New York State Department of Environmental Conservation
Division of Environmental Remediation, Region One
Building 40 - SUNY, Stony Brook, New York 11790-2356
Phone: (631) 444-0240 • FAX: (631) 444-0248
Website: www.dec.state.ny.us

Erin M. Crotty
Commissioner

December 17, 2002

Mark Roberts
U.S. Nuclear Regulatory Commission
Region 1
475 Allendale Road
King of Prussia, PA 19406

Re: Draft Soil Remediation Program Work Plan, October 2002
Former Sylvania Electric Products Facility, Hicksville, NY
Site # V00089-1

Dear Mr. Roberts:

For your information, I have enclosed one copy of the Draft Soil Remediation Program Work Plan, October 2002 for the Former Sylvania Electric Products Facility in Hicksville. The draft work plan ~~and~~ is still in the public comment period.

The actual extent of the proposed soil removal will be expanded based on new data which has been recently collected from 160 additional soil borings. The excavation is planned to start in May 2003 and be completed in November 2003.

Please call me at (631) 444-0244 if you have any questions.

Sincerely,

Robert R. Stewart

Robert R. Stewart
Environmental Engineer I

Enclosure

C-1

WORK PLAN

SOIL REMEDIATION PROGRAM WORK PLAN

DRAFT

FORMER SYLVANIA ELECTRIC PRODUCTS FACILITY

HICKSVILLE, NEW YORK

SITE NUMBER V00089-1

GTE Operations Support Incorporated

LOGISTICAL SOLUTIONS

URS

ENVIROCON

ENVIROCARE OF UTAH, INC.
THE SAFE ALTERNATIVE

For:

GTE Operations Support Incorporated
600 Hidden Ridge Drive
Irving, Texas 75038

January 18, 2002 (Revision 2: October 2002)

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FIGURES

APPENDIX

LIST OF ABBREVIATIONS AND ACRONYMS

ACBM	asbestos-containing building materials
ACGIH	American Conference of Governmental Industrial Hygienists
AEC	Atomic Energy Commission
AHERA	Asbestos Hazard Emergency Response Act
AIHA	American Industrial Hygiene Association
ALARA	As low as reasonably achievable
ANSI	American National Standards Institute
ASP	Analytical Services Protocol
ASTM	American Society for Testing and Materials
BG	background sample
bgs	below ground surface
bsl	below sea level
C	ceiling limit
CA	controlled area
CAMP	Community Air Monitoring Program
CAS	chemical abstract service
CERCLA	Comprehensive Environmental Response Compensation Liability Act
CFCs	chlorofluorocarbons
CFR	Code of Federal Regulations
CGI	combusible gas indicator
CHP	Certified Health Physicist
Ci	Curie
CIH	Certified Industrial Hygienist
CLP	contract laboratory program
COC	chain of custody
Comp	Composite sample
Con	concrete
cpds	compounds (chemical)
cpm	counts per minute
CPR	cardiopulmonary resusitation
CRZ	contamination reduction zone
CSXT	CSXT Railroad
CV	coefficient of variation
D	duplicate sample
DAC	derived air concentrations
dB	decibels
DCGLs	derived concentration guideline levels
Deb	debris
DOD	Department of Defense
DOE	Department of Energy
dpm	disintegrations per minute
dps	disintegrations per second
DQO	data quality objectives

LIST OF ABBREVIATIONS AND ACRONYMS

DSR	duplicate sample result
DUSR	Data Usability Summary Report
ECT	equivalent chill temperature
EML	Environmental Measurements Laboratory
ERG	emergency response guide
EZ	exclusion zone
F	Fahrenheit
FB	field blank
FSAP	Field Sampling and Analysis Plan
FSP	Field Sampling Program
ft^2	square feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
g/l	grams per liter
GC/MS	gas chromatograph / mass spectrometry
GCDR	Golf Course Driving Range
GFPC	gas flow proportional counters
GIS	Geographic Information Systems
GPR	Ground Penetrating Radar
GTEOSI	GTE Operations Support Incorporated
HASL	Health and Safety Laboratory Method
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Reponse Standard
HEPA	High Efficiency Particulate Air (Filter)
HVAC	Heating, Ventilation and Cooling
ICAO	International Civil Aviation Organization
ICP	inductively coupled plasma
IDL	instrument detection limit
IDLH	immediately dangerous to life or health
IL	Illinois
IMDG	International Maritime Dangerous Goods
INEEL	Idaho National Engineering and Environmental Laboratory
J	estimated value
L1	lift number
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
LEL	lower explosive limit
LFC	lowest feasible concentration
LO/TO	lockout / tagout
MARSSIM	Multi Agency Radiaiton Site Survey Investigation Manual
MCE	mixed cellulose ester
mCi	millicurie
μCi	microcurie
MCL	maximum contaminant level

LIST OF ABBREVIATIONS AND ACRONYMS

MD	matrix duplicate
MDA	minimum detectable activity
MDC	minimal detectable concentration
MDL	method detection limit
MDSA	minimum detectable surface activity
mg/Kg	milligram per kilograms
mg/l	milligram per liter
mg/m^3	milligram per cubic meter (measurement of air concentration of particulates)
MHF-LS	MHF Logistical Solutions
MHz	mega hertz
mrem	millirem
MS	matrix spike
MSA	Mine Safety Appliance Company
MSB	matrix spike blank
MSD	matrix spike duplicate
MSDS	material safety data sheet
n/a	not applicable
NaI	sodium iodide
NCDOH	Nassau County Department of Health
NCDPW	Nassau County Department of Public Works
ND	not detected
NGVD	National Geodetic Vertical Datum
NIOSH	National Institute of Occupational Safety and Health
NIST	National Institute of Standards and Technology
NJ	New Jersey
NORM	Naturally Occurring Radioactive Materials
NRC	Nuclear Regulatory Commission
NRR	noise reduction rating
NY	New York
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOL	New York State Department of Labor
NYSDOT	New York State Department of Transportation
OSHA	Occupational Safety and Health Administration
OSR	original sample result
OSWER	Office of Solid Waste and Emergency Response (USEPA)
PCB	Polychlorinated Biphenyls
PCE	tetrachloroethene
pCi	picocuries
pCi	picocurie
pCi/L	picocuries per liter (air concentration for radionuclides)
PEL	permissible exposure limit
Per	air sample

LIST OF ABBREVIATIONS AND ACRONYMS

PID	photoionization detector
PM	project manager
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PQL	practical quantitation limit
PT	point
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
R	Roentgen
RAM	real-time aerosol monitor (dust meter)
RAS	routine analytical services
RCRA	Resource Conservation Recovery Act
REL	recommended exposure limit
RER	relative error ratio
RESRAD	a computer program used to estimate radiation risk
RF	radio frequency
RHSM	Regional Health and Safety Manager
RL	reporting limit
RPD	relative percent difference
RRF	relative response factor
RSD	relative standard deviation
RSO	Radiation Safety Officer
SAS	special analytical services
SCBA	self-contained breathing apparatus
SCBAE	self -contained breathing apparatus - escape
SDMP	Site Decommissioning Management Plan
SKIN	significant exposure possible via skin absorption
SOP	Standard Operating Procedure
SS	Site Supervisor
SSO	Site safety officer
STEL	short-term exposure limit
SVOCs	semi-volatile organic compounds
SW	surface water
Syl	Sylvania
SZ	support zone
TAGM	Technical and Administrative Guidance Memorandum
TAL	target analyte list
TB	trip blank
TBD	to be determined
TCE	trichloroethene
TCL	target compound list
TCLP	toxicity characteristics leaching procedure

LIST OF ABBREVIATIONS AND ACRONYMS

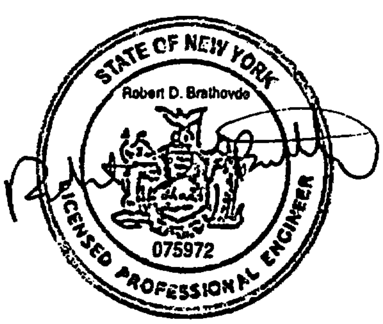
TCP	traffic control plan
TDG	Transportation of Dangerous Goods
Th-232	Thorium 232
TLD	thermoluminescent dosimeter
TLV	threshold limit value
TWA	time weighted average
U-238	uranium 238
UEL	upper explosive limit
UFPO	Underground Facilities Protection Organization
ug/kg	micrograms per kilogram
UPRR	Union Pacific Railroad
URS	URS Corporation
USCG	United States Coast Guard
USDOE	United States Department of Energy
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USRADS	Ultrasonic Ranging and Detection System
UST	underground storage tank
UT	Utah
UV	ultra violet
VCP	Voluntary Cleanup Program
VOC	Volatile Organic Compounds
WZ	work zones

URS

October 31, 2002

The remedial engineering work described in the following Work Plan was prepared under my supervision in accordance with New York Education Law, Title 8, Article 145. Detailed engineering plans and specifications will be prepared as described in the Work Plan. The results and opinions presented in this report were developed using generally accepted engineering practices and conform to the standard of care commonly used as state-of-the-practice in the profession. It is a violation of the law for any person, unless acting under the direction of the licensed professional engineer to alter this report or its attachments in any way, except as allowed under Section 7209.

URS Corporation – New York



Robert D. Brathovde, P.E.
Associate

EXECUTIVE SUMMARY

GTE Operations Support Incorporated (GTEOSI) has organized a team of environmental companies to manage, excavate, transport and dispose of soils, building materials and debris containing chemical, metal and radiological process residuals from the former Sylvania Electric Products, Inc. (Sylvania) facility (the "Site") in Hicksville, New York. These companies have been chosen for their experience with the type of remediation planned for the Site and have developed this Work Plan collectively.

Beginning in 1952, Sylvania manufactured nuclear reactor fuel elements, high temperature coatings and composite alloys. Operations and manufacturing practices resulted in the release of radioactive elements and solvents to the environment. While most of these constituents were removed from the facility with the closure of manufacturing operations, residual concentrations remain. Based on former Site investigations, there are several areas that are the focus of this Work Plan. The former Sylvania facility footprint covers three separate properties. The areas of interest on these properties include the eastern portion of 140 Cantiague Rock Road, now owned by GTEOSI, formerly Gilbert Displays (140 Property); the east and southeast portion of 100 Cantiague Rock Road, currently occupied by Magazine Distributors (100 Property); and the northern portion of 70 Cantiague Rock Road, currently occupied by Air Techniques (70 Property) (Figure 1). The 140 Property is the only property requiring remediation under a building. As a result, GTEOSI will conduct demolition, remediation, and restoration at the eastern end of the building. The 140 Property will be used as an operations and management center for the project team. The property is fenced and security will be hired to control access to the building and the Site.

The Site buildings are surrounded by asphalt parking areas and driveways; however, the eastern portion of the Site has few unpaved areas. Underground utilities will be mapped and marked. Excavation will be accomplished using a variety of mechanical equipment, as well as hand digging tools. Soils will be screened using field instruments and be supplemented by laboratory analysis. Soils removed will be segregated for disposal. Target cleanup levels are as follows.

- Radioactive Materials (processed natural uranium, thorium, and associated radioactive progeny);
  Total Uranium: 100 picoCuries per gram (radioactive levels provide appropriate protection for chemical toxicity of uranium)
  Uranium – 238: 50 picoCuries per gram
  Uranium – 234: 50 picoCuries per gram
  Thorium – 232: 2.8 picoCuries per gram above the background concentration

  In addition, post-remedial concentrations of these radionuclides will not result in a radiation dose exceeding 10 millirem/yr in accordance with TAGM 4003.

- Volatile Organic Compounds
  Tetrachloroethene (PCE): 1.82 parts per million
  Trichloroethene (TCE): 0.70 parts per million

- Metals
  Nickel: 560 parts per million

Once field measurements indicate cleanup levels have been achieved, confirmation and verification samples will be collected for laboratory analysis. Excavated soils will be placed in Lift-Liners™, manifested, screened, and loaded onto flat-bed trucks for transport to a nearby rail siding. The Lift-Liners™ will be transferred to gondola cars and transported by rail to Envirocare of Utah, a licensed radioactive waste disposal facility. The excavation will be backfilled and compacted with clean fill.

The project is scheduled to begin in the spring of 2003 and is to be completed by the end of the year. Since Site parking areas and driveways must be replaced, the project must be completed prior to the seasonal closure of the local asphalt plants. The work schedule provides for remediation access to the 100 Property, which GTEOSI leases.

Remediation will provide for unrestricted use of the Site. A Final Project Report will be prepared that includes project drawings, photographs, laboratory analyses, copies of waste disposal certificates, text and other pertinent data.

SOIL REMEDIATION PROGRAM WORK PLAN

FORMER SYLVANIA ELECTRIC PRODUCTS FACILITY
HICKSVILLE, NEW YORK
GTE OPERATIONS SUPPORT INCORPORATED

1.0 INTRODUCTION

This Work Plan has been developed to outline the planned removal of soils, building materials and associated debris and the restoration of the Property from the former Sylvania Electric Products Manufacturing facility (the "Site") that includes the Property located at 140 Cantiague Rock Road, currently owned by GTE Operations Support Incorporated (GTEOSI) (formerly Gilbert Displays) (140 Property), the Property located at 100 Cantiague Rock Road, currently occupied by Magazine Distributors (100 Property), and the Property located at 70 Cantiague Rock Road, occupied by Air Techniques (70 Property) shown on Figures 1 and 2. These three parcels are located in Hicksville, New York. This Work Plan is based on data gathered from previous Site investigations performed pursuant to the Voluntary Cleanup Program (VCP) agreement dated April 7, 1999, between GTEOSI and New York State Department of Environmental Conservation (NYSDEC).

The Work Plan describes the history of the former Site operations, parties responsible for various aspects of the remediation program, local environmental conditions, the approach to remediation and associated protocols, sampling and testing, communications, project documentation, health and safety requirements, Site security, and Site restoration.

2.0 PROJECT SCHEDULE AND KEY DELIVERABLES

The schedule to perform the remediation activities, including excavation, backfilling, restoration and the replacement of asphalt must be completed by late fall 2002, prior to the seasonal closure of asphalt plants. To accomplish this, GTEOSI needs to maintain an aggressive project schedule. GTEOSI intends to lease the 100 Property for six months beginning in July 2002 to provide the remediation team with access to certain areas of the Site that are not available while the Property is occupied. The remedial approach and schedule assumes that access to the Site properties can be obtained. If access difficulties are encountered, the approach and schedule to implement the Work Plan activities may require modification.

The following table summarizes key deliverables, milestones and deadlines.

Item	Critical Date
January 2002 Soil Remediation Work Plan submitted to NYSDEC	January 21, 2002
Meeting in Albany with Agencies to discuss January 2002 Work Plan	January 23, 2002
Agency comments on January 2002 Work Plan	February 25, 2002
Revised March 2002 Work Plan submitted to NYSDEC	March 15, 2002
Meeting in Albany with Agencies to discuss March 2002 Work Plan	August 8, 2002
Agency comments on March 2002 Work Plan	September 24, 2002
Revised October 2002 Work Plan submitted NYSDEC	October 31, 2002
Public Comment Period on October 2002 Work Plan	TBD
Public Meeting in Hicksville, NY	TBD
Work Plan approved by NYSDEC	TBD
Excavation begins	May 2003
Excavation ends	TBD
Lay asphalt	TBD
Asphalt plants close for season	November 15, 2003
Draft Cleanup Report to NYSDEC	TBD

TBD = to be determined

3.0 PROJECT TEAM

GTEOSI has assembled a project team to perform the planning and execution of the project at its direction. URS Corporation will be the consulting firm of record. Envirocon, Inc. will be responsible for the excavation and restoration of the Site. MHF Logistical Solutions will be responsible for the transportation of the excavated materials from the Site to the disposal facility provided by Envirocare of Utah, located in Clive, Utah. Following are summaries of each contributor's qualifications. Resumes of field personnel are included in Appendix I.

URS Corporation

URS Corporation (URS) is one of the nation's leading engineering, environmental and construction service firms serving government agencies and private industrial and commercial companies worldwide. The URS professional staff includes engineers with expertise in the full spectrum of disciplines, as well as planners, scientists, environmental specialists, information management specialists, architects and construction managers. Headquartered in San Francisco, URS is a publicly owned company listed on the New York and Pacific Stock Exchanges as URS. The company has 15,800 employees and operations in 30 countries.

URS maintains a specific practice in radiological issues related to the environment. The URS Nuclear Services Group supports radiological-specific projects such as facilities in the United States Army Corps of Engineers Formerly Utilized Sites Remedial Action Program (FUSRAP), Nuclear Regulatory Commission (NRC) Site Decommissioning Management Plan (SDMP) and sites with multiple types of contamination that fall under Resource Conservation Recovery Act (RCRA) or Comprehensive Environmental Response Compensation Liability Act (CERCLA). This Group has implemented guidance from the state agencies, the NRC and the United States Environmental Protection Agency (USEPA) regarding site clean-ups, including the dose and risk assessments needed to define clean-up criteria. Many of these projects have included enhanced concentrations of Naturally Occurring Radioactive Materials (NORM) such as thorium, radium, and uranium.

URS has assisted in the clean-up and management of United States Department of Energy (USDOE) sites with radioactive, hazardous, and mixed wastes, such as Oak Ridge RCRA Closures, Savannah River Site RCRA regulatory compliance, Idaho National Engineering and Environmental Laboratory (INEEL) risk assessments, and the ongoing West Valley Demonstration Project in West Valley, New York. At Brookhaven National Laboratory URS has been deeply involved in assisting the Laboratory with remediation of the Chemical and Glass Holes, the radioactive waste transfer/consolidation facility, and the Brookhaven Graphite Research Reactor. For this type of project, URS has provided project planning, health and safety planning and monitoring, waste characterization and on-site analysis, and hazardous/radioactive waste disposition and management recommendations.

Envirocon, Inc.

Envirocon, Inc. (Envirocon) is an experienced environmental remediation contractor with offices nationwide that service projects involving chemical and radioactive contamination. Current applicable projects include the remediation of nerve warfare agents at the Rocky Mountain Arsenal and decommissioning of nuclear warhead trigger facilities at Rocky Flats in Colorado, restoration of over 700 homes with thorium contamination in West Chicago, Illinois, and the final site restoration of Cesium-137 impacts at an aerospace manufacturing facility in New Jersey. To support these projects, Envirocon maintains a broad array of technically based construction personnel. These personnel are capable of providing effective remedial construction responses to the most technically-challenging of projects.

To support the fieldwork, Envirocon will provide a team of experienced personnel and the equipment necessary to accomplish each phase of the remediation process. Personnel responsible for implementation of the work required will be based out of Envirocon's Astin, Pennsylvania office. These personnel have extensive experience working with each of the constituents of concern and exhibit a broad array of skills including chemical and radioactive health and safety, as well as the requisite field disciplines to perform, monitor, and document Site remediation.

MHF Logistical Solutions, Inc.
MHF Logistical Solutions, Inc. (MHF-LS) is a US based company located in Cranberry Township (near Pittsburg), Pennsylvania and supported by six regional offices across the country, specializing in the design and implementation of innovative packaging and transportation programs. Current and past projects include the shipment of over 3,000 Lift-Liners™, 10,000 gondola cars, and 25,000 intermodal containers, containing low-level radioactive waste and materials. In addition, MHF-LS supports the Army Corp of Engineers with the two of the largest FUSRAP Projects in the United States, the St. Louis Airport Site and the Ashland and Linde Properties in Tonawanda, NY. MHF-LS is also involved with three nuclear power plant decommissioning projects at Maine Yankee, Connecticut Yankee, and Southern California Edison.

To support the project, MHF-LS will provide the necessary equipment, packaging, and transportation for the project. MHF-LS will also be providing a representative from their Technical Services Group to prepare shipping manifests and coordinate logistics requirements at the Site and rail yard. Personnel assigned to this project are experts in the safe handling and shipment of radioactive materials.

Envirocare of Utah, Inc.
Envirocare of Utah, Inc. (Envirocare) is a proven, mature organization that has assumed and maintained a leadership position as operator of the nation's largest fully regulated commercial radioactive waste disposal and mixed waste treatment and disposal facility. The company is regulated by 13 Federal, State and local agencies and maintains closely regulated closure funds to insure proper closure and monitoring. Since inception, Envirocare has received and disposed of radioactive waste from over 600 different generators. Each month Envirocare routinely receives waste from 40 different generators who send on average more than 10 million cubic feet of waste for treatment and disposal annually. Envirocare customers represent large and small remediation projects from commercial entities that encompass electricity production, nuclear fuel processing, chemical manufacturing, telecommunications, agricultural and biomedical research organizations. In addition to its commercial customer base, Envirocare services a wide variety of government agencies that ship on a continual basis. The federal government (i.e. USEPA, Department of Defense (DOD), and DOE) is the largest single customer of Envirocare. Some of Envirocare's projects include Fernald, Oak Ridge, Rocky Flats, INEEL, USEPA, and FUSRAP.

Envirocare operates the largest commercial mixed waste treatment facility in the nation and the only commercial mixed waste disposal facility. Envirocare holds multiple permits and licenses including a RCRA Part B permit which enables Envirocare to treat and/or dispose of hazardous and radioactive waste materials. Envirocare's primary treatment technologies include chemical fixation, stabilization, and Macroencapsulation. Envirocare has also implemented an extensive quality assurance program. These features allow Envirocare to provide innovative waste management solutions for many types of waste while providing safe and quality services. Envirocare provides permanent and safe waste disposal services in both a state and NRC licensed and regulated facility that is designed specifically for Class A low-level radioactive waste.

4.0 PROJECT BACKGROUND

This section provides an overview of the Site history, the former Site operations, and the current Site conditions.

4.1 SITE HISTORY

From 1952 to 1970 the Site was operated for the fabrication of reactor fuel elements, as well as high temperature coatings and composite alloys for space and aircraft industries. Records indicate that Sylvania operated the three main buildings, designated as buildings #1, #2, and #4, and twelve support buildings under license #SNM-82 (for fuel rod fabrication) issued from the Atomic Energy Commission (AEC) (NRC 1996). Buildings #1 and #2 on Lot 80 already existed when Sylvania first occupied the Property in 1952. Sylvania acquired the remainder of Lot 79 in 1957 and constructed building #4. A plan view of the current Site layout with the overlay of the 1960 structures is provided as Figure 3. With the sale of Sylvania Nuclear Division's equipment, tooling, and license assets to National Lead Industries in 1966, the production of nuclear fuel elements and components at the facility ceased. In 1967 the AEC removed the Site from licensing requirements due to cessation of nuclear product production activities. The Sylvania Parts Division continued Site operations until 1969.

The buildings were demolished in 1968 and 1969 with the exception of Building #4, which exists on the 70 Property. This building was decommissioned in accordance with applicable regulations and released for unrestricted use by the New York State Department of Labor (NYSDOL) in 1967. According to a letter from Rita Aldrich of the NYSDOL to Barbara Youngberg of NYSDEC dated March 21, 1997, Building #4 was reviewed by ORNL in December 1995, who found that "the building was suitable for unrestricted use according to present limits." Further, the letter indicates that NYSDOL made readings in January 1996 and found no readings above background. Before the construction of the current buildings, the Property was subdivided into three new parcels with new lot numbers. The current Site layout is presented on Figure 4.

4.2 DESCRIPTION OF FORMER OPERATIONS

The former Sylvania Plant fabricated reactor fuel elements and high temperature protective coatings was used in research and electric power generation. The plant had two production facilities, one for the manufacture of commercial-type fuel elements and the other for the government manufacture of special elements and reactor materials. Manufacturing processes performed included:

- Melting of enriched uranium-molybdenum and enriched uranium-aluminum in graphite and ceramic crucibles in vacuum furnaces;
- Sintering of uranium oxide-powdered stainless steel and rolling of uranium-stainless steel billets in hydrogen atmosphere furnaces;
- Applying high temperature protective coatings to the exhaust skirts of rockets and larger aerospace parts using a vacuum diffusion-coating furnace;
- Iso-static pressing of uranium pellets-aluminum tubing involving argon gas; and
- Chemical cleaning of products involving hot and cold acid, caustics, solvents, water and anodizing solutions in cleaning tanks, hoods, and degreasing stations.

Liquid wastes were generated from both the coolant used for the fabrication of equipment and the chemical cleaning baths. The coolant was dried and the resulting sludge burned to salvage the uranium. Sylvania discharged non-contact cooling water for equipment into a leaching pool. Some waste products were sent off-Site for disposal (greater than 5 grams per liter (g/l) uranium) while other process residuals were disposed of in on-Site recharge basins, leaching pools, or cesspools (circa 1959). In the mid-1960's, effluent was discharged to four sumps that were pumped to a Site dry well.

4.3 CURRENT SITE DEVELOPMENT AND OPERATIONS

Today, the Site is comprised of three separately owned lots: the 70 Property, 100 Property, and the 140 Property (identified as Lot 94, Lot 99 and Lot 100). Approximately 95 percent of the 9.5-acre fenced Site is either paved or occupied by buildings.

70 Property
The 70 Property, on the southern portion of the Site, consists of an approximately 79,210-square foot (ft^2) one-story brick building and the associated land. The portion of the Property not occupied by the building is paved and used for parking and storage. This Property was purchased by its current owner in 1979, and was expanded to the east after adjacent land (Lot 105) was purchased from Nassau County. The western portion of the building is the only original building (historically Building #4) that remains, as the other original buildings have been demolished.

100 Property
The 100 Property is centrally located on the Site and consists of the fenced area enclosing an 80,100-ft^2 two-story distribution building and paved parking lots. Two underground petroleum tanks are on the south side of the building.

140 Property
The 140 Property is on the northern portion of the Site, immediately south of the Nassau County Department of Public Works (NCDPW). The Property houses an approximately 54,500-ft^2 one-story office and industrial building. The Property is primarily paved with the exception of a small area on the east side that abuts the Nassau County Parks Department Golf Course Driving Range (GCDR).

Surrounding Land Use
The Site is bounded by the NCDPW to the north. The GCDR is to the east. A property formerly owned by General Semiconductor, a Class 2 State listed inactive hazardous waste site, is south of the Site. Cantiague Rock Road and commercial and industrial properties are to the west.

4.4 SUMMARY OF INVESTIGATIONS

Previous investigations at the Site include a non-intrusive investigation conducted in 1997 (Phase I) and a multi-phase intrusive investigation (Phase II) conducted from July 1999 to November 2001.

The following field activities were performed as part of Phase I:

- A ground penetrating radar (GPR) survey was conducted to evaluate the existence of subsurface structures and to assist in identifying subsequent surface and subsurface soil sampling locations.

- An Ultrasonic Ranging and Detection System (USRADS) survey was conducted to define, to the extent practicable, the lateral extent of above-background gamma emitting radioactive materials that could indicate the presence of process residuals, particularly uranium and thorium progeny and to assist in identifying subsurface soil sampling locations.

- A Site survey was conducted to identify the historic structures and produce a current map of the Site.

Phase II was comprised of invasive field activities conducted in the summer of 1999 (July 7 through 23, 1999 and August 9 through 12, 1999, the initial investigation), a supplemental investigation conducted from November 27 through December 10, 2000, a monitoring well installation field program conducted from June 27 through July 10, 2001, surface soil sampling at the Nassau County GCDR conducted on November 7, 2001 and an excavation test program and a subsurface geophysical screening program performed on December 18 and 19, 2001. Field efforts included:

- The initial investigation included the advancement of 128 soil borings and the completion of five temporary wells. Samples collected during this program were subject to field screening and selected laboratory analysis to evaluate the nature and extent of process residuals related to former Site use. The sampling of existing Site groundwater monitoring wells and three upgradient wells on NCDPW Property was also performed to evaluate the impact of process residuals in the groundwater under the Site.

- The supplemental investigation was performed to further evaluate areas identified during the initial investigation where process residuals (from previous manufacturing operations) consisting of uranium, thorium and tetrachloroethene (PCE), a common solvent, were potentially located. These locations were characterized through the advancement of over 60 soil borings and related soil sample analyses.

- The primary focus of the groundwater investigation and monitoring was to assess whether solvents and radionuclides related to former production activities were present in groundwater underlying the Site.

- A comprehensive groundwater sampling event was conducted to collect field parameters and samples from twelve Site monitoring wells (MW-01 through MW-12) and the three upgradient wells (NCDPW wells W-24, W-24D, and W-25).

- Surface soil sampling was conducted on the GCDR to verify that residual concentrations of concern were not present on the adjacent Property.

- An excavation test program and a subsurface geophysical screening program was performed on December 18 and 19, 2001. The program was conducted to assess the potential presence of piping and correlate radionuclide distribution as it affects instrument operations.

4.5 SITE PHYSIOGRAPHY

The Site is in west central Long Island in the western portion of Hicksville, New York (Figure 2). Regionally, the Site is on a glacial outwash plain. Topography becomes more varied northward near the Ronkonkoma and Harbor Hill moraines and associated ground moraine areas. Few surface water bodies are found near the Site.

4.6 LOCAL CLIMATIC CONDITIONS

Long Island has a humid climate that is controlled primarily by the prevailing westerly winds, causing most weather systems to approach from the continental United States. Temperature extremes tend to be subdued by the proximity of the Atlantic Ocean (Isbister 1966). Long Island depends on precipitation as its sole source of recharge to groundwater via natural infiltration, recharge basins and cesspools. The remainder of the precipitation is removed by either direct runoff or evapotranspiration (Peterson 1988). Annual precipitation averages about 43.87 inches. The average daily temperatures ranged from a low of 39.8°F in February to a high of 75°F in July. Average temperature and precipitation data for the area are collected at the National Climatic Data Center Mineola Cooperative.

4.7 GEOLOGICAL CONDITIONS

The regional geologic setting in Nassau County consists of unconsolidated geologic deposits overlying bedrock. The deposits are approximately 1,100 feet thick near the Site, thinner in the northwestern part of Nassau County and thicker southward. The deposits are divided into seven surficial geologic units: two members of the Raritan Formation, the Magothy Formation, two distinct units of the Port Washington deposit, the Port Washington clay unit, and the Upper Pleistocene deposits (Isbister 1966; Smolensky and Feldman 1988).

The unconsolidated deposits consist of residual or weathered bedrock, sand, silt, clay, and gravel of alluvial or glacial origin. The unconsolidated deposits are subdivided into stratigraphic or geologic units based on like characteristics, such as grain size distribution, sorting, porosity, composition of grains, and any other unique characteristics. Boundaries between unconsolidated geologic units are often marked by unconformity.

Overburden beneath the Site consists of unconsolidated deposits. Based on-Site boring logs, surficial deposits are fairly uniform, fine to coarse sands with little gravel. These deposits have been evaluated from the surface to 220 feet below ground surface (bgs). Discrete lithological differences were not noted during field investigations.

4.7.1 Bedrock Geology

The bedrock underlying Long Island is Precambrian to lower Paleozoic in age. The bedrock geology predominately consists of schist and gneiss with igneous intrusions. The bedrock is known to have some fractures; however, the fractures are not considered significant within the regional hydrogeology because of relatively low fracture permeability in comparison to the unconsolidated deposits. A highly weathered zone of approximately 50 feet exists at the top of the bedrock. This zone contains various colored clays and sandy clay mixed with degraded rock and mineral fragments. The bedrock surface slopes at approximately 62 feet per mile toward the southeast and ranges from 160 feet below sea level at the north shore of Nassau County, to approximately 855 feet below sea level near the Site (Kilburn 1979).

4.8 HYDROGEOLOGICAL CONDITIONS

The regional groundwater flow on Long Island is reportedly separated by a groundwater divide that trends east to west along the north central portion of Long Island. Groundwater north of the divide discharges to Long Island Sound and groundwater south of the divide discharges into Great South Bay (Kilburn 1979).

Four major aquifers exist within the unconsolidated deposits that underlie Nassau County. From deepest to most shallow, the aquifers are the Lloyd Aquifer, Port Washington Aquifer, Magothy Aquifer, and the Upper Glacial Aquifer. The Lloyd Aquifer rests unconformably on bedrock that is relatively impermeable and can be considered the base of the hydrogeologic system (Smolensky and Feldman 1988). The aquifer lies about 900 feet bgs and is estimated to be 300 feet thick. The aquifer is confined since it underlies a clay-rich Raritan confining unit and overlies bedrock. The Port Washington Aquifer rests unconformably upon bedrock in northern Nassau County. The Magothy Aquifer serves as the principal source of fresh water on Long Island. The aquifer is approximately 600 feet thick and lies about 85 feet bgs. Due to high concentrations of clays in the upper portions of the Magothy Aquifer, most public water supply wells are screened in the lower Magothy Aquifer. The upper glacial aquifer is the uppermost hydrogeologic unit on Long Island. The unit is approximately 85 feet thick with the upper 10-feet consisting of fill and recent deposits. The Upper Glacial Aquifer is nearly continuous across Long Island therefore, most recharge must infiltrate through the upper glacial aquifer to reach the lower aquifers. Most recharge originates from the precipitation that Long Island receives.

The four aquifers are hydraulically interconnected and are controlled by their water-bearing properties and the groundwater flow dynamics. A hydraulic aquifer is separated from the Magothy Aquifer by the Raritan confining unit. The Port Washington Aquifer is believed to be in close hydraulic communication with the adjacent Lloyd and Magothy aquifers. The Port Washington Aquifer also forms part of the valley fill deposits in the channels cut by Pleistocene rivers. The valley fill deposits can act as groundwater flow paths that increase the hydraulic connection between the aquifers (Kilburn 1979).

4.8.1 Regional Surface Water

Regionally, surface water in Nassau County consists of a few small streams, ponds, and marshes. Surface water collection is mainly controlled by precipitation rates, infiltration, runoff rates, and by perched water tables. Numerous perched ponds, marshes, and effluent streams occur north of the Ronkonkoma moraine (Isbister 1966).

Headwaters of the streams on Long Island tend to originate in the highlands of the Ronkonkoma and Harbor Hill moraines. To the north, sediments tend to be impermeable tills that support perched water tables and receiving streams. To the south of the highlands, outwash plain deposits are usually very permeable and will not support a perched water table. Streams to the south of the Ronkonkoma moraine tend to be losing and often disappear completely. Direct runoff from urban areas (pavement, rooftops) is re-routed by storm drainage systems to numerous recharge basins, which ultimately replenish the water table.

4.8.2 Site Hydrogeology

Hydrogeological data collected from investigations on and adjacent to the Site have focused on the upper glacial aquifer and the Magothy Aquifer. Test borings indicate that the Site is underlain by relatively simple stratigraphy consisting of gravelly sands overlying silty fine sands.

The water table at the Site is relatively flat. Groundwater elevations measured within monitoring wells on and adjacent to the Site varied by approximately 0.23 feet across the Site (73.36 through 73.59-feet bgs). Groundwater flow beneath the Site is generally toward the south.

4.9 CHEMICAL AND RADIOLOGICAL CONDITIONS

Approximately 195 borings have been advanced at the Site to evaluate subsurface conditions. Samples of both soil and groundwater collected from these activities were screened in the field and analyzed for radionuclides, nickel, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and semi volatile organic compounds (SVOCs). Findings suggest that there are isolated areas of above background radiation beneath the pavement on each of the properties investigated (O'Brien & Gere 2000). However, no immediate health hazard exists given that exposures are well within referenced acceptable levels. Tetrachloroethene (PCE) and trichloroethene (TCE), common solvents, were found to exist in several subsurface locations at the rear of the 140 Property and 100 Property, as well as in the groundwater from existing monitoring wells.

4.10 REGULATORY HISTORY

Buildings #1 and #2 already existed when Sylvania first occupied the Site in 1952. Records indicate that Sylvania operated under license #SNM-82 issued from the AEC. Production ceased in 1966 and the AEC removed the facility from licensing requirements in 1967. Since building #4 was to remain on-Site, it was decommissioned in accordance with applicable regulations and the NYSDOL released the Sylvania Site for unrestricted use. According to a letter from Rita Aldrich of the NYSDOL to Barbara Youngberg of NYSDEC dated March 21, 1997, Building #4 was reviewed by ORNL in December 1995, who found that "the building was suitable for unrestricted use according to present limits." Further, the letter indicates that NYSDOL made readings in January 1996 and found no readings above background.

In 1996, NYSDEC submitted a request to GTEOSI for information on the former Site activities. GTEOSI then received a letter requesting that an investigation be conducted due to findings by the NRC of elevated levels of radioactivity. NRC's findings were based on an August 1996 inspection as part of a program to ensure that licenses, for facilities where activities authorized by the AEC were conducted, have been terminated in accordance with the NRC's current criteria for release for unrestricted use. The inspection detected above background levels of radioactivity and concluded that additional measurements were needed. The NRC relinquished their responsibility for the Site to NYSDEC. In February 1997, GTEOSI notified NYSDEC that they would voluntarily investigate conditions at the Site. From 1997 to present, GTEOSI has conducted an on-going investigation of the former Sylvania facility. Both NYSDEC and New York State Department of Health (NYSDOH) have provided oversight of all phases of the investigation.

5.0 PROJECT PLANNING PROTOCOLS

This section provides the protocols for directing excavation progress and performing remedial activities at the Site. An excavation plan is provided as Appendix F. If unforeseen subsurface conditions, historical piping or leaching structures are encountered during the remedial activities, additional remedial protocols may be established to accommodate the conditions.

5.1 PROJECT OBJECTIVE

The objective of the remediation work planned for the Site is to remove source areas of chemical, nickel, and radioactively impacted soils exceeding target cleanup levels. Remediation will provide for unrestricted use of the Site in accordance with local zoning provisions. Under this program, work will be performed in accordance with applicable local, State and Federal guidance, subject to input from key stakeholders (i.e. the general public and Site workers).

This Work Plan defines the protocols necessary to support the remediation process. While the locations of chemical, nickel, and radioactive impacts have previously been investigated, the open format of this Work Plan provides the flexibility to further define the extent of impacts and remove impacts that exceed the target soil cleanup levels.

5.2 REMEDIAL APPROACH

The general approach for the project is the remediation of certain Site areas known to contain process residuals (radioactive, nickel, and VOCs). A series of borings accompanied by the sampling and analysis of soils and groundwater was conducted to investigate the locations of residuals. As part of the remedial process outlined herein, further delineation of the conditions existing between these discrete investigation locations will be performed as remediation progresses to ensure that impacted materials above the target cleanup levels are removed. The approach outlined herein summarizes the methods to be employed during remediation to best address the range of field conditions anticipated.

Remedial efforts in the field will be directed toward the removal of impacted soils, debris, or other building materials. The excavation will be performed concurrently with a detailed on-Site screening, analytical testing, and documentation program. Following the removal of the materials, sampling will be performed to confirm that target cleanup levels in soil have been met.

Part 375.1.10(c)

The Site will meet the cleanup criteria objectives that have been approved by New York State Department of Environmental Conservation through excavation and off-site disposal of contaminated soil.

Removal will result in achieving the remedial goals identified, thereby attaining a level of performance equivalent to that required through the use of another method or approach. In addition, removal of on-site contamination exceeding the cleanup objectives will provide for both short-term and long-term effectiveness of the remedial alternative. Excavation will provide for contaminant control in a relatively short time and will prevent off-Site migration through the permanent removal of contaminants.

The contaminated soils will be transported and disposed of off-site in order to reduce the volume of contamination on-site, thereby reducing the toxicity and mobility of the contaminants. In addition, the removal of volatile organic and radioactive constituents above cleanup objectives present in the soil will reduce the toxicity of the remaining soil. Envirocare of Utah will be the disposal facility.

Excavation and off-site disposal of contaminated soil provides for a comprehensive remedial alternative that is both effective and implemental in order to achieve No Further Action status and unrestricted use of the Site. Although other remediation methods have been considered for the Site, including management of soils and wastes on Site and the use of engineered barriers, these alternatives neither sufficiently reduce the exposure from radioactive materials nor do they ensure the integrity of soils and wastes managed long-term.

No technical difficulties are anticipated during the excavation and removal process. Off-site disposal has been demonstrated to be a reliable process with respect to the contaminants of concern, the volume of soils to be removed from the Site, and Site conditions.

A high level of overall protection of human health is achieved through the attainment of the cleanup criteria objectives, which will be demonstrated through confirmatory soil testing and modeling of residuals at the time of excavation as described in the Work Plan. Based on the achievement of cleanup criteria through permanent off-site disposal, community acceptance of this remedial alternative is expected to be high.

5.3 CONCEPTUAL SITE MODEL

The Site is in an environmental setting typified by a relatively consistent hydrostratigraphic unit comprised of sandy overburden to depth with the local water table found at approximately 75 feet bgs. Although the depth to bedrock has not been locally established it is interpreted to range from 160 feet below sea level at the north shore of Nassau County, to approximately 900 feet below sea level near the Site (Kilburn 1979). Historically, vertical migration of recharge to the aquifer is interpreted to occur relatively unimpeded, suggesting that impacts from historical operations would follow a similar flow path.

Currently, the Site is largely paved with recharge to the aquifer being limited to dry well point sources. Previous studies conducted at the facility support a conceptual model comprised of residual impacts with limited aerial extent mainly due to the high infiltration capacity of the overburden. In addition, with the exception of chlorinated solvents, the vertical mobility of the residuals in the Site soils is minimal. Consequently, remediation of impacted soils at the Site is focused on the highest concentration of residual impacts with the highest level of risk. These areas have been established to comply with NYSDEC target cleanup levels and are targeted for removal from the Site as outlined in the work plan.

5.4 DISPOSAL FACILITIES

Envirocare operates the nation's largest, fully regulated commercial radioactive waste disposal and mixed waste treatment and disposal facility. This facility is located approximately 80-miles from Salt Lake City, in the Tooele Hazardous Industry District, a 100-square mile area zoned for hazardous materials industries. The facility is in a remote, arid area that exhibits geologic and hydrogeologic conditions that support hazardous material handling. According to Envirocare, the conditions that provide an ideal setting for long-term waste disposal include:

- An average of 7-inches of precipitation and over 60 inches of evapotranspiration annually;
- Clayey soils exhibiting low permeability; and

- Naturally poor quality ground water.

Envirocare disposes of waste material in aboveground disposal cells that are in conformance with specifications created by the USDOE and USEPA and meet 40 CFR 264 and NRC disposal requirements. Mixed waste is disposed of using the same procedures as for low level radioactive and NORM. The permits and licenses maintained by the facility for accepting, treating, and disposing of waste materials are discussed in the following section.

5.4.1 Permit and License Information

Envirocare provides waste disposal services at a state and NRC licensed and regulated facility that is designed specifically for Class A low-level radioactive waste. Envirocare holds multiple permits and licenses, including a RCRA Part B permit that enables Envirocare to treat and/or dispose of hazardous and radioactive waste materials. Additional licenses and information pertinent to this project are listed below.

- Radioactive License (#UT2300249), Amendment 12, issued by the State of Utah;
- Mixed Waste Permit (#UTD982598898), issued by the USEPA;
- Ground Water Quality Discharge Permit (#UGW450005), with amendments, issued by the State of Utah; and
- 11e (2) Byproduct Material License (#SMC-1559), with amendments, issued by the NRC.

Envirocare offers a licensed, high quality waste management facility for the waste generated during the remediation activities. These licenses govern Envirocare's ability to receive, store, treat, and safely dispose of waste material.

5.4.2 Limits of Acceptance Criteria

For each shipment of waste, a waste profile including sample analytical results and waste pedigree information is required by Envirocare. Following shipment, the waste is contained in temporary storage containers while independent laboratories perform confirmatory analyses. The radionuclide concentration, physical form, and chemical characteristics of the waste are evaluated to evaluate if the materials meet radiological license requirements and can be accepted for treatment and/or disposal.

6.0 SITE OPERATIONS PROTOCOLS

To support the initial mobilization and daily Site operations throughout the remediation process, a series of protocols have been developed. This section provides a summary of these protocols.

6.1 PROJECT OFFICE

The project office with an attendant support facility will be maintained in the building on the 140 Property, away from the work exclusion zones. The office space provided by this building offers the ability to support field operations from a single location and will provide a means to communicate with the project team, as well as provide facilities and equipment to facilitate documentation of Site activities. Space will be made available, as appropriate, in the project office for Envirocon, URS, MHF-LS, GTEOSI and regulatory oversight personnel.

6.2 EQUIPMENT MANAGEMENT

During the soil excavation and materials handling efforts, both mechanical and support equipment will be used. Mechanical equipment used at minimum will include excavators, skid steer loaders, and a concrete saw cutter. The support equipment will include field survey monitoring and measuring meters (radiation instrumentation meters, photoionization detector (PID) and ambient air monitoring meters) and hand tools (shovels, brooms, tampers, etc.). Equipment will be delivered to the Site clean.

Field survey monitoring and measuring meters will be used and maintained by the on-Site Health and Safety Officer, Radiation Specialist, Field Supervisor, or designated personnel. These meters will be used in a manner that impacted surfaces are not contacted. However, if the meters are used within an area of known or suspected impacts and come in contact with the material, the meters will be carefully decontaminated in accordance with the appropriate protocols established in the Health and Safety Plan (HASP) (Appendix B). When this metering equipment is not in use, the equipment will be stored in the project office or in a clean designated area. In order to assure proper operation of instrumentation used in the field for quantitative measurements, certain operational checks will be performed. Checks include verifying the annual manufacturers calibration (prior to instrument use), reliability factor procure for counting instruments (prior to first use and monthly), exposure rate procedures (prior to first use and monthly), and source checks (daily) to evaluate if the instrument is within expected range. Additionally, daily quality assurance tests will be performed, as described in the Field Sampling and Analysis Plan.

Envirocon's on-Site construction team will manage and maintain the hand tools and mechanical equipment used during the remedial activities. Mechanical equipment that is rented through an outside service will be inspected prior to accepting the equipment for use at the Site. Hand tools will be stored in a tool trailer, shed or designated clean area. Mechanical equipment will be stored in a designated area inside the existing building and/or in a designated clean area in the parking lot of the 140 Property. If the mechanical equipment or hand tools are used in an area of known or suspected impacts, the equipment can be stored and maintained in the area for duration of the activities. However, if mechanical equipment or hand tools are used outside of that area, the equipment will be decontaminated prior to leaving that area in accordance with the protocols established in the HASP (Appendix B).

6.3 SITE SECURITY

Various forms of security measures will be employed on the Site to ensure that Site conditions, workers, general public, and the environment are adequately protected during remedial activities. These protective measures will include security personnel as well as institutional controls to limit Site access and routes of potential exposure. The components of the Site Security Program are provided in Appendix G.

6.4 PROJECT GROUND CONTROL SYSTEM

To meet the needs for delineation of impacted materials, a consistent and reproducible ground control system will be established. This system will be developed to ensure that impacted areas, Site utilities, and Site screening areas can be accurately located. The following subsections outline the procedures for developing and maintaining the ground control system.

6.4.1 Site Surveying

A series of control points across the Site will serve as key points of reference for Site location surveys. These control points will be tied into the already established local Site-coordinate system that historic boring locations are recorded within. A grid system will be developed in Geographic Information System (GIS) and will be translatable between a UTM coordinate system (or equivalent) and the already established local Site-coordinate system. The grid system will be developed prior to initiating remediation activities to ensure that both historical and new data are in a compatible format and the format will support ongoing remedial activities.

6.4.2 Grid System and Maintenance

Using the control points and the 1-meter overlay grid, a field grid identification system will be established to provide for line-of-sight identification of the locations within the work area as well as identification of historic boring locations. These grid locations will be defined through the use of small signs that are placed on stakes driven into the ground. Each grid location will be provided with an alphanumeric designation to limit potential documentation errors associated with transposition. Within finished areas of excavations, key grid lines may be provided with ropes, taping, or other visual means to help ensure proper identification of subsurface grid points.

The grid points established will be maintained throughout the project to ensure reproducibility within the field results. Accordingly, any damaged or lost signs will be replaced to maintain the proper degree of control during field operations.

6.4.3 Work Zone Delineation

Work zones will be developed specific to the Site conditions and will be modified throughout the project. For documentation purposes, and to ensure that appropriate health and safety and cross-contamination measures can be consistently employed, work zones will be established broadly to limit the number of changes required within the contaminant reduction and exclusion zones. The location of these work zones will be identified, to the extent practicable, using the ground control system established for the project.

6.4.4 Ground Control Documentation

Documentation of the ground control system will be incorporated into selected project as-built drawings. Such documentation will include the location of benchmarks and control points, grid locations and designations, and the location of the impacts as previously defined in relation to these features.

6.5 UTILITIES AND SITE FEATURES

A number of overhead and below-grade utilities exist at the Site. These utilities include water, sewer, gas, drywell, telephone, and electrical services. Additionally, other Site features may require protection or securing prior to initiating remedial activities. Although only selected utility services are within active work areas, a defined group of protocols have been developed to identify and protect each of the utilities that could potentially be affected by the proposed remediation efforts.

6.5.1 Identification and Documentation of Site Utilities

Prior to initiating the field survey, the locations and alignment of utilities will be identified on the ground surface using a color-coded system for easy identification. A master schematic of the various utility locations, depth, and whether they are active or inactive will be prepared. The schematic will include emergency contact numbers for the requisite service providers and a summary of required responses. The schematic will be maintained at the Site. The utility schematic will be updated as appropriate to accommodate utilities that may be identified, as well as actual locations that may change based on the fieldwork performed. The locations of utilities will be evaluated by reviewing historical Site maps and county records, as well as through direct consultation with local utilities and/or their locating service.

Utilities identified that may be relocated, replaced, or disturbed by the construction process will be further evaluated prior to such disturbance through the use of an air lance or a vacuum truck. This will identify the exact depth and alignment of each utility line. This invasive activity will be controlled so as to not jeopardize the utility's integrity. The information generated will be transferred to the master utility schematic. If information or locations vary from those previously identified by surface locating instruments, the locations will be altered to reflect an accurate utility alignment. In the event that utility clusters are identified, then the invasive locating efforts will consider that these utilities may exist at multiple depths.

6.5.2 Utility Management

Once utilities in areas subject to remediation or other forms of potential disturbance are identified, the potential for deactivation, relocation, replacement or other action will be assessed, and a utility management plan will be developed specifically to address each of the following considerations:

- Requirements regarding notification, material construction, schedule, or other information related to management of the specific service;
- Requirements of the borough, county, state or other entity as it relates to the utility, such as notifications, permits, licenses, materials of construction, construction specifications, Quality Assurance/Quality Control (QA/QC) requirements, etc.;

- The project-specific requirements associated with managing the utility, such as the schedule and the construction requirements; and

- The response actions that may be required in the event that utility services are compromised.

Each of these considerations will be evaluated and documented. Specific actions to be taken for utilities that will require relocation and the methods used to provide for protection of utilities are summarized in the following subsections.

During the project, utility lines adjacent to work areas or extending through work areas will be protected to prevent damage, disruptions in service, or releases. The preventative measures may include flagging, the installation of bollards or temporary barriers, bracing, underpinning or other appropriate methods. When possible, the utility will be subject to deactivation in addition to applying protective measures. Prior to working adjacent to a utility, a defined plan will be developed to outline the work activities required. The plan developed will be coördinated between the service provider, GTEOSI, Envirocon, and health and safety personnel. Disconnected utilities will be restored subsequent to work performed.

Electrical
Overhead electrical lines are not anticipated to be directly within work areas, although consideration will be given to their locations as they could be affected by structural erection, crane operation, dump bed movement on trucks, or other Site operations related to the remediation program. These services, if located near work activities, will be temporarily deactivated, flagged, or otherwise appropriately protected in accordance with consultation with the service provider.

Transformer lines at the 100 Property will be temporarily disconnected by the service provider. This electrical work will be performed prior to the initiation of fieldwork.

Driving Range Fencing
Previous investigations at the Site have indicated the presence of residual impacts at the Site boundary with the Cantiague Park GCDR. To provide for proper removal of these impacts during remediation, it will be necessary to temporarily remove the existing fence separating GCDR and the Site. A protection barrier will be installed to provide protection to workers involved with the remediation process. This work will be coordinated with the Nassau County Department of Parks and Recreation and the GCDR operator.

Equipment
Relocation of equipment such as transformers, underground storage tanks, or dry wells is not anticipated, although protection of this equipment will be considered in areas where remediation activities will be performed adjacent to the equipment. As appropriate, methods of protection may include shoring, underpinning, installation of temporary impact protection devices, or other measures to prevent impacts to the equipment.

7.0 PROJECT CHARACTERIZATION PROTOCOLS

During the remedial activities, project characterization protocols will be used to identify areas not previously known to be impacted and to guide excavation activities to effectively remediate the Site. These protocols will include a variety of mapping, field screening and sampling performed within this section. A brief description of these protocols is provided below, while detailed protocols for these activities are summarized within the Field Sampling and Analysis Plan (FSAP) provided in Appendix E. Where appropriate, parallelisms in terminology with the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM) are indicated.

The FSAP provides the basis for screening and sampling efforts during the remedial activities and describes the procedures that will be followed for screening and sampling activities associated with each media, including soil, concrete, surface water, groundwater, debris, and radionuclides. The data generated as part of this work plan and the FSAP will be used to:

- Verify subsurface conditions based on historical data to define target excavation areas;
- Establish background conditions for radiation on the Site;
- Guide excavation activities based on screening and sampling data;
- Collect screening and sampling data to define and support the definition of the limits of the excavation;
- Profile waste for manifesting and disposal; and
- Collect samples to verify compliance with target cleanup levels.

While details of the sampling and analysis protocols are provided in the QA/QC protocols (Appendix A) of the Quality Assurance Project Plan (QAPP) (Appendix H) and the FSAP (Appendix E), this section provides an overview of the characterization activities to be performed to support more formal sampling and analysis programs.

Various characterization efforts will be used as part of an overall program to assist with the identification of impacted locations and to guide remedial activities. These efforts will include, but are not limited to, mapping of the known distribution of impacts within each area and characterization of the nature and extent of impacts associated with VOCs, nickel, and radioactivity within these and adjacent areas.

Characterization efforts will be performed throughout the remediation process to confirm the presence of impacts and at project defined intervals integral to the evaluation of the status of remediation. The various elements of the characterization process are provided below.

7.1 MAPPING

Three-dimensional maps will be developed to detail the distribution of known impacts based on the extensive network of borings drilled at the Site. The maps will be used to illustrate the elevated concentrations of VOCs, nickel, and radioactive material in the subsurface soils. The maps will provide the basis for removal actions and will be supplemented with additional screening as needed to account for variability potentially encountered in the field. The evaluation of pre-excavation subsurface soil conditions is further described in Appendix E.

7.2 FIELD SCREENING

Field screening will be performed during the remediation process to evaluate the presence of impacts and the extent to which they will be removed and to provide on-going delineation of impacts, in accordance with the on-going analytical characterization efforts.

7.2.1 Volatile Organic Compound Screening

During excavation activities, soils will be screened for VOCs using a PID, Mini Rae™ or equivalent instrumentation. Previous investigative efforts indicate that the primary VOC on-Site is PCE and the field instrumentation selected will be capable of effectively characterizing the presence of this compound in the vapor phase. Soil samples will be collected from an interval 6- to 12-inches beneath the finished excavation surfaces at locations of suspected VOC residuals. A portion of these samples will be placed in clean jars for subsequent headspace analysis. The remainder of the samples will be containerized for potential characterization by an off-Site laboratory, as appropriate. If the headspace analysis indicates concentrations of VOCs in soils that are likely to exceed the cleanup level, then continued excavation may be required. This process will be repeated until it appears that the cleanup levels have been achieved. An off-Site laboratory will be used to confirm the target cleanup objectives were met by the excavation process. Monitoring and analysis protocols have been defined within the FSAP (Appendix E).

7.2.2 Radioactivity Screening

The presence of radioactivity will be monitored using a combination of field instruments identified in the FSAP (Appendix E). Radioactivity levels will be characterized using on-Site gamma spectroscopy analytical evaluations. Regulatory verification will be performed using an off-Site laboratory.

The ability to use field instruments to identify the presence of radioactivity will support field identification and removal activities. The use of an on-Site gamma spectroscopy analysis will confirm that the field instruments are providing an accurate characterization of field conditions. The field gamma spectroscopy system will use a high purity germanium detector and have shielded counting capabilities using a geometry that minimizes counting time and provides a high degree of accuracy. Instrument operators will follow the manufacturer's operating procedures to ensure dependable performance. Quality assurance and quality control functions of energy calibration accuracy, calibration stability, and duplicate analysis precision will be performed to ensure reliability. The nuclide library will be specific to the radionuclide constituents of concern at the Site and will be consistent with that used by the analytical laboratory (STL).

The primary nuclide at the Site is uranium-238 (U-238), although a discrete location of thorium-232 (Th-232) has also been identified. Based on the characteristics of these nuclides and their decay sequence, instruments capable of evaluating the presence of these nuclides will be used. Applying the results of an analysis performed on the nuclides present at the Site, a series of laboratory protocols have been developed specific to the evaluation of radioactivity and are outlined in the FSAP.

7.3 CHARACTERIZATION SAMPLING DURING REMEDIATION

During the field activities, samples will be collected and subsequently analyzed on-Site using gamma spectroscopy to quantify the presence or absence of residual impacts and to evaluate the effectiveness of the field monitoring instruments and techniques. This type of radiation survey is termed "remedial action support" using MARSSIM terminology.

7.4 CONFIRMATION SAMPLING AND ANALYSIS

Once the field instruments indicate that remedial efforts have achieved the established cleanup levels, a systematic confirmation sampling and analysis program will be performed. The locations for sampling will be biased toward those areas that had previously exhibited impacts, although select samples will also be recovered from within clean areas using a random selection protocol. The on-Site analysis will be used for confirmation sampling and for comparison purposes to field instruments. Based on the results, work will either be considered complete (and subject to final verification), or if residual impacts are noted, further remedial actions will be taken as necessary. If supplemental excavation is required, an additional confirmation sampling and analysis program will be performed to ensure that the impacts have been removed to meet the established cleanup levels.

7.5 VERIFICATION SAMPLING AND ANALYSIS

Upon meeting the established cleanup level, as determined by the confirmation program described above, sampling and subsequent analysis will be conducted for final verification of attainment of the cleanup goals. This survey is termed a "final status survey" using MARSSIM terminology (USEPA 2000).

The final status verification sampling plan will be submitted to NYSDEC prior to execution and will include samples from biased and unbiased locations using the sampling frequencies and separation distance established using MARSSIM methods. These locations will be documented in accordance with the ground control system. The samples collected will be sent to an off-Site laboratory for analysis subject to defined chain-of-custody procedures. All grid sampling points will be analyzed for VOCs, radiological parameters, and nickel and the grid will encompass the limits of the apparently contaminated soils. The results of these analyses will be evaluated using MARSSIM statistical methods and a determination will be made as to whether additional soil removal will be necessary or if the appropriate means for Site surface contour restoration may be performed.

8.0 REMEDIATION PROTOCOLS

On-Site remediation will be performed using defined protocols that address each of the chemical and radioactive impacts identified. While the protocols have been defined in response to the known impacts, the exact extent of these impacts may vary. Thus, remediation protocols have been developed to provide the flexibility needed to address the full range of potential field conditions. The following subsections provide a summary of these protocols and the methods used to ensure that both the workplace and the public's health and safety are protected.

8.1 DEMOLITION AND RECONSTRUCTION

An approximate 2,500-ft^2 area from the eastern portion of the building on the 140 Property will be removed to access potentially impacted soils beneath the foundation. This area extends from the eastern most set of support columns to the existing exterior wall. Prior to removing this portion of the structure, screening for the potential presence of hazardous materials will be performed in accordance with applicable local, State, and Federal requirements.

Upon completion of the demolition and remediation, the building will be reconstructed. The reconstruction will include the installation of a new load-bearing foundation and wall system.

8.1.1 Pre-Demolition Hazardous Materials Surveys

A comprehensive hazardous materials survey of the east bay of the building on the 140 Property will be conducted to evaluate the presence of materials that may be impacted during the demolition project. Personnel will survey for asbestos-containing building materials (ACBM), surfaces coated with lead-based paint, and for other suspect hazardous materials (i.e. PCBs, chlorofluorocarbons (CFCs), and mercury containing items). In addition, a representative fraction of demolition waste materials will be collected for analysis using the toxicity characteristic leaching procedure (TCLP) to evaluate the appropriate means for waste disposal. Tasks to be performed during the survey will include the identification of types, locations and quantities of hazardous materials; the collection and analysis of bulk samples of suspect materials; and the testing of potential lead-based paint coated surfaces.

Following completion of the field survey and sample analysis, an abbreviated survey report will be prepared, which will include a tabular listing of the materials determined to contain asbestos, lead-based paint, and other hazardous materials. These materials, if present, will be removed prior to the demolition of the building.

Asbestos
Asbestos bulk sampling will be conducted in accordance with USEPA Asbestos Hazard Emergency Response Act (AHERA) protocols in order to meet current Occupational Safety and Health Administration (OSHA) and USEPA requirements. The samples will be collected and analyzed in accordance with USEPA Methods 600/R/93/116 and 600/M4-82-920 to verify the presence of ACBM. ACBM will be grouped into homogeneous material categories (similar type, color, size, date of installation, etc.) and then sampled in accordance with AHERA protocols. Bulk samples of suspect ACBM collected during the field portion of the survey will be transported to URS' asbestos laboratory in Salem, New Hampshire.

Lead Paint

Suspect paint will be tested for lead using National Institute of Occupational Safety and Health (NIOSH) Method 7420. Testing will be performed by SCILAB in Weymouth, Massachusetts, a USEPA accredited laboratory. The results will be presented in an OSHA-acceptable format and copies will be provided to the contractors prior to building demolition.

Other Materials (CFCs, PCBs, and Mercury)

An inspection will be conducted for PCB containing ballasts, lifts or transformers, regulated refrigerants, and mercury containing items including signs, switches and thermostats. Potentially hazardous material will be sampled and profiled for appropriate off-Site disposal.

8.1.2 Engineering Survey

In accordance with the requirements of the OSHA, an engineering survey will be performed prior to demolition. This survey will address each of the potential hazards associated with the demolition effort, including the following:

- Structural analysis of the foundations including load-bearing walls and internal column foundations;
- Structural analysis of the above grade structures including the roof joist system, roof covering, and the associated connections;
- Evaluation of the concrete flooring system;
- Analysis of indoor HVAC, fire protection, and other internal operating systems and their need for deactivation and relocation;
- Analysis of subgrade utilities that will require protection or relocation;
- Evaluation of work activities performed during demolition and the identification of safe work practices;
- Evaluation of the effect of contamination on workers such as levels of training required under OSHA 1910.120; and
- Evaluation of the potential for off-Site influences to occur during work (airborne dust migration or debris falling off the Property).

8.1.3 Demolition Plan

Based on the results of the engineering survey, a Demolition Plan will be prepared that details the demolition field activities. This Plan will discuss the demolition effort in accordance with the information obtained during the engineering survey. The Demolition Plan will identify a sequential group of "hold points" that will require a status evaluation prior to moving forward. These hold points are intended to address each key element of the process that could represent a risk to Site workers, such as preparing for the removal of load bearing connections, walls or other support systems.

The Demolition Plan will be developed using drawings and a written narrative to define the key hold points and the methods used to reinforce workplace and public safety. Prior to initiating work, demolition personnel will be required to review the plan and be aware of the hold points identified.

The above grade demolition work will be performed prior to commencing below grade remediation activities. The approximate order of major demolition activities will be as follows:

- Internal utilities will be relocated and remnants removed;
- External brick walls will be removed to the extent that they are not functional to support of the roof or building structure;
- The roof will be removed in panels back to the final reconstruction line in accordance with appropriate asbestos management protocols, if necessary;
- The remaining structure will be dismantled to the reconstruction line; and
- Concrete flooring will be saw-cut in panels to facilitate screening and removal.

8.1.4 Structural Dismantling

The project sequence identified below provides for the removal of each structural building component based on its hierarchy within the structural support system. Accordingly, initial work efforts will be focused on the removal of brick walls as they provide no direct support to the steel frame structure. These walls will be removed by selectively sawing joints, if necessary, and then pulling down individual sections. These sections will be subject to pre-wetting to reduce dust. The resulting debris will then be loaded into dumpsters for off-Site disposal.

Once the brick walls have been removed, the roof will be taken apart in panels with each panel lifted using a crane and deposited directly into dumpsters for off-Site disposal. During this work, consideration will be made to the results of the ACBM survey such that if present, the roof panels will be removed subject to accepted protocols. As appropriate, the connections between panels will be severed and if necessary, these panels will be saw-cut to prevent placement of any external loads on the buildings steel framework and to facilitate removal. Materials that contain asbestos will be appropriately contained, documented and shipped to a licensed disposal facility. Materials that are not impacted with asbestos will be evaluated with respect to their potential for recycling and shipped to an appropriate off-Site management facility.

Upon completion of the roof removal, the steel framework will be dismantled and each structural member lifted individually. During this process any unsupported members will be stabilized subject to applicable rigging guidelines. Since chemical or radioactive impacts have not been noted on any of the existing above grade structural components, the work will be performed using clean protocols. However, any activity that could require exposure of the subgrade will be accompanied by chemical and radioactive screening.

8.1.5 Concrete and Masonry Demolition

Concrete floor slabs and foundations, as well as asphalt paving will be removed as part of the remediation process. In addition, portions of floor slabs will also be removed to support on-going delineation of impacts on soil. Removal of floor slabs will be performed by saw-cutting the limits of the area requiring removal. The removal areas delineated will be sufficient to support the range of excavation activities required. These excavations may include both excavations to evaluate the limits of impacted soil as well as for the removal of impacted soil. To help evaluate whether concrete and masonry materials have been impacted, these materials will be segmented into manageable size pieces. Each of these pieces can then be screened to evaluate whether radioactive impacts exist that require decontamination or to confirm they are clean and require no further action prior to disposal or recycling.

Flat work within potentially impacted areas will be removed in pieces that are segmented using an appropriate form of cutting saw or other similar device. The size of the pieces created will depend upon the structural characteristics and weight as they affect screening and management efforts. At present, it is anticipated that concrete will be segmented into pieces of approximately 20-square feet. These pieces will be removed and held for screening using a hydraulic excavator equipped with a bucket and thumb. Concrete foundation components will be removed in smaller sections due to the anticipated thicker sections. Asphalt will also be removed in smaller sections due to the lack of structural rigidity and the potential need to provide handling by hand.

Each piece of flat work removed will be subject to screening at the time of removal. The screening performed will include the use of field instrumentation calibrated to assess whether radioactivity is present at concentrations exceeding the established background conditions. These materials will be placed directly into dumpsters for shipment to the applicable management facility.

8.1.6 Structural Reconstruction

Once inspected soils have been removed within the area subject to demolition, a new-load bearing foundation will be constructed. Using this foundation, a new load-bearing wall will be constructed and connected to the existing building system in accordance with appropriate local building codes.

8.2 IMPACTED WORK AREA ENCLOSURES

During excavation activities, soils impacted with radionuclides, organic compounds, and nickel may be encountered. The potential routes of exposure include airborne or surface water contamination. Both of these pathways have been considered and will be managed through the use of a temporary enclosure. The structure will contain the airspace surrounding the excavation and act as a barrier to prevent surface water intrusion during large precipitation events. The enclosure will be of lightweight truss construction with vertical sidewalls that can be covered with a coated material to prevent vapor migration.

The enclosures will be constructed prior to commencing remediation at each location. The structure will be subject to local permitting requirements and will require certification that it meets local building codes for snow, wind, and seismic loads. If any foundations are required that necessitate below grade construction, such work will be monitored and remediated following the protocols outlined within this Work Plan. In particular, it is anticipated that the sands typical within the subsurface will provide bearing strengths suitable to support spread footing foundations.

8.2.1 Air Handling System

Based on the potential for airborne contaminates to migrate from the excavation, a negative pressure environment will be maintained. This air treatment system will provide a positive draw of air into the enclosure equivalent to four to six air changes per hour. The air recovered will be filtered to remove potential airborne particulates and treated using activated carbon. The carbon use will be monitored to evaluate when the carbon is spent and needs replacing.

The enclosure and air handling system have been designed for a nominal flow rate of 13,000 cubic feet per minute (CFM). This flow rate is adequate to maintain a capture velocity of a minimum of 100 feet per minute (FPM) with the main enclosure door fully open, and over 300 FPM with the main enclosure door lowered to within 4 feet of totally closed. The air velocity at the main enclosure door will be maintained at 100 fpm during excavation and loading activities in the enclosure. If the air handling system fails during these activities for any reason, the door/airlock will be fully closed. Air velocity entering the door/airlock will be measured periodically using a vane-type or other appropriate velometer capable of measuring air velocities of 0-400 FPM. Differential pressure (negative pressure) may also be monitored using a differential pressure manometer.

According to NYSDEC, an air-handling permit is not required however monitoring will be conducted. It is anticipated that NYSDEC will assist with the establishment of air handling guidelines to define the air handling process and the monitoring appropriate to verify compliance. The concentrations of organic vapors will be monitored in accordance with the community air-monitoring program (CAMP). The program includes the use of Mini Rae(s)™; portable air monitors (DustTraks), personal air sampling pumps, and radiation detection instrumentation.

Dust and Odor Suppression

Active forms of dust and odor suppression will be used throughout the project. The methods employed will be specific to the need, the work activity, the site conditions, and the specific risks posed. These efforts will include maintaining equipment and dust and odor suppression chemicals at the site. The specific types of activities performed are summarized as follows, although adaptations to provide a more complete form of coverage may be developed if determined to be appropriate.

Dust Suppression—Dust suppression methods will include the use of water misting systems within active work areas to minimize particulate mobilization. The amount of moisture applied will be monitored to provide the dust suppression needed while limiting the potential for saturation of the surface soils.

Within exposed soil areas subject to traffic, dust suppression compounds such as magnesium chloride or other form of environmentally benign binding agent may be used. Other forms of dust suppression such as the use of long duration foams such as those manufactured by Rusmar Foam Technology may be used. These materials may also be used to minimize sloughing of exposed soil slopes within excavations. These compounds and their use specific to the project activity will be reviewed with the NYSDEC Site Representative prior to application.

Odor Suppression—Odor suppression compounds or foams will be used specific to the concentration, compound, and degree of control required.

8.2.2 Enclosure Storm Water Control System

A significant amount of runoff may occur from the enclosure during major precipitation events. Further, the footprint of the enclosure may disrupt the natural flow paths for surface water migration based on the existing Site topography. In the event that surface water flow disruption occurs, methods will be applied to prevent surface water from ponding or entering the enclosure at the interface between the ground surface and the canopy (Appendix D).

Due to the runoff from the canopy, a passive system of berms will be used to prevent surface water intrusion from outside the canopy. Free water that contacts the ground outside the enclosure at the canopy-ground interface will be routed into a shallow, lined collection trench that discharges to either natural drainage courses or into a collection sump.

8.2.3 Decontamination and Service Areas

A mobile decontamination system will be maintained within the enclosure. This will limit the potential for cross-contamination and ensure that the exclusion zones are self-contained.

A refueling area will be established to limit the need for fuel delivery trucks to enter impacted work zones. Fueling of large equipment will be done through daily deliveries. Small volumes of oil and gasoline will be staged to maintain small equipment. Fueling operations will be performed in a manner that limits the potential for releases and that does not facilitate cross-contamination.

To support the routine servicing of equipment, equipment will be positioned within accessible portions of the excavations to accommodate service by personnel with appropriate health and safety training. This will reduce the threat of cross-contamination. In the event that major maintenance is required, the equipment will be subject to complete decontamination and removal from the working area.

8.3 MATERIAL MANAGEMENT

To support the packaging and transportation requirements, MHF-LS will provide packaging for the impacted materials using the Lift-Liner™ system and/or the 25 cubic yard IP1 intermodal containers. Transportation to the New York and Atlantic Rail siding will be via flatbed or roll-off truck (Figure 5). Transportation to the Envirocare Disposal Facility in Clive, Utah will be via MHF-LS high-sided gondola railcars for Lift-Liners™ and articulating bulk commodity (ABC) flatcars for the shipment of intermodal containers. MHF-LS will also be providing a representative from its Technical Services Group to prepare shipping manifests and coordinate logistical requirements at the Site and rail yard. At the rail yard, MHF-LS will be providing the lift equipment and personnel to properly load railcars and secure materials for shipment.

As the excavation work proceeds, impacted material will require management in a manner that considers the type and extent of impacts. Specifically, the characterization of the materials generated (clean vs. impacted) and the definition of management options will be an on-going requirement. Materials sorting, handling, and packaging will be completed within the enclosure to limit materials handling activities and provide for more efficient remediation. Containers for the storage of impacted as well as potentially clean materials will be placed within the enclosures during excavation. A schematic of the materials management process is provided as Figure 6.

Numerous considerations will be made as part of the overall management of excavated materials. The following sections discuss the management of these materials.

8.3.1 Handling

To the extent possible, excavation work will be performed in a manner that segregates clean and impacted materials. Soils with known impacts will be placed directly into Lift-Liners™ at the point of excavation (Appendix F). The Lift-Liners™ will be staged to await off-Site transportation to the rail siding where they will be loaded directly onto railcars for transport to the disposal facility. Materials that are anticipated to be clean will be segregated and stockpiled. The individual stockpiles will then be subject to confirmatory sampling and analysis to verify the soils meet the target cleanup levels established. Once verification has been completed, the soils will be moved to an outdoor storage location and covered. Upon completion of the excavation, clean materials will be used as backfill material.

8.3.2 Waste Staging

Waste will be packed in Lift-Liners™ and staged in a designated area until ready for shipment to the disposal facility. The staging containers will be isolated using fencing and designated by signs to limit access. Once Lift-Liners™ containing waste materials are prepared for shipment, they will be screened in the storage area using wipe samples and monitored for gamma exposure rate at a distance of 1 meter. Following screening and manifesting, each container will be transported to the rail siding. Waste will be staged in a designated area on the 140 Property. No waste will be staged at the rail siding.

8.3.3 Transport to Load-Out Area

Materials that have been packaged in Lift-Liners™ will be loaded onto flatbed trucks and transported to a nearby rail yard for load out. Lift-Liner™ specifications are provided as Attachment 1 in Appendix C. A pre-audited, certified hazardous material trucking company will perform the over-the-road transport of the Lift-Liners™ from the Site to the New York and Atlantic Railroad siding approximately ½ mile away. The Lift-Liners™ will be loaded and transported two at time, weight allowing, with the Lift-Liners™ being tied down to the flat bed truck using two, 2-inch nylon straps for each package. The Lift-Liners™ will be covered during their transport to the load-out area. Additionally, local law enforcement will be notified prior to transport if traffic control is deemed necessary. A Traffic Control Plan is provided as Appendix C.

8.3.4 Load-Out

High-sided gondola rail cars will be staged in the load out area prior to truck shipments leaving the Site. Prior to loading, a pre-inspection of the railcar will be performed to verify that contamination is not present. After inspection and acceptance of the railcar, a 10-mil polyethylene liner will be placed inside the railcar. Once the Lift-Liners™ arrive at the load-out area, they will be lifted by crane from the flatbed truck into the railcar. The personnel at the load-out area will spot the placement of Lift-Liners™ within each railcar. After the packages have been placed into the gondola, the liner will be closed in a "burrito wrap" fashion and secured with elastic bungee cords prior to final shipment.

8.3.5 Transportation

Once the gondola railcars are loaded and approved for shipment, the cars will be pulled from the rail spur to the New York & Atlantic Rail Road in Hicksville, NY. The gondolas will then be transported to Fresh

Pond, NY and interchanged with the CSXT Railroad (CSXT). The CSXT will haul the cars to Chicago, IL where the cars will be interchanged to the Union Pacific Railroad (UPRR). The UPRR will then haul the cars to Envirocare in Clive, UT for final disposition. Figure 7 demonstrates the routing the cars will take during rail transport. The gondolas physical location will be tracked daily, and reports of the car locations will be provided.

8.3.6 Disposal

Envirocare, the disposal facility, is directly served by rail from the UPRR. Upon acceptance at the facility, the railcars will be emptied via a rotary dumping method, the impacted material will be landfilled, and the railcars will return to service.

8.3.7 Compaction

Waste materials such as wood, soil, crushed concrete, and other loose material will be compacted, to the extent practicable, within the Lift-Liners™ to reduce the volume. Compaction efforts will use hand and machine-based methods to ensure compact and uniform distribution of the waste in the Lift-Liner™. As part of these compaction efforts, consideration will be given to the materials moisture content to ensure that free water does not accumulate at the top of the Lift-Liners™ during shipment.

8.3.8 Manifests

Shipping of impacted materials will be performed subject to defined State and Federal regulations, and in compliance with the receiving facilities requirements. Accordingly, shipping manifests will detail the weight and classification of wastes within each container and the total for each conveyance. The classification information will be based on waste profiling efforts that have been used to evaluate the most appropriate method for off-Site management, with the manifest recording the actual inventory of the individual package. Copies of the manifests will be maintained at the Site for the duration of the remediation program.

9.0 REMEDIATION CLEAN-UP LEVELS

Remediation will be performed to remove those materials impacted by process residuals at concentrations exceeding the target cleanup levels. Concentrations of impacts that exceed the target cleanup levels for two or more residuals will necessitate management of the material as a mixed waste. The materials potentially impacted and target cleanup levels are discussed in the following sections.

9.1 BUILDING MATERIALS AND DEBRIS

The building materials and debris recovered during the project may be impacted by residual. To the extent practicable, these materials will be decontaminated to remove residual impacts. If such impacts cannot be removed, then the impacted portion of the material or debris will be packaged and shipped to an appropriate off-Site disposal facility.

The target cleanup level for building materials and debris will be contaminant-specific. Due to the potentially broad range of material types, analysis of residual contamination may be performed subject to a variety of screening methods ranging from analyzing the material itself to collecting wipes to provide an assessment of removable contamination. The method chosen will be selected based on the type of material, the contaminant, and the applicable regulatory requirements.

9.2 SOILS

Soils may be impacted with one or multiple contaminants. Concentrations of these impacts that exceed the target cleanup levels for two or more contaminants will necessitate management of the material as a mixed waste. The target cleanup levels for each of the identified contaminants are as follows:

- Radioactive Materials (processed natural uranium, thorium, and associated radioactive progeny);
  Total Uranium: 100 picoCuries per gram (radioactive levels provide appropriate protection for chemical toxicity of uranium)
  Uranium – 238: 50 picoCuries per gram (to 16 feet bgs)
  Uranium – 234: 50 picoCuries per gram (to 16 feet bgs)
  Thorium – 232: 2.8 picoCuries per gram (to 16 feet bgs) above background concentration

  In addition, post-remedial concentrations of these radionuclides will not result in a radiation dose exceeding 10 millirem/yr in accordance with TAGM 4003.

- Volatile Organic Compounds
  PCE: 1.82 parts per million
  TCE: 0.7 parts per million

- Metals
  Nickel 560 parts per million

If upon excavation to 16 feet, there exists soil which exceeds the target cleanup levels, all relevant information will be reviewed to determine the next step. Radiological data (surveys, sampling results), engineering / safety concerns, location, etc. will all weigh in on the final decision. All reasonable options for addressing any remaining contamination will need to be considered. If unexpected contamination is encountered at greater depths, GTEOSI will consult with DEC and DOH to determine the appropriate approach.

The EPA maximum contaminant level (MCL) for uranium found in Title 40 CFR part 141 is based on the chemical toxicity of uranium in drinking water. The derivation of proposed cleanup criteria for uranium in soil included the exposure of an individual in the future through consumption of drinking water that was potentially contaminated with uranium. The proposed soil cleanup level for uranium is such that the potential uranium concentration in groundwater does not exceed the EPA Primary Drinking Water Standard MCL. Thus the soil cleanup level, expressed in radiological units, is protective for the chemical toxicity of uranium.

9.3 SURFACE, GROUND, AND DECONTAMINATION WATER

Water which is recovered as part of the project will be subject to sampling and analysis prior to off-Site disposal. Such waters may accumulate within excavations as a result of surface infiltration and/or subsurface migration into excavation areas.

9.4 SURFACE READINGS

Tools, instruments and equipment used during the project may be impacted over a portion of their surface area. The appropriate method for management of these materials will be evaluated using an assessment of the total and removable radioactivity components. Equipment will be visibly clean and removable surface contamination will be evaluated by smear surveys. Decontamination survey procedure is provided in the Health and Safety Plan.

10.0 FINAL PROJECT DOCUMENTATION

Final project documentation will include the use of photographs and written descriptions of work activities to support Site surveys and screening. This section outlines the various forms of documentation that will be provided to NYSDEC, and the fundamental considerations included within the documentation program.

10.1 PHOTOGRAPHIC DOCUMENTATION

Photographic documentation will be used to provide chronological documentation of remediation activities and Site restoration. In addition, photographic documentation will be performed to establish the conditions of the Site before construction activities. Efforts will be made to restore the Site to conditions that meet or exceed the pre-remedial action conditions.

10.2 FIELD NOTES AND LOGS

Photographic documentation will be supported by written documentation. The focus of the written documentation will be to summarize the following activities:

- Daily work activities;
- Daily Site safety meetings;
- Progress of work in relation to the schedule;
- Factors or conditions that may impact future work activities;
- Delineation of work areas based on the results of on-Site screening measurements; and
- Site conditions encountered during the remediation process.

Documentation will be comprehensive and provide a detailed tracking of remediation operations, locations, radioactive material management, and the results of field screening and testing.

10.3 INSTRUMENT CALIBRATION DOCUMENTATION

Instrument calibration records will be maintained current throughout the duration of the remedial activities in accordance with the manufacturer's requirements and as specified in the FSAP provided in Appendix E. Calibration records will be maintained for the duration of the remedial activities. The documentation will include comprehensive tracking and ensure instrument accuracy as necessary.

10.4 AS-BUILT DRAWINGS

As-built drawings will be prepared to document the post-remediation conditions of the Site, as well as post-excavation verification sampling and Site-wide gamma exposure or other applicable radiation surveys. The as-built drawings will also illustrate the reconfiguration of the building at the 140 Property and subsurface foundation. The as-built drawings will be prepared and submitted with the Final Project Report.

10.5 FINAL PROJECT REPORT

The Final Project Report will include documentation, and the supporting narrative necessary to support NYSDEC's release of the Site for unrestricted use. The Final Project Report will summarize the activities performed during the remediation, document and illustrate the post-remediation conditions of the Site, and it will include pertinent field information collected during the remedial activities. Drawings, copies of waste disposal certificates, and photographs will also be included or referenced therein.

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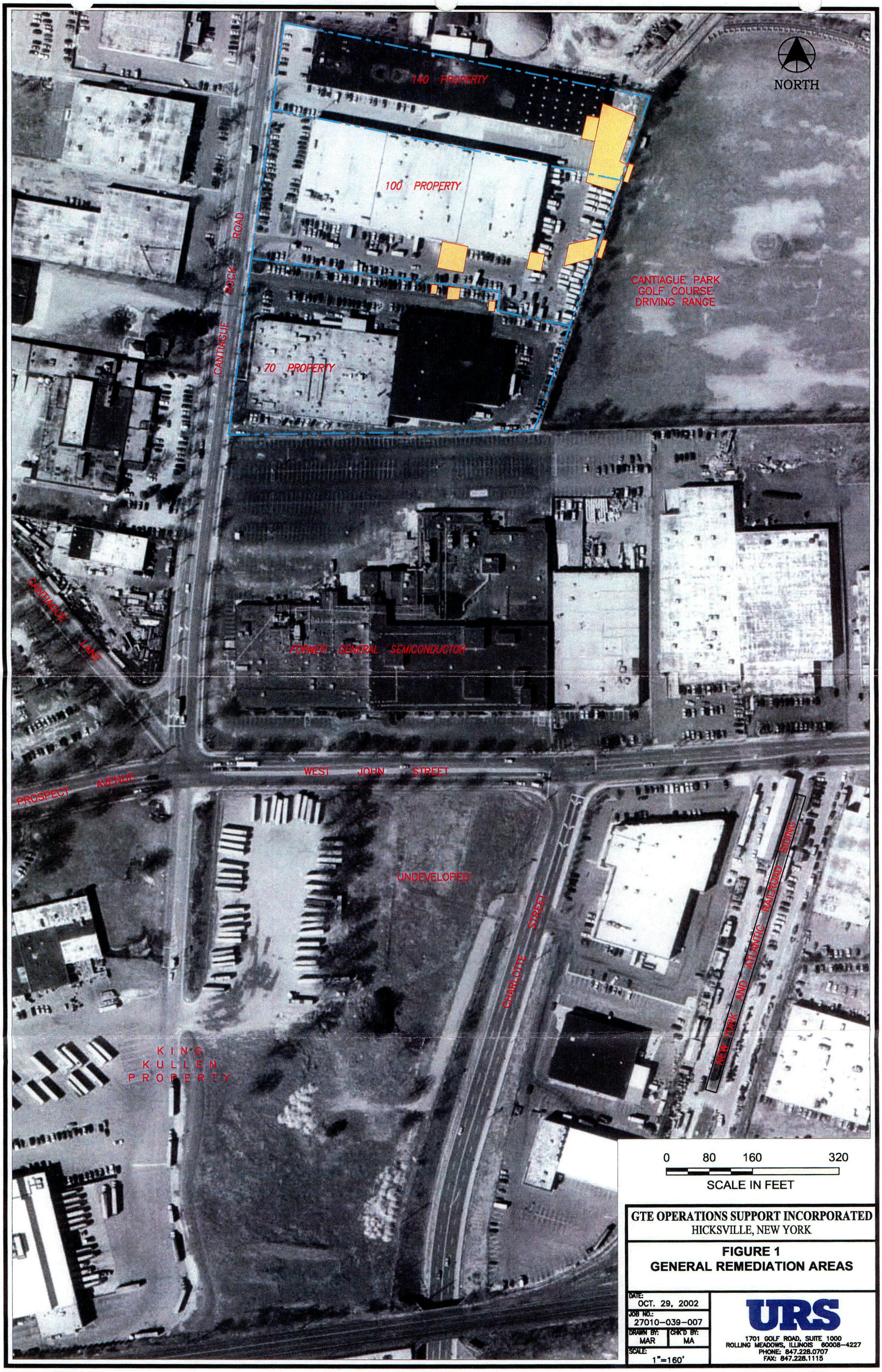


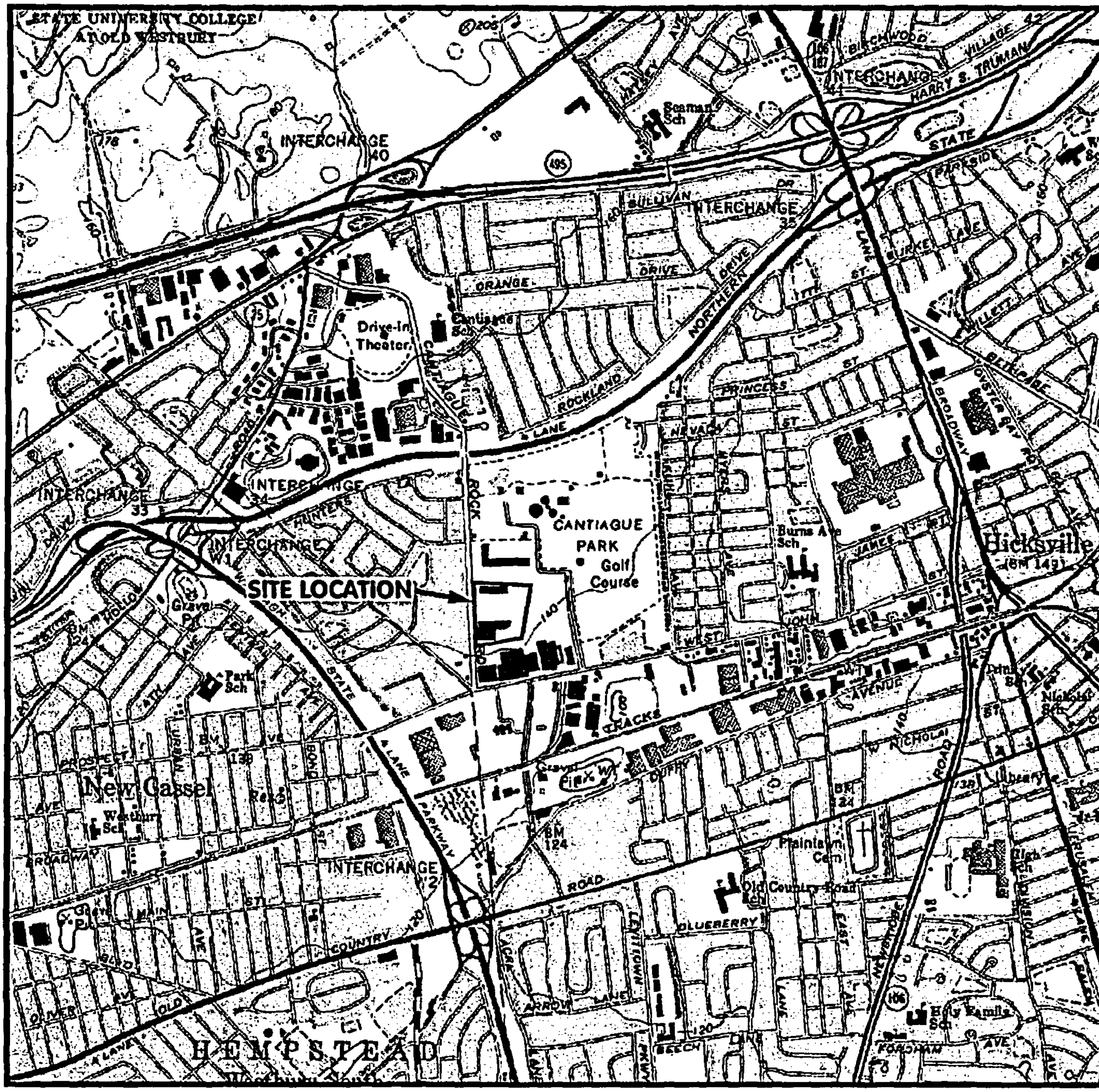
GTE OPERATIONS SUPPORT INCORPORATED
HICKSVILLE, NEW YORK

FIGURE 1
GENERAL REMEDIATION AREAS

DATE: OCT. 29, 2002	
JOB NO.: 27010-039-007	
DRAWN BY: MAR	CHK'D BY: MA
SCALE: 1"=160'	

URS
1701 GOLF ROAD, SUITE 1000
ROLLING MEADOWS, ILLINOIS 60008-4227
PHONE: 847.228.0707
FAX: 847.228.1115

C-01



SCALE: 1:24 000

1 — 1/2 — 0 — 1 MILE

1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 FEET

1 — .5 — 0 — 1 KILOMETER

NORTH

MAP REFERENCE:

PORTION OF U.S.G.S. QUADRANGLE MAP
7 ½ MINUTE SERIES (TOPOGRAPHIC)
HICKSVILLE, NEW YORK 1967
PHOTOREVISED 1979

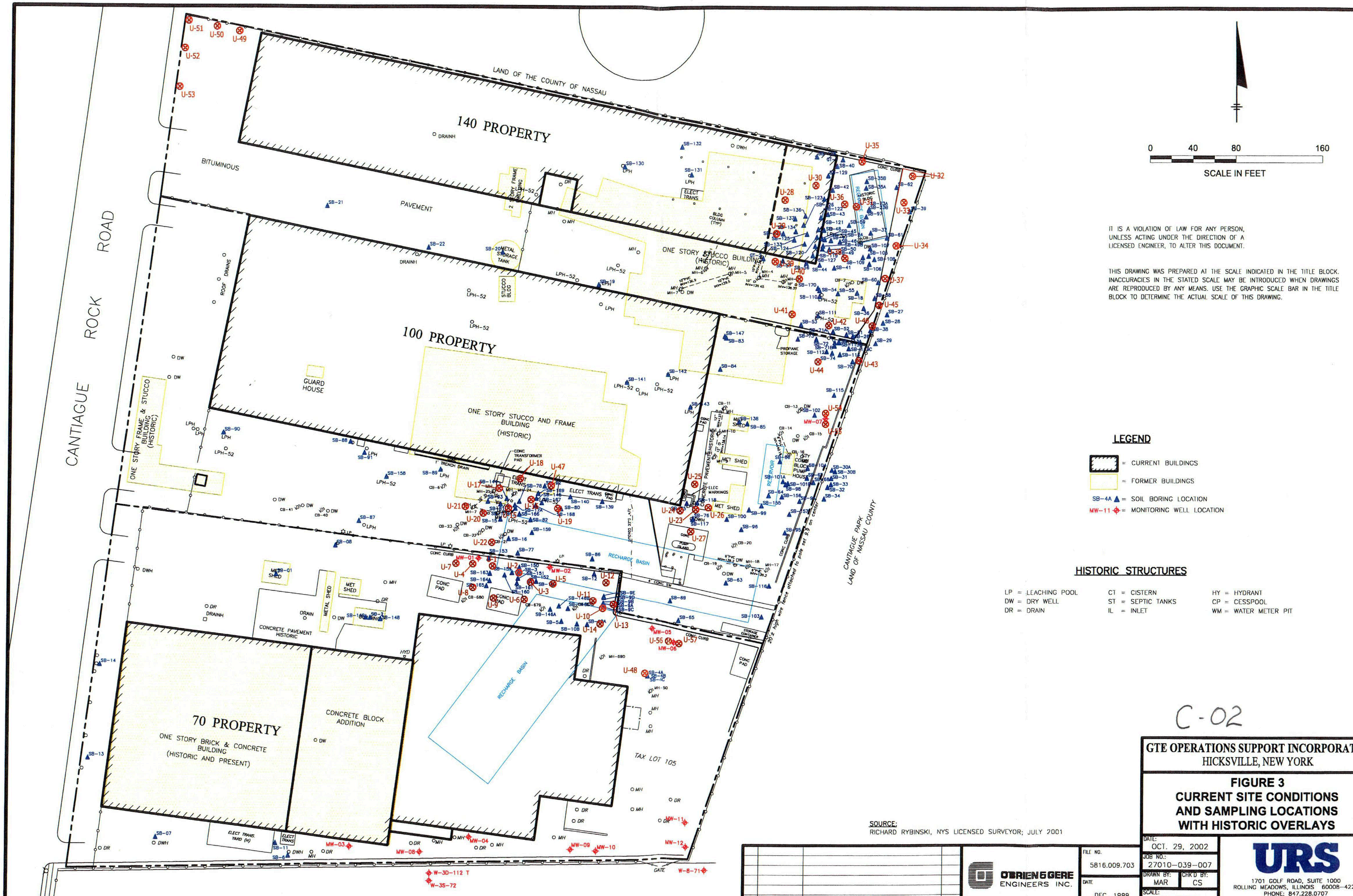
QUADRANGLE LOCATION

GTE OPERATIONS SUPPORT INCORPORATED
HICKSVILLE, NEW YORK

FIGURE 2
SITE LOCATION MAP

DATE: MAY 3, 2002	
JOB NO.: 27010-039-007	
DRAWN BY: MAR	CHK'D BY: CS
SCALE: AS SHOWN	

URS
1701 GOLF ROAD, SUITE 1000
ROLLING MEADOWS, ILLINOIS 60008
PHONE: 847.228.0707
FAX: 847.228.1115



IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT.

THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.

LEGEND

= CURRENT BUILDINGS

= FORMER BUILDINGS

SB-4A ▲ = SOIL BORING LOCATION

MW-11 = MONITORING WELL LOCATION

HISTORIC STRUCTURES

LP = LEACHING POOL	CT = CISTERN	HY = HYDRANT
DW = DRY WELL	ST = SEPTIC TANKS	CP = CESSPOOL
DR = DRAIN	IL = INLET	WM = WATER METER PIT

SOURCE:
RICHARD RYBINSKI, NYS LICENSED SURVEYOR; JULY 2001

C-02

GTE OPERATIONS SUPPORT INCORPORATED
HICKSVILLE, NEW YORK

FIGURE 3
CURRENT SITE CONDITIONS AND SAMPLING LOCATIONS WITH HISTORIC OVERLAYS

NO.	DATE	REVISION	INIT.

O'BRIEN & GERE ENGINEERS INC.

FILE NO. 5816.009.703

DATE DEC. 1999

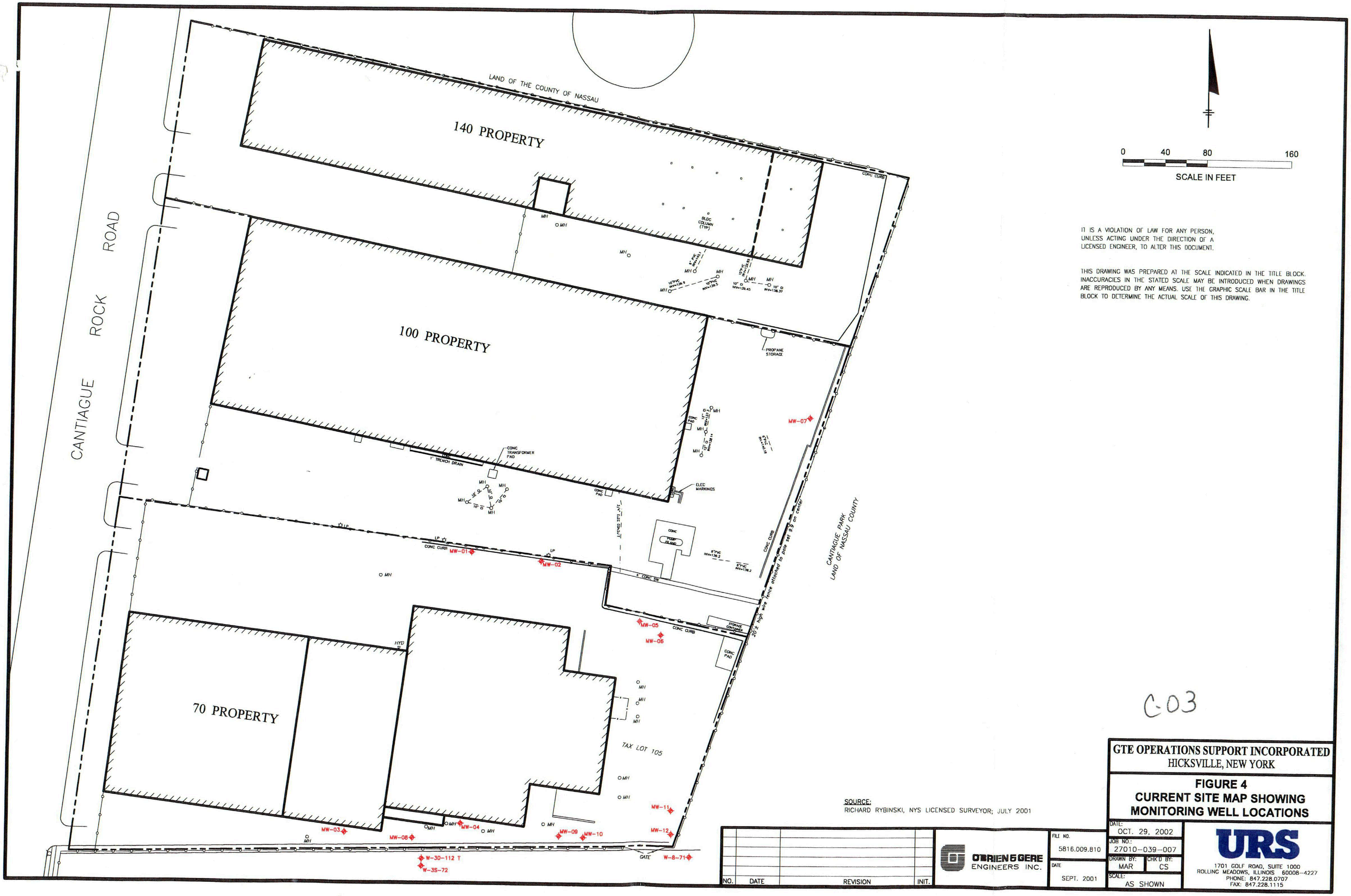
DATE: OCT. 29, 2002

JOB NO.: 27010-039-007

DRAWN BY: MAR CHK'D BY: CS

SCALE: AS SHOWN

URS
1701 GOLF ROAD, SUITE 1000
ROLLING MEADOWS, ILLINOIS 60008-4227
PHONE: 847.228.0707
FAX: 847.228.1115


LAND OF THE COUNTY OF NASSAU
140 PROPERTY
100 PROPERTY
70 PROPERTY
CANTIAGUE ROCK ROAD
CANTIAGUE PARK
LAND OF NASSAU COUNTY
TAX LOT 105
PROPANE STORAGE
CONC TRANSFORMER PAD
ELEC MARKINGS
CONC CURB
STORAGE CONTAINER
CONC PAD
GATE
MW-01
MW-02
MW-03
MW-04
MW-05
MW-06
MW-07
MW-08
MW-09
MW-10
MW-11
MW-12
W-30-112 T
W-3S-72
W-8-71
0 40 80 160
SCALE IN FEET
IT IS A VIOLATION OF LAW FOR ANY PERSON, UNLESS ACTING UNDER THE DIRECTION OF A LICENSED ENGINEER, TO ALTER THIS DOCUMENT.
THIS DRAWING WAS PREPARED AT THE SCALE INDICATED IN THE TITLE BLOCK. INACCURACIES IN THE STATED SCALE MAY BE INTRODUCED WHEN DRAWINGS ARE REPRODUCED BY ANY MEANS. USE THE GRAPHIC SCALE BAR IN THE TITLE BLOCK TO DETERMINE THE ACTUAL SCALE OF THIS DRAWING.
SOURCE:
RICHARD RYBINSKI, NYS LICENSED SURVEYOR; JULY 2001
C-03
NO. DATE REVISION INIT.
O'BRIEN & GERE ENGINEERS INC.
FILE NO. 5816.009.810
DATE SEPT. 2001
GTE OPERATIONS SUPPORT INCORPORATED
HICKSVILLE, NEW YORK
FIGURE 4
CURRENT SITE MAP SHOWING MONITORING WELL LOCATIONS
DATE: OCT. 29, 2002
JOB NO.: 27010-039-007
DRAWN BY: MAR
CHK'D BY: CS
SCALE: AS SHOWN
URS
1701 GOLF ROAD, SUITE 1000
ROLLING MEADOWS, ILLINOIS 60008-4227
PHONE: 847.228.0707
FAX: 847.228.1115

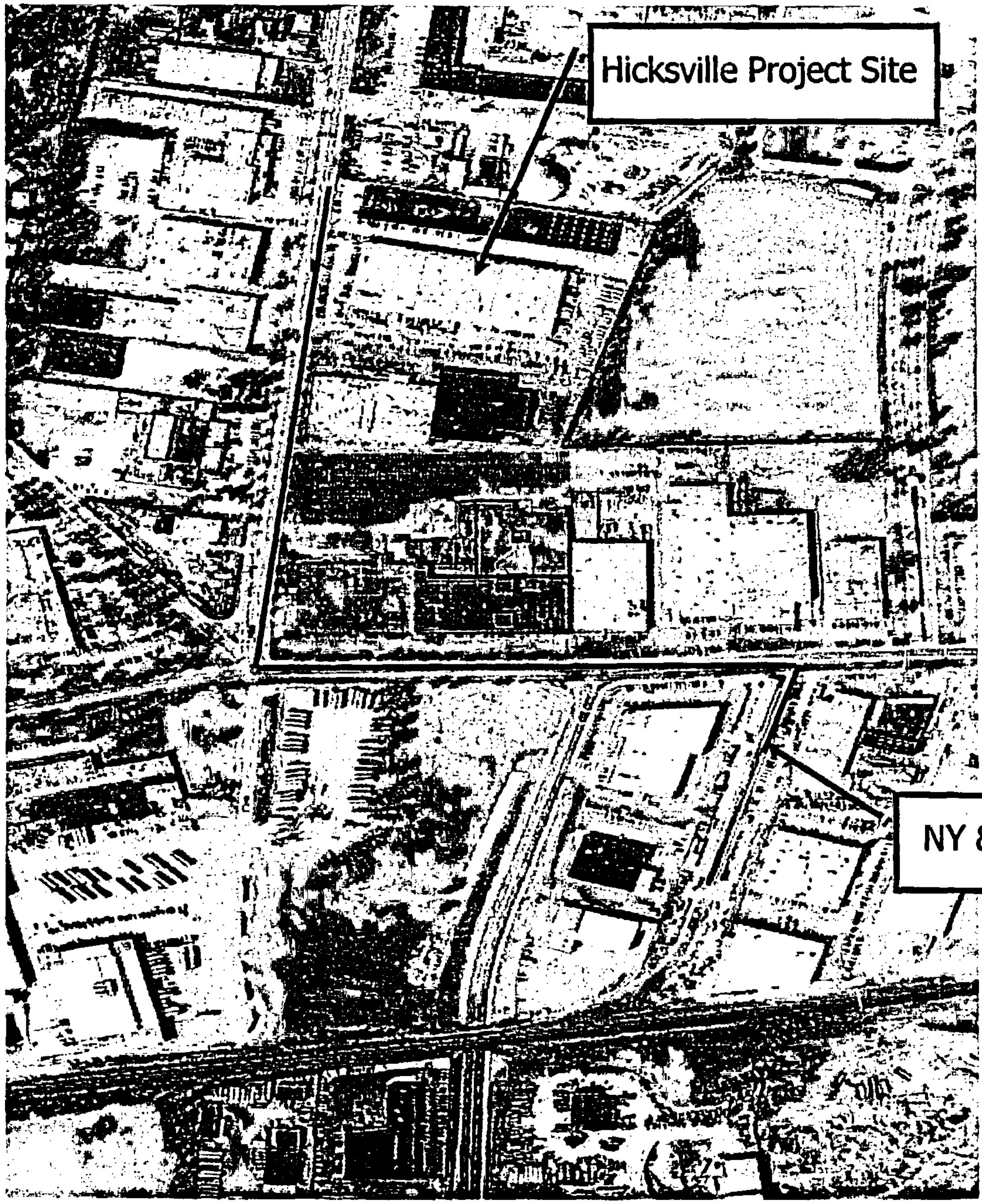


Figure 5

Truck Route To Rail Loading Area

From Site:

Left onto Cantiague Rock Road

Left onto West John St.

Right into Fenced Rail Yard

Figure 6
Schematic of Materials Management Process

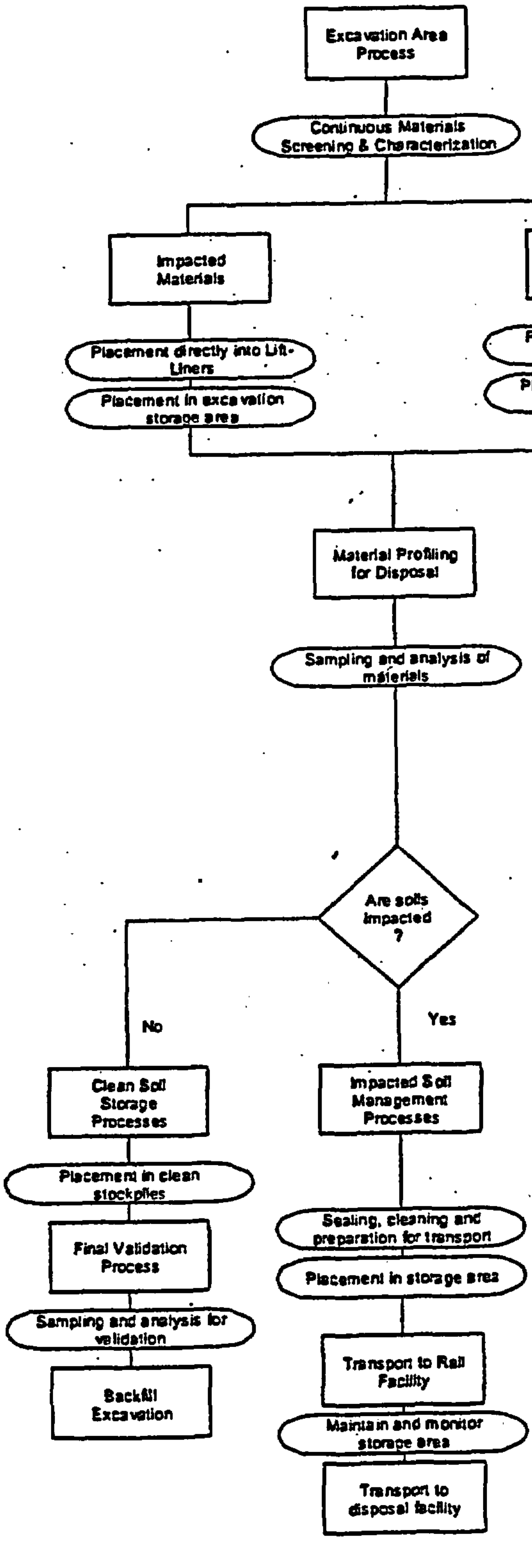
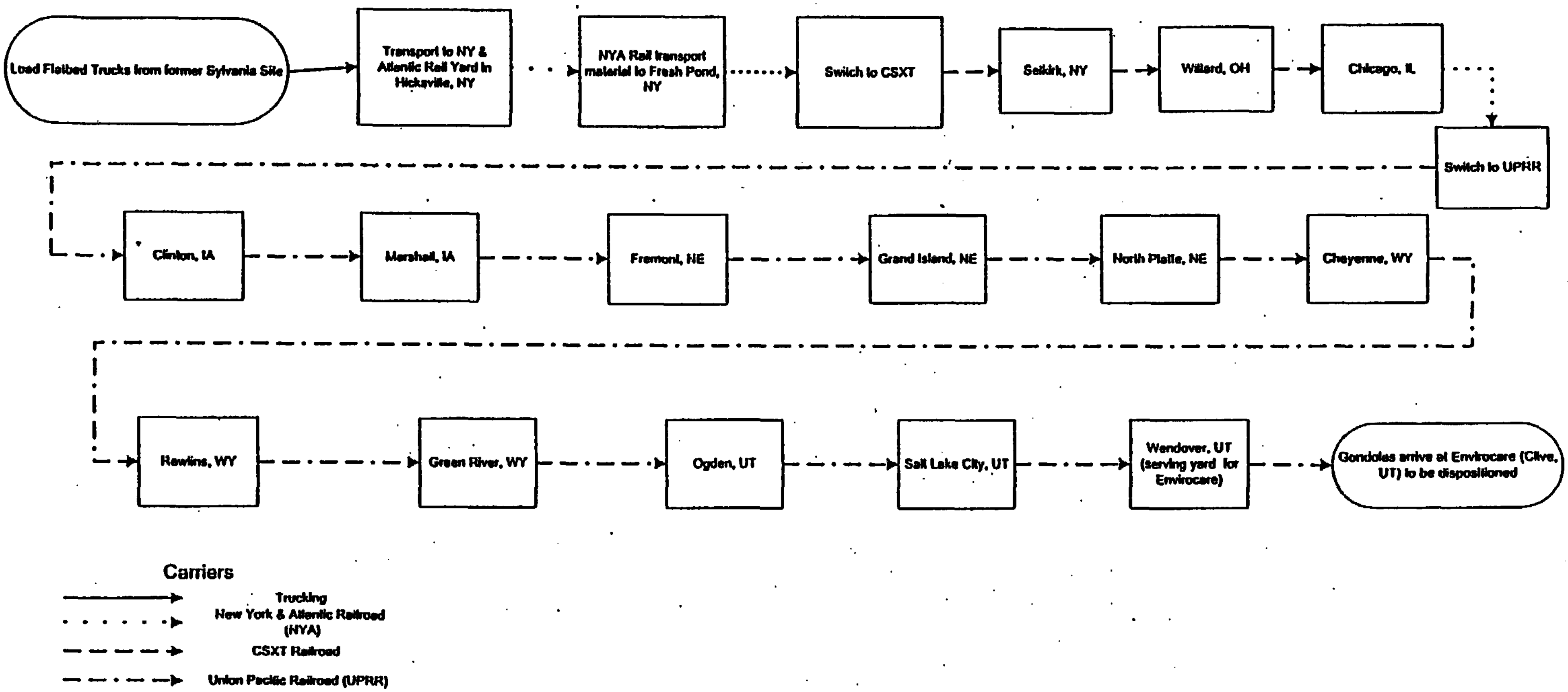


Figure 7
Flow Diagram For The Transportation of Waste Material From Hicksville, NY to Envirocare of Utah



APPENDIX A: QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

During the course of the project, field confirmation sampling will be performed using the quality assurance/quality control (QA/QC) protocols outlined within this section. These protocols have been developed specifically for the Site to consider each component of work that requires oversight and comparison to accepted QA/QC standards in light of industry-wide standards of care. The following sections outline these protocols and the methods to be used to provide verification that desired standards are achieved.

A.1. QUALITY ASSURANCE PROJECT PLAN

The Quality Assurance Project Plan (QAPP) used for the field remediation program was developed to support the Site sampling and analytical characterization. This QAPP can effectively be used to support the remediation efforts due to its ability to address both chemical and radioactive impacts. The QAPP is included in Appendix H. More information on proposed laboratory analytical methods is presented in Section A.3.

A.2. SAMPLING

Sampling during the remediation program will be performed to gauge the progress of remediation, as well as to confirm that cleanup goals have been achieved. While the QAPP will address sampling from the point of excavation through to packaging, shipping and analysis, other sampling protocols have been developed to define benchmarks for quality used in acquiring the samples.

Because the remediation work will involve excavations, sampling will rely mainly on grab samples of exposed soils. At locations of suspected VOC residuals, soil samples will be collected 6- to 12-inches beneath the surface. In general, the objective for sample recovery will be to acquire samples that are representative of Site conditions. Accordingly, this will require consideration of the media being sampled, the climatic conditions, and the data needed from the analysis.

A.3. ANALYTICAL CHARACTERIZATION / LABORATORY METHODS

Analytical characterization will be performed throughout the project subject to the laboratory characterization protocols defined by the QAPP. Accordingly, quality measures will be employed throughout the analytical characterization efforts.

Samples collected[1] will be submitted for analysis by *United States Environmental Protection Agency (USEPA) Methods with NYSDEC Analytical Services Protocol (ASP) June 2000.* Sample analyses will be performed in accordance with the *Methods for Chemical Analysis of Water and Waste, USEPA 600/4-83-020, Test Methods for Evaluating Solid Wastes, SW-486.* Select samples will be analyzed for VOCs (USEPA Method 8260B), nickel (USEPA Method 6010B), total percent solids (USEPA 2540-G), gamma spectrometry (EML Procedures Manual-United States Department of Energy (USDOE)-Health and Safety Laboratory Method (HASL) 300 4.5.2.3) and alpha spectrometry for thorium (National Academy of Science Method TH-NAS-NS-3004 or USDOE RP-725 Group Actinide Screening Using Extraction Chromatography (Eichrom)) and uranium (National Academy of Science Method U-NAS-NS)3050 or USDOE RP-725 Group Actinide Screening Using Extraction Chromatography (Eichrom)). Radionuclide analysis will be performed using Los Alamos National Laboratory (LANL) and USDOE Methods.

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[1] Additional analysis may be collected at the discretion of field personnel.

A.4. BACKFILL TESTING

Future Site land-use will be commercial/industrial and thus necessitate sound foundation support for Site traffic or building construction. Therefore, backfill materials will be placed subject to appropriate compaction levels and subject to testing to ensure attainment of those levels. Sampling and analysis efforts will also be required on imported fill materials to support verification that the fill materials are clean. The number and frequency of samples will be determined based on the source and the type of soils imported.

A.5. DECONTAMINATION

Equipment and hand tools used during the project that may contact chemically or radioactively impacted media will be subject to rigorous decontamination processes to ensure that such impacts are removed and the residuals properly managed. Decontamination will be performed using the methods outlined previously and will be confirmed with using wipe samples. These wipe samples will be subject to analytical characterization to identify whether the chemical or radioactive impacts remain on the portions of the equipment exposed to the impacted media. The analytical characterizations used will be specific to the types of equipment and the type of potential impact.

Prior to release of equipment or tools from the Site, documentation of the decontamination results will be developed subject to an inventory tracking number. Equipment and tools used at the Site will be issued an inventory number to document the effectiveness of decontamination once remediation work has been completed. Documentation of the decontamination results will be logged.

A.6. MATERIALS HANDLING AND TRANSPORT

Wastes leaving the Site will be documented with respect to their composition and the degree of chemical or radioactive impacts that may be present. As noted in the waste management section, such shipments will be subject to landfill profiling and transport manifesting procedures specific to the type of waste being managed.

In addition to characterization and manifesting efforts, detailed screening will be performed within areas used for packaging of waste materials and at locations used for loading containers. This screening will be performed both prior to, and following completion, of waste handling activities. The purpose of this screening will be to confirm that no residual chemical or radioactive influences are present above requisite cleanup levels at the time the fieldwork is completed.

A.7. WELL ABANDONMENT

As part of the remediation program, selected monitoring wells may be subject to abandonment. If well abandonment is required, it will be conducted in accordance with the NYSDEC Groundwater Monitoring Well Decommissioning Procedures (NYSDEC 1996) along with NYSDEC oversight. Abandonment will be performed by a licensed well driller and will be documented to validate that the work performed conforms to applicable standards.

A.8. CONFORMANCE WITH REGULATIONS

Throughout the project, work will be performed in conformance with this Work Plan and applicable State and Federal law. Accordingly, all facets of work will be subject to scrutiny by appropriate representatives from regulatory agencies.

APPENDIX B: HEALTH & SAFETY PLAN

B.1 PROJECT OVERVIEW

B.1.1 Introduction

This Site-Specific Health and Safety Plan (HASP) establishes the health and safety procedures required to minimize potential risk to personnel who will participate in Site remediation activities at the Former Sylvania Electric Products Facility (the "Site") in Hicksville, New York. The objective of the remedial work is to remove residual areas of chemical, nickel, and radioactively impacted soils exceeding target cleanup levels. Remediation will provide for unrestricted use of the Site in accordance with local zoning provisions. Under this program, work will be performed in accordance with applicable local, State and Federal guidance, subject to input from key stakeholders (i.e. the general public and Site workers). Remedial activities will include building demolition, and excavation of materials impacted with radionuclides, hazardous chemicals, and nickel. The project efforts also include packaging and transportation of the waste materials and Site ground restoration.

This plan applies to GTE Operations Support Incorporated (GTEOSI) and its contractors, government agency representative, and visitors. The procedures in this plan have been developed based on the information collected during prior Site investigations. The procedures address the chemical, radiological, and physical hazards that are either known or anticipated to be encountered during remedial activities. If Site conditions or work activities vary from the Work Plan, amendments to this HASP will be made as necessary.

This HASP has been written to comply with the requirements of the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120), as well as applicable regulations administered by New York State Department of Environmental Conservation (NYSDEC). All Site activities must be conducted in compliance with this HASP and applicable Federal, State, and local health and safety regulations. If conflicts exist between this document and the referenced standard, the standard that offers the most protection will govern.

Contractors and subcontractors will adhere to this HASP. This HASP will be made available to each employee who works at the Site. Each employee or Site visitor must report to the Site Safety Officer (SSO) and the Radiation Safety Officer (RSO) for a Site conditions/safety briefing prior to any Site activity. Each employee must sign a copy of the attached HASP sign-off sheet verifying knowledge and review of the information in the HASP.

Responsibility for the implementation of health and safety measures is an integrated effort among the Project Manager (PM), the Site Supervisor (SS), the Radiation Health and Safety Manager (RHSM), the SSO, the RSO, and each individual working on the Site. The RHSM is responsible for developing, interpreting and modifying the HASP. When required, the RHSM is also responsible for auditing the project to verify compliance with the HASP. In consultation with the RHSM, the SSO has the authority to correct all health and safety deficiencies and to immediately stop work in cases where potential danger is perceived. The SSO is responsible for initiating emergency response and coordinating Site evacuation if necessary. The SSO will maintain a daily sign-in log and head count logs during excavation activities.

The PM is responsible for ensuring that this HASP is made available to all members of the field team. The PM is responsible for collecting the necessary training and medical documentation from subcontractors as well as the HASP sign-off sheets from the field team.

All personnel on-Site are responsible for abiding by the health and safety procedures listed in this HASP and for maintaining their personal safety equipment. Any person who does not adhere to the provisions of this HASP will be denied access to the Site.

B.1.2 Site Description

Today the Site is comprised of three lots: the 70 Property, the 100 Property, and the 140 Property (identified as Lot 94, Lot 99 and Lot 100). Approximately 95 percent of the 9.5-acre Site is either paved or occupied by buildings.

70 Property

The 70 Property, located on the southern portion of the Site, consists of an approximate 79,210-square foot (ft^2) one-story brick building and the associated land. The portion of the Property not occupied by the building is paved and used for parking and storage. This Property was purchased by its current owner in 1979, and was expanded to the east after adjacent land (Lot 105) was purchased from Nassau County. The western portion of the building is the only original building (historically Building #4) that remains, as the other original buildings have been demolished.

100 Property

The 100 Property is centrally located on the Site and consists of the fenced area enclosing an 80,100-ft^2 two-story distribution building and paved parking lots. Two underground petroleum tanks are on the south side of the building.

140 Property

The 140 Property is on the northern portion of the Site, immediately south of the Nassau County Department of Public Works (NCDPW). The Property houses an approximate 54,500-ft^2 one-story office and industrial building. The Property is primarily paved with the exception of a small area on the east side that abuts the Nassau County Parks Department Golf Course Driving Range (GCDR).

Surrounding Land Use

The Site is bounded by the NCDPW to the north. The GCDR is to the east. The Property formerly owned by General Semiconductor, a Class 2 State listed inactive hazardous waste Site is south of the Site. Cantiague Rock Road and commercial and industrial properties are to the west.

B.1.2.1 Site History

From 1952 to 1970, the Site was operated for the fabrication of reactor fuel elements, as well as high temperature coatings and composite alloys for space and aircraft industries. Records indicate that Sylvania operated the three main buildings, designated as buildings #1, #2, and #4, and twelve support buildings under license #SNM-82 (for fuel rod fabrication) issued from the Atomic Energy Commission (AEC) (NRC 1996). Buildings #1 and #2 on Lot 80 already existed when Sylvania first occupied the Property in 1952. Sylvania acquired the remainder of Lot 79 in 1957; and constructed building #4. A plan view of the current Site layout with the overlay of the 1960 structures is provided as Figure 3 of the Work Plan.

The former Sylvania Plant fabricated reactor fuel elements and high temperature protective coatings used in research and electric power generation. The plant had two production facilities, one for the manufacture of commercial-type fuel elements and the other for the government manufacture of special elements and reactor materials. Manufacturing processes included the:

- Melting of enriched uranium-molybdenum and enriched uranium-aluminum in graphite and ceramic crucibles in vacuum furnaces;
- Sintering of uranium oxide-powdered stainless steel and rolling of uranium-stainless steel billets in hydrogen atmosphere furnaces;
- Applying high temperature protective coatings to the exhaust skirts of rockets and larger aerospace parts using a vacuum diffusion-coating furnace;
- Iso-static pressing of uranium pellets-aluminum tubing involving argon gas; and
- Chemical cleaning of products involving hot and cold acid, caustics, solvents, water and anodizing solutions in cleaning tanks, hoods, and degreasing stations.

Liquid wastes were generated from both the coolant used for the fabrication of equipment and the chemical cleaning baths. The coolant was dried and the resulting sludge burned to salvage the uranium. Sylvania discharged non-contact cooling water for equipment into a leaching pool. Some waste products were sent off-Site for disposal (greater than 5 grams per liter (g/l) uranium) while other process residuals were disposed of in on-Site recharge basins, leaching pools, or cesspools (circa 1959). In the mid-1960's, effluent was discharged to four sumps that were pumped to a Site dry well.

With the sale of the Sylvania Nuclear Division's equipment, tooling, and license assets to National Lead Industries in 1966, the production of nuclear fuel elements and components at the facility ceased. In 1967 the AEC removed the Site from licensing requirements due to cessation of nuclear product production activities. The Sylvania Parts Division continued Site operations until 1969.

The buildings were demolished in 1968 and 1969 with the exception of Building #4, which exists on the 70 Property. This building was decommissioned in accordance with applicable regulations and the released for unrestricted use by the New York State Department of Labor (NYSDOL) in 1967. According to a letter from Rita Aldrich of the NYSDOL to Barbara Youngberg of NYSDEC dated March 21, 1997, Building #4 was reviewed by ORNL in December 1995, who found that "the building was suitable for unrestricted use according to present limits." Further, the letter indicates that NYSDOL made readings in January 1996 and found no readings above background. Before the construction of the current buildings, the Property was subdivided into three new parcels with new lot numbers.

B.1.3 Project Description

Remedial efforts in the field will be directed toward the removal of impacted soils, debris, or other building materials. The excavation will be performed concurrently with a detailed on-Site screening, analytical testing, and documentation program. Following the removal of the materials, sampling will be performed to confirm that target cleanup levels in soil have been met. Scheduled project tasks include:

- Mobilization/demobilization;

- Survey;
- Utility markout;
- Soil screening;
- Manual soil sampling;
- Concrete sawing;
- Excavating;
- Equipment operations (fill, lift and move waste containers);
- Waste transportation to and loading onto rail cars; and
- Site restoration.

B.1.4 Health and Safety Responsibilities

B.1.4.1 Project Manager (PM)

The PM shall direct on-Site operations. The PM may delegate these responsibilities to the SS. The PM and SS, assisted by the SSO and the RSO, have primary responsibility to:

a. See that personal protective equipment (PPE) and monitoring equipment is available and properly used by on-Site personnel;

b. Document that Site personnel are aware of the provisions of this plan, are instructed in the work practices necessary to ensure safety, and are familiar with planned procedures for dealing with emergencies;

c. Document that all on-Site personnel have completed a minimum of 40 hours of HAZWOPER training, have appropriate medical surveillance and have been fit tested for a respirator;

d. Document that all on-Site personnel who will be working in areas that are suspected to contain chemical or radioactive materials have received training appropriate to their duties;

e. Ensure that Site personnel are aware of the potential hazards associated with Site operations;

f. Monitor the safety performance of all Site personnel to see that the required work practices are employed;

g. Correct any work practices or conditions that may result in injury or unnecessary exposure to hazardous chemicals or radioactive materials;

h. See to the completion of the Safety Plan Compliance Agreement forms by all Site personnel; and

i. Stop Work, if necessary, in the event of an emergency or to correct unsafe work practices.

B.1.4.2 Project Radiation, Health and Safety Manager (RHSM)

The RHSM has the primary responsibility to:

a. Implement this project HASP and report any deviations from the anticipated conditions described in these documents to the PM. Primary implementation is through supervision of two safety individuals on the project: the SSO and the RSO. Responsibilities of these individuals are specified in subsequent sections.

b. Ensure that a copy of this HASP is available on-Site at all times.

c. Review monitoring results, observe trends in personnel and workplace monitoring results, and evaluate the need for increases in PPE or modified work procedures associated with previous and current exposure results.

d. Maintain the project OSHA 200 Form, "Log and Summary of Occupational Injuries and Illnesses" for use in internal and reporting requirements.

e. Maintain all environmental, safety, health and radiological control records until relinquished to GTEOSI upon project completion.

B.1.4.3 Site Safety Officer (SSO)

The SSO has the primary responsibility to:

a. Conduct hazardous contaminant monitoring. Ensure that monitoring equipment is calibrated, checked, and used in accordance to the Operating Procedures and the manufacturer's instructions, and that results are documented.

b. Verify that project personnel have current medical and training authorizations.

c. Assume additional safety duties as directed by the PM, SS, or RHSM.

e. Coordinate with the RHSM and the subcontractor's occupational medicine support group to identify personnel for whom specific PPE or exposure monitoring may be required or desirable.

f. Conduct and document daily safety briefings.

g. Assist the PM in the development of work permits and posts such permits prior to the start of field operations.

h. Provide ongoing review of the protection levels required as project work is performed and to inform the PM of the need to upgrade/downgrade levels as appropriate.

i. Maintain a daily log of Site access, a record of personnel activities, monitoring performed, exposure results, radiological exposure results, and incidents.

j. Ensure that appropriate decontamination procedures are performed.

k. Stop work, if necessary, in the event of an emergency or to correct unsafe work practices.

l. Serve as the Project Local Emergency Coordinator to effectively evacuation of the Site or work area if necessary.

B.1.4.4 Radiation Safety Officer (RSO)

The RSO has the primary responsibility to:

a. Conduct radiation monitoring.

b. Ensure that radiological monitoring equipment is calibrated and properly used by project personnel in accordance with the manufacturer's instructions, and that the results are properly recorded and filed.

c. Assist the SSO in developing radiological work procedures prior to the start of work.

d. Ensure that all Site personnel use personal dosimetry, and maintain accountability for all assigned devices and the records generated from use.

e. Ensure that PPE is worn by Site personnel.

f. Assist with radiological monitoring for skin and inner clothing contamination after Site personnel have performed PPE doffing procedures.

g. Implement engineering controls and As Low As Reasonably Achievable (ALARA) principles (time, distance, and shielding techniques or contamination control strategies)

h. Document non-conformance, accidents, or incidents.

i. Maintain the radioactive sources used for instrument calibration. Notify the PM in the event of any loss of radioactive material.

B.1.4.5 Project Personnel

Project personnel are responsible for:

a. Taking precautions to prevent injury to themselves and to their fellow employees, including stopping work and notifying supervisors when conditions or operations appear to present a hazard.

b. Performing only those tasks they believe they can do safety, and immediately reporting any accidents and/or unsafe conditions to the safety personnel, operational supervisor or PM.

c. Implementing the procedures in this HASP, and reporting any deviations to safety personnel, operational supervisor or PM.

d. Notifying the corporate physician or SSO of any medications, allergies, or special medical problems that could affect job performance.

e. Attend Site safety briefings, participate in work planning discussions and evolution critiques, and adhere to the procedures specified in the Site safety briefing.

f. Adhering to the workplace substance abuse guidelines.

g. Reviewing this project HASP and signing the acceptance form(s).

The following table provides the key project positions and associated responsibilities.

Table B-1: Key Project Positions and Associated Responsibilities

Position	Responsibilities	Interactions
Project Manager(s) -technical -administrative	Responsible for technical and administrative performance of the project to ensure conformance with the scope reviews, progress, schedules, expenditures, and budget	Interacts closely with RSO, SSO, and RHSM
Site Supervisor	Coordinates daily work efforts and ensures activities are in compliance with the HASP. Provide project overview, assigns Site personnel to applicable tasks, and maintains consistency of technical approach. Briefs personnel on task requirements. Identifies and resolves technical problems. Provides periodic review of the project progress.	Interacts with PM and project workers
Radiation, Health and Safety Manager	Define, develop, implement, and enforce the on-Site safety program. Conducts periodic audits to ensure compliance and discusses project progress and health and safety related issues with PM and SS.	Interfaces with PM, SS, RSO, and SSO
Site Safety Officer	Assures compliance with HASP. Conduct daily pre-work meeting. Performs any monitoring activities as required. Evaluates monitoring data to make field decisions regarding health and safety. May discontinue Site operations and evaluate the Site if safety violations exist.	Reports directly to RHSM. Interacts closely with PM, SS and RSO
Radiation Safety Officer/ Health Physics Technician(s)	Performs radiological monitoring activities as required. Evaluates monitoring data to make field decisions regarding health and safety. Performs field screening of air and soil samples.	Reports to RHSM. Interacts closely with PM, SS and SSO
Individual Site Workers	Perform tasks safely, and reports any accidents or unsafe conditions to the safety personnel, operational supervisor or PM	

B.2 HAZARD ASSESSMENT

The radiological, chemical, and physical hazard assessments apply only to the activities covered by this HASP.

B.2.1 Radiological Hazards

Radionuclides at the Site include thorium-230/232 and uranium-234/235/238 and their decay progenies. These radionuclides are primarily alpha-radiation emitters. Therefore the predominant hazard to the Site worker is ingestion or inhalation of the materials.

Uranium has been identified as a nephrotoxic metal (kidney toxicant), exerting its toxic effects by chemical action mostly in the proximal tubules of the kidney in humans and animals. The kidneys normally have the ability to compensate for nephron-loss. For example, chronic renal failure occurs when there is around 60% nephron loss. During the gradual loss of functioning nephrons, the remaining nephrons appear to adapt, increasing their capacity for filtration, reabsorption, and excretion.

Uranium is a less potent nephrotoxin than the classical nephrotoxic metals such as cadmium, lead, and mercury, and at the concentrations observed on Site nephrotoxic effects are not expected to occur. Procedures and equipment used to protect site workers from the radiological aspects of uranium exposure also will be effective in protecting workers from the chemical toxic aspects.

Minimizing ionizing radiation hazards to project personnel will be governed by ALARA. To achieve this goal, a clear understanding of the characteristics and effects of ionizing radiation should be attained by all project personnel. Individuals will attend the Site-specific radiation safety training identified in Attachment 1, *Basic Radiation Safety Training*, which provides explanations of the different types of radiation, their effects, exposure standards, methods for reducing the hazards and working safely with radioactive materials. A copy of *Basic Radiation Safety Training* is attached to this appendix.

B.2.2 Chemical Hazards

Chemicals exceeding cleanup levels include tetrachloroethene, trichloroethene, and nickel have been detected on the Site. Contaminant concentrations in soil are expressed in milligrams per kilogram (mg/kg) or in micrograms per kilogram (ug/kg) which are equivalent to parts per million (ppm) and parts per billion (ppb), respectively. Contaminant concentrations in water are expressed in milligrams per liter (mg/l) or in micrograms per liter (ug/l) which are equivalent to ppm and ppb, respectively. Air concentrations are expressed in milligrams per cubic meter (mg/m^3).

Site-specific chemical exposure assessments were conducted . Based on the results of the assessments, it is unlikely, that Site workers will be exposed to chemicals above the OSHA Permissible Exposure Limit (PEL). The applicable OSHA PEL values are provided in Table B-2.

TABLE B-2: CHEMICAL HAZARDS AND LIMITS

CONTAMINANT CAS#	OSHA PEL*	OSHA CEILING/STEL	NIOSH REL	ACGIH TLV*	ACGIH STEL/C
CARBON MONOXIDE 630-08-0	50ppm	N/A	35ppm	25ppm	N/A
TETRACHLOROETHENE 127-18-4	100ppm	200ppm (C) 300ppm (max)	Ca LFC	25ppm	100ppm
TRICHLOROETHENE 79-01-6	100ppm	200ppm (C) 300ppm (max)	Ca LFC	50ppm	100ppm
ARSENIC †† 7440-38-2	0.01mg/m³	N/A	0.002mg/m³ (C)	0.01mg/m³	N/A
BARIUM(soluble) 10361-37-2	0.5mg/m³	0.5mg/m³	n/a	0.5mg/m³	N/A
BERYLLIUM †† 7440-41-7	0.002mg/m³	0.005mg/m³(C) 0.025mg/m³max	0.0005mg/m³ (max)	0.002mg/m³ (0.0002mg/m³)**	0.01mg/m³ ST
CADMIUM †† 7440-43-9	0.005mg/m³	(9mg/m³ IDLH)	Ca LFC	0.01mg/m³ 0.002mg/m³(cpds)	N/A
CHROMIUM (+3)† 7440-47-3	0.5mg/m³	N/A	0.5mg/m³	0.5mg/m³	N/A
CHROMIUM (+6)†† (Insoluble)	LFC N/A	0.1mg/m³(C) N/A	0.001mg/m³ N/A	0.05mg/m³ (0.01mg/m³)	N/A
LEAD 7439-92-1	0.050mg/m³	N/A	0.10mg/m³	0.050mg/m³	N/A
NICKEL† (metal) (sol.cpds) (insol.cpds) 7440-02-0	1mg/m³	N/A	0.015mg/m³	1.5mg/m³ 0.1mg/m³ 0.2mg/m³	N/A

All others are 8-hour time weight average exposure (NIOSH RELs are for 10-hour TWAs unless other noted).
** - Intended Change.
† - Potential human carcinogen.
††-Confirmed human carcinogen.
^ - Vapor
C – Ceiling limit (should not be exceeded at any time).
ACGIH – American Conference of Governmental Industrial Hygienists.
CAS – Chemical Abstract Service
LFC – Lowest Feasible Concentration.
OSHA – Occupational Safety and Health Administration.
PEL – Permissible Exposure Limit.
NIOSH – National Institutes for Occupational Safety and Health.
REL – Recommended Exposure Limit.
STEL – Short-Term Exposure Limit (15 minute).
SKIN – Significant exposure possible via skin absorption.
TLV – Threshold Limit Value.
IDLH – Immediately Dangerous to Life and Health.

B.2.2.1 Volatile Organic Compounds (VOCs)

B.2.2.1.1 Tetrachloroethene

Tetrachloroethene (PCE) is a colorless non-flammable liquid with a chloroform odor. Routes of exposure include inhalation, ingestion, and dermal contact. Symptoms of exposure include irritation of the eyes and mucous membranes, fatigue, weakness, confusion, dizziness, and a headache, as well as depression of the central nervous system. The organ of impact is the liver.

B.2.2.1.2 Trichloroethene

Trichloroethene (TCE) is a colorless non-flammable liquid with a chloroform odor. Routes of exposure include inhalation, ingestion, and contact. Symptoms of exposure are irritation of the eyes and mucous membranes, and headache, as well as depression of the central nervous system. Trichloroethene damages the liver.

B.2.2.2 Metals

Select metals were previously detected in Site soils. The metals characteristics and toxicity are discussed below.

B.2.2.2.1 Arsenic

Arsenic is a (ubiquitous) metal that is naturally found in soils. Arsenic is most commonly identified in a trivalent (+3) or pentavalent (+5) state. Most industrial arsenic is used in its trivalent state while natural arsenic is in its pentavalent state. Arsenic is a natural constituent of food. Arsenic compounds are used in veterinarian practice and agriculture. Arsenic is a by-product of coal combustion. Arsenic compounds may be toxic by ingestion or inhalation. The trivalent forms of arsenic are more toxic than pentavalent forms. Arsenic accumulates in the liver, muscle tissue, hair, nails, and skin. The symptoms of acute inorganic arsenic toxicity include burning and dryness of oral and nasal cavities, gastrointestinal disturbance, muscle spasms, vertigo, delirium (dizziness), and coma. Swelling of the face and eyelids also occur. Chronic arsenic toxicity is characterized by malaise and fatigue. Pale bands on the fingernails and toenails and hyperpigmentation and peripheral neuropathy may also occur. Nasal septum ulceration is seen after long periods of industrial exposure. Arsenic can be detected in hair, nails, and urine long after exposure situations are eliminated. Industrial and agricultural exposure to arsenic has been related to skin and respiratory tract cancer.

B.2.2.2.2 Barium

Barium is usually found as barium chloride, barium nitrate, or barium sulfate (occurs in nature). Barium is a white, odorless solid. Symptoms of barium exposure include eye, skin, and upper respiratory irritation, skin burns, gastroenteritis, muscle spasm, slow pulse, extrasystoles, and hypokalemia (potassium deficiency).

B.2.2.2.3 Beryllium

Beryllium is a hard, lightweight, brittle, gray-white solid. Chronic beryllium exposure causes an allergic pneumoconiosis called beryllosis, symptoms of which include anorexia, weight loss, weakness, chest pain, cough, clubbing of fingers, cyanosis, and pulmonary insufficiency. Other symptoms of beryllium exposure include eye irritation, and dermatitis. NIOSH considers beryllium to be an occupational carcinogen.

B.2.2.2.4 Cadmium

Cadmium is a silver-white, blue-tinged lustrous, odorless solid. It is a noncombustible solid, however it will burn in powder form. Cadmium has a melting point of 610°F. Cadmium is used in battery manufacture. Symptoms of cadmium exposure include pulmonary edema, dyspnea, cough, chest tightness, substernal pain, headache, chills, muscle aches, nausea, diarrhea, anosmia (loss of sense of smell), emphysema, proteinuria, and mild anemia. Cadmium causes lung and prostate cancers.

B.2.2.2.5 Chromium

Chromium is a metallic element that is hard, brittle, and gray in color. The chromium ion forms many compounds that vary in color. Chromium may exist in one of three valence states: divalent (+2), trivalent (+3), or hexavalent (+6). The hexavalent chromium compounds such as chromic acid and its salts-chromates are more toxic than the other valence states. Hexavalent chromium is a confirmed human carcinogen, while monochromates and dichromates are non-carcinogenic. Hexavalent compounds are irritants and corrosives that enter the body through inhalation, ingestion, and skin absorption. Trivalent, divalent, and elemental chromium enter the body through inhalation and ingestion. In some individuals, chromium compounds act as allergens with skin dermatitis reported, while other forms corrode skin and mucous membranes. Acute exposure to dust or mist containing hexavalent or trivalent forms of chromium (Cr^{+6} or Cr^{+3}) may cause coughing, wheezing, headache, fever, and chest pain. Respiratory irritation and edema may persist. Chromic acid mists and chromate dusts may cause severe irritation of the nose, throat, bronchial tubes, and lungs. Long-term or repeated exposure may cause ulceration/perforation of the nasal septum; respiratory irritation with asthma-like symptoms; skin rashes or allergic dermatitis.

B.2.2.2.6 Lead

Lead is a bluish gray, soft metal. When lead is ingested, much of it passes through the body unabsorbed, and is eliminated in the feces. The greater portion of the lead that is absorbed is caught by the liver and excreted, in part, in bile. For this reason, larger amounts of lead and longer exposure periods are necessary to cause toxic effects by ingestion. However, upon inhalation, absorption takes place easily from the respiratory tract and symptoms tend to develop quickly. Therefore, inhalation is a more important potential route of exposure. Inhalation or ingestion of lead is known to cause neurological, blood, liver, and kidney disorders. Symptoms of exposure include decreased appetite, insomnia, headache, muscle and joint pain, colic, and conjunctivitis.

B.2.2.2.7 Nickel

Nickel is principally found in ores containing iron or copper. Nickel has been mainly used in electronics, coins, steel alloys, batteries, food processing, and stainless steel. Dermatitis is the most frequent effect of exposure to nickel.

B.2.2.2.8 Carbon Monoxide

Carbon Monoxide is a colorless, odorless gas, which acts as an asphyxiant by binding itself to hemoglobin molecules. Because carbon monoxide binds to hemoglobin better than either oxygen or carbon dioxide, the affected red blood cells are ineffective at oxygen exchange. Carbon monoxide is a component of landfill gas and is also formed by the incomplete combustion of motor fuels, such as gasoline.

B.2.2.2.9 Hazardous Materials Brought On-Site

Material safety data sheets (MSDS) for chemicals used during the remedial activities will be available on-Site. All containers of hazardous materials brought onto the Site must be clearly marked in accordance with OSHA Hazard Communication Standard. MSDS must be presented for any hazardous materials brought on-Site.

B.2.3 Physical Hazards

The following list of potential physical hazards have been identified for the planned Site activities:

- Heavy Equipment;
- Exposure to Noise and Vehicles;
- Electrical Hazards;
- Slip, Trip, and Fall Hazards;
- Illumination;
- Concrete Saw;
- Hand Tools;
- Pneumatic Tools;
- Cutting and Welding;
- Excavations;
- Lightning;
- Drum Handling; and
- Heat or Cold Stress.

B.2.3.1 Heavy Equipment and Vehicles

The use of heavy equipment will require all personnel in the immediate work area to wear hard hats and steel-toed footwear in addition to personal protective equipment (PPE) required for performing work activities in the work area. No person shall walk underneath a piece of equipment when it is carrying a load, or if it is transporting materials to another area. In addition, Site workers must pay attention to automobile traffic in the parking lot areas during the lunch hour and at the end of day

The following guidelines should be adhered to when working around heavy equipment (front end wheel loaders, backhoes, rollers, bulldozers, etc.) and heavy materials:

- Hardhats are to be worn at all times on-Site. Other protective gear as specified in this HASP is applicable as well.

- Obtain visual contact with the equipment operator before passing into the swing radius or other danger zones.
- Establish hand signal communication when verbal communication is difficult. Determine one person per work group to give hand signals to equipment operators.
- Be cautious of solid footing at all times.
- Heavy equipment should have backup alarms of some type.
- Only qualified people are to operate heavy equipment.
- Use proper chains, hoists, straps, and any other equipment to safely move heavy materials. Tow chains are not to be used for lifting.
- Use proper personal lifting techniques. Use your legs, not your back.
- Do not walk directly in back of or to the side of heavy equipment without the operator's eye contact.
- Do not use a piece of equipment unless you are familiar with its operation. This applies to heavy and light equipment.
- Pipe sections and other materials to be utilized during this project will be heavy. Make sure all precautions have been taken prior to moving materials. Use equipment to move objects that are awkward or heavy.
- Be sure no underground or overhead power lines, electrical conduit, sewer lines, gas lines, water lines, telephone lines, or other utilities will present a hazard in the work area.
- Get information whenever you are in doubt about a material's weight.
- Use the buddy system.
- All heavy equipment will be secured/stored at zero energy potential (all hydraulics at rest, buckets locked or on ground, etc.) when not in use.

B.2.3.2 Exposure to Noise

Exposure to occupational noise in the construction industry is regulated by 29CFR 1926.52. The standard requires protection from the effects of noise exposure to be provided when exposures exceed 90-dBA for an 8-hour day. Exposure to impact or impulse noise should not exceed 115-dBA peak sound pressure level. Exposure to noise may result in the following:

- Temporary hearing losses where normal hearing returns after a rest period;
- Interference with speech communication and perception of auditory signals;
- Interference with the performance of complicated tasks; and

- Permanent hearing loss due to repeated exposure resulting in nerve destruction in the inner ear.

Noise monitoring may be performed to evaluate when and during what activities hearing protection will be required and to determine the appropriate noise reduction rating (NRR) that the protection must provide. The major points of the program include:

- A sound meter capable of reading on the A-weighted scale (dBA) will be used on-Site in situations where noise levels approach the action level. This meter will be used as an initial check when operations are begun using noise-producing equipment (e.g., gasoline-powered generator), and for periodic evaluation, thereafter.

- When continuous and impact noise levels may exceed 85 dBA, personnel in the vicinity of operating equipment will wear hearing protection (aural inserts or muffs) until data is available that indicates hearing protection is not necessary.

- Personnel will wash their hands prior to inserting ear plugs to avoid initiating ear infections.

- A rule of thumb is, if it is necessary to raise one's voice to be heard by another person when standing three feet apart, then hearing protection is required.

B.2.3.3 Electrical Hazards

Ground fault circuit interrupters will be used on all portable, electrically operated equipment. Equipment (i.e. backhoes, cranes, man lifts, etc.), which has the potential to come in contact with overhead power lines, shall not be positioned or operated within 10 feet of energized power transmission lines. Equipment and power lines with a potential electrical exposure will be verified, locked, and tagged as being out of service. This will be accomplished before any dismantlement operations are initiated. All lines must be traced to the main electrical panel or nearest junction box to confirm the lines have been de-energized.

The SSO is responsible for identifying any equipment or systems requiring lockout/tagout (LO/TO) protection when specific pieces of equipment are brought onto the work Site. At that time, LO/TO procedures specific to the equipment will be developed, and the SSO will cover the requirements with project personnel in safety briefings.

Lockout/tagout is required during activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining or servicing equipment connected to an energy source such as electricity, pressure or steam. These activities include lubrication, un-jamming equipment, or changes in equipment or procedures where an employee may be exposed to unexpected startup or energy releases. A lockout/tagout procedure is not necessary for routine operations of a mechanized device.

- All personnel must comply with lockout/tagout requirements and Site managers and the SSO must enforce the use of locks/tags to ensure protection where unexpected energizing may occur.

- When equipment is lockable, use of a lock is required by all exposed personnel. Where equipment is not lockable, tagout application or special lockout/tagout procedures shall be used as specified by the SSO.

B.2.3.4 Slip, Trip and Fall Hazards

Employees will be aware of slip, trip, and fall hazards on-Site and discuss at the daily tailgate safety meeting. The presence of heavy equipment requires all personnel on-Site to wear steel-toed footwear and hard-hats. Personnel in the immediate work vicinity should maintain a safe distance from operating machinery. Also, during any decontamination in Level C PPE, it may be possible that the floor is slippery, surfaces unreliable, debris present, and wet or dusty areas exist. Additional on-Site slip, trip, and fall hazards include aboveground piping, loose stone, existing landfill side slopes, existing access roads, and existing active landfill area. All personnel should be aware of the variability of the work surface in their work area. Every attempt will be made to prevent accidents due to slips, trips, and falls by thorough review of the daily tasks and Site conditions during the morning tailgate safety meeting.

Adjacent to the eastern property boundary is a golf course driving range. During construction activities, workers should be aware of stray golf balls hit onto the Site, and golf balls lying on the ground at the Site. Workers should take extra precaution not to trip or twist an ankle on a golf ball.

B.2.3.5 Illumination

If work takes place during other than daylight hours, or in confined spaces where there is insufficient natural light, work areas will be lit to provide each activity illumination in accordance with the requirements of 29CFR 1910.120(m).

B.2.3.6 Concrete Sawing (walk-behind and/or demo saw)

Concrete sawing using walk-behind and/or portable gas-powered saws will occur on this project. Hazards associated with the use of the concrete saw include:

- Exposure to noise levels in excess of the PEL.
- Cuts and lacerations when operating the saw.
- Injuries from improper ergonomic techniques.
- Pinch and nip point injuries.
- Release of contaminants to the environment
- Fires or sparks from friction heated blade

Only properly trained workers are to use saws on the project. Saws must be maintained with all critical guards and safety devices intact and functioning. In addition to standard PPE, the following PPE will be used:

- Respirator with P100 filters;
- Face Shield;
- Hearing Protection; and
- Leather Work Gloves.

B.2.3.7 Hand Tool Use

A variety of hand and power tools will be used during this project. This includes, plate tampers, jumping jacks, cut-off saws, chain saws, and other electrical and combustion-powered equipment. Prior to use of any equipment, the operator ensure knowledge of proper operation either by receiving instructions or reading manufacturer's operating manual. All operators will be required to demonstrate proficiency in tool operation to the SSO. Prior to each day's use, all guards, governors, and protective devices will be checked. Proper PPE for specific tools that may be required in addition to standard Level D or Level C PPE will be assigned by SSO and used. This may include a face shield, chaps, and metatarsal or foot guards. Loose clothing will not be worn when using power tools. All electrical hand tools shall be approved double-insulated or properly grounded, and used only with ground fault circuit interrupters.

B.2.3.8 Pneumatic Tools

Pneumatic power tools shall be secured to the hose or whip in a positive manner to prevent accidental disconnection. Safety clips shall be securely installed and maintained on impact tools. The manufacturer's safe operating pressure for all fittings shall not be exceeded. Proper PPE as determined by the SSO will be used for all such operations. The SSO will review operations and determine additional PPE requirements, if necessary.

B.2.3.9 Excavations

Excavation to depths greater than or equal to 4 feet and trenching will be conducted. The trench boundaries will be delineated by caution tape and/or barriers. An excavator will straddle the centerline of the trench and dig down to the depths provided in the Contract Drawings. Typically, the spoils will not be adjacent to the trench but loaded directly into bulk waste containers and any contaminated water will be channeled to flow back into the trench for collection. Initially, sloping back the sides of the trench to an angle of repose of 1:1.5 or gentler, use trench boxes, or use stabilization walls (i.e., sheet pile). The installation of geotextile and bedding material will not require entry of personnel into the trench. In the event hazardous materials are encountered, work will be halted, and the SSO and/or RSO will be notified. All parties will assess the situation, and work will proceed in accordance with the appropriate hazardous/radiological work procedures.

B.2.3.10 Lightning

Lightning strikes during field activities will require consideration to address the enclosure constructed over the work area. In the event of lightning strikes within the area, field personnel will be evacuated from aerial locations. Personnel within the enclosure will be protected by grounding the enclosure in accordance with manufacturer recommendations and the Uniform Building Code.

B.2.3.11 Buried Drum Handling

If buried drums are encountered, work will stop to determine whether the drums are empty or filled, intact or fragmented. Intact, filled drums will be handled, stored, sampled, and disposed in accordance with appropriate requirements. Empty or fragmented drums will be crushed, moved and placed within the waste staging areas. It is not anticipated that buried drums will be encountered on this project.

B.2.3.12 Heat/Cold Stress

Since Site work is to be conducted during the summer months, heat stress is a concern to the health and safety of personnel. Cold stress procedures are not anticipated to be required. Cold stress procedures submitted in previous HASPs are available if needed.

In temperate periods, wearing PPE puts a worker at a considerable risk of developing heat stress. Heat stress can result in health effects ranging from heat fatigue to serious illness or death. Consequently, regular monitoring and other precautions are vital.

Sweating does not cool the body unless moisture is removed from the skin by evaporation. The wearing of PPE reduces the body's ability to eliminate large quantities of heat because the evaporation of sweat is decreased. The body's efforts to maintain an acceptable temperature become impaired.

Heat related problems include heat fatigue, heat rash, fainting, heat cramps, heat exhaustion and heat stroke. Heat rash occurs because sweat isn't evaporating, making the skin wet most of the time. Standing erect and immobile in the heat allows blood to pool to lower parts of the body. As a result, blood does not return to the heart to be pumped to the brain, and fainting may occur.

Heat cramps are painful spasms of the muscles due to excessive salt loss associated with profuse sweating. The loss of large amounts of fluid and excessive loss of salt results in heat exhaustion. The skin will be clammy and moist and persons exhibit extreme wetness, giddiness, nausea and headache.

Heat stroke occurs when the body's temperature regulatory system has failed. Skin is hot, dry, red and spotted. The affected person may be mentally confused and delirious. Convulsions could occur. **EARLY RECOGNITION AND TREATMENT OF HEAT STROKE ARE THE ONLY MEANS OF PREVENTING BRAIN DAMAGE OR DEATH.** A person exhibiting signs of heat stroke should be removed from the work area to a shaded area. The person should be soaked with water to promote evaporation. Fan the person's body to increase cooling, and **GET MEDICAL ATTENTION IMMEDIATELY.** Increased body temperature and physical discomfort also promote irritability and a decreased attention to the performance of hazardous tasks.

Early Symptoms of Heat Related Problems:

- Decline in task performance
- Excessive fatigue
- Incoordination
- Insomnia
- Decline in alertness
- Muscle cramps
- Unsteady walk
- Dizziness

Susceptibility to Heat Stress Increases due to:

- Lack of physical fitness
- Obesity

- Lack of acclimation
- Drug or alcohol abuse
- Increased age
- Sunburn
- Dehydration
- Infection

People unaccustomed to heat are particularly susceptible to heat fatigue. First timers in Level D Modified PPE or higher need to gradually adjust to the heat.

Measures to Avoid Heat Stress:

- Establish work-rest cycles (short and frequent are more beneficial than long and seldom).
- Identify a shaded, cool rest area.
- Rotate personnel, alternative job functions.
- Water intake should be equal to the sweat produced. Most workers exposed to hot conditions drink less fluids than needed because of an insufficient thirst. DO NOT DEPEND ON THIRST TO SIGNAL WHEN AND HOW MUCH TO DRINK. For an 8-hour workday, 50 ounces of fluids should be consumed.
- Eat lightly salted foods or drink salted drinks such as Gatorade to replace lost salt.
- Save most strenuous tasks for non-peak hours such as the early morning or at night.
- Avoid alcohol during prolonged periods of heat. Alcohol will cause additional dehydration.
- Avoid double shifts and/or overtime.

The implementation and enforcement of the above mentioned measures will be the joint responsibility of the PM, SS, and SSO. Potable water must be available each day for the field team.

Heat stress monitoring will be performed for field activities where ambient (not adjusted) temperatures exceed 70 ° F for personnel wearing chemical protective clothing, including Tyvek coveralls, and 90° F for personnel wearing normal work clothes. The heat stress monitoring program requirements are detailed below.

Heat Stress Monitoring Program Requirements

A. Monitor ambient temperatures and conduct Heat Stress Monitoring when threshold temperatures are reached:
   70° F for personnel wearing chemical protective clothing, and
   90° F for personnel wearing normal work clothes

B. Conduct initial monitoring to determine first rest break.

   1. Measure the air temperature with a standard thermometer with the bulb shielded from radiant heat; this yields T (actual).

   2. Estimate the fraction of sunshine by judging what percent of the time the sun is not shielded by clouds that are thick enough to produce a shadow.
      100% sunshine - no cloud cover = 1.0;
      50% sunshine - 50 percent cloud cover = 0.5;

0% sunshine - full cloud cover = 0.0.

3. Plug these variables into the following equation to determine the adjusted temperature:

   T (adjusted) = T (actual) + (13 x fraction sunshine)

4. Use Table below to determine the length of the first work shift. At the first break, initiate the heart rate monitoring or body temperature monitoring as described below.

INITIAL WORK/MONITORING CYCLES

ADJUSTED TEMPERATURE	NORMAL WORK CLOTHES	PROTECTIVE CLOTHING
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5°-90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5°-87.5°F (28.1°-30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5°-82.5°F (25.3°-28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5°-77.5°F (22.5°-25.3°C)	After each 150 minutes of work	After each 120 minutes of work

C. Body Temperature Monitoring

1. Monitor oral body temperature to determine if employees are adequately dissipating heat buildup. Ear probe thermometers which are adjusted to oral temperature are convenient and the preferred method of measurement.
2. Determine work/rest regimen as follows:

a) Measure (oral adjusted) temperature at the end of the work period.

b) If temperature exceeds 99°F., shorten the following work period by 1/3 without changing the rest period.

c) If temperature still exceeds 99.6°F., shorten the following work period by 1/3.

d) Do not allow a worker to wear impermeable PPE when his/her oral temperature exceeds 100.6°F.

e) Oral temperatures are to be obtained prior to the employee drinking water or other fluids.

D. Record monitoring results on Heat Stress Monitoring Form

B.2.4 Biological Hazards

B.2.4.1 Poisonous Plants

Poison ivy is a climbing plant with leaves that consist of three glossy, greenish leaflets. Poison ivy is present at the Site along the fence on the eastern property boundary of Lot 100 and the golf course driving range. Poison ivy has conspicuous red foliage in the fall. Small yellowish-white flowers appear in May through July at the lower leaf axils of the plant. White berries appear from August through November. Poison ivy is typically found east of the Rockies. **Poison oak** is similar to poison ivy but its leaves are oak-like in form. Poison oak occurs mainly in the south and southwest. **Poison sumac** typically occurs as a small tree or shrub and may be 6 to 20 feet in height. The bark is smooth, dark, and speckled with darker spots. Poison sumac is typically found in swampy areas and east of the Mississippi. The leaves have 7 to 13 smooth-edged leaflets and drooping clusters of ivory-white berries appear in August and last through spring.

The leaves, roots, stems, and fruit of these poisonous plants contain an oil called *Urushiol*. Contact with the irritating oil causes an intensely itching skin rash and characteristic blister-like lesions. The oil can be transmitted on soot particles when burned and may be carried on the fur of animals, equipment, and apparel.

Proper identification of these plants is the key to preventing contact and subsequent dermatitis. Wear long sleeves and pants when working near poisonous plants. In areas of known infestation, wear Tyvek coveralls and gloves. Oils are easily transferred from one surface to another. Wash all contaminated clothing and equipment promptly. If you come in contact with poisonous plants, wash all exposed areas immediately with cool water to remove the oils. Some commercial products such as Tecnu's Poison Oak-n-Ivy Cleanser claim to further help with the removal of oils.

B.2.4.2 Tick-borne Lyme Disease.

Ticks are bloodsuckers, attaching themselves to warm-blooded vertebrates to feed. Deer ticks, which are associated with the transmission of Lyme Disease (ticks transmit the bacteria that causes the disease) are quite prevalent on Long Island. While it is unlikely that ticks will be encountered in the paved work areas on the Site, and while not all ticks carry the disease personnel should be aware of this hazard.

Personnel should carefully inspect themselves each day for the presence of ticks or any rashes. This is important since prompt removal of the tick can prevent disease transmission. Female deer ticks are about ¼-inch in length and are black and brick red in color. Males are smaller and all black. Removal of the tick is important in that the tick should not be crushed and care must be taken so that the head is also removed. If the head is not completely removed or if the tick is allowed to remain for days feeding on human blood, a condition known as **tick paralysis** can develop, which is due to a neurotoxin that the tick apparently injects while engorging. This neurotoxin acts upon the spinal cord causing incoordination, weakness, and paralysis.

One characteristic symptom of Lyme Disease is a bulls-eye rash that develops around the bite Site. The rash appears in about 60-80% of all Lyme Disease cases. Contact your SSO immediately if you develop such a rash.

Tick season lasts from April through October; peak season is May through July. Wear light-colored clothing (easier to spot ticks) with long sleeves and make sure that shirts are tucked into pants and pants are tucked into socks or boots. Ticks have a tendency to crawl upwards. These procedures will make it more difficult for a tick to reach your skin. Studies have determined that repellents containing *DEET* as a main ingredient are most effective against mosquitoes and ticks. *DEET* can be directly applied to the exposed skin of adults and/or clothing. *Permanone* is another repellent; however, it can only be directly applied to clothing.

B.2.4.3 Spiders, Insect bites and stings

Field personnel should exercise caution when lifting covers off manholes or sumps, when removing ground or stockpile covers, or when disturbing wood, rock, or brush piles, etc., since insects and spiders are typically found in these areas. Spiders in the United States are generally harmless, with two notable exceptions: the Black Widow spider (*Latrodectus mactans*) and the Brown Recluse or violin spider (*Lox osceles reclusa*). The symptoms of such a spider bite are: slight local reaction, severe pain produced by nerve toxin, profuse sweating, nausea, painful cramps in abdominal muscles, and difficulty in breathing and speaking. Victims recover in almost all cases, but an occasional death is reported. The bite of a Black Widow spider is the more painful and often the more deadly of the two.

General first aid for poisonous insect bites includes:

1. Minor Bites and Stings
   - Cold applications.
   - Soothing lotions, such as calamine.

2. Severe Reactions
   - Give artificial respiration if needed.
   - Apply a constricting band above the injection-Site on the victim's arm or leg (between the Site and the heart). Do not apply tightly; you should be able to slip your index finger under the band when it is in place.
   - Keep the affected part down, below the level of the victim's heart.
   - If medical care is readily available, leave the band in place; otherwise, remove it after 30 minutes.
   - Apply ice contained in a towel or plastic bag, or cold cloths, to the Site of the sting or bite.
   - Give home medicine, such as aspirin, for pain.
   - If the victim has a history of allergic reactions to insect bites or is subject to attacks of hay fever or asthma, or if he or she is not promptly relieved of symptoms, call a physician or take the victim immediately to the nearest location where medical treatment is available. In a highly sensitive person, do not wait for symptoms to appear, since delay can be fatal.
   - In case of a bee sting, remove and discard the stinging apparatus and venom sac.

B.2.5 Task and Operation Hazards

Conducting intrusive Site activities present the potential for hazards. Work activities, hazards associated with the activity and the preventative measures are present in Table 3.

TABLE B-3: TASKS AND OPERATIONS HAZARDS

WORK ACTIVITY	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE MEASURES
Mobilization	Slips, Trips & Falls	Housekeeping, material storage. (29 CFR 1926.250)
	Eye, Face Injuries	Safety glasses/face shield. (29 CFR 1926.102)
	Electrical Shock	De-energize power lines, only double insulated or grounded power tools will be used. (29 CFR 1926.400, 401)
	Struck by or Against Equipment, Tools or Vehicles	Back-up alarms, spotter, reflective vests serving areas.

WORK ACTIVITY	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE MEASURES
		(29 CFR 1926.201, 600)
	Cuts or Lacerations	Proper gloves, PPE. (29 CFR 1910.132)
	Muscle and Back Sprains and Strains	Training on proper lifting technique
	Noise	Monitoring, engineering controls, and hearing protection. (29 CFR 1926.52)
	Poisonous Plants/Insects	PPE, training, and repellent.
Site Preparation	Underground Utilities	Location disconnect. (29 CFR 1926.400)
	Overhead power lines	De-energize, maintain clearance. (29 CFR 1926.400, 401)
	Caught in or Between Objects (Pinch Points)	Maintain safe distances, wear proper work gloves. (29 CFR 1926.301, 1910.132)
	Exposure to Airborne Contaminants	Air monitoring, PPE. (29 CFR 1910.1000, 120)
	Contact with Contaminated Soil and Water	PPE, splash protection. (29 CFR 1910.132, 1910.120)
	Noise	Monitor, hearing protection. (29 CFR 1926.52)
	Eye Injuries	Safety glasses, face shield. (29 CFR 1926.102)
	Thermal Stress	Training on symptoms, control measures.
	Poisonous Plants/Insects	PPE, training, and repellent.
Excavation	Fire Explosion, Cutting	Work permit, no smoking, monitor LEL fire protection equipment, proper PPE. (29 CFR 1926.150-154, 350, 352, 353)
	Confined Space	Monitor air, ventilate, permit procedures. (29 CFR 1910.146)
	Falling into Excavations	Barricade. (29 CFR 1926.202)
	Underground, Overhead Utilities, Powerlines	Disconnect, de-energize utilities, maintain safe distances, Hand Test Pit area. (29 CFR 1926.550, 651)
	Noise	Monitor, hearing protection. (29 CFR 1926.52)
	Exposure to Contaminated Soil, Water	PPE, air monitoring, dust control. (29 CFR 1910.120, 132)
	Cave-Ins	Proper shoring, sloping, ladders or stairs provided for access and egress. (29 CFR 1926.651)
	Confined Space Hazards	Permit procedures, training for confined space. (29 CFR 1910.146)
	Poisonous Plants/Insects	PPE, training, and repellent.
Backfilling	Slips, Trips, Falling into Excavations	Housekeeping, barricades secure areas. (29 CFR 1925, 1926.250, 202)

WORK ACTIVITY	POTENTIAL HAZARDS	PREVENTATIVE OR CORRECTIVE MEASURES
	Struck by or Against Equipment	Backup alarms, reflective vests. (29 CFR 1926.600, 201)
	Contact With Contaminated Soils, Water	PPE, decon procedures, dust control. (29 CFR 1910.120, 132)
	Injuries From Falling Materials, Debris	Inspect all slings, chains, ropes prior to use, maintain safe distance. (29 CFR 1926.550)
	Confined Space Hazards	Monitor air, permit procedures. (29 CFR 1910.146)
	Noise	Monitor, hearing protection. (29 CFR 1026.52)
	Poisonous Plants/Insects	PPE, training, and repellent.

B.3 TRAINING REQUIREMENTS

B.3.1 General

All personnel performing intrusive work in areas on-Site covered by this HASP must have completed the appropriate training requirements specified in 29 CFR 1910.120(e). Each individual must have completed an 8-hour refresher-training course and/or initial 40-hour training course within the last year prior to performing any intrusive work on-Site. Also, on-Site managers and supervisors directly responsible for supervising individuals engaged in hazardous waste operations must have completed the specified 8-hour supervisors training course. At least one (1) person on-Site must have completed the supervisor's training course. Records will be maintained on-Site in the field offices that demonstrate all persons subject to the training requirements have actually met the requirements. The PM and SSO are responsible for verifying compliance of the project team and other parties subject to the training requirement.

At least one person qualified in First Aid and cardiopulmonary resuscitation (CPR) should be present during Site work.

Prior to the commencement of on-Site activities, a Pre-Construction On-Site Safety Meeting will be held to review the specific information and requirements of the approved HASP. HASP sign-off sheets will be collected at this meeting, and as new employees arrive on-Site. Safety refresher meetings will be conducted, as needed, throughout the duration of the project.

Site-specific training will include:

- Location of MSDS.
- Explanation of the approved HASP.
- Brief Site history.
- Special attention to signs and symptoms of overexposure to known and suspected Site contaminants.
- Health effects of Site contaminants.
- Air monitoring program description.
- Physical hazards associated with the project.
- Selection, use and limitations of available safety equipment.
- Personal hygiene and decontamination.

- Respirator face piece fit testing.
- PPE fitting to determine proper size for individuals.
- Site rules and regulations.
- Work zone establishment and markings.
- Site communication and the "Buddy System".
- Emergency preparedness and evacuation procedures.
- Decontamination activities.
- Medical monitoring procedures.
- Contingency Plan.
- Confined Space Entry and Permits.
- Work Permits.

B.3.2 Radiological Worker Training

Radiological Worker Training shall be completed by individuals prior to conducting non-routine operations, or performing work in areas with changing radiological conditions. Individuals will attend the Site-specific radiation safety training identified in Attachment 1 - *Basic Radiation Safety Training*, which provides explanations of the different types of radiation, their effects, exposure standards, and methods for reducing the hazards and working safely with radioactive materials.

B.3.3 Hazardous Materials Handling

All employees who handle, package and manifest hazardous materials for shipment will receive training, specific to their job function, as required under the US Department of Transportation (USDOT) Hazardous Materials Training (HM-126F) requirements.

B.3.4 Hazard Communication

The Hazard Communication Program has been established in order to comply with 29 CFR 1910.120, Hazard Communication. All employees will be briefed on this program, and have access to a copy for review.

B.3.4.1 Container Labeling

All containers received on-Site will be inspected. Containers will be clearly labeled as to the contents, hazard level, and the name and address of the manufacturer. All secondary containers will be labeled with either an extra copy of the original manufacturer's label or generic labels. All hazardous waste containers shall have labels that list the date when storage began in the container, i.e. out-of-service date.

B.3.4.2 Material Safety Data Sheets (MSDS)

Copies of MSDS for all hazardous chemicals known or suspected on-Site will be maintained in the field office. MSDS will be available to all employees for review at all times. The MSDS will be made available to the attending physician, and emergency medical staff in the event of a medical emergency.

B.3.4.3 Employee Training

Prior to starting work, each employee will attend a health and safety orientation which will include information regarding the

- An overview of the requirements contained in the Hazard Communication Standard, 29 CFR 1910.1200;
- Chemicals present in their work area;
- Location and availability of a Hazard Communication Program;
- Physical and health effects of the hazardous chemicals;
- Use of control/work practices and PPE;
- Emergency procedures to follow if they are exposed to these chemicals;
- How to read labels and review MSDS to obtain appropriate hazard information; and
- Location of MSDS file and location of hazardous chemical list in the field office.

Subcontractors who will perform work outside of the waste fill limits, or non-intrusive work within the Site boundary include electrical technicians, fence installers, and surveyors.

These contractors will receive a Site orientation but will not require training or physicals for entry to the Site. They will be allowed to work in non-waste contact areas only.

A Site Superintendent will be on 24-hour call if EZ entry is required after working hours.

Support personnel and vendors will be allowed to enter the Site up to the Office Support Area. These individuals will not be required to have 40-hour training nor will they be allowed to proceed past the Office Support Area.

B.3.5 Training Records

Training records will be submitted before the employee starts work on-Site and will be maintained on-Site. Each person will be required to complete the Site-specific training form provided on the following page. A copy of all training certificates will be kept at the Site for each person working at the Site.

SITE SPECIFIC TRAINING

I have attended a Site-Specific Health and Safety briefing, outlining health and safety provisions for remedial activities at the Site including:

- Explanation of the approved HASP.
- Health and Safety personnel and organization.
- Brief Site history.
- Special attention to the signs & symptoms of overexposure to known & suspected Site contaminants.
- Health effects of Site contaminants.
- Air monitoring description.
- Physical hazards associated with the project.
- Selection, use, & limitations of safety equipment & proper procedures for its use.
- Personal hygiene and decontamination.
- Respirator face piece fit testing.
- PPE fitting to determine proper size for individual use.
- Site rules and regulations.
- Site communications and the "Buddy System".
- Emergency preparedness procedures.
- Equipment decontamination.
- Medical monitoring procedures.
- Contingency Plan.
- Confined Space Entry.
- Basic Radiation Safety Training.

EMPLOYEE INFORMATION

Print Name	Signature	Date

SITE HEALTH AND SAFETY OFFICER

Print Name	Signature	Date

Position:
OSHA HAZWOPER 40-Hours
OSHA HAZWOPER 8-Hour Refresher
OSHA HAZWOPER Supervisor
Medical Monitoring
Respirator Fit Test

B.4 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (PPE) shields against dermal contact, ingestion and/or inhalation of hazardous chemicals, VOCs, metals and radionuclides. The careful selection and use of PPE will protect the respiratory system, skin, eyes, face, hands, feet, head, ears and body. PPE does not provide protection against exposure to penetrating radiation such as x-rays and gamma radiation. For protection from penetrating radiation, modified work practices and the ALARA principles of time, distance and shielding are effective protective measures.

The minimum PPE required in all Site work areas includes hard hat, safety glasses with side shields, and substantial footwear. Safety glasses, protective eyewear and face shields will conform to ANSI Standard Z87.1-1989. Hearing protection will conform to ANSI Standard S3.19-1974.

B.4.1 Levels Of Protection

Level D PPE. Worn as a work uniform when outside the area controlled due to radioactive materials. Level D PPE will consist of at a minimum:

- Long Sleeve/Long Pants Work Clothes or Coveralls
- Steel-toed Boots
- Hard Hat
- Safety Glasses with sideshields or Goggles (if prescription eyewear is necessary, it will conform to the requirements of ANSI Z87.1)
- Leather or Cotton Work Gloves
- Hearing Protection (if necessary as determined by the SSO)

Level D Modified PPE. Worn as a work uniform in the area controlled due to radioactive materials and airborne dusts or fumes are not elevated. Consists of at a minimum:

- Long Sleeve/Long Pants Work Clothes or Coveralls
- Steel-toed Boots
- Nitrile Overboots
- Hard Hat
- Safety Glasses with sideshields or Goggles (if prescription eyewear is necessary, it will conform to the requirements of ANSI Z87.1)
- Leather or Cotton Work Gloves
- Latex Inner Gloves
- Nitrile Inner Gloves
- Hearing Protection (if necessary as determined by the SSO)
- Tyvek Coveralls

Level C PPE. Worn as a work uniform in the area controlled due to radioactive materials when airborne dusts or fumes are a potential hazard. Consists of at a minimum:

- Hard Hat
- Safety Glasses with sideshields or Goggles (if prescription eyewear is necessary it will conform to the requirements of ANSI Z87.1)
- Steel-toed Boots
- Long Sleeve/Long Pants Work Clothes

- Polyethylene Tyvek Coveralls
- Latex Surgical Inner Gloves
- Nitrile Outer Gloves
- Over the Shoe Booties (if product saturated material are encountered)
- Canvas or Leather Gloves
- Hearing Protection
- Full Face Air Purifying Respirators with Combination (Organic Vapor/HEPA) Cartridges
- Hearing Protection (if necessary as determined by the SSO)

Level B. Worn when the highest level of respiratory protection is needed (not anticipated to be necessary on this Site except in confined space operations). Level B PPE will consist of at a minimum:

- Hard Hat
- Steel-toed Boots
- Long Sleeve/Long Pants Work Clothes
- Polylaminated Tyvek Coveralls (if product saturated materials are encountered)
- Latex Surgical Inner Gloves
- Nitrile Outer Gloves
- Over-the-Shoe Booties (if product saturated materials are encountered)
- Canvas or Leather Gloves
- Hearing Protection (if necessary as determined by the SSO)
- NIOSH Certified Supplied Air Respirator (SCBA or Air-Line Respirator with SCBAE, pressure demand regulators, full face piece); (if prescription eyewear is necessary, it will conform to the requirements of ANSI Z87.1)

The levels of protection required for given tasks are listed below.

Task/Operation	Initial Level of Protection
Mobilization/Demobilization, Initial Site Set-up, Install Erosion and Sediment Control	D
Clearing and grubbing	D
Mulching of Vegetation and Placement in Designated Areas	D
Demolition of Existing Site Features	D-Modified
Waste Excavation	D-Modified
Waste Excavation with airborne dusts	C
Excavation Outside Contamination Limits	D
Placement of Fill Materials	D
Construction of Drainage Features	D
Placement of Topsoil, Seeding and Landscaping	D
Relocation, loading and handling of Sealed Waste Packages	D
Confined Space Entry	B

PPE Levels will be upgraded/downgraded based upon air monitoring data in accordance with this HASP.

Hearing protection will be necessary if noise levels exceed 85dBA or understanding normal speech becomes difficult at a distance of 3 feet.

Employees or subcontractors with vision restrictions will not perform work requiring Level C or Level B PPE unless prescription insert glasses are used.

B.4.2 Respiratory Protection

During the course of work on the project, atmospheric conditions may exist where respiratory protection is required. If Level C (full-face air-purifying respirator) or Level B (full-face air-supplied respirator) respirators are required, it will be implemented in accordance with the action levels defined in this HASP. All field personnel entering the exclusion and contamination reduction zones will have medical clearance for respirator use and fit test documentation.

If respirators are required, full facepiece respirators, with combination organic vapor and high efficiency dust and mist cartridges, will be used. Only respirators and cartridges/filters approved and certified by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR Part 84 shall be used. Half-face respirators will not be used. Respirators belong to, and are only used and maintained by, the individual to whom they have been issued.

Each employee or subcontractor who anticipates working on-Site must be trained, fit tested, and declared medically fit to wear respiratory equipment prior to participating in field activities. Medical clearance for respirator use and fit test documentation must be submitted to the SSO by each individual.

The SSO will address PPE action levels in accordance with this HASP. Respiratory protection can be donned whenever odors are objectionable. If dust levels exceed 5mg/m^3 measured over a 5-minute period, dust suppression activities will commence.

B.4.3 Additional Safety Equipment

The following additional safety equipment will be available on-Site:

- ANSI-Approved 15-minute Eyewash;
- Site Telephone and 2-way radios;
- First Aid Kit;
- Fire Extinguishers;
- Visitor PPE; and
- (2) Emergency Self-Contained Breathing Apparatus (SCBA).

B.4.3.1 Donning an Ensemble of PPE

Procedures for donning a protective ensemble are important to insure success in the safety of the worker inside the PPE and are provided below. These procedures may be modified depending on the particular type of suit and/or when extra gloves and/or boots are used. These procedures assume that the wearer has previous training in self-contained breathing apparatus (SCBA) use and decontamination procedures. Assistance should be provided for donning and doffing, since these operations are difficult to perform alone, and solo efforts may increase the possibility of suit damage or loss of integrity of the PPE.

Procedures for Donning Level C PPE

Equipment Used: Full-face air purifying respirator, hardhat, Tyvek® coveralls, inner surgical-style gloves, outer chemical-resistant gloves, chemical-resistant boots or boot covers, duct tape.

1. Inspect the clothing and respiratory equipment before donning.
2. Adjust hard hat or headpiece if worn, to fit user's head.
3. Don the Tyvek® coveralls and secure all closures (zippers, etc) [a]
4. Put on the boots and/or boot covers, placing the leg cuffs of the coveralls over the boot;
5. Tape the cuffs in place on the boots [b]
6. Put on the inner surgical gloves;
7. Put on the outer gloves, place the coveralls sleeve over the gauntlets of the gloves, and tape the gloves in place [b,c]
8. Don the respirator and adjust it to be secure, but comfortable.[d] Perform negative and positive respirator facepiece seal test procedures.
   - To conduct a negative-pressure test, close the inlet part with the palm of the hand or squeeze the breathing tube so its does not pass air, and gently inhale for about 10 seconds. Any inward rushing of air indicates a poor fit. Note that a leaking facepiece may be drawn tightly to the face to form a good seal, giving a false indication of adequate fit.
   - To conduct a positive-pressure test, gently exhale while covering the exhalation valve to ensure that a positive pressure can be built up. Failure to build a positive pressure indicates a poor fit.
9. Put on the hardhat.[e]

Footnote:

a After donning the Tyvek® coveralls, move around to see that the coveralls fit well; check for tightness in the crotch (squats) and shoulders (shrugs).
b Bend your arm/leg prior to taping to assure freedom of movement.
c If a significant amount of "over the head" work will be done, consider taping the gloves over the coverall sleeves.
d If greater skin protection is needed, tape the hood of the protective suit to the face piece.
e For added stability, the hard hat can be taped to the protective suit's hood.

B.4.3.2 Evaluating Fit

Once the equipment has been donned, its fit should be evaluated. If the clothing is too small, it will restrict movement, thereby increasing the likelihood of tearing the suit material and accelerating worker fatigue. If the clothing is too large, the possibility of snagging the material is increased, and the dexterity and coordination of the worker may be compromised. In either case, the worker should be recalled and better fitting clothing provided.

B.4.3.3 Doffing an Ensemble of PPE

Procedures for doffing a protective ensemble are important to ensure the success in the safety of the worker inside the PPE and are provided below. These procedures may be modified depending on the particular type of suit and/or when extra gloves and/or boots are used. These procedures assume that the wearer has previous training in SCBA use and decontamination procedures. Assistance should be provided for donning and doffing, since these operations are difficult to perform alone, and solo efforts may increase the possibility of PPE damage and subsequent spread of contamination.

Procedures for Removal of PPE at a Step-Off Pad

Before stepping out of the contamination area on to the step-off pad, the worker should:

1. Remove exposed tape.
2. Remove rubber overshoes.
3. Remove outer gloves.
4. Remove hood front to rear.
5. Remove coveralls (Tyvek), inside out, touching inside only.
6. Remove respiratory protection, as applicable.
7. Remove tape or fastener from inner shoe cover, as applicable.
8. Remove each shoe cover, placing shoe onto step-off pad.
9. Remove inner gloves.
10. Perform whole body frisk or survey using personnel contamination monitor instrument

B.5 MEDICAL SURVEILLANCE

B.5.1 General Medical Surveillance Requirements

Field personnel covered by this HASP who will enter restricted areas on-Site during intrusive work must meet the medical surveillance requirements specified in 29 CFR Part 1910.120(f). Therefore, such personnel must have completed a baseline occupational medical surveillance examination, or an annual occupational medical surveillance examination within the previous twelve-(12) months.

The requirements for the medical surveillance examination includes the following components:

- Personal Medical Questionnaire;
- Occupational Exposure History;
- Physical Examination;
- Vision Testing;
- Spirometry;
- Audiometry;
- Blood Chemistry Panel (e.g., SMAC-20);
- Complete Blood Count with Differential;

- Urinalysis;
- Urine Drug Screen;
- Chest X-Ray (every two [2] years at a minimum); and
- Electrocardiogram (At Physician's Discretion).

B.5.2 Site-Specific Medical Surveillance Requirements

The following medical surveillance services are required in support of this project effort:

- Radiological monitoring personnel dosimetry during the project for each individual.
- Urine bioassay, at de-mobilization from the project.

B.5.3 Respirator Use Clearance

All employees who wear a respirator will have had a physical exam and/or medical consultation indicating fitness for respirator wear prior to wearing a respirator on the Site.

B.6 MONITORING

B.6.1 Introduction

The primary potential routes of exposure to hazardous materials will be inhalation hazard during this project from the generation of dusts or gases from contaminated soils or garbage, contamination or direct exposure to radionuclides, or ingestion of contaminants through inadvertent hand to mouth transfer. Both direct reading instrumentation and personal air samples will be used to assess worker exposure to direct radiation exposure, to total dust, including radionuclides, to volatile organic chemicals and to combustible gases within the established restricted areas and at their perimeter during closure construction.

The use of each type of direct reading instrument and requirements for personal monitoring are specified below. The SSO and RSO or designee will perform all monitoring within the restricted areas.

B.6.2 Direct Reading Instrumentation for Hazardous Chemicals, Dusts and Gases

<u>Instrument 1 - MIE Data-Ram Total Dust Monitor (or it's equivalent)</u>

The total dust monitor will be used to ensure that total dust levels upwind, downwind, and within the established restricted areas are maintained below the established action level of 150 $\mu g/m^3$. If downwind particulate levels are 150 $\mu g/m^3$ greater than the upwind particulate levels, dust suppression techniques will be employed. The readings will be taken at the locations within the restricted area, and during the time periods that are likely to represent worst-case conditions. The determination of worst case will be made by the SSO and will be dependent upon such variables as the type of work being performed and number of employees or level of activity in the zone.

Instrument 2 - GasTech Combustible Gas/Oxygen/H_2S / CO Indicator

The combustible gas indicator (CGI) will be used to determine the potential presence of flammable atmospheres during confined space and hot work activities. Its calibration should be verified at a minimum of once, at the beginning, and once at the end of each day's use. The instrument should be calibrated against a 50 percent lower explosive limit (LEL) methane in air standard, (or other flammable gas or vapor with relative response similar to methane) according to the manufacturer's instructions. CGI readings should be taken whenever PID readings in excess of 50 units above background have been measured. The instrument's alarm will sound when 10 percent of the LEL has been reached. Should the alarm sound, all sources of ignition should be shut down and field team members should back away from the immediate work area. Work should not resume until percent LEL readings have subsided below 10%. Oxygen, carbon monoxide, and hydrogen sulfide levels will also be measured.

Instrument 3 - HNu - Organic Vapor Photoionization Detector or Equivalent

The HNu is a direct reading instrument that will be used to provide instantaneous measurement of total hydrocarbons in the breathing air of employees. The process of photoionization is initiated by the absorption of a photon of ultraviolet radiation energetic enough to ionize a molecule releasing an electron. A lamp generates the UV radiation and the released ions are collected in an ionization chamber that is adjacent to the lamp and contains an accelerating electrode (+) and a collection electrode where the current is measured. After amplification, the current measured is proportional to the concentration of hydrocarbons with an ionization potential less than or equal to the energy of the lamp. The PID will be calibrated using 100 ppm of isobutylene.

The SSO routinely throughout the project will conduct area and personnel environmental air monitoring. The sampling plan can be divided into three (3) major segments. The segments are: 1) pre-testing to determine ambient conditions before invasive activities; 2) air monitoring during construction activities; and 3) personnel air sampling during construction activities. Each segment is described separately as follows.

B.6.3 Baseline Air Sampling

Prior to on-Site activity, the SSO will review or collect ambient air quality monitoring for flammable gas, oxygen deficiency, total VOCs, and total particulates. This study will provide a baseline for evaluation of subsequent perimeter air tests and PPE selection.

B.6.4 Air Monitoring During Intrusive Site Activities

During intrusive Site activity, air monitoring will be conducted using real time air monitoring equipment according to the following schedule.

Real-time monitoring (using direct reading instrumentation) will be conducted in each active intrusive work area. The real time air monitoring equipment includes:

- Organic vapor monitor - HNu Model PI-101 with a 10.2 eV Lamp;
- GasTech or equivalent combustible gas, oxygen, H_2S, CO meter, with alarm; and
- MIE Mini Ram dust monitor.

The SSO will use this equipment continuously and readings will be recorded in the field log on a regular basis. If direct monitoring levels for total dust, total organic vapors or explosive/flammable atmospheres exceed the action levels listed below, the SSO will stop work and continue investigation and sampling until a resolution is achieved.

The SSO and PM will prepare daily and/or weekly updated Exclusion Zone (Ezs) sketches that will be posted in the Site support zone for general informational purposes. This will be done to depict the EZs as they change during construction phases.

Real-time air monitoring will be conducted at the worker-breathing zone, at the perimeter of active EZs and at the Site perimeter on a regular basis during on-Site construction and environmental remediation activity. A mounted flag, wind sock, or hand held wind directional devise will be used to determine the wind direction for monitoring purposes. The results of the real time monitoring in work areas will be evaluated according to the operational action level table below. The results of the real time monitoring at the Site perimeter will be evaluated according to the Community Air Monitoring Plan, discussed below. The SSO will inspect the Site to determine the cause of any elevated levels observed. Activity will be modified to reduce elevated levels. If elevated levels persist, work will stop until the situation is rectified and acceptable levels are achieved.

TABLE B-6: OPERATIONAL ACTION LEVELS FOR WORK AREA BREATHING ZONE

CONTAMINANT

ACTION LEVEL*

RESPONSE

Volatile Organic Compounds
Rae Systems MultiRae Plus PID/Combustible Gas/O_2/H_2S /CO Indicator (or equivalent)

0 to 5 ppm above background

5 to 250 ppm above background at the breathing zone & sustained for 15 minutes.

250 to 500 ppm above background at the breathing zone & sustained for 15 minutes.

>500 ppm above background at the breathing zone & sustained for 15 minutes.

Level D continuous air monitoring.

Level C continuous air monitoring. Take colorimetric tube for benzene. >50 ppm and benzene present, work will stop for evaluation.

Upgrade to Level B, continuous air monitoring

Stop work, evacuate work zone and evaluate.

Combustible Gas Monitor
Rae Systems MultiRae Plus PID/Combustible Gas/O_2/H_2S /CO Indicator (or equivalent)

Less than 10% LEL

Greater than 10% LEL

Continue with caution.

Immediate exit work area and ventilate.

Oxygen Monitor
Rae Systems MultiRae Plus PID/Combustible Gas/O_2/H_2S /CO Indicator (or equivalent)

Less than 19.5%

Greater than 23.5%

19.5 to 23.5%

Stop work & ventilate, re-test prior to re-entry or upgrade to Level B.

Immediate withdrawal of personnel and investigate.

Continue work with air monitoring.

Hydrogen Sulfide Monitor
Rae Systems MultiRae Plus PID/Combustible Gas/O_2/H_2S /CO Indicator (or equivalent)

Less than 5 ppm

Greater than 5 ppm, sustained for 1 minute.

Level D, no action taken to upgrade PPE; continue monitoring.

Upgrade to Level B; continuous air monitoring.

Carbon Monoxide Monitor
Rae Systems MultiRae Plus PID/Combustible Gas/O_2/H_2S /CO Indicator (or equivalent)

Less than 35ppm

Greater than 35 ppm, sustained for 1 minute.

Level D, no action taken to upgrade.PPE; continue monitoring.

Stop work & ventilate, re-test prior to re-entry or upgrade to Level B.

Total Dust
MIE pDR-1000 (or equivalent)

0 to 0.150 mg/m^3 above background

0.150 to 5 mg/m^3 above background, sustained for 5 minutes.

5 to 50 mg/m^3 above background.

Level D, no action taken.

Level C, initiate dust control

Upgrade to Level B, continuous air monitoring; dust control, stop or modify work if necessary.

* All readings taken in the worker's breathing zone and sustained for 15 minutes, except where indicated.

B.6.5 Community Air Monitoring Plan

Real-time air monitoring for organic vapors and particulate levels at the perimeter of the work area will be conducted as follows:

Continuous monitoring will be conducted for organic vapors and particulates during all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. This specifically excludes structures or parts of structures known to be uncontaminated, such as the above-slab portions of the 140 Property. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring will be conducted for organic vapors and particulates during non-intrusive activities such as the collection of surface soil and sediment samples or the collection of groundwater samples from existing monitoring wells. "Periodic" monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include sampling or other potentially emission-producing activities conducted adjacent to; the driving range, Cantiague Rock Road, or site buildings that are still occupied.

B.6.5.1 VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) will be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring will be performed using a photoionization detector (PID) with a data logger. The equipment will be calibrated at least twice daily utilizing a mixture of 100 ppm (nominal) isobutylene in air. The data will be logged at 15-minute intervals, however, if VOC levels exceed the action levels listed below on a sustained basis (>15 minutes continuous), then the following actions will be taken:

- If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities will resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities will stop, except that vapor suppression may be employed as appropriate, and the reason for the elevated readings investigated.

- Additionally, the exhaust stack of the enclosure air-handling plant will be monitored using a Thermo TVA 1000 PID / FID with isokinetic sampling fitting. These measurements will be evaluated under separate criteria to determine conformance with regulatory requirements regarding permitted emissions.

All 15-minute readings will be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

B.6.5.2 Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously during emission-generating operations at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level (MIE Data Ram or equivalent). The equipment will be equipped with an audible / visual alarm to indicate any exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work will be stopped, slowed, or modified and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

- Additionally, the exhaust stack of the enclosure air-handling plant will be monitored using an MIE Data Ram with isokinetic sampling fitting and inlet heater. These measurements will be evaluated under separate criteria to determine conformance with regulatory requirements regarding permitted emissions.

All readings will be recorded and be available for State (DEC and DOH) personnel to review.

B.6.5.3 Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

- Emergency Response Contacts as listed in the HASP of this Work Plan will go into effect.
- The local police authorities will immediately be contacted by the SSO and advised of the situation.
- Frequent air monitoring will be conducted at 30-minute intervals within the 20-foot zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the SSO.

B.6.5.4 Air Monitoring Plan For Radionuclides

Continuous air monitoring for uranium and thorium will be conducted at the perimeter of the work area whenever intrusive work is in progress. This monitoring will assess if off-Site airborne radioactivity releases are less than ten percent of the environmental limits of NYSDEC Part 380. It will also identify that workers are not exposed to more than ten percent of the occupational limits for radionuclides as listed in the New York Department of Labor Code Rule 38.

Continuous air monitoring using an MCE filter attached to a vacuum pump will be established prior to any work activities. The sampler will be located at the edge of the work area. The number and location of samples shall be at the discretion of the SSO. Filters will be analyzed the following workday or at a frequency established by the SSO in consultation with the RSO. A new filter paper shall be installed at the beginning of each workday.

A gas flow proportional counter, alpha/beta dual scintillator or other lab type instrument (Ludlum Model 2929) will be used to assay the filters from perimeter sampler for alpha radiation. It is preferable to wait 12 to 24 hours before counting an air sample to allow adequate time for the radon daughters to decay and minimize interference from this source. The count rate of the filter samples will be verified to see that the result is actually an increase in airborne radioactivity.

The instrument will be source checked each day to verify operation of the detectors and a background radiation count will be performed. The lab instrument will be calibrated with an NIST traceable uranium or thorium source in a disc geometry. The activity is electroplated onto the surface of the disc to simulate the geometry of the air sample. The calibration will determine the efficiency to be used when calculating the activity of the air sample. The activity measured will be divided by the volume of the air sample to give the radioactivity concentration in microcuries per milliliter. The limits for thorium are the most restrictive and as such will be used until a nuclide specific assay is available.

When a nuclide specific analysis is required, air samples will be sent to an off-Site laboratory. This will be done when an air sample exceeds ten percent of any applicable thorium-based limit.

Blank air samples will be taken periodically upwind of intrusive work activity. These blanks can be counted to give an accurate estimate as to the background levels of radon daughters collected on particulate air samples.

B.6.6 Personnel Air Sampling

Personnel air sampling will be conducted for the first three days of intrusive activity for radionuclides (alpha emitters) using NIOSH 0500. Should additional personnel air sampling become necessary, it will be conducted using the appropriate NIOSH methods.

B.6.7 Radiological Monitoring

Radiation monitoring will occur on two levels:

a. area monitoring using portable survey meters. The survey instruments are used to measure the real-time dose rate in the work areas, to enable rapid response in an appropriate method to changing radiation levels.

b. personnel monitoring using individual thermoluminescent dosimeters (TLD), breathing zone and/or lapel air samplers, and Bioassay. The TLD air sample results, and the bioassay program provide the basis for a permanent record documenting the actual dose each worker receives.

B.6.7.1 Radiation Survey Monitoring.

External radiation survey monitoring is performed using

- a portable survey exposure ratemeter, such as the Bicron µRem meter or the Ludlum 12-S
- a gamma survey instrument, such as a Ludlum 3 with a 2"x2" NaI probe detector, and
- an alpha/beta survey instrument such as Ludlum 3 with a plastic scintillator dual detector.

The survey meter is capable of measuring background levels of radiation (expected to be 5 – 10 µR per hour) and will be able to detect levels elevated above ambient. The survey instruments with either gamma or alpha/beta probe will identify elevated levels of radioactive materials. The combination of instruments will enable workers and health and safety personnel to recognize and respond to any radiation hazards as they occur.

Background radiation levels/operational response will be determined for each instrument daily by taking readings at a location un-impacted area on the Site. Instrument checks will be performed and results will be recorded in project logs.

If the radiation level at a work location exceeds expected levels identified on the pre-work survey, the workers in that area will determine if this is from a localized source, such as a waste or sample container, or a general area level. This is accomplished by moving the meter away from the waste material and observing if the dose rate decreases. If the waste is determined to be the cause of the elevated readings, waste handling will proceed normally employing ALARA considerations. If the dose rate is elevated throughout the area, the workers will cease work, move to an area with a reduced dose rate, and notify the RSO or SSO. Work in that area will not resume until the source of radiation is identified and appropriate mitigation measures are employed. If possible, discrete sources of radiation should be segregated and shielded to minimize exposure to personnel.

B.6.7.2 Personnel Radiation Dosimeters

Each worker will be issued an individual dosimeter (thermo-luminescent dosimeter, TLD or equivalent). The dosimeter will be worn in accordance with the instructions below. These dosimeters will be collected periodically by the RSO, and submitted for laboratory processing, with results recorded in the project logs. The individual worker may request to be notified of dosimetry results.

Instructions for Wearing Radiation Dosimetry Badges

1. Always wear the badge when in posted areas and whenever you work with radioactive materials.
2. Wear the badge on a prominent area of your torso; on (not inside) a pocket, belt, collar, etc. The badge color and information label must face away from your body and not be covered by clothing or any other material.
3. Do not store the badge in a radiation area or near radioactive materials. Place the badge on the badge board when not in use.
4. The badge ***monitors*** exposure to ionizing radiation. It does not ***protect*** from radiation.
5. DO NOT open the badge holder or tamper with the seals in any way. Protect the badge from excessive heat, bright sunlight, humidity, or chemical vapors.
6. Report any lost or damaged badges to the Project RSO or your supervisor
7. Never wear more than one badge at the same time unless specifically instructed to do so by qualified supervisory personnel or the RSO. Never wear a badge assigned to another individual.
8. DO NOT deface the badge or the badge information label with the bar code in any manner. If necessary for identification purposes a removable label may be affixed to the back of the badge with the wearer's last name and identification number.
9. Return the badge on the day of the posted exchange date or when you leave the project, whichever is first.

It is important to realize that if one does not return the TLD badge for prompt processing, there is no way to measure the exposure to the badge.

B.6.7.3 Bioassay

Each worker will have a urine analysis administered after the completion of on-Site duties or at intervals directed by the RSO. Additional whole body counts and urine bioassays may be performed as directed by the RSO. Target radionuclides for the bioassays are Thorium-232, Uranium 234, Uranium 235, Uranium 238 and progeny.

B.6.7.4 Airborne Radioactivity

Air sampling for radioactive particulates will be implemented in the work area and perimeter. In general:

a. Samples will be obtained using an air pump with flow rate sufficient to meet the detection sensitivity required for the anticipated duration of the operation.
b. Air is drawn through a glass fiber filter Gelman, Type A/E, 47 mm (1.8 inches) in diameter or a mixed cellulose ester (MCE) filter in a plastic cassette. These filters are rated at 99.98% efficient for DOP aerosol of 0.3 m.
c. The pump flow rate will be measured before and after collection to correct for filter loading; the typical flow rate value is 1.5-2.5 liters per minute.
d. Pumps will be placed in the work area at the beginning of the shift and remain until the end of the potentially contaminating work. The filter apparatus will be mounted at approximately 3 to 5 feet off the ground.
e. Following the sample collection, the filters will be analyzed on-Site for gross alpha and gross beta radioactivity using a Ludlum Model 2360 scaler with Model 43-1-1 probe (or equivalent instrument)

The minimum air volume requirements will be met to achieve the required Derived Air Concentration (DAC) for air monitoring of Uranium and Thorium.

B.6.7.5 Surface Contamination Surveys

B.6.7.5.1 Personnel Contamination Surveys

Personnel contamination will be monitored for workers exiting work areas. Frequency will initially be 100%; frequency may be adjusted based on contamination potential. Surface contamination will be measured using hand-held instruments, such as with the Ludlum Model 2360/43-1-1 or equivalent. The instrument will be used to monitor personnel contamination at the work area egress point. Attachment 2 - *Contamination and Radiation Monitoring*, will be used to implement personnel contamination surveys.

B.6.7.5.2 Equipment/Materials Surface Contamination

Equipment/materials contamination surveys will be performed on all equipment/materials having the potential for being contaminated during Site activities, prior to release from the Site for unrestricted use. Surface contamination will be measured with direct reading instruments and with wipes for removable activity, such as with the Ludlum Model 2360/43-1-1 or equivalent. Attachment 2 will be used to implement equipment/materials contamination surveys and identify applicable release limits. Surveys and swipe evaluations will also be performed in the support zone to verify that controls are being effective.

B.6.7.5.3 Radioactive Materials Shipments Surveys

Waste and sample shipments from the Site exhibit radiological characteristics that must be considered with respect to the United States Department of Transportation (USDOT) regulations for transport of radioactive materials. Direct radiation surveys can be performed using a dose rate meter (Bicron Micro Rem) or energy-compensated exposure rate meter (Ludlum Model 3/44-38). Surface contamination surveys can be performed using standard swipe methods, counted with a Ludlum Model 2360/43-1-1 or equivalent. Attachment 2 will be used to implement sample shipment surveys and to identify applicable release/labeling requirements.

B.7 SITE CONTROL MEASURES

To prevent both exposure of unprotected personnel and migration of contamination due to tracking by personnel or equipment, Work Zones (WZ), along with PPE requirements will be clearly identified. A sign clearly identifying the Site address will be placed at the front of the building for emergencies and Site deliveries.

B.7.1 Site Control and Security

All employees, subcontractors, government agency representatives and visitors will be required to sign in and out on the Sign-In Log located in the field office in the office support area. A Site representative will accept all deliveries.

Work Zones (WZ) will be established around waste excavation and placement work areas, and be moved as work progresses. Only authorized personnel will be allowed to enter the active WZ. Security will control access to the active work area. Visitors will not be permitted to enter the facility unless accompanied by authorized personnel. Names and affiliation of each visitor will be recorded and maintained. A brief documented safety meeting detailing safety procedures must be held for visiting personnel before they can enter and observe Site activities. A copy of the HASP will be kept on-Site for reference and must be reviewed by all visitors and assigned personnel. All persons allowed on-Site will require written acknowledgement of having reviewed the HASP.

Additionally, a Site map clearly delineating WZ and routes into and out of WZ and the Site will be posted. The SSO will post EZ sketches in the field office for visitors' information. The primary and alternate Site evacuation routes will be designated on the Site map, and permanently posted in the field office.

B.7.2 Designation of Zones

Where applicable (i.e., drum or bulk hazardous waste handling), the PM delineates WZ as suggested in the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities," NIOSH/OSHA/USCG /USEPA, November 1985. They recommend the areas surrounding each of the intrusive work areas on hazardous waste Sites where there is a potential for exposure to be divided into three (3) zones:

- Exclusion Zone (EZ);
- Contamination Reduction Zone (CRZ); and
- Support Zone (SZ).

B.7.2.1 Exclusion Zone

The EZ will consist of a corridor around the active work area where excavation, dewatering, or other soil or water handling activities are taking place, and there is chance of exposure to subsurface contaminants or groundwater. It will be large enough to allow heavy equipment movement while being kept as small as possible so as not to impact facility operations. The perimeter of the EZ will also be sufficiently large to preclude unprotected personnel from contact with vapors that may arise from these operations. The perimeter of the EZ will be marked with yellow caution tape, hi-visibility fence, traffic cones, etc. All personnel entering these areas must wear the prescribed level of protective equipment and satisfy Site access training requirements.

The EZ includes those areas that are considered contaminated or have the potential to be contaminated in the event of a spill. A checkpoint will be established at the interface of the EZ and CRZ to control the movement of personnel and equipment into and out of the contaminated area. It will be large enough to allow heavy equipment to pass through. The EZ will be clearly bounded and delineated by the "hotline". An EZ sign-in sheet will be maintained in the CRZ to log personnel times in and out of the EZ.

B.7.2.2 Contamination Reduction Zone

The CRZ will be a clearly marked corridor between the EZ and SZ. This is where personnel will be in the sequential decontamination process when exiting the EZ. To prevent cross contamination and for accountability purposes, all personnel will enter and leave the EZ through the CRZ. Equipment will also be initially decontaminated in this area to allow repeated passage in and out of the EZ. Operators of equipment and vehicles who will not be leaving their driving position are not required to go through the decontamination process until the last passage out of the EZ is made. The CRZ serves as a buffer zone between the SZ and the EZ.

Personnel will process through the "clean" end of the CRZ on their way into the EZ. Personnel will process through the contaminated side of the CRZ when leaving the EZ, and will be "contaminant free" before entering the SZ. The CRZ will be located in the direction upwind from the EZ, based upon prevailing wind patterns. Exiting from the CRZ requires the removal of all suspected or known contaminants through compliance with the personnel and equipment decontamination procedures as outlined in this HASP.

B.7.2.3 Support Zone

The SZ will consist of those areas around the CRZ where support equipment is staged. It will be set up in an area believed to be free of above surface contamination. The SZ includes the area where the command post and all other support for operations will be located. It will also include already remediated areas that have been sampled, surveyed and released.

B.7.3 Additional Control Measures

The following measures are designed to augment the specific health and safety guidelines regarding the designation of work zones.

- The "buddy system" will be used at all times by all field personnel. No one is to perform fieldwork alone. Standby team members must be intimately familiar with the procedures for initiating an emergency response.

- Avoidance of contamination is important. Whenever possible, avoid contact with contaminated (or potentially contaminated) surfaces or materials. Walk around (not through) puddles and discolored surfaces. To minimize the potential for puncture wounds due to sharp objects, do not walk through exposed waste if you can avoid it. Do not kneel on the ground or set equipment on the ground if possible.

- The office support area has been designated for eating and drinking on-Site. NO SMOKING ON-SITE. Smoking is permitted in designated areas ONLY.

- Eating, drinking, chewing gum, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of materials is prohibited in all work areas.

- Hands and face must be thoroughly washed upon leaving the work area and before eating, drinking or any other activities.

- Beards or other facial hair that interfere with respirator fit are prohibited when respiratory protection is required.

- The use of alcohol or illicit drugs is prohibited at all times, and grounds for **immediate termination.**

- PPE equipment will be required for all field personnel unless otherwise approved by the RHSM or SSO.

B.7.4 Site Safety Equipment

The following safety equipment will be available for personnel. Subcontractors will be responsible for supplying their own safety equipment.

- 10 A-B-C fire extinguisher
- First aid kit
- ANSI-approved 15 minute eyewash
- Respirators and air purifying cartridges
- Tyvek coveralls
- Nitrile gloves
- Hardhats
- Work gloves
- Eye/face protection
- Disposable outer boots
- Hearing Protection

B.8 DECONTAMINATION PROCEDURES

B.8.1 Decontamination Station

The Exclusion, Contamination Reduction, and Support Zones (EZ, CRZ, and SZ, respectively) will be defined prior to commencing any intrusive work in the EZs. The EZ will be delineated and marked with caution tape, high-visibility fence, traffic cones, etc. Temporary signs will also be posted defining levels of protection required for entry. Subsequently, the CRZ will be constructed and delineated for personnel decontamination activities.

A decontamination area will be established within each CRZ just inside the access/egress point. The decontamination area shall be underlain with plastic sheeting that shall be replaced when torn or heavily soiled.

All spent decontamination fluids (wash and rinse waters) will be handled as radioactive waste until laboratory results indicate otherwise. Fluids will be placed in proper containers, such as 55 gallon, metal, DOT approved drums, and handled and labeled in accordance with OSHA (or State equivalent), EPA, and DOT regulations.

Disposable clothing, gloves and spent respirator cartridges will be disposed of after each work shift. All personal protective equipment to be disposed of that has been used in areas of suspected or detected radiological contamination will be monitored prior to disposal. Any contaminated PPE will be placed in a separate plastic bag from uncontaminated PPE and properly marked and kept separate from uncontaminated PPE. These items are to be placed in waste receptacles located inside the CRZ. Contaminated clothing will be disposed of in a manner consistent with regulations for the level of surface contamination.

Employees will use a clean respirator on each work shift. Employees will be responsible for the cleaning and maintaining their respirators. Used respirators, face shields, hardhats, safety glasses, etc., which have been surveyed as free from radiological contamination are to be cleaned by the employee at the end of each shift. Clean respirators are to be stored in respirator bags.

B.8.2 Personnel Decontamination Error! Bookmark not defined.

Personnel should follow the general decontamination procedures outlined below for Level D, C and B protection:

a. Locate a decontamination area.
b. Establish a personnel decontamination station consisting of a hand-held radiation detector sensitive to the radiation of concern (alpha/beta), a basin with soapy water, rinse basin with plain water, and a can with a plastic bag or liner.
c. Monitor boots and gloves for radioactivity.
d. Remove boots and outside gloves and discard them in a plastic bag.
e. Remove disposable suit and discard it in a plastic bag.
f. Monitor your body with the hand-held instrument or proceed to the radioactivity portal monitor and process through as instructed.

Upon leaving the contamination area, all personnel will proceed through the appropriate Contamination Reduction Sequence described above. All protection gear should be left on-Site during lunch break following decontamination procedures.

B.8.3 Personal Hygiene

Portable hand and face wash-up facilities will be provided outside of each of the established exclusion zones. To reduce the possibility of hand to mouth transfer of contaminants and absorption through skin contact, personnel will be required to wash their face and hands upon exiting the work areas and prior to smoking, eating, or drinking, if necessary. Eating will not be allowed in exclusion or CRZs. In addition, portable sanitary facilities will be provided. The number of facilities provided will be in accordance with the requirements of 29 CFR Part 1910.120(n). They will be maintained in clean condition at all times.

B.8.4 Instrument Decontamination Activities

Instruments will be decontaminated whenever they are taken out of the EZ. Instrument clean up will occur in the CRZ. It will consist of the removal of any dust or soil from the surfaces of instruments. Equipment decontamination will be under the supervision of the SS and RSO.

B.8.5 Site Equipment Decontamination

Equipment should remain on-Site until the end of the project, or until it is no longer needed to support project operations. At project completion, equipment that is potentially contaminated will undergo decontamination procedures by project personnel. The equipment will then be surveyed for residual radioactive materials by the project RSO. If detectable contamination is found, equipment will not be allowed to leave the Site until additional decontamination and a re-survey to assure compliance with the release criteria.

B.8.5.1 Decontamination of Vehicles and Heavy Equipment

Where it is likely that vehicles or heavy equipment have come in contact with contaminated material, such equipment will be decontaminated and surveyed before leaving the Controlled Area/Exclusion Zone (CA/EZ).

B.8.5.2 Decontamination of Tools Error! Bookmark not defined.

When all work activities have been completed, contaminated tools (drill augers, hand trowels, shovels, etc.) shall be totally decontaminated. A job is NOT considered complete until the work area has been cleaned, all used material properly discarded and tools cleaned and properly stowed.

It is expected that all tools will be constructed of non-porous, non-absorbent materials. This will aid the decontamination process. Any tool, or part of a tool, which is made of a porous/absorbent material (that is, wood or cloth) shall be discarded and disposed of as a hazardous waste if it cannot be properly decontaminated.

Tools to be decontaminated will be placed on a decontamination pad or into a bucket and thoroughly washed using a soap solution and brushing, followed by a water rinse. All visible particles should be removed before the tools are considered clean. Visibly clean tools will be surveyed for radiological contamination before storage or release from the Site.

B.8.5.3 Equipment Release Surveys and Criteria

Prior to release from the CA/EZ, surveys of all equipment and materials shall be performed by the RSO. The RSO can make the determination on whether to conduct independent free release surveys or verify contractor-generated data. All equipment and materials used in the CRZ and CA/EZ must be visibly clean.

Equipment and materials are checked for removable radioactive contamination by counting 47 mm or 1.75" diameter smears that have been wiped over 100 cm^2 of the object being monitored. Equipment and materials are checked for fixed plus removable contamination by project personnel using a hand-held survey meters or low background counter (for alpha, beta and/or gamma radiation). Attachment 2 will be used to implement equipment/materials contamination surveys and identifies applicable release limits. Any detectable contamination that is greater than the limits specified in Attachment 2 must be removed.

The PM, SSO, or SS will maintain an Equipment Decontamination Log. The SSO will provide on-Site training to individuals who require it prior to inspecting decontamination activities. The following checklist may be used during this activity.

Decontamination Site Checklist		
Equipment Description		Date:
1	Exterior of vehicles/equipment visually dirty?	Yes No
2	Soil or other materials are adhering to the vehicle/equipment body or undercarriage?	Yes No
3	The vehicle/equipment is leaking or dripping liquids?	Yes No
4	Is the vehicle/equipment completely decontaminated so as not to permit potentially fugitive particulate matter to become airborne?	Yes No
5	Is the vehicle adequately decontaminated, permitted to leave the decontamination pad, and removed from the Site?	Yes No
6	Additional comments (if any)	Yes No
Printed Name:	Title:	
Signature:	Date:	

EQUIPMENT DECONTAMINATION LOG

Date	Time	Equip. Make & Model	ID #	Operation Location	Amount of Decontamination	Method of Decontamination

B.9 EMERGENCY PLAN

B.9.1 Emergency Management

A Site emergency is considered to be a event that has or threatens to have a detrimental physical impact on facilities, people, or the environment and requires immediate action. This definition applies to work locations and employees, as well as the people and property associated with contractors and the community.

Emergencies can be grouped into three categories:

- Fire, leak, spill, or release;
- Medical; and
- Natural (hurricanes, flooding, etc.).

B.9.1.1 How to Respond to an Emergency

Fire, Leak, Spill, or Release

If an employee discovers a fire, leak, spill, or release:

- Report the emergency by Site radio to the SSO or SS. Give your name, exact location, and the nature of the emergency;
- Shut down all equipment; and
- Leave the area immediately.

The phone numbers of the police and fire departments, ambulance service, local hospital, and representatives are provided in the Emergency Reference sheet on the following page. Directions to the hospital are also provided.

Medical

- *For medical emergencies that are life threatening*, the appropriate community emergency services will be mobilized. The personnel within the EZ, regardless of level of PPE, will bring the injured person out of the EZ, bypassing the decontamination procedures. The injured person will be ready at the CRZ for immediate evacuation by emergency personnel or local ambulance.

- *For employees with less serious injuries*, Certified personnel are responsible for providing first aid care. Injuries that border being first aid cases that do require outside assistance, i.e. emergency transportation. In more severe cases, the field personnel at the scene will stabilize the injured person as much as possible within the EZ. Emergency response personnel will enter the EZ in appropriate PPE to conduct first aid and/or remove the injured person for appropriate medical attention through decontamination procedures.

Natural

In the event of a natural emergency, such as flooding, electrical storms, hurricane, tornado, etc., Appropriate precautions will be taken (e.g., secure material, gas bottles, tanks, as well as cranes and other equipment). Personnel may also be required to get off high structures or platforms.

B.9.2 Personnel Responsibilities

Prior to initiating work on-Site, a field team member, usually the SSO will be appointed to activate emergency response actions when required. In the event an injury or illness requires more than first aid treatment, the SSO or designee will accompany the injured person to the medical facility and will remain with the person until release or admittance is determined. The escort will relay all appropriate medical information to the SSO, PM, and the RHSM.

The PM has the authority and responsibility both to commit company resources to appropriately respond to an emergency and to exclude all personnel not directly responding to the emergency.

B.9.3 Emergency Reporting

Any incident (other than minor first aid treatment) resulting in injury, illness or property damage requires an accident investigation report, and will be reported to the SSO. The investigation will be initiated as soon as emergency conditions are under control. The purpose of this investigation is not to attribute blame but to determine the pertinent facts so that repeat or similar occurrences can be avoided.

The investigation should begin while details are fresh in the mind of anyone involved. The person administering first aid may be able to start the fact gathering process if the injured are able to speak. Pertinent facts must be determined. Questions beginning with who, what, when, where, and how are usually most effective to discover ways to improve job performance in terms of efficiency, quality of work, as well as safety and health concerns.

Potential emergencies that may arise are most likely to be associated with physical hazards from heavy equipment operation and/or lifting and loading of debris. Emergency response will in most cases be permissible to be performed in Level D.

B.9.4 Evacuation Plan

The basic elements of an emergency evacuation plan include employee training, alarm systems, escape routes, escape procedures, critical operations or equipment, rescue and medical duty assignments, designation of responsible parties, emergency reporting procedures and methods to account for all employees after evacuation.

Employee Training: Employees will be instructed in the specific aspects of emergency evacuation applicable to the Site as part of the Site safety meeting prior to the commencement of all on-Site activities. On-Site refresher or update training is required anytime escape routes or procedures are modified or personnel assignments are changed.

During the Pre-Construction Site Safety Meeting held, all employees will be trained in and reminded of the location of the evacuation plan, the procedures outlined in this plan, the communication systems and evacuation routes used during an emergency. Figure B1 details the emergency route to the Nassau County Medical Center in Hempstead, New York and Table 10-B1 lists emergency phone numbers. Safe distances and rally points will be established for each phase of work, posted, and reviewed by all workers at the daily tailgate safety meetings.

On a continual basis, individual personnel should be constantly alert for indicators of potentially hazardous situations and signs and symptoms in themselves and others that warn of hazardous conditions and exposures. Rapid recognition of dangerous situations can avert an emergency. Potential emergencies that may arise are most likely to be associated with physical hazards from heavy equipment operation and/or lifting and loading of debris.

In the event of any emergency that necessitates an evacuation of the Site, on-Site personnel shall be notified by two-way radios to evacuate the area by immediate emergency exit. An alternate method of communication will be the use of portable air horns sounded in regularly spaced, repeated blasts, as detailed in this HASP.

During an evacuation, all non-emergency radio transmissions shall cease. The SSO and SS shall control the scene until the appropriate municipal and state agencies arrive as necessary. The SSO/SS are responsible for head count of all personnel at rally points following evacuation.

B.9.5 Alarm Systems/Emergency Signals

An emergency communication system must be in effect on-Site. The most simple and most effective emergency communication system in many situations will be direct verbal communications. Verbal communications will be supplemented anytime voices can not be clearly perceived above ambient noise levels (i.e. noise from heavy equipment; drilling rigs, backhoes, etc.) and anytime a clear-line-of-sight cannot be easily maintained amongst all Site personnel because of distance, terrain, or other obstructions. When verbal communications must be supplemented, the following Emergency Signals (using hand held portable air horns) shall be implemented:

- ONE HORN BLAST: GENERAL WARNING

  One horn blast is used to signal relatively minor, yet important events on-Site. An example of this type of event would be a minor chemical spill where there is no immediate danger to life or health yet personnel working on-Site should be aware of the situation so unnecessary problems can be avoided. If one horn blast is sounded, personnel must stop all activity and equipment on-Site and await further instructions from the SSO and PM.

- TWO HORN BLASTS: MEDICAL EMERGENCY

  Two horn blasts are used to signal a medical emergency where immediate first aid or emergency medical care is required. If two horn blasts are sounded all first-aid and/or CPR trained personnel should respond as appropriate, all other activity and equipment should stop and personnel should await further instructions from the SSO and PM.

- THREE HORN BLASTS FOLLOWED BY ONE CONTINUOUS BLAST: IMMEDIATE DANGER TO LIFE OR HEALTH

  Three horn blasts followed by another extended or continuous horn blast signals a situation that could present an immediate danger to the life or health (IDLH) of all personnel on-Site. Examples of possible IDLH situations could include fires, explosions, hazardous chemical spills or releases, hurricanes, tornadoes, blizzards or floods. If three horn blasts followed by a continuous blast are sounded, all activity and equipment must stop, all personnel must evacuate the Site to an appropriately designated area located outside the Site gate or further off-Site if necessary. (Note: Unless otherwise specified, all decontamination procedures must be implemented.) All personnel must be accounted for and other response actions determined by the SSO or PM must be observed.

B.9.6 Medical Treatment/First Aid

The on-Site SSO and PM shall have first aid kits for use in a medical emergency. First Aid Kits and eye wash stations will be located in the field office at the main support area, and at work activity locations. Decontamination procedures must be implemented prior to sick or injured personnel leaving the Site. On-Site employees that have a basic knowledge of first aid can assist the SSO. Community emergency services (EMS, Fire, and Police) shall be notified immediately if deemed their resources are needed on-Site, and the phone numbers are provided in Table 10-B1.

If necessary, the injured or sick party shall be taken to Nassau County Medical Center. Please refer to Figure B1 (route to closest hospital) located at the end of this section.

A copy of the map and emergency reference information table shall be posted in the office trailers and guardhouse, located near the entrance gate.

B.9.7 Fire Extinguishers

Support Area - Each trailer will be equipped with 10 A; 30BC multipurpose dry chemical type fire extinguishers. One fire extinguisher will be by each door.

Impacted Work - Two 20 ABC fire extinguishers will be located at each impacted work location.

Equipment - All of the heavy equipment are supplied with at least 2ABC multipurpose dry chemical type fire extinguishers. ABC type fire extinguishers can also be found in all vehicles.

TABLE 10-B1
EMERGENCY REFERENCE INFORMATION

Municipality/Company		Phone Number
Ambulance		911
Police		911
Fire		911
National Response Center – Spill Reporting		(800) 424-8802
Chemical Transportation Emergency Center		(800) 424-9300
Poison Control Center		(800) 764-7661
Hospital - Nassau County Medical Center		(516) 542-0233
NYSDEC Spill Response Hotline		(800) 457-7362
Directions to the Hospital - Turn left onto Cantiague Rock Road (south). Take Cantiague Rock Road ½ block to traffic light (Prospect Avenue/West John Street) turn left. Turn right onto Charlotte Avenue. Go under railroad (slight right onto Duffy Ave.). Turn right at Hess Station onto Old Country Road. Turn right onto Wantagh State Parkway – south Exit 3W – NY Route 24 West – Hempstead. Turn left on Hempstead Turnpike (NY-24E). Hospital emergency entrance on the right side of the street.		

B.10 SPILL RESPONSE

Reportable spills occurring on-Site, whether liquid or solid, will be reported promptly to the PM and SSO. It is not anticipated, due to the nature of this project, that any reportable quantities of solid materials will be released. No liquids that would pose a threat if spilled are being utilized or generated. However, the following section describes management of waste spills and preventive measures.

Any solids spilled during the removal action will be promptly recovered and replaced into the container they came from if possible. If container is damaged, the spill will be contained with local soil or a spill control kit. The following procedures will then be implemented:

1. Notify representative(s) immediately.
2. Isolate the spill area and control entry to the area quarantined.
3. Only personnel in the proper PPE will be allowed to enter the area.
4. Keep all traffic away from the spill.
5. Use a water fog to suppress vapors, fumes, dust or mist if imminent release from the Site is apparent.
6. Remove and stockpile or containerize the waste immediately or as directed by SSO and/or PM.

YAHOO! GetLocal Maps

Yahoo! Maps

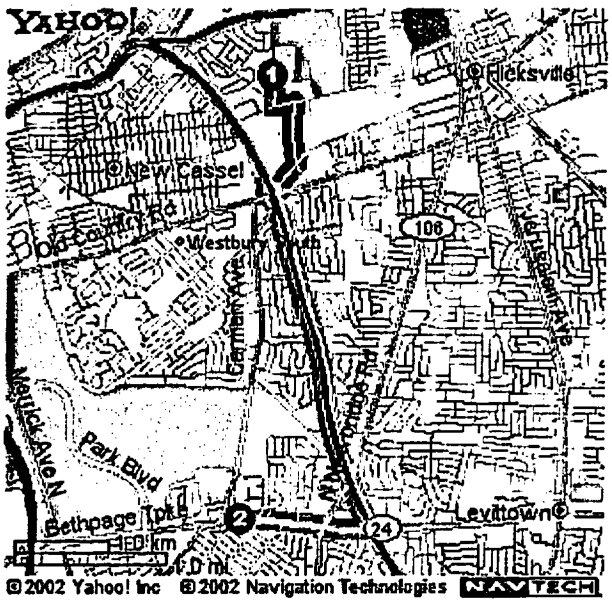
Back to Directions

Starting from: 1 140 Cantiague Rock Rd, Hicksville, NY 11801-1127

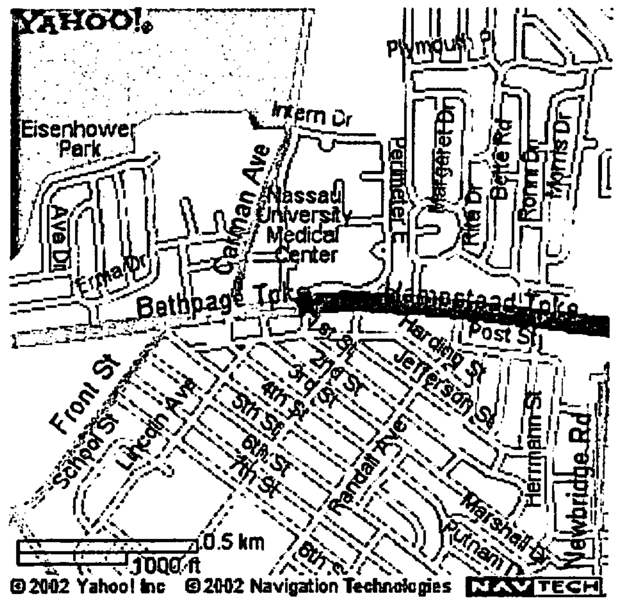
Arriving at: 2 2201 Hempstead Tpke, East Meadow, NY 11554-1859 Phone: 516-542-0233

Distance: 4.3 miles **Approximate Travel Time:** 8 mins

Full Route



Destination



Directions	Miles
1. Start on Cantiague Rock Road heading south	0.2
2. Turn east (left) on W. John Street	0.2
3. Turn south (right) on Charlotte Avenue	0.4
4. Turn southwest (right) on Duffy Avenue	0.2
5. Turn right on Old Country Road	0.1
6. Bear south (right) to take the Wantagh Pkwy south ramp	0.1
7. Merge on highway	2.2
8. Take the W3 W/RT-24 West exit towards Hempstead	0.1
9. Continue on local road	0.0
10. Turn west (right) on Bethpage Tpke/Hempstead Tpke	0.8

Figure 10B-1 Hospital Route Map
From Site to Nassau County Medical Center

B.11 HEALTH AND SAFETY INSPECTION

The RHSM may perform a Site-specific Health and Safety Inspection during Site activities. Inspections are typically conducted monthly. The purpose of the Health and Safety Inspection will be to:

(1) Verify the effectiveness of the HASP in protecting the health and safety of GTE employees and their subcontractors;
(2) Confirm that the Site Operations Plan and HASP are being correctly implemented; and
(3) Assure all aspects of the project safety are properly represented by these plans.

B.12 CONFINED SPACE ENTRY

Entry into Permit-Required Confined Spaces likely will not be required for any work on this project. Should confined space work be required, field personnel will adhere to the following procedures:

All employees required to enter confined spaces will observe requirements specified in 29 CFR 1910.146. Prior to entry, employees will have completed a confined space training program. Depending upon risk level, atmosphere testing for oxygen deficiency, combustible gases, and toxic agents may be required.

Confined spaces pose special hazards to the remedial workers because they can allow contaminants to concentrate to levels which are immediately hazardous and restrict the employees' movement as necessary to escape hazards such as moving equipment, collapsing earth, etc. Procedures for entry into the confined space are prepared for each project and included in this HASP.

The following items should be addressed prior to entry into the confined space:

- Sources of ignition shall be removed from confined spaces where flammable vapors may be present.
- Provisions of the lockout procedure must be satisfied, where applicable.
- Employees working in the confined space must be under the constant observation of a competent employee stationed outside the confined space.
- Every person entering an enclosed, confined space must wear a rescue harness with lifeline attached.
- When a ladder is required to enter a vessel, the ladder must be made secure at the top and must not be removed while anyone is inside.
- Adequate illumination must be provided. Approved, low-voltage, protected-type fixtures should be employed.
- The confined space is to be emptied, flushed, or otherwise purged of hazardous substances.
- Pipes or lines which convey any kind of substance to the confined space are to be disconnected, blinded, or have the valve locked off to prevent such substances from entering the confined space while work is in progress.

- Rescue equipment must be at the project Site prior to commencing work. Rescue equipment will include extra rope, safety harnesses, and emergency self-contained breathing apparatus (SCBA). No one should enter a confined space until adequate safety equipment is present to remove an unconscious person.

The SSO is responsible for evaluating general safety hazards including executing confined space permits, locking out equipment, providing adequate lighting, tools, etc., and for assuring the conditions established for the confined space entry are maintained.

B.12.1 Definitions

A *"confined space"* is defined as a space that by design or construction has one or more of the following characteristics:

- Limited openings for entry and exit;
- Is large enough and so configured that an employee can enter and perform assigned work.
- Is not intended for continuous employee occupancy.

A *"Permit-required confined space (permit space)"* means a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential for engulfing an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor, which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized serious safety or health hazard.

B.12.2 Atmospheres

The primary hazard presented by entry to the confined space is the likely presence of an atmosphere that provides a hazardous situation. Hazardous atmospheres normally encountered in confined spaces can be divided into five (5) distinct categories:

- *Flammable* - A flammable atmosphere generally arises from enriched oxygen atmospheres, vaporization of flammable liquids within the explosive range, by products of work, chemical reactions, concentrations of combustibles, dust, and desorption of chemicals from the inner surfaces of the confined space. Flammability is measured in terms of the LEL and upper explosive limit (UEL). The LEL is the point above which a sufficient concentration of gas exists to support combustion. The UEL is the point at which an excess amount of flammable gas is present to support combustion. The LEL and UEL are different for each individual type of explosive gas.

- *Toxic* - The substances to be regarded as toxic in a confined space can cover the entire spectrum of gases, vapors and finely divided airborne dust in industry. The sources of toxic atmospheres encountered include flammable materials listed above, volatile nonflammable gases that pose a threat to health (e.g., hydrogen cyanide, hydrogen sulfide).

- *Irritant* - An atmosphere posing a threat of irritation that may or may not be immediately evident. The body's sensitivity abilities can be generally weakened due to damage of the nerve endings in many cases. Thus, the worker is not aware of any increase in the exposure to toxic substances. An example of an irritant would be elemental iodine.

- *Oxygen Depletion* - An asphyxiating atmosphere can be created by three (3) basic operations:

  1. Consumption of oxygen takes place during combustion of flammable substances, as in welding, heating, cutting, and brazing operations.

  2. Oxygen can also be consumed during non-combustion chemical reactions, as in the formation of rust on the exposed surfaces of the confined space.

  3. Oxygen displacement by another gas, such as argon, carbon dioxide, nitrogen and methane can displace the oxygen-bearing air, thus creating an environment immediately dangerous to life and health.

- *Oxygen Enrichment* - A toxic atmosphere could be present containing >23.5% Oxygen.

B.12.3 Pre-Entry Testing

Typically, monitoring tests are performed prior to the entry of personnel into the confined space. The testing regime is developed to detect the presence of flammable atmospheres (i.e. higher than LEL or lower than UEL), toxic atmospheres, oxygen enrichment (i.e. >23.5%), oxygen deficiency (i.e. <19.5%), or other harmful physical agents.

Combustible gas detectors are used to detect the potential for a flammable environment. These devices are usually calibrated to issue an alarm when a given percentage of the LEL (usually 25 percent) is reached. Other types of gas detectors such as Dreäger tubes, photoionization detectors, flame ionization detectors may be used to detect the presence of other potentially harmful gases. An oxygen meter can be used to detect the concentration of oxygen in the confined space to alert operators to the presence of an oxygen deficient condition.

B.12.4 Equipment and Tools

The standards for the use of equipment and tools in the confined space must be increased to account for the special dangers presented by the confined space environment. These enhanced standards are selected for each project and can include any combination of the following procedures can include:

- Increased inspection frequency.

- All equipment must be clean and in good repair.

- Any time 110-volt electrical power is to be used in confined space entry, power must be provided through a ground fault interrupter. The ground fault interrupter must be located outside of the vessel and as close to permanent wiring as possible to ensure against shock hazards from faulty or damaged power tools and extension cords.

- Lighting fixtures must meet appropriate codes depending on the expected atmosphere (i.e. explosion-proof, intrinsically safe, etc.).

- Air-driven hand tools shall be used when flammable liquids are present.

- Cylinders of flammable compressed gases shall never be taken into a confined space.

- Torches or other equipment must not be left in confined spaces where an open or leaking valve could fill the space with flammable gas and/or oxygen. Gases should be shut off at their source when not in immediate use.

- An approved lifeline and harness will be used when entering a closed type confined space.

B.12.5 Standby Person

A standby person is required when activities are being conducted inside a confined space. The standby person is assigned the responsibility of assisting the individual(s) who are entering the confined space. The standby person has the following duties:

- Assuring the entrants to the confined space have a valid permit each day.

- Knowing who is in the confined space and keeping them under surveillance from outside the confined space.

- Keeping unauthorized people out of the area.

- Recognizing early symptoms of danger in the space.

- Watching for hazards outside as well as inside the space.

- Maintaining clear access to and from the space.

- Remaining at his station at all times except when necessary to summon help.

If rescue of the individuals inside the confined space becomes necessary, the standby person is the person responsible for assuring that the appropriate measures are carried out in a timely manner. These duties include:

- Calling for rescue personnel.

- Staying outside until back-up personnel arrive.

- Performing the rescue from outside the confined space, whenever possible.

- Being able to promptly summon assistance.
- Being able to quickly locate and provide safety equipment, such as fire extinguishers and safety showers.
- Shutting down the equipment used in the confined space, such as welding equipment.
- The observer does not enter the vessel in case of emergency until other assistance arrives. Every person entering any vessel for rescue purposes must wear a harness with lifeline attached and a positive pressure air supplied respirator or SCBA.

B.12.6 Authorized Entry Supervisor

All confined space entry work conducted is thoroughly evaluated prior to starting. The space, potential hazardous materials present, planned work activities, assigned PPE, surrounding work activities, and Site location are reviewed by the confined space entry supervisor. This individual must:

- Know potential hazards that may occur with confined space entry.
- Verify and check that the confined space entry permit is complete, all tests specified on the permit have been made, and all procedures and equipment specified on the permit are in place. This verification is to be followed by signature on the permit.
- Terminate entry by canceling permit when necessary.
- Verify that rescue services are in place, available, and procedures established for calling them if necessary.
- Remove unauthorized individuals from permit spaces.
- Determines entry operations remain consistent and acceptable if attendant or entrant assignments change.

B.12.7 Authorized Entrant

Any employee directed to enter a confined space as part of their assigned duties has the responsibility to perform said duties knowledgeably and safely.

The responsibilities of an authorized entrant are:

- To know the hazards that may be faced during entry. These will be found in the Site-specific HASP and include signs, symptoms, and consequences of exposure.
- To properly use assigned PPE.
- To communicate any unexpected/changed conditions or symptoms of exposure in the space to the attendant.
- To exit the permit space as quickly as possible when ordered by attendant to evacuate.

B.12.8 Cessation of Activities

A confined space entry permit becomes void and activities should be interrupted and the confined space evacuated if any of the following occur:

- The job is interrupted for more than 60 minutes, for any reason.
- An employee working in the vessel becomes ill or injured.
- A power failure occurs which renders the lighting or the telephone inoperative.
- Communication systems become inactive or non-functional.

B.12.9 Atmospheric Monitoring Procedures

The monitoring equipment will be operated according to the procedures for that particular piece of equipment. Placement of the probe into the confined air vessel should use extra care to hold the probe off the bottom of the confined space and to avoid pumping liquid into the analyzer. Often times longer lengths of sampling lines may be necessary in deep vessels to avoid entering the vessels. Typically, an oxygen measurement should be conducted to assure that the O_2 level is normal. For this project, any confined space entry will require monitoring for O_2, CO, VOCs, and hydrogen sulfide using direct read instrumentation and action levels defined in this HASP.

B.12.10 Work in Confined Spaces

Confined space environments also place special requirements on practices employed for hot work. No welding, cutting, or use of spark producing tools is permitted in any confined space where the flammable vapor concentration is or becomes above zero on the test unit. Welding and burning equipment, other than torches, hoses, cables and electrodes, will not be taken into any vessel. Gas cylinders and/or welding machines will be left outside the vessel.

All welding and burning equipment used inside a vessel must be provided with quick shut-off under control of the outside observers. When gas welding or burning is suspended for an indefinite period of time, the gas supply is to be shut off at the cylinders and the torch removed from the vessel.

The SSO will execute work permits, and a copy of this document is included.

B.12.11 Try Procedure

Prior to starting dismantlement, efforts to start process equipment locked and tagged will be made by the SS and/or SSO.

B.12.12 Permit System

Entry into a permit-required confined space normally requires a permit specific to that particular entry. Exceptions to that rule include projects that largely consist of dedicated confined space entry such as when an enclosure has been constructed over the project. The permit is an authorization and approval in writing that specifies the location and type of work to be done, and certifies that all existing hazards have been evaluated by the SSO, and necessary protective measures have been taken to insure the safety of each worker. The permit shall be dated and carry an expiration time that will be valid for one shift only. The permit shall be updated for each shift with the same requirements. The permit should be filled out completely, all questions should be answered, where the questions are "not applicable" then "NA" should be filled in for those questions. Entry into the confined space cannot be executed until all questions are addressed and all required signatures are obtained.

A copy of the Confined Space Permit and Diagram Form is included.

IMPACTED AREA WORK PERMIT	
Project Name: **Date:**	
Site Supervisor: **Welder's Name:**	
Description of Work:	**Estimated Length of Task:**
Visual inspection of Site for combustible materials completed.	**Yes No**
All combustible materials removed or protected from heat source.	**Yes No**
Confined spaces checked for flammable gases.	**Yes No**
Fire Watch	**Name:**
Flame/Heat Resistant Clothing Worn	**Yes No**
Eye Protection Adequate	**Yes No**
Fire Extinguishers	**Size and Type:**
Other Project Workers notified of work	**Yes No**
Signature of Site Supervisor: **copy to be retained in permanent project file**	

Confined Space Entry Permit Date: ________

Customer: ________________Customer Address: ____________________________ Project #:______

General Job Location: ___________Tank or Vessel I.D.:____

Describe Material in Space: ____

Description of Work Planned: ____

TIME	LEL %	OXYGEN %	BENZENE (PPM)	TOLUENE (PPM)	XYLENE (PPM)	______ (PPM)	______ (PPM)	______ (PPM)	INITIAL

CHECKLIST	INITIAL		Personal Protective Equipment
	Yes	N/A	EYES
All lines to and from confined space have been blinded or disconnected			chemical goggles
Electrical services disconnected or locked out			safety glasses
All grounding and bonding cables in place			Face shield
All lighting, fittings and cords are approved explosion-proof equipment			EXTREMITIES
Ground fault circuit indicator operational			Gloves
All ignition sources isolated			boots (pvc/neoprene)
Breathing supply and alarms in proper condition			
Respiratory supply system in proper condition			BODY
All safety harnesses and lifelines in proper condition			hvy suit (pvc/neoprene)
All required protective clothing, gloves, boots, etc. used			Saranex suit
Employees trained in the use, care and limitations of PPE			tyvek suit: white-yellow
Outside safety watch trained in emergency procedures and resuscitation			RESPIRATORY:
Vessel contains leaded product			airline respirator
Emergency systems (air packs, fire extinguishers, etc) ready for use			airline w/egress
Special warning signs posted			cartridge type:
Ventilation system in use			Hearing Protection
No facial hair, eye glasses preventing respirator seal incl. standby observer			
No contact lenses in an atmosphere where respirator is needed			Lifeline and Harness

DIAGRAM THE CONFINED SPACE. INDICATE THE LOCATION OF MANWAYS AND VENTILATION. INDICATE THE LOCATIONS WHERE TESTS WERE CONDUCTED.

VIEW FROM TOP (INDICATE NORTH)	VIEW FROM SIDE
( ) MANWAYS (00) VENTILATOR	X-TEST LOCATION

THIS LOG OF INSPECTIONS AND TESTS FOR PERMIT TO ENTER A CONFINED SPACE IS APPLICABLE AND VALID ONLY FOR ONE SHIFT ONLY FOR THE EMPLOYEES DESIGNATED BELOW:

EMPLOYEES ASSIGNED (PRINT NAME)	ATTENDANT PERSONNEL ASSIGNED
__________	__________
__________	__________
__________	__________
__________	QUALIFIED PERSONNEL:
__________	__________
__________	__________
__________	__________

SUPERVISOR NAME:__________ DATE:__________

SIGNATURE:__________ CLOSEOUT DATE: __________

Attachment 1 to Appendix B

Basic Radiation Safety Training

ATTACHMENT 1
BASIC RADIATION SAFETY TRAINING

I. INTRODUCTION

This Basic Radiation Safety and Training document was developed on behalf of GTE Operations Support Incorporated (GTEOSI) for use at the Hicksville, New York Project. This document was developed to provide Site workers with a level of training and project understanding to work safely in this radiological environment. The intent of the program is NOT to provide a substitute or certification for training in adherence to the Radiological Worker Training Program as defined by the Department of Energy.

A. Purpose

1. Understanding radiation and radiation risks
2. Understanding terminology
3. Understanding biological effects of radiation
4. Put radiation risks in perspective
5. Familiarity with radiation detection instrumentation
6. Understanding radiation safety regulations
7. Familiarity with occupational exposures to radiation
8. Understanding the problem of indoor radon

B. Content

1. Basic radiation physics
2. Terminology and units
3. Biological effects
4. Sources of radiation exposure
5. Principal methods of detection
6. Radiation safety regulations
7. Typical occupational exposures and basic radiation safety techniques
8. Origin and health effects of radon and its progeny

II. NATURE OF RADIOACTIVITY

A. Structure of the Atom - Review

1. Basic particles: protons, neutrons, electrons
2. Nucleus: protons + neutrons
3. Electrons in orbit around nucleus

B. Terminology and Shorthand

1. Atomic number (Z) = number of protons
2. Atomic mass (A) = number of nucleons (protons + neutrons)
3. Terminology and abbreviations

$^{12}_{6}C$	carbon	6 protons + 6 neutrons
$^{14}_{6}C$	carbon	6 protons + 8 neutrons
$^{238}_{92}U$	uranium	92 protons + 146 neutrons

C. Radioactivity (Figures 1, 2, and 3)

1. When the nucleus of an atom has excess energy it gets rid of it by emitting radiation - radioactive decay.
2. Line of stability
3. Types of ionizing radiation

a.) Particulate

- i.) Alpha particles - ^{4}He nuclei
- ii.) Beta particles - electrons/positrons originating from nucleus

b.) Electromagnetic

- i.) Gamma photons - originate from nucleus
- ii.) X-rays - originate from outside nucleus
  - Bremsstrahlung
  - Characteristic x-rays

c.) Neutrons

Radiation Type	Mass (amu)	Charge	Energy Distribution Range	Penetrability	Specific Ionization (ip/µm)
Alpha (α)	4	+2	Monoenergetic 4-8 MeV	Low	4000
Beta (β)	0.000549	-1 +1	Spectral 0.018-2.3 MeV	Moderate	10–100
Gamma (γ)	0	0	Monoenergetic 0.1-3 MeV	High	N/A
X-ray	0	0	Spectral <50 keV -2 MeV	High	N/A

Figure 1. Electromagnetic Spectrum

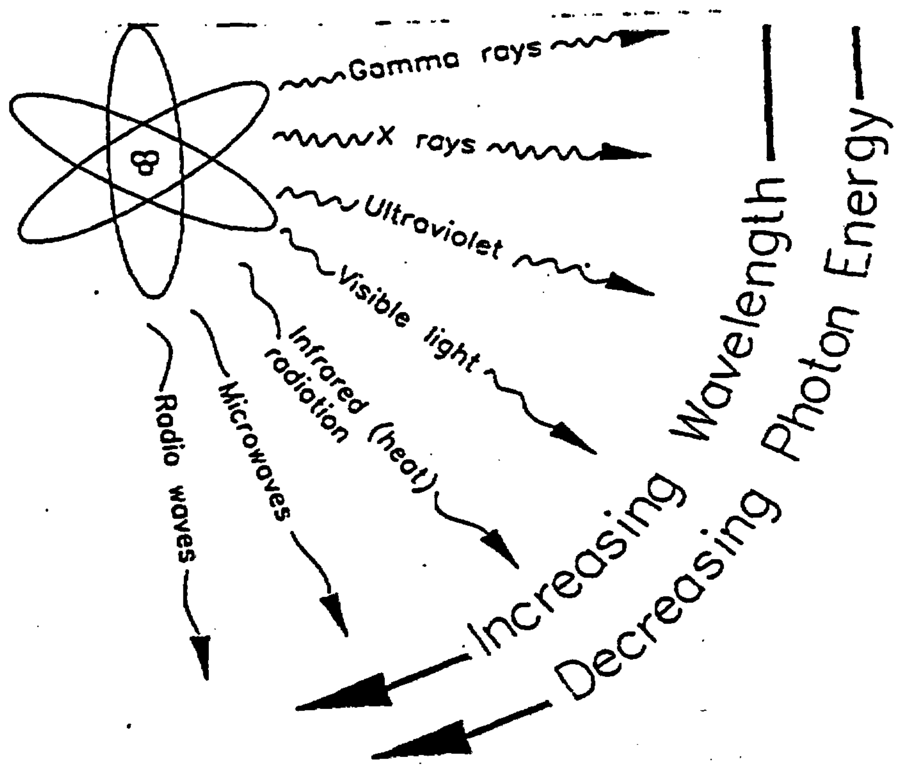


Figure 2. Line of Stability

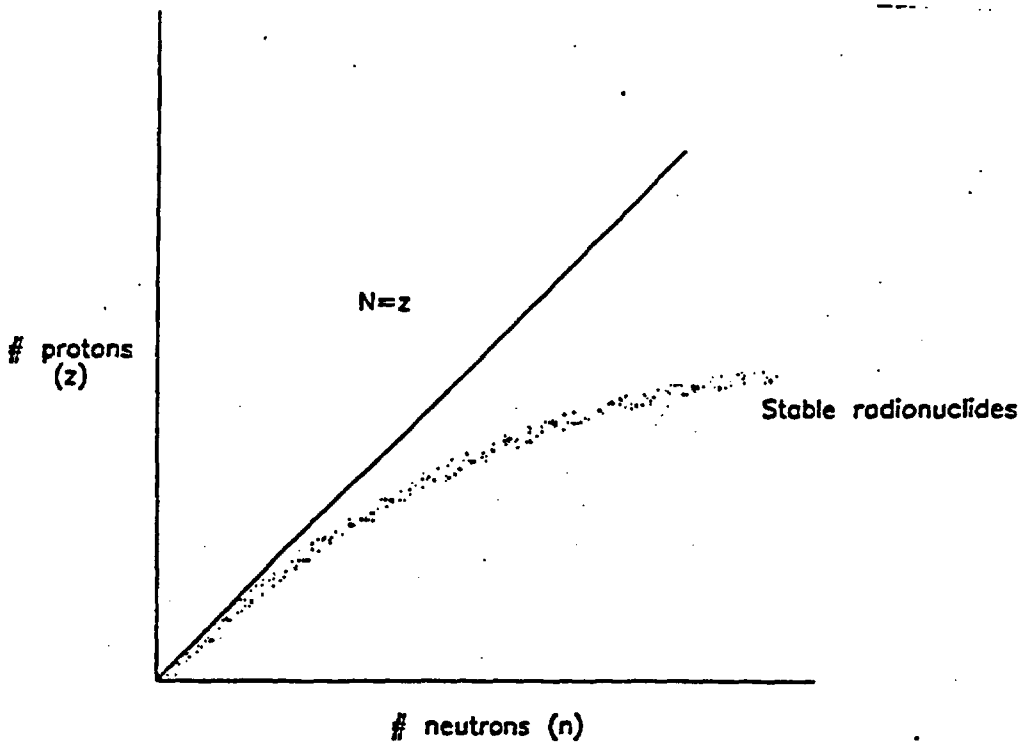
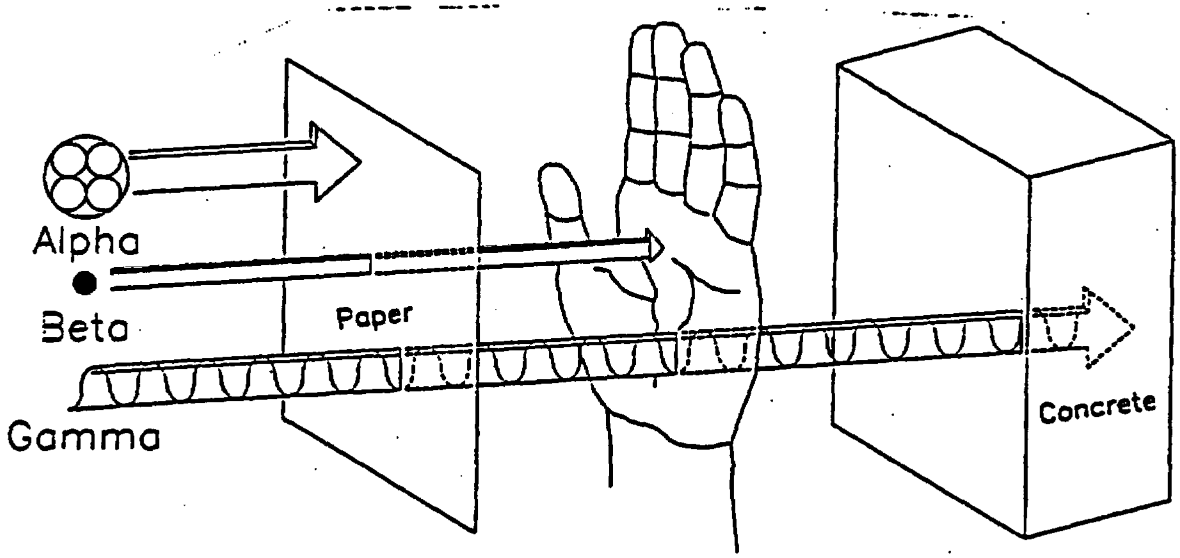


Figure 3. Penetrability of Different Types of Radiation



D. **Characteristics of Different Types of Radiation**

Determine biological effects and usefulness as well as methods of detection

1. Alpha particles - high energy; low penetrability; can be stopped by a sheet of paper or layer of dead skin cells.

2. Beta particles - moderate penetrability; several centimeters to several meters in air; less than one centimeter in tissue.

3. Gamma photons and X–rays - very penetrating; lead or concrete can be used to shield them.

E. **Radioactive Decay**

Radioactive decay is a random process. The probability of any radioactive atom decaying in a given period is defined as the *decay constant*. While it is impossible to predict when any one radioactive atom will decay, it is possible to predict the fraction of atoms that will decay in any given time interval.

$-dN/dt = \lambda N$ where λ = decay constant

$A = -dN/dt$

$-dN/dt = \lambda N$

$-\int dN/N = \lambda \int dt$

$\ln N = -\lambda t + I$ where I = constant of integration

at $t = 0$ $I = \ln N_0$

$\ln N = -\lambda t + \ln N_0$

$\ln N - \ln N_0 = -\lambda t$

$\ln N/N_0 = -\lambda t$

$N/N_0 = e^{\lambda t}$

F. **Half-life**

The half-life is the time it takes for half of the radioactive atoms present to decay.

$\ln N/N_0 = \ln 0.5 = -\lambda T_{1/2}$

$\ln 0.5 = -0.693 = -\lambda T_{1/2}$

$T_{1/2} = 0.693 / \lambda$

Half-life is characteristic of a given radionuclide and cannot be changed by chemical or physical means.

Half-lives of common radionuclides:

^{238}U	4.5 billion years
^{239}Pu	24,000 years
^{14}C	5,700 years
^{226}Ra	1,600 years
^{3}H	12.3 years

^{222}Rn	3.8 days
^{214}Po	0.000164 seconds

G. Typical Decay Equations, Characteristics

1. Particulate

   a. α decay $^{238}U \Rightarrow {}^{234}Th + {}^{4}He\ (\alpha)$

   b. β decay $^{14}C \Rightarrow {}^{14}N + \beta$

2. Electromagnetic

   a. γ $^{214}Bi \Rightarrow {}^{214}Po + \beta + \gamma$

   b. X-ray

      1. Characteristic - results from change in orbital electron shell reconfiguration following particulate decay.

      2. Bremsstrahlung ('braking radiation") - results from reduction in energy of free electron as it passes in vicinity of nucleus and bound orbital electrons.

H. Interaction of Radiation With Matter (Figures 4 and 5)

1. Charged Particle (Particulate)

   a.) Excitation - electrons raised to excited state

   b.) Ionization - electrons stripped from the atom to form ion pair

2. Electromagnetic radiation interactions with matter

   a.) Photoelectric interaction

   b.) Compton interaction

   c.) Pair production

Figure 4. Particulate Radiation Interaction with Matter

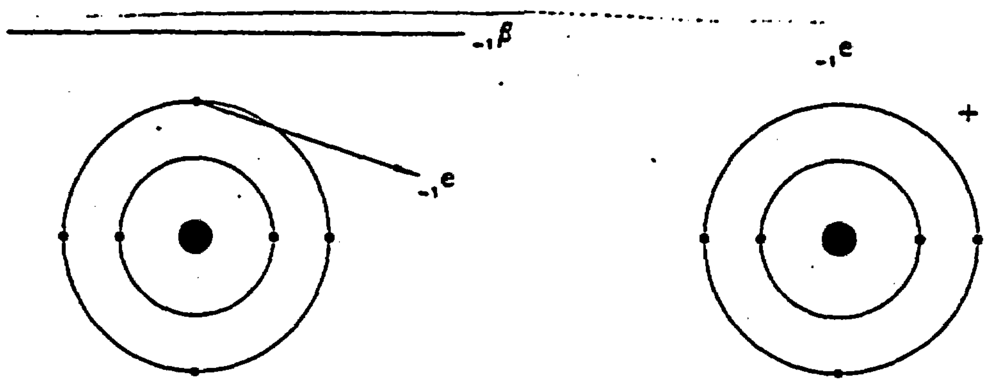
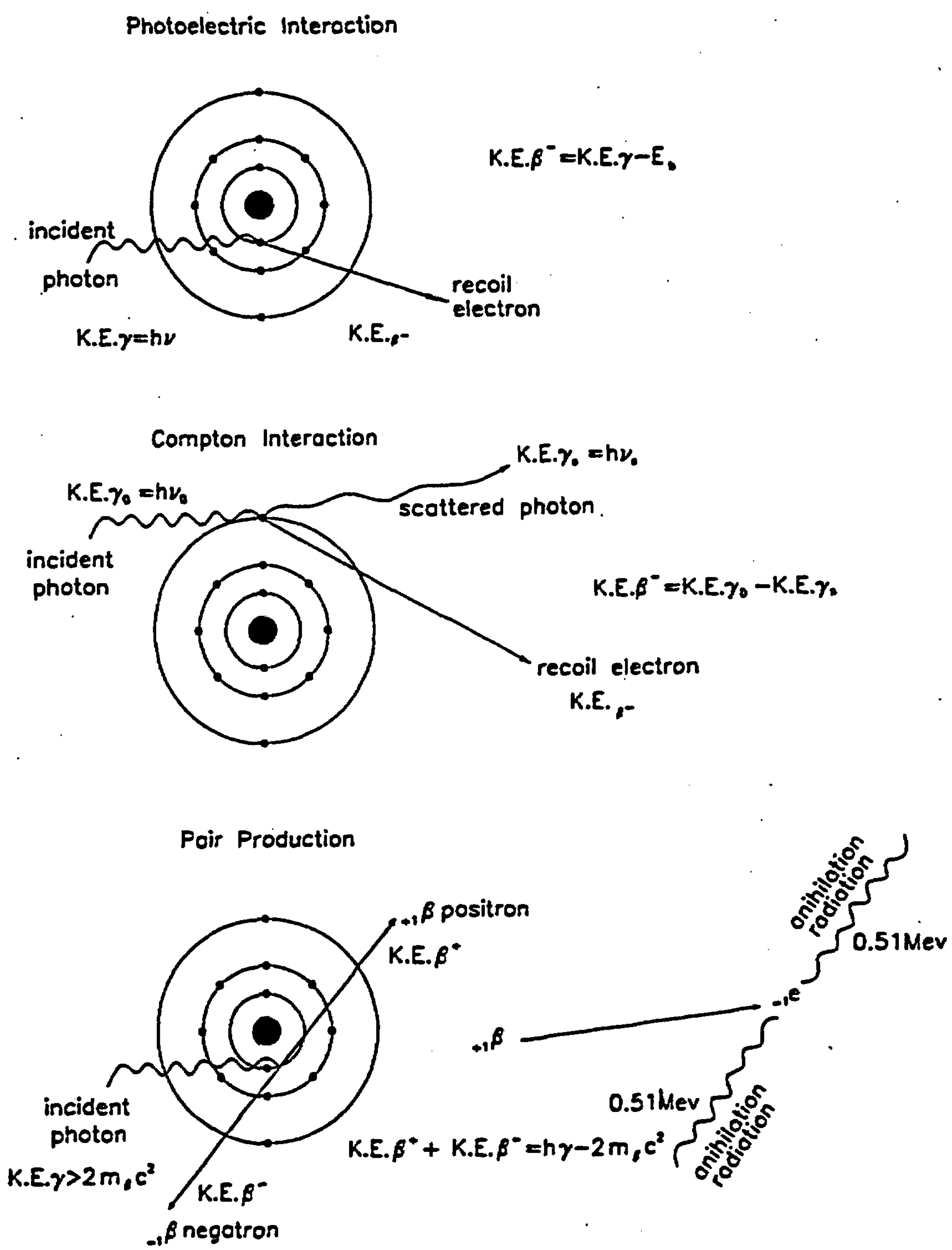


Figure 5. Electromagnetic Radiation Interaction with Matter



III. TERMS AND UNITS OF RADIATION

A. Definitions

Radiation <ionizing radiation> - alpha particles, beta particles, gamma rays, x-ray, neutrons, high-speed electrons, high-speed protons, and other particles capable of producing ions. *Radiation,* as used in this document, does not include non-ionizing radiation, such as such as radio- or microwaves, visible, infrared, or ultraviolet light.

Gray (Gy) - the SI unit of *absorbed dose.* One *gray* is equal to an *absorbed dose* of 1 J/kg (100 *rads*).

Rad (rad) - the special unit of *absorbed dose.* One *rad* is equal to an *absorbed dose* of 100 ergs/g or 0.01 J/kg (0.01 *gray*).

Rem (rem) - the special unit of any of the quantities expressed as *dose equivalent.* The *dose equivalent* in *rems* is equal to the *absorbed dose* in *rads* multiplied by the *quality factor* (1 *rem* = 0.01 *sievert*).

Sievert (Sv) - the SI unit of any of the quantities expressed as *dose equivalent.* The *dose equivalent* in *sievert* is equal to the *absorbed dose* in *grays* multiplied by the *quality factor* (1 *sievert* = 100 *rems*).

Stochastic Effects - health effects that occur randomly and for which the probability of the effect occurring, rather than its severity, is assumed to be a linear function of the *dose* without threshold. Hereditary effects and cancer incidence are examples of *stochastic effects.*

Nonstochastic Effects - health effects, the severity of which vary with *dose,* and for which a threshold is believed to exist. Radiation-induced cataract formation is an example of a *nonstochastic effect* (also called a deterministic effect).

Activity (A) - rate of disintegration (transformation) or decay of radioactive material. The units of *activity* are the curie (Ci) and the becquerel (Bq).

Exposure (X) - being exposed to ionizing radiation or radioactive material.

Dose or *Radiation Dose* - a generic term that means *absorbed dose, dose equivalent, committed dose equivalent, effective dose equivalent, committed effective dose equivalent,* or *total effective dose equivalent,* as defined below.

Absorbed Dose (D) - the energy imparted by ionizing radiation per unit mass of irradiated material. The units of *absorbed dose* are the rad (rad) and the Gray (Gy).

Quality Factor (Q) - the modifying factor that is used to derive *dose equivalent* from *absorbed dose.*

Dose Equivalent (H_T) - the product of the *absorbed dose* (in tissue medium), *quality factor,* and all other necessary modifying factors at the location of interest. The units of *dose equivalent* are the *rem* and the *sievert.*

Weighting Factor (w_T) – the proportion of the risk for an organ or tissue (T) of *stochastic effects* resulting from irradiation of that organ or tissue, to the total risk of *stochastic effects* when the whole body is irradiated uniformly.

Committed Dose Equivalent $(H_{T,50})$ - the *dose equivalent* to organs or tissues of reference (T) that will be received, from an intake of radioactive material by an individual, during the 50-year period following the intake.

Effective Dose Equivalent (H_E) - the sum of the products of each *dose equivalent* (H_T) to an organ or tissue (T) and the applicable organ or tissue *weighting factor*.

Committed Effective Dose Equivalent $(H_{E,50})$ – the sum of the products of the *weighting factor* applicable to each organ or tissue (T) irradiated and the *committed dose equivalent* applicable to each organ or tissue.

Deep-dose Equivalent (H_d) – the *dose equivalent* at a tissue depth of 1 cm (1000 mg/cm^2); applies to external whole-body *exposure*.

Total Effective Dose Equivalent (TEDE) – the sum of the *deep-dose equivalent* (H_d) for external exposures and the *committed effective dose equivalent* $(H_{E,50})$ for internal exposures.

B. Units of Activity

1. Curie (Ci) = 3.7×10^{10} disintegrations-per-second (dps) = 3.7×10^{10} becquerel (Bq)

   millicurie (mCi) = 3.7×10^{7} dps
   microcurie (µCi) = 3.7×10^{4} dps
   picocurie (pCi) = 0.037 dps

2. Becquerel = 1 dps = 2.7×10^{-11} Ci

3. Useful Conversion Factors

   1 pCi = 0.037 Bq = 2.22 disintegrations-per-minute (dpm)
   1 Bq = 27 pCi = 60 dpm

C. Units of Exposure - Roentgen - Charged Produced in Air Due to Radiation

1. Roentgen applies only to x-rays and gamma radiation

2. Roentgen (R) = 2.58×10^{4} coulombs/kg in dry air

D. Units of Absorbed Dose (D) - Energy of the Radiation Absorbed in a Medium

(In radiation safety, the medium generally considered is tissue.)

1. 1 rad = 100 ergs/g

2. 1 Gy = 1 J/kg

3. 1 Gy = 100 rads

E. Units of Dose Equivalent (H_T)

1. $H_T = D \times Q \times n$

   where n is a modifying factor which is rarely used

   a.) rem = rad x Q

b.) Sv = Gy x Q

2. Quality Factors

Type of Radiation	Quality Factor (Q)	Dose Equivalent of Absorbed Dose (D) =1 ($H_T = D \times Q$)
X-ray, γ, β radiation	1	1
α particles, multiple-charge particles, fission fragments, heavy particles of unknown charge	20	20
Neutrons of unknown energy	10	10
High-energy protons	10	10

F. **Effective Dose Equivalent (H_E)**

1. $H_E = H_T \times w_T$

2. ***Weighting Factor (w_T)*** - varies according to the organ affected and is a measure of the sensitivity of a particular organ. The risk of fatality due to radiation is less if only one organ is irradiated compared to the risk if the whole body is irradiated.

Organ or Tissue (T)	w_T
Gonads	0.25
Breast	0.15
Red Bone Marrow	0.12
Lung	0.12
Thyroid	0.03
Bone Surfaces	0.03
Remainder[(1)]	0.30
Whole Body	1.00

[(1)] 0.30 results from 0.06 for each of the five "remainder" organs (excluding the skin and lens of the eye) that receive the highest doses.

III. RADIATION BIOEFFECTS

A. Radiation Exposure

1. External - source of radiation remains outside the body as with medical x-rays.

   a.) α Particles - because they cannot penetrate the layer of dead skin cells, alpha particles are not typically a hazard outside the body.

   b.) β Particles - can cause damage to the skin from outside the body but cannot reach other major organs.

   c.) γ– and x-rays - can penetrate to any part of the body to cause damage to major organs.

2. Internal - radioactive material inside the body

   a.) Routes of entry

      i.) Inhalation - most common

      ii.) Ingestion - common

      iii.) Absorption through the skin – less common

      iv.) Injection – least common

   b.) Deposition in body organs depends on the nuclide and chemical form; is generally independent of radiological characteristics.

   c.) Alpha particles are approximately 20 times more hazardous (Q=20) than beta particles and gamma photons per unit of energy absorbed.

      i.) High Linear Energy Transfer (LET) (high concentration of ion pairs)

      ii.) Greater concentration of damage to cells in a small volume of tissue

B. Cellular Effects of Radiation Dose

1. None - incident radiation has no interaction/effect in cell
2. Cell Repair - cell completely repairs damage
3. Cell Killing - cell is damaged to the extent that it cannot reproduce
4. Cell Transformation - cell is damaged but retains the ability to reproduce; mechanisms that control cell replication may be damaged so that cell divides in an uncontrolled fashion

C. Acute Effects of Radiation Dose

1. Types of exposures

   Chernobyl firemen
   Nuclear war
   Criticality accidents
   Other accidents (Brazil, Mexico, etc.)

2. Acute radiation sickness - cell killing

   a.) Hematopoietic syndrome
   b.) Gastro-intestinal syndrome
   c.) Central Nervous System (CNS) effects

3. Effect of fractionation of dose

D. Chronic Effects of Low Level Radiation Dose (Figures 6 and 7)

1. Chronic effects of radiation have not been observed in human populations

   a.) Inferred from animal studies

   b.) Epidemiological studies of populations exposed at relatively high radiation levels

      i.) Hiroshima and Nagasaki

      ii.) Medically irradiated patients

2. Increased risk of cancer is the principal concern with chronic exposure to radiation

   a.) Mechanism - radiation damages the cell and causes it to reproduce in an uncontrolled manner.

   b.) Dose response relationship - it is assumed that the increase in cancer risk is a linear function of incremental dose (linear-non-threshold assumption).

   c.) Risk estimates based on studies of Hiroshima and Nagasaki survivors.

3. Genetic effects

   a.) Genetic effects have not been observed in human populations but have been inferred from animal studies.

   b.) British studies have shown an increased risk of childhood leukemia among children whose fathers worked in a nuclear plant. However, this effect has not been seen in other populations such as the A-bomb survivors and individuals in areas with abnormally high background radiation levels. Most experts in radiation safety generally discount this effect.

   c.) Current wisdom: Genetic effects are not as significant as once believed to be.

4. Effects on the fetus

   a.) Birth defects seen at Hiroshima and Nagasaki at relatively high radiation doses (10-50 rads).

   b.) Increased risk of childhood leukemia among children irradiated in utero.

   c.) Increased risk of spontaneous abortion seen in female veterinary personnel who used diagnostic x-rays in their practices during pregnancy (two studies).

Figure 6. Direct and Indirect Effects of Radiation on Cells

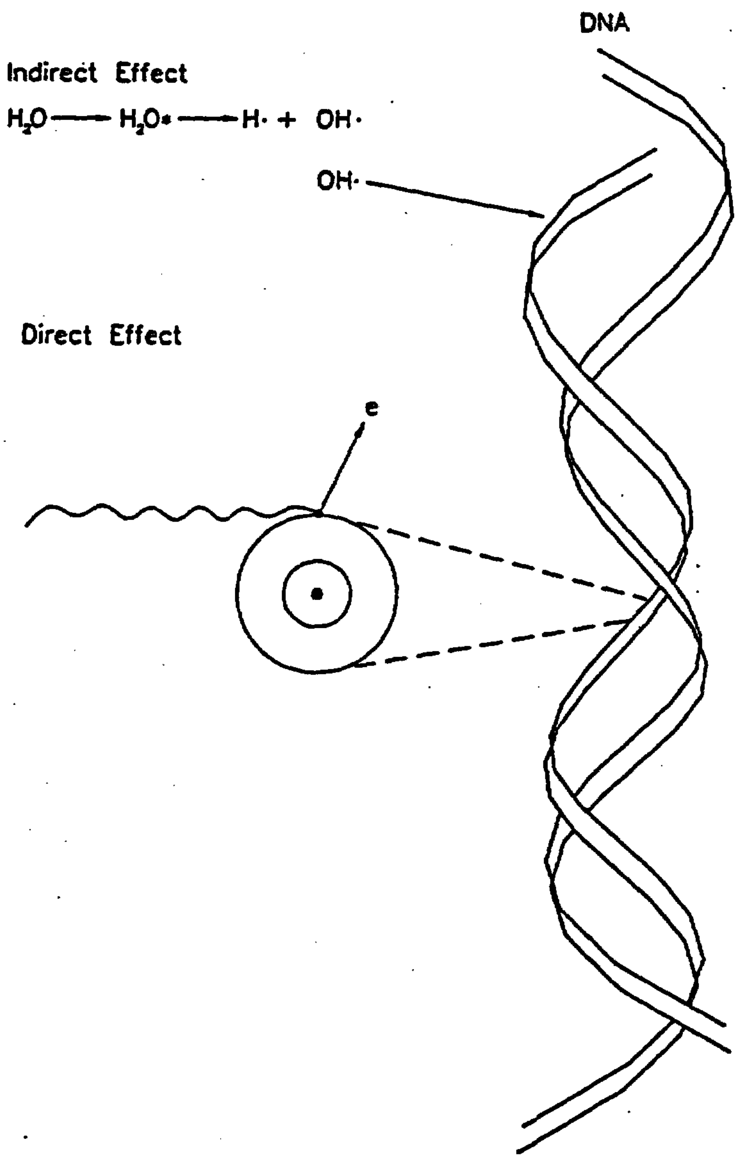
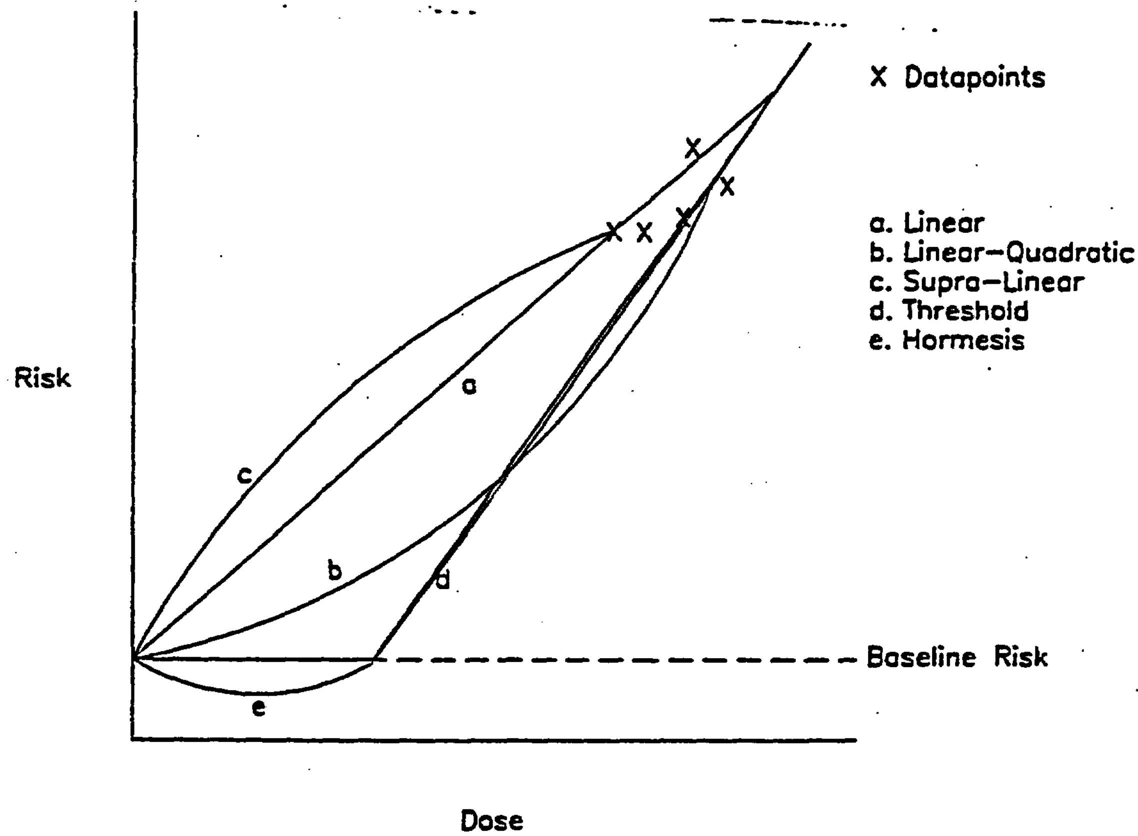


Figure 7. Radiation Dose Response Models



IV. SOURCES OF RADIATION

A. Natural Background

Radiation has been a part of the environment since the world was formed. It comes from earth's crust, outer space, and internally deposited, naturally occurring radionuclides.

1. Cosmic Radiation - Comes from outer space; levels increase with altitude because there is a thinner blanket of atmosphere to absorb the radiation.

   Levels in Denver are twice the national average
   Levels in Leadville are twice the levels in Denver.

2. Terrestrial Radiation - naturally occurring radionuclides in the earth's crust.
   - a.) Uranium series
   - b.) Thorium series
   - c.) ^{40}K

3. Internal radiation
   - a.) Uranium series
   - b.) ^{40}K
   - c.) Other radionuclides (^{3}H, ^{14}C, etc.)

B. "Man-made" Radiation

1. Fallout from nuclear bomb testing and nuclear accidents
2. Medical x-rays
3. Consumer products - smoke detectors, TV screens, lenses
4. Reactors

C. Technologically Enhanced Radiation

Natural radioactivity which has been brought to the surface or used in a way which increases radiation dose to people.

1. Uranium mill tailings and other mining and milling waste
2. Indoor radon - shelter, energy conservation

D. Natural Background Radiation Levels

1. Background radiation levels depend on the location of residence, life-style factors.

Radiation Type	Average Annual Background Dose (mrem/yr)	
	U. S. Average	Denver
Cosmic	28	50
Terrestrial	28	82
Internal	39	39
Indoor Radon	200	400
Total	295	571

2. Other doses from natural background
   a.) Cross-country airplane flight - 2 mrem
   b.) One week of skiing at 10,000 ft. - 1 mrem
   c.) Living at 6,000 ft. rather than 5,000 ft. - 7 mrem/yr
   d.) Cigarette smoking: 1,300 mrem/yr

E. Typical Medical X-rays

1. Annual average - 50-100 mrem/yr
2. Chest x-ray - 10 mrem
3. Dental x-ray series - 5-10 mrem

F. Environmental and Occupational Doses

1. Mean for radiation worker - 100-200 mrem/yr
2. Limit for radiation worker - 5,000 mrem/yr
3. Excess Dose at the boundary of Rocky Flats - 1 mrem/yr

V. COMPARISON OF VARIOUS LEVELS OF RADIATION DOSE

A. Acute Dose

1. Acute Radiation Sickness

   a.) Blood abnormalities observed - 50-100 rad

   b.) LD_{50}: 300-350 rad

   c.) Acute radiation sickness

      i.) Hematopoietic syndrome - >100 rad
      ii.) GI tract syndrome - >300 rad
      iii.) CNS effects - 1,000 rad

2. Fractionated doses or partial body irradiation reduces the severity of acute effects

B. Chronic Doses

1. Typical natural background: 0.2-0.3 rem/yr (including indoor radon)

2. Typical diagnostic x-rays: 0.01-1 rem

3. Maximum permissible dose to worker - 5 rem/yr

4. Maximum allowable dose to a member of the general public: 0.1 rem/yr

5. Maximum allowable dose to the fetus: 0.5 rem

6. Indoor radon: 0.1-10+ rem/yr

   Average U.S.: 0.2 rem/yr
   Average Colorado: 0.4 rem/yr

VI. RADIATION RISKS

A. Fatal Cancer

Risk coefficient calculated on the basis of Hiroshima and Nagasaki studies = 8×10^{-4} per rem

Risk coefficient adjusted for dose-rate effectiveness and non-fatal detriments = 6.2×10^{-4} per rem.

B. Genetic Effects (in first two generations)

1×10^{-4} per rem

C. Risk in Perspective

Estimated annual risk of fatality due to common activities

All risks from smoking	3.0 in 10^3
Cancer risk from smoking	1.2 in 10^3
Work in agricultural jobs	6.0 in 10^4
Motor vehicle accidents	2.4 in 10^4
Home accidents	1.1 in 10^4
Work in service and government jobs	1.1 in 10^4

Average lifetime risk from one year of exposure:

Indoor radon	
Smoker	2.0 in 10^4
Non-smoker	3.0 in 10^5
Natural background (excluding radon)	
Colorado	7.0 in 10^5
U.S. Average	4.0 in 10^5

EPA acceptable risk level for environmental contaminants (lifetime risk of 1 in 1,000,000)

Annual acceptable risk	2.0 in 10^8

VII. RADIATION DETECTION

A. Gas Ionization (Figures 8 and 9)

Incident radiation produces ions in a gas; electrons are collected on an anode to produce an electrical pulse or a current.

1. Ionization Chambers - all ions produced directly by the radiation are collected on the anode to produce a pulse that is equal to the amount of energy deposited in the chamber. Pulse can be converted to current.

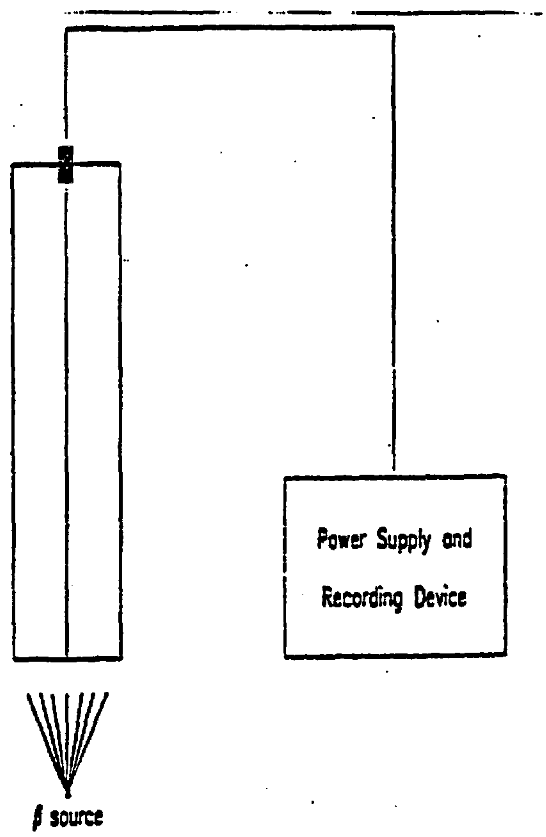
2. Proportional Counters - when the voltage on the anode is great enough, the electrons produced initially by the radiation may be given sufficient energy to cause "secondary" ionization.

   With proportional counters, alpha particles can be detected in the presence of betas.

3. GM Counters - when the voltage on the anode is high enough, the chamber may be saturated. That is, the size of the pulse is independent of the energy initially deposited in the chamber or tube by the radiation. As long as one ion pair is formed in the tube, the size of the pulse will be equal to the maximum. GM counters cannot discriminate between different types of radiation.

   GM counters are much more efficient for detecting betas than gammas and are usually used for detecting and quantifying surface contamination or activity of a sample.

Figure 8. Radiation Detection by Gas Ionization



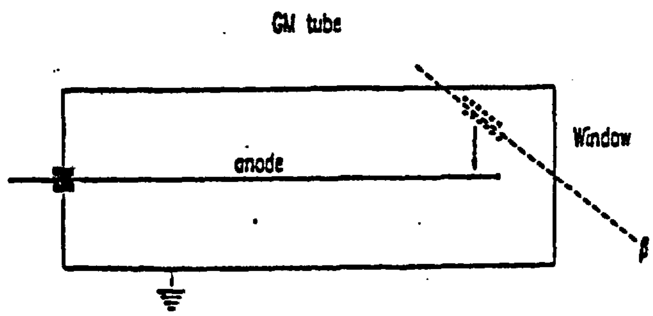
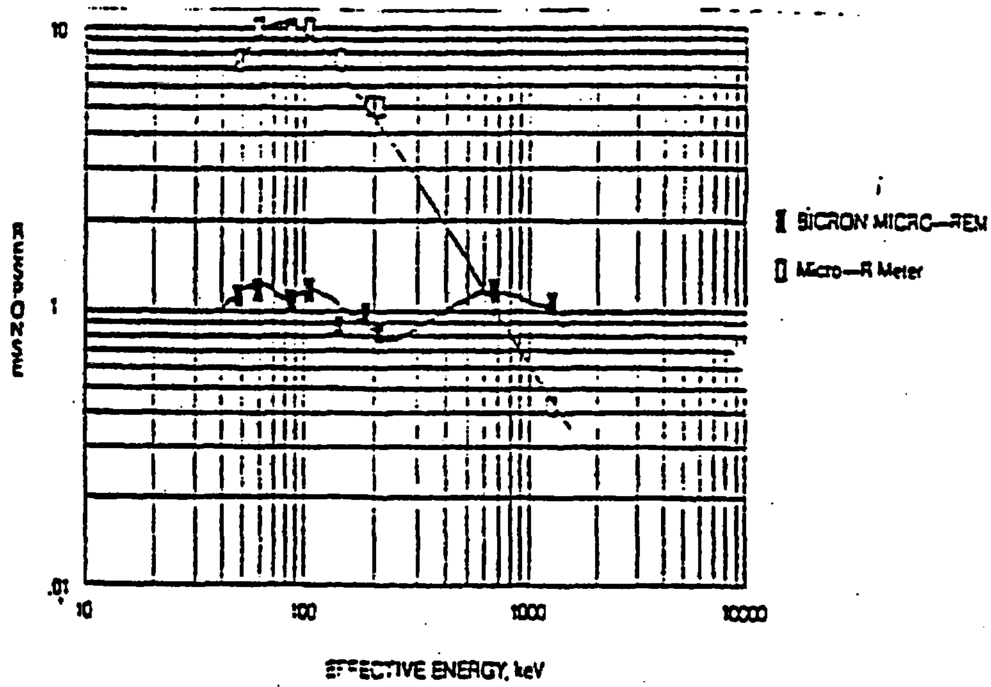


Figure 9. Log Scale Efficiency Chart



B. Scintillation (Figures 10, 11, 12 and 13)

Electrons in a crystal exist in a specific energy state (ground state) unless they are excited to a higher energy level. Radiation passing through a crystal can raise crystal electrons to the excited state in proportion to the amount of energy deposited in the crystal.

When excited electrons in certain crystals drop back down to the ground state they release light photons. These photons can be converted to an electrical pulse by the use of a photomultiplier tube. The size of the pulse is directly proportional to the amount of energy absorbed by the crystal.

1. Gamma and X-ray Survey Meters (NaI crystals)
   a.) Gamma scintillometer - moderate to high energy gammas and x-rays
   b.) Thin crystal scintillometers - low energy x-rays and gammas
2. Alpha Survey Meters (ZnS Crystal)
3. Gamma Spectrometers (NaI Crystals)
4. Liquid Scintillation Counters

C. Personal Monitors

1. Purpose
   a. Integrated measurement of radiation doses from various types of radiation
   b. Provide documented radiation exposure records
2. Types
   a. Film Badges - α, β, n
   b. Thermoluminescent Dosimeters (TLDs) – γ, X-ray, n
   c. Workspace/Breathing Zone Air Particulate Detectors – various emissions; physical collection medium

D. Semi-Conductors

1. GeLi Detectors - γ Spectroscopy
2. Surface Barrier Detectors - α Spectroscopy

Figure 10. Radiation Detection by Scintillation

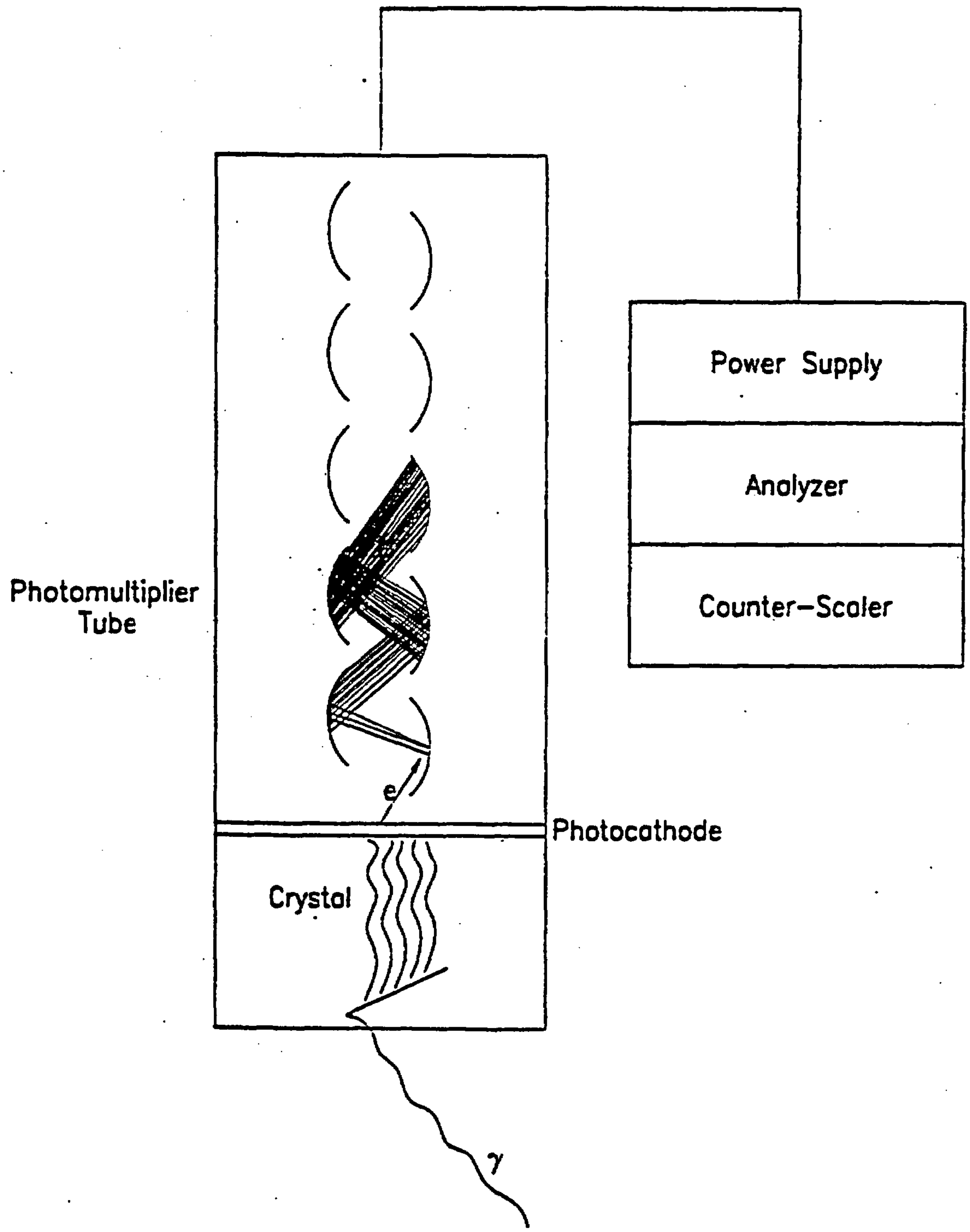


Figure 11. Pulse Size versus Voltage

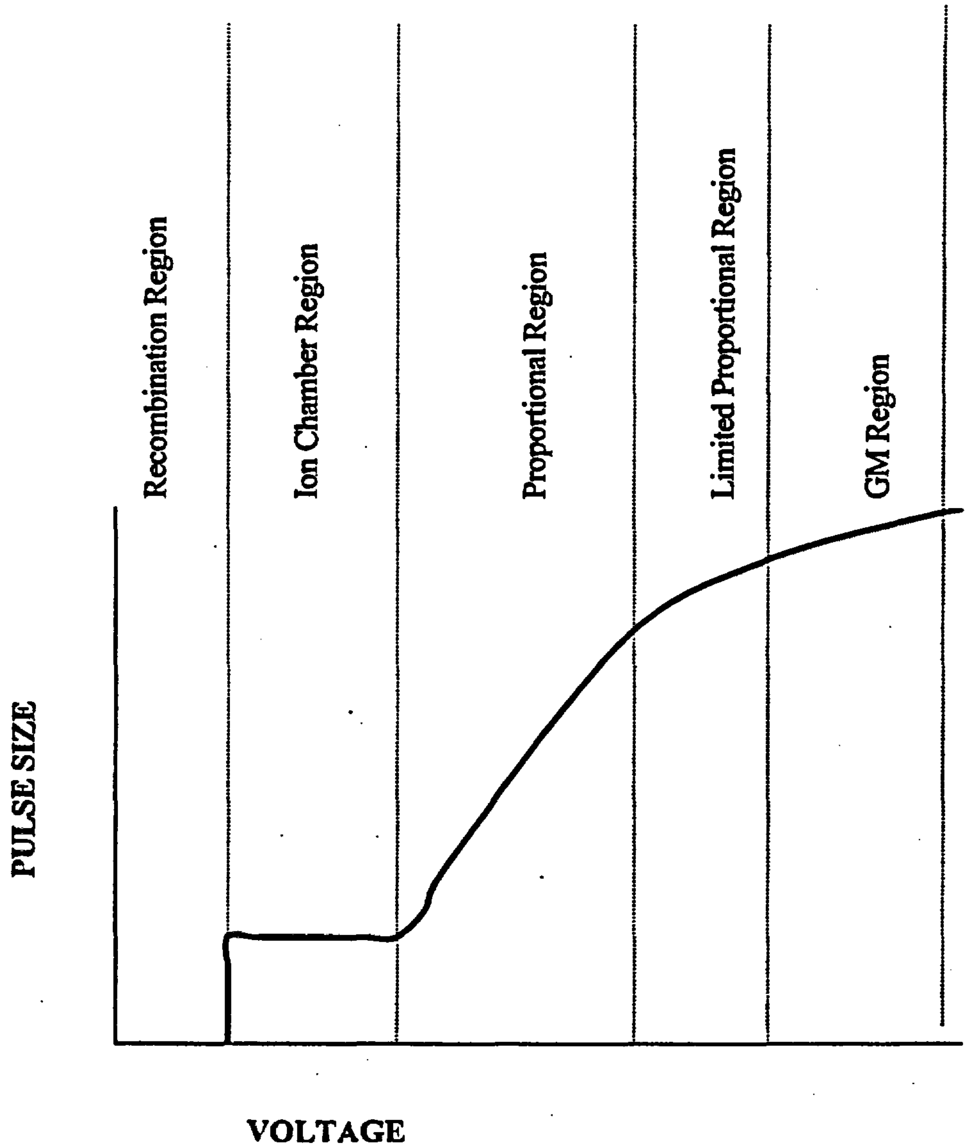


Figure 12. Typical Alpha Spectrum

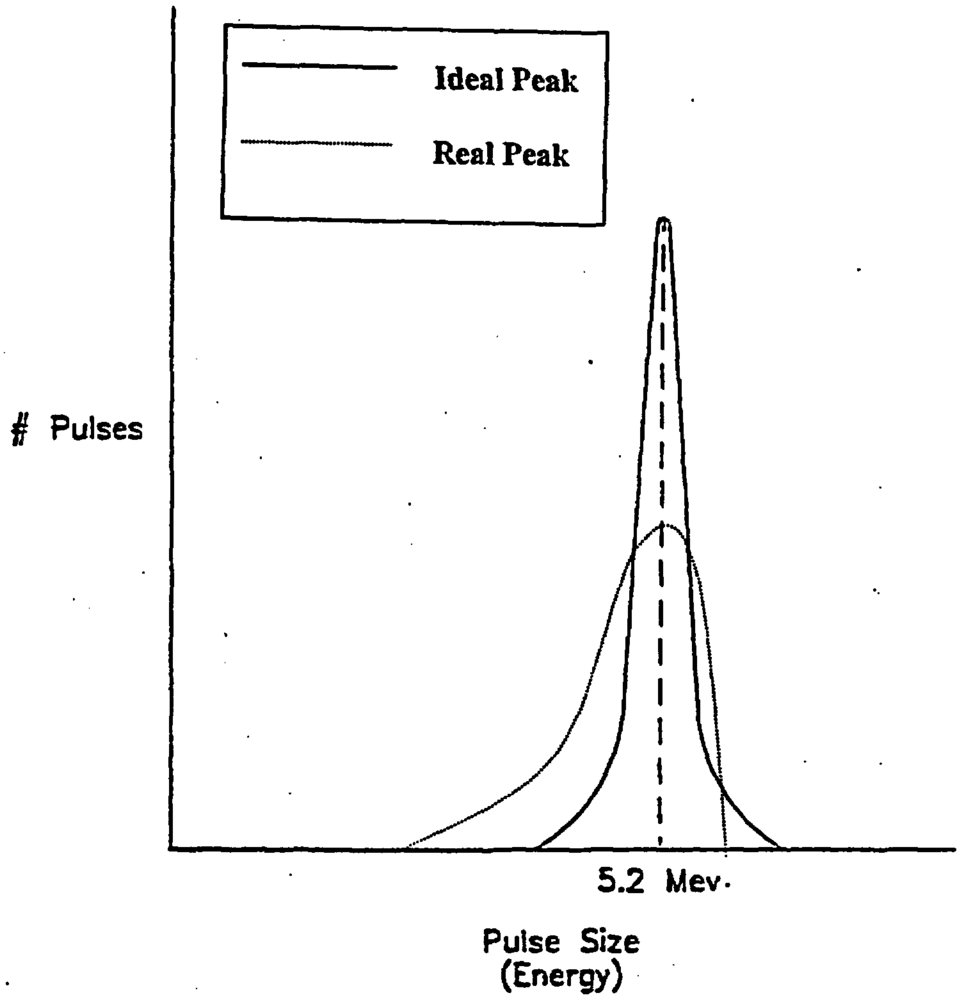
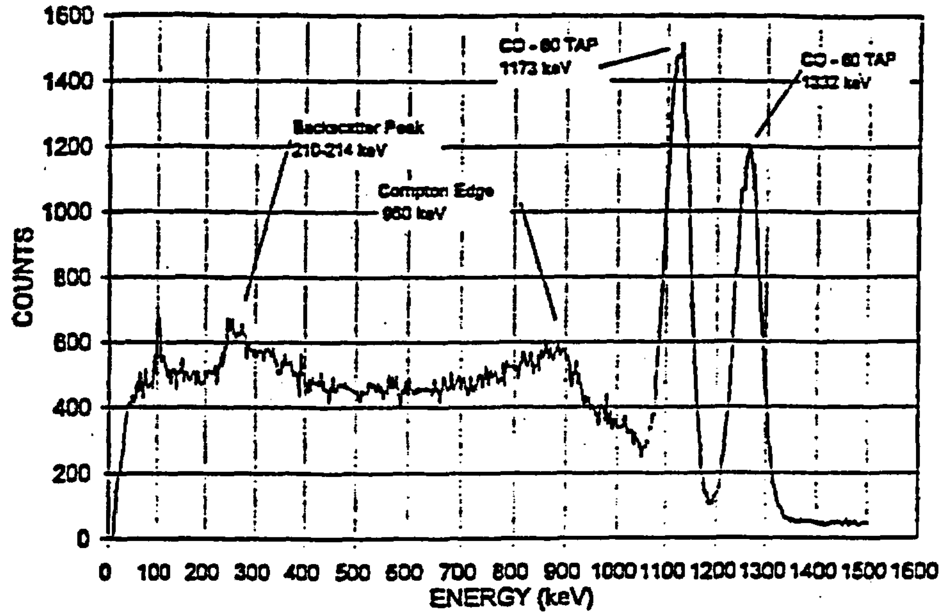
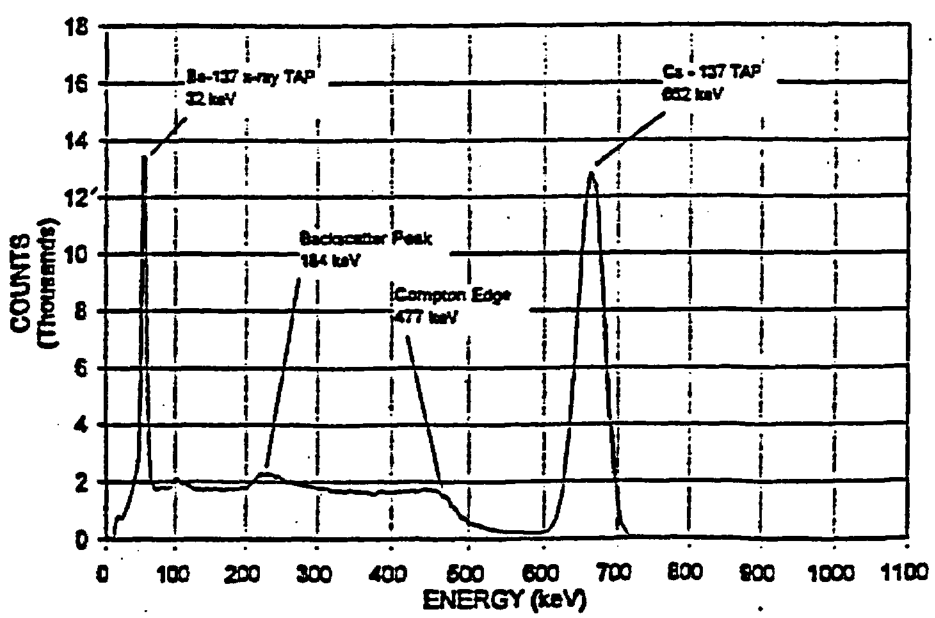


Figure 13. Typical Gamma Ray Spectrum

Co-60 SPECTRUM



Cs-137 SPECTRUM



IX. STANDARDS AND REGULATIONS

A. Process

1. USEPA provides guidance that is binding on other regulatory agencies - recommends radiation safety standards.

2. Nuclear Regulatory Commission (NRC) regulates "byproduct" and "source" material - issues licenses for use of radioactive materials.

3. Agreement States accept the responsibility for regulating the use of radioactive materials in place of the NRC.

   a.) New York is an Agreement State

   New York Department of Conservation, Bureau of Radiation and Hazardous Site Management
   Bureau Director - Paul Merges
   Radiation Section Chief – Barbara Youngberg

   b.) Utah is an Agreement State

   c.) Wyoming is an example of a non-Agreement State - NRC regulates use of radioactive materials.

4. Radiation producing machines such as x-ray machines are generally regulated by the state.

5. Nuclear reactors are regulated by the NRC.

B. Regulations

1. Federal - 10 CFR 20

   Based on the 1977 recommendations of the International Commission on Radiological Protection (ICRP). The ICRP revised its 1977 recommendations in 1991. It will be at least 10 years before the new recommendations are implemented in the United States.

2. State – 6 NYCRR Part 380 and TAGM 4003

   State regulations must conform to a standard set by the Conference of Radiation Control Directors. State standards must be at least as stringent as NRC standards. State regulations are governed by the New York Code of Rules and Regulations (6 NYCRR Part 380) and Technical and Administrative Guidance Manual (TAGM) 4003 for the Cleanup of Soils.

C. **Table of Radiation Safety Standards**

Radiation Worker	Component(s)	Dose Equivalent
Total Effective Dose Equivalent[1]	$H_d + H_{E,50}$	5 rem/year
Single Organ Dose Equivalent	Organ $H_d + H_{T,50}$	50 rem/year
Lens of the Eye	Lens Dose Equivalent	15 rem/year
Skin or any Extremity	Shallow Dose Equivalent	50 rem/year
Worker Under 18	TEDE	0.5 rem/year
Fetus (Declared Pregnant Worker)[2]	TEDE	0.5 rem/gestation period
Annual Limit of Intake[3]	ALI	Nuclide Specific
Derived Air Concentration[4]	DAC	Nuclide Specific
General Public		
Any member	TEDE	0.1 rem/year
Specific member with prior approval of the regulatory agency	TEDE	0.5 rem/year

[1]Total Effective Dose Equivalent (TEDE) is the sum of the internal effective dose equivalents and the external dose equivalents.

[2]The worker must declare the pregnancy in writing to the employer in order for the dose limit to the fetus to be implemented.

[3]Annual Limit of Intake is that intake of a radionuclide that will result in a committed effective dose equivalent of 5 rem for a worker or 100 mrem for the general public.

[4]Derived Air Concentration (DAC) is that concentration of a radionuclide in air which will result in a committed effective dose equivalent to a worker of 5 rem if inhaled for 2,000 hours/year or a committed effective dose equivalent of 100 mrem to a member of the general public if inhaled for 8,760 hours/year.

X. BASIC RADIATION SAFETY

A. Basic Principles of Radiation Safety

1. Justification
2. Optimization

   ALARA - keep doses As Low As Reasonably Achievable, social and economic factors being taken into account.

3. Limitation

B. Protection Against External Radiation

1. Time of exposure
2. Distance from the source
3. Shielding
   - a.) Types
     - Concrete walls
     - Lead aprons and gloves
   - b.) Reduction in dose due to shielding is an exponential function with shielding thickness.

C. Protection Against Internal Radiation (same as for any contaminant)

1. Prevent ingestion
2. Prevent inhalation
3. Prevent absorption/injection through the skin
4. Control methods
   - a.) Isolation - ventilation, hoods, shielding
   - b.) Substitution
   - c.) Good housekeeping
   - d.) Administrative controls
   - e.) Personal protective devices - respirators, gloves, anti-Cs

XI. COMMONLY USED CALCULATIONS

A. Specific Activity (activity per unit mass)

$$A = \lambda N$$

where:

A ≡ activity (Bq/g)
λ ≡ decay constant = ln $2/T_{1/2}$
N ≡ number of atoms present
$T_{1/2}$ ≡ nuclide half-life

B. Decay

$$A_t = A_o e^{-\lambda t}$$

where:

A_t ≡ activity at time t
A_o ≡ activity at time zero
λ ≡ decay constant = ln $2/T_{1/2}$
$T_{1/2}$ ≡ nuclide half-life
t ≡ time

C. Inverse Square Law

Exposure from a source is inversely proportional to the square of the distance from the source. This is applicable to a photo-emitting source whose largest dimension is small with respect to its distance from the exposure point.

$$X_1/X_2 = (d_2/d_1)^2$$

XI. RADON

A. **Natural Radioactivity in the Earth's Crust**

1. ^{40}K

a.) Natural abundance - 0.0119%

b.) Total in the body - 140 g (0.12 μCi)

2. Uranium

a.) Decay scheme (Figures 14 and 15)

b.) Concentration in the earth's crust - 4 ppm

c.) Concentration in typical ore - 0.2%

d.) Concentration of radium in soil

i.) Background: 1-5 pCi/g

ii.) Limits for clean-up of impacted sites

5 pCi/g in the first 15 cm
15 pCi/g below the first 15 cm

3. Thorium

a.) Decay scheme (Figure 16)

b.) Concentration in the earth's crust ~ 10 ppm

B. **Radon Gas - Decay Product of Uranium**

1. History

a.) Occupational exposure

1500s - Central Europe - lung disease in miners noted

1879 - Miners' disease recognized as cancer

1932 - Radon gas implicated as the cause

1954 - Prospective study of US miners initiated

1960s - Radon daughters generally accepted as the causative agent

b.) Residential exposure (indoor radon)

1970s - Health physics profession expressed concern due to energy conservation
Scandinavian studies published

1984 - Watras house in Pennsylvania - Reading Prong

1986 - EPA guidelines published

1990s - Building regulations

c.) Terminology

i.) Working Level (WL) - 100 pCi / L radon in equilibrium with its short-lived daughters or any combination of daughters with an equivalent energy potential (1.3×10^5 MeV total alpha energy through complete decay)

ii.) Working Level Month (WLM)

WLM = WL x hours exposed / 170 hours / month

d.) Regulations and guidelines

i.) Occupational

Current MSHA - 4 WLM / yr

Proposed MSHA - 1 WLM / yr

NIOSH recommendation - 1 WLM / yr

Average for underground uranium miners in the 1980s - 1 WLM / yr

ii.) Indoor radon (occupational and residential)

EPA Guideline - 4 pCi / L - 0.8 WLM / yr

NCRP Recommendation - 2 WLM / yr

Mean US - 0.2 WLM / yr (1 pCi / L)

Mean Denver - 0.5 WLM / yr (2.5 pCi / L)

C. **Biological Effects of Inhalation of Radon Daughters**

1. Deposition of daughters attached to particulates in upper bronchial tree
2. Deposition of unattached daughters in the upper respiratory tract
3. Irradiates bronchial epithelium (basal cells)
4. Cancer induction in the upper bronchial region

Figure 14. Decay Scheme for Uranium 238

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities† α	β	γ
$^{238}_{92}U$	Uranium I	4.51×10^{9} y	4.15 (25%) 4.20 (75%)	---	---
$^{234}_{90}Th$	Uranium X_1	24.1d	---	0.103 (21%) 0.193 (79%)	0.063c* (3.5%) 0.093c (4%)
$^{234m}_{91}Pa$ (99.87% / 0.13%)	Uranium X_2	1.17m	---	2.29 (98%)	0.765 (0.30%) 1.001 (0.60%)
$^{234}_{91}Pa$	Uranium Z	6.75h	---	0.53 (66%) 1.13 (13%)	0.100 (50%) 0.70 (24%) 0.90 (70%)
$^{234}_{92}U$	Uranium II	2.47×10^{5} y	4.72 (28%) 4.77 (72%)	---	0.053 (0.2%)
$^{230}_{90}Th$	Ionium	8.0×10^{4} y	4.62 (24%) 4.68 (76%)	---	0.068 (0.6%) 0.142 (0.07%)
$^{226}_{88}Ra$	Radium	1602y	4.60 (6%) 4.78 (95%)	---	0.186 (4%)
$^{222}_{86}Rn$	Emanation Radon (Rn)	3.823d	5.49 (100%)	---	0.510 (0.07%)
$^{218}_{84}Po$ (99.98% / 0.02%)	Radium A	3.05m	6.00 (~100%)	0.33 (~0.019%)	---
$^{214}_{82}Pb$	Radium B	26.8m	---	0.65 (50%) 0.71 (40%) 0.98 (6%)	0.295 (19%) 0.352 (36%)
$^{218}_{85}At$	Astatine	~2s	6.65 (6%) 6.70 (94%)	? (~0.1%)	---
$^{214}_{83}Bi$ (99.98% / 0.02%)	Radium C	19.7m	5.45 (0.012%) 5.51 (0.008%)	1.0 (23%) 1.51 (40%) 3.26 (19%)	0.609 (47%) 1.120 (17%) 1.764 (17%)
$^{214}_{84}Po$	Radium C'	164μs	7.69 (100%)	---	0.799 (0.014%)
$^{210}_{81}Tl$	Radium C"	1.3m	---	1.3 (25%) 1.9 (56%) 2.3 (19%)	0.296 (80%) 0.795 (100%) 1.31 (21%)
$^{210}_{82}Pb$	Radium D	21y	3.72 (.000002%)	0.016 (85%) 0.061 (15%)	0.047 (4%)
$^{210}_{83}Bi$ (~100% / .00013%)	Radium E	5.01d	4.65 (.000007%) 4.69 (.000005%)	1.161 (~100%)	---
$^{210}_{84}Po$	Radium F	138.4d	5.305 (100%)	---	0.803 (0.0011%)
$^{206}_{81}Tl$	Radium E"	4.19m	---	1.571 (100%)	---
$^{206}_{82}Pb$	Radium G	Stable	---	---	---

Figure 15. Decay Scheme for Uranium 235

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{235}_{92}U$	Actinouranium	7.1×10^{8}y	4.37 (18%) 4.40 (57%) 4.58c‡ (8%)	---	0.143 (11%) 0.185 (54%) 0.204 (5%)
$^{231}_{90}Th$	Uranium Y	25.5h	---	0.140 (45%) 0.220 (15%) 0.305 (40%)	0.026 (2%) 0.084c (10%)
$^{231}_{91}Pa$	Protoactinium	3.25×10^{4}y	4.95 (22%) 5.01 (24%) 5.02 (23%)	---	0.027 (6%) 0.29c (6%)
$^{227}_{89}Ac$ 98.6% / 1.4%	Actinium	21.6y	4.86c (0.18%) 4.95c (1.2%)	0.043 (~99%)	0.070 (0.08%)
$^{227}_{90}Th$	Radioactinium	18.2d	5.76 (21%) 5.98 (24%) 6.04 (23%)	---	0.050 (8%) 0.237c (15%) 0.31c (8%)
$^{223}_{87}Fr$	Actinium K	22m	5.44 (~0.005%)	1.15 (~100%)	0.050 (40%) 0.080 (13%) 0.234 (4%)
$^{223}_{88}Ra$	Actinium X	11.43d	5.61 (26%) 5.71 (54%) 5.75 (9%)	---	0.149c (10%) 0.270 (10%) 0.33c (6%)
$^{219}_{86}Rn$	Emanation Actinon (An)	4.0s	6.42 (8%) 6.55 (11%) 6.82 (81%)	---	0.272 (9%) 0.401 (5%)
$^{215}_{84}Po$ ~100% / .00023%	Actinium A	1.78ms	7.38 (~100%)	0.74 (~.00023%)	---
$^{211}_{82}Pb$	Actinium B	36.1m	---	0.29 (1.4%) 0.56 (9.4%) 1.39 (87.5%)	0.405 (3.4%) 0.427 (1.8%) 0.832 (3.4%)
$^{215}_{85}At$	Astatine	~0.1ms	8.01 (~100%)	---	---
$^{211}_{83}Bi$ 0.28% / 99.7%	Actinium C	2.15m	6.28 (16%) 6.62 (84%)	0.60 (0.28%)	0.351 (14%)
$^{211}_{84}Po$	Actinium C'	0.52s	7.45 (99%)	---	0.570 (0.5%) 0.90 (0.5%)
$^{207}_{81}Tl$	Actinium C"	4.79m	---	1.44 (99.8%)	0.897 (0.16%)
$^{207}_{82}Pb$	Actinium D	Stable	---	---	---

Figure 16. Decay Scheme for Thorium 232

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{232}_{90}Th$	Thorium	1.41×10^{10}y	3.95 (24%) 4.01 (76%)	—	—
$^{228}_{88}Ra$	Mesothorium I	6.7y	—	0.055 (100%)	—
$^{228}_{89}Ac$	Mesothorium II	6.13h	—	1.18 (35%) 1.75 (12%) 2.09 (12%)	0.34c† (15%) 0.908 (25%) 0.96c (20%)
$^{228}_{90}Th$	Radiothorium	1.910y	5.34 (28%) 5.43 (71%)	—	0.084 (1.6%) 0.214 (0.3%)
$^{224}_{88}Ra$	Thorium X	3.64d	5.45 (6%) 5.68 (94%)	—	0.241 (3.7%)
$^{220}_{86}Rn$	Emanation Thoron (Tn)	55s	6.29 (100%)	—	0.55 (0.07%)
$^{216}_{84}Po$	Thorium A	0.15s	6.78 (100%)	—	—
$^{212}_{82}Pb$	Thorium B	10.64h	—	0.346 (81%) 0.586 (14%)	0.239 (47%) 0.300 (3.2%)
$^{212}_{83}Bi$	Thorium C	60.6m	6.05 (25%) 6.09 (10%)	1.55 (5%) 2.26 (55%)	0.040 (2%) 0.727 (7%) 1.620 (1.8%)
64.0% → $^{212}_{84}Po$	Thorium C'	304ns	8.78 (100%)	—	—
36.0% → $^{208}_{81}Tl$	Thorium C"	3.10m	—	1.28 (25%) 1.52 (21%) 1.80 (50%)	0.511 (23%) 0.583 (86%) 0.860 (12%) 2.614 (100%)
$^{208}_{82}Pb$	Thorium D	Stable	—	—	—

Attachment 2 to Appendix B

Standard Operating Procedures
Process Residuals Monitoring

ATTACHMENT 2
STANDARD OPERATING PROCEDURE FOR PROCESS RESIDUALS MONITORING

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to monitor contamination and external gamma radiation control practices. This SOP contains procedures for performing contamination and external gamma radiation surveys and associated limits.

2.0 POLICY

It is the policy of GTE Operations Support Incorporated (GTEOSI) to provide a safe working environment for workers. Contamination and external gamma radiation control is a major aspect of this policy. This policy has been created specifically for the field operations at the Hicksville Site.

3.0 SAFETY ISSUES

- Standard safety protocol shall be observed at all times.
- Treat all samples and unknowns as potentially hazardous. Radioactive materials need to be handled with caution.
- All personnel shall perform their work in a safe manner and shall keep exposures to radiation and hazardous materials as low as reasonably achievable (ALARA).
- This procedure does not purport to address all of the safety issues. It is the responsibility of the user to establish appropriate health and safety practices and determine the applicability and regulatory limitations prior to use.

4.0 SCOPE/APPLICABILITY

4.1 Categories

This SOP applies to the four categories of contamination and radiological control listed below.

4.1.1 Facility/Site

4.1.1.1 Contamination Control

The basis for contamination control at the Site is driven by process residuals. The detection limits of survey instrumentation used at the Site should be adequate to perform direct measurements (scans) to quantify contamination values at the applicable action limits.

4.1.1.2 External Gamma Radiation

The basis for external gamma radiation monitoring at the Site is to identify areas where elevated exposure rate fields might exist. Elevated exposure rate fields at the Site are expected to be in the vicinity of excavation and segregated piles of elevated soils. No area at the Site is expected to exhibit gamma exposure rate levels that would require restricted classification (ex: classification of a 'restricted area') per the applicable State regulations.

4.2.1 Equipment/Materials

On occasion the Site will release equipment and materials that have been used in radiological activities for unrestricted use or conventional disposal. It is important to verify that such materials and equipment do not contain radioactive contamination, as a result of radiological activities, in excess of regulatory limits for unrestricted release. The appropriate limits to be used to satisfy this requirement are those set forth in the document entitled "Radiation Safety Surveys at Medical Institutions" (NRC Regulatory Guide 8.23)(**Exhibit 1**). These values are the same as those set forth in the NRC Regulatory Guide 1.86 for nuclear facilities.

4.2.2 Shipping/Receiving

The criteria for shipping radioactive materials are set forth in 49 CFR 172 and 173. Section 172.403 established external gamma dose rate limits for a package containing radioactive materials that is offered for transport (**Exhibit 2**). Section 173.443 establishes contamination limits for a package containing radioactive materials that is offered for transport (**Exhibit 3**), as well as the maximum contamination levels that can occur on a package during transport (as a result of the radioactive materials in the package.)

4.2.3 Personnel

The contamination control practices at the Site should be adequate assure that personnel performing routine radiological activities are at low risk of being contaminated with radioactive material. However, the potential for personnel contamination exists; therefore, it will be necessary to perform personnel contamination surveys on workers performing radiological activities. This SOP uses the limits for personnel and clothing contamination set forth in NRC Regulatory Guide 8.23, (**Exhibit 4**).

4.3 Related Procedures

Other SOPs that may be executed in conjunction with this SOP include:

- "Calibration and Operational Requirements of Survey Instrumentation"

5.0 SUMMARY

This SOP provides steps and limits for:

- determining the extent of radioactive contamination on equipment, shipping packages, and personnel surfaces; and

- monitoring the levels of external gamma radiation levels at the Site and associated with radioactive material packages offered for transport.

6.0 SAMPLE HANDLING AND PRESERVATION

Samples handled at the site (soil, air particulate, wipe, etc.) are not expected to present any significant radiological hazards to the handlers; however care must be taken in handling samples to minimize the potential for cross-contamination.

7.0 APPARATUS

The following methods and equipment may be used in implementing this SOP:

7.1 Personnel Protective Equipment (PPE)

Under routine contamination survey conditions, the appropriate PPE required will be based on the conditions set in the area being surveyed. For example, gloves may be required as a condition for working in an area; therefore, gloves should be worn when surveying in that area.

7.2 Survey Equipment

The following survey equipment should be used in accordance with applicable procedures and regulations:

- Ludlum Model 43-1-1 Scintillator calibrated to a Model 2224 or Model 2360 Scaler/Ratemeter (Model 43-1-1); the lead-shielded Model 180-16 counting stand is optional for wipe measurements. This instrument is typically used for:

a. counting wipes (with the counting stand);
b. performing equipment/materials surface contamination surveys, and
c. performing personnel contamination surveys (with protective screen).

- BICRON MicroRem meter (MicroRem). This instrument is typically used for:

a. Performing gamma dose rate surveys at levels below 2 mrem/hr, and
b. Performing radioactive material shipping dose rate surveys at levels below 2 mrem/hr.

- Ludlum Model 44-38 Energy Compensated Beta-Gamma Detector calibrated to a Model 3 Ratemeter (Model 44-38). This instrument is typically used for:

a. Performing gamma exposure rate surveys at levels above 2 mR/hr, and
b. Performing radioactive material shipping dose rate surveys at levels above 2 mrem/hr.

- **Ludlum Model 3030** This instrument is typically used for quantifying alpha and high-energy beta contamination on wipes.

- Wipes are typically used to quantify removable contamination on surfaces.

7.2.1 Calibration Requirements

All survey equipment used in satisfying the requirements in this SOP will meet the calibration requirements specified in the applicable SOP or by the manufacturer, which ever is more stringent. Additionally, all survey equipment should meet the detection limit criteria specified in the applicable SOP.

For example, "Calibration Operational Requirements of Survey Instrumentation," specifies that the instrumentation should only be used for surveys in which its detection limit (MDC) is approximately one-half the applicable action limit. This means that, for an action limit of 1,000dpm/100cm², the MDC for the survey instrumentation should be no greater than about 500dpm/100cm².

8.0 REAGENTS AND STANDARDS

Refer to the appropriate calibration procedure for applicable calibration standards.

9.0 WASTE CONTROL

9.1 Samples

All samples should be maintained for the duration of the project and subsequent confirmation, at which point, samples can evaluated for either radiological or conventional disposal.

9.2 Waste Separation

Any materials that can be disposed of efficiently should be disposed of in a separate waste stream from impacted soils. Waste generated as a result of decontamination efforts should be considered candidate for radioactive waste stream segregation.

10.0 PROCEDURE

10.1 Survey Methods

Contamination surveys are typically accomplished by two methods:

10.1.1 Scans

Scan – direct measurement survey performed by placing the active surface (window) of a detector directly on the surface being surveyed. The detector can be used to take a static measurement, or it can be moved slowly across the surface to survey a surface area larger than that of the detector. This survey method can be used to quantify the total, average, or maximum contamination levels on a given surface.

10.1.2 Wipes

Wipes – indirect measurement of a surface for removable contamination by wiping the surface with a moderately absorbent, standard industry Wipe pad, then counting the wipe with an appropriate detector. Wipes are typically limited to 100 cm^2, or the total area being surveyed if less than 100 cm^2.

10.2 External Gamma Radiation Surveys

External gamma radiation surveys are typically performed using a survey instrument sensitive to gamma radiation and insensitive to other forms of radiation. The surveys are typically performed by holding the detector probe toward or adjacent to the area of interest. The surveyor monitors the radiation levels by audio (if applicable) and visual observations of the instrument readout.

10.2.1 Area Surveys

Typically, area surveys at the Site can be performed by holding the probe approximately one meter away from floor or wall surfaces or about 30 cm (one foot) from radioactive sources.

10.2.2 Radioactive Material Shipment Surveys

Radioactive material shipment surveys are performed to satisfy the requirements in 49 CFR 172.403 and 49 CFR 173.441.

External Surface

The purpose of this survey is to determine the maximum gamma dose rate reading on the external surface of the outermost packaging material. The survey is performed over the entire accessible surface (including the bottom) of the outer package. The highest repeatable reading obtained during this survey is compared to the category values in **Exhibit 2.**

Transport Index

The purpose of this survey is to determine the maximum gamma dose rate reading one meter from the external surface of the outermost packaging. The survey is performed at one meter distance, over the entire accessible surface (including the bottom) of the outer package. The highest repeatable reading obtained during this survey is compared to the category values in **Exhibit 2.**

The results of the above radioactive shipment surveys are compared to the values in **Exhibit 2** for category labeling.

Transport Vehicle – Exclusive Use Shipments

Specific survey requirements for exclusive use shipments are detailed in 49 CFR 173.441.

10.3 Equipment/Materials Surveys

10.3.1 Frequency

Contamination surveys for the unrestricted release or disposal of equipment/materials are performed on an "as-needed" basis. Any equipment/materials with the potential of becoming contaminated in performing licensed activities are subject to this SOP prior to unrestricted release or conventional disposal.

In addition to conventional equipment/materials being surveyed, this procedure can be extended to included facility structure surfaces (floors, walls, etc.) during operation. However, these facility structure materials will likely require release under dose-based radiological criteria, following cessation of operations, as a condition of Site release for unrestricted use.

10.3.2 Scans

This section is based on the use of a Ludlum Model 2360/43-1-1 for performing scans.

In this SOP, scans serve two purposes:

1. Provide the surveyor with a qualitative assessment of surfaces for small areas of elevated contamination, identifiable by both audible and visual monitoring of the instrument readout.

2. Used to quantify the average (or maximum) contamination level over a given surface area by performing an integrated count.

10.3.2.1 Qualitative Scans

The primary purpose of qualitative scans it to identify localized areas of elevated contamination. The surveyor scans the surface at the established scan rate while simultaneously monitoring the audible/visual indications for sudden increases in response. These areas can subsequently be scheduled for further assessment, such as quantitative (integrated) scans or wipes.

10.3.2.2 Integrated Scans

The primary purpose of integrated scans is to quantify the contamination level of a given area. This integrated measurement is usually one of two types:

1. Continuous integrated scan, averaging over an area that is larger than the probe window area but less than 1-m^2. This value is typically compared against the average or removable limits in **Exhibit 1**.

NOTE: Under favorable survey conditions, it may be possible to establish survey parameters for the integrated scans that will detect contamination levels below the detection limit for the removable contamination action limit. In this case, a survey result below the removable limit could obviate the need for wipes.

2. Static integrated measurement on an elevated measurement location that is no larger than 100 cm^2. This value is typically compared against the applicable maximum limit in **Exhibit 1**.

10.3.3 Wipes

- Wipes should be performed on accessible surfaces with the greatest potential for contamination.

- An adequate number of wipes should be performed to assess the average contamination levels -

  a. For large surface areas, one wipe should be performed for each 1 m^2 on accessible surfaces with high contamination potential.

  b. For small surface areas, one wipe should be performed for each separate accessible surface with high contamination potential.

- A single wipe, no greater than 100 cm^2, should be taken to represent an area no greater than 1-m^2.

- The wipe is taken by applying moderate pressure and wiping the surface in an 'S' pattern. For a wipe pad about 4-5 cm in diameter, the path to cover 100 cm^2 should be about 25 cm (about 10 inches).

10.3.4 Minimum Detectable Activity

The detection limit of a survey instrument used for scans is determined by calculating the minimum detectable activity (MDA). The three primary factors that affect the MDA are:

- Background count rate;
- Detection efficiency; and
- Count time.

10.3.4.1 Background Count Rate

The following table can be used to document the gross alpha and beta background count rates for the Model 2360/43-1-1.

Table B-A2-1 Background Count Rates for the Model 2360/43-1-1.

Radiation Type	Background Count Rate (counts per minute)
□ Scan	
□ Scan	
□ Wipe	
□ Wipe	

Different materials exhibit different background count rates. For example, naturally occurring radioactive materials (NORM) in concrete or cinder block might result in □ and □ background count rates of 15 and 500 cpm, respectively, whereas, the shielding effects of steel (no NORM) might result in □ and □ background count rates below 2 and 300 cpm, respectively.

For the purposes of determining MDA values in this SOP, the gross and background count rate values will be used.

10.3.4.2 Detection Efficiency

The following table can be used to document the efficiencies associated with instrumentation used to perform contamination surveys of equipment/materials for unrestricted release.

Table B-A2-2 Efficiencies of Instrumentation used in Contamination Surveys for Unrestricted Release of Equipment/Materials.

Analysis	Instrument	Efficiency [(dpm/100 cm²)/cpm]
Scan Gross Alpha	2360/43-1-1	
Scan Gross Beta	2360/43-1-1	
Wipe Gross Alpha	2360/43-1-1	
Wipe Gross Beta	2360/43-1-1	
Wipe Gross Alpha	3030	
Wipe Gross Beta	3030	

10.3.4.3 Count Time

The count time is usually the factor that can be varied in order to achieve the desired MDA. The count time applies to scans in two ways:

1. Qualitative Scans – The scan time is actually the residence time (how long the active probe window is over the contamination). Therefore, the count time depends on the scan rate.

2. Integrated Scans – The scan time depends on the ability to collect adequate data to quantify the residual contamination level in excess of background.

Scan Rate

All scans performed with the Model 2360/43-1-1 should typically be performed at a scan rate **no faster than about three inches (½ probe face diameter) per second.** This assures that, during qualitative scans, the residence time of the active window of the probe over an area is sufficient to detect enough counts to actually identify the presence of localized contamination. Scanning too fast can result in missing localized areas of elevated contamination that exceed release limits.

Scan Time

The total integrated scan time is a variable factor in the MDA determination. The optimal scan time depends on the MDA vs. the action limit. For example, if a one-minute integrated scan results in a MDA in excess of that specified for the action limit, two minutes might be adequate.

Scans can sometimes be performed such that the detection limit is low enough to distinguish between background and the removable action limit. Based on the removable contamination action limits in **Exhibit 1** of natural uranium of 1000 dpm/100 cm^2, it might be possible to scan a surface and obtain a MDA below 500 dpm/100 cm^2. Therefore, this survey could reliably verify that the contamination levels are below 1,000 dpm/100 cm^2, thereby eliminating the need for a wipe for removable contamination measurement.

10.3.4.4 MDA Values

Table 12-2-3 can be used to summarize the MDA values calculated using the equation in Section 13 for the Model 2360/43-1-1 and the following parameters:

Background Cnts (C_b) = Table B-A2-1
Count Time (T) = Iterative Variable
Efficiency = Table B-A2-2

Table B-A2-3 MDA Values for the Model 2360/43-1-1.

Survey Type	MDA (dpm/100 cm²)
☐ Scan	
☐ Scan	
☐ Wipe	
☐ Wipe	

NOTE: Based on the above MDA values, it should be determined if the Model 43-1-1 could be used to quantify and removable contamination levels below 1,000 dpm/100 cm² using a reasonable integrated scan time.

10.3.5 Documentation

Analysis results for equipment/materials contamination surveys are documented on the log page in Exhibit 5.

10.3.6 Action Limits

Exhibit 1 contains a table of the action limits from the NRC Regulatory Guide 8.23, along with a discussion of applicability, which should be used for unrestricted release of equipment/materials from the Site. The surveyor should use professional judgment in selecting applicable action limits based on process knowledge. For example, if a piece of equipment impacted with natural uranium radionuclides, then the first row of limits should apply.

10.3.7 Corrective Actions

Equipment/materials scheduled for unrestricted release that exhibit contamination levels in excess of the applicable action limits cannot be released until decontamination efforts have successfully reduced the levels to below the limits.

Follow-up surveys should be performed at and around the location of the decontamination to verify acceptable cleanup. If decontamination efforts are not successful, the equipment/materials will have to be considered for disposal as radioactive waste.

10.4 Shipping Surveys

10.4.1 Frequency

Contamination and dose rate surveys will be performed on each radioactive materials package, offered for shipment, for which the potential exists that the contamination or radiation levels could exceed the limits set forth in 49 CFR 172.403 and 49 CFR 173.443.

10.4.2 Scans

The only scans performed on a radioactive material shipment package are the external surface and transport index surveys described this SOP. If a shipment ends up being classified as *exclusive use*, refer to the Transport Vehicle – Exclusive Use Shipments section of this SOP.

All scans on radioactive material shipment packages should be performed using either the Bicron MicroRem (readings less than 2 mrem/hr) or the Model 44-38 (readings greater than 2 mrem/hr).

10.4.3 Wipe Standards

Wipes performed on a radioactive material shipment package for removable contamination are performed in accordance with this SOP. This survey is performed to satisfy the requirements in 49 CFR 173.443. Three 100 cm^2 wipes should be strategically taken on each applicable package.

NOTE: 49CFR 173.443 implicitly allows that contamination surveys are not required under certain circumstances, such as when new shipping containers (boxes, buckets, etc.) that are unlikely to be impacted are used.

10.4.4 Documentation

Survey results for shipping receiving contamination surveys can be documented on the log book page in **Exhibit 6.**

10.4.5 Action Limits

The categorization limits for external dose rates on radioactive material packages are listed in **Exhibit 2** and are detailed in 49 CFR 172.403. The removable contamination limits are listed in **Exhibit 3** and are detailed in 49 CFR 173.443.

10.4.6 Corrective Actions

Radioactive material packages scheduled for transport that exhibit contamination levels in excess of the applicable action limits cannot be released until decontamination efforts have successfully reduced the levels to below the limits. Follow-up surveys should be performed to verify acceptable decontamination.

10.5 Personnel/Clothing Contamination Surveys

10.5.1 Frequency

Personnel/clothing contamination surveys for are performed on an "as-needed" basis; typically, upon exit of areas where the potential for personnel contamination exists.

- Personnel/clothing scans should be performed in accordance with this SOP. The scans should be performed using the Model 43-1-1, applying the scan rate philosophy.

- Wipes are not performed in quantifying personnel/clothing contamination levels.

10.5.2 Documentation

Survey results for personnel/clothing contamination surveys are documented on the appropriate logbook page in **Exhibit 7.**

10.5.3 Action Limits

The action limits for personnel/clothing contamination surveys are in **Exhibit 4.**

10.5.4 Corrective Actions

Personnel/clothing that exhibit contamination levels in excess of the applicable action limits cannot be released until decontamination efforts have successfully reduced the levels to below the limits. Follow-up surveys should be performed to verify acceptable decontamination.

11.0 CALCULATIONS

The equation used to calculate minimum detectable activity (MDA) is:

$$MDA = \frac{3 + 4.65 * s_b}{TE}$$

Where:

s_b ≡ Standard deviation of background counts in time T (counts), can use $\sqrt{C_b}$ for single background count (C_b)
T ≡ Background/survey count time (minutes)
E ≡ Detection efficiency, corrected for probe area (cpm/dpm/100 cm^2)

12.0 RESPONSIBILITIES

The Lead Health Physicist has overall responsibility for the implementation of this SOP. The daily responsibility for proper implementation of this SOP lies with the individual trained surveyor.

13.0 DEFINITIONS

The following definitions are taken from the 10 CFR 20.

Radiation Area – Any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5 mrem in 1 hour at 30 cm from the source of radiation or from any surface that the radiation penetrates.

Restricted Area – Any area, access to which is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to sources of radiation.

Unrestricted Area – Any area, access to which is neither limited or controlled by the licensee.

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14.0 REFERENCES

10CFR20, "Standards for Protection Against Radiation."

49CFR172.403, "Class 7 (Radioactive) Material" Radiation Level Labeling Requirements for Radioactive Material Packages Offered for Transport.

United States Nuclear Regulatory Commission (NRC). Regulatory Guide 8.23, "Radiation Safety Surveys at Medical Institutions" Washington, DC.

Exhibit 1 – Unrestricted Release Contamination Limits for Equipment/Materials (Reference: NRC Regulatory Guide 8.23).

ACCEPTABLE SURFACE CONTAMINATION LEVELS FOR UNCONTROLLED RELEASE OF EQUIPMENT

Nuclide[a]	Average[b,c]	Maximum[b,d]	Removable[b,e]
U-nat, U-235, U-238, and associated decay products	5,000 dpm α/100 cm^2	15,000 dpm α/100 cm^2	1,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm $\beta\gamma$/100 cm^2	15,000 dpm $\beta\gamma$/100 cm^2	1,000 dpm $\beta\gamma$/100 cm^2

[*] Adapted from Regulatory Guide 1.86 (Ref. 30).

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area of not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionately and the entire surface should be wiped.

Exhibit 2 – Radiation Levels for Radioactive Shipment Classification (49 CFR 172.403).

Transport index	Maximum radiation level at any point on the external surface	Label category[1]
0[2]	Less than or equal to 0.005 mSv/h (0.5 mrem/h).	WHITE–I.
More than 0 but not more than 1	Greater than 0.005 mSv/h (0.5 mrem/h) but less than or equal to 0.5 mSv/h (50 mrem/h).	YELLOW–II.
More than 1 but not more than 10	Greater than 0.5 mSv/h (50 mrem/h) but less than or equal to 2 mSv/h (200 mrem/h).	YELLOW–III.
More than 10	Greater than 2 mSv/h (200 mrem/h) but less than or equal to 10 mSv/h (1,000 mrem/h).	YELLOW–III (Must be shipped under exclusive use provisions; see 173.441(b) of this subchapter).

[1] Any package containing a "highway route controlled quantity" (§ 173.403 of this subchapter) must be labelled as RADIOACTIVE YELLOW–III.

[2] If the measured TI is not greater than 0.05, the value may be considered to be zero.

Exhibit 3 – Non-Fixed Contamination Wipe Limits for Radioactive Shipments (49 CFR 173.443).

Contaminant	Maximum permissible limits		
	Bq/cm²	uCi/cm²	dpm/cm²
Beta and gamma emitters and low toxicity alpha emitters	0.4	10^{-5}	22
All other alpha emitting radionuclides	0.04	10^{-6}	2.2

Exhibit 4 – Unrestricted Release Contamination Limits for Personnel and Clothing (Reference: NRC Regulatory Guide 8.23).

RECOMMENDED ACTION LEVELS FOR REMOVABLE SURFACE CONTAMINATION IN MEDICAL INSTITUTIONS*

Type of Surface	Type of Radioactive Material**					
	Alpha Emitters		Beta or X-Ray Emitters		Low-Risk Beta or X-Ray Emitters	
	($\mu Ci/cm^2$)	($dpm/100cm^2$)	($\mu Ci/cm^2$)	($dpm/100cm^2$)	($\mu Ci/cm^2$)	($dpm/100cm^2$)
Personal clothing worn outside restricted areas	10^{-7}	22	10^{-6}	220	10^{-5}	2,200
Skin	10^{-6}	220	10^{-6}	220	10^{-5}	2,200

*As adapted from Table 1 of Reference 10. Averaging is acceptable over nonliving areas of up to 300 cm^2 or, for floors, walls, and ceiling, 100 cm^2. Averaging is also acceptable over 100 cm^2 for skin or, for the hands, over the whole area of the hand, nominally 300 cm^2.

**Beta- or x-ray emitter values are applicable for all beta- or x-ray emitters other than those considered low risk. Low-risk nuclides include C-14, H-3, S-35, Tc-99m, and others whose beta energies are less than 0.2 MeV maximum, whose gamma- or x-ray emission is less than 0.1 R/h at 1 meter per curie, and whose permissible concentration in air (see 10 CFR Part 20, Appendix B, Table 1) is greater than 10[illegible] µCi/ml.

Exhibit 5 – Unrestricted Release Contamination Limits for Equipment/Materials **Logbook Page _**

#	Date	Equipment/Material Description, Serial #	Survey Type						Pass <or> Fail	Comments Follow-up Actions Release Information
			Average Activity Scan (2 min)		Maximum Activity Static (2 min)		Removable Activity Wipe (5 min)			
			□	□	□	□	□	□		

Exhibit 6 – Shipping Surveys Log Page

#	Date	Description	Dose Rate (mrem/hr)	Alpha					Beta				
				Gross (cpm)	Bkg (cpm)	Net (cpm)	Eff(1)	Net (dpm/100 cm^2)	Gross (cpm)	Bkg (cpm)	Net (cpm)	Eff(1)	Net (dpm/100 cm^2)

(1) Use efficiency applicable for source/sample-to-detector calibration geometry.

Exhibit 7 – Personnel/Clothing Contamination Surveys Log Page

Instructions

1. Turn instrument on.
2. Set count time to 1 minute.
3. Depress button to start count.
4. Slowly scan affected areas, hands, and soles.
5. If action limit is exceeded, decontaminate and repeat surveys.
6. Record gross α and β readings.

Gross □ Action Limit = ___________ cpm

Gross □ Action Limit = ___________ cpm

#	Date	Name	Gross □ Count Rate (cpm)	Gross □ Count Rate (cpm)	Pass Y/N	Comments

APPENDIX C: TRAFFIC CONTROL PLAN

A Traffic Control Plan (TCP) will be developed prior to initiating the transportation of waste from the Site to a disposal facility. The TCP will be developed in accordance with local and state requirements. The appropriate agencies will be contacted to ensure that the TCP provides adequate protection for Site workers and the surrounding community. The TCP will, at a minimum, include the following components:

- Pre-Project Screening and Restoration;
- Site Ingress and Egress;
- Truck Access Routes;
- Waste Transportation Routes;
- Emergency Response Contingency Plan; and
- Post-Project Validation.

The Emergency Response Contingency Plan is provided below.

EMERGENCY RESPONSE CONTINGENCY PLAN

C.1 PURPOSE AND SCOPE

This section is intended to provide guidelines and minimum emergency response requirements to transporters contracted by MHF-LS. This section is also intended to raise the awareness of generators, shippers and clients involved in MHF-LS business as to these minimum requirements. This section is intended to apply to all contractors involved in the transportation chain. This document however, is general in nature and NOT intended to be all inclusive or used in place of current Federal, State or local laws, regulations or ordinances nor is it intended to take the place of good judgement.

C.2 BACKGROUND

The Hazardous Materials Regulations of the Department of transportation are published in the Code of Federal Regulations (CFR) 49 and specifically address "Emergency Response Information" in Part 172, Subpart G, Sections 172.600, 172.602 and 172.604.

C.3 RECORD KEEPING

MHF-LS Corporate Offices in Cranberry Township, Pennsylvania will obtain and maintain a copy of the following from every contractor:

- Insurance Certificate with their level of hauling;
- Emergency Response Plan or Contingency Plan; and
- A current and accurate list of Emergency Response Coordinator telephone numbers including at least one 24-hour contact number.

These documents will be obtained prior to executing an agreement with any contractor. These documents will be updated as required and at minimum annually.

C.4 MINIMUM INDUSTRY STANDARDS

No MHF-LS contractor can accept for transportation, transport, transfer, store or otherwise handle hazardous materials unless they have:

- Emergency Response information conforming to Part 172 of 49 CFR immediately available for use at all times the hazardous material is present; and
- Emergency Response information required by Part 172 of 49 CFR immediately available to any person who, as a representative of a Federal, State or local government agency, responds to an incident involving the material, or is conducting an investigation, which involves the material.

EXCEPTION: The requirements of Part 172 of 49 CFR DO NOT APPLY to hazardous materials that are exempt from the shipping papers requirements of 172 of 49 CFR, such as: materials that are not hazardous wastes or substances but are identified by an "A" or "W" or Other Regulated Material, Class D defined in Part 173.144 in 49 CFR and in the table at 172.101.

NOTE: Current Federal, State, and local regulations MUST be consulted for full compliance with the regulations.

C.5 EMERGENCY RESPONSE INFORMATION

MHF-LS' contractors must comply with current Federal, State and local guidelines pertaining to the availability and format of Emergency Response Information. For hazardous waste shipments this information is commonly referred to on the shipping papers. The hazardous waste manifest MUST include a reference to an emergency response telephone number and will usually refer to a page number in the Emergency Response Guide (ERG). This guide is commonly used to supply the necessary information to respond to a haz-mat incident. All manifests MUST offer this information and the MHF-LS contractor MUST know how and when to use the information given. This means that every operator MUST have in his/her possession at the time of the movement a current copy of the ERG and be trained in its proper use. If the ERG page number representing the hazardous material proper handling in the event of an incident is not referenced on the shipping document, the following information MUST be made available at a minimum to all parties involved in the shipment and responders in the event of an incident involving the waste.

INFORMATION REQUIRED: For the purpose of Part 172 of 49 CFR the term "Emergency Response Information" means information that can be used in the mitigation of an incident involving hazardous materials and, as a minimum, must contain the following:

1. The basic description and technical name of the materials as required by Section 172.202 and 172.203, the International Civil Aviation Organization (ICAO) Technical Instructions, International Maritime Dangerous Goods (IMDG) Code or the Transportation of Dangerous Goods (TDG) Regulations, as appropriate.
2. Immediate hazards to health.
3. Risks of Fire or Explosion.
4. Immediate precautions to be taken in the event of an accident or incident.

5. Immediate methods for handling Fires.
6. Initial methods for handling spills or leaks in the absence of fire.
7. Preliminary First Aid measures.

NOTE: As part of this requirement the information must be:

1. Printed legibly in English
2. Available for use away from the package(s) that contains the hazardous material.
3. Presented: A) on a shipping paper (eg. Manifest) and / or
   B) in a document, other than a shipping paper, that included both the basic description and technical name of the hazardous material as required by Sections 172.202 and 172.203 I (k), the *ICAO Technical Instructions, **IMDG Code, or the ***TDG Regulations, as appropriate and the Emergency Response Information required by Part 172 of 49 CFR.

* ICAO= International Civil Aviation Organization
** IMDG= International Maritime Dangerous Goods
*** TDG= Transportation of Dangerous Goods

Maintenance of Information for MHF-LS contracted Transporters:

Each carrier who transports a hazardous material shall maintain the information specified above in the same manner as the USDOT regulations required for shipping papers. The information must be immediately accessible to train crew personnel and drivers of motor vehicles for use in the event of incidents involving hazardous material.

Maintenance of Information for other MHF-LS contractors:

Each operator of a facility where materials are received, stored or handled during the transportation shall maintain the emergency response information specified above whenever the material is present. This information must be in a location that is immediately accessible to facility personnel in the event of an incident involving the material.

Current Federal, State, and local regulations MUST be consulted for compliance with the regulations.

C.6 EMERGENCY RESPONSE NOTIFICATION AND REPORTING

Spill or Incident Reporting:

Mr. Richard W. Zink, MHF-LS Vice President, or his designee will be the primary collection point for gathering of all information and paperwork generated as a result of a spill or incident involving transportation handling by MHF-LS. Mr. Zink or his designee will be responsible for obtaining a copy of any forms or reports generated by the carrier or supplier that is required by current Federal, State or local law or regulation or individual company policy and will maintain that information for a minimum period of five years. The information maintained will include but is not limited to:

- MHF-LS incident report forms;
- Any report generated by a carrier, contractor, generator or facility as a result of current Federal, State or local law or regulation of individual company policy;

- Any report, document or photographs related to the incident or spill.

The carrier or supplier will send the information without delay to:

MHF Logistical Solutions, Inc.
ATTN: Richard W. Zink
800 Cranberry Woods Drive, Suite 450
Cranberry Township, PA 16066

Telephone Reporting:

In the event of a spill or incident involving MHF-LS transportation, the carrier or supplier will, in addition to any required telephone reporting by current Federal, State, or local law or regulation, immediately notify by telephone a MHF-LS representative using the following number Monday through Friday 8:00 a.m. – 5:00 p.m., EST.

MHF Logistical Solutions, Inc.
800 Cranberry Woods Dr.
Cranberry Twp., PA 16066
Phone: (724) 772-9800 extension 5524
Fax: (724) 772-9850

AFTER HOURS ANSWERING SERVICE (412) 369-4700

A 24-hour emergency contact list "calling tree" with individuals' names and numbers will be made available to the agencies, transportation contractors, and Site personnel.

The caller will supply the following information:

1. Name
2. Employer
3. Contact Number
4. Date, time and exact location of incident
5. The extent of injuries, if any
6. Name, classification and quantity of materials involved
7. Type of vehicle or container and reporting mark of vehicle or container
8. Type on incident and nature of hazardous material involvement and whether a continuing danger to life exists at the scene
9. Steps that contractor have taken to mitigate or contain spill or incident

C.7 EMERGENCY RESPONSE TELEPHONE NUMBERS

MHF-LS will assure that the shipping paper for each material shipped by MHF-LS includes a 24-hour emergency response telephone number (including the area code or international access code) for use in the event of an emergency involving the material. Each carrier or supplier MUST have such a number. The telephone number must be:

- Answered 24 hours a day 365 days a year;

- The number of a person who is either knowledgeable of the hazards and characteristics of the hazardous material being shipped and has comprehensive emergency response and accident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information; and
- The number must be legibly entered on the shipping paper.

NOTE: Current Federal, State, and local Regulations MUST be consulted for full compliance with the regulations.

C.8 CARRIER AND SUPPLIER EMERGENCY RESPONSE REQUIREMENTS:

Every contractor of MHF-LS will immediately initiate emergency procedures for the proper mitigation of any spill or incident involving MHF-LS waste materials. The contractor will comply with all current Federal, State or local laws and regulations relative to the response to any incident and/or spill.

Motor Carrier Minimum Requirements:

USDOT Training – USDOT regulations 49 CFR Part 177 requires motor carriers to properly train the driver in, "Procedures to be followed in case of accident or other emergency, including unanticipated pressure increase or decrease." Proof and records of this training will be made available to MHF-LS upon request.

1. Immediate Notification Requirements- When an incident occurs during transportation in which a hazardous material is involved, a report to the USDOT may be necessary. IMMEDIATE notice is required by each carrier who transports materials (including hazardous wastes) for each incident that occurs during the course of transportation (including loading, unloading and temporary storage) in which as a direct result of the materials:

    a. A person is killed; or
    b. A person receives injuries requiring treatment away from scene (hospital); or
    c. Estimated carrier or property damage exceeds $50,000; or
    d. One or more major transportation arteries or facilities are closed or shut down for one (1) hour or more; or
    e. In the carrier judgement it should be reported.

These IMMEDIATE reports must be made by phone to the USDOT at 800.424.8802 or 202.267.2675 at the earliest practical moment as required by Section 171.15.

The following information will be requested from the caller:

1. Name of reporter;
2. Name and address of carrier represented by reporter;
3. Phone number where reporter can be contacted;
4. Date, time and exact location of incident;
5. The extent of injuries, if any;
6. Classification, name and quantity of hazardous materials involved, if available, at time; and
7. Type of incident and nature of hazardous material involvement and whether a continuing danger to life exists at the scene.

Contractors Minimum Requirements:

In the event of a spill the MHF-LS contractor assumes the responsibility of a generator and must comply with the emergency procedures and disposal requirements as set forth in 49 CFR 265.56. Duties include at minimum emergency notification, emergency response, and material disposal. All associated costs incurred for the proper mitigation of an incident will be the responsibility of the contractor. MHF-LS will not assume any liability associated with any incident or spill but may offer the contractor assistance in these endeavors.

C.9 SUMMARY OF DUTIES AND RESPONSIBILITIES

Contractor:

- ✓ Provide MHF-LS with a current copy of their emergency response plan.
- ✓ Provide MHF-LS with a current copy of their insurance information as required.
- ✓ Provide MHF-LS with an updated list of their emergency response telephone numbers.
- ✓ Be familiar with and in compliance will all requirements relative to the transportation and handling of hazardous materials including, but not limited to:
  - ➢ Shipping documents
  - ➢ Emergency Response
  - ➢ Emergency Response notification to governing agencies
  - ➢ Emergency Response notification to MHF-LS
- ✓ Full compliance with all current requirements relative to hazardous waste manifests.
- ✓ Full compliance with current USDOT training requirements.

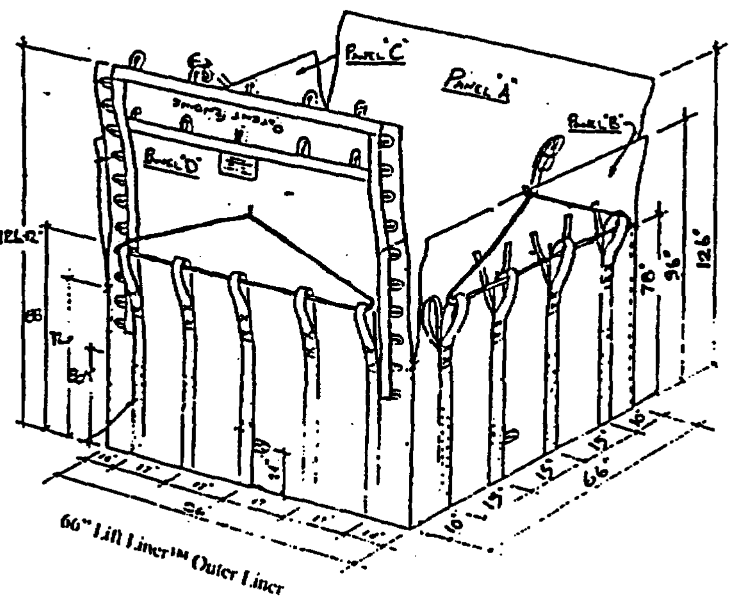
MHF Logistical Solutions, Inc.:

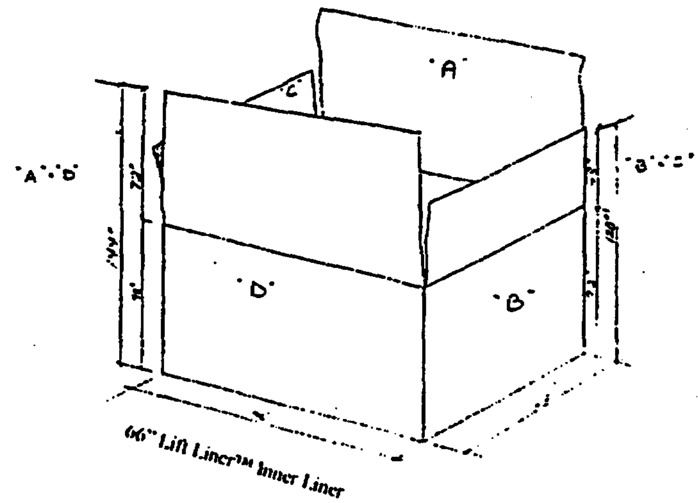
- ✓ Record keeping
- ✓ Emergency Response Plan for all contractors
- ✓ A list of Emergency Response telephone numbers for all contractors
- ✓ Insurance information required for each contractor
- ✓ A current copy of USDOT's Emergency Guidelines
- ✓ Assuring that contractors are familiar with current Federal, State and local laws and regulations.

Attachment 1 to Appendix C

Lift-Liner™ Specifications

TRANSPORT PLASTICS, INC.





Product Specification - 66" Lift Liner™ System

Item Number:	11-LL9666 - Lift Liner™ 96X66X72Outer Liner
Item Number:	11-IL9666-2 Double Layer Inner Liner for 66" Lift Liner™ System
Model Number:	11-LF9666 Lifting Frame for 66" Lift Liner™System
Model Number:	11-LOD9666 - Loading Frame for 66" Lift Liner™System

Lift Liner™ Specifications

Overall Manufactured Size:	96"X66"X72" (Nominal) +/- 1" all dims
Suggested Loadable Size:	96"X66"X66" (Nominal) +/- 1" all dims
Volume Capacity:	242 Cu. Ft.
Empty Weight:	40 lbs.
Weight Capacity:	24000 lbs.

Lift Liner™ Construction

Fabric:	Woven & Coated Polypropylene
Lift Straps:	18 Ea @ 6000 lb. tensile test Each woven polyester fabric
Closure Top Flaps:	4 Ea; 2 full overlapping, 2 centering
Securing Straps:	20 Ea. 1" poly webbing with corresponding receiver loop

Inner Liner Specifications

Overall Dimensions:	96"X66"X72" (Nominal) +/- 1" all dims
Empty Weight:	32 lbs.

Inner Liner Construction

Fabric:	Double Layers of woven & coated Polypropylene fabric
Closure top flaps:	4 Ea; 2 full overlapping, 2 centering

Lifting Frame Specifications

Overall Size:	92"X68" X24" (Nominal +/- 1" all dims
Empty Weight:	1240 lbs.
Lifting Weight Capacity:	24,000 lbs. @ 125% certified (per DOE-STD 1090 Hoisting & Rigging Devices)
Design Capacity:	40,000 lbs
Means to Lift:	Crane or forklift
Lifting Frame Construction:	All steel per ASTM A-500 (USA/CAN)
Hooks:	3 ton carbon steel (USA)

Loading Frame Specifications

Overall Outside Dimensions:	96"X66"X62" or 96"X66"X70" * (Nominal) +/- 1" per wall
Empty Weight:	960 lbs. or 1020 lbs.*
Loading Frame Construction:	1 ½" square steel tube
Walls:	10 gal steel sheet
Floor:	1 ½" square tube steel grid and 10 ga steel sheet

*Indicates Loading Frame with Fork Lift Pockets

Patented, US Patent Number 6,079,934

8/22/01
Rev 3

TRANSPORT PLASTICS, INC.
P. O. Box 12 • 190 Transport Drive
Sweetwater, TN 37874
(423) 337-3003
FAX (423) 337-2184

FABRIC SPECIFICATIONS

FOR LIFT LINER SYSTEM 66" OUTER BAG

DESCRIPTION

8 oz. White	Uncoated Bulk Bag Fabric-Flat Woven/Ultrasonic Slit Edge
8 oz. White	Coated 1 Mil PP/PE Bulk Bag Fabric-Flat Woven/Ultrasonic Slit Edge

TYPICAL PROPERTIES	TEST METHOD	
Fabric		Polypropylene
Coating		Polypropylene/Polyethylene
Color		White
Standard Widths, Inches (+1,-0)		36,42, and 48
Construction		22.1 EPIx13.3 PPI 1.5x12.5 (minimum)
Weight, Oz/SY		8.5 8.0 (minimum)
Tensile Strength, Lbs.	ASTM D-4632	476x474 430x400 (minimum)

Elongation,%	**ASTM D-4632**	**22.9x20.7** **(no minimum)**
Trapezoid Tear Strength,PSI	**ASTM D-4533**	**169X164** **125X125 (minimum)**
Puncture, Lbs.	**ASTM D-4833**	**220** **200 (minimum)**
Mullen Burst Strength	**ASTM D-3786**	**937** **800 (minimum)**
UV Resistance **Strength Retention, %**	**ASTM D-4355**	**>70% After** **1200 Hours Exposure**

(1) All components meet US FDA guidelines for food contact applications
(²) The above properties are typical averages based on uncoated test data only.

Date:01/01 This data sheet supersedes all previously issued data sheets.

TRANSPORT PLASTICS, INC.
P.O. Box 12 • Sweetwater, TN 37874
(423) 337-3003

TECHNICAL DATA SHEET

6.5 oz IBC FABRIC
66" INNER LINER

TYPE C2-8-42 U.V. STABILIZED WOVEN POLYPROPYLENE FABRIC. IT AVAILABLE AS COATED AND UNCOATED AT THE FOLLOWING STANDARD WIDTHS: 70, 72, 74, 76, AND 80" 2 PLY. THIS FABRIC HAS EIGHT 4" WIDE BANDS.

PROPERTIES	UNITS	TYPICAL VALUE
MATERIAL FABRIC/COATING	—	PP/PP (.001")
COLOR	—	NATURAL WHITE
CONSTRUCTION	TAPES/INCH	WARP 9.0/WEFT 10.6
UNIT WEIGHT	OZ/YD	6.50 EXCL BANDS 7.40 INCL BANDS
TENSILE GRAB STRENGTH	LBF	WARP 300/WEFT 300/ BAND 550
PUNCTURE STRENGTH	LB	UNC53 CTD 138
MULLEN BURST STRENGTH	LB/PO	UNC 638 CTD 579
TEAR STRENGTH (TRAPEZOID)	LB	WARP 125/ WEFT 120
UV RESISTANCE	% STRENGTH HOUR EXPOSURE	>75% AFTER 1200 HOURS
MELTING PPOINT	°C (°F)	160° (320°)

APPENDIX D: STORMWATER MANAGEMENT AND EROSION CONTROL PLAN

Surface water throughout the remedial activities will be managed in a fashion to ensure that run-on or run-off within the construction areas are minimized. Surface water and/or sediments from construction activities will be controlled and/or collected using soil berms, silt fences, hay bales, low point sumps and sump pumps as necessary. Controlling and managing the surface water will minimize erosion and transportation of sediments into construction areas while minimizing the potential for transporting impacted sediments from the construction areas. During active Site work, Envirocon will develop a stormwater management and erosion control plan and specific to the Site topography and the operations layout. This plan will identify surface water drainage pathways to ensure that all such water is diverted around active excavation areas. This plan will also identify the location of diversion features, as well as erosion control features. The plan will meet the regulations of the Nassau County Sewer Sanitation and Water Supply Department that requires two inches of stormwater storage across the site.

APPENDIX E: FIELD SAMPLING AND ANALYSIS PLAN

E.1 INTRODUCTION

The Field Sampling and Analysis Plan (FSAP) includes procedures for screening and sampling efforts during and following the remedial activities. The Work Plan and therefore the Field Sampling Plan intent is to respond to field conditions as needed (i.e. the depth of excavation may be modified based on subsurface conditions).

E.1.1 Objectives

The overall objective of the FSAP is to generate data that will be used to:

- Verify subsurface conditions based on historical data to define target excavation areas;
- Establish background conditions for radiation on the Site;
- Guide excavation activities based on screening and sampling data;
- Collect screening and sampling data to define and support the limits of the excavation;
- Profile waste for manifesting and disposal; and
- Collect samples to verify compliance with target cleanup levels.

The data collected during the field activities will demonstrate Site remediation. The FSAP will be implemented concurrently with the requirements set forth in the Health and Safety Plan (HASP) and Quality Assurance Project Plan (QAPP) (Appendix B and H, respectively).

E.2 FIELD INVESTIGATION AND REMEDIATION GUIDELINES

This section describes the field investigation and remediation guidelines to be implemented at the site.

E.2.1 Sample Designation

Each sample will be given a unique designation including the grid location. Samples will be classified by matrix, location, depth, name of sampler, date, time, analysis, special characteristics and sample preservatives, if applicable. Permanent labels will be attached to each sample container.

Indelible ink will be used for labels and containers. The sample identification nomenclature is outlined below:

Abbreviation	Description
011502	Date in a mm/dd/yy format
AB10	Grid location collected
L1	The depth or lift number within the specific grid location. Number 1 designates the ground surface before excavation activities.
PT	Point sample
Comp	Composite sample
BG	Background sample
Per1	Air sample "Per" location.
1440	Time air collection began and ceased (in military time)
SW01	The location of the "sw" surface water sample corresponding to a location on a drawing.
10	The depth the surface water sample(s) (in inches).
D	Duplicate samples
TB	Trip blanks
FB	Field blanks
"12"	The depth of a sample within the specific grid location in inches
Con01	"Con" will designate concrete sample
Deb01	"Deb" will designate debris sample.

Examples:

1. A debris sample (Deb03) collected on March 21, 2002 from a grid location C25 at a depth of 35 inches would be named: 032102-C25-35-Deb03.

2. A grab soil sample collected on March 3, 2002 from a grid location C25 before excavation is initiated would be named: 030302-C25-L1-PT.

E.2.2 Field Records

Field logbooks will provide a daily record of events, observations, and measurements taken during the field investigation. Field logbooks and copies of chain-of-custody forms will be maintained by GTEOSI following project completion.

E.3 FIELD INSTRUMENTS

Field instruments used during the project will provide for diagnostic interpretation of the VOCs and radioactivity in the air, soils, or on debris.

Volatile Organic Compounds Survey Instruments

Survey instruments that will be used to field screen soil samples for exposure to volatile organic compounds include:

- A photoionization detector (PID - MultiRae Plus™, or equivalent), capable of detecting volatile organic compounds with an ionization potential of less than 10.6 eV will be used. This ionization potential range accounts for 70 percent of the VOCs on NYSDEC ASP Target Compound List (TCL). The two main solvents previously detected at the Site, PCE and TCE, have ionization potentials of 9.32 eV and 9.45 eV, respectively. A battery-check and field calibration will initially be performed three times daily using 100 ppm isobutylene in air. If more than a 10% variance of response is noted between any two calibrations, the calibration interval will be adjusted as necessary to keep variance <10%. This information will be recorded in field logbooks and on the calibration log sheets.

- Colorimetric tubes, ("Draeger tubes") will be used if elevated PID readings are noted in order to assess whether PCE, TCE, or benzene are present as part of the total VOC reading to ensure worker safety. Detection ranges are 2-250 ppm for TCE, 2-300 ppm for PCE, and 0.5 to 10 ppm for benzene.

Radiation Survey Instruments

Radiation survey instruments will be used to screen soil for radioactivity and monitor air for radioactive dust particles. Pre-operational checks shall be performed on radiation survey instruments including an annual calibration (from manufacturer), physical inspection, battery check, zero check, response time setting, and daily source checks. These efforts will be performed using National Institute of Standards and Technology (NIST) standards.

The field instruments are capable of detecting the decay of the key nuclides of interest. Based on the nature of the decay sequence exhibited by U-238 and Th-232, these instruments will include the ability to evaluate alpha, beta, and gamma emissions. The sensitivity of the instruments and on-Site gamma spectroscopy will provide the diagnostic support necessary to identify the presence of impacted materials. Conformance with target cleanup levels will rely on an off-Site laboratory. Throughout the project, evaluations will be made to correlate the activity noted by the field instruments and the concentrations of nuclides measured by the off-Site laboratory.

- A Gamma Exposure Rate Survey Meter uses a Sodium Iodide (NaI) crystal that provides a gauge of gamma radiation exposure.

- A Ratemeter with an Alpha, Beta, Gamma Probe can use a NaI or plastic scintillator probe.

Air monitoring survey instruments

The perimeter of the Site will be monitored for dust containing alpha particles using the DustTrak®. The DustTrak® detects the presence of total or respirable particulates through use of a laser photometer. A pump draws particles through an optics chamber for measurement purposes. The instrument will be zeroed prior to each use and factory calibrated annually. Additional calibrations will be implemented as necessary in accordance with the operations manual.

On-Site Analysis Instrumentation

On-Site gamma spectroscopy analysis will be conducted to guide excavation activities. The field gamma spectroscopy system will be set up to identify the radionuclides previously detected on-Site using a high purity germanium detector. Instrument operators will follow the manufacturer's operating procedures to ensure dependable performance. QA/QC functions of energy calibration accuracy, calibration stability, and duplicate analysis precision will be performed to ensure reliability. The nuclide library will be specific to the radionuclide constituents of concern at the Site and will be consistent with that used by the analytical laboratory (STL). The system will include a shielded counting capability using a geometry that minimizes counting time and provides a high degree of accuracy. The resumes of the operators are included in Appendix I.

E.4 FIELD ACTIVITIES

Field activities will be performed while attempting to minimize disturbance to any active on Site business or local traffic patterns. Samples will be screened in the field to aid in assessing the need for additional areas of excavation.

E.4.1 Pre-excavation screening

This section presents the screening and sampling schedule, and rationale for the remedial activities. Baseline radioactive soil screening (gamma exposure rate survey) will be conducted prior to initiating remedial activities to establish pre-excavation conditions.

- *Indoor Baseline and Verification Survey*

An indoor baseline radiation screening survey will be performed in the facility in areas that could be potentially impacted by remediation activities. This survey will be performed to establish the pre-remediation background radiation levels in building structure materials. This will facilitate post-remediation verification surveys in the facility to assess the extent of impacts that remediation activities may have had on building surfaces.

This baseline survey will be performed using standard industry survey instrumentation such as recommended by MARSSIM and NUREG 1507. The instrumentation may include gas flow proportional counters (GFPC) or equivalent, suitable to cover applicable building surface areas and capable of achieving minimum detectable surface activity (MDSA) levels sufficiently below established unrestricted release criteria.

MARSSIM will be the primary guidance for instrumentation selection and survey methodology. It is anticipated that a standard systematic baseline survey will be performed at intervals that will allow sufficient coverage and data adequacy to perform the statistical evaluations recommended by MARSSIM.

RESRAD-BUILD may be used to perform a dose model for the facility to determine the derived concentration guideline levels (DCGLs) that will be used to verify that the facility is suitable for unrestricted release. The DCGLs should be commensurate with the potential constituents of interest and the most likely occupational scenario for the facility.

Following completion of all remediation activities, including Site and facility cleaning, the facility will be re-surveyed to assess the extent, if any, of residual contamination on building structure surfaces. The verification survey should be used in conjunction with the initial baseline survey to facilitate distinguishing residual contamination levels or to verify that the facility meets the requirements of unrestricted release.

- *Outdoor Baseline Screening Survey*

An outdoor gamma exposure survey will be performed prior to the commencement of excavation activities to assess the range of outdoor exposure rates. This survey will form the basis for Site evaluations and to confirm outdoor areas with above background radiation levels.

E.4.2 Soil Excavation

Based on historical VOC, nickel, and radionuclide data, remedial efforts will be focused toward select areas (Figure 1). The nature of the releases is not well defined and therefore the horizontal and vertical extent of the impacts may be variable. To establish pre-excavation subsurface soil conditions in the target impacted areas, three-dimensional maps will be developed prior to excavation for VOCs, nickel, and radionuclides.

E.4.3 Remedial Activities Screening

Screening and analysis will be used to guide soil removal, separation, and manifesting activities. Concrete, soils and other debris in impacted areas will be surveyed using the radiation survey instruments and other screening tools. Soil samples will be collected to identify the radionuclides present and there concentrations.

Sample grids will be established at the Site using 1-meter square components that reference the ground control system. These grids will document the locations of readings and verification samples collected and analyzed. Each grid location will be marked on the ground surface and will be maintained throughout the remedial program.

Volatile Organic Compounds Screening

Soils will be screened for VOCs using a PID or equivalent. Grab samples suspected to contain VOCs will be collected, jarred, and placed in a cooler on ice (target temperature of approximately 4° Celsius). Each sample will be brought to ambient temperature prior to headspace analysis. The location and quantity of the VOCs samples collected will be selected in the field based on Site conditions encountered.

E.4.4 Soil Separation

During the excavation activities, soil will be segregated into non-impacted and impacted material. Impacted materials will be placed in Lift-Liners™, sampled, and manifested for disposal.

Non-impacted materials will be stockpiled, and screened using a gamma exposure rate meter and a PID and sampled to confirm that the material is clean. Soil will be analyzed for VOCs, nickel and radioactive material. Non-impacted soils will be used as backfill.

E.5 SOIL SAMPLING PROGRAM

Soil sampling will be conducted during excavation to guide the excavation activities, correlate analytical results to field screening instrumentation, guide waste disposal activities, manifest materials, and to separate non-impacted soils. Once soil excavation activities are complete based on screening instrument methods, soil confirmation sampling will be performed on the bottom and sidewalls of the excavation[1]. A 6-meter square sampling grid will be established and one representative sample (chemical and radiological) will be collected from each grid location to confirm that the soil meets established cleanup levels. The soil confirmation samples will typically be biased in areas that originally exhibited or are suspected to contain high concentrations of VOCs, metals or radioactivity. In those areas where nickel has historically been detected, confirmation samples will be analyzed for nickel.

[1] At locations of suspected VOC residuals, soil samples will be collected 6- to 12-inches beneath the surface

Based on the results of the sample analysis, the area will be designated:

- available for verification of final status using MARSSIM-based survey design and statistical evaluation;
- unavailable awaiting further excavation; or
- additional sampling required (subdivide).

Further excavation of an area will depend on the type and concentration of residual impacts. If the analytical results indicate concentrations slightly above the established cleanup levels, the grid may be subdivided into quarters and re-sampled. If additional excavation is required, the excavated area will be re-sampled in accordance with requirements discussed above. Soil sampling protocols are outlined in the Statement of Procedures (SOP) at the end of this appendix.

Site investigations have indicated that remediation will be driven by the presence of radioactive material; VOCs and nickel are typically commingled with the radioactive materials. It is unlikely that either VOCs or nickel-impacted materials will need to be handled separately from radioactive impacted materials.

E.5.1 Volatile Organic Compounds

Soil samples collected from the bottom or walls of an excavation will be obtained from with an interval from 6-to 12-inches beneath the finished excavation surfaces. Confirmation/verification soil samples will be collected from each 6-meter by 6 meter square grid and sent to an off-Site laboratory for VOC analysis using USEPA Method 8260B. Soils that exhibit VOC concentrations greater than the specified cleanup levels will continue to be excavated.

During excavation activities, soil samples will be collected for VOC laboratory analysis to verify elevated PID readings, characterize waste (segregation and/or disposal), and to confirm impacted soils have been removed from the excavation. Soil PID headspace measurements will be performed in the field to guide excavation activities. A PID threshold reading of greater than 50 ppm will be considered elevated for field screening purposes (although on-going work will be performed in the field to refine this threshold concentration based on soil conditions and VOC distribution encountered).

E.5.2 Metals

Soils that are suspected to contain elevated concentrations of nickel will be sampled and sent to an off-Site laboratory for analysis using USEPA Method 6010B. Sampling for nickel will be conducted concurrently with the VOC samples collected to define the limits of the excavation. Soils that exhibit nickel concentrations greater than the established cleanup levels will be excavated and removed from the Site.

E.5.3 Radioactive Material

Soil removal operations will be performed using hand tools and mechanical equipment from areas exhibiting radioactive gamma levels greater than background. Samples will be subjected to shielded gamma spectroscopy analysis on-Site for evaluating radioactivity of the soils and for field instrumentation correlation purposes. The correlation developed will be used to guide field activities and to facilitate removal of only those soils exhibiting above background radiation.

Soil samples will be sent to an off-Site laboratory for radiochemistry analyses. Samples will be analyzed using gamma spectroscopy via Environmental Measurements Laboratory (EML) Procedures, USDOE Health and Safety Laboratory Method 300 4.5.2.3 (HASL 300). Samples may be analyzed by alpha spectroscopy for isotopic thorium using either the National Academy of Sciences Method TH-NAS-NS-3004 or the USDOE RP-725 Group Actinide Screening Using Extraction Chromatography (Eichrom) Method.

Samples may also be analyzed by alpha spectroscopy for isotopic uranium using either the National Academy of Sciences Method U-NAS-NS-3050 or the USDOE RP-725 Group Actinide Screening Using Extraction Chromatography (Eichrom) Method.

E.6 ANALYTICAL PROGRAM

The analytical program has been designed to both define and confirm that the chemical and radioactive constituents associated with historic Site activities have been removed and established cleanup levels have been achieved. Verification of attainment of established cleanup levels and release criteria will be based on methods described in the Multi Agency Radiation Site Survey Investigation Manual (MARSSIM). Table E-1 is a summary of the analytical program.

Table E-1 Analytical Summary Program

Field Task	Rationale	Analyses	Environmental Samples**	QC Samples		
				Field Duplicates	Trip Blanks	MS/MSD
Soil Samples Chemistry	Confirm unaffected soils remain	VOCs Nickel	TBD TBD	1 in 20 1 in 20	1 per shipment	1 in 20 1 in 20
Soil Samples Radionuclides	Quantify process residuals Verify non-impacted soils	Gamma spec. Alpha spec.	Typically 20-30 per survey unit Number of samples will be determined using methods identified in MARSSIM, following the remediation activities	1 in 20	1 in 20	N/A
Water Sample(s) (if necessary)	Verify disposal parameters	TCLP VOCs Radionuclides	TBD TBD	0 0	1 per shipment	0 0
Air Samples (if necessary)	Verify ambient air content	PCE/TCE Radionuclides	TBD TBD	1 in 20 0	1 per shipment 0	0 0

Notes:

- Analyses for radionuclides may include thorium 230, 232, uranium 234, 235, 238, and radium. Field duplicates will be collected at an appropriate rate of one duplicate for each 20 samples. Soils analyzed by Alpha Spectroscopy will target uranium or thorium.
- Based on previous analytical results, the soils will not be analyzed for SVOCs, PCBs or TAL Metals (other than nickel). If oily or significantly stained soils are noted based on field observations, additional analyses may be performed at the discretion of field personnel.

** The actual number of samples will vary depending upon the field conditions encountered and the need to delineate process residuals that are found during the investigation.

Samples collected will be submitted to a NYSDOH ELAP Certified laboratory for analysis by *United States Environmental Protection Agency (USEPA) Methods with NYSDEC Analytical Services Protocol (ASP) 2000.* Sample analyses will be performed in accordance with the *Methods for Chemical Analysis of Water and Waste, USEPA 600/4-83-020, Test Methods for Evaluating Solid Wastes, SW-486.* The QAPP presents the analytical methods and QC objectives to be used during the field activities. Additional samples may be collected at the discretion of the field supervisor.

E.7 POST-EXCAVATION

Subsequent to completing the excavation activities, a post-excavation survey will be performed to evaluate the above background concentrations. The survey results will be compared to the pre-excavation screening results to verify that the areas of remediation meet target cleanup levels. The survey grid will be the same as that used for the ground control system.

Readings will be taken from the ground surface contact and at a height of 1-meter above the ground surface using a NaI gamma detector. Areas exhibiting gamma levels not within either the statistical range of background or the pre-excavation survey may be subject to further evaluation, and if appropriate, removal operations and confirmation sampling.

E.7.1 Equipment Decontamination Sampling

Following decontamination, the equipment will be screened for radioactivity using survey instruments and wipe samples. The wipe samples will identify whether radioactive impacts remain on the equipment. The analysis will be specific to the types of equipment and the potential impact. Equipment and tools used at the Site will be issued an analysis certification and tracking number to document the decontamination. Decontamination logs will be maintained in the project files.

Sampling Standard Operating Procedures (SOP)

This section describes the SOP for collecting samples during the remedial activities. The types of samples include soil, air, concrete, asphalt, surface water, and debris. The SOP is described below.

Soil Sampling

Sampling will be performed to screen soils for VOCs, radionuclides, and nickel. It is assumed that soils sampled for shielded gamma ray spectroscopy will have only residual soil moisture and not require any oven drying. The following elements, at a minimum, will be required:

- Samples will be collected using either a 2-inch diameter steel drive sampler (push tube) or stainless steel scoop. Confirmation/verification soil samples for VOC analysis will be collected from the interval 6- to 12-inches beneath the finished excavation surface.
- Soils will be placed in clean glass jars, cans, or plastic bags, sealed and labeled;
- Soil jars will be filled so that available void space is eliminated;
- Each sample will be labeled in permanent ink;
- Each sample will be recorded on a chain-of-custody (COC) form;
- Shielded gamma ray spectroscopy will be recorded on a COC and in the field logbook and hand delivered to the technician for analysis;
- Soil samples designated for VOC or metals analysis will be placed in a cooler on ice and maintained at 4° Celsius;
- Samples will be sent to the off-Site laboratory for analysis; and
- The soil sample location will be identified on a Site map to ensure that all soil sample locations can be retrieved.

Air Monitoring

Air monitoring will be conducted to ensure that VOCs and airborne particulates do not exceed action levels for on-Site workers or create an unacceptable risk to the surrounding community. The air monitoring activities will be coordinated with the requirements set forth in the HASP, which includes the CAMP.

Volatile Organic Compounds

Total VOCs will be monitored in the worker's breathing zone and at the site perimeter using a photoionization detector (PID – MultiRae Plus or equivalent) to ensure that the HASP and CAMP Action Levels are met. Colorimetric tubes ("Draeger tubes") will be used to screen for benzene, PCE and TCE whenever elevated PID readings are noted. Personal and site perimeter sampling for VOCs may also be conducted, as appropriate, using organic vapor badges, which will be analyzed according to appropriate NIOSH methods.

Airborne Particulates

Airborne dust particulates will be monitored in the breathing zone of workers and at the Site perimeter using real-time aerosol monitors (RAM) and portable air samplers, as described in the sections on work area air monitoring and the Community Air Monitoring Program (CAMP) in the HASP. Personal and site perimeter air samples will be analyzed on site for alpha-emitting radionuclides. If these readings approach occupational or ambient air regulatory limits, they will be sent off-site to a laboratory for isotopic analysis.

Concrete Sampling

Concrete collected within impacted areas will be surveyed to identify the extent of residuals are on the surface of the material and whether they require removal. Samples of concrete will be limited to chips collected using a fracturing chisel. These chips will be logged in the field notebook, noted on a detailed grid sheet, and placed in containers within the gamma spectrometer.

Surface Water Sampling

In the event of a severe weather occurrence or if unforeseen field activities causes excessive water in the excavation that is allowed to mix with impacted soils, surface water samples will be collected to verify that radioactive materials, VOCs or metals have not impacted surface water. The following elements will be required for surface water sampling operations:

- Sample bottles will be filled by submerging the bottle without causing solids to migrate into the container;
- Field measurements (pH, specific conductance, and temperature) of the surface water will also be taken and recorded;
- The location, date collected, and sample identification will be noted on a map;
- Each sample will be labeled with permanent ink;
- A summary of each sample will be provided in the field logbook and chain-of-custody for the project; and
- Surface water samples will be placed in a cooler on ice (4° Celsius) and sent to the off-Site laboratory for analysis.

APPENDIX F: EXCAVATION PLAN

Remediation at the Site will be largely based on the removal of impacted soils, building materials and debris. This section has been developed to outline various facets of the excavation process and to help define the procedures used to guide excavation activities.

F.1 HAND EXCAVATION

During various facets of the project, hand excavation will be used to remove radioactive impacted soils. The hand excavation process will typically be performed in areas with limited impacts that will benefit from surgical removal to limit soil volumes. To facilitate hand excavation, field screening will be performed concurrently.

F.2 MECHANICAL EXCAVATION

Mechanical excavation is anticipated to represent the primary form for removal of impacted soils. The equipment to be used for such excavation work is anticipated to include the following:

- Track-mounted skid steer loader;
- Mini-excavator; and
- Hydraulic excavator (25,000 to 45,000 pound class machines).

The skid steer loader will be used to blade the surface of the excavations to recover wide, yet thin lifts of impacted soils and to support moving drums or other heavy objects located within the confines of the excavation.

The excavators to be used will provide for production excavation and will be sized to accommodate the extent of radioactive soil impacts. The primary consideration used in sizing the equipment will be the distinction between high production excavation in areas of known impacts as compared to lower production in areas without widespread impacts.

F.3 CONCRETE/ASPHALT REMOVAL CONSIDERATIONS

Soils beneath concrete floors and asphalt materials within certain areas of the facility have been identified as being impacted by residual amounts of radioactive materials. These materials may require removal to assess these impacts or to allow access for removal of the impacted material. Such removal will be performed using techniques that limit the volume of material generated, as noted above.

Concrete and asphalt may also be impacted by chemical materials and may warrant surgical removal of selected fragments if decontamination is not possible. Depending upon the configuration of the material being decontaminated, surgical removal will be performed in one of the following ways:

- Surgical removal using blast-less expansive agents;
- Saw-cutting;
- Coring; or
- Jack hammer or hoe ram removal.

Once the concrete or asphalt is removed, the underside of each slab of material will be screened to evaluate the presence of residual radioactive impacts. If impacts are found, the slab will be transported to the decontamination station for further characterization and decontamination. If the slab is not impacted, it will be placed within a clean container subject to selective confirmation sampling and analysis.

F.4 SURFACE AND GROUNDWATER CONTROL

As noted within previous sections of this plan, a defined stormwater management and control plan will be used to limit the potential for surface water to run into excavations. However, despite best efforts, it is possible; given the coarse-grained, highly permeable nature of the subsoil that surface water may infiltrate areas surrounding the excavation and migrate into the excavation. In an effort to be prepared for this possibility, sump pumps will be maintained at the Site and will be installed in excavations as needed.

To the extent possible, sump pumps will be placed at recovery points that draw water away from impacted areas. Water recovered from the excavations using sump pumps will be pumped to a large surge tank that will be maintained at the Site. This surge tank will be provided with secondary containment. Water recovered in the tank will be sampled (as discussed in Appendix E), and analyzed to evaluate potential impact by Site contaminants. If impacted, water will be treated prior to shipment off-Site for disposal.

F.5 SUBSURFACE DEBRIS AND OBSTRUCTIONS

Based on the limited Site history available and the field excavation program performed, as outlined in the *Excavation Pilot Test Summary Report* (Envirocon 2002) it is anticipated that subsurface debris or obstructions will be encountered. Accordingly, the excavation process and equipment used will depend upon the size and nature of the obstructions encountered. If large obstructions are found, they will be reduced into smaller sizes that can be more easily handled to support screening, and as needed, decontamination.

To the extent practicable, the fate of such obstructions will be determined as they are identified so that work operations within the excavation can continue unimpeded. The field screening, decontamination, and waste management protocols outlined previously have been developed specifically to provide the flexibility needed to accommodate the full range of potential field conditions while not limiting the degree of environmental protection provided. If subsurface piping associated with historical activities is encountered and appears to be impacted, reasonable attempts will be made to investigate the pipe and surrounding material/soil (as warranted) for impacts and established origin and destination. But if reasonable attempts to find the origin and destination of pipes fails, then this will be addressed in future investigatory phases. The piping will be removed if warranted.

F.6 EXCAVATION STABILITY

Excavation work will be performed subject to applicable OSHA open excavation guidance. This guidance defines the allowable depth of unbraced excavations, the requirements for internal working slope angles, the requirements for stability analysis, and the methods to be used for shoring, if needed. Based on the potential depth of excavation, excavation stability will be considered at various depths of cut from the surface down to the maximum extent of the excavation. Such consideration will be ongoing based on the potential changes that may exist within the excavation limits previously defined.

Based on an analysis of previously developed boring logs, the soils underlying the Site appear to be uniformly distributed sand and gravel at depths from zero to 4-feet beneath the surface. These materials are represented by significant shear strength, although the lack of cohesion will limit open cut stability. Accordingly, various methods may be used to provide stable excavations with the principal methods including cut back slopes, as well as structurally-stable walls.

The stability of open excavations will be subject to prior planning by a qualified person in accordance with OSHA requirements. On-going assessments of the stability that accommodate changing loads at the tops of the slopes, among other dynamic factors will also be addressed on a continuous basis.

F.7 EXCAVATION SHORING

Shoring used for excavations will be developed specifically to meet the structural needs associated with the excavation process. At the present time, the methods considered for shoring will include the use of a tangent caisson soldier pile wall, the use of steel sheet piling, and the use of H-piles with wood lagging. The design for any shoring system used will be performed by a registered Professional Engineer within the State of New York and will be constructed to accommodate the full range of loadings anticipated throughout the project.

F.8 EXCAVATION SEGREGATION

As excavation proceeds, impacted and non-impacted materials will be segregated, to the extent possible, within the limits of the excavation. In particular, impacted materials will be placed directly into Lift-Liner™ bags while in the excavation. Clean soils will be placed directly into containers appropriate for conveyance to the clean soil stockpile area. This approach will limit double-handling, provide for immediate containment, and foster safer handling of the impacted material.

Lift-Liners™ may also be used to contain clean soils or debris, provided screening efforts can effectively delineate the extent of impacts. As noted previously, regardless of screening results, these materials will also be subject to confirmatory sampling and analysis to ensure that they are clean.

F.9 SEGREGATION CONTROL MEASURES

As excavation work proceeds and the bottom of the impacted zone becomes smaller, it will be increasingly important to provide a barrier over clean soils to ensure that the excavation of impacted materials does not create cross-contamination. To provide such separation, it is planned that reinforced polyethylene sheet be used to cover areas of excavations that have been defined as being cleaned. These areas will require confirmatory sampling and analysis prior to release but the barrier provided will reduce the potential for cross-contamination.

F.10 BACKFILL OF EXCAVATIONS

Upon completion of excavation activities and final confirmation that cleanup levels have been met, excavation areas will be backfilled. Backfill material will be placed in 12-inch maximum thickness lifts and compacted to a minimum of 90 percent of the maximum dry density as determined by American Society for Testing Materials (ASTM) Method D-698. These lifts will continue to be placed and compacted until the final finished grade is reached. This grade will conform to the elevation sufficient to support the thickness of sub-base and asphalt required to meet local paving criteria.

F.11 ASPHALT PAVING

Upon completion and contouring of the compacted base course, hot-mix asphalt will be placed and compacted to conform to local building codes.

APPENDIX G: SITE SECURITY PLAN

G.1 SITE ACCESS LIMITATIONS AND SECURITY

Site security will be provided on a 24-hour per day basis during active periods of work at the Site. This will ensure that access to the Site is limited to defined ingress and egress points and that access is limited to Site workers and otherwise authorized personnel. To ensure limited access, the active work zones will be provided with a fenced, gated perimeter kept locked during non-working hours.

G.2 SIGNAGE

Signage will be provided at various locations of the Site to ensure that workers and persons entering the Site are explicitly directed to appropriate areas and specifically away from hazard areas. Signs will be brightly colored to ensure identification of hazards at the Site. Key areas of signage will include the following:

- Site address;
- Site entrance;
- Office location postings;
- Exclusion area locations;
- Overhead hazard areas;
- Decontamination areas;
- Materials storage areas; and
- Equipment and truck traffic corridors.

G.3 BARRICADES AND FENCING

The number of people that can access the Site or individual work areas will be controlled. Barricades and fencing will be used to ensure perimeter control at key locations such as Exclusion Zones that are identified during the project. The location of these zones will change over the course of the project. In general, fencing around work areas will be polyethylene construction grade fence placed sufficiently far enough from hazards, such as excavations, to ensure worker safety.

G.4 WELLHEAD PROTECTION PROGRAM

Wellhead protection will be provided for leaching pools, wet wells, and monitoring wells to ensure that no releases into the well bores may occur as a result of either routine surface water runoff or flooding associated with storm events. These features will be flagged and provided with a sign for visual identification. Each location will be mapped and evaluated with respect to their elevation in relation to adjacent areas to determine potential surface water flow patterns.

The integrity of each wellhead or drain feature will be evaluated and a determination made of protective measures that are necessary to prevent uncontrolled or unintended drainage into the subsurface. Any drain or wellhead that could serve as an inappropriate conduit for surface water or fines migration into the subsurface will be sealed prior to commencing work. The type of seals installed will be dependant upon the conditions at the drain but will seek to seal the entire perimeter of the point of access. Seal material will be a durable product that can be either structurally bound to the drain or attached using an elastomeric sealer.

Wet wells or leaching pools within work areas will be subject to detailed screening prior to initiating field remediation efforts, and as appropriate will be cleaned of debris to ensure proper function with respect to the infiltration of clean storm water runoff. Diversion or routing of surface water during various periods of the project will be performed to prevent surface water run-on within active remediation areas.

G.5 SITE UTILITY PROTECTION

Utility services used during the project are expected to be limited to existing services. Prior to and during the course of the project, all active utilities entering or leaving the active remediation areas will be marked and protected as necessary to prevent disturbance.

G.6 DRAIN SEALING

Drains that are located proximate to work areas will be sealed prior to commencing any invasive activity that could generate materials that could enter such drains. Sealing will be performed using silicon, or other appropriate watertight sealing material, and will be placed around the entire perimeter of the drain. To the extent possible, within areas where surface water could inundate the drain, curbing will be provided to prevent water from ponding over the sealed drain.

Dry wells that are located within the work area will also be sealed subject to the considerations noted previously for Site storm water management.

APPENDIX H: QUALITY ASSURANCE PROJECT PLAN

H.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been developed for GTE Operations Support Incorporated (GTEOSI). The QAPP provides quality assurance/quality control (QA/QC) criteria for work efforts associated with sampling of environmental media at the former Sylvania Electric Products Incorporated Facility (the "Site") in Hicksville, New York. This QAPP is one component of the Work Plan, which also includes a Health and Safety Plan, Field Sampling Plan, Traffic Control Plan, Storm Water Management and Erosion Control Plan, Excavation Plan, and Site Security Plan. This QAPP is based on the previously NYSDEC-approved Work Plans developed by O'Brien & Gere Engineers, Inc. for investigations conducted at the Site during the period 1999 through 2001.

While each person involved in the remedial activities and generation of data is implicitly part of the QA program for the project, certain individuals have specifically designated responsibilities as defined in the Project Team Section of the Report (Section 3). This document has been prepared in accordance with NYSDEC RCRA QAPP Guidance (NYSDEC 1991) and the *USEPA's Guidance for Quality Assurance Project Plans (USEPA QA/G-5, 1998)*. This QAPP will assist in generating data of a known and acceptable level of precision and accuracy. The QAPP provides information regarding the project description and sets forth-specific procedures to be used during sampling of relevant environmental matrices, other field activities, and analyses of data. The following quality assurance topics are addressed in this plan:

- Quality objectives for data measurement;
- Sampling procedures;
- Documentation and chain-of-custody;
- Calibration procedures;
- Sample preparation and analytical procedures;
- Data reduction, usability, and reporting;
- QA/QC checks;
- Performance and system audits;
- Preventive maintenance;
- Data assessment procedures;
- Corrective actions; and,
- QA reports to management.

The remainder of this document provides details on these topics.

H.2 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are both quantitative and qualitative statements specifying the quality of the environmental data required to support the decision making process. DQOs define the total acceptable uncertainty in the data for each specific activity conducted during the remedial activities. The uncertainty includes both sampling and analytical error. Zero uncertainty is the goal however, both field and laboratory variables inherently contribute to the uncertainty of the data. The overall objective is to keep the total uncertainty within a range that will not hinder the intended use of the data. The QA/QC requirements have been established such that there will be a high degree of confidence in the measurements.

The principal DQOs of the remedial activities are to generate data of sufficient quality to support both qualitative and quantitative conclusions concerning the evaluation of the nature and extent of process residuals at the Site. In order to achieve these DQOs, the process of data generation was designed to develop a body of analytical data of sufficient quality to be used to support conclusions made as a result of the remedial activities. Specific data quality criteria for precision, accuracy, representativeness, completeness, comparability, and sensitivity are specified in this document.

Laboratory analyses and analytical levels will adhere to the guidelines described in USEPA's Data Quality Objectives for Remedial Response Activities (USEPA 1987). Analytical levels are defined in the guidance document as follows:

- Level I implies field screening or analysis using portable instruments. Results are often not analyte specific and not quantitative but results are available on a real-time basis.
- Level II implies field analyses using portable analytical instruments (mobile Site laboratory). There is a wide range of the quality of data that can be generated for Level II analyses depending on the use of suitable calibration standards, reference materials, sample preparation equipment, and training of the instrument operator. Results are available on a real-time basis or within several hours.
- Level III implies off-Site laboratory analysis. Level III analyses may or may not use USEPA Contract Laboratory Program (CLP) procedures or a CLP laboratory, but may not use documentation procedures required of Level IV analyses. Level III analyses can provide data of the same quality as Level IV, but USEPA Methods such as Test Methods for Evaluating Solid Waste (SW-846) (USEPA 1996) are used instead of CLP methods.
- Level IV implies CLP routine analytical services (RAS). All analyses are performed in an off-Site CLP analytical laboratory following CLP protocols. Level IV is characterized by rigorous QA/QC protocols and documentation.
- Level V implies analyses by non-standard methods including CLP special analytical services (SAS). All analyses are performed in an off-Site analytical laboratory. Method development or method modification may be required for specific constituents or detection limits.

Table H-1 contains sampling efforts, objectives, analyses, data uses, and analytical levels. The remainder of this QAPP describes the specific approaches that will be taken to achieve the required DQOs.

The USEPA states that the purpose of a QA/QC program is to define "procedures for the evaluation and documentation of sampling and analytical methodologies and the reduction and reporting of data. The objective is to provide a uniform basis for sample collection and handling, instrument and methods maintenance, performance evaluation, and analytical data gathering and reporting" (USEPA 1987). NYSDEC's, guidance document for QAPPs, states that "quality assurance is a management system for ensuring that all information, data, and decisions resulting from the remedial activities are technically sound, and properly documented" (NYSDEC 1991). QC is the functional mechanism through which QA achieves its goals.

Table H-1. Sampling efforts, objectives, analyses, data uses, and analytical level.

Sampling effort	Objective	Types of analysis*	Data uses	Analytical level
Soil sampling	Quantify process residuals formerly used at the Site, if any	VOCs Nickel Radionuclides	Worker health and safety and proper disposition of soils	I, II and III
Air Sampling	Quantify PCE and TCE levels in the ambient air, if any; Radionuclides in dust particles, if any are present	VOCs Radionuclides	Worker health and safety and compliance with the Community Air Monitoring Program	I, II, and III
Surface Water	Impounded surface water, if any is encountered	VOCs, Nickel, Radionuclides	Proper disposition of surface water	II and III

Notes:
VOCs – volatile organic compounds
Radionuclides may include alpha spectroscopy and gamma spectroscopy on a sample specific basis.
* If oily or significantly stained soils are noted based on field observations, additional analyses may be performed at the discretion of field personnel.

The following is a brief description of the chemical data quality parameters addressed in the QAPP.

Precision describes the reproducibility of measurements under a given set of conditions. Specifically, it is a quantitative measure of the variability of a group of measurements that have been made in an identical manner, compared to their average value. Precision can be expressed in absolute methods such as deviation from the mean or median values, standard deviation and variance, or relative methods, such as relative deviation from the mean or median. The overall precision may be established through the analysis of field and laboratory duplicate samples. For this project, a DQO goal for precision has been established that 80 percent of the analytes must meet the established criteria to be considered usable. If this goal is not met, appropriate corrective actions will be taken.

Accuracy is defined as the degree of difference between measured or calculated values and the true value. The closer the numerical value of the measurement comes to the true value, or actual concentration, the more accurate the measurement. Accuracy is expressed in terms of absolute or relative error. Accuracy will be determined through analysis of spiked samples and standards with known concentrations. An overall project DQO goal for accuracy has been established that 80 percent of the analytes must meet established accuracy criteria to be considered accurate and usable. If this goal is not met, appropriate corrective actions will be taken.

Representativeness refers to the degree to which a sample taken from a site accurately reflects the matrix at the site. This qualitative parameter is most concerned with the design of the sampling program. Factors that should be considered in the determination include appropriateness of sampling and analytical methodologies, and representativeness of the selected media and analytical procedures. Representativeness will be achieved by the use of procedures for the collection and preservation of samples as described in the methods, NYSDEC's RCRA QAPP Guidance (NYSDEC 1991), the Work Plan, and this QAPP.

Comparability refers to the use of consistent procedures, second source reference standards, reporting units, and standardized data format with document control. Adherence to standard procedures and the analysis of external source standard materials indicates that data generated from a particular method at a given laboratory can be validly compared to the data of another. This QAPP has been written to provide data that will be comparable to other data collected, as standard methods will be used for the remedial activities.

Completeness refers to the process of obtaining the required data as outlined in the Work Plan. Completeness is also defined as the percentage of measurements judged to be useable. Samples for which the critical data points fail completeness objectives will require reanalysis of (within the specified holding times) until the DQOs are met. The completeness goal has been specified at 90 percent.

Sensitivity refers to a measurable concentration of an analyte that has an acceptable level of confidence. Method detection limits (MDLs) are the lowest concentration of an analyte that can be measured with 99 percent confidence that the analyte concentration is greater than zero. Practical quantitation limits (PQLs) and/or reporting limits (RLs) are levels above the MDLs at which the laboratory has demonstrated the quantitation of analytes. The chemical analytical methods associated with this project have MDLs, PQLs, and RLs at sufficiently low levels to adequately assess the project DQOs.

For radiochemical analyses, detection levels are estimated based on the characteristics and observations of the analyses of a given sample and are, therefore, sample based. Here detection levels are referred to as minimum detectable concentrations.

H.2.1 Field Sampling

The objective of field sampling procedures is to obtain samples that represent the environmental matrix being investigated. This will be accomplished through the use of proper sampling techniques and equipment as presented in the Work Plan.

H.2.2 Laboratory Analyses

To obtain data of a quality sufficient to meet the applicable project DQOs, the following methods will be performed:

- Volatile Organic Compound (VOC) analysis by gas chromatography/mass spectrometry (GC/MS);
- Nickel analysis by ICP; and
- Radionuclide analysis by alpha and gamma spectroscopy, on a sample specific basis.

The specific methods, analytical QA/QC, and data reporting will adhere to the analytical methods listed in Table H-2 along with NYSDEC Analytical Services Protocol (ASP) 6/00 revisions, Exhibit E requirements as applicable to chemical analyses (NYSDEC 2000). Severn-Trent Laboratories (STL) in Earth City, Missouri will perform the analyses for chemical and radiological parameters. STL is NYSDOH ELAP certified and NELAP accredited in the State of Utah.

Table H-2. Analytical methods

Parameter*	Analytical method	Reference
VOCs	SW-846 Method 8260B	1
Nickel	SW-846 Method 6010B	1
Thorium 228, 230, 232	TH-NAS-NS-3004 or DOE RP - 725	2, 3
Uranium 234, 235, 238	U-NAS-NS-3050 or DOE RP-725	4, 3
Gamma Spectroscopy	EML HASL 300 4.5.2.3 or LANL ER-130 Method 901.1 (Modified)	5, 6

Notes:
VOCs - volatile organic compounds
* If oily or significantly stained soils are noted based on field observations, additional analyses may be performed at the discretion of field personnel.

References:
1- *Test Methods for Evaluating Solid Waste, 3rd Edition*. Washington, D.C. USEPA, 1996.
2- National Academy of Science Method TH-NAS-NS-3004.
3- US Department of Energy (DOE) RP-725- Group Actinide Screening Using Extraction Chromatography (Eichrom).
4- National Academy of Science Method U-NAS-NS-3050
5- Environmental Measurements Laboratory (EML) Procedures Manual, - US Department of Energy – Health and Safety Laboratory Method (HASL) 300 4.5.2.3.
6- *Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance*, LA-10300-M, Vol. II, Los Alamos National Laboratory (LANL), Los Alamos, New Mexico, May 1986 (Revised March 1995).

H.3 SAMPLING PROCEDURES

Sampling procedures, practices, and locations that will be used during the remedial activities are presented in the Work Plan.

H.3.1 Field QA/QC Samples

In order to evaluate data quality, QA/QC samples will be collected during the remedial activities. Table H-3 lists the QC samples to be collected by analyses and matrix type. The discussion of field QA/QC samples is directed largely to samples collected for chemical analyses.

Table H-3 Analytical Summary Program

Field Tasks	Rationale	Analyses*	Environmental Samples**	QC Samples		
				Field Duplicates	Trip Blanks	MS/MSD
Soil Samples Chemistry	Confirm unaffected Soils remain	VOCs Nickel	TBD	1 in 20 1 in 20	1 per shipment	1 in 20 1 in 20
Soil Samples Radionuclides	Quantify process residuals. Verify non-impacted soils	Gamma spec. Alpha spec.	Typically 20-30 per survey unit Number of samples will be determined using methods identified in MARSSIM, following the remediation activities	1 in 20	1 in 20	N/A
Water Sample(s) (if necessary)	Verify disposal parameters	TCLP VOCs Radionuclides	TBD TBD	0 0	1 0	0 0
Air Samples (if necessary)	Verify ambient air content	PCE/TCE Radionuclides	TBD TBD	1 in 20 0	1 per shipment 0	0 0

Notes:

- Analyses for radionuclides may include thorium 230, 232, uranium 234, 235, 238, and radium. Field duplicates will be collected at an appropriate rate of 1 duplicate for each 20 samples (5%). Soils analyzed by Alpha Spectroscopy will target uranium or thorium.
- Based on previous analytical results, the soils will not be analyzed for SVOCs, PCBs or TAL Metals (other than nickel).

* If oily or significantly stained soils are noted based on field observations, additional analyses may be performed at the discretion of field personnel.

** The actual number of samples will vary depending upon the field conditions encountered and the need to delineate process residuals that are found during the investigation.

Table H-4 (attached) discusses the handling and preservation of soil samples.

H.3.1.1 Field Duplicate Samples

Collection of field duplicate samples (samples collected from one location and sent to the laboratory blind) provides for both the evaluation of the laboratory's performance by comparing analytical results of two samples from the same location and to evaluate field sample collection procedures. One field duplicate sample will be collected for every 20 environmental samples (frequency of 5 percent).

H.3.1.2 Matrix Spikes and Matrix Duplicates, Matrix Duplicates

For chemical analyses, matrix spike/matrix spike duplicate (MS/MSD) samples are duplicate samples that have spiking solutions added. MS/MSD samples are considered identical to the original sample and require that the sampled material be homogenized in the field and laboratory prior to analyses. Due to the potential loss of VOCs during homogenization, samples collected for VOCs analyses will not be homogenized. The percent recovery of the spiked amount indicates the accuracy of the extraction as well as interference caused by the matrix. Relative percent difference (RPD) between spike sample recoveries will indicate the precision of the data. One MS/MSD sample set will be collected for every 20 environmental samples (frequency of five percent).

For radiochemical analyses, matrix duplicate (MD) analyses will be performed according to the following criteria. A Relative Error Ratio (RER) of less than one for 80 percent of the total radiochemical measurements and less than 3.5 for all measurements will be considered acceptable. An RER is a measure of precision, which is dependent of the actual analyte concentration being measured. The RER may be calculated as:

$$RER = \frac{R_1 - R_2}{\sqrt{TPU^2_{1(1\sigma)} + TPU^2_{2(2\sigma)}}}$$

where: R_1 = analytical sample result
R_2 = analytical duplicate result
$TPU_{(1\ )}$ =2 sigma total propagated uncertainty for sample (1) or duplicate (2)

In addition, for alpha spectrometry measurements, each sample will be spiked with appropriate tracers to evaluate recovery.

H.3.1.3 Field Blanks/Equipment Blanks

Field blanks/equipment blanks will consist of samples of analyte-free water that are passed through and or over decontaminated sampling or excavation equipment. One equipment blank will be collected per sampling event. Field/equipment blanks will not be required if dedicated sampling equipment is used. The field/equipment samples will be subject to the same analyses as the environmental samples.

H.3.2 Sample Preparation and Preservation

Immediately after collection, samples will be transferred to labeled sample containers and properly preserved. Table H-4 (attached) lists the proper sample containers, volume requirements, and preservations. Samples requiring refrigeration for preservation will be promptly transferred to coolers packed with ice. Samples will be transported within 24 hours and arrive at the laboratory no later than 48 hours after collection. Samples will be extracted, digested and/or analyzed within the holding times specified in Table H-4. Proper chain-of-custody documentation will be maintained as discussed below.

H.4 SAMPLE CUSTODY

Chain-of-custody procedures will be instituted and followed throughout the remedial activities. These procedures include field custody, laboratory custody, and evidence files. Samples are physical evidence and will be handled according to strict chain-of-custody protocols documenting the samples from collection through analyses. The USEPA has defined custody of evidence as follows:

- Actual possession;
- In view after being in physical possession; and
- In a secure, restricted area.

QA measures will begin with the sample containers. Pre-cleaned sample containers will be purchased from an USEPA-certified manufacturer. Chain-of-custody records will be kept starting in the field when sample collection is completed. In the field logbook, samplers will note physical characteristics of the sample, date, time, location, abnormalities and equipment employed during collection. The chain-of-custody form will be signed and placed in the shipping container. The custody seals will be initialed and affixed to the latch and lid of the shipping container. Broken seals will indicate tampering prior to reaching the laboratory. When the samples arrive at the laboratory, the sample custodian will sign the vendor's air bill or bill of lading and attach the shipping label to the chain of custody.

The sample custodian's duties and responsibilities upon sample receipt will be to:

- Document receipt of samples;
- Inspect sample shipping containers for integrity;
- Sign the appropriate forms or documents, verify and record the agreement or disagreement of information on sample documents and, if there are discrepancies, record the problem and notify the field manager;
- Label sample with laboratory sample number; and
- Place samples in secure, limited-access storage.

At the laboratory, the analysts will be required to log samples and extracts in and out of storage as the analysis proceeds. Samples and extracts will be returned to secure storage at the close of business. Written records will be kept of each time the sample or extract changes hands. Care must be exercised to properly complete, date, and sign items needed to generate data. Copies of the following will be stored for incorporation into the sample file:

- Documentation of the preparation and analysis of samples;
- Bench sheets, graphs, computer printouts, instrument logs, chromatograms, mass spectra, and copies of the analyst's notebooks, as applicable;
- Copies of QA/QC data; and
- Analytical tracking forms that records the date, time, and identity of the analyst for each step of the sample preparation, extraction, and analysis.

H.5 CALIBRATION AND FREQUENCY

Proper calibration of laboratory analytical instrumentation is essential to obtain reliable data and meets the established DQOs. Analytical instrument calibration is monitored through the use of control limits that are established for individual analytical methods. Calibration procedures are specified in the analytical methods and in NYSDEC ASP 6/00 revisions, Exhibit E (NYSDEC 2000). These procedures specify the calibration materials to be used and the type, range, and frequency of calibration. The laboratory will be responsible for proper calibration and maintenance of laboratory analytical equipment. The following subsections detail some of the calibration procedures.

H.5.1 Gas Chromatography/Mass Spectrometry (GC/MS)

Before the GC/MS is calibrated, the mass calibration and resolutions of the instruments are verified by a 50-ng injection of 4-bromofluorobenzene (BFB) for VOCs. The tune must meet the ion abundance criteria specified in the analytical method. The system must be verified every 12 hours of analysis and when the instrument performance check solution fails to meet criteria. After re-tuning, the performance check solution is reanalyzed. Samples are not analyzed until tuning criteria are met.

An initial five-point calibration is performed for the target compounds prior to start-up and whenever system specifications change or if the continuing calibration acceptance criteria have not been met. One of the calibration standards must be at a concentration between one and five times reporting limits. The relative response factors (RRFs) and percent RSD of specific compounds must meet established criteria as specified in the method. If these parameters fail to meet criteria, corrective actions must be implemented and the initial calibration must be repeated.

A midpoint continuing calibration standard containing the target compounds is analyzed at the beginning of every 12-hour period following the GC/MS tune. This standard must meet specific QC limits listed in the method to verify that the initial five-point calibration is still valid.

H.5.2 Nickel

A two-point calibration for metals ICP analyses and a five-point curve is performed for spectrophotometers and graphite furnace is performed daily. The calibration curves must have correlation coefficients greater than or equal to 0.995. Calibration verification is monitored by analyzing a verification standard and a blank following calibration, every 10 samples, and at the end of the analytical sequence. The calibration verification standard recovery must be within 90 to 110 percent for all metals or the instrument must be resloped and, if necessary, recalibrated. The calibration blank must not contain target compounds at concentrations greater than the reporting limits or corrective actions are implemented. To verify inter-element and background corrective factors for ICP analysis, interference check samples (ICSA and ICSAB) must be analyzed at the beginning and end of the analysis sequence or a minimum of twice per 8-hours. The percent recoveries for ICS solutions must be within 80 to 120 percent or corrective actions must be implemented. In addition, a serial dilution analysis must be performed per sample matrix. If the analyte concentration is greater than fifty times the instrument detection limit (IDL) in the original sample, a five-fold serial dilution must agree within ten percent of the original determination. Detection limits, inter-element corrective factors, and linear ranges must be established at the frequency specified in the method.

H.5.3 Radionuclides

For isotopic analyses, on an annual basis, NIST-traceable sources are used for determining detector efficiencies of solid-state detectors. These efficiencies are checked weekly using non-NIST standards. The check source data are only used to verify reproducibility of the detectors. On a quarterly basis, system amplifiers are calibrated to align source energies into calibrated sources. The reproducibility of the energy calibrations is checked weekly. Peak resolution checks are performed on a daily basis using electronic pulsars. The resolutions are determined to not exceed 100 keV FWHM. System backgrounds are determined weekly and subtracted from sample results. Calibration sources will contain a mixture of alpha emitters giving well-separated peaks that cover the region from 2 to 4 meV.

The manufacturer will calibrate equipment used for field isotopic analyses. During the remedial activities, the working condition of the equipment will be evaluated using check sources at the beginning and ending of each day's work using standardized check sources.

H.5.4 Standards and Solutions

The use of standard materials of a known purity and quality is necessary for the generation of reproducible data. The laboratory will monitor the use of laboratory solutions, standards, and reagents.

Standard reference materials, performance evaluation materials, and solutions are obtained from the NIST USEPA, or USEPA-certified commercial vendors. Verification in the form of a certification from the supplier, comparison to a standard curve, or another standard from a separate source is performed prior to use. Standards are routinely checked for signs of deterioration, including unusual volume changes, discoloration, formation of precipitates, or changes in analyte response.

Solvent materials are also verified prior to use. Each new lot of solvent is analyzed to verify the absence of interfering constituents. Reagent and method blanks are routinely analyzed to evaluate possible laboratory-based contamination of samples.

H.5.5 Records

A bound notebook will be kept with each instrument that requires calibration. The notebook will contain a record of activities associated with QA monitoring and instrument repairs. The laboratory will also maintain a record book for standards indicating the material name, control or lot number, concentration, supplier/manufacturer, preparation date, chemist who prepared the standard and the expiration date. These records will be checked during periodic equipment review and internal and external QA/QC audits.

H.5.6 Equipment

Each major piece of analytical laboratory instrumentation that will be used on this project has been documented and is on file with the laboratory. An equipment form will be prepared for each new purchase and old forms will be removed from the instrument area and filed when an instrument is replaced.

The laboratory will be required to maintain an equipment form detailing both preventative maintenance activities and the required QA testing and monitoring. In the event the instrument does not perform within the limits specified on the monitoring form, the Laboratory Manager will be notified and a decision will be made as to what corrective action is necessary. The corrective action procedure shall be documented in the instrument log. If repairs are made to the instrument, they will be documented in the instrument logbook. Required QA/QC testing and monitoring will be completed prior to the resumption of sample analysis.

H.6 ANALYTICAL PROCEDURES

The accuracy and precision of the analytical data generated by the laboratory will be determined through the analysis of duplicate, spike, reference, laboratory control, and blank samples. Interferences will be identified, documented, and acted on by the laboratory to achieve the specified detection limits. Samples may be diluted only if analytes of concern generate responses in excess of the linear range of the instrument. The selection of analytical cleanup methodologies will follow method requirements. In such cases, the laboratory will document that the laboratory demonstrated good analytical practices in order to achieve the specified detection limits.

The accuracy of the method will be evaluated by spiking the sample matrix with analytes and surrogates. Standards and reference materials will also be analyzed to determine analyte concentrations for comparison with expected concentrations and to provide a measure of accuracy of the methods. Percent recoveries of the spikes will be calculated and compared with control limits. A measure of precision will be obtained through the RPD between MS/MSD and laboratory duplicates. Sampling precision will be evaluated based on the RPD of duplicate field samples and compared to established control limits.

The generated data will be input into the laboratory's database management system. Records will be incorporated into the final file for the samples. Complete descriptions of analytical procedures to be used in the laboratory are described in the methods and in the laboratory's QA Manual.

H.6.1 Method Detection Limit

The MDL is the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is present and is greater than zero. For inorganics, the instrument detection limit (IDL) is determined by multiplying the Students t-Test value the standard deviation obtained for the analysis of a standard solution at a concentration of 3 to 5 times the estimated IDL on 3-days with a minimum of seven measurements. The PQL is the lowest concentration that can be reliably quantified within specified limits of precision and accuracy during routine laboratory operations. Tables H-5 through H-7 list typical laboratory PQLs or reporting limits.

Table H-5 Laboratory PQLs for VOCs (SW8260B)

Parameter	*Soil PQL (ug/kg), dry wt.*	*Water PQL (ug/L)*
Chloromethane	5	2
Vinyl Chloride	5	1
Bromomethane	5	2
Chloroethane	5	2
Acetone	10	10
1,1-Dichloroethene	2.5	1
Methylene chloride	5	1
Carbon disulfide	2.5	1
Trans-1,2-Dichloroethene	2.5	1
1,1-Dichloroethane	2.5	1
2-Butanone	10	5
cis-1,2-Dichloroethene	2.5	1
Chloroform	2.5	1
1,1,1-Trichloroethane	2.5	1
Carbon tetrachloride	2.5	1
1,2-Dichloroethane	2.5	1
Benzene	2.5	1
Trichloroethene	2.5	1
1,2-Dichloropropane	2.5	1
Bromodichloromethane	2.5	1
4-Methyl-2-pentanone	10	5
cis-1,3-Dichloropropene	2.5	1
Toluene	2.5	1
Trans-1,3-Dichloropropene	2.5	1
1,1,2-Trichloroethane	2.5	1
Dibromochloromethane	2.5	1
2-Hexanone	10	5
Tetrachloroethene	2.5	1
Chlorobenzene	2.5	1
Ethylbenzene	2.5	1
Xylene (total)	2.5	1

Parameter	*Soil PQL (ug/kg), dry wt.*	*Water PQL (ug/L)*
Styrene	2.5	1
Bromoform	2.5	1
1,1,2,2-Tetrachloroethane	2.5	1
Notes: PQL indicates practical quantitation limit.		

Table H-6 Laboratory PQLs for TCL Nickel (SW6010B).

Parameter	*Soil PQL (mg/kg), dry wt.*	*Water PQL (ug/L)*
Nickel	4	40
Note: PQL indicates practical quantitation limit.		

Table H-7 Laboratory Reporting Limits for Radionuclides

Parameter	*RL soil (picocuries/g)*	*RL water (picocuries/L)*
Thorium 228, 230, 232	0.4	1
Uranium 234, 235, 238	0.4	1
Gamma spectroscopy	0.2*	20
Note: RL Indicates reporting limit * = relative to Cesium 137		

For radionuclides the Minimal Detectable Concentration (MDC) is typically calculated at the 95 percent confidence level.

H.7 DATA REDUCTION, EVALUATION, AND REPORTING

For data to be scientifically valid, legally defensible, and comparable, valid procedures must be used to prepare this data. Laboratory analytical Level III (USEPA 1987) documentation will be required for each verification sample analysis. The following describes the data reduction, usability and reporting procedures to be used for the Analytical Level III laboratory data.

H.7.1 Data Reduction

Computer data reduction procedures and calculations will be checked manually by the laboratory to verify that compound identification and quantitation adhere to method requirements. The laboratory will be responsible for maintaining a listing of computer-based data reduction programs and SOPs for data reduction. Sample preparation or extraction logs will be used to document sample preparation information (i.e. preparation weights, volumes, and reagents). Instrument injection logs or bench sheets will also be maintained for each instrument. Analysts will perform qualitative identification and quantitation of organic analytes.

H.7.2 Laboratory Data Review

Analytical results are generally entered into the laboratory computer system by the analyst, independently reviewed, and approved by the Laboratory Manager. The following are requirements that are generally examined as part of this review:

- Initial and continuing calibrations met the acceptance criteria defined in the method standard procedure. Standards in the calibration curve covered the expected concentration ranges of the samples including the PQL or RL.
- Sample results fell within the range of the standard curve.
- For GC/MS methods requiring internal standards, retention times and area responses were evaluated against limits established by the daily calibration.
- Method blanks were processed with each analytical batch and no detectable levels of contamination were identified.
- MS/MSD were performed at the required frequency and recoveries were within acceptable control limits.
- Duplicate analyses were performed at the required frequency and results were within the control limits.
- Laboratory control sample (LCS) analyses were performed with each analytical batch and the results obtained were within control limits.
- Compounds identified by GC/MS have been manually rechecked by comparison with the data system library for both target compounds and tentatively identified compounds. Retention times and ratios of fragmentation were verified.
- Calculations have been accurately performed.
- Reporting units are correct.
- Data for the analysis provide a complete audit trail.
- Reported detection limits comply with data quality indicator requirements.

The analyst's supervisor will check a minimum of 10 percent of the data back to raw data in a secondary review. When required analyses on the samples in a project are complete, entered, and reviewed, a report will be generated. At minimum, the report will be reviewed for the following items:

- QC data will be reviewed to identify whether or not internal specification and contract requirements have been met.
- Non-conformance reports, if any, will be reviewed for completion of corrective actions and their impact of results. Non-compliance and corrective action procedures will be documented in the case narrative in the final report.

The report requires the signature of the Laboratory Project Supervisor or designee. Electronic data are copied onto computer tape, inventoried, and stored off-site in a secure facility, or within locked cabinets on site. This data archive system is maintained minimally for 10 years. Analytical data packages, which can be fully validated and include document sample preparation, extraction, and analysis, will be provided for the analyses. Data report forms will be securely bound and the pages will be sequentially numbered. The analytical reports for sample matrices will conform to the data deliverable requirements as listed in NYSDEC ASP 6/00 revision, Category B (NYSDEC 2000). The laboratory will provide both hardcopy and electronic versions of the analytical data.

H.7.3 Data Usability and Data Qualifiers

A Data Usability Summary Report (DUSR) will be performed to determine whether or not the data meets Site specific criteria for data quality and use. Excursions from QA/QC criteria will be qualified based on guidance provided in the following documents:

- Science Applications International Corporation (SAIC). 1992. *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyzes,*
- United States Department of Energy (USDOE) 1995. *Guidance for Radiochemical Data Validation,*
- *United States Environmental Protection Agency Region II Evaluation of Metals Data for the CLP 3/90* (USEPA 1992), and
- *United States Environmental Protection Agency Region II Contract Laboratory Program (CLP) Organics Data Review, SOP No. HW-6, Revision #11* (USEPA 1996a).

or the most recent USEPA Region II data validation guidelines.

<u>Preparation of a DUSR</u>:

The DUSR is developed by reviewing and evaluating the analytical data package. During the course of this review the following questions must be answered:

1. Is the data package complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables?
2. Have all holding times been met?
3. Do all the QC data: blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
4. Have all of the data been generated using established and agreed upon analytical protocols?
5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?
6. Have the correct data qualifiers been used?

<u>Laboratory data qualifiers may include the following:</u>

U Indicates that the compound was analyzed for, but was not detected. The sample quantitation limit is presented and adjusted for dilution and percent moisture. This qualifier is also used to signify that the detection limit of an analyte was raised as a result of analytes detected in laboratory and/or field blank samples.

J Indicates that the detected sample result should be considered approximate based on excursions from QA/QC criteria. Additionally, for organic analyses this qualifier is used either when estimating a concentration for tentatively identified compounds or when the mass spectra data indicate the presence of a compound that meets identification criteria but, the sample result is less than the compound quantitation limit.

UJ Indicates that the detection limit for the analyte in this sample should be considered approximate based on excursions from QA/QC criteria.

E Indicates that the reported result is over the calibration range and therefore the sample must be rerun with a dilution.

Evaluation of NYSDEC ASP Matrix Spike Blank (MSB) data - If the MSB recovery is less than the ASP criteria, the positive results should be qualified as J, estimated biased low. If the MSB recovery is less than the ASP criteria, but greater than 10 percent, the non-detects should be qualified J, biased low. If the MSB recovery is less than 10 percent, the non-detect data must be rejected.

H.8 INTERNAL QUALITY CONTROL CHECKS

H.8.1 Laboratory QA/QC Checks

The overall effectiveness of a QC program depends upon operating in the field and laboratory according to a program that systematically ensures the precision and accuracy of analyses by detecting errors and preventing their recurrence or measuring the degree of error inherent in the methods applied.

Tables H-8 through H-11 (attached) summarize the laboratory corrective actions by analytical method. Requirements as listed in NYSDEC ASP revision 6/00 Exhibit E will be adhered to (NYSDEC 2000). A brief description of laboratory QA/QC analyses is contained in the following subsections.

H.8.1.1 GC/MS Tuning

Tuning and performance criteria are established to verify mass resolution, identification, and to some degree, instrument sensitivity. These criteria are not sample specific; conformance is determined using standard materials. Therefore, these criteria should be met in all circumstances.

H.8.1.2 Calibration

Compliance requirements for satisfactory instrument calibration are established to verify that the instrument is capable of producing acceptable quantitative data. Initial calibration demonstrates that the instrument is capable of acceptable performance at the beginning of analysis, and continuing calibration and performance checks document satisfactory maintenance and adjustment of the instrument on a day-to-day basis.

H.8.1.3 Blanks

The laboratory will analyze several types of blanks. Corrective action procedures will be implemented for blank analyses if target compounds are detected at concentrations greater than the PQL (or five times the PQL for acetone, 2-butanone, methylene chloride, toluene, and phthalate compounds). The criteria for evaluation of blanks apply to any blank associated with a group of samples. If problems with a blank exist, data associated with the project must be carefully evaluated to determine whether or not there is an inherent variability in the data for the project, or if the problem is an isolated occurrence not affecting other data.

A reagent blank consists of laboratory distilled water and any reagents added to a sample during analysis only, or straight solvent. A reagent blank is usually analyzed following highly contaminated samples to assess the potential for cross-contamination during analysis. A method blank is a water or soil blank that undergoes the preparation procedures applied to a sample (i.e. extraction, digestion, clean up). These samples are analyzed to examine whether sample preparation, clean up, and analysis technique result in sample contamination. The laboratory will prepare and analyze a method blank with each group of 20 samples of similar matrix that are extracted, digested, or analyzed at the same time (within same 12 hour period for GC/MS analysis).

Equipment and trip blanks will also be collected and submitted for laboratory analysis, where appropriate to assess contamination introduced during field sampling procedures and sample shipment, respectively. Equipment and trip blanks will be handled in the same manner as environmental samples.

H.8.1.4 Internal Standards Performance

Internal standards, which are compounds not found in environmental samples, will be spiked into blanks, samples, MS/MSDs, and LCS at the time of analysis for VOC. Internal standards are used to quantitative results and correct for injection variability for VOC analyses. Internal standards must meet retention time and performance criteria specified in the analytical method or the sample will be reanalyzed.

H.8.1.5 Surrogate Recovery

Accuracy and matrix biases for individual samples are monitored for organic analyses using surrogate additions. Surrogates are compounds that are spiked into environmental samples, blanks, and quality control samples prior to sample preparation for organic analyses. The evaluation of the results of these surrogate spikes is not necessarily straightforward. The sample itself may produce effects due to such factors as interference's and high concentrations of analytes. Since the effects of the sample matrix are frequently outside the control of the laboratory and may present relatively unique problems, the review and usability of data based on specific sample results is frequently subjective.

H.8.1.6 LCS Analyses

LCSs are standard solutions that consist of known concentrations of the target analytes spiked into laboratory-distilled water or clean sand. They are prepared or purchased from a certified manufacturer from a source independent from the calibration standards to provide an independent verification of the calibration procedure. They are spiked with target analytes bromofluorobenzene, 1,2-dichloroethane-d4, and toluene-d8. These QC samples are prepared and analyzed using the same procedures as for environmental sample analysis to assess method accuracy independently of sample matrix effects. The laboratory will prepare and analyze a LCS with each group of 20 samples of similar matrix that are extracted, digested, or analyzed at the same time (within same 12 hour period for GC/MS analysis). Percent recoveries will be evaluated to assess the efficiency of preparation and analysis method independent of environmental sample matrix effects.

H.8.1.7 MS/MSD or Laboratory Duplicate Samples

MS/MSD or laboratory duplicate analyses will be performed on environmental samples VOC and nickel analysis at a frequency of one for every 20 samples of a similar matrix. Whenever possible MS/MSD and laboratory duplicate samples will be prepared and analyzed within the same batch as the environmental samples. MS/MSD samples will be spiked at the laboratory with target analytes. MS/MSD and laboratory duplicate data are generated to determine long-term precision and accuracy of the analytical method with respect to sample matrices.

H.8.1.8 Compound Identification and Quantitation

Qualitative criteria is used to minimize the number of erroneous identifications of compounds and maximize the accuracy of data and sensitivity of the instrument. An erroneous identification can be either a false positive (reporting a compound present when it is not) or a false negative (not reporting a compound that is present). False positives are more difficult to identify since they represent an absence of data. Samples should be analyzed undiluted to maximize sensitivity. However, samples must be reanalyzed at a dilution when concentrations exceed the linear calibration range to maximize accuracy.

H.8.2 Control Limits

In the event that method control limits are not provided, laboratory control limits will be established separately for spike and duplicate analyses. Laboratory control limits can be considered action limits. and are defined as "three standard deviations of the mean and correspond to 99.7 percent confidence limits of a normal distribution curve. The laboratory will establish control limits for each analyte of concern using a minimum of 20 data points. Laboratory control limits may change since limits are minimally updated on an annual basis with the addition of new data points. The laboratory control limits used to assess data for this program will be summarized by the laboratory in the analytical report.

H.8.3 Field Sampling QA/QC

Bound logbooks and appropriate data sheets will be used to document the collection of samples and data so that an individual sample or data set can be traced back to its point of origin, sampler, and type of sampling equipment. Sampling will be performed according to the methods provided in the Work Plan and in this QAPP. Blind field duplicate samples will be collected and sent to the laboratory for analysis in conjunction with the environmental samples. Field sampling precision will be evaluated through the RPD of the duplicate sample analyses results. Control limits for field duplicate precision have been established at 100 percent for soil samples. Decontamination of sampling equipment will be verified through the analysis of equipment blanks. Proper chain-of-custody protocols will be followed.

H.9 PERFORMANCE AND SYSTEM AUDITS

Field and laboratory performance audits consisting of on-site performance evaluations may be conducted during the field and laboratory analysis program. These audits will evaluate the adherence to the QA program. The protocols used to conduct the audits may be found in the following sections. Acceptance criteria used in determining the need for corrective action will be those criteria defined in this QAPP. Where acceptance criteria are not defined for laboratory procedures and analytical methods, the laboratory's standard operating procedure and QA Manual will be consulted. Audits and any corrective actions that were implemented as a result of the audits, will be included in the technical report.

The laboratory audit will note factors that may affect the quality of the analytical results. The areas of concern of the laboratory audit will include:

- Implementation of a scientifically sound QA/QC program addressing precision, accuracy, reproducibility, comparability, completeness, and blank contamination;
- Sufficient documentation and record keeping for technical personnel external to the laboratory to recreate each analytical event; and
- Compliance with the project requirements for laboratory analysis.

The specific parameters to be evaluated include:

- Data comparability;
- Calibration and quantitation;
- QC execution;
- Out-of-control events;
- Standard operating procedures;
- Sample management;
- Record keeping;
- Instrument calibration records;
- Other analytical records;
- QC records;
- Corrective action reports;
- Maintenance logs;
- Data review;
- Limits of detection;
- QC limits; and
- Analytical methods.

H.9.1 Field Audit Protocol

The purpose of a field audit is to identify whether the systems and procedures described in the Work Plan and QAPP are operational in the field and contributing to the production of accurate and defensible analytical results. The areas of concern in a field audit include:

- Sampling procedures;
- Decontamination of sampling equipment, if applicable;
- Chain-of-custody procedures;
- Standard operating procedures; and
- Proper documentation in field notebooks.

H.9.2 System Audits

Laboratory and field performance will be monitored through the analysis of equipment and laboratory blanks, spiked samples, laboratory control samples, laboratory and field duplicates, and performance evaluation samples. The laboratory in conjunction with the Project Manager, will formulate corrective actions in the event that QC limits specified in this document are exceeded. The results of the system audits will be documented in the Remediation Report.

H.10 PREVENTIVE MAINTENANCE

Preventive maintenance procedures will be carried out on field equipment in accordance with the procedures outlined by the manufacturers' equipment manuals. Field equipment used during this project will have a specific maintenance instruction sheet accompanying it. Maintenance activities involving field equipment will be recorded in a field logbook.

Major analytical equipment at the laboratory is typically covered by some type of maintenance contract, usually with the instrument manufacturer. The degree and extent of contracted routine or preventive maintenance assistance is a function of the complexity of the equipment, amount of equipment redundancy and the laboratory in-house expertise relative to repair and maintenance of the particular piece of equipment. Maintenance activities will be documented and maintained in the laboratory files.

H.11 DATA ASSESSMENT PROCEDURES

The procedures employed by the laboratory to assess the quality of data generated include at minimum analytical precision per method, analytical accuracy per method, analytical completeness; MDLs, IDLs, and PQLs. Data quality reviews contribute to the total process. Precision and accuracy will be assessed using control charts consisting of line graphs that provide a continuous visual representation of the state of each analytical procedure. The standard deviation of the mean of the QC measurement will be calculated. The upper and lower warning limits will be set at plus or minus two standard deviation units. However, the upper and lower control limits are set at plus or minus three standard deviation units. Acceptable data are realized when results fall between the lower and upper warning limits. If the QC value falls between the control and the warning limit, the analysis should be scrutinized as possibly out of control.

In general, the accuracy of the methods will be evaluated by spiking the sample matrix with the analyte and by analyzing reference materials with known concentrations. The spiking levels will be selected to reflect the concentration range of interest. Percent recoveries of the spikes and reference materials will be calculated and compared to the established limits. The precision of the methods will be evaluated by the analysis of matrix spike and laboratory and field duplicate samples. The precision will be evaluated by calculating the RPD between the duplicates. RPD calculations will be compared to the established limits.

The definitions and equations used for the assessment of data quality are discussed below.

Accuracy - Is a measure of the nearness of an analytical result, or a set of results, to the true value. The term accuracy is often used synonymously with percent recovery and is expressed in terms of error or bias. Percent recovery describes either the recovery of a synthetic standard of known value, or the recovery of known amount of analyte (spike) added to a sample of known value. The percent recovery or accuracy can be calculated by using:

standards: percent R = (observed value/true value) x 100

spikes: percent R = ((conc. spike + sample conc.) – sample conc. x 100) / conc. spike

Precision - Refers to the agreement or reproducibility of a set of replicate results among themselves without assumption of any prior information as to the true result. Precision is usually expressed in terms of the % difference or relative percent difference (RPD).

The % difference is calculated by using:

.1 **% Difference = (larger SR - smaller SR) x 100)/smaller SR**

Where:
SR is the sample result

The RPD is calculated by using:

$$RPD = (*OSR - DSR* \times 100)/((OSR + DSR)/2)$$

Where:
OSR is the original sample result
DSR is the duplicate sample result.

Average - The average or arithmetic mean (X) of a set of n values (Xi) is calculated by summing the individual values and dividing by n:

$$X = (\Sigma Xi_{I=1 \text{ to } n})/n$$

Range - The range (Ri) is the difference between the highest and lowest value in a group. For n sets of duplicate values (X2, X1) the range (Ri) of the duplicates and the average range (R) of the n sets are calculated by the following:

$$R_i = X_2 - X_1$$

$$R = \Sigma Ri_{i=1 \text{ to } n}/n$$

Standard Deviation and Variation - The standard deviation (S) of a sample of n results is the most widely used measure to describe the variability of a data set. It is calculated by using the following equation:

$$S = \sqrt{\frac{\Sigma (Xi - X)^2_{i-1 \text{ to } n}}{n}}$$

Where:
X is the average of the n results
Xi is the value of result i.

Normally, X "S will include 68% and X" 2S includes about 95% of normally distributed data.

The variance is equal to S^2. The percent relative standard deviation (RSD) or coefficient of variation (CV) is the standard deviation divided by the mean and multiplied by 100 as follows:

$$CV = 100S/X$$

The laboratory will identify any data that should be rated as "unacceptable", based on the assessment of the QA/QC criteria. Data assessment will be evaluated and discussed in the data usability report(s).

H.12 CORRECTIVE ACTION

Corrective action procedures will be implemented based on unacceptable audit results or unacceptable data during evaluation. Two types of audits may be performed during the remedial activities. The data generation process may be audited by assessing adherence to method or laboratory control limits and by performing an on-site laboratory audit. The field program may be audited by assessing adherence to the procedures outlined in the Work Plan, the analysis of field QC samples, and by performing an on-site field audit. If needed, corrective action procedures will be developed on a case-by-case basis and will be documented in the appropriate notebook, log, or case file.

Corrective actions may be taken by the laboratory. When calibration, instrument performance, and blank criteria are not met, the cause of the problem will be located and corrected and the analytical system will be recalibrated. Sample analysis will not begin until calibration, instrument performance, and blank criteria are met. When matrix spike, reference standard, or duplicate analyses are out of control, samples analysis will cease and the problem will be investigated. Depending on the results of the overall QC program for the sample set, the data may be accepted, accepted with qualification, or determined unusable. If the laboratory determines data to be unusable, those samples will be prepared and reanalyzed. If matrix interferences are suspected, samples will be subjected to one or more of the clean-up techniques specified in the analytical methods. If QC criteria are met upon reanalysis, only the new results are reported. If QC criteria are still not met upon reanalysis, both sets of sample results will be reported.

The laboratory will make every reasonable effort to correct QC excursions and to document the presence of matrix interferences. In this way, unnecessary resampling of difficult matrices may be avoided. However, if matrix interferences are not documented resampling may be required. Corrective actions during remedial activities, if required, will generally involve altering the field procedure to match the guidelines set forth in the Work Plan and in this QAPP. If problems arise with procedures or guidelines set forth herein, the client, the laboratory, and the Project Manager, in conjunction with the appropriate agencies, will formulate an appropriate corrective action.

H.13 QA REPORTS TO MANAGEMENT

A Data Usability Summary Report (DUSR) will be prepared for the analyses outlined in this Work Plan. The DUSR will be submitted as part of the Final Project Report. The deliverables associated with the remedial activities will contain separate QA sections where data quality information collected during the remedial activities is summarized. These reports will include the QA Officer's report on the accuracy, precision, and completeness of the data and the results of the performance and system audits.

Table H-4. Field Sample Handling Summary Table

Parameter	Matrix	Sample containers and volumes	Preservation	Holding times (from verified time of sample receipt (VTSR))	Environmental samples*	QC Samples		
						Field duplicates (frequency)	Trip blanks	MS/MSDS (frequency)
VOCs	Soil	125 milliliter wide mouth glass container sealed with a septum	4°C	7 days (unpreserved)	TBD	5%	1 each per shipment	5 percent
Metals	Soil	4 ounce wide mouth glass container with Teflon® lined lid	4°C	180 days	TBD	5%	0	5 percent
pH	Soil	50 milliliter wide mouth container with Teflon® lined lid	4°C	ASAP	TBD	5%	0	5 percent
Radionuclides, Gamma Spectroscopy	Soil	2-250 milliliter wide mouth containers with Teflon® lined lid	4°C	6 months	TBD	0%	0	0 percent

Note: MS/MSD indicates matrix spike/matrix spike duplicate sample
VOCs - volatile organic compounds
Metals - nickel
Radionuclides include thorium 228, 230, 232, uranium 234, 235, 238, and radium. MD for radionuclides will be performed according to the MD criterion presented in section 4.3.2.

* Note: The actual number of samples will be determined in the field in accordance with the Work Plan and Table E-1 in the FSP.

Table H-8
Volatile (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8260B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Holding times	Samples must be extracted and analyzed within holding time.	VOCs: Analyze within 10 days from verified time of sample receipt if preserved, 7 days if unpreserved.	If holding times are exceeded for initial or reanalysis required due to QC excursions, notify QAO immediately since resampling may be required.
MS Tuning	Once every 12 hours.	Bromofluorobenzene key ions and abundance criteria listed in the method must be met for all nine ions.	1. Tune the mass spectrometer. 2. Document corrective action - samples cannot be analyzed until control limit criteria have been met.
Initial Calibration	Prior to sample analysis and when continuing calibration criteria are not met.	1. Five concentrations bracketing expected concentration range for all compounds of interest. 2. Criteria as listed in NYSDEC ASP 6/00 Exhibit E.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Continuing Calibration	Every 12 hours, following bromofluorobenzene.	Criteria as listed in NYSDEC ASP 6/00 Exhibit E.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria are met.
Preparation Blank Analysis	Every 12 hours, following continuing calibration	Common laboratory contaminants less than 5x PQL; anything else less than PQL.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument, recalibrate analytical system, and reanalyze all samples with the same compounds as detected in the blank. 3. Document corrective action - samples cannot be analyzed until blank criteria have been met.
Field / Equipment Blank Analysis	Every 20 samples.	Common laboratory contaminants less than 5x PQL; anything else less than PQL.	1. Investigate problem, contact QAO. 2. Write an explanation.

Table H-8
Volatile (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8260B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Trip Blank	One per cooler containing VOC samples.	Common laboratory contaminants less than 5x PQL; anything else less than PQL.	1. Investigate problem, contact QAO. 2. Write an explanation.
Laboratory Control Sample Analysis	Each analytical batch (every 12 hours). Prepared independently from calibration standards.	Recovery within matrix spike blank limits (NYSDEC ASP 6/00 Exhibit E) if available, otherwise within laboratory control limits. Spike must contain all target analytes.	1. If recovery failures are above control limits and these compounds are not detected in the associated samples, contact QAO. 2. Reanalyze LCS and examine results of other QC analyses. 3. If recovery is still outside limits and other QC criteria are met, contact QAO. 4. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 5. Document corrective action.
Internal Standards	All samples and blanks (including MS/MSD)	1. Response -50% ±100% of internal standards from continuing calibration of the day. 2. Response time must be ± 30 seconds from associated standard.	1. Reanalyze. 2. If still outside of the limits, qualify data. 3. Document corrective action.
Surrogate Spike	All samples and blanks (including MS/MSD)	Recovery within NYSDEC ASP 6/00 Exhibit E control limits.	1. Reanalyze any environmental or QC sample with surrogates that exceed control limits. 2. Qualify the data. 3. Document corrective action.

Table H-8
Volatile (GC/MS) Quality Control Requirements and Corrective Actions
SW-846 8260B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
MS/MSD Analysis	One per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Recovery and RPD within NYSDEC ASP 6/00 Exhibit E limits, if available, otherwise within laboratory limits.	1. Reanalyze if <10%. 2. If >10% and LCS criteria are met, document in case narrative; no additional corrective action required. 3. If >10% and LCS criteria are exceeded, examine other QC data for source of problem; *i.e.* surrogate recoveries for extraction efficiency and calibration data for instrument performance issues. 4. Take corrective action as required, re-extract or reanalyze samples and associated MS/MSD and LCSs as required.
Field Dup. Analysis	One per matrix and analytical batch and every 20 samples of similar matrix	100% RPD for soil.	If these criteria are not met, sample results will be evaluated on a case by case basis.

Table H-9
Radionuclides Quality Control Requirements and Corrective Actions
Modified Method EML Th-0l-and EMLU-02
with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Holding Times	Samples must be extracted and analyzed within holding time.	Extract and analyzed within 6 months of verified time of sample collection for soil samples.	If holding times are exceeded for initial or any reanalysis required due to QC excursions, notify the QAO immediately since resampling may be required.
Initial Calibration	For thorium and uranium: Efficiency - annually Efficiency check - monthly or prior to use Energy - quarterly or prior to use Energy check, resolution, background - weekly or prior to use	All calibrations should be evaluated statistically against determinations performed previously. If results are outside of statistical range, an explanation of the change in performance shall be provided.	If calibration results are measured outside of statistical ranges, the QAO will be notified. Explanations will be provided in the case narrative and in the instrument maintenance logbook.
Method Blank Analysis	1 per 20 samples of similar matrix extracted at the same time or 1 per batch.	Results must be less than or equal to MDC or less than 5X below lowest activity of the sample.	1. Reanalyze the batch. 2. If holding times have elapsed, contact the QAO immediately since resampling will be required.
LCS Analysis	1 per 20 samples of similar matrix extracted at the same times or 1 per batch for both alpha and beta emitter.	75 - 125% recovery.	1. Reanalyze the batch 2. If holding times have elapsed, contact the QAO immediately since resampling will be required.
Matrix Spike Analysis	For thorium and uranium: 1 per matrix type or per batch and every 20 samples of similar matrix.	40 - 160% recovery.	1. If LCS criteria are met, document in case narrative; no additional corrective action required.
Matrix Duplicate Analysis	1 per matrix type or per batch and every 20 samples of similar matrix.	RER<3.0.	1. If LCS criteria are met, document in case narrative; no additional corrective action required.
Equipment Blank Analysis	One per sampling equipment and after every 20 samples, where applicable.	Result $\leq$ control requirements detection limits	1. Investigate problem; examine for potential cross contamination at lab or at field 2. Notify the QAO immediately since resampling may be necessary.

Table H-9
Radionuclides Quality Control Requirements and Corrective Actions
Modified Method EML Th-01-and EMLU-02
with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Laboratory Corrective Action
Field Duplicate Analysis	One per matrix type and every 20 samples of similar matrix.	RER $\leq$ 3.	No corrective action required since the laboratory will not know the identity of the field duplicate samples. Sample results will be evaluated on a case by case basis during the data evaluation process.
Tracer Recoveries	For thorium and uranium: Samples and QC samples	For thorium and uranium: 45 - 105% recovery.	1. If recovery is outside control limit, repeat analysis. 2. If reanalysis is outside control limit, notify QAO and document a matrix specific QC problem in the case narrative.
Note: For initial calibration, select the least stringent criteria; for example, weekly or prior to use is defined as must be performed prior to use of action has not been performed within a week prior to use.			

Table H-10
Radionuclides Quality Control Requirements and Corrective Actions
Gamma Spectrometry

Audit	Frequency	Control Limits	Laboratory Corrective Action
Holding Times	Samples should be counted within holding time.	Though there are not regulatory holding times for radiochemistry parameters, samples should be counted within 6 months of the collection date.	If holding time is exceeded for initial or any re-analyses, contact the QAO immediately in order to discuss the possible need for re-sampling.
Efficiency Calibration Efficiency Calibration Check Energy Calibration Energy Calibration Check Resolution Check Background Background Check	annually weekly or prior to use monthly or prior to use weekly or prior to use weekly or prior to use monthly or prior to use weekly or prior to use	All calibrations should be evaluated against previously determined calibrations to verify consistency of response factors. Calibration checks should be statistically evaluated against initial calibrations to determine consistency and stability of systems.	If calibrations are inconsistent with those determined previously, no samples shall be counted until the variations are explained. If calibration checks are inconsistent, they should be repeated. If upon repeating they are still inconsistent, primary calibrations should be repeated. No samples should be counted until calibration anomalies are resolved.
Method Blank Analysis	1 per 20 samples	Results must be less than reporting limits or less than 5x below lowest sample activity for each isotope detected.	1. Reanalyze batch 2. If holding times have elapsed, contact QAO for instructions
LCS Analysis	1 per 20 samples	40 – 160% recovery	1. Reanalyze batch 2. If holding times have elapsed, contact QAO for instructions
Matrix Duplicate Analysis	1 per 20 samples	RER <2.0	1. If LCS criteria are met, document in case narrative; no additional corrective action is required.
Equipment Blank Analysis	One per sampling equipment and after every 20 samples where applicable	Results must be less than reporting limits or less than 5x below lowest sample	1. Investigate problem; examine potential for contamination in the field or lab 2. Notify QAO
Field Duplicate Analysis	One per matrix type and every 20 samples of similar matrix	RER <3.0	No corrective action required since the identity of field duplicates will be blind to the lab.

Table H-11
Metal Quality Control Requirements and Corrective Actions
SW-846 6010B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Holding Times	Samples must be digested and analyzed within holding time.	Metals – Analyze 180 days from verified time of sample receipt	If holding times are exceeded for initial or any reanalysis required due to QC excursions, notify the QAO immediately since resampling may be required.
Calibration Verification (ICV, CCV)	Calibrate daily according to method and each time instrument is set up; verify at more frequent of 10% or every 2 hours. Also verify at the end of each run. Standard at 1-2 times the PQL should be analyzed after initial cal for ICP.	90% to 110% of expected value for ICP and AA. NYSDEC ASP Exhibit E requirements.	1. Reanalyze. 2. If criteria are still not met, identify and correct problem, recalibrate. 3. Document corrective action - samples cannot be analyzed until calibration control limit criteria have been met.
Calibration Blank	At beginning and end of run and at a rate of 10% during run.	NYSDEC ASP Exhibit E requirements.	1. Identify and correct problem. 2. If criteria are still not met, recalibrate. 3. Document corrective action - samples cannot be analyzed until blank control limit criteria have been met.
Preparation Blank Analysis	1 per batch of samples digested, or 1 in 20, whichever is greater.	NYSDEC ASP Exhibit E requirements.	1. Reanalyze blank. 2. If limits are still exceeded, clean instrument and recalibrate analytical system and prepare and reanalyze affected samples if detected. 3. Document corrective action - samples cannot be analyzed until blank criteria are met.
Field / Equipment Blank Analysis	Every 20 samples, where applicable	NYSDEC ASP Exhibit E requirements.	1. Investigate problem, contact QAO. 2. Write an explanation.
Laboratory Control Sample Analysis	Every 20 samples or each digestion batch. Prepared independently from calibration standards.	Recovery within NYSDEC ASP 6/00 Exhibit E limits if available, otherwise within laboratory control limits.	1. Reanalyze LCS and examine results of other QC analyses. 2. If recovery is still outside limits, and other QC criteria are met, contact QAO. 3. If other QC criteria have not been met, stop analysis, locate and correct problem, recalibrate instrument and reanalyze samples since last satisfactory LCS. 4. Document corrective action.

Table H-11
Metal Quality Control Requirements and Corrective Actions
SW-846 6010B with NYSDEC ASP Exhibit E Requirements

Audit	Frequency	Control Limits	Corrective Action
Serial Dilution Analysis	Only required when analyte concentration is >50 times the IDL after dilution for metals.	NYSDEC ASP 6/00 Exhibit E requirements.	1. Qualify data. 2. Document corrective action.
Interference Check Sample Analysis	Beginning and end of each analytical run or twice during every 8 hours, whichever is more frequent for metals.	NYSDEC ASP 6/00 Exhibit E requirements.	1. Reanalyze. 2. If limits are still exceeded, adjust instrument. 3. Restart analytical run and reanalyze samples analyzed since last satisfactory ICS. 4. Document corrective action.
Matrix Spike Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	Recovery within NYSDEC ASP 6/00 Exhibit E limits if available, otherwise within laboratory control limits.	1. Analyze post spike. 2. Document corrective action.
Laboratory Duplicate Analysis	1 per group of similar concentration and matrix, 1 per case of samples, or 1 in 20, whichever is greater.	NYSDEC ASP 6/00 Exhibit E requirements	1. Investigate problem and reanalyze. 2. Document corrective action.
Field Dup. Analysis	1 per matrix and analytical batch and every 20 samples of similar matrix	100% RPD for soil.	If these criteria are not met, sample results will be evaluated on a case by case basis.

PROJECT TEAM RESUMES

Envirocon

Michael Shane (Shane) Brightwell, CHP
Vincent (Vince) Daliesso, Jr., CIH
Dale Evans, PE
Daniel Felton
Larry Johnston
Tom McCracken, JD, PE
Charles (Chip) Mickel, Jr., PE
Richard (Lucky) Tabor

MHF-LS

Mark Head
Walter (Walt) Hipsher
Steve Singledecker
Steve Thompson
Rob Woodburn
Lee Young

URS Corporation

Michael W. Ander
Robert Brathovde. PE
Pam Cox, CPG
William Duggan, PhD, PE, CHP
Larry Luckett, CHP
Carol Scholl, CPG
Waye Sheu, PhD, PE
Kevin Sullivan, PE

MICHAEL SHANE BRIGHTWELL

TITLE Radological Specialist

EXPERIENCE

Mr. Brightwell specializes in applied health physics, radiation detection instrumentation, decommissioning, hazardous waste management, nuclear engineering, and reactor operations. His areas of expertise include: radiation safety officer duties, decontamination and decommissioning, dose modeling, radioactive materials licensing, project management, work plan development, radiation detection instrumentation, environmental and reactor health physics, audits/inspections, radioactive materials shipping, and hazardous waste management.

His selected project experience includes:

- Approved by the State of Colorado as Radiation Safety Officer at a decommissioning uranium heap leach facility and an environmental/radiochemistry laboratory
- Radiation safety program implementation and maintenance, including licensing, procedures development, personnel training, personnel and environmental monitoring/dose assessment, radioactive materials handling, and radiation monitoring
- Byproduct and source material licensing
- Comprehensive decommissioning of radiochemistry laboratory
- Project Management over university broad scope licensing radiological decommissioning project
- Design, development, and execution of decontamination and decommissioning plans using MARSSIM and other applicable regulatory guidance
- Calibration and maintenance of laboratory and field instrumentation in accordance with manufacturer's specifications
- Site-specific dose modeling using RESRAD Family of Codes
- Supervision of large-scale earth moving operations and management of QA/QC program for remediation of tailings and wind-blown radionuclide contamination at uranium mill sites
- Audits/inspections of radiation safety programs
- Performance of radioactive material shipments in accordance with DOT regulations
- Low-level radioactive waste preparation and shipments
- Management of environmental and trace characterization laboratory for regulatory compliance, QA/QC, research, and industrial applications.

EDUCATION/TRAINING

M.S. Health Physics, Texas A&M University, 1995

B.S. Nuclear Engineering, Texas A&M University, [redacted]

Ex. 6

Argonne National Lab Environmental Assessment Division RESRAD/RESRAD-BUILD Deterministic and Probabilistic Dose Assessment Training

Oak Ridge Associated Universities MARSSIM Training

OSHA 40-hour Environmental Health & Safety Training for Hazardous Waste Site Operations, 29 CFR 1910.120

Radiation Safety Officer, 40-hour Training

Health Physics Society Summer Schools on Decommissioning and Restoration of Nuclear Facilities, and Radiation Instrumentation

Radiation Safety and the Use of Nuclear Gauges

AAHP Course in Statistics and Decommissioning

Ludlum Measurements Inc., 40-hour Training

Radioactive and Hazardous Material Transportation Training

Canberra Gamma Spectroscopy Training on System Management and Algorithms

Senior Reactor Operator Training

Navy Nuclear Power Program

CERTIFICATIONS AND LICENSES

Certified in the Comprehensive Practice of Health Physics, American Board of Health Physics, 1999

Licensed as Senior Reactor Operator, Texas A&M University 1-MW research reactor, 1989

REGISTRATIONS AND AFFILIATIONS

Registered as a Qualified Expert in the State of Colorado, 2001–Present

Member, American Academy of Health Physics, 1999–Present

Member, Health Physics Society, 1996–Present

Texas A&M Corps of Cadets, 1988–1992

PROFESSIONAL HISTORY

2000-Present	President, Professional Radiation Consulting, Inc., Loveland, Colorado
1998–Present	Contract Radiation Safety Officer, Barringer Laboratories, Golden, Colorado
1998–Present	Contract Radiation Safety Officer, Umetco Maybell Facility, Maybell, Colorado
1997–2000	Senior Staff Engineer/Health Physicist, Shepherd Miller, Inc., Fort Collins, Colorado
1996–1997	Staff Engineer/Health Physicist, Shepherd Miller, Inc., Fort Collins, Colorado
1993–1996	Technical Services Manager, Texas A&M Nuclear Science Center, College Station, Texas
1989–1996	Senior Reactor Operator, Texas A&M Nuclear Science Center Reactor, College Station, Texas

PUBLICATIONS

Brightwell, M.S. 2001. "Radiation Detection Instrumentation Used In Decommissioning." Radiation Instruments, Textbook of and Lecture at the *Health Physics Society Summer School*, Findlay, Ohio, June 2001.

Brightwell, M.S. and Reece, W.D. 1999. "Fast Neutron Flux Irradiation Device for a 1-MW TRIGA Research Reactor." Proceedings of and Presentation at the *32nd Midyear Topical Meeting of the Health Physics Society*, Albuquerque, New Mexico, January 1999.

Fiske, L.E., Doyle, S., Johnson, J.A., and Brightwell, M.S. 1999. "Orphaned Radioactive Sources." *Proceedings of the 1999 Conference of the Solid Waste Association of North America*, Tucson, AZ.

Herrold, J.F., Brightwell, M.S. 1998. "Using Regulatory Guidance in Decommissioning Under an NRC Broad-Scope Byproduct Material License." *RSO Magazine* 3:17-23.

Landau, M.S., Brightwell, M.S., and Johnson, J.A. 1998. "Schwartzwalder Mine Haul Road Radiation Survey." Proceedings of and Presentation at the *Spectrum '98 International Conference on Decommissioning and Decontamination and on Nuclear and Hazardous Waste Management*, Denver, Colorado, September 1998.

Brightwell, M.S. 1995. "Minimizing the Production of Unwanted Activation Products in the Argon-40/Argon-39 Dating Method." Thesis, Texas A&M, Department of Nuclear Engineering.

VINCENT M. DALIESSIO, JR., CIH

TITLE Certified Industrial Hygienist/Regional Safety Supervisor

EXPERIENCE

Mr. Daliessio has worked in the safety field for 11 years. He has managed all aspects of health, safety, and environmental compliance including worker's compensation case management, incident/accident investigation, job safety performance, developing and administering health and safety programs, and preparing site specific site safety plans. Mr. Daliessio specializes in site-specific risk assessment and automated data collection and management.

His selected project experience includes:

- Safety Supervisor for a demolition project in Front Royal, Virginia. Mr. Daliessio was responsible for all aspects of health and safety, compliance, and supervision of site employees.

- Safety Supervisor for the installation of sheet pile bulkhead along the Delaware River bank, excavation of contaminated sediment from within a temporary cofferdam and placement of material within the on-site landfill. Mr. Daliessio was responsible for all aspects of health and safety, compliance, and supervision of site employees.

- Safety Supervisor for soil removal and installation of a ditch liner system in Middlesex, New Jersey. Mr. Daliessio was responsible for all aspects of health and safety, compliance, and supervision of site employees.

- Safety Supervisor for a stabilization project in Edison, New Jersey. The project required conditioning and stabilization 36,000 tons of BTEX, SVOC and metals contaminated soils. Mr. Daliessio was responsible for all aspects of health and safety, compliance, and supervision of site employees.

- Safety, Health, and Compliance Manager for an environmental remediation and construction company where Mr. Daliessio reduced lost workday injuries by 90% while revenue increased by 40%. Responsible for all aspects of health and safety, and environmental compliance, and developed measures to improve safety performance and the health and safety program. Reviewed health and safety requirements during bidding process.

- Safety and Health Compliance Manager for a environmental remediation and construction company where he lead a team that worked 3 years and 1 million man-hours without a lost time injury. Work included a $280 million hazardous material cleanup at a operating petroleum refinery in Pennsylvania and a $25 million stream and residential cleanup for an explosives manufacturing plant in New Jersey. Additional work included $50 million worth of hazardous material cleanup projects at manufacturing, metal finishing, petrochemical, pharmaceutical, and research facilities throughout the Eastern and Southern United States and the Caribbean. Duties included risk/hazard assessment, compliance management and enforcement, workers compensation injury/case management, ergonomics, hearing conservation, hazard materials and right-to-know training. Managed 10 health and safety technicians.

- Served as Industrial Hygienist performing safety, health, and environmental compliance support for a $85 million hazardous materials cleanup/construction project at a pharmaceutical research and development facility in New Jersey. Also worked on a $30 million hazardous waste landfill closure project in Westchester County, Pennsylvania. Responsibilities included safety and health compliance, hazard communication/right-to-know training classes, occupational and environmental sampling, laboratory waste management and disposal, laboratory and instrument maintenance, and report preparation.

- Safety Engineer for a major oil corporation at the Paulsboro Refinery in Paulsboro, New Jersey. Assisted Contractor Safety Program Coordinator and implemented EPA/OSHA PSM requirements, and performed safety audits.

- Served as Industrial Hygiene Technician performing industrial hygiene and environmental monitoring, survey and inspection services for manufacturing plants, schools, hospitals, office buildings, machine shops, petroleum refineries, and electric generating stations.

EDUCATION

B.S., Environmental/Occupational Health Sciences, West Chester University, West Chester, Pennsylvania

TRAINING

40-Hour Hazardous Waste Operations Training
8-Hour Hazardous Waste Operations Supervisor Course

CERTIFICATIONS AND AFFILIATIONS

American Board of Industrial Hygiene – Certification #7319
American Industrial Hygiene Association – Delaware Valley Section

DALE W. EVANS, P.E.

TITLE Executive Vice President

EXPERIENCE

Mr. Evans has over 20 years of professional experience in the areas of construction, environmental and geotechnical engineering, and maintains unique specialization in areas related to the development of remediation, reclamation, and construction technologies, as well as the implementation of design-construct programs. This experience has been gained on projects in 48 states as well as a number of international locations. Mr. Evans has developed and implemented remediation programs for complex, large-scale projects that have included the entire life-cycle of project activities, including site characterization, regulatory liaison, community relations, technology assessment and development, engineering design, and remedial construction. He has also been responsible for numerous major mine reclamation programs, as well as heavy geotechnical construction projects associated with dams and foundations. This experience has included a number of high-profile fast-track projects that were performed using a design-construct execution format. Mr. Evans' involvement with many forms of contamination, including radioactive, organic, and inorganic materials, has resulted in his participation in the development work associated with new remediation technologies such as zero-valent iron and in-situ oxidation technologies. Presently he is on the Dam Decommissioning Committee for the United States Society on Dams. He has also participated on a number of projects involving regulatory and legal positioning for lawsuits as both a coordinator and testifying expert on projects related to site remediation, damage assessments, contracting, and toxic torts.

A summary of selected project experience involving various disciplines and types of projects is provided as follows:

- Developing a comprehensive remediation program for a manufacturing building and surrounding facilities in New Jersey which were impacted by radioactive fission-product materials.
- Design support and management of construction for one of the first permeable reaction systems using zero-valent iron within a constructed gate section and a 1000-foot slurry wall at a site in Coffeyville, Kansas.
- Design and construction of a number of slurry wall containment systems throughout the United States, as well as parallel efforts for a number of permeable reaction systems using zero-valent iron, including several projects that represented firsts with respect to the field implementation strategy.
- Remediation and demolition of chemical production facilities impacted by radioactive materials in Fords, New Jersey.
- Remediation of PCB-contaminated soils at a former aluminum machining facility in Norwalk, California.
- Developed the overall site management strategy and lead technical and remedial construction activities for a $20 million Brownfield remediation program at a closed refinery in Toledo, Ohio.
- Design and construction of a tar sludge impoundment closure program in Crossett, Arkansas for sludges containing poly-nuclear aromatic hydrocarbon compounds. The viscous nature of the material required the development of a structurally-stabilized system capable of supporting the load associated with the cap.
- Design and construction of a remediation program for petroleum hydrocarbon-impacted groundwater and soils at a major Midwest pipeline terminal using a unique in-situ air-sparging/biologic treatment and extraction trench system. This system rapidly removed separate-phase product and associated dissolved-phase impacts.
- Investigation, design, and remediation of a major petroleum pipeline terminal in St. Louis, Missouri. This facility had numerous historic releases with significant volumes of separate-phase product.
- Developed processes for the remediation of arsenic, lead, mercury, uranium, and volatile organic compounds (VOCs) in soils and groundwater. Mr. Evans also developed an oxidative decomposition process for VOCs in soils that can be used on both ex-situ and in-situ basis.

- Represented a major electronics company for litigation associated with VOC groundwater contamination at a semiconductor facility.

- Design and construction of a slurry wall containment system to contain migration of a dissolved-phase VOC groundwater plume at a major electronics facility in Loveland, Colorado.

- Developed and implemented a groundwater remediation system to address cyanide contamination at a precious metal processing facility in Nevada.
- Lead a study on the development of corporate-wide management strategies for oilfield exploration and production wastes generated by a Fortune 10 company.

- Designed a 10-million-ton, fly-ash disposal facility for a co-generation facility in Billings, Montana.

- Developed permitting documents for a number of major precious-metal and base-metal mining facilities.

- Developed and implemented numerous removal actions and interim remedial measures programs for sites administrated subject to Superfund and RCRA regulatory authority.

- Emergency response work on four projects that received extensive national and international media coverage. These projects included remediation of a church site adjacent to Yellowstone National Park near Corwin Springs, Montana after 30,000 gallons of gasoline and diesel fuel were released from an underground bomb shelter complex. Provided similar response work for three train derailments and two spills at a major rail yard.

- Managed the development of all aspects of site remediation at a rail yard in Livingston, Montana, which had been operationed for over 100 years. Site was contaminated with an estimated 500,000 gallons of diesel fuel, 130,000 tons of cinders mixed with sludges, four oily waste sludge pits, oily wastes from previous waste oil re-refining, and halogenated solvents in the groundwater. Work also included the compilation of available site history and technical data, development of an interim measures work plan, development and implementation of sludge containment operations, development of regulatory positioning and community relations strategies, and development of petroleum recovery programs.

- Evaluated these technologies for the purposes of potential acquisition of the proprietary rights to market the technology.

- Developed a biotreatment research project for the California Department of Health Services, and an environmental assessment for a major mining district in Colorado.

- Designed a 300-acre fuel/gas desulferization sludge waste disposal impoundment for a utility facility near Rock Springs, Wyoming.

- Designed a 17-acre kiln dust disposal impoundment for a cement company's facility at Cloverdale, Virginia.

- Designed waste disposal vaults for a Class I hazardous waste disposal facility in Casmalia, California.

- Developed a comprehensive reclamation plan for a uranium mine and mill facilities in Gallup, New Mexico. Mr. Evans was also involved in reclamation designs for uranium mine and mill facilities in New Mexico and Wyoming, which resulted in the joint development of a standardized methodology for radon barrier design in association with Nuclear Regulatory Commission (NRC) technical staff.

- Evaluated hazardous waste sites and the developed remediation plans and construction documents for projects: including chlorinated solvents, metal plating wastes, pesticides and herbicides, kiln dust, radioactive materials, PCBs, resource recovery plant wastes, and various chemical wastes as contaminants of concern.

- Developed reclamation plans for 15 different abandoned coal mine sites in Washington. Sites required design of caps and plugs to limit access, regard to limit acid mine generation, and extinguishing a fire within a large coal spoil pile.
- Design and installation of large-capacity pile and drilled-pier foundation systems for a lodge in Mount Crested Butte, Colorado and a shopping mall in Lakewood, Colorado.
- Designed a large retaining wall systems for a commercial development in Mount Crested Butte, Colorado that was subject to slope failure.
- Designed a system to enhance mine spoil pile stability for a coal mine near Florence, Colorado.
- Participated in a study on laterally-loaded transmission line towers for the Electric Power Research Institute.
- Developed and taught a 4-hour mini-course on slope stabilization, mine subsidence abatement, and acid mine drainage at the University of Kentucky.
- Has worked extensively on projects throughout the United States and Latin America involving the restoration of former mining facilities. This work led to the development of several new technologies for abandoned mine reclamation as related to mine subsidence, shaft and audit closures, and acid mine drainage. Also served as a contributing author for government design manuals for metal and non-metal tailings disposal and abandoned mine reclamation (Development of Systematic Waste Disposal Programs Metal and Non-Metal Mines, and Chapter 7 of the Office of Surface Mining Abandoned Mined Lands Reclamation Handbook).
- Design of a high wall system for a large open pit using a unique failure analysis protocol at the Union Minerals Sweetwater Uranium Mine.

EDUCATION

Ph.D. Course work, University of Pittsburgh
M.S., Civil Engineering (Geotechnical/Environmental), University of Pittsburgh
B.S., Civil Engineering, University of Pittsburgh

TRAINING/CERTIFICATIONS

40-Hour Hazardous Waste Operations Training
Nuclear Safety Training Certification
Nuclear Density Gauge Operation and Safety
Registered Professional Engineer in the Following States:

Alabama (No. 19971)
Arkansas (No. 8993)
New Hampshire (No. 9313)
Colorado (No. 19947)
Florida (No. 0050996)
Georgia (No. 15794) Civil
Kansas (No. 14308)
Kentucky (No. 19433)
Mississippi (No. 11874) Civil
Missouri (No. E-28226)
Montana (No. 10078) Civil
New Jersey (No. 37932) Civil
New Mexico (No. 12120) Civil
Nevada (No. 011312) Civil
North Dakota (No. 2790) Civil
Ohio (No. 59215) Civil
Pennsylvania (No. 044578R)
South Carolina (No. 16991)
Texas (No. 59508) Civil

PUBLICATIONS

Evans, D.W. "Reducing Dam Rehabilitation and Reclamation Costs: Innovative Contract Methods." ASDSO Tailing Dams 2000 Conference, Las Vegas, Nevada, 2000.

Evans, D.W. "Development of Cost-Effective Waste Fixation and Stabilization Processes." First Annual Environmental Business Symposium, Envirocon, Inc., Whitefish, Montana, 1999.

Evans, D.W. "Construction Considerations for Reactive Iron Treatment Systems." First Annual Environmental Business Symposium, Envirocon, Inc., Whitefish, Montana, 1999.

Evans, D.W. "Considerations for Successful Slurry Wall Design and Construction." First Annual Symposium Center for Waste Remediation Technology, American Institute of Chemical Engineers, Symposium on Permeable Reaction Barriers, 1995.

Evans, D.W. "The Role of Fate and Transport in the Development of Groundwater Remediation Programs." Annual Aerospace Conference. Phoenix, Arizona, 1991.

Evans, D.W. "Oil Field Waste Regulatory Basis and Management Considerations." Client-sponsored product, 1991.

Evans, D.W. "The Compatibility of Chlorinated Organic Hydrocarbons with Slurry Wall Materials." Client-sponsored product, 1991.

Evans, D.W. "The Livingston Rail Yard Remediation Program." Montana Academy of Sciences, Clark River Symposium. Missoula, Montana, 1990.

Evans, D.W. "Source Control Measures for Contaminant Releases." Environmental Conference Solutions that Work, Northwest Mining Association of Cost Engineers Conference. Denver, Colorado, 1990.

Evans, D.W. "Suitability of Very Low Density Polyethylene as a Geomembrane." Symposium on Mining, Hydrology, Sedimentology, and Reclamation. Reno, Nevada, 1988.

Evans, D.W. "Consideration in the Development of Household Hazardous Waste Collection Program." Eleventh Annual Madison Waste Conference. Madison, Wisconsin, 1988.

Evans, D.W. "Review of Uranium Tailings Cover Design." American Society of Chemical Engineers National Convention. Nashville, Tennessee, 1988.

Evans, D.W. "The McCoy Tailings Impoundment Design: A Case Study." Symposium on Mining, Hydrology, Sedimentology, and Reclamation. Reno, Nevada, 1988.

Evans, D.W. "Development of Abatement Measures for the Control of Acid Mine Drainage, Slope Stability, and Mine Subsidence." National Symposium on Surface Mining, Sedimentology, Revegetation, and Reclamation. 4-hour mini-course presentation, Lexington, Kentucky, 1983.

Evans, D.W. "Program for Development for Backfilling Mines to Prevent Mine Subsidence." In proceedings of the 19th Annual Symposium on Engineering Geology and Soils Engineering, Pocatello, Idaho. 1982.

Evans, D.W. "Control of Mine Subsidence utilizing Coal Ash as Backfill Material." Second Conference on Ground Control in Mining, West Virginia University, Morgantown, West Virginia, 1982.

Evans, D.W. Systematic Development of Waste Disposal Plans for Metal and Non-metal Mines. U.S. Bureau of Mines, contributing author, 1981.

Evans, D.W. "A Study of Soil Anchors and Model Testing Techniques." University of Pittsburgh. Master of Science Thesis, 1980.

DANIEL G. FELTON

TITLE Project Superintendent

EXPERIENCE

Mr. Felton has 22 years of construction-related experience, 17 years of experience managing work crews, and 12 years of specialty and heavy equipment operation experience. As Project Superintendent, Mr. Felton's responsibilities include oversight of site safety, field construction, cost and schedule tracking, transportation and disposal coordination, regulatory compliance, subcontractor management, and client communication. Mr. Felton's unique background is well suited for the demands of his position.

His selected project experience includes:

- Project Superintendent for a 5.5 acre cap and closure of an electric arc furnace landfill for Republic Technologies International in Canton, OH. Closure activities included sub-grade preparation (including existing temporary liner removal), clay installation, liner installation, common fill and topsoil installation, and vegetative cover. A cap drainage system was also designed and installed prior to demobilization.

- Project Superintendent for a stabilization project involving hexavalent chrome contaminated soil. The ex-situ remediation utilized a ferrous sulfate chemical reagent and portland cement as the stabilization reagent to chemically fix and stabilize the chrome waste. Total chrome levels were reduced from 4,000 mg/kg to <100 mg/kg. 7,500 tons of soil were successfully stabilized at multiple sites in Kearny, New Jersey. Mobile equipment including two pugmills were utilized to complete the project in a two month period.

- Superintendent for a 55-acre landfill cap for a major steel manufacturer in northern Indiana. This eleven-month project included three and one half feet of cover materials, more than 2 million square feet of 40 mil PVC liner, and 725,000 square feet of geocomposite drainage material. More than 300,000 cubic yards of granular slag sand were screened and transported from five miles away within the steel plant and placed for liner sub-base and protective cover. The cover also included installation of gas vent and underdrain (8,900 linear feet) system, stormwater control channels, and a 260,000 square foot armor cover system consisting of a polyethylene geocell material. The four-inch deep geocell was placed on the steeper slopes (approaching 1:1) for stability and erosion control. The geocell was anchored to the slopes and infilled with slag. Envirocon was then required to incorporate compost, fertilize and seed over the entire slag cover, using an innovative soil amendment mix to enhance growth in this difficult soil matrix. The project was completed ahead of schedule and incorporated significant, cost-saving suggestions initiated by Envirocon.

- Supervised the construction of a 7-acre solid waste cell and installation of a 23-acre cap at a landfill in Michigan. The project included a crew of operators/cleanup technicians and local hires working seven days a week, 12 hours per day, to complete the project. Cell construction activities included installation of an HDPE liner system and leachate collection system. The project was performed safely and completed ahead of schedule.

- Supervised a crew of 6 equipment operators and 12 laborers/cleanup technicians during the RCRA closure/capping of the 12-acre Laskin Poplar Superfund Site in Jefferson, Ohio. This landfill closure involved the excavation and placement of over 80,000 cubic yards of soil, clay, and stone. The soil was placed in compacted lifts and checked. Installed two cement/ bentonite mixture slurry walls. Responsible for daily work planning. Equipment used at the site included a Cat 235 excavator, D-6 and D-5 Cat dozers, 815 Cat compactor, and 988 Cat loader. Responsible for maintenance, repair, and operation of all equipment and overseeing/scheduling work for all equipment operators on site. Supervised a subcontractor during the installation of a geotextile liner over the site.

- Supervised a crew of equipment operators, cleanup technicians, and laborers at a project site in Connecticut where we cleared a slope of vegetative cover, re-graded the underlying F006 hazardous waste that had been mixed with the soil, and constructed a RCRA cover over the resulting graded slope. This RCRA closure involved the installation of 40-mil and 80-mil VLDPE geomembranes, a geosynthethic clay liner layer (Claymax), and construction of a drainage layer with an integral stormwater infiltration piping collection system. The area of the regrading and RCRA cover installation work was approximately 6.5 acres. Project specifications required "zero release" of contaminants from the landfill area while it was temporarily exposed during earthwork. In addition, the project authorization was delayed and started late in the construction season. As a result, the crew conducted earthwork and installed cover materials on a 24-hour, around the clock basis, using double shifts for supervisory, technical support, QA/QC, and construction personnel. High-powered lights were used around the perimeter of the work areas through the night to allow for safe, continuous construction operations. During grading and other earthwork operations, a temporary landfill cover and stormwater runoff drainage system were available for rapid installation should a storm event occur. This feature minimized the release of contaminates from the exposed work areas.

- Supervised remedial actions at the Outer Loop Recycling and Disposal Facility (RDF) in Louisville, Kentucky. Supervised a crew of 21 equipment operators, a field cost administrator, a civil engineer, cleanup technicians, and local hires during the installation of three 1½-acre sediment ponds for the collection of noncontaminated surface water and the long-term closure of an existing 7-acre construction/demolition debris landfill. Over 350,000 cubic yards of material (300,000 CY's of clay) were moved on this project. The project was completed safely and on schedule.

- Supervising the construction of two, 4-acre holding cells for waste sludge from the process of making ductile iron water pipe in Coshocton, Ohio. The 4-acre cell was constructed after the removal of 80,000 cubic yards of sludge. When the 4-acre cell construction was completed, HDPE liner was installed. Five feet of impermeable clay was placed beneath the liner and 2 feet of cover was placed on top of the liner. Approximately 80,000 cubic yards of sludge was placed in the cell. An additional 4-acre cell was constructed for future holding capacity for sludge waste. This project also involved the capping of a 9-acre landfill. The landfill was capped with HDPE liner and Claymax with 2 feet of protective cover and 6 inches of topsoil and then seeded. A stormwater runoff system was installed consisting of 3,000 linear feet of concrete pipe. Both cells contained leachate underdrain systems, which were pumped to existing wastewater treatment facilities.

- Constructing an 18-acre cell for the storage of low-level radioactive waste in Ashland, Kentucky. Approximately 160,000 cubic yards of clean material and waste was moved. The cell area was then graded and lined with HDPE liner. Underdrain piping was installed in the cell and 10,00 tons radioactive waste was then placed in the cell.

- Installing a 42-acre clay landfill cap for the U.S. Navy in Bainbridge, Maryland. The crew performed shaping, cutting and filling of landfill and installed a 6-inch subbase with HDPE liner. Three feet of clay protective cover was installed on top of the liner, along with a 6-inches of topsoil and seeding. Constructed two stormwater channels to direct flow at the top and bottom of the landfill. Approximately 400,000 cubic yards of cover material was obtained from an on-site borrow area.

- Supervising the capping of an 18-acre landfill for a major corporation in Greenwood, South Carolina. The project involved the placement of 108,000 cubic yards of clay for the cap. An on-site borrow area was used for cover material. Scrapers were used to haul material from the borrow area to the landfill cap. The material was placed in lifts and compacted.

- Supervised the selective excavation of 20,000 tons of PCB-contaminated soil for a large steel manufacturer in Chicago, Illinois. Two separate crews performed concurrent selective excavation of TSCA and non-TSCA soils. The materials were kept segregated for disposal at appropriate facilities for their respective classifications. Two separate loading schedules and transportation subcontractors were managed. All off-site shipments were closely tracked and documented prior to arrival at the final destination.

- Worked at the DOE's Weldon spring Site Remedial Action Project in Missouri. The project involved the excavation, sorting, hauling, and on-site storage of approximately 121,000 cubic yards of bulk quarry wastes contaminated with dinitrotoluene (DNT), trinitrotoluene (TNT), volatiles, PCBs, asbestos, and radionucliedes. Responsible for overseeing the work of five other operators as well as maintenance, repair, and operations of a Cat 235 with Labounty UB90 processor, two Cat 320 excavators, and an IT28, and an RT745 (a 45-ton Grove mobile crane). As the main operator and foreman of the crane crew, made over 350 successful lifts in compliance with DOE regulations.

- Supervised a crew of equipment operators, cleanup technicians, and craft laborers during mobilization and site setup activities for the remediation of explosives-contaminated soil at the Former Nebraska Ordinance Plant in Mead, Nebraska. The scope of the work required the on-site incineration of 16,000 tons of TNT-contaminated soils. The project utilized an 18-ton-per-hour rotary kiln incineration system.

- Supervised a 9-man crew during the removal of 20 aboveground storage tanks and the cleaning of four emergency rainwater intereceptors at the Rickenbaucher Air National Guard Base in Columbus, Ohio. The project included investigation and sampling of all tank areas and the removal and disposal of any contaminated soil encountered. Mr Felton coordinated the transportation and disposal of waste oils and the recycling of reusable fuels and metals. This project required extensive coordination with air control tower and base security personnel to prevent interference with ongoing missions.

TRAINING

40-Hour Hazardous Waste Operations Training
8-Hour Hazardous Waste Operations Refresher
40-Hour Site-Safety Training
40-Hour Field Sampler's Course
Supervisory and Management Training Program
4-Hour Rigging Training
First Aid /CPR Training
Defensive Driving Course
DOE Lockout /Tagout Training
Dupont Stop Safety Program
Hydraulic Mobile Crane Operator's Safety Course, OSHA/ANSI Certified Course

AFFILIATIONS

Crane Safety Association of America

LAWRENCE G. JOHNSTON

TITLE Sr. Project Manager

EXPERIENCE

Mr. Johnston has 28 years of experience in the construction and environmental remediation sectors. He has 14 years experience as project director/senior project manager/estimator in the environmental remediation field and 14 years experience in power plant construction engineering. Mr. Johnston has planned, scheduled, estimated, and managed projects involving landfill caps/closures/construction, coal tar remediation, radioactive waste removal, decon/decommissioning/demolition, on-site treatment, dual vapor extraction/injection, air stripping, pump & treat systems, buried drum removal, numerous environmental emergency responses (highway, rail, water, and fixed facility), wastewater treatment plant construction, and power plant (nuclear & co-generation) construction.

His selected project experience includes:

- Sr. Project manager/estimator for removal and rail transport of 22,600 cubic yards of radioactive waste at the Hazelwood Interim Storage Site, USACE – FUSRAP, in St. Louis, Missouri.

- Project director/estimator for construction of a 20-acre CAMU (included waste collection, stabilization, and transport of EAF dust) for Laclede Steel in Alton, IL; cap and closure of a 5.5 acre electric arc furnace dust landfill for Republic Technologies International in Canton, OH; closed a 30-acre landfill for LTV Steel in Hennepin, IL; cap and closure of 45-acre landfill with gas and leachate collection systems for TWA in Kansas City, MO; and 60-acre landfill cap and closure with gas and leachate collection systems for Wheeling Trust Landfill in Northwestern Missouri.

- Project director/Sr. project manager/estimator of coal tar remediation projects for Northern Indiana Public Service Company and Central Illinois Public Services Company. The projects were very high profile removals in commercial areas in northern Indiana and central Illinois cities. Although an aromatic waste, controls were used on all projects to prevent the release of fugitive emissions.

- Scheduled, planned, estimated, and managed the installation and operation of a large soil vapor extraction/injection system for USEPA – Region VIII in Commerce City, CO. Strategically installed horizontal and vertical wells over the 40-acre site capable of functioning as both injection and collection points. Two 650 scfm blowers, four 450 scfm vacuum pumps, a catalytic oxidizer, three heat exchangers, and two vapor-phase carbon filters where connected to the main header piping in a unique configuration that allowed complete and confirmed subsurface remediation of the LNAPL contaminants.

- Planned, scheduled and managed the removal, by selective excavation, of 67,000 cubic yards of TCE and PCE contaminated soils for a manufacturing company in the western Chicago suburbs. Areas of contamination beneath buildings were removed by underpinning the structures. As soils were excavated to pre-engineered limits, samples were taken and examined by the on-site laboratory to verify that cleanliness objectives were met. A schedule was developed and administered for waste removal and site restoration that had minimal impact on factory activities.

- Project manager for U.S. Army Corps of Engineers on the following projects: Crab Orchard National Wildlife Refuge (selective excavation of lead-contaminated soils); FUSRAP, St. Louis, MO (radioactive contaminated soils); Fortuna, North Dakota (removal of underground storage tanks); Pierre, South Dakota (PCB clean-up); and Fort McCoy, Wisconsin (clean-up of burn pits).

- Managed the Four County Landfill in Rochester, Indiana for the Indiana Department of Environmental Management (IDEM) for two years. The project consisted of re-construction of the cover on two cells; leachate collection, transportation, and disposal; and maintenance of the facility.

- Held the position of construction manager during the construction and start-up phase of a $70 million wastewater treatment plant in Delaware County, Ohio. The project included a state-of-the-art pre-treatment system building, six sets of three aeration tanks with fine bubble diffusers and non-clog mixers, blower building with sludge & scum wells, four 135-foot clarifiers, solids handling building with filter presses and gravity filters, coarse aeration storage tanks, an eight bridge filter building, and a non-chlorination post treatment (UV) building.

- Performed duties as the subcontract manager for the installation of twelve 87-megaWatt gas turbines with heat recovery steam generation systems for the Midland Cogeneration Venture in Midland, Michigan. Served as construction engineer for the complete refurbishment of all existing equipment used in the conversion from nuclear to gas turbine power generation. Also work as a maintenance superintendent on completed units and systems.

- Worked as senior mechanical construction engineer/supervisor on system balancing and equipment alignments, 79.14 walk-downs, mechanical shock arrestors (installation and adjustment), and pipe whip restraints (structural installation, hot-functional measurement, and installation of energy absorbing material) during the construction and hot-functional testing phase at the following power plants: Plant Vogtle Nuclear Power Plant in Waynesville, Georgia; Shearon Harris Nuclear Power Station in New Hill, North Carolina; Wolf Creek Nuclear Generating Station in New Strawn, Kansas; and the Callaway Nuclear Power Plant in Fulton, Missouri.

EDUCATION

B.S., Geology, Illinois State University
Construction Engineering, University of Missouri

TRAINING

40-Hour HAZWOPER Training – OHM Corporation
8-Hour HAZWOPER Supervisor Training – OHM Corporation
Radioactive Waste Training - IEM
Certified CQC Management Training – U.S. Army Corps of Engineers
Project Management Training – OHM Corporation
Radiation Safety Training – Commonwealth Edison Zion Station

THOMAS L. MCCRACKEN, P.E.

TITLE Eastern Regional Manager

EXPERIENCE

Mr. McCracken has over 20 years experience in the environmental and construction industries. His current responsibilities as the Eastern Regional Manager include all aspects of operations management including marketing, estimating, resource allocation, scheduling, contract administration, regulatory compliance and client relations. Mr. McCracken has successfully completed projects involving RCRA pond closures, landfill capping, landfill construction, demolition of process facilities, river dredging, thermal treatment, hazardous waste packaging, transport and disposal, residential removal and restoration, and water treatment units. Related experience includes UST removal, precast concrete production and drilling.

His selected project experience includes:

- Managed dredging of 12,000 yards of contaminated material from river utilizing environmental clamshell, installation of temporary sheet pile walls, transport of removed material in barges, off loading of material and disposal in onsite cell, and restoration of dredged areas. Project performed under the Army Corps of Engineers and EPA Region 2 oversight. Installation of sealed sheet pile wall to isolate groundwater along shoreline of existing landfill.

- Managed remediation of former manufactured gas plant site. Initial phase as subcontractor consisted of removal of 16,000 yards of contaminated material from underground masonry tanks and material preparation activities. Isolated groundwater and provided structural support for tanks using a freeze-wall. All activities performed in a controlled atmosphere to contain volatile emissions. Excavated material was sized for thermal treatment for removal of contaminants. Final phase as general contractor included removal ans shipment off site of remaining material, demolition of thermal unit and restoration of tanks with clean backfill. Responsibilities included client interface and negotiation, progress schedule updates, subcontractor evaluation and selection and permit applications and submittals

- Managed closure of 14-acre former lagoon within active chemical plant. Duties performed onsite due to critical nature of project with regards to cost and schedule. Duties included negotiation with client, coordination of work with plant activities.

- Managed removal of contaminated soils adjacent to natural trout stream and local senior citizens complex. Coordinated removal, transport and disposal of 7,500 cubic yards of material. Restoration of site included backfill placement and seeding according to stringent conservation district requirements.

- Managed removal of lead contaminated material from test firing range at arms manufacturer site. Transported material to central storage area for stabilization activities. Restored areas for future site as a business park.

- Managed all onsite operations for 50-acre landfill cap. Project consisted of import and placement of 750,000 tons of certified clean fill materials, installation of 70 methane gas vents, installation of 50 acres of geomenbrane, geonet, and geotextile layers followed by topsoil placement and seeding. Duties included liaison activities with client and engineer, subcontractor and vendor negotiations, coordination of quality control activities and oversight of all Health and Safety Protocols.

- Managed excavation and disposal of 5,000 cubic yards of contaminated soils including all sampling and segregation activities to minimize the amount of material sent for incineration (2000 tons). Responsibilities included coordination with site occupants, oversight of all transport and disposal activities, negotiation of change orders (based on changed site conditions), and preparation of requisite closure reports for submittal to governmental agencies.

THOMAS L. MCCRACKEN P.E. (Cont.)

EDUCATION

B.S., Civil Engineering, The Pennsylvania State University, State College, Pennsylvania
J.D, The Widener University School of Law, Wilmington, Delaware

TRAINING/CERTIFICATIONS

40-Hour Hazardous Waste Operations Training
8-Hour Hazardous Waste Operations Supervisors' Training
8-Hour Hazardous Waste Operations Qualified Person Training
First Aid/CPR
Managing Safety- Dupont
Explosive and Ammunition Safety Course
Registered Professional Engineer in Delaware, New Jersey, New Mexico, New York, Pennsylvania
Certified Construction Reviewer- Delaware

CHARLES (CHIP) MICKEL, JR., P.E.

TITLE Engineering Manager

EXPERIENCE

Registered professional engineer with over ten years experience in the environmental consulting industry. This experience has included conducting and implementing remedial assessments, site investigations and characterizations, feasibility studies (FSs), technology development and assessments, remedial designs and remedial actions. Experience also includes project management, supervision and support, QA/QC, design and construction for remediation of impacted soil, groundwater, and surface water. Provided remedial services and solutions for chlorinated volatile organic compounds, metals, pentachlorophenol, dioxins, LNAPL, DNAPL and petroleum hydrocarbon. Participated in the implementation of several innovative remedial technologies such as funnel and gate, and *in situ* chemical oxidation.

Managed investigation and remedial activities for a state superfund site in Montgomery, Illinois. Investigated soil, DNAPL and groundwater impacts by advancing geoprobe borings and installing groundwater monitoring wells in the vicinity of a former solvent recovery still. Currently, evaluating remedial alternatives to address impacts. Managing the operation and maintenance of a groundwater and product recovery and treatment system, and soil vapor extraction system at a separate release area located at the site.

Managed groundwater monitoring activities, operation and maintenance of a groundwater recovery system and the implementation of an *in situ* ozone/air sparge (KV Associates) pilot test for a state superfund site in Abilene, Kansas. The ozone/air sparge technology is being evaluated for remediating groundwater impacted with chlorinated solvents.

Designed and developed specifications for an engineered surface water channel at a superfund site in Denison, Texas. Provided oversight for the construction of the engineered channel. Other remedial/construction activities included the excavation, transportation and disposal of creosote-impacted soil at an on-site land treatment unit.

Supervised an engineering group including two project engineers and two staff engineers.

Prepared a RI/FS work plan to investigate and assess impacts at 33 solid waste management units at a former petroleum refinery in Illinois. The former refinery is approximately 1,000 acres in size and was in operation since early 1900's.

Prepared a work plan and implemented an *in situ* chemical oxidation injection program using potassium permanganate at a site located in Colorado Springs, Colorado.

Supervised phase II drilling activities at eight natural gas plants as well as their associated piping and compressor stations. Responsibilities included managing over 20 employees and three drilling companies to drill and soil sample over 100 borings and drill, install and sample over 100 wells within 90 days. The phase II investigation activities were associated with the property transfer of approximately 23 natural gas compressor plants. Other responsibilities included preparing remediation costs for the 23 natural gas plants to identify the environmental liability associated with the property transfer.

Prepared a Corrective Measures Plan (CMP) to evaluate and screen remedial alternative for a State Superfund site in Denver, Colorado. As part of the CMP, seven treatability studies were performed including three bench-scale studies (aerobic biodegradation, anaerobic biodegradation, and chemical oxidation) and four pilot-scale studies (total fluids extraction, hydro-fracturing, intrinsic bio-sampling, and fluids injection test). Preferred remedial alternatives include full-scale implementation of *in situ* chemical oxidation, *in situ* aerobic biodegradation and total fluids extraction.

Prepared a design for integrating two individual groundwater and separate phase liquid (light and dense) recovery and treatment systems at a site in Montgomery, Illinois. Supervised the O&M of the operating pump and treat system with SVE.

Performed an *in situ* chemical oxidation pilot test at a State Superfund site in Malta, Ohio. Supervised bench-scale chemical oxidation and aerobic bioremediation treatability studies for groundwater and soil impacted with pentachlorophenol.

Prepared an Interim Remedial Measures Work Plan to evaluate various corrective measures for impacted soil, impacted groundwater and NAPL in a complex hydrogeologic setting at a State Superfund site in Denver, Colorado. As part of the Work Plan, a funnel and gate system design (50 percent), and a groundwater and NAPL treatment system upgrade design (100 percent) was prepared. Provided senior technical support during the upgrade of the groundwater and NAPL treatment system.

Prepared a RCRA Facility Investigation Work Plan to investigate six solid waste management units at an active petroleum refinery in Ponca City, Oklahoma.

Prepared a design and provided technical support during construction of a reactive zero-valent iron treatment system (funnel and gate) at a Superfund site in Somersworth, New Hampshire. Responsibilities included preparation of design drawings and specifications for installation of this innovative technology.

Prepared Corrective Action Plans for a major petroleum retail company at various sites throughout the State of Colorado. Responsibilities included investigating petroleum releases, characterizing soil and groundwater quality, evaluating site conditions and screening remedial technologies. Technologies evaluated as part of this work included SVE, air sparging, conventional excavation, *in situ* bioventing, and groundwater pump and treat.

Prepared an *In situ* SVE Work Plan and conducted a pilot test for full-scale design and remediation at an aircraft manufacturing facility in Colorado. Subsequently prepared a FS to evaluate and screen SVE, and funnel and gate technologies for site remediation.

Managed and coordinated design and construction activities for a RD/RA associated with VOC impacted groundwater at a NPL site in Clare, Michigan. Responsibilities included preparing construction drawings, specifications, a Construction Quality Assurance Plan, and an O&M plan for a groundwater pump and treatment system. Additional work included obtaining permits for construction and supervising construction activities for installation of the system.

Prepared a Petition for Amendment to the USEPA ROD for a NPL site in Clare, Michigan. As part of the Petition for Amendment, alternative remedial technologies for VOC impacted soil were proposed, evaluated and screened. The remedial technologies evaluated included chemical oxidation, low temperature thermal desorption (LTTD), SVE, landfill capping and slurry wall containment. Chemical oxidation and LTTD treatability studies were conducted as part of the screening process.

Provided technical assistance for design of a 1,100 gpm groundwater remediation system. Prepared a FS for remedial action of a large open pit mine in Butte, Montana. Work included developing and evaluating alternatives to treat/manage seven million gallons per day of mine water impacted with heavy metals. Other responsibilities included performing a field investigation and assessment for determining overland and subsurface components of impacted water flooding at a large open pit mine and supervising the drilling and geophysical logging of deep and shallow borings and subsequent installation of monitoring wells.

Conducted a drum characterization event in which hazardous soils and liquids were identified, classified and subsequently disposed at off-site waste disposal facilities. Soils were impacted with dioxins and pesticides.

Prepared a slurry wall design report and related construction specifications as part of a RA for a Superfund site in Texas City, Texas. Designed a groundwater and DNAPL extraction and injection conveyance system to transport impacted media to and from a treatment facility.

Prepared and conducted a geotechnical investigation of subsurface soils along the alignment of a slurry wall at a Superfund site in Texas City, Texas. Work included supervising geotechnical drilling and laboratory analysis of soil properties and strengths. Conducted subsurface stability analyses for critical segments along the slurry wall alignment and prepared the corresponding technical report.

Prepared soil and water sampling analysis plans for Superfund sites. Subsequently implemented and supervised these soil and water sampling activities and prepared data summary and interpretation reports.

Served as resident engineer for the construction of a concrete pad associated with an innovative treatment process technology and waste stabilization system at a Superfund site in Portland, Oregon. Responsibilities included construction site start-up, field layout, quality control inspection and procurement of equipment and materials.

Researched state and federal regulations for a landfill closure and performed earthwork and material balance calculations for landfill build-out and cover. In addition, designed a mine waste repository cap based on the evaluation of radon attenuation using a computer model.

Prepared a RI/FS report for a CERCLA landfill in Somersworth, New Hampshire. Evaluated alternatives including biological restoration, a patented *in situ* restoration process (funnel and gate), groundwater extraction and treatment, off-site disposal/discharge of treated water and a slurry wall.

Ex. 6

EDUCATION

B.S., Civil Engineering, [redacted] University of Delaware; Newark, Delaware

REGISTRATIONS/CERTIFICATIONS

Professional Engineer, State of Colorado (No. 30585), 1995
40-hour OSHA HAZWOPER training
8-hour OSHA Refresher

RICHARD "LUCKY" TABOR

TITLE Project Manager

EXPERIENCE

Mr. Tabor has over 25 years of experience in the hazardous waste field and has successfully completed numerous hazardous materials remediation projects. In his current assignment with Envirocon, he supports remediation and restoration of projects by managing personnel, equipment, transportation, disposal, on-site treatment, quality control, and site safety operations at various western region project sites. His previous experience as a Construction Project Manager encompassed overall management of assigned activities within authorized funding and approved scope and schedule. He was also responsible for costs and schedule control of project accounts, and ensuring that all project phases were completed safely, on time, within budget, and in compliance with applicable regulations and terms of the contract. Mr. Tabor also maintained effective working relationships with other support departments, as well as architectural and engineering firms, contractors, vendors, and national laboratories.

His selected experience includes:

- Project Manger for the construction of an 8-acre RCRA containment facility (OCF) for the former Ruston Smelter facility. This project consists of clearing, grading, and debris removal, excavation of 90,000 cubic yards of native materials and placement of 500,000 tons of imported embankment to construct the the earthen portion of this 8-acre, 70-foot deep impoundment. Placement of a multi layer combination lining system including the on-site production of 30,000 cubic yards of low permeability material using an 8% bentonite to imported soils ratio. The low perm or clay layer was constructed to a final lift thickness of 3-feet. Above this layer are a series of synthetic and geosynthetic materials comprising the final configuration. Installation of a leachate detection and collection system including pumps, piping, compressors, controls, vaults, and distribution system. Placement of 240,000 cubic yards of Source Areas wastes from surrounding areas, within the OCF.

- Project Manager for the excavation and remediation of a beach site in Central California. This 10-month project involved the excavation, backfill, and site restoration of a popular recreational beach. Major activities included excavation of approximately 150,000 cubic yards of contaminated or affected soils where TPH was the primary constituent of concern. Much of the excavation was completed below groundwater. Envirocon backfilled and regraded the site with approximately 200,000 cubic yards of imported and suitable native materials. All excavation work was performed within a sheetpiled area and executed in six distinct cells within the site. Much of the excavation took place along 1,400 feet of beach or beachfront property. The bulk of the beach community and storefront properties were demolished to accommodate our excavation work.

- Managing the grading and stabilization of Class IV residue at a former zinc refinery site in Bartlesville, Oklahoma. The refinery produced various metals from the refining of zinc concentrates, secondary materials, and other zinc rich materials. The scope of work included the excavation, hauling, stabilization, and placement of three types of on-site materials, 68,800 cubic yards of geothite, 39,800 cubic yards of hot tower precipitate (HTP), and 23,000 cubic yards of contaminated pond sediments. The contaminants of concern for the above materials were lead, arsenic, cadmium, and zinc.

- Project Manager for a project consisting of excavation of approximately 230,000 cubic yards of petroleum waste. The waste is excavated and transported to a 14 acre constructed engineered landfill including a clay bottom and top. The waste is stabilized within the landfill using a soil stabilizer to mix 5 % Portland cement (by weight). Following stabilization, the waste is compacted and allowed to cure. The project also involves dewatering, water treatment, and shoring.

- Construction Manager for the Portland Cement Kiln Dust #2 and #3 Superfund Site in Salt Lake City, Utah. Responsible for all activities relating to excavation, backfill, and general construction at this site. Managed numerous employees, subcontractors, and construction activities.

RICHARD "LUCKY" TABOR (Cont.)

- Construction Manager for the Sharon Steel/Midvale Tailings Project, Operable Unit 2, Phase 4, Midvale, Utah. This project involved the remediation and restoration of 147 commercial/residential properties. Work included excavating, sampling, analyzing, transporting, and disposing of lead, arsenic, and cadmium-contaminated soil. Managing numerous employees, subcontractors, and construction activities.

- Construction Manager for the Ralph Gray Trucking Company Superfund Site in Westminster, California. Supervised all activities related to excavation, backfill, and general construction at this site. This project involved the removal and disposal of contaminated soils and waste, transporting the material to a hazardous waste disposal facility, and backfilling, compacting, and restoring affected areas. Managed numerous employees, subcontractors, and construction activities as well as coordinated activities with the United States Bureau of Reclamation.

- Project Manager for two projects at Hill Air Force Base, Utah. One involved the removal of contaminated debris and the other was the replacement of Glycol storage tanks. Responsible for managing field operations, personnel, and subcontractors.

- Site Manager for the Sharon Steel/Midvale Tailings project, Operable Unit 2, Phase 2, Midvale, Utah involving the remediation of 118 commercial/residential properties near Salt Lake City. Work included excavating, sampling, analyzing, transporting, and disposing of lead arsenic, and cadmium-contaminated soil. This project was performed in a highly populated area and quality control was monitored closely through regular meetings to minimize health risks to site personnel and residents. Responsible for coordinating equipment, personnel, transportation, disposal, on-site treatment, quality control, and site safety.

- Project Manager for the Grand Junction Uranium Mill Tailings Remedial Action (UMTRA) low-level radiological remediation of vicinity properties for five years. Managed remedial budgets ranging from $6 - $10 million per year. Mr. Tabor's outstanding work earned him the Presidents PQI award for quality work. Responsibilities included budgeting, scheduling, oversight of field management, and operations and subcontractors, for radiological vicinity property cleanup. This included coordinating the work on over 900 properties per year.

- He interfaced extensively with the design review team, facility support group (radiological control), and the health and safety group. Specific project work included:

– UMTRA Commercial Simple Properties - Mr. Tabor was responsible for project management of commercial property low-level radiological remediations. The scope of work ranged from removal and replacement of sidewalks, to relocation of businesses and total structural renovation of the interior.

– UMTRA Priority Properties - Responsibilities included budget control, scheduling, and construction management of School District projects and DOE properties. Work included resolution of programmatic issues during assessment, engineering design, and negotiations with owners, and client (DOE) relations. Through matrix management, Mr. Tabor prioritized work and assigned personnel as needed to maintain the schedule and achieve field activity completion. One of the projects that fell under this program was the UMTRA project which involved approximately 4,200 radiologically contaminated residential and/or commercial properties in Mesa County, Colorado.

– UMTRA Warranty Properties - Mr. Tabor's duties included budget control, scheduling, and construction management for warranty resolution of concerns raised by property owners after remediation was performed on their property. This included investigating job sites and formulating corrective action plans, if required.

– UMTRA Major Residential Properties - The scope of work encompassed the removal and replacement of sidewalks, yards, gardens, etc. for major residential properties requiring remediation. Residents were relocated during remedial actions requiring major structural renovation of the interior. Mr. Tabor's duties included budgeting, scheduling, and interfacing with the property owners.

RICHARD "LUCKY" TABOR (Cont.)

- Performed the decontamination and decommissioning of three satellite field calibration sites in Reno, Nevada; Spokane, Washington; and Morgantown, Virginia.

EDUCATION

A.A.S., Environmental Health and Safety Government Institutes, Inc.

TRAINING

40-Hour Hazardous Waste Operations Training
40-Hour Environmental Protection Agency Hazardous
8-Hour Hazardous Waste Operations Supervisors Training
Waste Site Training
RCRA Regulations Training
Grand Junction Projects Office Environmental
Compliance Training
Asbestos Worker, Supervisor, Manager/Planner, and
Inspector Training
HAZMAT for Manager

Colorado Environmental Laws and Regulations Training
DOT Hazardous Materials Shipping (HM_181)
Cost Schedule Control Systems (CS2)
CPM Scheduling in Program Management and Claims,
Unit Price Estimation for Project
EEO/AA Managers for Basic Training
Guide to FARS and DFARS
Groundwater Monitoring Training
Radiation Worker Training

Mark E. Head

Experience and skills in varied disciplines that include Radiation Protection, Maintenance/Fabrication, and Construction. Positions of Project Manager, Site Supervisor, Maintenance Supervisor and Radiation Protection Supervisor have been successfully implemented during Mr. Head's tenure in the Nuclear field.

Mr. Head has twenty five (25) years of Project Supervision and Management in the Nuclear Industry.

Experience:
MHF Logistical Solutions, Inc.
Project Manager- Providing support to MHF Logistical Solutions Technical Services for the development of procedures, work plans, and transportation needs. Serve as Project Manager/shipper on the CP&L Power Uprate Project at Brunswick Nuclear Plant, logistics coordinator at the ETTP Portal 10 facility for MHF, and provides health physics, construction, and shipping expertise for various in-house and contracted projects.

J & M Enterprises, Kingston, Tn.
Consultant/Owner- Providing consultant services to MHF Logistical Solutions for the development of procedures, work plans, transportation needs, and technical expertise for the Technical Services group. Named as Project Manager, RSO, and Broker for several pending projects. Other services include construction, demolition, excavation, and fabrication to the private sector.

Nuclear Facility Experience:
- ✓ ATG Services, Oak Ridge, TN-**Project Manager**
- ✓ ATG Catalytics, Oak Ridge, TN-**Project Supervisor, Radiation Protection Supervisor**
- ✓ Niagra Mohawk-Nine Mile 2- **Refueling Floor Supervisor**
- ✓ Southern Company-Vogtle-**Lead Nuclear Technician**
- ✓ Duke Power-Catawba-**Lead Nuclear Technician**
- ✓ Southern Company-Edwin I. Hatch-**Lead Health Physics Technician**
- ✓ Tennessee Valley Authority-Browns Ferry & Sequoyah-**Project Manager & Senior Health Physics Technician**
- ✓ Entergy System-Arkansas Nuclear One & Grand Gulf- **Senior Nuclear Technician & Lead Health Physics Technician**
- ✓ Nebraska Public Power-Cooper-**Refueling Floor Supervisor**

EDUCATION

- High School - Graduated - Science Curriculum
- College – Harford Technical College - Classes in Mechanical Engineering Technology
- Numerous classes and courses in Nuclear Technology, and formal Health Physics certification through employment with Philadelphia Electric Company and Pennsylvania Power and Light Company.
- Completed Nuclear Physics and Reactor Chemistry Training with Radiation Management Corp. and General Physics Corp. through Drexel University/Philadelphia Electric Company

Other Qualifications:

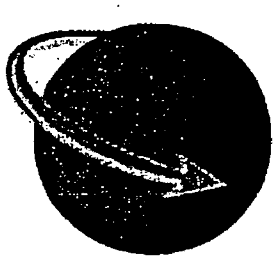
- Completed extensive Supervisory and Management Training course by Nuclear Support Services Corporation
- Institute of Nuclear Power Operation (INPO) Certified Nuclear Technician
- ANSI Qualified Supervisor, Crewleader, Senior Technician
- Completed RETN, Inc. Advanced Gamma-Spectroscopy Course
- Successful completion of State of Tn. Industrial Contractor License Test
- Completed General Electric Corporation Reactor Systems Certification
- Hazardous/Radioactive Waste Shipper Certification

Extensive training in reactor plant/component repair, construction, and preventative maintenance

ATG Catalytics - Oak Ridge, Tn
Project Supervisor - Provided oversight and management of mechanical and electrical construction projects. This included all cts from planning and system development to procurement and installation. Reviewed drawings and blueprints for feasibility of installations. Responsibilities also included employee payroll, project tracking, budget management, contractor/vendor bidding processes and oversight. Provided material specifications and procurement, design reviews, and build to completion Management.
se projects included reactor/CPU upgrades and modifications, cesium trap installation and testing, evaporator conversion and related system modifications, GHT slurry system upgrades, peroxide injection and scrubber installation and modifications, site shielding project and installation, and numerous other projects. Expertise of all system components including valves, pumps, compressors, vessels, hydraulics, all types of welding and fabrication, and heavy equipment operation; allowed a broad range of experience and capability.

ATG Catalytics- Oak Ridge, Tn.
Radiation Protection Supervisor - Maintained licensed activities at Catalytic conversion facility. Included handling of highly radioactive wastes, and the processes involved. Direct management and supervision of technicians and labor support, including payroll, budget issues, and vendor interface. Provided expertise to construction crews during extensive plant modifications involving hazardous environment entry and occupancy. Wrote, modified, and approved operational procedures, and was Site Technical Rep. for radiological controls, count room and sampling analysis, and radiological shipping methods/compliance.

April 1998 – June 1998 – Niagra Mohawk – Nine Mile 2
Refueling Floor Supervisor – Responsible for all phases of refueling; which included Reactor disassembly/re-assembly, internals removal/replacement. Provided support for 10 year ISI of vessel shroud and weldments; corespray/feedwater nozzle flushing and inspections. Used and supported *OD Tracker* and TEIDE robotics. Removal of control rod blades and fuel support castings using *Take-Two* specialty equipment. Jet-pump plug placement/removal, and removal/retrieval of instrumentation conduit lines. Placement/removal of recirc suction plugs using NES technology. All other vessel/internals ISI, camera, and related work.



March 1998 – April 1998 - Southern Company - Vogtle
Lead Nuclear Technician - Coverage provided to upper and lower containment 10 year ISI. RCP pump removal/replacement, steam generator eddy current, core barrel removal/replacement, various primary and secondary ISI, split-pin replacement, valve reworks and related support.

November 1997 - January 1998 - Duke Power - Catawba
Lead Nuclear Technician - Provided support to upper containment during reactor disassembly/reassemble, and fueling/defueling. Included extensive vessel ISI and related inspections, fuel bundle leak detection, and general refuel support. Also provided various auxiliary-building surveillances, CVCS and RCS filter change-outs, and specialty cask usage. Various other duties included support to Radwaste group and Rad material storage facility.

October 1997 - November 1997 - Southern Company - Edwin I. Hatch
Lead Health Physics Technician - Reactor Building support, included RHR, core spray, torus valve reworks, heat exchanger repairs, and pump repairs. Provided coverage for reactor water clean-up (RWCU) heat exchanger repairs and valve replacements. Various fuel pool heat exchanger (HTX) and RWCU valve nest surveillance's. TIP room entry and support, specialty machining methods; log entry, RWP briefings, and control point guidance and interim lead technician as required.
September 1997 - October 1997 - Tennessee Valley Authority - Browns Ferry
Project Manager - Directed the management and supervision of (30) personnel. Performed all interactions with client managers for in-processing procedures, shift assignments, payroll determinations, required discipline and supervisory consulting. Responsible for all phases of Reactor Building refurbishment and maintenance. Provided budget, schedules, and technical expertise to the project. Successfully implemented milestones that provided the utility with record results during the refurbishment effort.

May 1997 - June 1997 - Entergy System - Arkansas Nuclear One
Senior Nuclear Technician - Provided reactor building support. Included steam- generator manway removal/replacement, 100% eddy-current and related support, various ISI performed on shutdown cooling and safety-injection system valves. Reactor cooling pump seal replacement, check valve (primary) reworks/inspections. Supported reactor cooling pump motor removal/replacement, remote monitoring response/trouble shooting, steam-generator crew guidance/support. Heat-up/start-up surveillance's and inspections also provided.

March 1997 - April 1997 - Nebraska Public Power - Cooper
Refueling Floor Supervisor – Directed refuel floor activities. Included the use of Westinghouse robotics systems, underwater surveillance systems and monitoring, core support plate inspections, lower fuel-support-piece removal. Complete jet-pump inspections/ISI. Vessel nozzle inspections/ISI. Control-rod removal/replacements, feedwater/core spray ISI and visuals. Removal/replacement of twenty-eight (28) shroud-head bolts on reactor moisture-separator.

February 1997 - March 1997 - Tennessee Valley Authority - Browns Ferry
Project Manager - Directed the management and supervision of thirty-eight (38) personnel. Performed all interactions with client managers for in-processing procedures, shift assignments, payroll determinations, required discipline and supervisory consulting. Also responsible for Reactor Building support. RWCU pump and heat exchanger repairs, torus proper entry, torus de-sludge and related diver support. Various primary system valve reworks and replacements. Residual Heat Removal (RHR) mods. Routine surveillance's and RWP determinations.

October 1996 - November 1996 - Entergy System - Grand Gulf
Lead Health Physics Technician - Responsible for support to Refueling Floor. Provided support and guidance during control-rod removal, upper core support removal and vessel ISI activities. Camera, under-water tooling and robotics guidance/support was provided. Also maintained normal support for RPV head removal/replacement, defueling/refueling, and cavity decon activities.

August 1996 - October 1996 - Duquesne Light - Beaver Valley
Lead Health Physics Technician - Responsible for support to Refueling Floor during 10 year ISI of primary system. Included guidance during use of Westinghouse robotics, core barrel removal, internals and reactor vessel ISI. Transfer canal entry and mods also provided. Also maintained normal support for RPV head removal/replacement, defueling/refueling, and cavity decon with strippable membrane media. Performed routine Aux. and Radwaste surveillance's, under-water dose determinations on irradiated components, and related tasks.

March 1996 - April 1996 - Tennessee Valley Authority - Browns Ferry
Project Manager - Duties included: Directed management and supervision of twenty-eight (28) personnel. Performed all interaction with client managers for in-processing procedures, shift assignments, payroll determinations, required discipline, and supervisory consulting. Responsible for reactor building maintenance. Duties included: RHR loop mods, RWCU pump and heat exchanger coverage, primary system valve reworks. Also provided coverage for drywell activities for major ISI activities, and various reactor component repairs, torus repair and valve reworks. Routine surveillance and RWP determinations also included during this support.

November 1995 - February 1996 - Public Service & Gas Company - Hope Creek
Senior Health Physics Tech - Duties included: Support to balance of plant. Included RWP desk coverage, involving maintaining, issuing, and assigning tasks as required. Responsible to reactor plant and radwaste for coverage and surveys, RHR, RWCU, and fuel pool systems supported during valve reworks, high radiation escorts, pump rebuilds, and associated work. Various surveys provided to radwaste system during resin transfers, tank room and vault entry, and associated tasks.

September 1995 - November 1995 - Tennessee Valley Authority - Sequoyah
Project Manager - Direct supervision and management of seventy-eight (78) personnel. This included all interactions with client managers for in-processing procedures, shift assignments, payroll determinations, and disciplinary actions. Responsible for employee evaluations, training, consulting. Certified behavioral observer supervisor. Responsible for $80,000 per week payroll. Also provided Health Physics support to the Radwaste Group. This included shipping, surveys and analysis, loading and packing, and all other phases of Radwaste shipping/handling. Coverage provided during highly radioactive filter and ion-exchange resin transfer and disposals. Helped in over-seeing sorting operations and made determinations in the field for shipping viability of various packages (drums, boxes, LSA, etc.)

July 1995 - August 1995 - Tennessee Valley Authority - Sequoyah
Project Manager - Radwaste Group - Radwaste Reclamation Project - Provided coverage/support to minimize on-site stored LSA material. Provided guidance in use of decon techniques, and surveyed material as necessary. Tracked segregated items to give client, such as volume, weight, and estimated costs of the recovered items. Significant reduction of Radwaste inventory, burial cost and major equipment recovery was obtained. Provided site management to 10 technicians in HP, Dosimetry, and Training positions. Provided direct supervisory duties including payroll, fitness for duty evaluation, and discipline as required.

March 1995 - April 1995 - Union Electric - Callaway
Senior Health Physics Technician - Responsible for support to Refueling floor during 10 year ISI of systems. Included providing support and guidance during use of Westinghouse robotics, core barrel removal, internals and reactor vessel ISI. Transfer canal entry and mods, were provided. Also provided normal support for RPV head removal/replacement, defueling/refueling, and cavity decon with strippable membrane media. Supported chemical decon activities of steam generator secondary. Performed routine Aux. and Rad Waste Building surveillance's, under-water dose determinations, and related work.

January 1995 - March 1995 - Entergy System - Arkansas Nuclear One
Senior Health Physics Technician - Provided containment crew support. Included reactor coolant pump seal(s) removal/rebuilding, all phases of 10 year ISI of primary components, outside platform support to steam generator crew, cold-leg drain-line mods. and specialty cutting operations, in-core instrumentation work and coverage, support during core-barrel removal, and all other phases of reactor building health physics support.

September 1994 - November 1994 - Tennessee Valley Authority - Browns Ferry
Project Manager- Direct supervision and management of thirteen (13) personnel. All client interaction provided for, including in-processing procedures, payroll, shift assignments. Responsible for employee evaluations, training, and consulting. Also responsible to Health Physics laboratory support. Provided in-plant radiological controls and assessments. Surveillance testing and data evaluation, C.A.M. servicing, and routines, computer input and reporting also provided. Supported entry team during unit start-up with power entries at 5-10%. Maintained neutron, Oxygen, and safety evaluations during these entries. Other routine surveys and data also provided, including RWP issues and briefings.

May 1994 - September 1994 - Tennessee Valley Authority - Sequoyah
Project Manager - Direct supervision and management of eighteen personnel. This included all interaction with client managers for in-processing procedures, shift assignments, payroll determinations, disciplinary actions. Responsible for employee evaluations, training, consulting. Directly responsible for support to refueling floor and upper-containment outage. Coverage included reactor head and internals removal, transfer-canal mods, reactor vessel ISI, core-barrel removal and ISI, valve reworks, and all other related refueling operations. Supported Westinghouse group using FFRDS fuel leak detection equipment. Maintained controls during cavity/equipment pit evaluations, core-barrel removal/replacement, specialty decon operations. Also supported Southwest Research team using PAR device for reactor vessel ISI activities. This included placement/removal from vessel.

February 1994 - May 1994 - Georgia Power Company - E. I. Hatch Nuclear
Lead Health Physics Technician - Reactor Building coverage. Included major mods to residual heat removal (RHR) and core spray, torus proper initial entry, torus support work, Rx water clean-up (RWCU), pump and heat exchanger (HTX) repairs and ISI, radiography support and controls.

Provided coverage for fuel pool htx and filter demin piping mods. Responsible for TIP room and hot machine shop work, including specialized decon methods of primary components. Numerous other valve reworks and various support. Provided log entry data, RWP briefings, control point guidance.

March 1993 - January 1994 - Tennessee Valley Authority - Sequoyah
Project Manager - Direct management and supervision of thirty-six personnel. Included all interaction with client managers for in-processing procedures, shift assignments, payroll determinations, and required discipline, and supervisory consulting. Supplied support to refueling floor and upper-containment outage. Coverage included reactor head and internals removal, extensive transfer-canal modifications, vessel ISI, core-barrel removal and ISI, valve reworks, refueling operations. Assigned to specialty Westinghouse group using Brown-Boveri (ABB) FFRDS fuel leak detection equipment. Included all phases of assembly, full rack placement, and support. Also provided coverage during cavity/equipment pit drain-down and decon activities using strippable membrane media, and routine surveillance and analysis. Support provided during dual PWR unit restart activities which included various power entries from 15-100% power for reactor coolant pump (RCP)inspections, "at power" valve repairs, various seal table evolutions. Several specialty evolutions covered including extensive transfer canal repairs/reworks, and reactor cavity seal area (reactor annulus) repairs and inspections. Provided expertise to client as refueling/containment specialist. Other activities included daily routine surveillances, overall plant maintenance, and general "return to service" repairs.

Senior Chemistry & Radiological Controls Classroom Instructor

Supervised instructors and instructed all Navy and civilian contractor personnel in health physics and reactor/steam plant chemistry. Coordinated and supervised classroom and laboratory lesson preparations and presentations. Certified other instructors to teach chemistry and health physics, classroom lessons and laboratory training exercises and prepared and administrated chemistry check (QA) analysis standards for instructor and student analytical chemistry certifications. Issued, collected and analyzed Self-reading and Thermo luminescent dosimetry (TLD). As Radiological Containment Supervisor, was responsible for design, construction, installation and use of contamination containment devices. Supervised and administered decontamination of site personnel for Site Emergency Preparedness.

Leading Engineering Laboratory Technician

Supervised overall reactor and steam plant chemistry and health physics. Prepared and reviewed Radiation

Work Permits (RWP) for plant maintenance and ensured prompt completion of work during a refueling overhaul and subsequent operations. Maintained personnel exposure records, responsible for ALARA program, control and transfer of all radioactive and hazardous chemical waste, calibration and maintenance of all chemistry and health physics instrumentation, administered Maintenance/Material/Management System for ships equipment during overhaul, initial criticality, sea trials and operational missions.

Education

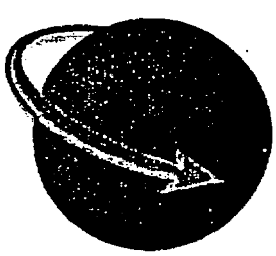
United States Navy Schools:
Nuclear Power Program
Engineering Laboratory Technician (ELT) School - Navy Health Physics and Chemistry Technician School

Walter M. Hipsher

[illegible]

Mr. Hipsher provides DOT certification training, transportation program assessment and radiation safety officer (RSO) services relative to facility licensing and radiation safety program management.

Experience:



TRANSPORTATION & TRAINING SERVICES
Owner
September 1997
Responsible for the operation and profitability of the company. Transportation & Training Services provides DOT certification training, transportation program assessment and radiation safety officer (RSO) services relative to facility licensing and radiation safety program management.

SCIENTIFIC ECOLOGY GROUP, INC.
August 1986 - September 1997
During eleven (11) years at SEG, Mr. Hipsher was responsible for all of the transportation compliance for the radioactive materials shipped to and from SEG. In August 1986 SEG did not have procedures, programs or trained individuals experienced in the shipment of radioactive materials. By December 1986 Mr. Hipsher had completed the development of the operating procedures, assisted in the development of the computer tracking system, trained all individuals involved with the preparation and shipment of the radioactive materials. Since 1986 more than 2000 shipments each year were either shipped by SEG and/or hauled by SEG's wholly owned subsidiary, Hittman Transportation Services. Mr. Hipsher was responsible, as SEG Vice President, for maintaining the high quality and profitability of the SEG transportation business and assuring that all SEG HAZMAT employees maintained qualifications to prepare shipment of radioactive materials. Mr. Hipsher trained and certified up to 250 individuals at SEG each year developing seven different training lesson plans for the various activities involved in the proper preparation and shipment of radioactive materials. In addition, HAZMAT certification courses were provide to SEG's customers to assist them in maintaining required HAZMAT (DOT) qualifications for their transportation staff.

NUS PROCESS SERVICES CORPORATION
1984 - 1986
At NUS Corporation, Mr. Hipsher was responsible for certification of radioactive material packages, manufacturing of NRC approved shipping casks and all transportation and training projects. He was responsible as Project Manager for the procurement of five NRC approved shipping casks serving as the procurement and Quality Assurance manager. Additional responsibilities included the development of training for NUS employees and training for clients awarding HAZMAT (DOT) training contracts to NUS. Training was developed to certify management and technician to prepare and ship large quantities of radioactive materials in NRC approved shipping casks.

US ECOLOGY, INC.
1979 - 1983
At US Ecology Mr. Hipsher was responsible for gaining NRC approvals for the use of five different company owned models of shipping casks and the procurement and Quality Assurance for new casks. As Project Manager, he was responsible for gaining approval of high integrity container used by Three Mile Island in transport and disposal of radioactive waste. Mr. Hipsher developed and provided DOT HAZMAT training to clients in the areas of radiation protection, transportation packaging of radioactive materials, and implementation of NRC regulations (10 CFR 61) governing radioactive waste disposal. This training was provided to more the 300 representatives from over 100 companies.

U.S. NAVY
1974 - 1979
As an Officer on nuclear powers submarines, Mr. Hipsher served as division officer for engineering divisions and as the Radiation Protection Officer. Qualified as Engineering Officer of the Watch and Officer of the Deck.

EDUCATION
Purdue University, BS, [redacted] Ex. 6
U.S. Navy
Nuclear Prototype School, 1975
Nuclear Power School, 1974

TRAINING
Provided over 150 DOT HAZMAT certification courses to nuclear power electric producers, government and industry.
Successfully managed the radioactive materials transportation programs for three companies since 1979.
Developed profitable DOT certification training business at three different companies. These training programs were used to train employees as well as clients.

Managed projects to build and certify packages to meet DOT Type A and Type B and NRC High Integrity Containers (HIC) requirements. Developed transportation audits to determine adequacy of clients programs and procedures to meet the regulatory requirements. Instructor at Roane State Community College for Hazardous Waste Management and Environmental Regulations courses. Lecturer for the Harvard University School of Public Health course on Radioactive Waste Management.

MEMBERSHIPS (Former)
American Nuclear Society
Adjunct Staff - Roane State Community College
Visiting Lecturer, Harvard University
National Council on Radiation Protection and Measurements (NCRP) Scientific Committee 87-1

Steven J. Singledecker

TITLE Executive Vice President

EXPERIENCE

Allied Technology Group, Incorporated, August 1999 to Present:

- Waste Broker/Shipper: Responsible for characterizing, packaging, and transportation of government and commercial radioactive and mixed waste in accordance with 49CFR 106-180, 40CFR 260-268, and 10CFR 51-74.

Manufacturing Sciences Corporation, March 1999 to July 1999:

- Transportation Coordinator/Broker: Responsible for packing, storing, handling, and processing of incoming/outgoing shipments in a high volume metals recycling facility. Other duties include warehouse management, inventory control, and transportation quality assurance.

ADF Environmental Services, Incorporated, October 1998 to March 1999:

- Director of Environmental Services: Responsible for developing and coordinating large scale projects, developing project proposals, and directing the Environmental Department, including Senior Project Managers, Waste Brokers, and Transportation Managers.

- Senior Project Manager: Responsible for the coordination of Project Managers, developing business leads and project bids, and oversight of multiple, large scale projects.

- Senior Waste Broker/Management Officer: Responsible for characterizing, packaging, and transportation of government and commercial radioactive and mixed waste in accordance with 49CFR 106-180, 40CFR 260-268, and 10CFR 51-74. Also responsible for training Junior Waste Brokers in applicable transportation regulations and building the transportation department.

Soil and Land Use Technology, Incorporated, October 1997 to October 1998:

- Senior Project Manager: Responsible for the coordination of Project Managers, developing business leads and project bids, and oversight of multiple, large scale projects.

- Senior Waste Broker/Management Officer: Responsible for characterizing, packaging, and transportation of government and commercial radioactive and mixed waste in accordance with 49CFR 106-180, 40CFR 260-268, and 10CFR 51-74.

- Project Manager: Responsible for all aspects of project management including waste characterizing, packaging and shipping, coordination of subcontractors, budget design and control, project development and bidding, and interfacing with customers and regulatory officials.

Zhagrus Environmental, Incorporated, August 1996 to October 1997:

- Project Manager: Responsible for all aspects of project management including waste characterizing, packaging and shipping, coordination of subcontractors, budget design and control, project development and bidding, and interfacing with customers and regulatory officials.

Steven J. Singledecker

TITLE Executive Vice President

EXPERIENCE

Allied Technology Group, Incorporated, August 1999 to Present:

- Waste Broker/Shipper: Responsible for characterizing, packaging, and transportation of government and commercial radioactive and mixed waste in accordance with 49CFR 106-180, 40CFR 260-268, and 10CFR 51-74.

Manufacturing Sciences Corporation, March 1999 to July 1999:

- Transportation Coordinator/Broker: Responsible for packing, storing, handling, and processing of incoming/outgoing shipments in a high volume metals recycling facility. Other duties include warehouse management, inventory control, and transportation quality assurance.

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- Director of Environmental Services: Responsible for developing and coordinating large scale projects, developing project proposals, and directing the Environmental Department, including Senior Project Managers, Waste Brokers, and Transportation Managers.
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Soil and Land Use Technology, Incorporated, October 1997 to October 1998:

- Senior Project Manager: Responsible for the coordination of Project Managers, developing business leads and project bids, and oversight of multiple, large scale projects.
- Senior Waste Broker/Management Officer: Responsible for characterizing, packaging, and transportation of government and commercial radioactive and mixed waste in accordance with 49CFR 106-180, 40CFR 260-268, and 10CFR 51-74.
- Project Manager: Responsible for all aspects of project management including waste characterizing, packaging and shipping, coordination of subcontractors, budget design and control, project development and bidding, and interfacing with customers and regulatory officials.

Zhagrus Environmental, Incorporated, August 1996 to October 1997:

- Project Manager: Responsible for all aspects of project management including waste characterizing, packaging and shipping, coordination of subcontractors, budget design and control, project development and bidding, and interfacing with customers and regulatory officials.

4/92-4/96
HP Supervisor, Cintichem
Tuxedo Park, NY
D/D of 5 MW open pool Research and Production Reactor & Hot Cells

1980-1992
Traveling contract HP Tech
Experienced in all aspects of Health Physics profession at numerous commercial plants (detailed list provided upon request)

MILITARY

1967-1980

Submarine Service, US Navy
Including 4 years as Radiological Controls Supervisor on submarine tenders

EDUCATION

[redacted] Ex. 6

STEVEN THOMPSON

EXPERIENCE

RCT, Site Safety/Health Officer, Hazardous and Radioactive Material Shipping/Advanced Mixed Waste Shipping certified.

11/12-11/19/01
Site Coordinator, ATG
Burial Mound Remediation, Fort McCellan, AL
Remediate Burial Ground including removal, packaging and shipment of nonconforming material, screening of removed soil, survey and fill.

9/11/01-11/02/01
Site Supervisor, ATG
Chemical Holes Soil Pile Disposal Project
Brookhaven National Labs, Upton NY
Screen, sort nonconforming material from chemical holes and load for shipment.

7/20/01-8/20/01
Project Manager/Site Supervisor, ATG
Heritage Minerals, Lakehurst, NJ
Load and ship tailings waste

4/6/01-7/3/01
Project Manager/Site Supervisor, ATG
Lake City Army Ammo Plant Lake City, MO
Demo DU wing Bldg 3A including remediation, demolition of structure, packaging and shipment of waste.

6/3/00-4/1/01
Site Supervisor, ATG
Brookhaven National Labs, Upton, NY
Boneyard Legacy Waste Removal Project/Chemical Holes Soil Pile Removal Project.
Characterize, sort, repackage, ship or prep to ship legacy waste and chemical holes material.

3/1/99-6/2/00
Senior HP Tech, ATG Catalytics
Oak Ridge, TN
Bear Creek Facility operations

2/1/98-2/28/99
Senior HP Tech/Safety & Health Officer, ATI
Oak Ridge, TN
K-25 Asset Recovery Project

4/15/96-1/1/98
Lead RCT, ORNL
Oak Ridge, TN
WAG-5 OHF Tank Riser Installation/WAG-4 Seeps Removal Action & STF
Tanks Riser Installation

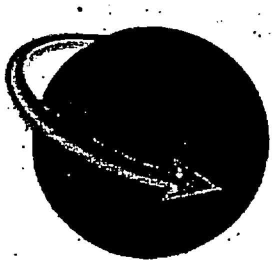
Rob Woodburn

FUSRAP, Dupont - Deepwater, NJ
Westinghouse Waltz Mill Site
West Valley Demonstration Project

Rob contributes over 9 years of extensive and diverse environmental project experience to MHF-LS. His relevant professional experiences and specific training in targeted areas are optimal for providing MHF-LS clients with comprehensive customer service, and assist meeting their waste transportation needs in an innovative manner.

Responsibilities:

- ✓ ***Management of Multiple, On-going Transportation Projects***
- ✓ ***Daily coordination with Clients to meet their shipping needs***
- ✓ ***Continuous interaction with MHF-LS vendors to expedite shipments***
- ✓ ***Allocation of project specific equipment in order to meet customers schedule***
- ✓ ***Provide customers with daily shipment tracking***



Relevant Experience:

- Over nine years of extensive and diverse environmental project experience.
- Environmental Project Management experience with the transportation of hazardous and non-hazardous waste streams, site assessments, site-specific engineering, QA/QC, regulatory requirements and site construction-remediation methods.
- Project Management of numerous Government, commercial, nuclear power plants, and chemical sites.
- Extensive knowledge of MHF-LS equipment utilized for rail shipments including IP-1 and IP-2 Packaging, intermodal flatcars, bulk gondola cars, tank cars, and heavy-duty flatcars.
- Experienced in developing and reviewing hazardous waste shipping paperwork and the generation of railroad shipping paperwork
- Provided turn-key solution for the movement of over-dimensional radioactive components from commercial power plants

Rob has extensive on-site experience relating to the environmental industry ranging from complete technical support and oversight for all phases of remedial site activities -to the management and transportation of both hazardous and non-hazardous waste streams.

These experiences have contributed to his ability to develop innovative waste transportation solutions for current and potential clients.

Qualifications:

- ✓ *Radiation Worker I & II Training – 1999-01*
- ✓ *Certified OSHA 1910.120 40-Hour and Safety and 8 Hour Refresher– 1992 –01*
- ✓ *Certified OSHA 8 Hour Supervisors training*
- ✓ *U.S. Army Corps Of Engineers " Construction Quality Management for Contractors"*
- ✓ *40 Environmental Sampling Training*

Experience:

Project Manager; MHF Logistical Solutions, Inc.

Responsible for managing several transportation projects for MHF-LS' customers. Projects vary greatly and include intermodal shipments of radioactive materials, gondola cars of radioactive contaminated soils, tank car shipments of flammable liquids, box car shipments of flammable liquids in drums, etc. Successfully transported over dimensional radioactive components for commercial power plants. Provides customers with assistance in using and maintaining equipment. In constant contact with customer to arrange for transportation and scheduling of shipments. Works with railroads and trucking companies to coordinate shipments from customer sites, which includes managing and generating paperwork involved with the shipment. Uses computer skills to track railcar shipments and to use the information to expedite rail shipments.

Field Engineer; OHM Remediation Services Corporation
ENSR Remediation

As Field Engineer, responsibilities encompassed management of major site activities. His specific duties focused on the coordination of on-site personnel and materials procurement using a comprehensive computer database program in order to meet intermediate project deadlines. Additional duties included serving as intermediary between on-site teams of personnel and clients to devise cost-effective solutions to potential problems and organizing systematic methods of updating project progress so that necessary adjustments can be made in a timely manner.

Education: Bachelor of Science, Environmental Science (minor in Environmental Geology and Earth Science) from Edinboro University of Pennsylvania

Two years of Civil Engineering Courses, Point Park College, Pittsburgh, PA

Responsibilities:

- ✓ *Manage Technical Services Group*
- ✓ *Provide oversight of customer service line supporting clients in Radioactive and Hazardous waste shipments and disposal*
- ✓ *Development and implementation of technical plans and procedures for the appropriate transport and disposal of waste streams*
- ✓ *Execution of field waste management and remediation projects*

Lee Young

[illegible]

Experience:

Radiological Characterization Surveys of Manhattan Project Sites

Technical Oversight of Interim Storage Cell Construction on Latty Avenue Adjacent to HISS

Lee brings over 20 years of practical field experience providing radiological controls, health & safety coverage, decommissioning / remediation project planning, budgeting, implementation, and reporting, including waste management and transportation services to commercial and federal clients.

Relevant Experience:

- Over 20 years of experience in the related fields of health physics, industrial hygiene, and safety on field projects involving characterization, waste management, and remediation for commercial and government clients.
- Twelve years of project / program manager experience related to turnkey decommissioning projects.
- Developed and managed successful waste management and remediation projects for IT Corporation, SEG, Quadrex, US Ecology, NES, ATG and MHF Logistical Solutions.
- Provided comprehensive bid responses including technical approach, schedule development, cost estimate, and subsequently managed the successful execution of multi-million dollar field remediation projects.
- Experience includes the development of waste treatment and disposal optimal approaches and schedule controls for the effective execution of projects.
- Background includes regulatory compliance, radiological characterization / remediation, waste management, and transportation.

Lee has a variety of project experience in site / waste stream sampling and characterization; waste profiling; NORM, LLRW and mixed waste treatment and disposal alternatives development; matching waste packaging, disposal, and transport modes for cost effectiveness; and, hands-on field execution of remediation and waste treatment, transportation, and disposal projects. He has demonstrated the ability to implement successful projects under dynamic conditions.

Qualifications:

- ✓ *Rad Worker (commercial) – 1980-01*
- ✓ *DOE Rad Worker II – 1995-01*
- ✓ *Certified OSHA 1910.120 40-Hour and Safety and 8 Hour Refresher– 1990 –01*
- ✓ *HAZMAT 49 CFR 172, subpart H – 2001*

Lee has developed project Work Plans for remediation activities under CERCLA removal actions with FFA milestones, and routinely provides project specific HASP, QAPP, trans, and WM plans. closure plans. Ken has been involved in approving work plans for field sampling programs associated with sediment, surface soil, surface water and groundwater investigations, analyzed remedial alternatives for applicability, effectiveness, risk, implementation, cost, and scheduling in order to identify remedial actions to be taken to support site cleanup.

Experience:

Manager, Technical Services Group; MHF Logistical Solutions, Inc.

Responsible for business development and implementation of complimentary customer service lines including waste stream profiling, load-out, shipping / brokering, emergency response, and site remediation. Duties include identification of the technical requirements, regulatory compliance issues, and client objectives for ensuring the adequacy of service response, resource assignment, scheduling and coordination for a relatively seamless execution of the project. Also provides for continual oversight of the technical, cost, and schedule status to meet client requirements and corporate objectives. Interface with existing service line management for synergistic growth of the business lines.

Field Services Manager, ATG, Inc.

As Manager of Field Services, lead program development including proposal writing and subsequent project implementation for the Remedial Services Group. Provided revenue to the corporation of in excess of $2.5M annually for waste brokerage activities, radiological characterization of sites and facilities, and turnkey D&D projects.

Education

Master of Science in Occupational Health & Safety (school of Public Health) from the University of Tennessee, Knoxville, TN; and Bachelor of Science in biology from East Tennessee State University, Johnson City, TN.

AREAS OF EXPERTISE

- Natural Gas Industry
- Environmental Analysis/Impact Assessment

EDUCATION

M.S., Biological Sciences, Northern Illinois University, 1970

B.S., Biological Sciences, Northern Illinois University, [redacted] Ex. 6

PROFESSIONAL HISTORY

Aviation Electronics Technician, U.S. Navy (1969-1973)

Maintenance of electronic systems of A-7 attack aircraft.

Counselor, Naval Drug Rehabilitation Center.

PROFESSIONAL AFFILIATIONS

North American Benthological Society

PROFESSIONAL REGISTRATIONS

Certified SCUBA Diver

REPRESENTATIVE EXPERIENCE

Mr. Ander joined Dames & Moore in 1973 and conducts and manages environmental and hazardous waste contamination studies for industrial and government clients throughout the United States.

Mr. Ander has participated in a wide variety of projects, including the following:

Project Director

- Strategic Management Committee member for a Dames & Moore/BP Amoco company (Amoco Remediation Management Services). Provides strategic, technical and business guidance to enhance shareholder value.
- Negotiations with USEPA Region III to develop an Administrative Order of Consent on behalf of a Dames & Moore client for a multimillion dollar, 10-year investigation/corrective action environmental program.
- Negotiations with various USEPA Regions (III, IV, and V) and state regulatory agencies (Illinois, Indiana, Wisconsin, Mississippi, Delaware, and Maine) on behalf of numerous clients to establish cleanup goals, work plans, and remediation approaches for sites with a variety of contaminants, including metals, solvents and PCBs.
- Project Director for numerous Illinois Site Remediation Program projects including GTE, CP Clare, Flint Ink, American Landmark Properties, Phillips Petroleum, Opus Corporation, and Midway Games.
- Environmental audits and/or assessments for hundreds of industrial and commercial facilities throughout the United States and Canada.
- Pre-acquisition assessments, environmental studies, development of remedial action plans and remediation oversight for the natural gas industry, including PCB contamination at several hundred compressor stations, mercury at several thousand gas measuring facilities, and other contaminants at liquid removal points, storage wells, pig launchers and receivers, and related facilities.
- Environmental assessment of three former manufactured gas plant sites in northern Illinois. Provided expert testimony regarding environmental impacts of residual contaminants related to one of these sites.
- Environmental assessment and audit of 3 primary

aluminum smelters in Kentucky, West Virginia and South Carolina.

- Environmental assessment of lead in the soils and ground water near battery reprocessing plants in Illinois, Missouri, Oregon, and Louisiana.
- Remedial Investigation/Feasibility Study (RI/FS) for a Superfund site in north central Michigan.
- Investigation and remediation of a variety of industrial sites contaminated with chlorinated solvents in Illinois, Alabama, Michigan, New York, Pennsylvania, Tennessee, Mississippi, Arizona, California, Maine, and Connecticut.
- Assessment of the impact to benthic and fish communities generated by the increase of industrial effluent to a river in northern Illinois.
- Evaluation of the environmental enhancement resulting from the dredging of polluted sediments from the Little Calumet River in Illinois.
- Study of the economic and environmental implications of developing low-head hydroelectric power on the Fox River in Illinois.

Project Manager

- Preparation and coordination of Final Safety Analysis Report and Environmental Report for a nuclear power plant in Missouri.
- Environmental assessment related to dredging an estuary and salt marsh on the Cooper River for the construction of an Amoco chemical plant in Wando, South Carolina, including analysis and evaluation of fisheries, plankton, tidal influence, and water chemistry with special emphasis on the collection and analysis of benthic macroinvertebrates.
- Geohydrologic assessment of a chemically contaminated plant site and chemical waste disposal facility in Michigan, including evaluation of containment and treatment measures for contamination in soils and ground water that included PBBs, DDT (and derivatives), metals, and radioactive chemicals.
- Environmental baseline studies and impact assessment of an Exxon Minerals copper/zinc mine in northern Wisconsin, including analysis and evaluation of fisheries, plankton, periphytic algae, water chemistry and benthic

macroinvertebrates.

- Land reclamation study for a highly acidic abandoned coal strip mine in north central Illinois.
- Environmental assessment of selected river basins, tributary to the Illinois River, for a statewide stream survey for the Illinois Environmental Protection Agency. Project involved the collection and analysis of nearly 2,000 benthic samples.

Principal Investigator

- Preparation of environmental reports for various clients to support FERC applications leading to certification, licensing and permitting for construction and operation of proposed natural gas pipelines, compressor stations and other associated facilities. Work involved analyzing the potential affects of the proposed project on water use and quality, wetlands, biology, cultural resources, soils, noise quality, air quality, socioeconomics, geology, and land use, recreation and aesthetics.
- Environmental studies required for the preparation of permit applications and reclamation plans for several coal mines and a coal preparation plant in eastern Kentucky.
- Environmental baseline studies for nuclear power plants in Illinois, Florida, Wisconsin, Missouri, Texas, and Washington.
- Environmental baseline studies for the phosphate mining industry in Florida.

Project Quality Assurance Coordinator

- Management of all projects requiring quality assurance in compliance with Nuclear Regulatory Commission regulations.
- Implementation of Dames & Moore's quality assurance manual on all nuclear-related projects.

Depositions

- Gould Inc. vs. Arkwright Mutual, etc., et al. 1995. Testimony regarding findings of site assessment at a former battery recycling facility.
- People's Gas vs. EJ&E Railroad. 1995. Expert testimony regarding contamination related to a former manufactured gas plant.

- Highwood vs. Cecchin Plumbing & Heating, et.al. 1998. Expert testimony regarding the source of petroleum compounds contaminating the City of Highwood's potable water system.

ROBERT D. BRATHOVDE, P.E.

Title: Associate/Engineering Manager

Expertise:
Civil and Geotechnical Engineering
Earthen Dam and Impoundment Design, Construction and Inspection
Environmental Investigation and Remediation
Litigation Support

Academic Background:
B.S., Civil Engineering – Arizona State University, Tempe, Arizona [redacted]
Graduate Studies in Geotechnical Engineering, Arizona State University

Certifications/ Registrations:
Civil Engineer (Arizona, 1983)
Civil Engineer (Michigan, 1997)
Land Surveyor (Arizona, 1984)
Licensed Professional Engineer (New York, 1998)
Licensed Professional Engineer (Connecticut, 1998)
Registered Professional Engineer (New Jersey, 1998)
Registered Professional Engineer (Pennsylvania, 1998)

Professional Affiliations: National Society of Professional Engineers

Experience: Robert D. Brathovde, P.E., is an associate in the Cranford, New Jersey office of URS. Since joining URS (Dames & Moore) in 1979, Mr. Brathovde has provided site investigations, design, construction and remediation services for earthen structures and impoundment's, including preparation of design documents, project management, and cost estimation for numerous projects throughout the United States. Specific project experience is detailed below:

Civil and Geotechnical Engineering

- Lead Consultant for the foundation investigation and design of the planned baseball stadium at St. George station on Staten Island, NY. This project involves geotechnical investigation, design and recommendations for all the building and parking structures; including the stadium, bleachers, railroad crash walls, scoreboard and waterfront promenade. Our services included evaluating deep dynamic compaction as an alternative to traditional pile foundations. An additional element of the project involved the project planning and monitoring of anticipated vibrations associated with the planned construction and its impact on the adjacent properties.

- Principal Investigator for development of labor and equipment estimates and construction cost analysis on design alternatives for removal and disposal of approximately 2,500,000 tons of uranium and vanadium mine waste material and tailings(UMTRA Project). Project included design and specification of material removal and evaluation of on-site and off-site disposal. U.S. Department of Energy required evaluations included disposal alternatives with public hearings on traffic impacts for surrounding communities.

- Principal Investigator for engineering and cost estimation related to the U.S. Army Corps of Engineers (USACE), Section 205 feasibility study. The project included the investigation and design of flood control measures for the lower four-mile reach of Poplar Brook, in Monmouth County, NJ. The project included evaluation of storm events and their impacts, alternative design and costing of control measures to mitigate future damage for the Army Corps of Engineers. The project included clearing and upgrading channels, detention structures, control dikes, adding and enlarging culverts and culvert work beneath operational railroads.

- Project Manager responsible for the advanced planning of civil works for the second largest copper mine in southern Arizona. This project includes anticipation and evaluation of surface water control needs and tailing disposal area requirements with the associated structures.

- Lead Consultant for the remedial geotechnical investigation and design and reconstruction of three large diameter (100 foot) bulk oil storage tanks. The tanks had been constructed on soft soils and had experienced substantial total and differential settlement. The project included soils investigation, laboratory analysis, design analysis and recommendations for reconstruction of the tanks, and construction observation during reconstruction.

- Project manager for the remedial geotechnical investigation of two large diameter bulk oil storage tanks. The tanks had been constructed on soft soils and had experienced substantial settlement. The project included soils investigation, laboratory analysis, design analysis and reconstruction recommendations.

- Lead consultant for the interim grading plan and subgrade plan design of Cell 6/7 for the Fresh Kills Landfill on Staten Island, New York. This landfill cell covers approximately 300 acres with a cap height of approximately 120 feet. This project included evaluation of the Agency approved design storm, erosion control measures, grading plans and integration with the existing and planned landfill gas collection system.

- Lead Consultant for the design and installation of a series of leachate collection systems along the face of Cell 1/9 to control landfill liquids. The project included the design, specification and contract bid documents for installation of the systems.

- Principal investigator for Maricopa County's Northwest Regional Landfill, Maricopa County, Arizona. Concerned with development of a 50-year life landfill, supporting buildings and ancillary facilities. Responsible for the public hearings, design, specification, construction cost estimate, bid evaluation, permitting, and development of the operations plan.

- Project design and preparation of construction specifications for hazardous waste landfill in northern Oregon.

- Conceptual and design engineering for uranium waste management systems.

Earthen Dam and Impoundment Design, Construction and Inspection

- Project coordinator for dam safety inspection of 139 sediment control and water supply dams for Peabody Coal Company in Arizona. The project included geotechnical, hydrologic and hydraulic inspections, design analysis and redesign of structures, spillways, outflow channels, haulroads and conveyor belt lines. Work was performed to comply with permit requirements that the mine site have a zero surface water discharge.

- Project Manager for design of upgrades and expansion of the fly ash and bottom ash ponds for the Cholla Power Plant in Central Arizona. Project involved the geotechnical investigation, design and construction monitoring of the two new bottom ash disposal basins and the rehabilitation of the expanded fly ash containment dam.

- Principal Investigator for embankment stability and rehabilitation for a diatomite mining operation in central California. The project included investigation, analysis, design and construction of a stability improvement program for the retention dam of the waste disposal area.

- Project Manager and Lead Consultant for the design, specification, annual monitoring and safety of dams inspection of a copper tailing dam in southern Arizona. The project scope involved a 5-year evaluation program of slope stability, monitoring the embankment instrumentation and annual inspections. This dam is currently over 200 feet in height, dam length of nearly 2.5 miles, with impounded area of exceeding 2,400 acres.

- Lead Consultant for the design, specification, and bid document preparation and construction supervisions of three leachate collection ponds for a mine in southern Arizona. The ponds were designed and constructed to collect leachate solution coming from copper leach piles and included cutoff walls, single and double HDPE lined basins, leak detection systems and downstream monitoring. The systems capacity varied from 15 to 50 acre-feet.

- Lead Consultant for evaluation, redesign and rehabilitation of two copper tailing dams in central Arizona. The dams had experienced significant erosion during a period of extreme precipitation. The project included investigation, instrumenting the dams, slope stability evaluation, design and specification for rehabilitation and stabilization, and construction inspection of the structures.

- Project Manager for the design and construction inspection of two storm water retention structures for a copper mine in northern Arizona. The project included preparation of cost estimates, construction specifications, bid documents and review of contractors bids. These earthen structures were designed to contain up to 150 acre-feet of storm water and copper leachate. The smaller of the two ponds also included a double HDPE liner and was ultimately used for leachate recovery and storage. The systems included the design and construction of a series of storm water diversion channels around the mine site to limit the volumes of impacted water entering the retention structures.

- Principal Investigator for engineering analysis, construction cost estimation, report and technical specification preparation relating to the design and construction for lead mine, tailings disposal systems on the North Slope of Alaska. Project included investigation and design of a tailing disposal dam and a process water storage dam.

- Principal Investigator for analysis and design of seven earthen dams designed to contain copper tailings and fresh process water in mainland China. The embankments varied in height from 75 to 175 meters.

- Project Manager for the investigation, design and construction of a seepage control system from an existing process solution containment pond.

- Lead Consultant for a hydrologic evaluation of a copper mine site. Evaluation included identification of the appropriate storm event for control structure design and the flood routing of the identified storms. The intent of the program was to establish an EPA defensible criteria for zero stormwater discharge from a copper mine site.

Environmental Investigation, Design and Remediation

- Project Manager for the remediation phase of the Tucson Area Remediation Program (TARP) Superfund site in Tucson, Arizona. This project included the investigation and installation of mitigation wells to control a solvent contaminant plume that extended approximately five miles from the source. This project included protection and mitigation of two distinct drinking water aquifers.

- Lead Consultant for the environmental investigation of the Newark Elizabeth Rail Link (NERL) in Newark, NJ. This project included the investigation of the planned rail alignment for environmental impact, plans and specifications for mitigating identified contaminants, environmental cost impact evaluation, impacts to construction methods and schedules, permitting requirements, and operational constraints. The project also involved a constructability review of the geotechnical design related to dewatering for tunnel construction and building support.

- Project Manager for the investigation and remediation of kerosene and solvent contaminated soils and groundwater at a metal fabricating plant in Arizona. The project included evaluation of soil on the 600-acre site and possible groundwater impacts over an approximate 26 square mile area. The investigation included evaluation of solvent impact, installation of ground water monitoring and remediation wells, design, layout and specifications for soil excavation and design, installation and operation of a dual-phase vapor extraction using vacuum systems.

- Lead Consultant for environmental investigations of a five-mile long channel project in Southern Arizona. The project included identification and investigation of suspect contamination areas within the planned channel. Also included was the remediation of impacted areas of the channel, including buried construction materials and drums. Remediation services included the layout, design, specification, cost estimate and construction oversight for a third party remediation contractor.

- Principal Investigator for Dredge Sediment Testing and Analysis for the USACE, New York District, on their dredge material management alternatives project in the Raritan Bay in NY and NJ.

- Principal Investigator for the Long Slip Canal Habitat Creation Project, Hoboken and Jersey City, NJ. Work scope included geotechnical engineering investigation and alternative evaluation for the canal dredging and constructed backfill structures.

- Lead Consultant for investigation of potential groundwater impact and closure of a Type V injection well in southeast Michigan. Project included groundwater investigation and preparation of closure documents, including design plans, specifications and engineers cost estimate.

- Lead Consultant for the investigation and closure of a Type V injection well in eastern Pennsylvania. Chemicals of concern included chlorinated solvents and vinyl chloride.

- Principal Investigator for the site investigation, retrofit design, cost estimation, and construction specification preparation for three large hazardous waste lagoons in Ohio. The lagoons contained elevated levels of heavy metals. The remediation had to be designed and implemented to allow the facility to maintain two of the three lagoons operational at all times during the remediation. In addition to the lagoon remediation, approximately three hundred drums were located at the edge of the lagoons that had to be incorporated into the remediation planning and costing.

Litigation Support

- Lead Consultant and expert witness for third party claims related to a RCRA closure of a landfill and liquid waste lagoons in Ohio. The project involved investigation of responsible parties (generators) contributing to identified contamination at the landfill. Chemicals of concern included organic compounds, inorganic compounds and PCB's as solid, semi-solid and liquid wastes.

- Lead Consultant and expert related to cause, extent of damage, and appropriate repair of storm water damage to a series of structures in southern Michigan.

- Project Manager and expert witness for the investigation of building distress for the City of Flagstaff, Arizona. The building in question was the primary pump station for the city's water supply. Our scope of work included identification of the extent of damage, cause of the damage, necessary repairs to the building and pumping systems and litigation support.

- Lead Consultant and expert witness for a litigation support project involving environmentally impacted soils along a large surface water drainage channel. Our scope of work involved the identification of the type and extent of environmental impact before and after a major flood altered the alignment of the drainage channel.

Past Experience

- Performed construction supervision and inspection on numerous commercial and industrial buildings. Performed numerous foundations investigations including the drilling, logging, and laboratory testing of foundation soils and rock.

Pam M. Cox

Senior Project Scientist

TECHNICAL EXPERTISE

- Investigation and remediation of hazardous sites
- Hydrogeologic Investigations

PROJECT ASSIGNMENT

YEARS OF EXPERIENCE
9

EDUCATION

MS/1999/Hydrogeology-Water Resource Management; Syracuse University & SUNY Environmental Science and Forestry, Syracuse, New York

BS[redacted]Environmental Law, Policy and Management; SUNY Environmental Science and Forestry, Syracuse, New York

PROFESSIONAL REGISTRATIONS

Certified Professional Geologist (National) – Application 8/01

PROFESSIONAL PROFILE

Ms. Cox has 9 years of experience in designing, implementing, and managing hydrogeologic investigations, remedial investigations, site assessments, asbestos surveys, geotechnical investigations, and extensive field sampling programs. Project Managet responsibiliities include writing proposals, budgeting, approving invoices, serving as client liason, and reviewing documents for technical accuracy. Field work experience includes field supervising, collecting soil samples, installing and developing monitoring wells, and sampling ground water. Data interpretation work includes water budget analyses, groundwater flow maps, discharge maps, and vapor transport modeling that simulates contaminant vapor migration from the groundwater to the indoor air by both diffusion and convection using site-specific parameters.

REPRESENTATIVE PROJECTS

HAZARDOUS WASTE MANAGEMENT:

Ms. Cox's hazardous waste experience includes site investigations and remedial program design and implementation. Specifically, she has been involved in:

- Hydrogeologic studies
- soil sampling
- monitoring well installations
- slug testing
- geophysical surveys
- ground water sampling
- sediment sampling programs
- biological studies
- aerial photograph interpretations
- report preparation
- interim remedial measure implementation

Ex. 6

Ms. Cox has been the Project Manager and hydrogeologist for several multi-sources, multi-contaminant ground water investigations. Responsibilities included acting as client liaison, writing reports, reviewing previous site work, training junior personnel, preparing project budgets, developing New York State Department of Environmental Conservation (NYSDEC) - approved work plans, mapping plumes, obtaining site closure and managing the appropriate release of sensitive public information.

Regulatory compliance work includes audits and Hazardous Materials Surveys for mercury, lead, polychlorinated biphenyls (PCBs) and chloroflourocarbons (CFCs) of industrial facilities.

Ms. Cox has managed and performed field work including evaluating sites by magnetometer, ground penetrating radar, soil gas surveys, soil boring installation, pump tests, down-hole geophysical studies, packer testing, tank excavations, installation of nested piezometers and extensive biological sampling and other tasks related to ecological and human health risk assessment. Additionally, she has conducted geotechnical investigations throughout New York.

Former Farm Site – The 100-acre site was impacted by PCBs, Metals (Ni, Cd, and Pb) and solvents emanating from a nearby former ammunitions manufacturing property. Project responsibilities included extensive multi-media and biological sampling, electro-shocking, working closely with the NYSDEC and subcontractors, and soil sampling, excavation and disposal.

Plastics Molding Company, Syracuse, NY – Delineated nature and extent of accidental PCB release. Impacted soils and stream sediments were excavated and removed.

Packaging Company – Conducted a geotechnical investigation of the site, that included test borings, collection of disturbed and undisturbed soil samples, laboratory testing of the collected samples for consolidation testing and Atterberg limits. The results of the geotechnical investigation were used to evaluate engineering properties of the soil for foundation and slope stability calculations.

Steel Manufacturer – Performed geotechnical test borings and applicable sampling to be used during estimating bearing capacities of foundations for building expansion and heavy industrial furnaces.

Petroleum Manufacturer, Project Manager – Managed several sites involving oversight of the operation and maintenance of soil vapor extraction (SVE), air sparging and ground water pump-and-treat systems.

Confidential Client, NY – Provided project oversight during an electromagnetic geophysical survey of a site with buried drums. Primary responsibilities included developing the survey grid, data reduction, interpreting survey results, and making recommendations for further investigation requirements.

WATER RESOURCES:

Ms. Cox has supervised hydrogeology programs related to industrial and public water supply wells. These programs have involved:

- drilling supervision
- soils analysis
- aquifer testing
- well design and installation

Representative projects include:

Large Aluminum-Recycling Facility, Project Manager – Wetland wastewater coolant system investigation that included extensive multi-media and biological sampling, electro-shocking, working closely with the NYSDEC, subcontractor coordination, soil classification, and monitoring well installation, development and sampling.

Industrial manufacturer, NY – Groundwater flow mapping (bedrock, overburden, till), evaluating ground water flow direction and rate of flow.

Manufacturer of Medical Supplies – Oversaw down-hole geophysical methods, packer testing, and installation of nested piezometers, surface water and ground water sampling, and a soil vapor survey beneath the building at a site with freon contamination in the deep aquifer (greater than 300 ft below ground surface).

Municipal Water Supply, Liberty, NY – Project included well installation, ground water flow mapping, slug testing and source investigation and control. The pumping well drew in contamination from multiple sources.

ENVIRONMENTAL ASSESSMENT:

Ms. Cox has developed proposals, conducted site visits, composed reports and managed over 500 Phase I and II Environmental Site Assessments. As part of these assessments she characterized soil and ground water in relation to a variety of environmental considerations. In addition, she has been involved in reducing and analyzing analytical data, writing reports, interacting with clients, coordinating subcontractors, removing tanks, advancing test pits, responding to technical questions, classifying soils and installing, developing and sampling wells.

Representative projects include:
- Natural Gas Facilities
- Solar cell manufacturing plant
- Food manufacturers
- Printing Companies
- Large wire manufacturer
- Textile companies
- Steel Mills
- An electronic components manufacturer
- Television/Entertainment Industry

INDUSTRIAL HYGIENE:

Asbestos Surveys

Performed asbestos surveys for site assessments, demolition and renovation projects in industrial, commercial, and residential facilities. Coordinated project work schedules with the contractor(s) or owner(s) and maintained chain-of-custody documentation throughout sample analysis. Prepared reports for these surveys that included quantities, location and estimated abatement costs for identified materials.

Representative projects include:
- Large Vacant Mall prior to demolition
- Three high rise mixed residential and retail building
- Industrial Plant, Hudson Falls, NY
- Lincoln Plant Facility, Rochester, NY

Health & Safety

Ms. Cox acted as the office Health and Safety officer. Her duties included scheduling and maintaining company training records, conducting health and safety meetings, preparing health and safety plans and developing a ground water sampling Statement of Procedures.

Site Health & Safety officer for several remedial projects. Tasks included writing and implementing the site health and safety plan, conducting daily health and safety briefings, writing up incident reports and formulating corrective actions for injuries that occurred on-site.

LABORATORY ANALYTICAL EXPERIENCE:

Conducted chemical analyses of ground water, drinking water, soil and leachates for Phase II Investigations, SPDES and NPDES Permits and remediation projects.

PROFESSIONAL TRAINING

OSHA 40-Hour Safety Training
OSHA Supervisor Training
OSHA 8-Hour Refresher
Hazardous Materials Transportation Training: DOT/HM-126F
CPR and First Aid Certified
AHERA-Accredited Inspector
New York State Licensed Asbestos Inspector
Underground Storage Tank Closure Training
DNAPL Short Course: "Practical Site Characterization & Remediation Techniques", University of Waterloo
PCB Short Course: "PCBs What they are and How they are analyzed"

PROFESSIONAL AFFILIATIONS

Association for Women Geoscientists – Northeastern Representative
Central New York Association of Professional Geologists
Environmental Breakfast Club of Central New York
Society of Military Engineers (SAME)

Pam M. Cox

Senior Project Scientist

SELECTED PUBLICATIONS

An Evaluation of Methyl Tertiary Butyl Ether in the Ambient Air Above a Petroleum Spill: A Vapor Transport Analysis. 1999.

URS

Curriculum Vitae

WILLIAM P. DUGGAN, Ph.D., P.E., C.H.P.

Title	Vice President Senior Health Physicist
Expertise	Health Physics & Nuclear Engineering Radioactive Waste Management Environmental Remediation

Experience

Lead Radiological Investigator for ongoing RI/FS of uranium- and thorium-contaminated FUSRAP site. Prepared Baseline Risk Assessment for Remedial Investigation and dose models for site monitoring reports. Interaction with federal and state regulators on site monitoring and remediation criteria.

Project Director for decommissioning of Above Grade Ducts at the Brookhaven Graphite Research Reactor at DOE's Brookhaven National Laboratory. URS provided engineering and field services for dismantlement, segmentation, and disposition of concrete duct sections contaminated with radiological and hazardous materials.

Project Manager of facility investigation and upgrade of thorium contaminated industrial site. Impact assessment of remediation alternatives included evaluation of pathways and calculation of potential dose commitments to workers and off-site public. Project required establishment and execution of field health physics program.

Lead Consultant for environmental due diligence in transfer of nuclear-related business of Waste Management, Inc to Duratek. Managed evaluation of operations and environmental and safety conditions at Barnwell Disposal Facility and other sites for current and long-term compliance and liabilities.

Project Manager and Lead Radiological Consultant for environmental due diligence in support of merger of US nuclear operations of Framatome and Siemens. Developed cost estimates for decommissioning of two nuclear fuel fabrication facilities and remediation of associated properties.

Project Manager and Health Physicist for URS/Dames & Moore's licensing and assessment support of Illinois LLRW Disposal Facility license application by Chem-Nuclear Systems, Inc. Coordinated multi-discipline efforts in preparation of license applications and evaluation of safety and environmental impacts for two sites. Performed time and motion studies for projected facility operations to evaluate impacts on radiation exposure to workers and the public.

Lead Radiological Investigator for Due Diligence investigation of multi-site corporate transfer valued at over $1 billion. Radiological inspections were conducted of 10 active and inactive industrial and research facilities in five states and Europe.

Lead Consultant for development and analysis of regulatory alternatives for closure of Western New York Nuclear Services Center for evaluation in EIS. Addressed Federal (NRC, EPA, and DOE) and State (Departments of Health and Environmental Conservation) requirements to consider legal responsibility and authority under different clean-up scenarios.

Lead Investigator of due diligence for the privatization of Nordion by the Canadian Government. Addressed radiological and conventional environmental issues at three sites involved in the handling, packaging, transportation, and use of radioisotopes for irradiation and medical diagnostics. Included in the transfer was an experimental nuclear reactor.

Technical support in preparation of license application for the North Carolina Low-Level Radioactive Waste Disposal Facility. Responsibilities include technical review of dose and performance assessments and related calculations that comprise the Safety Analysis Report.

Project Manager of technical and management assistance contract for the New York State Energy Research and Development Authority (NYSERDA), the agency responsible for construction and operation of New York's LLRW disposal facility. Tasks include planning for interim storage needs, preparing NYSERDA's program plan, and assisting in facility design and licensing.

Technical support of radioactive waste storage study for the New York State Energy Research and Development Authority. Managed the preparation of a Conceptual Design and Cost Estimate for Interim Low-Level Radioactive Waste Storage Facility.

Pathways analyses, risk assessment and calculations of dose commitments for a former uranium fuel fabrication facility. Site characterization and field investigations in support of remedial planning.

Evaluation of remedial alternatives for EPA Superfund site. Risk assessment and calculation of doses to public and workers from remedial operations and post-closure conditions. Use of various computer codes such as RESRAD and ISOSHIELD for pathways modeling and radiation shielding.

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Curriculum Vitae

WILLIAM P. DUGGAN, Ph.D., P.E., C.H.P.

Experience (continued)

Project Manager for URS/Dames & Moore's Basic Ordering Agreement with Brookhaven National Laboratory. Management and technical responsibility for environmental services task order projects, including environmental analyses for high energy physics accelerator projects and asbestos sampling and assessment.

Performance assessment of West Valley Demonstration Project Class B and C LLRW drum cell. Evaluated compliance with 10 CFR Part 61 objectives, particularly with respect to intruder scenarios. Prepared position paper for WVDP use.

Project Manager and Principal Investigator for industrial facility handling material with high radium concentrations. Duties involved assessment, through analysis and sampling, of exposures to workers and the public from radon emanations and particulate dispersion.

Technical support in development of the Environmental Assessment and Safety Analysis Report for the West Valley Demonstration Project. Principal duties include accident analyses and system hazard classification as part of the Safety and Environmental Assessment Group.

Technical support in preparation of a generic Safety Analysis Report for a Low Level Radioactive Waste disposal facility based on below-ground vault technology. Responsibilities included development of the environmental monitoring plan and auxiliary system requirements.

Project Engineer in support of an application for onsite disposal of radioactive waste under 10 CFR Part 20.302. The submittal was the first under the guidance of NUREG 1101.

Engineer, Stone and Webster Engineering Corp., Boston, Mass. Technical support for design and licensing several nuclear power plants, including Millstone-3, Beaver Valley-2, and Shoreham. Principal duties included analyzing containment pressure and temperature transients due to accidents, determining non-accident radiation source term, and evaluation of shielding requirements.

Academic Background

Ph.D., Nuclear Engineering, Rensselaer Polytechnic Institute, 1987.
M.S., Nuclear Engineering, Renssalaer Polytechnic Institute, 1982.
B.S., Nuclear Engineering, Minor: Public Policy Studies
Rensselaer Polytechnic Institute, [redacted]

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Publications	Duggan, W. P. "Pathways Analysis to Establish Clean-up Criteria" Mixed Waste Regulation Conference, Atlanta, GA, June 17-18, 1991 Berlin, R. E., Stanton, C., and Duggan, W. P. "Developing a Graduate Program in Nuclear Waste Management/Facility Restoration" Waste Management '91, Tucson, AZ Feb 24-28, 1991
Professional Affiliations	Professional Engineer, New York State Certified Health Physicist, 1996 American Nuclear Society Health Physics Society American Society of Mechanical Engineers

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CURRICULUM VITAE   LARRY W. LUCKETT, CHP

Title Senior Health Physicist

Expertise Health Physics
Radiological Engineering, Remediation and Decommissioning
Occupational Radiation Protection

Experience Mr. Luckett is a Certified Health Physicist with 29 years experience in the assessment and management of radiological conditions in occupational, environmental, medical and emergency situations in the United States, the Western Pacific, Europe, and the Former Soviet Union. Currently, he provides project management and radiological consultation for radioactive waste management engineering, environmental risk assessment, siting and licensing services. Prior to joining URS-Dames & Moore in 1993, he served as a health physicist with the US Army Medical Service Corps for 22 years, retiring at the rank of Lieutenant Colonel.

Professional History

Analytical Physicist for the radiological characterization of facilities and wastes during decommissioning of the Brookhaven Graphite Research Reactor with the BNL Accelerated Site Technology Deployment Project. Developed a comprehensive QAPP, operating procedures and project specific survey plans based on MARSSIM guidance to implement this innovative technology including the Canberra ISOCS *in situ* gamma spectrometer and the BetaScint Inc field beta radiation/Sr-90 analysis system.

Health and Safety Manager for CERCLA Removal Actions at Brookhaven National Laboratory (BNL to

- excavate, characterize, sort, and dispose waste materials and debris exhumed during the remediation of the Glass Holes and Animal/Chemical Pits Area. Work was performed in Level B protection, and involved radioactive, hazardous, and medical wastes, degraded gas cylinders, and potentially shock sensitive materials.
- characterize, remove, treat and dispose of high level radioactive and mixed hazardous waste sludges from underground storage tanks.

Analyst to develop MARSSIM-based sampling plans for remediation projects at BNL including Landscape Soil Remediation, Bldg 811 Waste Consolidation Facility Remediation, and the OU-V Sewerage Treatment Beds Sampling Strategy.

Analyst of the environmental impact under NEPA of potential accidents, normal operations and clean-up/release criteria for Department of Energy operations at Hanford, Oak Ridge, Los Alamos, and the West Valley Demonstration Project, using codes such as RESRAD, ALOHA™ and CAP88-PC, to assess risks to the environment, to workers and to the public.

Principal Instructor in a professional-level education course on the DOE/DOD/NRC/EPA *Multi-Agency Radiation Survey and Site Investigation Manual*

(MARSSIM) presented to engineering and regulatory support personnel at nuclear power stations undergoing characterization, decommissioning and final status certification.

Developed a validation sampling plan based on the MARSSIM to demonstrate compliance with the clean-up criteria following completion of the D&D efforts at a monzanite processing plant contaminated with thorium, uranium and radium. Familiarity with the MARSSIM during drafting of the manual enabled the incorporation of this guidance into the planning process early in the project, so that effort and expense were not wasted on soon-to-be out-of-date methods.

Project Manager for the evaluation of a 1000-acre area of private properties contaminated by fission products downwind of a nuclear fuel reprocessing facility in Western New York. Performed risk assessment using RESRAD code to demonstrate that the measured concentrations were in compliance with dose-based regulatory release criteria, without needing further remediation. Developed an innovative instrument survey procedure to replace extensive soil sampling and laboratory analysis, thus saving time, effort and expense in project resolution. Managed and interpreted database of 80,000 radiation measurements in the evaluation of the properties.

Health Physicist in a USAF Base Realignment and Closure action for exhumation of six concrete slabs from a low-level radioactive waste burial site. Performed *in situ* analysis to identify and quantify distinct radioactive material sources in the slabs resulting in 7:1 reduction in waste disposal volume. Performed soil and water analyses on site to enable timely site closure and restoration of surface contours.

Organized and executed the health physics portion of a three week field survey of environmental contamination in areas of western Russia impacted by the fallout from the Chernobyl Nuclear Power Station accident, consulting with and advising Russian territorial officials while instructing students in practical environmental monitoring techniques.

Project manager for the inventory and characterization of legacy radioactive and mixed RCRA wastes at Brookhaven National Laboratory. Performed *in situ* high-resolution gamma spectroscopy and modeling using the MicroShield™ code to characterize over 750 pieces and allow disposition of 30,000 cubic feet of waste.

Project manager for recycle and disposition of 700,000 pounds of armor plate contaminated from the impact of depleted uranium armor penetrators at Aberdeen Proving Grounds, MD. Ensured compliance with DOD requirements, NRC license conditions, revised DOT shipping regulations, and waste acceptance criteria at commercial disposal facilities.

Associate Professor in the Department of Physics at the United States Military Academy, West Point, NY. Managed nuclear operations under two Nuclear Regulatory Commission Licenses including a sub-critical assembly of natural uranium, multiple uses of radioactive material sources, and a Van de Graaff particle accelerator. Developed $1.1M program to upgrade equipment in the Physics

Department instructional laboratories, providing state of the art computer, experimental and analytical facilities to enhance student educational experiences.

Senior health physics advisor to DOD Joint Chiefs of Staff for response to nuclear accidents or incidents, Represented the national authority during participation in nuclear response exercises.

DOD Representative on Food and Health Effects Federal Working Group, to evaluate the environmental impact and response to re-entry of Cosmos - 1900, an out-of-control Russian satellite containing a nuclear reactor. Determined action criteria, survey instruments and procedures for county and state emergency forces responding to nuclear contamination.

Chief Health Physicist in an Environmental Engineering Group providing radiation consultation services to U.S. Army units throughout Europe. Directed a staff of five health physicists and two technicians conducting on-site radiation safety evaluations of health care and industrial facilities using nuclear material, x-ray, laser, and microwave radiation sources.

Consulted with Federal and international authorities in an extensive evaluation of the impact on US facilities and personnel in Europe from radioactive fallout after the Chernobyl Nuclear Power Station accident.

Team Leader of the DOD Radiological Advisory Medical Team; deployed to Moscow, USSR in May 1986, to advise US Ambassador Hartman on hazards to US personnel in the Soviet Union immediately following the accident at the Chernobyl Nuclear Power Station.

Devised and conducted periodic training courses for safety and health care professionals in topics of: Nuclear Weapons Accident Response Procedures; Radiation Protection Officer Course for Safety Personnel; Radiological Health for Medical Personnel; and Handling Contaminated Patients in the Emergency Room.

Diagnostic Radiological Physicist, Walter Reed Army Medical Center. Consulted with Radiology Staff on physical principles of radiation production, interaction, detection and quality assurance to ensure high level of patient care. Evaluated patient dosimetry from exposures to routine and special diagnostic x-ray examinations.

Occupational Health and Safety oversight to audit radiation safety and ALARA activities at Enewetak Atoll, Marshall Islands for Project CLEAN-UP, during DOD site remediation of atomic bomb test range to return the islands to native inhabitants.

Health Physicist for 650-bed teaching hospital, responsible for all aspects of health and safety in the utilization of radiation sources in diagnostic and therapeutic patient care and in medical research. Managed radioisotope usage under two Nuclear Regulatory Commission licenses, a Broad-scope Human Use License and a Teletheraphy (Cobalt-60) Human Use License.

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Academic Background

Ph.D., (Candidate), Nuclear Engineering, Rensselaer Polytechnic Institute, Troy, NY
M.S., Nuclear Engineering/Health Physics, Texas A&M University, 1973.
B.S., Physics, *cum laude*, Trinity University, Texas, [redacted] Ex. 6

Other Training

Comprehensive Health Physics, American Board of Health Physics, 1982
(Re-certified 1986, 1990, 1994, and 1998)
DOE Radiological Worker Training (I and II)
OSHA Hazardous Materials Worker (40 hrs), Annual Refresher (8 hrs)
OSHA Hazardous Waste Site Supervisor Training (8 hrs)
Update to Revised DOT/NRC Transportation Regulations 1997

Publications

"Deployment of *in situ* Measurement Techniques and the MARSSIM Process for Characterization of the Brookhaven Graphite Research Reactor", presented to *Waste Management 2000 Conference,* Tucson, AZ, Feb 2000 (P. Kalb, L. Milian, C. Gogolak, and D. Watters).

"Operation *Chernobyl Challenge*: The Public Health Response by U.S. Military Forces in Europe", presented to *International Radiological Post-Emergency Response Issues Conference*, USEPA, Washington, DC, Aug 1998 (E. Daxon and J. Parker).

"Determination of Site Status in an Evolving Regulatory Environment", presented to *Waste Management '97*, Tucson, AZ, March 1997. (M. Willett).

"Radionuclides in River Sediments in Western Russia", presented to *38th Annual Meeting*, Health Physics Society, Atlanta, GA, July 1993. (W. Chess and C. McGowan).

"Participation in Coordinated Federal Response Planning for the Re-Entry of COSMOS-1900", presented to *Annual Research Review*, Armed Forces Radiobiology Research Institute, Bethesda, MD, Sept, 1989.

"Radiological Considerations in Medical Operations", in Textbook of Military Medicine, Part I, Volume 2, Medical Consequences of Nuclear Warfare, edited by R.I. Walker and T.J. Cerveny, pp. 227-244. Washington, DC: Office of the Surgeon General, US Army, 1989. (B.E.Vesper).

"Site Restoration Planning at the US Army Service Response Force Exercise, 1988", presented to *Conference on Physics in Military Medicine*, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD, Oct, 1988.

"Radiological Monitoring Mission: MOSCOW", presented to *31st Annual Meeting*, Health Physics Society, Pittsburgh, PA, July 1986. (J. Bliss, M. Pacilio, M. Strang, and J. Wempe).

Professional Affiliations

American Nuclear Society (Life Member)
American Association of Physicists in Medicine
American Academy of Health Physics
Society of Nuclear Medicine
Health Physics Society

Curriculum Vitae

CAROL J. SCHOLL, C.P.G.

Title Senior Geologist

Expertise Geology
Groundwater Hydrology

Academic Background Course work toward Ph.D. with emphasis on Geochemistry and Mineralogy, Miami University-Oxford
M.S. (1970) Geology, Miami University-Oxford
B.S [redacted] Geology, Kent State University-Ohio

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Registration Certified Professional Geologist: Indiana (#1188), Kentucky (#2068)

Experience Provides consultation on geologic and groundwater aspects of the firm's hazardous waste, nuclear, and mining projects.

- Investigation and remediation of environmentally impacted sites. Assists upper management with training staff, reviews and edits reports to ensure Dames & Moore standards are maintained, and implements technical improvements in field and office procedures.
- Designed and managed several field investigations involving chlorinated solvent contaminated soil and ground water; discrete delineation of aquifer quality expedited the choice of the remedial measures; several of the sites have been either partially or completely remediated.
- Evaluated data bases for two sites owned by a chemical manufacturer in Illinois with the objective of assessing if the facilities are in compliance with state corrective action objectives.
- Assisting in the implementation and evaluation of natural attenuation studies for major clients with petroleum and/or chlorinated-solvent impacted sites; studies are on going.
- Assisted client with post-closure permitting requirements for a closed facility situated in a karstic limestone terrain.
- Received auditor training from Dames & Moore's Quality Assurance Manager.
- Managed the initial phases of a RCRA facility investigation in central Indiana and provided consultation and management on the IRM requiring sampling and reporting the water quality of private wells within the community.
- Coordinated data validation of CLP-type data package for a USACE site in New Jersey and provided data validation for CLP data from a Michigan NPL site.
- Investigated environmental impacts to soil and groundwater quality from the operations of an adhesives and mastics manufacturing facility in northern Illinois. A feasibility study of potential remedial options was carried out. Plans for a pilot test of the chosen remedial measure are in progress.
- Provided consultation on a proposed IRM for a closed copper recycling facility in northern Illinois. The IRM involves capping the site, installation of a cut-off wall and pumping and treating the groundwater.

- Managed RI/FS for NPL site located in central Michigan. Contaminants include trichloroethene, 1,2-dichloroethene, 1,1-dichloroethane, and benzene which have contaminated some of the potable wells in the municipal well field area.

- Designed and managed the first phase of a field investigation to determine the contamination source of a potable municipal well contaminated with chlorides, ammonia, and heavy metals.

Project Geologist

- Performed cost-effectiveness analyses of alternate disposal methods for hazardous waste contaminated soils.

- Designed and managed hazardous waste field investigations at United States Air Force installations in seven states. Program involved managing interdisciplinary field teams in the acquisition of groundwater, surface water, soil and air samples. Hazardous materials included fuels, solvents, trace metals, pesticides, and byproducts of waste treatment plants. Sites investigated included landfills, fuel spill sites, pesticide application areas, Sewage treatment plants, and underground tanks and line leaks.

- Managed field investigation to assess the environmental impacts of the uncontrolled disposal of heavy metals and industrial wastes in till plain soils.

Staff Geologist

- Planned and managed a hydrogeologic investigation of a waste management facility for a petrochemical firm.

- Performed environmental assessments on the impacts of landfills to the environment.

- Designed and managed a field investigation involving in the impact of a chemical process facility on groundwater and surface water quality.

- Prepared personnel safety plans for investigations at hazardous waste sites.

- Dames & Moore's Group Contract Coordination for the Electric Power Research Institute's Seismic Risk Hazard Analysis Program, Region 2.

- Prepared responses to questions posed by the NRC concerning faulting studies for a nuclear power plant in southern Indiana.

Assistant Geologist

- Assisted in the compilation and reduction of groundwater data for PSARs for three nuclear power plant sites (NPPS).

- Participated in detailed field structural geological studies of a NPPS in Pennsylvania.

- Performed geological and groundwater investigations of a NPPS contaminated by industrial wastes.

- Performed engineering geological duties during rock coring and soil sampling program ant a NPPS in northwestern Illinois.

- Assisted in reduction of groundwater data for a hydrologic study of a proposed coal strip mine in eastern Montana.

Professional History

Senior Geologist, Dames & Moore, Inc., Chicago, Illinois (1988 to Present)
Project Geologist, Dames & Moore, Inc., Chicago, Illinois (1987 to 1988)

Staff Geologist, Dames & Moore, Inc., Chicago, Illinois (1983 to 1987)
Assistant Geologist, Dames & Moore, Inc., Chicago, Illinois (1973 to 1975)
Group Programs Head, Field Museum of Natural History, Chicago, Illinois (1977 to 1979)
Instructor of Geology, Field Museum of Natural History, Chicago, Illinois (1976 to 1979)
Graduate Teaching Fellow, Associate, and Teaching Assistant, Miami University, Oxford, Ohio (1970 to 1972)

Citizenship United States

Countries Worked In United States

Language Proficiency English

Professional Affiliations American Association for the Advancement of Science
National Water Well Association

AREAS OF EXPERTISE

- Geotechnical Engineering
- Site Investigations and Remediation Assessments
- Hazardous Waste Management

EDUCATION

University of Colorado, Ph.D., Geotechnical Engineering, 1984

National Taiwan University, M.S. Civil Engineering 1979

National Central University, B.S. Civil Engineering [redacted] Ex.6

REGISTRATION

Professional Engineer: Illinois, Indiana, Colorado, Michigan, Minnesota, Taiwan

PROFESSIONAL HISTORY

Principal-In-Charge/Senior Engineer, Dames & Moore, Inc., Chicago, Illinois (1987 to Present)

Geotechnical Engineer, Battelle Project Management Division, Office of Nuclear Waste Isolation Project, Columbus, Ohio (1986 to 1987)

Geotechnical Engineer, Chen & Associates,

REPRESENTATIVE EXPERIENCE

Principal-in-Charge and Senior engineer on geotechnical and environmental studies pertaining to engineering investigations for industrial plants, water tanks, chemical storage tanks, wastewater treatment plants, bridge structures, roadways and roadway structures, nuclear power plants, building structures, and transmission mains; dynamic analyses for machine foundations; seismic and liquefaction analyses for industrial sites and structures; geotechnical modeling for soil-structure interaction problems and groundwater flow; development of work plans and engineering design for cleanup of hazardous waste contaminated sites.

Geotechnical Site Investigations

- Conducted a site engineering study for a gas processing and storage facility in Chicago area, which includes site survey, geotechnical investigation, seismic study, stormwater/flood analysis and wind analysis.
- Conducted a preliminary geotechnical investigation for an electric generating station in central Ohio and provided foundation design and site development recommendations.
- Conducted a geotechnical site investigation for a cogeneration plant in Syracuse, New York.
- Established foundation recommendations for waste treatment plants in California. Major concerns centered on the reduction of differential settlement for large tank mats and the behavior of foundation subjected to earthquake.
- Conducted geotechnical and environmental site investigations for several new oxygen plants for Liquid Carbonic Corporation in Connecticut and Wisconsin including the development of foundation recommendations for several liquid oxygen/liquid nitrogen tanks.
- Conducted geotechnical investigation, dynamic analysis and machine foundation design for two gas compressor stations for ANR Storage Company in Michigan and New York.
- Conducted geotechnical investigations and developed foundation recommendations for five 5- to 7.5 million-gallon water storage standpipes for DuPage Water Commission with tank diameters ranging from 80 to 112 feet and design water loads ranging from 6,400 psf to 9,900 psf. Ring wall foundations were proposed for these five standpipes.
- Conducted geotechnical investigations and developed foundation recommendations for several 2.5 to 4.0 million-gallon elevated water storage facilities for the Village of Woodridge and Lisle in Illinois.

Denver, Colorado (1984 to 1986)

Geotechnical Engineer, Moh & Associates, Taipei, Taiwan (1977 to 1979)

- Conducted dynamic analysis and machine foundation design for an air compressor to be founded on granular fill for AT&T in Illinois.
- Conducted seismic analysis for a power plant founded on alluvial deposit in the southern part of Taiwan.
- Conducted liquefaction analyses for industrial plant sites and seismic analyses for retaining structures.
- Developed deep foundation recommendations for a bridge and provided geotechnical recommendations for a braced excavation for Martingale Road Extension Project in Schaumburg, Illinois.
- Conducted subgrade improvement design using expanded polystyrene foam (EPS) in a thick peat deposit for both Randall Road Improvement Projects in McHenry County, Illinois and Atkinson Road Improvement Project in Grayslake, Illinois.
- Investigated the causes of building and structure distress and conducted underpinning design for a cement plant built on collapsible soils in Utah. Also developed pile foundation design and pile driving criteria, supervised the construction of pile foundation, and conducted static and dynamic pile loading tests. Conducted dynamic analysis and evaluated foundation vibration for a heavy rotating kiln founded on pedestals.
- Conducted soil bearing capacity evaluation for interim radwaste storage facilities for LaSalle County, Quad Cities, and Zion Nuclear Power Stations for Commonwealth Edison.
- Investigated the cause of subgrade subsidence of an industrial plant in Milwaukee, Wisconsin, and provided floor slab and foundation underpinning recommendations.
- Developed large-diameter drilled pier foundation recommendations for several high-rise buildings in Denver, Colorado and Chicago, Illinois.
- Developed geotechnical concepts and prepared design plans for four FGD waste impoundments in Ohio.
- Developed geotechnical recommendations for an 11-mile section of a major transmission main.
- Developed geotechnical recommendations for several high-rise buildings founded on soft soil formations and conducted retaining structure and slurry wall design for deep excavations with shallow water table.
- Developed foundation recommendations for structures founded in swelling clay in Denver, Colorado.

Site Investigation and Remediation Assessments

- Conducting environmental site investigations for numerous existing gas stations and environmental baseline study for several new gas stations.
- Conducting Phase II environmental site investigations and managing site remediation for numerous voluntary cleanup projects under the Illinois Site Remediation Program. Remediation technologies used include low temperature thermal desorption (LTTD), soil vapor extraction, groundwater pump-and-treatment, natural attenuation, excavation for off-site disposal, and installation of engineered barriers. Dr. Sheu has successfully negotiated more lenient cleanup objectives for the site soil and ground water using the RBCA three-tiered approach established by the Illinois Environmental Protection Agency.
- Providing turnkey services for remediating petroleum and chlorinated solvent impacted soils by using low temperature thermal desorption treatment for several industrial clients in Illinois and received No Further Remediation letters for the project sites from the Illinois EPA.
- Conducting soil and ground water remediation by using vapor and groundwater extraction systems for two chlorinated solvent-contaminated sites in Oxford, Michigan and Western Springs, Illinois.
- Managing remedial action programs for several leaking underground storage tank and voluntary cleanup sites in Illinois, Indiana, Iowa, Minnesota, Michigan, and Wisconsin.
- Conducting predesign investigations for remediating two Superfund sites with chlorinated solvent and metal contamination in Ashippun, Wisconsin and Buena Borough, New Jersey.
- Conducting remedial design for a Superfund site in Buena Borough, New Jersey for remediating soil and water contamination with chlorinated solvent.
- Conducting engineering design and construction management of RCRA surface cover system installation on several impoundments in Ohio and Illinois.

- Developing a work plan and coordinating the contractors for in-situ air stripping remediation at an industrial site in Mississippi
- Conducting subsurface investigations and developing corrective action plans for several leaking underground storage tank sites.
- Managing environmental assessment projects for numerous industrial and commercial clients.
- Developing a work plan and conducting construction management for PCB-contaminated site remediation in Mentor, Ohio
- Conducting on-site investigations and developing remediation work plans for several industrial sites in Illinois.
- Conducting secondary containment system design and construction for above-ground storage tanks for an industrial client in Illinois.

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Curriculum Vitae

Kevin D. Sullivan, P.E.

Title	Project Civil/Geotechnical Engineer
Expertise	Project Management Design and Remediation
Experience	12 years experience.

Professional History

Design Engineer for a USEPA Superfund Site Remedial Design project involving excavation, removal, and offsite disposal of 11,000 cubic yards (cy) of radionuclide impacted soils and 23,000 cy of metals impacted soils; decontamination of site buildings; and design of remedial action support surveys and final status surveys to clear the site for unrestricted future use in accordance with MARSSIM guidelines.

Construction Project Manager for a $2 million project involving filling a 1-mile long abandoned drinking water intake tunnel (through bedrock, 50 feet below water level) with cement-bentonite grout. Work involved installation of grout pipes throughout the mile-long tunnel, preparation and placement of 1.3 million gallons of grout, demolition of intake structures, and drilling/boring to verify grout placement. Organized and directed subcontractors, cost control, point-of-contact for all involved parties.

Construction Project Manager for a $3 million project involving a landfill perimeter drain replacement. Work involved utilization of horizontal directional drilling, braced trench excavation, and biopolymer trench excavation methods for drain pipe replacement. Organized and directed subcontractors, plant and utility interruptions, cost control, point-of-contact for all involved parties, prepared O&M Plan, and coordinated startup of monitoring activities.

Senior Project Engineer for design and construction of a groundwater extraction/treatment system, site capping, injected barrier wall, wetlands remediation, storm sewer replacement, and soil vapor extraction system for an operating facility. Construction Engineer for the $2 million project completion including enforcement of design project specifications, and client/contractor/agency liaison.

Project Manager for the preparation of design drawings and specifications for a shallow drain collection system at a Pennsylvania hazardous waste site. Coordinated construction including securing subcontractors and staffing project.

Curriculum Vitae

Kevin D. Sullivan, P.E.

Professional History (cont.)

Provided site engineering and project management for client on various projects including:

- Installation of bedrock aquifer purge, treatment, and recirculation network and source control system
- Excavation, transportation, and disposal of 35,000 cubic yards of hazardous waste soil
- Remediation of a contaminated sewer including installation of 1,000 feet of new HDPE sewer pipe and manholes
- Performance of a precipitation infiltration/runoff study and evaluation of abnormally high seasonal flows in a perimeter overburden collection system. Study resulted in several conclusions and recommendations, including installation of a low permeability overburden barrier wall
- Production of weekly reports documenting progress, accumulated costs, and budget consumption

Project Engineer for design of 7-acre composite landfill cap including pregrading cut and fill calculations, landfill design calculations, construction specifications, and design drawing revisions.

Project Engineer for design of a 60+ acre landfill closure project involving import of 200,000 cubic yards of clean fill, construction of a 10,000 linear foot perimeter barrier wall/overburden drain tile collection system, construction of a 3,500 linear foot storm sewer system, and final cap installation.

Assisted in design of seep collection and treatment system for waste dump site.

Prepared design and report for groundwater treatment plant capacity upgrade.

Prepared evaluation of non-destructive pipe testing techniques to client; provided oversight of laboratory.

Provided engineering and site management at an industrial facility for a client during various projects:

- Demolition of approximately 20 process buildings including process piping and tanks, production of weekly reports documenting progress, accumulated costs, and budget consumption
- Development of construction specification for the installation of a sewer bedding plug/contaminant collection system

Professional History (cont.)

- Development of work plan, drawings, and schedule for the relocation of major utilities to allow a slurry wall installation to proceed without interruption
- Updating of surface characteristics drawings and estimated plant wide runoff coefficients

Prepared RI/FS Work Plans and FS Reports including development of objectives and screening of alternatives for New York State hazardous waste sites.

Provided engineering and site management for client in excavation of 3,000 cubic yards of contaminated soils and removal and disposal of 75,000 gallons of arsenic contaminated water; negotiated rates and secured construction and disposal contractors, performed contract administration and provided contract change orders; provided cost control and produced final construction report following project.

Prepared site-specific reviews (for 10+ sites) of potentially applicable innovative technologies to be used as primary or supplemental remedy. Technologies included chemical oxidation, permeable reactive walls, bioremediation, air/chemical injection, constructed wetlands.

Provided design of reinforced concrete components for a groundwater treatment building.

Provided site and engineering services for a client during various projects including:

- Design of a groundwater extraction and tank car loading system
- Development of the O&M manual for the constructed groundwater extraction and tank car loading system
- Development of options and costs for solutions to on-site and off-site drainage problems
- Setup and performance of bedrock aquifer pumping tests

Project engineering for a facility-wide sewer video inspection and integrity evaluation program; performed QA/QC and health and safety supervision.

Provided civil drawings and specifications detailing the addition of a locker/wash room to an existing facility.

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Curriculum Vitae

Kevin D. Sullivan, P.E.

Academic Background	B.Sc. Civil Engineering, State University of New York at Buffalo, [redacted] Ex. 6
Professional Affiliations	Professional Engineer, State of New York