CHAPTER 6

Sampling

6-1. Data Quality Objectives (DQO).

a. DQO are statements made to ensure sample taking is focused on achieving the objectives of the study. They define the type of data to collect, the conditions for collecting the samples, the decision error limits, the quantity of samples taken, and the required quality of the analyses. The MARSSIM (Appendix D) outlines the DQO process - seven steps used to ensure that the data gathered provide information that will allow an informed decision to be made about the next action to take at a site. An example of a good DQO is the following:

> (The purpose of this walkover survey is to determine if there is elevated 122 keV gamma radiation from Co-57 contamination in this area, and if so where it is and how elevated it is.) DQO: Identify potential small areas (100 cm^2) of Co-57 surface soil (<15 cm) contamination in the survey unit with a 95% confidence limit using radiation detection equipment and scanning methods with an estimated Scan-MDC below the Co-57 screening level of 8.7 pCi/g [EPA PRG for residential soil]. Each potential area will be considered contaminated if the result of a direct measurement exceeds the critical level, Lc, calculated from background measurements in a reference area similar to the survey unit using values of 0.05 for alpha and beta errors.

b. This DQO could be met through by implementing a survey procedure like the one that follows:

> 100% of the surface area will be surveyed using a 2”x 2” Sodium Iodide detector held 1 meter above the surface and moved at 2 inches per second. The detector is capable of measuring 5 µR/hr gamma radiation in the 80 to 180 keV energy range (850 cpm = 1 µR/hr). The survey meter is calibrated with the detector to read out in units of µR/hr. Background has been previously determined to be 12 µR/hr (10,200 cpm). The required level of confidence is 95% for detecting true positives and 0.05% of finding false positives. The minimum detectable count rate for the ideal observer is computed to be 10,531 cpm (12.4 µR/hr). The action level for this survey is set at 12.4 µR/hr. Each location where a reading of 12.4 µR/hr or greater is detected will be flagged with a pin flag. Each flagged point will be resurveyed for 1 minute and the readings and location recorded in the survey log.

6-2. Scanning. There are a number of types of scanning done at HTRW sites-area scanning, building surface scanning, soil surface scanning, and excavation surface scanning. Scanning is performed by passing a field instrument at a set distance and slow speed over an area

suspected of having radioactive contamination. Scans can detect some alpha and many beta emitting radionuclides on a surface and most gamma emitting radionuclides on the surface or a few centimeters below the surface scanned. Methods for doing scans vary a little for each type of scan.

a. Area Scanning. This is usually done to determine if an area is safe to access. This scan may find areas of high gamma radiation, which could pose a hazard to workers in the area. This type of scan is usually performed inside buildings where large quantities of radioactive materials are used, or where radiation generating devices are in use. For an area scan, a gamma ray detecting probe is held 1 meter off the floor and the radiation readings are monitored throughout the room. The readings will be used by health physics personnel to determine work procedures in the room.

b. Building Surface Scans. This type of scan is used to determine if there is radioactive contamination on building surfaces or debris, or possibly infused into the building material or debris. The instrument selected for a building surface scan depends on the radiation emitted by the contaminant. Surface scanning instruments preferentially have a large window detector, allowing more surface area to be scanned at one time. The detector is held very close to the surface to be scanned. This detector is moved slowly over a prescribed percentage of the surface area. For final status survey of class 1 areas, see Chapter 13 for a discussion of area classification, this is typically 100% of the surface, and 25% of the total surface for class 2 areas, areas. Additionally, a wipe or smear survey is usually done in conjunction with a building or debris scan to determine if the contamination is removable. A health physicist will need to ensure that the combination of the type and size of the detector, the distance from the surface, and the speed that the detector is moved are such that the instrument will be capable of detecting contaminants at a low enough concentration to meet the survey goals. The building or debris surface scan should result in a report detailing the total square footage of the building or debris surface, the total square footage that was contaminated above the action level, the average level of contamination and the highest level of contamination measured, and whether the contamination is removable of non-removable.

c. Soil Surfaces. Soil surfaces are scanned similarly to building surfaces but may present other problems. Vegetation may need to be removed. Soil surfaces may be rugged, making it difficult to maintain the detector at a set distance from the surface. As with building scans, soil scans may detect gamma-emitting radionuclides a few centimeters deep in the soil. Most radionuclides would not be detectable at depths below a few centimeters unless they are present in large quantities. A health physicist can calculate the depth to which the instrument can detect a certain quantity of a specific radionuclide.

d. Excavation Surfaces. These are scanned in the same manner as soil surfaces. Open excavations are usually scanned to determine if further excavation is necessary. As before, if a sufficient thickness of soils is between the detector and the contaminant, the instrument will

not be capable of detecting it. If an excavation is scanned and no contamination is detected, and the excavation is backfilled with clean fill, it can be expected that no contamination will be detected if the backfilled excavation is re-scanned.

6-3. In-Situ Measurements. These are made using a sodium iodide (NaI) detector or a high purity germanium (HPGe) detector in conjunction with a spectrum analyzer. This system will allow a spectrum of all gamma radiations to be recorded and analyzed. Most of these systems can identify the source radioisotope of each gamma radiation measured. Some systems have incorporated algorithms to enable the system to quantify the contaminants of concern, and attempt to determine the depth in the soil at which the contaminant is present. These systems are very complex and careful evaluation will be needed to provide a level of confidence in their measurements.

6-4. Down-hole or Well Logging. Another form of scanning is down-hole logging. In this situation, a detector is lowered into the borehole and a record of the measurements vs. the depth of the detector is recorded. This method can sometimes locate the depth that a contaminated layer of soil is at relative to the ground surface. It can also sometimes locate hotspots within the ground. Down-hole logs are influenced by a number of factors, including soil density, moisture content, and soil type. Ensure that the individual interpreting the survey is experienced in accurate down-hole survey interpretation techniques.

6-5. Sampling Surface Soils. This is commonly done at locations where scanning indicates elevated radiation levels. This is called biased sampling. A grid may be set out over the site and soil samples taken at selected grid nodes. Additionally, random surface soil samples may be taken to verify remediation effectiveness. A surface soil sample, usually about 1 kilogram, is removed and packaged then forwarded to a lab for analysis.

a. Subsurface soil sampling is usually done with a coring device. A soil core from the surface to a set depth is taken and soil from a certain layer is removed form the core, usually homogenized, and sent to the lab for analysis. Subsurface sampling may be achieved by other means, such as removing the cover or topsoil with a shovel or backhoe, then taking a soil sample at a specific depth. Often the contaminant is excavated to a prescribed depth, then samples of the soils in the bottom or on the sides of the excavation are taken to confirm that all the contaminated soil was removed from the site. Subsurface sampling may be necessary to determine the three-dimensional extent of contamination at a site.

b. As with all grab samples, care must be taken in the interpretation of surface and subsoil results. Biased sampling may indicate the areas and the maximum concentrations of a contamination a site, but is not representative of the site as a whole. Gridded samples may provide the best indicator of the site-wide conditions, but must be evaluated using statistical tools to ensure that enough samples were taken to have an acceptable level of confidence in the results. Subsurface samples are more difficult to acquire and so are more expensive.

Excavation sampling must consider the safety requirements for potential sloping and shoring before an individual is allowed into the excavation. All gridded sampling relies on the assumption at the contaminant is distributed over the site in some manner. Problems in interpretation can arise when the contaminant is heterogeneous over a site rather than homogeneous. A heterogeneously distributed contaminant is one where larger pieces of the radioactive contaminant are randomly scattered over a site, with little or no continuous contamination of surrounding soils. In this case, statistics based on a distribution break down.