors (HNU meter)	[3] ≤ Detectable [3] > Detectable, ≤ 10 ppm >10 ppm, ≤ 25 ppm >25 ppm	[1]Half-face, APR [1]Full-face, APR Supplied air respirator Withdraw
Dust (MIE RAM-1)	[2] ≤ 0.5 mg/m³ [2]> 0.5 mg/m³, ≤ 5 mg/m³ [2]> 5 mg/m³	[1]Half face APR [1]Full face APR Supplied air respirator

1 = Combination cartridge, organic vapors, and particulate HEPA filter.
2 = Complies with most restrictive action limit (arsenic and silver).
3 = Detectable is 1 ppm greater than background.

8.0 MONITORING

8.1 Monitoring shall be conducted for long-lived radionuclides by general-area, high-volume sampling. Asbestos, arsenic, lead, and magnesium fluoride airborne levels shall be monitored on individuals using breathing-zone air samplers. Breathing-zone samplers shall be placed on the crane operator, spotter, and fog operators. Specific equipment needs are listed in Table 6.

TABLE 6

Hazard Monitored	Sampling Method	Analysis	Frequency
Uranium	Filter sampling	Counts on filter and activity	Continuous
Asbestos	Filter sampling	Optical particle counts per NIOSH 7400 method	Continuous
Arsenic, lead, mercury & silver	Filter sampling	Atomic absorption analysis per NIOSH 7300 method	Continuous
1,1,2,2-Tetrachloroethane	Photo ionization	HNu-101 photo-ionization instrument calibrated with 100 ppm isobutylene prior to use	Prior to movement, hourly, & upon completion
External Radiation [1]	TLD	Direct	Continuous
Internal Radiation	Urinalysis	Florescence	Annual
External Contamination	NA	Direct scintillation	Exiting
Particulate	Photometer	MIE RAM-1	Continuous
Temperature	Call Control 6295	Thermometer	Prior to start and as needed.
Magnesium fluoride	Filter sampling	Specific ion Electrode per NIOSH 7902 method	Continuous

1 = Direct reading dosimeter not required at the dose rates around the waste pit.

8.2 Real time air particulate sampling with a MIE RAM-1 photometer (minimum detectable level 0.1 mg/m^3) will be used.

8.3 This section provides a description of the various monitoring equipment.

8.3.1 High volume air samplers

8.3.1.1 Hazard monitored: Radioactive particulates

8.3.1.2 Application: Collects radioactive particulates for subsequent counting

8.3.1.3 Detection method: Not applicable

8.0 **MONITORING** (Continued)

8.3.1.4 General care/maintenance: Pre-use inspection and maintain proper liquid level in U-tube manometer

8.3.2 Breathing-zone air samplers

8.3.2.1 Hazards monitored: Inorganic and radioactive particulates.

8.3.2.2 Application: Collects particulates for subsequent analysis or counting for the individual contaminants.

8.3.2.3 Detection method: Not applicable

8.3.2.4 General care/maintenance: Calibrate air flow rate prior to use.

8.3.3 Thermo Luminescent Dosimeter

8.3.3.1 Hazard monitored: External radiation exposure.

8.3.3.2 Application: Collects energy deposited by ionizing radiation.

8.3.3.3 Detection method: Thermo Luminescence

8.3.3.4 General care/maintenance: Wear on trunk of body and outside process area clothing.

8.3.4 Ultraviolet (UV) Photoionization Detector (PID)

8.3.4.1 Hazard monitored: Many organic and some inorganic gases and vapors.

8.3.4.2 Application: Detects total concentration of many organic and some inorganic gases and vapors. Some identification of compounds are possible if more than one probe is measured.

8.3.4.3 Detection method: Ionizes molecules using UV radiation; produces a current that is proportional to the number of ions.

8.3.4.4 General care/maintenance: Recharge or replace battery. Regularly clean lamp window. Regularly clean and maintain the instrument and accessories.

8.0 **MONITORING** (Continued)

8.3.4.5 Typical operating time: 10 hours. Five hours with strip chart recorder.

8.3.5 Alpha Radiation Survey Instrument

8.3.5.1 Hazard monitored: Alpha radiation

8.3.5.2 Application: Radioactive contamination monitor

8.3.5.3 Detection method: Scintillation

8.3.5.4 General care/maintenance: Perform pre-use inspections and source checks. Unit to be calibrated in accordance with SPP-035-028.

8.3.6 Real Time Aerosol Monitor

8.3.6.1 Hazard monitored: Particulate

8.3.6.2 Application: Measures total particulate in the air.

8.3.6.3 Detection method: Conversion of internal light beam refraction into concentration (mg/m^3).

8.3.6.4 General care/maintenance: Recharge batteries. Replace desiccant.

9.0 **SAFETY EQUIPMENT**

9.1 The following safety equipment will be available at the worksite:

- 4'x4'x7' white metal box (drip containment)
- half-face respirators
- full-face respirators
- leather gloves
- glove liners
- rubber gloves
- coveralls
- barrier rope
- signs/postings
- 2 buckets (5-gallon)
- scrub brushes
- non-phosphate detergent
- rolls of tape

9.0 **SAFETY EQUIPMENT** (Continued)

- RTV
- caulk-gun
- Herculite
- stanchions
- fire extinguishers
- portable safety shower

10.0 **DECONTAMINATION**

10.1 The primary method to be employed to ensure that equipment and personnel are free of contamination will be direct alpha scintillation monitoring in lieu of decontamination. If contamination is found, one of three actions will occur.

10.1.1 Disposable items will be packaged and disposed of as LLW.

10.1.2 Non-disposable items will be soap-and-water scrubbed and rinsed with the rinseate diverted into Waste Pit 6.

10.1.3 Personnel contamination:

10.1.3.1 The affected area will be covered.

10.1.3.2 Radiological Safety and the AEDO shall be notified.

10.1.3.3 The individual will be transported to the infirmary.

10.1.3.4 Radiation Safety shall decontaminate the affected areas in accordance with SPP-35-017, "Personnel Decontamination."

11.0 **CONTINGENCY PLANS**

11.1 Spill Procedures

11.1.1 The use of the drip containment for final decontamination and storage of the clamshell are the primary methods to prevent spills.

11.0 **CONTINGENCY PLANS** (Continued)

11.1.2 In the event of a spill, the workers shall immediately notify (by radio, if possible) the AEDO of the spill. Clean-up shall be done in accordance with Standard Operating Procedure (SOP) 20-C-6606, "Hazardous Material Spill Clean-up," and under the direction of the AEDO. Clean-up of spilled material shall be undertaken only after consultation with the Radiation and Industrial Safety representatives to determine any other requirements. It is not anticipated that the spills will require any action beyond normal reporting and clean-up under the direction of the AEDO. A Minor Event Report shall be submitted for any spill incident.

11.2 Incidents or injuries involving possible intake of radiological or chemical substances by individuals

11.2.1 The steps to be followed shall be as described in SOP 11-C-245 for uranium intakes. Incidents or injuries involving potential intake of radionuclides or other hazardous substances shall immediately be reported to the supervisor and the site Medical Section by the involved individual and an investigation report completed by the involved individual.

11.3 Repair of punctured liner

11.3.1 If the liner is punctured, a temporary patch shall be applied as an interim action to allow for proper controls and plans to be developed until an authorized firm can be contracted to place a permanent patch. The temporary patch shall be applied by the following procedure:

11.3.1.1 Clean and dry, if possible, the area around the punctured liner where the patch is to be applied.

11.3.1.2 Cut a patch from the polyvinyl chloride to at least six inches larger than the puncture on all sides. Edges of the patch shall be rounded.

11.3.1.3 Apply liberal amounts of RTV to liner around the puncture and/or the patch.

11.3.1.4 Place the patch over the puncture and apply weight to the patch for 24 hours. (If the puncture is below the water line, do not remove the weight. The weight will help plug the hole.)

11.3.1.5 Visually inspect the patch for potential leaks. Place additional patches over areas where repairs appear defective.

11.0 **CONTINGENCY PLANS** (Continued)

11.3.2 Contact Environmental Monitoring so an assessment of the situation can be made.

11.4 Pre-emergency planning

11.4.1 During the training and pre-work safety meetings, all employees involved in this task shall be trained and reminded of the provisions of the plant emergency procedure, alarm signals and communications, evacuation routes, and emergency reporting.

11.5 Lines of Authority

11.5.1 The supervisor-in-charge has the primary responsibility for the prevention of emergency conditions. In the event that an emergency does occur, the individual involved in or observing the situation shall immediately notify the supervisor, the communication center, or the AEDO. The AEDO is responsible for ensuring that corrective actions have been implemented, the appropriate individuals notified, and reports completed as required.

11.6 Evacuation

11.6.1 In the event of an emergency which necessitates an evacuation of the exclusion area, a supervisory alert alarm (3-3 alarm) will be sounded over the plant alarm system. Then a voice message will follow over the Emergency Message System (and radio) instructing individuals to go to their designated Rally Point (see Figure 4). Individuals shall immediately proceed to the Rally Point and participate in the accountability process. Assistants will follow relay instructions given by the Rally Point Coordinator. When an "all-clear" condition has been achieved, individuals will be released from the Rally Point.

11.7 Emergency notification

11.7.1 All emergencies, including spills and leaks, shall be reported immediately. Emergencies can be reported over the telephone by dialing 6511 or over the radio by calling "Control." The communication center operator will activate the emergency response team and dispatch them to the affected location. If a fire is in the incipient stage and perceived controllable without endangering oneself, personnel may use available fire extinguishers. If not in the incipient stage, individuals in the immediate area shall evacuate to a safe position and await instructions.

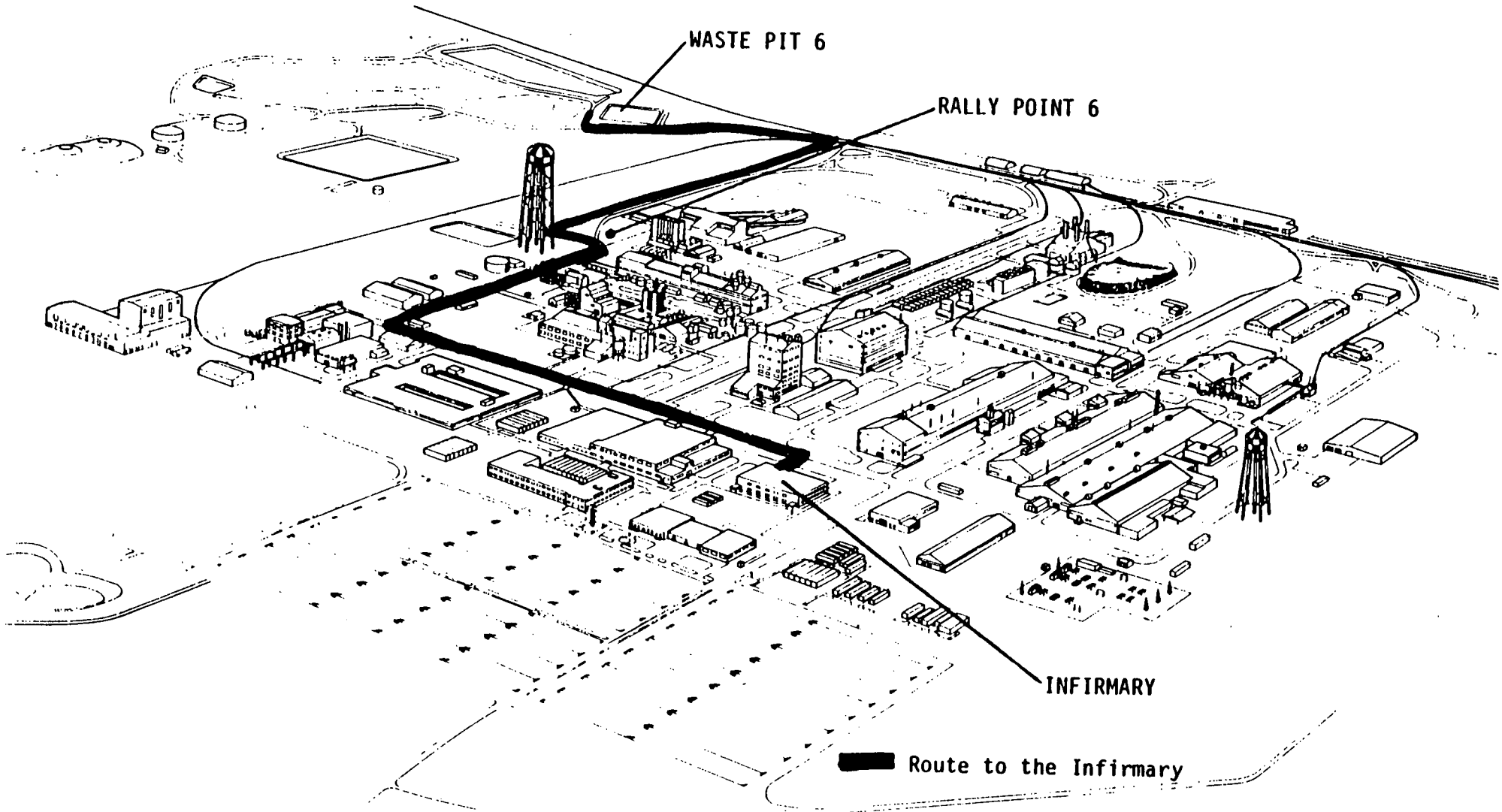

FIGURE 4

11.0 CONTINGENCY PLANS (Continued)

11.8 Additional information

11.8.1 Hospitals

11.8.1.1 The FMPC Medical Facility (Building 53) is the primary initial treatment facility for onsite injuries. The FMPC ambulance will transport the injured to the nearest hospital if necessary. FMPC maintains an emergency response capability which includes an ambulance and Emergency Medical Technicians (see Figure 4).

11.8.2 Emergency Telephone Numbers

11.8.2.1 Ambulance: 6511
Hospital: 6511
Fire: 6511

Name	Work	Radio
EMERGENCY RESPONSE	6511	Control
Industrial Hygiene	6207	357
Radiation Safety	6889	355
Fire and Safety	6235	303
Assistant Emergency Duty Officer (AEDO)	6431, or 6295	202

12.0 AMENDMENTS

12.1 This Health and Safety Plan is based on information available at the time of preparation. Unexpected conditions may arise that require reassessment of the safety procedures. Unplanned activities and/or changes in the hazard status shall require a review of and may necessitate changes in this plan.

Changes in the anticipated hazard status or unplanned activities are to be submitted as an amendment to this plan. Amendments must be approved by the Operable Unit 1 manager/project engineer and the appropriate IRS&T representative (e.g., Industrial Hygiene or Radiation Safety representative, depending on change) prior to implementation of the amendment.

Sampling Procedure Supplement
to the Waste Pit 6
Removal Action Work Plan

Detailed project sampling plans have been prepared to document the scope and methodology of airborne particulate radioactivity measurements for the Waste Pit 6 Removal Action Work Plan.

The following considerations form the basis for the project specific sampling program

- Frequency of samples
- Location and number of monitoring stations to be used
- Methods of sampling and media to be sampled
- Type and kind of analysis to be performed at the laboratories
- Procedures and precautions to be followed during sampling
- Quality control blanks

FREQUENCY OF SAMPLES

Samples will be taken 3 times per week before the removal action activities. Samples will be taken continuously during all Waste Pit 6 material movements. Samples will be taken three times per week for three weeks after the completion of the removal action.

LOCATION AND NUMBER OF SAMPLES

Two samplers will be used - downwind at the perimeter of the waste pit.

METHODS OF SAMPLING AND MEDIA TO BE SAMPLED

High-volume air samples will be collected to measure airborne particulate radioactivity.

TYPE AND KIND OF ANALYSIS TO BE PERFORMED AT THE LABORATORY

Each sample will be tested for:

- Kinetic Phosphorescence (total uranium) (RSL-121)
- Gross beta and alpha (RSL-308)
- Gamma spectroscopy (RSL-112)

PROCEDURES AND PRECAUTIONS TO BE FOLLOWED DURING SAMPLING

- Samples will be collected on an 8 x 10 inch glass-backed filter.
- Sample flow rate is to be set at about one cubic meter per minute.
- Care shall be used to avoid contaminating the filter while it is being handled.
- Record date and time of sample.
- With the air pump, off-load a new filter in the housing.
- Close the housing.
- Start the pump.
- Record time and differential pressure (dp). Convert dp to flow rate in cubic meters per minute.
- At completion of sampling, record time and flow rate.
- Stop pump.
- Unload filter holder and place in a clean plastic bag.
- Calculate and record total flow.
- Record air temperature, wind speed and direction.
- Complete and attach chain-of-custody record sheet.
- Transfer filter and chain-of-custody record sheet to Safety Chemistry Lab for shipment to IT Analytical Services for analysis.

QUALITY CONTROL BLANKS

- A quality control blank will be submitted to the testing lab with every tenth sample (estimated 4 total QA samples).

INTERNATIONAL TECHNOLOGY CORPORATION

RADIOLOGICAL LABORATORY

NO.: RSL-112

RADIOANALYTICAL LABORATORY PROCEDURE

TITLE: Operation of Germanium Gamma Spectroscopy System (ND9900)

APPROVED: James W. Willard DATE: 1-18-90
ITAS/RL TECHNICAL DIRECTOR

APPROVED: H. Dick DATE: 1/22/90
ITAS/RL QC COORDINATOR

APPROVED: Linda P. Reeves DATE: 4/12/90
ITAS DIRECTOR OF QUALITY AND COMPLIANCE

CONCURRED: James T. Harvey DATE: 1/30/90
ITAS/ORL DIRECTOR

COPY NO.: 06 ISSUED: MAY 14 1990

REVISION:	0	1		
DATE:	05-21-87	01/18/90		

908

TITLE: Operation of Germanium Gamma Spectroscopy System (ND9900)	NO: RSL-112	PAGE: 1 of 6
	REVISION: 1	DATE: 01/18/90

1.0 PURPOSE

This procedure provides instructions for the operation of the ND9900 Germanium Gamma Spectroscopy System.

2.0 SCOPE

This procedure applies to the routine operation of the Germanium Gamma Spectroscopy System.

3.0 RESPONSIBILITY

3.1 It is the responsibility of the Laboratory Manager, or his designee, to ensure that this operating procedure is followed during the use of all gamma spectroscopy systems.

3.2 It is the responsibility of the Laboratory Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure and with associated equipment.

3.3 It is the responsibility of the technician to operate the instrument in accordance with this procedure and to report any abnormal results to the Laboratory Manager, or his designee, immediately.

4.0 REFERENCES

4.1 Requirements and Specifications

4.1.1 Title 10, Code of Federal Regulations, Part 50, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criteria "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.

4.1.2 U.S. Nuclear Regulatory Commission, Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants.

44

4.1.3 U.S. Nuclear Regulatory Commission, Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment.

4.1.4 "Quality Assurance Program Requirements for Nuclear Facilities", ANSI/ASME NQA-1 (latest edition).

4.1.5 ITAS Quality Assurance Manual.

4.1.6 ITAS-RSL Quality Assurance Manual, Laboratory Specific Attachment.

4.2 Standards

None

4.3 Procedures

None

4.4 Other Publications

4.4.1 ND9900 VAX/VMS Spectroscopy Applications Package User's Manual (07-0196), Nuclear Data Inc., Schaumberg, Ill., August 1986.

4.4.2 Nuclide Identification Software Instruction Manual, Nuclear Data Inc., Schaumberg, Ill, August 1986.

4.4.3 "Handbook for Analytical Quality Control in Radioanalytical Laboratories," L.G. Kanipe, EPA.

5.0 REQUIREMENTS

5.1 Equipment

5.1.1 Germanium gamma spectroscopy system utilizing ND9900 data acquisition system.

5.2 Materials

None

5.3 Reagents

None

6.0 PROCEDURE

6.1 Initial Setup

6.1.1 Establish the normal instrument settings for all controls. These settings are tabulated in the individual instrument logbook. Controls shall be checked before each use of the instrument.

6.1.2 Place the sample on the top of the germanium detector. For liquid samples cover the germanium detector with a plastic bag to avoid any possible contamination. Once the sample is properly seated, close the lead shield and secure the door.

6.2 Initiation of Counting

6.2.1 With the terminal board of the ND9900, clear the old results by depressing the ERASE key followed by the DO key.

6.2.2 Start counting by depressing the ACQ key followed by the DO key.

6.2.3 Change sample parameters by typing "Pars Detect" (1-2 Etc.). Type ED PR (Time), ED SA (Sample), ED Peak Parameters etc. Type EX once completed.

6.2.4 Transfer the efficiency data for the sample geometry to the detector being used for counting by typing, for example: MOVE/PART PETRI-1/EFF DETECT1.

NOTE: This example is for movement of Petri Dish Efficiency for Detector 1 to the Detector 1 configuration. Other established geometries (Appendix 10.1) are moved in a like manner.

6.3 Retrieval of Data

6.3.1 Depress PF1 key on ND9900 Terminal for data acquisition on Detector 1. Depress PF2, 3, 4 etc. for other detectors.

NOTE: By depressing PF1, 2, 3, etc., keys prompt an automated analysis command procedure. The procedure performs a peak hypermet search, NID, weighted-mean calculation, and minimum activity calculation with all results listed to the line printer.

6.3.2 Repeat step 6.2 to 6.4 for all subsequent samples.

7.0 PRECISION AND ACCURACY

None

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsibility for Inspection

8.1.1 The Laboratory Manager shall periodically observe the technician during the use of this procedure to ensure the results obtained are in accordance with the procedure.

8.1.2 The technician performing this procedure shall ensure that all equipment used is working properly and is calibrated prior to starting this procedure.

8.1.3 The Quality Assurance staff shall periodically perform surveillances to determine compliance to this procedure and review all associated control charts for any long-range trends in data.

8.2 Acceptance Criteria

None

8.3 Material Monitoring

None

8.4 Equipment Monitoring

8.4.1 The germanium detector system shall have passed all applicable quality control tests at the required frequency prior to use.

8.5 Certification

8.5.1 This procedure shall be tested by running spiked samples through the procedure steps.

9.0 CALCULATIONS

None

10.0 APPENDICES

APPENDIX 10.1

Geometry Tables

For 900 mL marnelli (Detector 1)
move/part M900-1/eff Detect 1

For 900 mL marnelli (Detector 2)
move/part M900-2/eff Detect 2

For 500 mL marnelli (Detector 1)
move/part M500-1/eff Detect 1

For 500 mL marnelli (Detector 2)
move/part M500-2/eff Detect 2

For charcoal filter (Detector 1)
move/part chfilter1/eff Detect 1

For charcoal filter (Detector 2)
move/part chfilter2/eff Detect 2

For single air filter
move/part SAF-1/eff Detect 1
move/part SAF-2/eff Detect 2

For composite air filter
move/part 13-cfilter-1/eff Detect 1
move/part 13-cfilter-2/eff Detect 2

For 650 gram marnelli (Detector 1)
move/part msoil-1/eff Detect 1

For 650 gram marnelli (Detector 2)
move/part msoil-2/eff Detect 2

For Petri Dish (Detector 1)
move/part petri-1/eff Detect 1

For Petri Dish (Detector 2)
move/part petri-2/eff Detect 2

*Be alert to units changes (e.g., uCi to pCi). To change units, type:
"Go pars Detect (enter detector number)
ED NID"
You will be prompted to change the units by entering a multiplication factor (e.g., enter "1.0" for units of uCi, enter 1.0 E+06 for units of pCi).

For 900 mL marnelli (Detector 3)
move/part M900-3/eff Detect 3

For 900 mL marnelli (Detector 4)
move/part M900-4/eff Detect 4

For 500 mL marnelli (Detector 3)
move/part M500-3/eff Detect 3

For 500 mL marnelli (Detector 4)
move/part M500-4/eff Detect 4

For 650 gram marnelli (Detector 3)
move/part msoil-3/eff Detect 3

For 650 gram marnelli (Detector 4)
move/part msoil-4/eff Detect 4

For Petri Dish (Detector 3)
move/part petri-3/eff Detect 3

For Petri Dish (Detector 4)
move/part petri-4/eff Detect 4

908

INTERNATIONAL TECHNOLOGY CORPORATION

RADIOLOGICAL LABORATORY

NO.: RSL-121

RADIOANALYTICAL LABORATORY PROCEDURE

TITLE: Operation of the Kinetic Phosphorescence Analyzer

APPROVED: _____ DATE: 1-29-90
ITAS/RL TECHNICAL DIRECTOR

APPROVED: _____ DATE: 1/30/90
ITAS/RL QC COORDINATOR

APPROVED: _____ DATE: 2-6-90
ITAS DIRECTOR OF QUALITY AND COMPLIANCE

CONCURRED: _____ DATE: 1-31-90
ITAS/RL DIRECTOR

COPY NO.: 06 ISSUED: MAY 14 1990

REVISION:	0	1		
DATE:	2-23-88	02-06-90		

50

1.0 PURPOSE

This procedure provides detailed instructions on the operation of a kinetic phosphorescence analyzer for the determination of total uranium in a liquid matrix.

2.0 SCOPE

This procedure applies to all samples requiring total uranium analysis.

3.0 RESPONSIBILITY

3.1 It is the responsibility of the Laboratory Manager, or his designee, to ensure that this procedure is followed during the analysis of all samples requiring total uranium determination.

3.2 It is the responsibility of the Laboratory Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure and with the equipment associated with implementation of this procedure.

3.3 It is the responsibility of the technician to follow this procedure and to report any abnormal results to the Laboratory Manager, or his designee.

4.0 REFERENCES

4.1 Requirements and Specifications

4.1.1 Title 10, Code of Federal Regulations, Part 50, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criteria "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.

4.1.2 U.S. Nuclear Regulatory Commission, Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants.

4.1.3 U.S. Nuclear Regulatory Commission, Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment.

4.1.4 "Quality Assurance Program Requirements for Nuclear Facilities", ANSI/ASME NQA-1 (latest edition).

4.1.5 ITAS Quality Assurance Manual.

4.1.6 ITAS-RSL Quality Assurance Manual, Laboratory Specific Attachment.

4.2 Standards

None

4.3 Procedures

None

4.4 Other Publications

4.4.1 "Operation and Service Manual-Kinetic Phosphorescence Analyzer KPA-10," Chemchek Instruments, Inc., Richland, WA, 1987.

5.0 REQUIREMENTS

5.1 Equipment

5.1.1 Repipet

5.1.2 Cuvettes

5.1.3 Balances (2 place)

5.1.4 Assorted Volumetric Flasks

5.1.5 Assorted tools and routine laboratory equipment

5.2 Materials

5.2.1 Routine laboratory supplies

5.3 Reagents

5.3.1 URAPLEX, proprietary complexing agent for uranium (Chemchek Instrument, Inc.).

5.3.2 Methyl Alcohol, Technical Grade.

5.3.3 Sulfuric acid (H_2SO_4), concentrated, ACS Reagent Grade.

CAUTION: Mix the following acid dilutions in an acid fume hood and wear the following safety equipment at a minimum: elbow length gloves or vinyl sleeves; labcoat; face shield; safety glasses; and safety shoes.

5.3.4 1N Sulfuric acid (H_2SO_4): Add 28 ml of concentrated H_2SO_4 to 72 ml of demineralized water in an open container (beaker) that is cooled in an ice bath.

5.3.5 Nitric acid (HNO_3), concentrated, ACS Reagent Grade.

5.3.6 4N Nitric acid (HNO_3): Add 254 ml of concentrated HNO_3 to 500 ml of demineralized water and dilute to 1 liter with demineralized water.

5.3.7 0.8N Nitric acid (HNO_3): Add 5 ml of concentrated HNO_3 to 50 ml of demineralized water and dilute to 100 ml with demineralized water.

5.3.8 30% Hydrogen Peroxide (H_2O_2), ACS Reagent Grade.

5.3.9 Hydrofluoric Acid (HF), 48%, ACS Reagent Grade.

5.3.10 Perchloric Acid ($HClO_4$), Concentrated, ACS Reagent Grade.

5.3.11 Hydrochloric Acid (HCl), Concentrated, ACS Reagent Grade.

6.0 PROCEDURE

6.1 Record all analysis data on a sample work sheet (Appendix 10.1). Calibrate Kinetic Phosphorescence Analyzer KPA as described in Appendix 10.2. Analyze an analytical blank, spike and duplicate with each set of samples. Run a known standard in both Low and High range after system is calibrated. If results is not within calculated 2 sigma error, notify Laboratory Manager or his designee.

6.2 Preparation of Samples for Uranium Analysis

6.2.1 Liquid Samples

6.2.1.1 Thoroughly shake the sample to suspend any particulates. Concentrate appropriate aliquot volume down to 5 mL to meet required detection limit.

6.2.1.2 Measure an appropriate volume (up to 5 ml) of sample or concentrated sample and place in a tared glass liquid scintillation vial that has been pre-leached in 4N HNO_3 at approximately 60°C for 48 hours followed by boiling in demineralized water and final rinse with demineralized water. Determine aliquot volume by weight to 3 significant figures.

6.2.1.3 Add 3 ml of concentrated HNO_3 and 0.5 ml of 30% H_2O_2.

6.2.1.4 Place vials on a hot plate at medium heat. Wet-ash to dryness. Repeat reagent additions and wet-ashing three (3) more times.

6.2.1.5 Muffle vials at 525°C for 1 hour. Cool.

6.2.2 Air Filter Samples

6.2.2.1 Place the filter(s) in a Teflon beaker. Add concentrated HF dropwise until filter matrix is destroyed or filter is dissolved. Evaporate to dryness. Repeat with 10 ml of concentrated HF. Add 10 ml of concentrated HNO_3 and 10 mL of concentrated $HClO_4$ and heat over low heat in the perchloric acid hood until perchloric acid fumes are no longer present. Transfer to a glass beaker using 10 mL of concentrated HNO_3 and evaporate to dryness. Place beakers in muffle furnace at 210°C for 2 hours, then at 375°C for 2 hours and finally at 525°C for 4 hours.

6.2.2.2 Add 20 ml (or enough to cover residue) of concentrated HNO_3 to the residue and evaporate to dryness. Repeat.

6.2.2.3 Dissolve and transfer residue with concentrated HNO_3 to a pre-conditioned and tared glass liquid scintillation vial. Continue at step 6.2.1.3 with the peroxide addition.

6.2.3 Milk Samples

6.2.3.1 Measure an appropriate sample volume (up to 50 ml) into a 100 ml beaker. Record volume on appropriate work-sheet and logbook.

6.2.3.2 Dry under a heat lamp in a hood until all moisture is removed from the sample.

6.2.3.3 Dry in a drying oven at 110°C for eight hours or until dry.

6.2.3.4 Ash sample in muffle furnace at 210°C for 2 hours, then at 375°C for 2 hours and finally at 525°C for 8 hours or until ash is white. Cool.

6.2.3.5 Dissolve and transfer residue with concentrated HNO_3 to a preconditioned and tared glass liquid scintillation vial. Continue at step 6.2.1.3 with additions of H_2O_2.

6.2.4 Fish, Vegetation, Vegetables, and Animal Parts

6.2.4.1 Dry the sample(s) in a drying oven at 110°C for 8 hours or until dry. Ash the sample in a muffle furnace for 4 hours at 210°C, 4 hours at 375°C, and 10 hours at 525°C. Cool.

6.2.4.2 Using a Teflon policeman, pulverize the sample into a fine ash. Transfer the ash to ceramic crucible. Muffle at 800°C for 6 hours or until ash is white. Cool.

6.2.4.3 Dissolve the residue in a small amount of 2:1 HNO_3/HCl mixture. Transfer to the original beaker, build up to 50 ml and place on hot plate.

6.2.4.4 Evaporate the sample to dryness slowly. Repeat the acid addition and evaporation.

6.2.4.5 Dissolve the residue in 50 ml concentrated HNO_3 and evaporate to dryness. Repeat twice.

6.2.4.6 Transfer the sample to a preconditioned and tared glass scintillation vial with concentrated HNO_3 and go to step 6.2.1.3 at the peroxide addition.

6.2.5 Oils

6.2.5.1 Cut up ashless filter paper into a crucible.

6.2.5.2 Using a transfer pipette, weigh out 100 lambda or 0.1g of oil and put the amount on the filter paper.

6.2.5.3 Place the crucible in the muffle furnace and ash as in step 6.2.4.1.

6.2.5.4 Transfer the residue with concentrated HNO_3 to a preconditioned and tared glass scintillation vial and go to step 6.2.1.3 at the peroxide addition.

6.3 Dissolve residue in 1 mL of 4 M HNO_3. Add 4 mL of demineralized water. Determine volume of solution by weight to three (3) significant figures.

6.4 Add 1.5 ml of URAPLEX solution to a precleaned sample cuvette. See Appendix 10.3 for cleaning procedure.

6.5 Pipet up to 1 ml of sample into the cuvette and mix. Record volume of sample used.

6.6 In Analyze Mode (select F1-No Change, Continue), enter the following instructions:

Enter Sample ID
Enter Sample Description
Select Concentration Range (H,L)
Enter Final Volume after Treating Aliquot*
Enter Sample Aliquot Volume*
Check that mode switch is in the correct HIGH (up) or LOW (down) position which agrees with selected concentration range.
Press enter.

*Note: Volume units must be the same.

6.7 Select F1 and repeat steps 6.3 through 6.6 to continue analyzing samples.

7.0 PRECISION AND ACCURACY

7.1 The standard deviation for a single determination is 10% at 5 ng/ml.

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsibility for Inspection

8.1.1 The Laboratory Manager, or his designee, shall inspect the work of the technicians performing this procedure for completeness and adequate quality.

8.1.2 The technicians performing this procedure shall inspect work sheets for accuracy and completeness, shall inspect sample for proper volume and size, shall inspect labels and tags for accuracy, shall inspect equipment for proper operation, and shall inspect balances to ensure that calibration is not out of date.

8.2 Acceptance Criteria

None

8.2.1 Step 6.1 requires verification of calibration.

8.3 Material Monitoring

Reagents shall be ACS reagent grade or better. If ACS reagent grade is not available, the best grade available shall be used. Lower grade material may be used for items as indicated in Section 5.3.

8.4 Equipment Monitoring

8.4.1 The Kinetic Phosphorescence Analyzer shall be calibrated before use.

8.5 Certification

8.5.1 This procedure shall be certified by running standard samples through the procedure steps.

9.0 CALCULATIONS

Uranium concentration (ng/ml) = UC

$$UC = \frac{CONC - BKG}{RF}$$

CONC = ng/ml U reported from KPA
BKG = ng/ml U analytical blank background
RF = recovery factor

Uranium Two Sigma Error (ng/ml) = ERR

$$ERR = 2 * UC * [UAR_{(S)}^2 + UAR_{(B)}^2 + 0.0025]^{1/2}$$

$$UAR_{(S)} = \frac{SD_{(S)}}{CONC} \qquad UAR_{(B)} = \frac{SD_{(B)}}{BKG}$$

where: $SD_{(S)}$ = standard deviation (sample)
$SD_{(B)}$ = standard deviation (blank)
0.0025 = sum of all other errors

Lower Limit of Detection (ng/ml) = LLD = 1 ng/ml for a 5 mL unconcentrated sample.

10.0 APPENDICES

10.1 Worksheet

10.2 Calibration Procedure

10.3 Cuvette Cleaning Procedure

APPENDIX 10.1

Due Date_____

Appendix 10.1
IT/RSL LAB WORK SHEET
Total U Computation RSL 121

Customer_____
Sample ID_____
_____
Sample Matrix_____
Collection Date and Time:
Start_____
Stop_____
Sample Volume_____
Results Requested in:_____

Date Received_____
P.O. Number_____
Survey Instrument Reading_____mR/hr
Wipe Counting Results_____cpm
_____ of_____pages
Special Instructions:

Laboratory Number_____ Analyst ID_____

INPUT DATA

Count Date_____
Instrument KPA
Aliquot Weight(g)_____
Final Volume Weight(g)_____
Aliqout(ml.or g.)_____

units
ACT = _____
ERR = _____
LLD = _____

Remarks and Calculations

SAMPLE PREPARATION_____
SAMPLE ANALYSIS _____
CALCULATIONS _____
DATA REVIEW _____
APPROVAL _____

59

APPENDIX 10.2

Calibration Procedure

10.2.1 Select F3, "Measure Background for BOTH Low and High Ranges"

10.2.2 Select F5, "Recall Standard for Low Range, Point A"
Select F6, "Recall Standard for Low Range, Point B"
Select F7, "Recall Standard for Low Range, Point C"
Press Enter

10.2.3 Select F5, "Recall Standard for High Range, Point A"
Select F6, "Recall Standard for High Range, Point B"
Select F7, "Recall Standard for High Range, Point C"
Press Enter

10.2.4 Place water blank (1 ml 0.8 N HNO_3 and 1.5 ml URAPLEX) cuvette into KPA-10 sample holder and close sample door. Measure background for Low and High Range.

10.2.5 Press F1 to continue calibration.
Select Low Range calibration points A, B & C
Select High Range calibration points A, B & C

10.2.6 Select Analyze. (Calibration is now complete).

APPENDIX 10.3

Cuvette Cleaning Procedure

10.3.1 Vacuum aspirate sample from cuvette.

10.3.2 Rinse cell with 1N sulfuric acid. Aspirate rinse acid. Repeat.

10.3.3 Rinse cell with demineralized water. Aspirate rinse water. Repeat twice.

10.3.4 Dry outside of cuvette with a clean lint free tissue.

INTERNATIONAL TECHNOLOGY CORPORATION

RADIOLOGICAL SCIENCES LABORATORY

NO.: RSL-308

RADIOANALYTICAL LABORATORY PROCEDURE

TITLE: Determination of Gross Alpha and/or Beta Activity

APPROVED: James T. Harney DATE: 4-28-87
Laboratory Manager

APPROVED: [illegible] DATE: 5/4/87
ITAS QA Director

CONCURRED: John A. Auxier DATE: 4-28-87
RSL Director

COPY NO.: #6 ISSUED: 4-2-87

REVISION: 0				
DATE: 4-20-87				

PROCEDURE DEVELOPMENT/CHANGE

Supplement to existing procedure? Yes (X) No ( )
If yes, enter paragraph number to reference insertion point: 9.0; 9.1.1; 9.1.2; 9.2.1; 9.2.2; 9.3.1; 9.3.2
Procedure Title & Number (If exists) RSL-308, R0
Determination of Gross Alpha and/or Beta Activity
Description of experiment or method Correct equations to calculate Error and Lower Limit of Detection

Time Period From: 4/20/87 To: 8/11/87 Samples Affected All between 4-20-87 and 8-11-8

Procedure: (Test Eqpt., Data Recorded, Problems, Steps Used, etc.) DATE

8-11-87

see attached

Submitted by: James M. Willard

Approved by: John R. Fraga, Laboratory Manager

Approved by: John G. Cupin, Laboratory Director

Approved by: Cheryl D. Prince, QA/QC/Director, ITAS

63

TITLE: Determination of Gross Alpha and/or Beta Activity	NO: RSL-308	PAGE: 7
	REVISION: 0	DATE: 4-20-87

9.0 CALCULATIONS

9.1 Air Filter Calculations

9.1.1 Beta

Beta Activity (pCi/m^3) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME}$

Beta Activity Error (pCi/m^3) =

$$ERR = ACT* \left[\frac{TSC}{(TSC - BKG)^2} + 0.01 \right]^{1/2}$$

Lower Limit of Detection (pCi/m^3) = LLD = $\frac{[4.65* (BKG)^{1/2} + 3]}{2.22*EFF*VOL*CTIME}$

TSC	=	Sample counts (Beta)
BKG	=	Background counts
CTIME	=	Count time (min)
EFF	=	Counting efficiency
VOL	=	Total air volume (m^3)
2.22	=	Conversion from dpm to pCi
4.65, 3	=	Constants
0.01	=	Estimate of relative error from all other sources

9.1.2 Alpha

Alpha Activity (pCi/m^3) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME}$

Alpha Activity Error (pCi/m^3) =

$$ERR = ACT* \left[\frac{TSC}{(TSC - BKG)^2} + 0.01 \right]^{1/2}$$

Lower Limit of Detection (pCi/m^3) = LLD = $\frac{[4.65* (BKG)^{1/2} + 3]}{2.22*EFF*VOL*CTIME}$

TSC	=	Total sample counts (Alpha)
BKG	=	Background counts
CTIME	=	Count time (min)
VOL	=	Total Air Volume (m^3)
EFF	=	Counting efficiency
2.22	=	Conversion from dpm to pCi
4.65, 3	=	Constants
0.01	=	Estimate of relative error from all other sources

TITLE: Determination of Gross Alpha and/or Beta Activity	NO: RSL-308	PAGE: 8
	REVISION: 0	DATE: 4-20-87

9.2 Solid Sample Calculations

9.2.1 Beta

$$\text{Beta Activity (pCi/g)} = ACT = \frac{TSC - BKG}{2.22*EFF*VOL*RF*CTIME}$$

Act (pCi/kg) = ACT*1000

Beta Activity Error (pCi/g) =

$$ERR = ACT*\left[\frac{TSC}{(TSC - BKG)^2} + 0.01\right]^{1/2}$$

ERR (pCi/kg) = ERR*1000

$$\text{Lower Limit of Detection (pCi/g)} = LLD = \frac{\left[4.65*(BKG)^{1/2} + 3\right]}{2.22*EFF*VOL*RF*CTIME}$$

LLD (pCi/kg) = LLD*1000

TSC	=	Total sample counts (Alpha)
BKG	=	Background counts
CTIME	=	Count time (min)
EFF	=	Counting efficiency
VOL	=	Sample volume (g)
RF	=	Ratio factor
2.22	=	Conversion from dpm to pCi
1000, 4.65,3	=	Constants
0.01	=	Estimate of relative error from all other sources

Ash to dry	RF = dry weight/ash weight
Ash to wet	RF = wet weight/ash weight
Dry to wet	RF = wet weight/dry weight
Otherwise	RF = 1

9.2.2 Alpha

$$\text{Alpha Activity (pCi/g)} = ACT = \frac{TSC - BKG}{2.22*EFF*VOL*RF*CTIME}$$

ACT (pCi/kg) = ACT*1000

Alpha Activity Error (pCi/g) =

$$ERR = ACT*\left[\frac{TSC}{(TSC - BKG)^2} + 0.01\right]^{1/2}$$

ERR (pCi/kg) = ERR*1000

Lower Limit of Detection (pCi/g) = LLD = $\frac{[4.65*(BKG)^{1/2} + 3]}{2.22*EFF*VOL*RF*CTIME}$

LLD (pCi/kg) = LLD*1000

TSC = Total sample counts (Alpha)
BKG = Background counts
CTIME = Count time (min)
EFF = Counting efficiency
VOL = Sample volume (g)
RF = Ratio factor
2.22 = Conversion from dpm to pCi
1000, 4.65, 3 = Constants
0.01 = estimate of relative error from all other sources

Ash to dry RF = dry weight/ash weight
Ash to wet RF = wet weight/ash weight
Dry to wet RF = wet weight/dry weight
Otherwise RF = 1

9.3 Liquid Samples Calculations

9.3.1 Beta

Beta Activity (pCi/l) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME*R}$

Beta Activity Error (pCi/l) =

$$ERR = ACT*\left[\frac{TSC}{(TSC - BKG)^2} + 0.0025\right]^{1/2}$$

Lower Limit of Detection (pCi/g) = LLD = $\frac{[4.65*(BKG)^{1/2} + 3]}{2.22*EFF*VOL*CTIME*R}$

TSC = Total sample counts (Beta)
BKG = Background counts
CTIME = Count time (min)
EFF = Counting efficiency
VOL = Sample volume (l)
R = Self absorption correction
2.22 = Conversion from dpm to pCi
4.65, 3 = Constants
0.0025 = Estimate of relative error from all other sources

TITLE: Determination of Gross Alpha and/or Beta Activity	NO: RSL-308	PAGE: 10
	REVISION: 0	DATE: 4-20-87

9.3.2 Alpha Activity (pCi/l) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME*R}$

Alpha Activity Error (pCi/l) =

$$ERR = ACT* \left[\frac{TSC}{(TSC - BKG)^2} + 0.0025\right]^{1/2}$$

Lower Limit of Detection (pCi/l) = LLD = $\frac{\left[4.65* (BKG)^{1/2} + 3\right]}{2.22*EFF*VOL*CTIME*R}$

TSC	=	Total sample counts (Alpha)
BKG	=	Background counts
CTIME	=	Count time (min)
EFF	=	Counting efficiency
VOL	=	Sample volume (l)
R	=	Self absorption correction
2.22	=	Conversion from dpm to pCi
4.65, 3	=	Constants
0.0025	=	Estimate of relative error from all other sources

10.0 APPENDICES

PROCEDURE DEVELOPMENT/CHANGE

Supplement to existing procedure? Yes (X) No ( )
If yes, enter paragraph number to reference insertion point: 9.0

Procedure Title & Number (If exists) RSL-308, Ro

Determination of Gross Alpha and/or Beta Activity

Description of experiment or method Correct activity, error and LLD calculation.

Time Period From: Issue of RSL-308, Rev. 1 To: / / Samples Affected ALL

Procedure: (Test Eqpt., Data Recorded, Problems, Steps Used, etc.) DATE

See attached sheet.

Submitted by: [signature]

Approved by: [signature], Laboratory Manager

Approved by: [signature], Laboratory Director

Approved by: [signature], QA/QC/Director, ITAS

9.0 CALCULATIONS

9.1 Air Filter Calculations

9.1.1 Beta

Beta Activity (pCi/cu.m.) = ACT

$$ACT := \frac{TSC - BKG}{2.22\ EFF\ AVOL\ CTIME}$$

Beta Activity Error (pCi/cu.m.) = ERR

$$ERR := 2\ |ACT|\ \sqrt{\frac{TSC + BKG}{(TSC - BKG)^2} + .01}$$

Beta Activity Error where TSC=BKG>0

$$ERR := \frac{2}{2.22\ EFF\ AVOL\ CTIME}\sqrt{TSC + BKG + .01}$$

Beta Activity Error where TSC=BKG=0

$$ERR := \frac{2}{2.22\ EFF\ AVOL\ CTIME}$$

Lower Limit of Detection (pCi/cu.m.) = LLD

$$LLD := \frac{4.65\sqrt{BKG} + 3}{2.22\ EFF\ AVOL\ CTIME}$$

TSC	=	Sample Counts (Beta)
BKG	=	Background Counts
CTIME	=	Count Time (minutes)
EFF	=	Counting Efficiency
AVOL	=	Total Air Volume (cu.m.)
2.22	=	Conversion from dpm to pCi
4.65.3	=	Constants
.01	=	Estimate of relative error from all other sources

9.1.2 Alpha

Alpha Activity (pCi/cu.m.) = ACT

$$ACT := \frac{TSC - BKG}{2.22\ EFF\ AVOL\ CTIME}$$

Alpha Activity Error (pCi/cu.m.) = ERR

$$ERR := 2\ |ACT| \sqrt{\frac{TSC + BKG}{(TSC - BKG)^2} + .01}$$

Alpha Activity Error where TSC=BKG>0

$$ERR := \frac{2}{2.22\ EFF\ AVOL\ CTIME} \sqrt{TSC + BKG + .01}$$

Alpha Activity Error where TSC=BKG=0

$$ERR := \frac{.2}{2.22\ EFF\ AVOL\ CTIME}$$

Lower Limit of Detection (pCi/cu.m.) = LLD

$$LLD := \frac{4.65 \sqrt{BKG + 3}}{2.22\ EFF\ AVOL\ CTIME}$$

TSC	=	Total Sample Counts (alpha)
BKG	=	Background Counts
CTIME	=	Count time (minutes)
EFF	=	Counting Efficiency
AVOL	=	Aliquot Volume (cu.m.)
2.22	=	Conversion from dpm to pCi
4.65,3	=	Constants
.01	=	Estimate of relative error from all other sources

9.2 Solid sample calculations

9.2.1 Beta

Beta Activity (pCi/g.) = ACT

$$ACT := \frac{TSC - BKG}{2.22\ EFF\ AVOL\ RF\ CTIME} \qquad ACT\ (pCi/kg.) = ACT\ 1000$$

Beta Activity Error (pCi/g.) = ERR

$$ERR := 2\ |ACT| \sqrt{\frac{TSC + BKG}{(TSC - BKG)^2} + .01}$$

Beta Activity Error where ACT=BKG>0

$$ERR := \frac{2}{2.22\ EFF\ AVOL\ RF\ CTIME} \sqrt{TSC + BKG + .01}$$

Beta Activity Error where ACT=BKG=0

$$ERR := \frac{.2}{2.22\ EFF\ AVOL\ RF\ CTIME}$$

ERR (pCi/kg.) = ERR 1000

Lower Limit of Detection (pCi/g.) = LLD

$$LLD := \frac{4.65 \sqrt{BKG + 3}}{2.22\ EFF\ AVOL\ RF\ CTIME}$$

LLD pCi/kg.) = LLD 1000

TSC	=	Total Sample Counts (beta)
BKG	=	Background Counts
CTIME	=	Count Time (minutes)
EFF	=	Counting Efficiency
AVOL	=	Aliquot Volume (g.)
RF	=	Ratio Factor
2.22	=	Conversion from dpm to pCi
1000.		
4.65.3	=	Constants
.01	=	Estimate of relative error from all other sources

Ash to dry RF = dry weight/ash weight
Ash to wet RF = wet weight/ash weight
Dry to wet RF = wet weight/dry weight
Otherwise RF = 1

9.2.2 Alpha

Alpha Activity (pCi/g.) = ACT

$$ACT := \frac{TSC - BKG}{2.22\ EFF\ AVOL\ RF\ CTIME} \qquad ACT\ (pCi/kg.) = ACT\ 1000$$

Alpha Activity Error (pCi/g.) = ERR

$$ERR := 2\ |ACT| \cdot \sqrt{\frac{TSC + BKG}{(TSC - BKG)^2} + .01}$$

Alpha Activity Error where ACT=BKG>0

$$ERR := \frac{2}{2.22\ EFF\ AVOL\ RF\ CTIME} \cdot \sqrt{TSC + BKG + .01}$$

Alpha Activity Error where ACT=BKG=0

$$ERR := \frac{.2}{2.22\ EFF\ AVOL\ RF\ CTIME}$$

ERR (pCi/kg.) = ERR 1000

Lower Limit of Detection (pCi/g.) = LLD

$$LLD := \frac{4.65\ \sqrt{BKG + 3}}{2.22\ EFF\ AVOL\ RF\ CTIME}$$

LLD (pCi/kg.) = LLD 1000

TSC = Total Sample Counts (alpha)
BKG = Background Counts
CTIME = Count Time (minutes)
EFF = Counting Efficiency
AVOL = Aliquot Volume (g.)
RF = Ratio Factor
2.22 = Conversion from dpm to pCi
1000,
4.65,3 = Constants
.01 = Estimate of relative error from all other sources

Ash to dry RF = dry weight/ash weight
Ash to wet RF = wet weight/ash weight
Dry to wet RF = wet weight/dry weight
Otherwise RF = 1

9.3 Liquid sample calculations

9.3.1 Beta

Beta Activity (pCi/l.) = ACT

$$ACT := \frac{TSC - BKG}{2.22\ EFF\ AVOL\ CTIME\ R}$$

Beta Activity Error (pCi/l.) = ERR

$$ERR := 2\ |ACT|\ \sqrt{\frac{TSC + BKG}{(TSC - BKG)^2} + .0025}$$

Beta Activity Error where TSC=BKG>0

$$ERR := \frac{2}{2.22\ EFF\ AVOL\ CTIME\ R}\sqrt{TSC + BKG + .0025}$$

Beta Activity Error where TSC=BKG=0

$$ERR := \frac{.1}{2.22\ EFF\ AVOL\ CTIME\ R}$$

Lower Limit of detection (pCi/l.) = LLD

$$LLD := \frac{4.65\ \sqrt{BKG} + 3}{2.22\ EFF\ AVOL\ CTIME\ R}$$

TSC	=	Total Sample counts (beta)
BKG	=	Background Counts
CTIME	=	Count time (minutes)
EFF	=	Counting Efficiency
AVOL	=	Aliquot Volume (l.)
R	=	Self-absorption Correction
2.22	=	Conversion from dpm to pCi
4.65,3	=	Constants
.0025	=	Estimate of relative error from all other sources

9.3.2 Alpha Activity (pCi/l.) = ACT

$$ACT := \frac{TSC - BKG}{2.22\ EFF\ AVOL\ CTIME\ R}$$

Alpha Activity Error (pCi/l.) = ERR

$$ERR := 2\ |ACT| \sqrt{\frac{TSC + BKG}{(TSC - BKG)^2} + .0025}$$

Alpha Activity Error where TSC=BKG>0

$$ERR := \frac{2}{2.22\ EFF\ AVOL\ CTIME\ R} \sqrt{TSC + BKG + .0025}$$

Alpha Activity Error where TSC=BKG=0

$$ERR := \frac{.1}{2.22\ EFF\ AVOL\ CTIME\ R}$$

Lower Limit of detection (pCi/l.) = LLD

$$LLD := \frac{4.65\ \sqrt{BKG + 3}}{2.22\ EFF\ AVOL\ CTIME\ R}$$

TSC	=	Total Sample Counts (alpha)
BKG	=	Background Counts
CTIME	=	Count Time (minutes)
EFF	=	Counting Efficiency
AVOL	=	Aliquot Volume (l.)
R	=	Self-absorption Correction
2.22	=	Conversion from dpm to pCi
4.65,3	=	Constants
.0025	=	Estimate of relative error from all other sources

TITLE: Determination of Gross Alpha and/or Beta Activity	NO: RSL-308	PAGE: 1
	REVISION: 0	DATE: 4-20-87

1.0 PURPOSE

This procedure provides an analytical method for the determination of gross alpha and/or gross beta activity.

2.0 SCOPE

The procedure applies to all samples requiring gross alpha and/or gross beta activity analysis.

3.0 RESPONSIBILITY

3.1 It is the responsibility of the Laboratory Manager, or his designee, to ensure that this procedure is followed during the analysis of all samples requiring gross alpha and/or gross beta activity determination.

3.2 It is the responsibility of the Laboratory Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure and with the equipment associated with implementation of this procedure.

3.3 It is the responsibility of the technician to follow this procedure and to report any abnormal results to the Laboratory Manager, or his designee.

4.0 REFERENCES

4.1 Requirements and Specifications

4.1.1 Title 10, Code of Federal Regulations, Part 50, Appendix I, Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criteria "As Low as is Reasonably Achievable" for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.

4.1.2 U.S. Nuclear Regulatory Commission, Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants.

4.1.3 U.S. Nuclear Regulatory Commission, Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment.

4.1.4 "Quality Assurance Program Requirements for Nuclear Facilities", ANSI/ASME NQA-1 (latest edition).

4.1.5 ITAS Quality Assurance Manual.

4.1.6. ITAS-RSL Quality Assurance Manual, Laboratory Specific Attachment.

4.2 Standards

None

4.3 Procedures

4.3.1 "Procedures for Determination of Stable Elements and Radionuclides in Environmental Samples," Public Health Service Publication 999-RH-10, January 1965.

4.4 Other Publications

4.4.1 "Radioisotope Techniques," R.T. Overman and H.M. Clark, McGraw-Hill Book Co., Inc., New York, 1960. (Chapter 6)

4.4.2 "Determination of Beta Activity in Water," F.B. Barker and B.P. Robinson, U.S. Geological Survey Water-Supply Paper 1696-A, Washington, D.C., 1963.

4.4.3 "Prescribed Procedures for Measurement of Radioactivity in Drinking Water"; H.L. Krieger and E.L. Whittaker, EPA-600/4-80-032, August 1980.

4.4.4 "Standard Methods for the Examination of Water and Waste Water," APHA, AWWA, WPCF, American Public Health Association, Washington, D.C, latest edition.

4.4.5 "Annual Book of ASTM Standards", Section 11.02, Water and Environmental Technology, American Society for Testing and Materials, Philadelphia, PA 19103, latest edition.

4.4.6 "Lower Limit of Detection: Definition and Elaboration of a Proposed Position for Radiological Effluent and Environmental Measurements", L.A. Currie, NUREG/CR-4007, U.S. Nuclear Regulatory Commission, September 1984.

4.4.7 "Handbook for Analytical Quality Control in Radioanalytical Laboratories", L.G. Kanipe, EPA-600/7-77-088, August 1977.

4.4.8 "Establishing a Quality Assurance Program for Analytical Chemistry Laboratories Within the Nuclear Industry", Annual Book of ASTM Standards, Vol. 12, C1009-83.

5.0 REQUIREMENTS

5.1 Equipment

5.1.1 Analytical balance (0-160.0000 gram capacity)

5.1.2 pH meter

5.1.3 Hot plate

5.1.4 Heat lamp

5.1.5 Desiccator

5.2 Materials

5.2.1 Assorted stainless steel planchets

5.2.2 Assorted tools and routine laboratory equipment (such as spatulas, forceps, beakers, graduated cylinders)

5.3 Reagents

5.3.1 Nitric Acid (HNO_3); ACS reagent grade; concentrated

5.3.2 1M Nitric Acid: Add 65 ml of concentrated HNO_3 to 935 ml of demineralized water. Mix thoroughly.

6.0 PROCEDURE

6.1 Air Filters

6.1.1 Record the sample information on the appropriate data form. See appendix 10.1.

6.1.2 Secure the air filter into a shallow stainless steel planchet. No portion of the filter shall be exposed above the lip of the planchet. Determine counting background for air filters by using a blank (clean) air filter.

6.1.3 Submit the sample to the counting room for counting.

6.1.4 Record the counting data on the appropriate data form.

6.1.5 Calculate the results as shown in the appropriate section of paragraph 9.0.

6.2 Solid Samples

6.2.1 Record the sample information on the appropriate data form. See appendix 10.2.

6.2.2 Refer to Table I for appropriate sample sizes depending on sample type.

Table I

Sample Type	Sample Size (grams)
beef	2
fish	2
food crops	2
grain	2
poultry	2
sediment	3
soil	3
vegetation	2

6.2.3 Distribute the sample or sample ash evenly in a tared deep stainless steel planchet and carefully pack down with a flat weight of the same diameter as the planchet. Record the tare and total weight in grams.

6.2.4 Submit the sample to counting room for counting.

6.2.5 Record the counting data on the appropriate data form.

6.2.6 Calculate the results as shown in the appropriate section of paragraph 9.0.

6.3 Water Samples

6.3.1 Record the sample information on the appropriate data form. See appendix 10.3.

6.3.2 Using a graduated cylinder, measure an appropriate volume of the sample into a beaker. Record the sample volume used.

6.3.3 Add 5 ml of concentrated nitric acid.

6.3.4 Place samples on a hotplate, and evaporate to near dryness. Transfer to smaller tared beaker, as necessary, to determine solids content of the sample. Use concentrated nitric acid to assist transfer.

6.3.5 Evaporate to dryness. Determine the solids content of the sample. If the solids content exceeds 100 mg, return to 6.3.2 and adjust the initial sample volume accordingly.

6.3.6 Dissolve the sample in a small volume of 1 M nitric acid.

6.3.7 Quantitatively transfer the sample to a tared deep stainless steel planchet. Using a rubber policeman, wash down the beaker walls with small portions of 1 M nitric acid.

6.3.8 Evaporate to dryness under a heat lamp positoned not closer than 8 inches above the planchet. If green residue forms, see Laboratory Manager, or his designee.

6.3.9 Weigh the cooled planchet and record the tare and total weight in grams. Do not exceed 100 mg of solids in the planchet.

6.3.10 Store in a dessicator until the sample is counted for gross alpha and/or gross beta analysis.

6.3.11 Submit the sample to counting room for counting.

6.3.12 Record the counting data on the appropriate data form.

6.3.13 Calculate the results as shown in the appropriate section of paragraph 9.0.

7.0 PRECISION AND ACCURACY

7.1 For gross alpha, the standard deviation for a single determination is 25% at 20 pCi/l.

7.2 For gross beta, the standard deviation for a single determination is 5% at 100 pCi/l.

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsibility for Inspection

8.1.1 The Laboratory Manager, or his designee, shall inspect the work of the tehnician performing this procedure for completeness and adequate quality.

8.1.2 The technicians performing this procedure shall inspect worksheets for accuracy and completeness, shall inspect sample for proper volume and size, shall inspect labels and tags for accuracy, shall inspect equipment for proper operation, and shall inspect balances to ensure that calibration is not out of date.

8.2 Acceptance Criteria

8.2.1 The following sections of this procedure contain acceptance criteria:

6.2.2 Sample size

6.3.8 Color of residue

6.3.9 Weight limitation

8.3 Material Monitoring

None

8.4 Equipment Monitoring

8.4.1 Balances shall be checked to ensure calibration dates have not expired.

8.4.2 Balance shall be in control as determined by routine balance check procedure.

8.4.3 Counting instruments shall be calibrated before use.

8.5 Certification

8.5.1 This procedure shall be certified by running spiked samples through the procedure steps.

9.0 CALCULATIONS

9.1 Air Filter Calculations

9.1.1 Beta

Beta Activity (pCi/m^3) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME}$

Beta Activity Error (pCi/m^3) =

$$ERR = ACT* \frac{TSC}{(TSC - BKG)^2} + 0.01$$

Lower Limit of Detection (pCi/m^3) = LLD = $\frac{4.65* \ BKG + 3}{2.22*EFF*VOL*CTIME}$

TSC = Sample counts (Beta)
BKG = Background counts
CTIME = Count time (min)
EFF = Counting efficiency
VOL = Total air volume (m^3)
2.22 = Conversion from dpm to pCi
4.65, 3 = Constants
0.01 = Estimate of relative error from all other sources

9.1.2 Alpha

Alpha Activity (pCi/m^3) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME}$

Alpha Activity Error (pCi/m^3) =

$$ERR = ACT* \frac{TSC}{(TSC - BKG)^2} + 0.01$$

Lower Limit of Detection (pCi/m^3) = LLD = $\frac{4.65* \ BKG + 3}{2.22*EFF*VOL*CTIME}$

TSC = Total sample counts (Alpha)
BKG = Background counts
CTIME = Count time (min)
VOL = Total Air Volume (m^3)
EFF = Counting efficiency
2.22 = Conversion from dpm to pCi
4.65, 3 = Constants
0.01 = Estimate of relative error from all other sources

9.2 Solid Sample Calculations

9.2.1 Beta

Beta Activity (pCi/g) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*RF*CTIME}$

Act (pCi/kg) = ACT*1000

Beta Activity Error (pCi/g) =

$$ERR = ACT* \frac{TSC}{(TSC - BKG)^2} + 0.01$$

ERR (pCi/kg) = ERR*1000

Lower Limit of Detection (pCi/g) = LLD = $\frac{4.65*\ BKG + 3}{2.22*EFF*VOL*RF*CTIME}$

LLD (pCi/kg) = LLD*1000

TSC	=	Total sample counts (Alpha)
BKG	=	Background counts
CTIME	=	Count time (min)
EFF	=	Counting efficiency
VOL	=	Sample volume (g)
RF	=	Ratio factor
2.22	=	Conversion from dpm to pCi
1000, 4.65,3	=	Constants
0.01	=	Estimate of relative error from all other sources

Ash to dry	RF = dry weight/ash weight
Ash to wet	RF = wet weight/ash weight
Dry to wet	RF = wet weight/dry weight
Otherwise	RF = 1

9.2.2 Alpha

Alpha Activity (pCi/g) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*RF*CTIME}$

ACT (pCi/kg) = ACT*1000

Alpha Activity Error (pCi/g) =

$$ERR = ACT* \frac{TSC}{(TSC - BKG)^2} + 0.01$$

ERR (pCi/kg) = ERR*1000

Lower Limit of Detection (pCi/g) = LLD = $\frac{4.65* \quad BKG + 3}{2.22*EFF*VOL*RF*CTIME}$

LLD (pCi/kg) = LLD*1000

TSC = Total sample counts (Alpha)
BKG = Background counts
CTIME = Count time (min)
EFF = Counting efficiency
VOL = Sample volume (g)
RF = Ratio factor
2.22 = Conversion from dpm to pCi
1000,
4.65, 3 = Constants
0.01 = estimate of relative error from all other sources

Ash to dry RF = dry weight/ash weight
Ash to wet RF = wet weight/ash weight
Dry to wet RF = wet weight/dry weight
Otherwise RF = 1

9.3 Liquid Samples Calculations

9.3.1 Beta

Beta Activity (pCi/l) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME*R}$

Beta Activity Error (pCi/l) =

$$ERR = ACT* \frac{TSC}{(TSC - BKG)^2} + 0.0025$$

Lower Limit of Detection (pCi/g) = LLD = $\frac{4.65* BKG + 3}{2.22*EFF*VOL*CTIME*R}$

TSC = Total sample counts (Beta)
BKG = Background counts
CTIME = Count time (min)
EFF = Counting efficiency
VOL = Sample volume (l)
R = Self absorption correction
2.22 = Conversion from dpm to pCi
4.65, 3 = Constants
0.0025 = Estimate of relative error from all other sources

9.3.2 Alpha Activity (pCi/l) = ACT = $\frac{TSC - BKG}{2.22*EFF*VOL*CTIME*R}$

Alpha Activity Error (pCi/l) =

$$ERR = ACT* \frac{TSC}{(TSC - BKG)^2} + 0.0025$$

Lower Limit of Detection (pCi/l) = LLD = $\frac{4.65* \ BKG + 3}{2.22*EFF*VOL*CTIME*R}$

TSC	=	Total sample counts (Alpha)
BKG	=	Background counts
CTIME	=	Count time (min)
EFF	=	Counting efficiency
VOL	=	Sample volume (l)
R	=	Self absorption correction
2.22	=	Conversion from dpm to pCi
4.65, 3	=	Constants
0.0025	=	Estimate of relative error from all other sources

10.0 APPENDICES

Appendix 10.1

INTERNATIONAL TECHNOLOGY CORPORATION

IT/RSL LAB WORK SHEET

CUSTOMER _____

SAMPLE IDENTIFICATION _____

LABORATORY NUMBER _____

SAMPLE MATRIX _____

COLLECTION DATE AND TIME: _____

START _____

STOP _____

SAMPLE VOLUME _____

DATE RECEIVED _____

P.O. NUMBER _____

SURVEY INSTRUMENT READING _____ mR/hr.

WIPE COUNTING RESULT _____ cpm

_____ OF _____ PAGES

SPECIAL INSTRUCTIONS:

ALIQUOT						
ANALYSIS						
DATE AND TIME OF ANALYSIS						
% RECOVERY						
COUNTER NO.						
COUNTER BKG c/m						
COUNTER EFF. d/c						
COUNT START DATE AND TIME						
COUNT STOP DATE AND TIME						
COUNT TIME-MIN						
TOTAL COUNTS						
GROSS c/m						
BKG c/m						
NET c/m						
d/m PER ALIQUOT						

RESULTS REQUESTED IN: _____

REMARKS AND CALCULATIONS

SAMPLE PREPARATION						
SAMPLE ANALYSIS						
SAMPLE COUNTING						
CALCULATION						
DATA REVIEW						
APPROVAL						

367 9 86

908

Appendix 10.2

INTERNATIONAL TECHNOLOGY CORPORATION

IT/RSL LAB WORK SHEET

CUSTOMER _____

SAMPLE IDENTIFICATION _____

LABORATORY NUMBER _____

SAMPLE MATRIX _____

COLLECTION DATE AND TIME: _____

START _____

STOP _____

SAMPLE VOLUME _____

DATE RECEIVED _____

P.O. NUMBER _____

SURVEY INSTRUMENT READING _____ mR/hr.

WIPE COUNTING RESULT _____ cpm

_____ OF _____ PAGES

SPECIAL INSTRUCTIONS:

ALIQUOT						
ANALYSIS						
DATE AND TIME OF ANALYSIS						
% RECOVERY						
COUNTER NO.						
COUNTER BKG c/m						
COUNTER EFF d/c						
COUNT START DATE AND TIME						
COUNT STOP DATE AND TIME						
COUNT TIME-MIN						
TOTAL COUNTS						
GROSS c/m						
BKG c/m						
NET c/m						
d/m PER ALIQUOT						

RESULTS REQUESTED IN: _____

REMARKS AND CALCULATIONS

SAMPLE PREPARATION						
SAMPLE ANALYSIS						
SAMPLE COUNTING						
CALCULATION						
DATA REVIEW						
APPROVAL						

387-9 86

430-1 87

86

908

TITLE: Determination of Gross Alpha and/or Beta Activity	NO: RSL-308	PAGE: 1 13
	REVISION: 0	DATE: 2-23-87

Appendix 10.3

INTERNATIONAL TECHNOLOGY CORPORATION

IT/RSL LAB WORK SHEET

CUSTOMER _____

SAMPLE IDENTIFICATION _____

LABORATORY NUMBER _____

SAMPLE MATRIX _____

COLLECTION DATE AND TIME: _____

START _____

STOP _____

SAMPLE VOLUME _____

DATE RECEIVED _____

P.O. NUMBER _____

SURVEY INSTRUMENT READING _____ mR/hr.

WIPE COUNTING RESULT _____ cpm

_____ OF _____ PAGES

SPECIAL INSTRUCTIONS:

ALIQUOT						
ANALYSIS						
DATE AND TIME OF ANALYSIS						
% RECOVERY						
COUNTER NO.						
COUNTER BKG c/m						
COUNTER EFF d/c						
COUNT START DATE AND TIME						
COUNT STOP DATE AND TIME						
COUNT TIME-MIN						
TOTAL COUNTS						
GROSS c/m						
BKG c/m						
NET c/m						
d/m PER ALIQUOT						

RESULTS REQUESTED IN _____

REMARKS AND CALCULATIONS

SAMPLE PREPARATION						
SAMPLE ANALYSIS						
SAMPLE COUNTING						
CALCULATION						
DATA REVIEW						
APPROVAL						

367 9 86

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87