ENERGY*SOLUTIONS*

Attachment G

Environmental Monitoring Plan (Draft)
December 15, 2008

ENVIRONMENTAL MONITORING PLAN (DRAFT)

1.0 PURPOSE AND SCOPE

Purpose: The purpose of the Environmental Monitoring Plan is to provide a comprehensive plan for monitoring radiation and radioactive emissions to the environment. This information will be used to verify regulatory compliance and evaluate the effectiveness of measures to control the environmental impact of disposal operations.

Scope: The scope of this plan includes the activities Energy*Solutions* performs to monitor the Clive site and surrounding areas to determine and report the release of radioactive material to the surrounding environment from its operations. The details of this plan include the applicable assumptions, tested parameters, and testing methods that collectively express regulatory compliance with regard to radioactive emissions and non-occupational radiation doses.

With the exception of the PCB soil sampling this plan does not include occupational, chemical, or groundwater monitoring requirements.

2.0 REFERENCES

Clive, *Radiation Protection Program*, Salt Lake City, Energy*Solutions,* Inc, Utah, As Revised.

ICRP Publication 30, *Limits for the Intake of Radionuclides by Workers*, Annals of the International Commission on Radiation Protection Vol. 19, November 1978.

ICRP Publication 60, *Recommendations of the International Commission on Radiation Protection*, Annals of the International Commission on Radiation Protection Vol. 21 No. 1-3, 1990.

ICRP Publication 65, *Protection against Radon-222 at Home and at Work*, Annals of the International Commission on Radiation Protection Vol. 23 No. 2, 1993.

ICRP Publication 66, *Human Respiratory Tract Model for Radiation Protection*, Annals of the International Commission on Radiation Protection Vol. 24, 1994.

ICRP Publication 68, *Dose Coefficients for Intakes of Radionuclides by Workers*, Annals of the International Commission on Radiation Protection Vol. 24 No. 4, 1995.

ICRP Publication 72, *Age-dependent Doses to Members of the Public from Intake of Radionuclides*, Annals of the International Commission on Radiation Protection Vol. 26 No. 1, 1996.

Regulatory Guide 1.86, *Termination of Operating Licenses for Nuclear Reactors*, United States Nuclear Regulatory Commission, 1974

NRC Regulatory Guide 3.64, *Calculation of Radon Flux Attenuation by Earthen Uranium Mill Tailings Covers*, United States Nuclear Regulatory Commission, 1989

NRC Regulatory Guide 4.14, *Radiological Effluent and Environmental Monitoring at Uranium Mills*, United States Nuclear Regulatory Commission, 1980

NRC Regulatory Guide 4.15, *Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, United States Nuclear Regulatory Commission*, 2007.

NRC Regulatory Guide 4.20, *Constraint on Releases of Airborne Radioactive Materials to the Environment for Licensees Other Than Power Reactors*, United States Nuclear Regulatory Commission, 1996.

NRC Regulatory Guide 8.34, *Monitoring Criteria and Methods to Calculate Occupational Radiation Doses*, United States Nuclear Regulatory Commission, 1992.

NRC Regulatory Guide 8.37, *ALARA Levels for Effluents from Materials Facilities*, United States Nuclear Regulatory Commission,1993.

10 CFR Part 20, *Standards for Protection Against Radiation*, United States Nuclear Regulatory Commission, As Revised.

10 CFR Part 40, *Domestic Licensing of Source Material*, United States Nuclear Regulatory Commission, As Revised.

49 CFR.173.428, *Empty Class 7 (radioactive) materials packaging*, United States Department of Transportation, As Revised

49CFR 173.443, *Contamination control*, United States Department of Transportation, As Revised

Utah Administrative Code, R313-15, *Standards for Protection against Radiation*, As Revised.

Utah Administrative Code, R313-25, *Requirements for the Land Disposal of Radioactive Waste*, As Revised.

3.0 DEFINITIONS

Activity Mean Aerodynamic Diameter (AMAD): Fifty percent of the activity in the aerosol is associated with particles of aerodynamic diameter greater than the Activity Mean Aerodynamic Diameter.

As Low As Reasonably Achievable (ALARA): Reasonable effort to maintain exposures to radiation as far below the dose limits as is practical consistent with the purpose for which the licensed activity is undertaken. The determination of what is "reasonable" considers; the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations.

Non-contaminated Restricted Area Exits: A gate in the Restricted Area Security fence used to exit directly from a Non-contaminated Restricted Area.

Committed Dose Equivalent (CDE): The dose equivalent to organs or tissues from an intake of radioactive material by an individual during the 50-year period after intake.

Committed Effective Dose Equivalent (CEDE): is the sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues.

Controlled Area: an area, outside of a restricted area but inside the site boundary, access to which can be limited by the licensee for any reason.

Deep Dose Equivalent (DDE): applies to external whole-body exposure, is the dose equivalent at a tissue depth of 1 cm (1000 mg/cm^2).

Dose Coefficient: Factors determining the radiation exposure of individual organs and the whole body by incorporated radioactive substances. Dose factors depend on the radionuclide, the incorporation type (inhalation/ingestion), the chemical compound of the radionuclide and on the age of the person.

Effluent Concentration Limit (ECL): Radionuclide which, if inhaled or ingested continuously over the course of a year, would produce a stochastic total effective dose equivalent of 50 mrem. With the exception of radon-220 (radon) and radon-222 (thoron), the dose coefficients from International Commission on Radiation Protection Publication 68 and International Commission on Radiation Protection Publication 72 were used to calculate effluent concentration limit values. The Dose Coefficients used assume a 50 year CEDE and a 1 um AMAD particle size. International Commission on Radiation Protection Publication 65 "Protection against Radon-222 at Home and at Work" was used to calculate the Radon ECL and the thoron ECL was taken from 10CFR20. Table 3 lists the "ECL" values for several licensed radionuclides, and provides additional details regarding the ECL derivation process.

Member of the Public: A member of the public as defined by UAC, R313-15-301 is "any individual except when that individual is receiving an occupational dose". A member of the public as applied to Utah Administrative Code R313-15-101(4), and Utah Administrative Code R313-25-19 is unassociated with Site operations and located outside controlled area boundaries.

Minimum Detectable Concentration (MDC): the smallest radioactivity of radioactive material in a sample that will yield a net count (above system background) that will be detected with 95% probability with only 5% probability of falsely concluding that a blank observation represents a "real" signal.

Occupancy Factor: The fraction of time a person may have occupied a space or area having a known quantity of exposure. The exposure rate is assumed to be fairly constant for the entire exposure period.

Particulate Air Sample (PAS) Action Levels: Airborne particulate alpha or net beta concentration used to insure that the PAS results remain below the ECL. The alpha action level is 1.4E-13 uCi/ml, based on the thorium-230 Class S effluent concentration limit, and the beta action level is 2.1E-12 uCi/ml, based on the lead-210 Type F effluent concentration limit.

In the past the alpha PAS action level was based on the Th-232 ECL. While Table 3 of the Environmental Monitoring Plan indicates that Th-232 is more restrictive, Th-232 is always accompanied by several alpha emitting decay progeny at or near secular equilibrium with the Th-232 parent. The Th-232 ECL must be adjusted to account for the alpha emitting daughters when it used as the PAS Action Level. For this reason the Th-230 ECL is more restrictive.

Regulatory Guide 3.51 states that thorium in ore, yellowcake, and tailings dusts is 100% class Y, which is consistent with most of the waste containing Th-230. Class "Y" under the ICRP 30 system is analogous to type "S" under the newer ICRP recommendations.

Radiological Release: Survey, documentation and actions as required to meet the following:

- DOT Empty Release, in accordance with 49CFR173.428.
- Return to Service Release, in accordance with 49CFR173.443
- Unrestricted Use Release, in accordance with NRC Regulatory Guide 1.86

Replicate Error Ratio (RER): The difference between two different analytical results divided by the statistical sum of their analytical uncertainty. The value is used to assess amount of agreement between two different analytical results with respect to their analytical uncertainty.

$$RER = \frac{|A-B|}{\sqrt{\sigma_A{}^2 + \sigma_B{}^2}}$$

Where:

A = First analytical result.

B= Second analytical result

s_A= Reported analytical uncertainty for the first sample.

s_B= Reported analytical uncertainty for the second sample.

Restricted Area: An area where access is limited by the licensee for the purpose of protecting individuals against undue risks from exposure to radiation and radioactive materials. The fenced area that includes the disposal embankments and associated radioactive waste handling areas is generally referred to as the Restricted Area.

Soil Action Levels: 5 pCi/g by gamma spectroscopy for a naturally occurring radionuclide (other than potassium-40), 3 pCi/g cesium-137, or 2 pCi/g for any other radionuclide.

Total Effective Dose Equivalent (TEDE): The sum of the deep-dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Vacuum Assisted Thermal Desorption (VTD): Treatment used to extract volatile contaminants from Mixed Waste. The VTD unit is located in the Mixed Waste Storage Building.

4.0 DESCRIPTION

The Site is located in the semi-arid west desert of Utah. The surrounding region is restricted by zoning statute for exclusive use by the hazardous waste industry. The closest residents are the live-in care takers at the I-80 rest stop, seven miles northeast of the Site.

The disposal site is a parcel of land, consisting of one square mile in Tooele County, Utah. Energy*Solutions* also owns the adjacent one square mile section of land to the North and an adjacent 0.5 square mile section of land to the south. The disposal site is used for unloading, hauling, processing, treatment, and disposal of radioactive material and mixed waste. Operations requiring the handling of radioactive material and mixed waste are limited to the Restricted Area. The Restricted Area is completely surrounded by fence. There is a buffer area of 100 feet between the Restricted Area fence and the foot print of any embankment. There is also a secondary buffer area of 300 feet between the closest edge of any embankment and the property line. Most of the other land within a 10 mile radius of the site is public domain administered by the Bureau of Land Management. The dry arid desert limits use of the land to sheep grazing, jack rabbit hunting, and recreational driving.

The site boundaries are under continuous electronic surveillance by a full-time security staff. This security staff physically patrols the site boundary several times during each 24 hour period. Any unauthorized individuals found near the controlled area are advised by the security staff not to loiter near the Site.

4.1 EXPOSURE PATHWAY: INGESTION

Regulatory Guide 4.14 states that vegetation and surface water samples should be collected "Where a significant pathway to man is identified in individual licensing cases." Because there is no significant ingestion pathway, vegetation and surface water samples are not taken.

The site has no nearby residents or crops. The groundwater is not suitable for irrigation, or consumption by either humans or animals. Surrounding vegetation is accessible to grazing animals but the sparse foliage and water sources are not adequate to keep livestock near the site.

There are no natural bodies of surface water near the site, and storm water quickly evaporates from the puddles which appear temporarily in shallow depressions following precipitation events. There is no natural drainage of this storm water away from the site area, and the facility design precludes runoff outside the approved waste management areas.

Administrative procedures require an immediate response to promptly characterize and remediate any suspected radioactive liquid found anywhere outside of the approved liquid waste management areas. Any incidental deposition of effluent radionuclides outside of the restricted areas is easily detected by soil sampling.

4.2 EXPOSURE PATHWAY: EXTERNAL RADIATION

External radiation to members of the public is limited to gamma radiation. The potential sources of radiation include the waste disposal cells, waste unloading areas, treatment areas, storage pads, the railcar rollover, the rotary dump, the shredder, the laboratory, the Clive Processing facility (CPF), and haul roads. Historically, external radiation contributes a small fraction of the off-site dose.

External radiation is monitored at designated air stations located along the Restricted Area boundaries. In addition, monitors are set up, as needed, inside buildings and on the Restricted Area fence to ensure compliance with the regulations.

4.3 EXPOSURE PATHWAY: INHALATION

Direct inhalation of radioactive airborne particulates, radon, and thoron has the highest potential for off-site dose. Sources of inhalation exposure particulates include the rollover, the rotary dump, the shredder, rail car unloading area, bulk waste storage areas, haul roads, the VTD, the CPF, and waste disposal cells.

Airborne radioactive particulates and gasses are continuously monitored at designated monitoring stations. With the exception of locations used to establish background and the VTD effluent monitoring station, the monitored locations are situated near the fenced boundaries that surround waste management areas. The overall sampling pattern is designed to intercept airborne radioactive effluents leaving the site in any direction. The airborne exposure measured at these monitoring stations is used to calculate the dose received from Site airborne effluents.

4.4 DOSE LIMITS

The exposure limits for the disposal facilities are contained in Utah Administrative Codes (UAC), R313-15-301, R313-15-101(4), and R313-25-19 to demonstrate compliance. The dose limits in UAC R313-15-301 and the ALARA Constraint limit in UAC R313-15-101(4) also apply to the CPF effluent. Energy*Solutions* uses the air monitoring stations located around the Restricted Area boundary to determine the radioactive exposure to the environment from the disposal facilities and the CPF.

Environmental exposure is calculated by multiplying the measured dose, CEDE, TEDE or CDE, at the air monitoring stations by an occupancy factor. The occupancy factor should be a conservative estimate of the time a person may have been present at the location where the exposure occurs. To demonstrate compliance, the TEDE results are compared directly with the UAC R313-15-301 limit to demonstrate compliance. The TEDE results excluding, radon-222 and its decay products, is used to demonstrate compliance with the ALARA constraint limit in UAC R313-15-101(4).

The maximum CDE dose excluding the exposure contribution from the CPF effluent is used to demonstrate compliance with UAC R313-25-19. The CPF effluent contribution is determined by multiplying the measured CPF Stack 1 CDE by the diffusion calculated each quarter using ISO-AERMOD software. The largest value from the net CDE measured at each station and the Stack 1 CDE is used to demonstrate compliance with UAC R313-25-19.

The assumption and methods used to determine the occupancy factor are described in Energy*Solutions*' ALARA Program document.

4.4.1 UAC R313-15-101(4) ALARA Constraint

This regulation requires meeting a constraint of 10 mrem per year CEDE to the individual member of the public, located outside the Site boundary, who is likely to receive the highest dose from effluent air emissions. Regulatory Guide 4.20, "Constraint on Releases of Airborne Radioactive Materials to the Environment for Licensees other than Power Reactors", outlines the acceptable methods for demonstrating compliance with this regulatory requirement. Energy*Solutions* will employ one or more of the general techniques in Reg. Guide 4.20 to demonstrate compliance.

4.4.2 UAC R313-15-301 Public Dose limits

This regulation requires that the TEDE to individual members of the public from licensed or registered operations does not exceed 100 mrem in a year. Compliance is determined using one of the approved options presented in UAC R313-15-302.

4.4.3 UAC R313-25-19 Public Dose limits

The radioactive material which may be released to the general environment shall not result in an annual dose exceeding 25 mrem to the whole body, 75 mrem to the thyroid, and 25 mrem to any other organ of a member of the public. Compliance is demonstrated by calculating the CDE multiplying the airborne monitoring results measured at each of the air monitoring stations by an occupancy factor, which is representative of a member of the public located outside the Site Boundary.

5.0 OPERATIONAL REQUIREMENTS

5.1 AIR SAMPLING

5.1.1 AIRBORNE PARTICULATES - Alpha/Beta Screening

Air is continuously sampled at the sample locations, listed in Table 1 and Drawing 07007-J01, Revision 4, with the exception of the VTD effluent which is only sampled during VTD operation. The stations located around the Restricted Area perimeter are used to determine the airborne concentration of radioactive particulates from disposal operations. Station A-16, located west of the Site, at the Clean Harbors Clive facility, is used to determine background.

Radioactive airborne particulate samples are collected using a constant-flow air sampler to draw air through a glass fiber filter, or a functionally

similar particulate sampling media. The particulate air sampling apparatus maintains a flow rate of approximately 60 liters per minute through the filter media. The airborne particulate sampling filters are changed twice weekly under most circumstances. When holidays or other production stoppages limit radioactive waste handling or disposal operations to three days or less during any calendar week, the particulate filters collection may be reduced to once a week.

All particulate filters are analyzed for alpha and beta activity at least 7 days but not more than 14 days after collection. The delay of 7 days is needed to allow for the decay of short-lived radon progeny that could potentially interfere with detecting the long-lived contaminants of concern. The time limit of 14 days is to ensure that samples are analyzed in a timely manner. With the exception of the VTD sample, the alpha and beta concentration measured at Station A-16 is subtracted from the concentrations measured at the other stations. If for some reason the data from A-16 is not available or is indeterminate, no background will be subtracted for the samples collected during the sampling period, so the gross concentrations will be used instead of the net concentrations.

Any individual sample filters with a net alpha or net beta concentration above the applicable PAS Action Level will be analyzed by gamma spectroscopy within 3 working days of the alpha/beta analysis. Gamma spectroscopy analysis results will be reviewed to determine if any additional actions need to be taken.

When an individual filter has a net alpha concentration above 3E-12 uCi/ml or net beta concentration above 5E-11 uCi/ml (approximately 25 times the PAS Action Level, based on 25 or 26 filters per quarter per location), additional radiochemical analyses will be performed on that filter according to the requirements for quarterly composite filters, unless gamma spectroscopy associates at least 50 percent of the net alpha or net beta activity present on the filter with gamma-emitting radionuclides.

5.1.2 AIRBORNE PARTICULATE – Quarterly Composite

All particulate air sample filters collected during the quarter are gathered into a composite sample for each air monitoring station. Each composite sample is analyzed by gamma spectroscopy using either the on-site instruments or one of the qualified contractor laboratories. The composite samples (with the exception of VTD) will also be analyzed specifically for uranium-238 (U-238), uranium-234 (U-234), and uranium-235 (U-235), thorium-228 (Th-228), thorium-230 (Th-230), and thorium-232 (Th-232), radium-226 (Ra-226), lead-210 (Pb-210), and polonium-210 (Po-210). The specific analytical methods are determined by the accredited laboratories doing the analysis.

In order to maximize the detection sensitivity for the important radionuclides, any additional radiochemical analyses shall be limited to those radionuclides that could reasonably be expected to contribute more

than five percent of the aggregate CEDE over the quarter. The potential relative dose fraction for each radionuclide will be determined each quarter by weighting its effective inhalation dose coefficient according to its relative abundance in the waste disposed during the quarter. Containerized Waste, large components, and encapsulated Mixed Waste are inherently not wind dispersible, so the nuclide activities of these waste types are therefore excluded from consideration for the quarterly nuclide dose fraction determination.

5.1.3 RADON AND THORON

Air is continuously sampled at the locations listed in Table 1 and Drawing 07007-J01, Revision 4 for radon and thoron. Stations B-2, A-27, and A-16 sample results are used to determine background.

The ICRP 65 radon dose conversion factor is 388 mrem CDE per working-level month (WLM) for members of the public, and 227 Bq/m^3 per Working Level (WL). The radon concentration that will result in 50 mrem TEDE per year of continuous exposure is approximately 1 WL, or 6 pCi/L, when the ICRP 66 lung weighting factor of 0.12 is applied. ICRP 65 does not provide a dose conversion factor for thoron so the thoron ECL in 10 CFR 20 is assumed. Radon and Thoron working levels have been too low to empirically determine an equilibrium factor for radon released from waste so the radon dose estimate assumes that particulate decay products are not present.

Radon and thoron concentrations are monitored using Landauer RadTrak® Dosimeters. A single dosimeter is used to measure both radon and thoron concentrations. The algorithm used to calculate exposure assumes that total exposure is due to radon. Because the radon ECL is lower than the thoron ECL, the calculated dose from the single radon plus thoron measurement is more conservative. The radon plus thoron concentration will be reported as "radon equivalent" to indicate that the radon efficiency was used to determine the reported concentration.

5.1.4 AIRBORNE TRITIUM (H-3)

Tritium is monitored at the air stations identified in Table 1 and Drawing 07007-J01, Revision 4. The airborne tritium concentration is determined by collecting water vapor in a desiccant material, at a flow rate of approximately 200-300 ml/min. The samples shall be analyzed at the end of each quarter. The H-3 ECL used to calculate dose is 4.6E-08 uCi/ml.

5.2 VTD EFFLUENT

General

The VTD discharge is sampled for airborne particulates, and may be sampled for H-3, iodine-129 (I-129), krypton-85 (Kr-85), and krypton (Kr-81) if these contaminants are present within the waste fed into the VTD unit. The VTD discharge stack is located down stream of the stack filters but up stream of the discharge blower. VTD effluent concentration for each of these sample types is determined by dividing the measured VTD air sample concentrations by 200. This is done to account for the effluent dilution resulting from the blower. Because the VTD particulate air sampler draws suction from a closed system the results do not include a background, consequently the A-16 concentration is not subtracted from the measured concentrations.

Alpha/Beta Screening

Air is continuously sampled at the VTD discharge while the VTD is used to treat radioactive wastes. Radioactive airborne particulate samples are collected using a constant-flow air sampler to draw air through a glass fiber filter, or a functionally similar particulate sampling media. The particulate air sampling apparatus maintains a flow rate of approximately 60 liters per minute through the filter media. All particulate filters are analyzed for alpha and beta radioactivity at least 7 days but not more than 14 days after collection.

Any individual sample filters with a net alpha or net beta concentration above the applicable PAS Action Level will be analyzed by gamma spectroscopy within 3 working days of the alpha/beta analysis. Gamma spectroscopy analysis results will be reviewed to determine if any additional actions need to be taken.

When an individual filter has a net alpha concentration above 3E-12 uCi/ml or net beta concentration above 5E-11 uCi/ml (approximately 25 times the PAS Action Level, based on 25 or 26 filters per quarter per location), additional radiochemical analyses will be performed on that filter according to the requirements for quarterly composite filters, unless gamma spectroscopy associates at least 50 percent of the net alpha or net beta activity present on the filter with gamma-emitting radionuclides.

Airborne Particulate – Composite samples

Quarterly composite VTD samples will be analyzed by gamma spectroscopy using either the on-site instruments or one of the qualified contractor laboratories and those isotopes expected to contribute more than five percent to the aggregate CEDE. The potential relative dose fraction for each radionuclide will be determined each quarter by weighting its effective inhalation dose coefficient according to its relative abundance in the waste treated using VTD during the quarter.

Tritium, Iodine -129, Krypton – 85, and Krypton – 81

Tritium is monitored at the VTD discharge when tritium is manifested in the waste. The airborne tritium concentration is determined by collecting water vapor in a desiccant material, at a flow rate of approximately 200-300 ml/min. VTD effluent tritium samples shall be analyzed at the end of each quarter. The H-3 ECL used to calculate dose is 4.6E-08 uCi/ml.

Iodine-129 (I-129) is also continuously monitored at the VTD discharge, when I-129 is manifested in the waste being treated. The sample is collected using a charcoal cartridge installed in the sampling line after the particulate sampling filter. Iodine-129 cartridges shall be analyzed by gamma spectroscopy within seven days of sample collection. The I-129 ECL used to calculate dose is 5E-11 uCi/ml.

Radioactive gasses, Kr-81 and Kr-85, are monitored by taking a "grab sample" at the VTD discharge, when these gasses are manifested in the waste being treated. The sample is collected using a Marinelli beaker installed in the stack sampling manifold. Kr-81 and Kr-85 samples from the VTD discharge shall be analyzed by gamma spectroscopy within seven days of sample collection. The Kr-81 ECL and the Kr-85 ECL used to calculate dose is 3E-06 uCi/ml and 7E-07 uCi/ml, respectively.

5.3 GAMMA RADIATION

Gamma radiation is continuously monitored at each designated airborne radioactivity monitoring location listed in Table 1 and Drawing 07007-J01, Revision 4 using an optically stimulated luminescent dosimeter (OSL) or a functionally equivalent device. Locations B-2, A-27, and A-16 are used determine the background gamma radiation exposure. Additional monitoring is performed near the fenced boundary that surrounds the waste management areas, and at additional locations as directed by the Director of Health Physics (DHP).

5.4 SOIL

5.4.1 General

Environmental Soil samples required by the Environmental Monitoring Plan are analyzed by Gamma spectroscopy. In order to facilitate the accurate measurement of radionuclides, the samples shall be collected from the top one inch of soil. To prepare the soil samples for gamma spectroscopy analysis the soil sample shall be dried, sifted, homogenized for matrix uniformity, and placed in sealed containers. Alternative soil collection and analytical preparation methods may be used provided it is authorized and documented by the Environmental Manager.

Soil samples shall be sealed, or canned, for at least 14 days prior to analysis in order to ensure that the accurate measurement of Ra-226. Soil samples used to facilitate remediation activities are not required to be held for 14 days after canning for gamma spectroscopy analysis however, a 14 day hold time is required for the soil samples used to verify that an area is below the soil action levels.

Routine soil samples that exceed the Soil Action Levels shall also be analyzed for isotopic thorium. The locations of any quarterly or annual soil sample above these action levels will be further characterized by additional sampling to verify the initial finding, and to subsequently determine the nature, extent, and cause of any problem once the initial finding is verified. Areas with confirmed radioactivity above the Soil Action Level shall be remediated.

Except for sampling activities, Executive Secretary of the Division of Radiation Control shall be notified prior to disturbing the soil inside quarterly soil monitoring stations.

5.4.2 Quarterly Soil Samples

The quarterly soil sample locations and analytical requirements are listed in Table 1 and Drawing 07007-J01, Revision 4. Quarterly soil samples are also required at active Non-contaminated Restricted Area exits, in accordance with Section 5.5.

5.4.3 Annual Soil Samples

Soil samples will also be collected annually to assess potential wind blown contamination from the site. Surface soil samples will be taken at 300 meter intervals along the 8 compass directions centered near the center of Section 32. The first sample will be taken just outside the site boundary and additional samples will be taken at 300 meter intervals extending out to 1500 meters. All 48 samples will be analyzed by gamma spectroscopy.

5.4.4 PCB Soil Samples

Samples are also collected to determine PCB concentrations in soil. Soil samples are collected twice each year from the Soil Monitoring stations identified in Table 1 and Drawing 07007-J01, Revision 4. The samples are collected from the soil surface and each sample will weigh approximately 30 g. Samples are refrigerated and stored in the dark when collected. Sample analytical preparation shall be started within 14 days after collection and the analysis shall be completed within 40 days after collection.

5.4.5 Quarterly Restricted Area Exit Gate Soil Samples

Radioactivity concentrations in the soil near rail gates and gates that directly access Non-contaminated Restricted Areas shall be monitored. A soil sample shall be taken near rail gates used to exit the Restricted Area during the quarter. A soil sample shall also be taken at gates that directly access Non-contaminated Restricted Areas; where vehicles, person, or material were permitted to exit during the quarter without a radiological release. The sample should be taken where the soil is most likely to be affected by contamination that may be present on vehicles exiting the Restricted Area. All soil samples will be analyzed by gamma spectroscopy.

Additional soil samples shall be collected when soil sample radioactivity exceeds the soil action level to determine the cause and scope of the elevated radioactivity. Areas found to exceed the soil action levels shall be remediated as necessary until the radioactive contamination in the area is below the Soil Action Level.

6.0 QUALITY ASSURANCE/QUALITY CONTROL

6.1 ANALYTICAL LABORATORY QUALIFICATIONS

Analyses to be used for dose determination or for comparison to standards are performed by a laboratory accredited or certified by the National Environmental Laboratory Accreditation Conference (NELAC) or the State of Utah to perform radiochemical and gamma spectroscopy analysis on environmental samples.

The Energy*Solutions* gamma spectroscopy system has been qualified by a company that performs such evaluations as a commercial service. The State of Utah has accepted that as evidence of Energy*Solutions*' qualifications for performing gamma spectroscopy analysis.

6.2 MDC REQUIRMENTS

6.2.1 General

The detection sensitivity can be influenced by several factors. These include branching ratios, the presence of interfering contaminants, and the probability of a given type of emission per disintegration. Most gamma emitting radionuclides of concern are easily detected by gamma spectroscopy at the specified sensitivity levels. In practice the typical detection levels achieved in radiological analysis of environmental samples are very close to natural background radiation levels.

All analyses will achieve the specified MDA at the commonly accepted error of two standard deviations, or an approximate confidence interval of 95%.

Samples that indicate a positive result for the target analyte(s) need not be counted to achieve the specified MDA(s) if the counting uncertainty is less than 50% of the mean.

6.2.2 Particulate Air Sample Alpha/Beta screening

The required MDA for the initial alpha and beta screening is based on 50% of the Th-230 concentration action level, or 7E-14 uCi/ml for gross alpha before the background contribution from A-16 is subtracted. The gamma spectroscopy performed on samples above the alpha or beta action levels will be sensitive enough to detect 50% of the concentration listed in Table 3 of the Environmental Monitoring Plan for the gamma emitting nuclides of concern, or as needed to positively characterize the major contributors to the activity present.