

ATTACHMENT 4

HAZARD COMMUNICATION PROGRAM
AND
EMPLOYEE GUIDE TO HAZARDOUS MATERIALS

1000 HAZARD COMMUNICATION PROGRAM

I. PURPOSE

The purpose of the OSHA Hazard Communication Standard is to establish uniform requirements to make sure that:

1. The hazards of all chemicals produced, imported or used within the United States are evaluated, and ...
2. This hazard information is transmitted to affected employers and employees.

At MWH Americas, our first consideration in the performance of work is the protection of the safety and health of all employees. MWH Americas has developed this Hazard Communication Program to ensure that employees receive adequate information about the possible hazards of hazardous substances used in the workplace.

II. DISCUSSION

A. APPLICABILITY

This program applies to chemicals known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency. The hazardous materials that are exempt include:

- Foods, drugs, and cosmetics intended for personal consumption by employees while in the workplace.
- Consumer products packaged for distribution to, and use by, the general public. These materials must be used in the workplace in the same manner as normal consumer use, and cannot result in a duration and frequency of exposure greater than exposures experienced by consumers.

B. MWH AMERICAS FACILITIES

At MWH Americas the majority of our facilities are "office" areas and would not be bound by the specific requirements of this program. However, many office products contain hazardous substances and are potential sources of employee chemical exposure. Care should always be exercised when using any hazardous material, even within an office setting.

MWH Americas operations other than office areas may not be exempt from the provisions of the Hazard Communication Standard and therefore must strictly abide by the procedures set forth in this program. These include chemical use operations, such as the print shops, laboratories, graphics areas, research and development shops, hazardous waste sites, construction sites, water and wastewater treatment plants as well as work at industrial facilities.

MWH Americas laboratories utilize numerous chemicals and hazardous materials that have been interpreted as falling under the provisions of the "Occupational Exposure to Hazardous Chemicals in Laboratories" regulation, which supersedes this program. For details, see the Laboratory Chemical Hygiene Plan (MWH Americas Safety and Health Policies and Procedures No. 1001).

C. NON-MWH AMERICAS FACILITIES

MWH Americas employees may be faced with greater potential exposure to hazardous materials while working on non-MWH Americas regulated facilities. All MWH Americas employees should understand that it is a Federal and State OSHA requirement that every employer using hazardous materials in the workplace have an effective Hazard Communication Program or equivalent. A specific component of these programs is the responsibility of employers to provide information regarding their hazardous substances to contractors and guests.

When visiting a client's facility, MWH Americas employees should abide by the onsite health and safety procedures, become familiar with the site emergency procedures and utilize Material Safety Data Sheets (MSDSs) to gain information on the hazardous materials present.

III. DEFINITIONS

Appendix B of MWH Americas' Health and Safety Policies and Procedures Manual contains the MWH Americas Employee Guide to Hazardous Materials. At the end of this guide is a glossary of terms used frequently in the Hazard Communication Standard and on MSDSs. A few of the more commonly used terms are repeated here.

Carcinogen: A substance or agent capable of causing or producing cancer in humans or animals.

Designated representative: Any individual or organization to whom an employee gives written authorization to exercise a right of access to exposure and/or medical records.

Hazard warning: Any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the health hazards and physical hazards of the substance(s) in the containers(s).

Hazardous Substances: A hazardous substance is one for which scientifically valid evidence exists that it is a combustible liquid, compressed gas, explosive, flammable, organic peroxide, radioactive, oxidizer, pyrophoric, unstable (reactive), or water reactive.

Health Hazards: A health hazard is a substance which is an irritant, skin hazard, toxic agent, highly toxic agent, corrosive material, eye hazard, agent that acts on the blood system, is a sensitizer, cancer-causing agent, reproductive toxin, liver toxin, kidney toxin, nervous system toxin, or agent that damages the skin, eyes, or mucous membranes.

Health hazard effects can generally be classified as either acute (an immediate response to a short-term exposure) or chronic (from repeated exposure over a long period of time).

Material Safety Data Sheet (MSDS): A fact sheet summarizing information about material identification, hazardous ingredients, health, physical, and fire hazards; first-aid; chemical reactivities and incompatibilities; spill, leak, and disposal procedures; and protective measures required for safe handling and storage. OSHA has established guidelines for descriptive data that should be concisely provided on a data sheet to serve as the basis for written hazard communication programs. The Chemical Manufacturer's Association developed a set of guidelines for a consistent MSDS format. This format has been accepted by the American National Standards Institute.

Physical hazard: A substance for which there is evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an oxidizer, unstable (reactive), or water-reactive.

IV. PROCEDURE

A. HAZARD DETERMINATION

The Hazard Communication Standard requires that either chemical manufacturers, importers or employers evaluate chemicals and determine if they are hazardous. At MWH Americas, we purchase materials from importers, distributors, or manufacturers for use "as-is", and do not produce our own chemical products. We meet the hazard determination requirement by relying on the analysis already performed by the manufacturers of the substances and do not reevaluate their hazards. Where necessary, we may perform independent analysis of mixtures of materials to determine if additional hazards exist.

The following are sources for lists of hazardous substances:

1. The Director's List of Hazardous Substances prepared by the Director of Industrial Relations for the State of California and similar lists produced by the Governor's office in States with OSHA-approved State Plans.
2. 29 Code of Federal Regulations 1910, Subpart Z "Toxic and Hazardous Substances" (Occupational Safety and Health Administration).
3. "Threshold Limit Values for Chemical Substances in the Work Environment" by the American Conference of Governmental Industrial Hygienists (ACGIH).

B. CONTAINER LABELING

1. Original Manufacturer's Containers

Manufacturers, importers, and distributors of materials which MWH Americas purchases must label, tag, or mark each container of hazardous substance(s) with the following information:

- Identity of the hazardous substance(s).
- Appropriate hazard warnings.
- Name and address of the manufacturer, importer or other responsible party.

No container of hazardous substances shall be released for use in the workplace unless the container is correctly labeled and the label is legible.

Receiving departments, or person(s), must check all chemical containers (such as bags, drums, pails, etc.) to ensure that the label is intact, legible, written in English and has not been damaged in any way during shipment. Any containers with damaged labels must be kept separate and not used until they are re-labeled. A supply of new labels should be obtained from the manufacturer, importer, or distributor for this purpose.

2. Secondary Containers

Appropriate hazard warning labels must also be placed on secondary containers (i.e., containers used to store material dispensed from the manufacturer's original container). The secondary container must be labeled with either a copy of the manufacturer's label or a produced label that includes:

- Product identity
- Fire, physical and health hazards
- First Aid procedures
- Manufacturer's name

This label information can be obtained from the manufacturer's original container or the applicable MSDS. Business Units must ensure that all labels on secondary containers are clearly visible, legible, and include the required information. Whenever practical, MWH Americas Business Units are encouraged to order/purchase hazardous materials in sizes that reduce/eliminate secondary container use.

3. Stationary Process Containers

A stationary process container is a fixed vessel or tank used to hold process chemicals. For example, a closed tank used to hold chemicals which are metered into continuous treatment processes, such as water treatment systems, is considered a stationary process container.

Appropriate hazard warning labels, signs, placards, process sheets, batch tickets, or operating procedures must be placed on or in the immediate area of all stationary process containers which contain hazardous materials. These must specify:

- Hazardous substance identity
- Hazard warnings (fire, physical, health)
- Emergency and first aid procedures
- Manufacturer's name (if applicable)

C. PROPOSITION 65 WARNINGS

Proposition 65, The Safe Drinking Water and Toxic Enforcement Act, has been incorporated into the Hazard Communication Standard for the State of California. In addition to the other requirements of the Hazard Communication Standard, Proposition 65 requires businesses in California to give a clear and reasonable warning if they expose any individual, including workers and consumers, to a listed chemical (those considered to cause cancer or reproductive harm) within twelve months after a chemical first appears on the list. The list includes tobacco smoke, aspirin, and may include other chemicals found in the MWH Americas workplace. Because the Proposition 65 list is updated frequently, a current listing is maintained by the Health and Safety Manager. To comply with the Hazard Communication Proposition 65 requirements, the following procedures should be followed in California:

1. Contact the Health and Safety Manager for a current listing of Proposition 65 chemicals.
2. Conduct a Chemical Inventory, listing all chemical components of mixed materials (i.e., there may be lead or chromium pigment in paint; and there may be benzene in gasoline).
3. Identify if any chemicals from the inventory match the Proposition 65 list.

If no chemicals match - document the efforts and place in Proposition 65 Compliance File.

If you recognize any listed chemical in your work area, whether office, print shop, laboratory, hazardous waste site, etc.:

- a. Check to see if that chemical/product is already labeled with some type of warning, which refers to that chemical's carcinogenic or reproductive hazards.
- b. If so labeled, ensure employee awareness, including appropriate hazard communication.

If not so labeled, place the following worded sign near/on the chemical:

1. "WARNING: This area contains a chemical known to the State of California to cause cancer."
 2. "WARNING: This area contains a chemical known to the State of California to cause birth defects or other reproductive harm."
- c. If the chemical is part of a building/structure with no obvious label, i.e., asbestos insulation, a "warning" sign, as noted above, needs to be affixed.

Note: Avoid creating exposure hazards when affixing signs, i.e., drilling through asbestos wallboard.

- For more information on Proposition 65, see MWH Americas Safety and Health Policies and Procedures No. 302 or contact the Health and Safety Manager.

8.4.1.1.1.1.1 D. MATERIAL SAFETY DATA SHEETS

1. General

An MSDS explains the hazards associated with the use of a product and is a key source of hazard information for employees. Other than specifically exempt products, MWH Americas is required to have available for employee and contractor/guest review the MSDSs for the hazardous materials utilized by employees. Business Units are responsible for surveying their areas for all hazardous materials used and stored there and establishing a list of hazardous substances. Based on this inventory of hazardous substances, Business Units must maintain a current MSDS for each product.

To assist Business Units, MWH Americas' current practice is to require vendors to send MSDSs with each shipment of hazardous materials. When an MSDS does not accompany the shipment and no copy of the MSDS is

available within the company, the shipment should be set aside in a controlled area until the MSDS is received.

2. Material Safety Data Sheet Binders

Copies of MSDSs are to be kept in an MSDS Binder that must be readily available to all department employees. The Business Unit Supervisor will be responsible for maintaining this binder and ensuring that it is properly maintained. The binder should be kept in a location that is readily accessible to employees during all shifts; if necessary, copies may also be placed in other locations to facilitate availability.

The MSDSs in the binder should generally be organized alphabetically by manufacturer and then product name. For example, methyl ethyl ketone (MEK) from Shell Oil Company would be found under "S" for Shell and then "M" within the Shell products.

The Business Unit's list of hazardous substances should serve as the table of contents for the MSDS binder. All items listed on the inventory should have a MSDS and every MSDS should correspond to an inventory item.

3. Material Safety Data Sheet Review

New materials will not be introduced into the workplace until an MSDS has been received. Employees are required to receive information regarding the hazards of the materials they work with prior to actual usage.

PHSCs will work with chemical users to review incoming MSDSs for completeness and any new and significant health and safety information. They will ensure that MSDSs are available to employees for every applicable product used and any new information is passed on to appropriate employees.

If an MSDS is not provided by the manufacturer, importer or distributor, or if any of the required MSDS information is missing, the using Business Units will contact the appropriate party and request a complete MSDS. This request must be in writing, directed to the product manufacturer, importer or distributor and be made within 7 working days of missing MSDS/information discovery. If a response to the inquiry is not received within 25 working days, the Business Unit Supervisor should send a copy of the written request to the MWH Americas Health and Safety Manager and the State agency responsible for Industrial Relations.

4. New Information

Whenever new and significant health information is made known to MWH Americas concerning a hazardous substance being used in the workplace, an updated MSDS must be requested from the manufacturer, importer, or distributor. This new information will be discussed with all affected employees (within 30 days of receipt) and the new MSDS placed into the Business Unit MSDS binder. Similarly, if MWH Americas receives a new or revised MSDS the new information must be provided to employees within 30 days.

E. LIST OF HAZARDOUS SUBSTANCES

A list of all the hazardous substances used by a Business Unit is required to be placed or posted in an area that is readily accessible to affected employees. This list provides employees with their workplace hazardous substance inventory and shows which MSDSs are contained in the Business Unit's MSDS binder (it should also serve as the binder's table of contents). It is the Business Unit Supervisor's responsibility (with assistance from the PHSC) to keep the list current.

One purpose of the Hazardous Substance List is to assist employees in finding the MSDS for hazardous substances used in the Business Unit. The list must identify the manufacturer and product identity. It should be organized alphabetically by manufacturer and then by product name. Catalog numbers, order numbers, or reference numbers can also be included on the list to facilitate product identification.

F. EMPLOYEE INFORMATION AND TRAINING

1. General

All employees included in this program who are exposed or potentially exposed to hazardous substances in their work must be provided Hazard Communication information and training. Information and training will be given prior to initial work assignment and whenever a new hazard is introduced into their work area. In addition, those already trained must be periodically checked, retrained, and their compliance with applicable requirements enforced.

At a minimum, employees should receive Hazard Communication training/retraining to demonstrate knowledge of the following topics:

- An overview of the Hazard Communication Standard requirements, including employee rights.
- Information on any operation in their work areas where hazardous substances are present.

- The location and availability of the MWH Americas Written Hazard Communication Program, i.e., this policy/procedure and the MWH Americas Employee Guide to Hazardous Materials, Appendix B to the MWH Americas Safety and Health Policies and Procedures Manual.
- The physical and health hazards of the hazardous substances in the work area.
- Methods and observation techniques for determining the presence or release of hazardous substances in the workplace.
- How to lessen or prevent exposure to hazardous substances through controlled work practices, proper handling, and personal protective equipment.
- The steps MWH Americas has taken to lessen or prevent exposure to these substances.
- Emergency and first aid procedures to follow if employees are exposed.
- How to read labels and review MSDSs to obtain appropriate hazard information.

2. Employee Rights

OSHA and the Hazard Communication Standard provides the following rights to every MWH Americas employee. All employees must be informed of these rights.

- Employees or their designated representative can receive all information regarding any hazardous substances they work with or are exposed to. This includes occupational monitoring results, exposure records, MSDSs, and medical records (medical records can be released to other individuals only when written permission is granted by the employee). Access must be provided within 15 days of a written request.
- Employees are protected from discharge or other discrimination for exercising any of their employee rights.
- Employees can refuse to work with a hazardous substance if the company cannot find out and communicate the hazards.

3. Documentation

All employee health and safety training (group, "tailgate", classroom, individual) must be thoroughly documented. Proper documentation includes the type of training conducted, date, attendees, instructor, and copies of handouts/material covered. Business Unit Supervisors may utilize the health and safety training attendance sheet included as Attachment A of the MWH Americas Safety Meeting Policy (MWH

Americas Safety and Health Policies and Procedures No. 700) as the backbone for documenting training efforts.

G. HAZARDOUS NON-ROUTINE TASKS

Employees may be required to perform non-routine tasks involving hazardous materials as part of their work. Prior to the start of such non-routine work, Business Unit Supervisors must provide each affected employee with information about hazards to which they may be exposed. This information will include:

- Specific hazard information
- Protective or safety measures which must be utilized.

H. HAZARDOUS SUBSTANCES IN UNLABELED PIPES

Unlabeled pipes containing hazardous substances represent a serious safety concern for any employee working on these pipes. Prior to initiating any work on unlabeled pipes employees must be informed of the hazards of the materials contained within the pipes. Pipe diagrams and schematics are excellent sources of information and should be made readily available to employees.

Prior to starting work on unlabeled pipes, supervision must provide the following information to employees:

- The identity of the hazardous substance(s) within the pipes.
- The potential hazards of those substances.
- Safety precautions which must be taken.

I. CONTRACTOR WORK

The Hazard Communication Standard requires that contractors be informed of the nature of hazardous substances to which their employees may be exposed while performing their work. In situations where contractor exposure to hazardous materials may occur, Business Unit Supervisors shall provide the following information prior to the beginning of the work:

- The identities of hazardous substances used by MWH Americas that the contractor's employees may be significantly exposed to while on the job site.
- Location and access to applicable MSDSs.

- Recommended precautions, protective measures and emergency procedures.

In addition, MWH Americas employees must be protected from the hazardous materials used by contractors. MWH Americas Business Unit Supervisors, with assistance from PHSCs, should review with contractors the hazardous materials that they are intending to utilize in performing their work. If necessary, MWH Americas Business Unit Supervisors should request MSDSs from the contractors.

J. PLAN ADMINISTRATION

This Hazard Communication Program will be monitored by the Health and Safety Manager who will be responsible for ensuring that all facets of the program are carried out and that the program is functioning effectively.

V. REFERENCES

- A. Title 29 Code of Federal Regulations 1910.1200, Hazard Communication.
- B. Title 8 California Code of Regulations Section 5194.
- C. Genium Publishing Corporation. The MSDS Pocket Dictionary 2nd Ed. Schenectady, NY. 1994.

8.4.1.1.1.2 EMPLOYEE GUIDE TO HAZARDOUS MATERIALS

I. INTRODUCTION

As a MWH Americas employee, your duties may require you to work with substances which are potentially hazardous to your health. Training you to work safely with these hazardous substances is a critical step in providing a workplace that protects your health and safety. This guide was developed as part of the MWH Americas Hazard Communication Program and together with training will provide you with information on current regulations, health hazards, safety procedures, and emergency procedures associated with the hazardous substances you work with.

Specifically, this guide will introduce and explain the requirements of two regulations which have been established by the Occupational Safety and Health Administration (OSHA). These regulations are known as "Access to Employee Exposure and Medical Records" (29 CFR 1910.1020) and the "Hazard Communication Standard" (29 CFR 1910.1200). (Note: Approved State OSHA plans have their own regulation corresponding to these Federal OSHA standards.)

II. ACCESS TO EMPLOYEE EXPOSURE AND MEDICAL RECORDS

This regulation requires that MWH Americas provide employees or their designated representative access to their own Exposure and Medical Records.

Employee Exposure Record includes any environmental and biological monitoring that has been taken to estimate your exposure to toxic substances or harmful physical agents.

Employee Medical Record contains information concerning the health status of an employee. Maintained by a physician or nurse, this record includes any medical history questionnaires, medical opinions, and diagnoses. It also contains descriptions of treatments, prescriptions and employee complaints.

Written requests for these records should be directed to the Health & Safety Manager.

III. INTRODUCTION TO TOXICOLOGY AND CHEMICAL HAZARDS

A. **WHAT ARE HAZARDOUS SUBSTANCES?**

Hazardous substances are chemicals which due to their toxic effects; physical properties like flammability, explosivity and reactivity; or potential to adversely affect the environment have been identified as requiring special precautions during their use. Very simply, they are materials that can cause you harm.

The Hazard Communication Standard is specifically concerned with potential harm that these materials can cause to workers. The types and forms of hazardous substances you might find in your workplace are: acids, bases, solvents, dusts, fumes, mists, gases, fuels, smokes, and oils.

B. WHAT DOES THE TERM "TOXIC" MEAN?

While you may easily understand the hazard that a flammable liquid poses to you, the effects of a "toxic" exposure may be more complex. Simply stated, "toxic" means poisonous. However, you must understand that all chemicals, including common table salt and sugar, are toxic if consumed in large enough quantities. Therefore, you should look at the term "toxic" from the standpoint of how toxic is the substance, and how much has been absorbed by the body.

For example, very little exposure to a highly toxic substance will cause you harm. For a less toxic substance, a much larger exposure would be necessary to cause harm.

C. WHAT ARE "EXPOSURE LIMITS"?

OSHA (the Occupational Safety and Health Administration) has reviewed medical and toxicological data on many hazardous substances. It has established airborne levels for many hazardous substances below which an average worker can safely work with the substance. These levels are called "**Permissible Exposure Limits (PELs)**." An employer must reduce worker exposure below the PEL by using control measures.

There is another source of exposure limits which are not set by the government, but by a private organization called the ACGIH (American Conference of Governmental Industrial Hygienists). These levels are called **Threshold Limit Values (TLVs)**. They are not legal limits, but are guidelines for worker exposures to hazardous substances.

Other factors discussed below are also important in understanding how hazardous substances may result in a toxic effect.

D. HOW DO HAZARDOUS SUBSTANCES ENTER THE BODY?

There are three common routes of entry for hazardous substances to enter your body: by inhalation, by absorption, and by ingestion.

Inhalation: Gases, vapors, mists, dusts, and fumes, when breathed, in, can either harm the lungs directly or can be absorbed into the bloodstream and affect other organs, like the liver and kidneys. Because inhalation is the most common and potentially the most harmful type of exposure, nearly all PELs and TLVs refer to airborne levels of toxic substances.

Absorption: Some substances that come into contact with your skin or eyes can be absorbed into your bloodstream through your skin or if splashed in your eyes. The MSDS will indicate if skin absorption or direct skin injury may occur with a hazardous material.

Ingestion: Ingestion is not a common way that a hazardous substance enters your body. However, even small amounts of some highly toxic materials can be ingested and cause

harm to you from bad personal hygiene practices (such as eating or smoking without first washing your hands).

E. WHAT ARE THE TYPES OF TOXIC EFFECTS?

In general, there are two major types of toxic effects: acute and chronic.

Acute effects can occur when your exposure to a chemical is large enough so that it affects you right away. Examples of acute toxicity are chemical skin burns, asphyxiation and sudden poisoning.

Chronic effects can occur with repeated exposures after a long period of time. These effects may occur with fairly low-level exposures, so that the damage may not be obvious at first, but can eventually result in harm to you. The resulting injury may be slight (for example, skin irritation), or it may involve severe damage to organs and systems of your body (such as lung disease, cancer, or impaired reproductive function).

Some hazardous chemicals have only acute or chronic effects, but some have both.

F. HAZARD GROUPS

It is important for you to understand the potential hazards of the substance with which you work so that you can help maintain a safe environment for yourself and your fellow workers. *Most hazardous substances can be used safely if you combine a basic understanding of the potential hazards with care, common sense, and appropriate control measures.*

Commonly used groups of these substances and their potential hazards are reviewed on the following pages.

1. Flammables

Substances that are easily ignited and which burn rapidly are called flammables. There are three factors that must exist to have a fire: fuel, oxidizer (supplies oxygen in a chemical reaction), and ignition source. These three components make up the fire triangle.

Flammable liquids are a common cause of fire in industry. A flammable liquid can form an ignitable mixture with air at room temperatures. The flammable liquid is the fuel, the air is the oxidizer, and the flame or spark, the ignition source.

2. Corrosives

Substances that can cause destruction or irreversible damage to human tissues are called corrosives. They may be liquid, solid, or gas, although they most commonly occur in the liquid state as acids or bases.

Corrosives are also defined in terms of pH. Strong acids, such as sulfuric acid and hydrochloric acid, usually have a pH less than 2. Strong bases, also referred to as caustics, such as ammonium hydroxide and potassium hydroxide, usually have a pH greater than 12. Pure water has a neutral pH of 7.

Corrosives are mainly damaging to the skin and eyes. Strong bases have a more corrosive effect on tissue than most strong acids. Bases are capable of dissolving skin fat, softening the skin layers, and sensitizing the skin to chemicals. Acids cause symptoms that resemble severe burns, such as redness, blistering, cracking, and rashes.

3. Irritants

Irritants are substances that may cause an inflammation when in contact with human tissue. Epoxy resin systems and organic solvents are two common examples. The areas most commonly affected by irritants are the skin, eyes, and respiratory tract.

4. Sensitizers

Sensitizers do not always cause noticeable skin effects on first contact. They may cause unseen changes in the body's immune system, making the person allergic to future exposures to the same substance. Examples of sensitizers are epoxy resins and hardeners, and phenolic plastics.

Photosensitizers are chemicals which sensitize the skin to sunlight so that the skin becomes sunburned unusually quickly. Coal tar pitch and crude petroleum are examples.

5. Asphyxiants

Asphyxiants are substances that deprive the body of oxygen, which must be transported from the lungs via the bloodstream to the cells. With complete deprivation of oxygen, brain cells perish in 4 to 6 minutes. If allowed to continue, oxygen deprivation may result in death. Asphyxiants are classified as either simple or chemical.

Simple asphyxiants are inert gases which displace the oxygen in the atmosphere to levels below that required for sufficient oxygen supply to body cells. Some common examples include carbon dioxide, ethane, helium, hydrogen, methane, and nitrogen.

Chemical asphyxiants are gasses that prevent the uptake of oxygen by the blood or interfere with oxygen transportation from the lungs to the tissues. Common examples include carbon monoxide, hydrogen cyanide, and hydrogen sulfide.

6. Cryogenics

Cryogenics are very cold liquids usually contained within pressurized cylinders. Among the most common are oxygen, nitrogen, natural gas, argon, helium, and hydrogen. Hazards associated with these materials include explosive atmospheres (where liquid natural gas or hydrogen is used), asphyxiation (where the cryogenic vapors have displaced the breathable air), and skin and eye hazards due to the extremely low temperatures of these materials.

7. Carcinogens

Carcinogens are defined as substances which are capable of causing or producing cancer in humans or animals. The substances that induce cancer do so in a way that is still not understood. No one really knows why some substances are carcinogenic and others are not. We can be exposed to carcinogens not only through the air we breathe and the water we drink, but also by our diet. Certain elements of our lifestyle, both on and off the job, may contribute to cancer.

OSHA lists carcinogens with which employers must use special precautions to prevent harmful exposure to workers. Exposures to these carcinogens is reduced by limiting their amount in solid or liquid mixtures, using localized ventilation, providing employee training, using protective clothing, and prohibiting eating, drinking, and smoking in regulated areas.

8. Incompatibles

Certain materials will react violently when combined with each other. They are called incompatibles. Their reactions may produce fire, explosion, toxic gases, or tremendous heat. Some examples are:

Acids and Cyanides — the reaction between acids and cyanide salts gives off poisonous hydrogen cyanide gas. Many electroplating operations use both cyanide solutions and acid solutions. The two should never be mixed.

Acids and Bases — the reaction between strong acids and strong bases will give off large amounts of heat, often violently. Care must be taken not to mix the two.

Water Plus Strong Acids or Bases — strong acids and bases will also react by giving off large amounts of heat when mixed with water. When diluting strong solutions, always add the acid or base slowly to a large amount of water.

Oxidizers and Flammables — an oxidizer is an efficient source of oxygen which can keep a fire burning. It may be reactive enough to start a fire. Oxidizers sometimes supply enough heat to make fire extinguishers ineffective. Examples

of oxidizers are nitric acid and potassium permanganate. (Flammables were discussed earlier.)

REMEMBER, incompatible materials must be stored separately at all times to avoid hazardous reactions that can occur during spills, container leakages, fire, or earthquakes.

IV. THE HAZARD COMMUNICATION STANDARD — 29 CFR 1910.1200

A. PURPOSE OF THE HAZARD COMMUNICATION LAW

The purpose of this standard is to communicate to you and all employees the hazards of the materials that you work with. It is sometimes also called the "Employee Right-to-Know" law. This information is provided through the MWH Americas **Hazard Communication Program** which includes the following:

- Written Hazard Communication Program
- Hazardous Substances Listing and Inventory
- Material Safety Data Sheet Inventory
- Labeling and Hazard Warning System
- Employee Information and Training Program

B. SCOPE AND APPLICATION OF THE LAW

This law requires manufacturers or importers to find out the hazards of materials which they produce or import, then provide this information to employers by way of MSDSs (Material Safety Data Sheets). The employer is then required to supply the MSDS and other hazardous material information to employees. This law applies to any hazardous material which is in the workplace and used in a way that could cause exposure to employees under normal conditions of use or in an emergency.

V. MAJOR COMPONENTS OF HAZARD COMMUNICATION:

A. THE WRITTEN PROGRAM

1. Details how the company is fulfilling all the requirements of the Hazard Communication Law.
2. Is part of the MWH Americas Safety and Health Policies Manual (No. 1000 Hazard Communication Program).
3. Is available, upon request, to you and your designated representatives.

B. LIST OF HAZARDOUS SUBSTANCES

1. The list must be posted in every work area.
2. The list must also be in every department MSDS binder.

3. The list itemizes the hazardous substances used in the Business Unit or specific work area.
4. The list can be utilized as a reference to the MSDSs in the binder and for hazardous substances used.

C. HAZARDOUS SUBSTANCES TRAINING

1. Is required for all employees exposed to hazardous substances.
2. Informs you of the physical and health hazards of the substances which you work with, how you can protect yourself, and the requirements of the standard.
3. Training will cover:
 - a. The general requirements, the details of the Hazard Communication Program, the location and availability of MSDSs, the list of hazardous substances, the written program and other general hazardous substances information.
 - b. Additional training will be given as needed on the specific health and physical hazards of substances which you work with.

D. CONTAINER LABELING

1. Original Manufacturer's Containers

- a. Manufacturers, importers and distributors of substances which MWH Americas purchases must label, tag or mark each container of hazardous substance(s) with the following information:
 - Identity of the hazardous substance(s).
 - Appropriate hazard warnings.
 - Name and address of the manufacturer, importer or other responsible party.
- b. No container of hazardous substances shall be released for use in the workplace unless the container is correctly labeled and the label is legible.
- c. Any containers with damaged labels must be kept separate and not used until they are relabeled. A supply of new labels must be obtained from the manufacturer, importer or distributor for this purpose.

2. Secondary Containers

- a. Appropriate hazard warning labels must also be placed on secondary containers (i.e., containers used to store material dispensed from the manufacturer's original container).

- b. The secondary container must be labeled with either a copy of the manufacturer's label or a department produced label that includes:
 - Product identity
 - Fire, physical and health hazards
 - First Aid procedures
 - Manufacturer's name
- c. This label information can be obtained from the manufacturer's original container or the applicable Material Safety Data Sheet (MSDS).
- d. Business Unit Supervisors must ensure that all labels on secondary containers are clearly visible, legible and include the required information.

E. MATERIAL SAFETY DATA SHEETS (MSDS)

1. MSDSs for every hazardous substance used in your work area should be in the plainly marked MSDS binder which is located in your Business Unit Supervisor's office. In some cases, there will be an MSDS binder in other work areas as well.
2. Each MSDS should contain the following information:
 - a. Source of the MSDS (manufacturer)
 1. The name, address and emergency phone number of the preparer of the MSDS and the date of MSDS preparation.
 - b. Identity of the substance
 1. Common name.
 2. Scientific or chemical name.
 3. Trade name or abbreviation.
 4. Chemical formula.
 5. Chemical Abstract Service (CAS) number.
 - c. List of hazardous ingredients
 1. Exception: trade secrets don't need to be listed, but the information must be made available to safety and health professionals.

- d. Physical and chemical characteristics
 - 1. Boiling point, specific gravity, vapor pressure, appearance and odor, etc.
- e. Fire and explosion information
 - 1. Conditions which could result in a fire or explosion.
 - 2. Appropriate fire extinguisher.
 - 3. Approved fire fighting methods.
- f. Physical hazards
 - 1. Materials which are incompatible with the substance.
 - 2. Any conditions to be avoided.
- g. Health hazards
 - 1. Signs and symptoms of overexposure.
 - 2. Acute and chronic effects.
 - 3. Routes of entry.
 - 4. Medical conditions aggravated by exposure.
 - 5. Listing as carcinogen or potential carcinogen.
 - 6. Occupational exposure limits:
 - a) OSHA PELs.
 - b) ACGIH TLVs.
- h. Special protection information
 - 1. Personal protective equipment to be used.
 - 2. Safe handling requirements.
 - 3. Engineering and administrative controls.
- i. Emergency and first aid procedures
- j. Special precautions

1. Special handling and storage requirements.
2. Spill and leak procedures.

F. EMPLOYEE RIGHTS

OSHA, through the Hazard Communication standard, gives you the following rights:

1. You can personally receive all information regarding any hazardous substances you work with or are exposed to.
2. Your doctor or collective bargaining agent can receive information regarding any hazardous substances you work with or are exposed to.
3. The company cannot discharge you or discriminate against you for exercising any of your rights under this law.
4. You can refuse to work with a hazardous substance if the company cannot find out the hazards and communicate them to you.

VI. PREVENTING EMPLOYEE EXPOSURE

A. EMPLOYER MEASURES

Ways the company limits or prevents your exposure:

1. Engineering Controls

Ventilation systems and physical isolation of the chemical from the worker are examples of engineering controls. Engineering controls are the surest means of controlling your exposure to hazardous substances. They are also the most expensive and are sometimes not practical to install. Proper design and maintenance are important to keep them operating at maximum efficiency.

2. Administrative Controls

Substitution of less hazardous materials, providing rest periods, and rotating employees (where appropriate), are examples of reducing exposure through administrative controls. Business Unit Supervisors should use information provided in MSDSs to determine whether administrative controls can be used to further protect you from hazardous substances.

3. Personal Protective Equipment

Respirators and impervious gloves are examples of personal protective equipment (PPE). PPE reduces a worker's exposure to hazardous substances, but does not improve the overall workplace environment. Some PPE, like respirators, require special training and fitting to ensure proper protection, as well as a medical examination.

B. EMPLOYEE RESPONSIBILITIES**1. Use safe work practices**

Certain practices over which you have personal control (for example how fast a machine operates or how ingredients are added to a mixing vessel) can significantly affect your exposure. You should be carefully trained to recognize this fact and always work according to prescribed procedures.

2. Personal hygiene

Measures as simple as washing your hands before eating, or smoking, or showering at the end of a work shift can significantly reduce your exposure to hazardous substances. Personal hygiene is particularly important when handling highly toxic substances. OSHA regulations for certain substances (like lead) require specific personal hygiene practices.

3. Read and follow label warnings

Labeling (as required by the Hazard Communication Law) can be an important control measure if workers read, understand, and follow label instructions. If you see the words: "danger," "warning," or "caution," make sure you read the label carefully and refer to the MSDS for more information.

C. DETECTING HAZARDOUS SUBSTANCES

The following methods or reactions can be used to help you detect the presence of, release of or exposure to hazardous substances.

1. Air Sampling

Industrial hygienists are trained to use a variety of sampling equipment which is designed to detect mists, vapors, dust or fumes in the air.

2. Visual Appearance

Some hazardous substances will form colored "clouds" or stain surfaces which they contact.

3. Odor

In some cases a hazardous substance will have a particular odor and be easily detected, e.g. ammonia. Although many hazardous substances will not have any odor at all, e.g. carbon monoxide.

4. Dizziness/Headache

Some hazardous substances will cause headache and dizziness when you are exposed.

5. Skin/Eye/Throat Irritation

Many hazardous substances will cause irritation of the eyes, skin and/or throat if you are exposed.

It is very important that you understand the health hazards and other properties of the hazardous substances you work with in an effort to predict, prevent or detect potentially hazardous releases or exposures.

Many hazardous substances will cause irritation of the eyes, skin and/or throat if you are exposed.

Glossary

Acute effect — an adverse effect, usually as a result of a short-term but high-level exposure.

ACGIH — American Conference of Governmental Industrial Hygienists. ACGIH publishes recommended occupational exposure limits for hundreds of chemical substances and physical agents.

Carcinogen — a substance or agent capable of causing or producing cancer in humans or animals.

Chronic effect — an adverse effect with symptoms that develop over a long period of time or which recur frequently. This effect is usually a result of a long-term exposure.

Combustible substance — any substance which after ignition will continue to burn in air.

Designated representative — any individual or organization to whom an employee gives written authorization to exercise a right of access to exposure and/or medical records.

DOT — Department of Transportation.

Emergency — Any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which may or does result in a release of a hazardous substance into the workplace.

Exposure or Exposed — Any situation arising from work operation where an employee may ingest, inhale, absorb through the skin or eyes, or otherwise come into contact with a hazardous substance.

Flammable liquids — liquids with a flash point below 100 F.

Flash point — the minimum temperature at which a liquid gives off vapor at sufficient concentrations to form an ignitable mixture with air.

Fumes — small, solid particles usually created by heating metals above their melting point.

General exhaust ventilation — provides air circulation throughout a room or building by natural infiltration of air or with an air moving device.

Hazard — possibility that exposure to a material will cause injury or harm when used under certain conditions.

Hazard warning — Any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the health hazards and physical hazards of the substance(s) in the containers(s).

Hazardous substance — Any substance which is a physical hazard or a health hazard. In a broad sense, any substance with properties capable of producing adverse effects on the safety or health of a human being.

Health Hazard — A substance for which there is evidence that acute or chronic health effects may occur in exposed employees. The term “health hazard” includes substances which are carcinogens, toxic agents, irritants, corrosives, sensitizers, and agents which damage the lungs, skin, eyes, or mucous membranes.

Ingestion — the swallowing of substances.

Inhalation — the breathing in of a gas, mist, fume, vapor, or dust.

Label — Any written, printed, or graphic material displayed on or affixed to containers of hazardous substances.

LC — lethal concentration; a concentration of a substance that is fatal for a test animal.

LD — lethal dose; a dose, usually in grams or milligrams, that is fatal for a test animal.

LD50 — Lethal dose-50; a dose at which 50 percent of a population of the same species will die within a specified time.

LEL — lower explosive limit; the lowest concentration of a substance that will produce an explosion when an ignition source is present.

Local exhaust ventilation — captures and removes the contaminant being controlled at or near the place where it is created or dispersed.

Local health effect — damage which occurs where the chemical makes initial contact with the body.

Material Safety Data Sheet (MSDS) — A fact sheet summarizing information about material identification; hazardous ingredients; health, physical, and fire hazards; first aid; chemical reactivities and incompatibilities; spill, leak, and disposal procedures; and protective measures required for safe handling and storage. OSHA has established guidelines for descriptive data that should be concisely provided on a data sheet to serve as the basis for written hazard communication programs. The Chemical Manufacturer’s Association developed a set of guidelines for a consistent MSDS format. This format has been accepted by the American National Standards Institute.

Organic — chemicals that contain carbon.

OSHA — Occupational Safety and Health Administration. Part of the U.S. Department of Labor.

Oxygen deficiency — an atmosphere with less than the percentage of oxygen found in normal air. OSHA defines an oxygen deficient atmosphere as having less than 19.5 percent oxygen.

Particulate — solid substance which may be suspended in air.

PEL — permissible exposure limit; an exposure level set by OSHA which may either be a time-weighted average (TWA) or a short term exposure limit (STEL).

pH — a scale from 0 to 14 which is used to measure the strength of acids and bases, with neutrality indicated

at 7. Acids have a pH less than 7 and bases have a pH greater than 7.

Physical hazard — A substance for which there is evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an oxidizer, unstable (reactive) or water-reactive.

ppm — parts per million; a unit for measuring the concentration of a gas, vapor, or other contaminant in the air. It is a measure of the parts of gas, vapor, or other contaminant per million parts of air.

Polymerization — a chemical reaction in which small molecules combine to form larger molecules. This becomes a hazard when a large amount of energy is released during the process.

Sensitizer — a substance that may cause some individuals to develop an allergic reaction after extended or repeated exposure.

Stability — the ability of a material to remain unchanged.

Systemic health effect — damage which occurs when a chemical is absorbed and travels through the body to a specific organ.

TLV — threshold limit value; an estimate of the chemical levels, in parts per million or milligrams per cubic meter of air, that most people can be exposed to without adverse effects. TLVs are recommendations established by the American Conference of Governmental Industrial Hygienists and are used only as guidelines.

TLV-ceiling — the concentration which should not be exceeded, even for an instant.

TLV-STEL — short-term exposure level; the maximum concentration to which workers can be exposed for a period of up to 15 minutes.

TLV-TWA — the allowable time-weighted average concentration for a normal 8 hr workday or 40 hr workweek.

Toxic material — a substance which produces injury or illness if it is ingested, inhaled, or absorbed.

Toxicity — The capacity of a substance to produce an unwanted effect.

UEL — upper explosive limit; the highest concentration of a substance that will produce an explosion when an ignition source is present.

Unstable — the tendency of a material to decompose or change chemically during normal handling or storage.

Vapors — the gaseous form of substances, which are normally in the solid or liquid state at room temperature and pressure.

ATTACHMENT 5

RESPIRATORY PROTECTION PROGRAM

RESPIRATORY PROTECTION PROGRAM

1.0 PURPOSE

The purpose of this procedure is to provide instruction and guidance for determining when respiratory protection is required and for the use, fitting, inspection, cleaning, and storage of respiratory protection equipment. The requirements for wearing respiratory protection equipment apply to all personnel entering real or potential airborne radioactivity areas. The Radiation Safety Officer (RSO) is responsible for ensuring that all aspects of this procedure are followed.

2.0 REFERENCES

- 2.1 United States NRC Regulatory Guide 8.15; Acceptable Programs for Respiratory Protection.
- 2.2 Occupational Safety and Health Administration respiratory protection standard 29 Code of Federal Regulations Section 110.134

3.0 REQUIREMENTS

3.1 Prerequisites

3.1.1 Before any person can use respiratory protection devices, the person must have:

3.1.1.1 received a current medical certificate (no more than one year old) from an approved medical doctor indicating that the employee is medically fit to wear respiratory protective devices;

3.1.1.2 completed a respiratory protection training class as part of the training program; and;

3.1.1.3 successively completed an approved respiratory protection fit test if negative pressure respirators are used.

4.0 PROCEDURE

4.1 General

4.1.1 No individual shall wear a respiratory protection device (mask) for a period of more than five (5) consecutive hours without a one (1) hour break and for no more than a total of ten (10) hours in any work day.

4.1.2 If an individual working in a mask experiences any of the following, he or she shall leave the area, adhere to normal exiting procedures detailed in Step 4.3.11, and immediately contact his or her supervisor:

- 4.1.2.1 Equipment malfunction
- 4.1.2.2 Physical or emotional distress
- 4.1.2.3 Procedural or communication failure
- 4.1.2.4 Significant deterioration of operating conditions
- 4.1.2.5 Any other condition that might require relief
- 4.1.3 No individual shall be allowed to wear respiratory protection devices until all training and fit testing have been completed.
- 4.1.4 Respiratory protection is required when airborne radioactive materials exist in concentrations to such a degree that an individual present in the area without respiratory protective equipment could exceed, during the hours an individual is present in a week, an intake of 0.6 percent of the annual limit on intake (ALI) or 12 derived air concentration (DAC)-hours.
- 4.1.5 In an area where the airborne radioactive material concentrations are unknown or where the work to be performed may cause an unknown concentration, respiratory protection shall be worn until the airborne concentration is determined to be within the requirement of 4.1.4.
- 4.1.6 In any area where the airborne radioactive material concentration is greater than the airborne conditions stated in 4.1.4, an evaluation of the need for respiratory protection shall be performed and documented.
- 4.2 Determination of Airborne Radioactive Material Concentrations
 - 4.2.1 The health physicists shall collect and count air samples to determine the number of MPCs present and the estimated MPC-hours for a work area.
- 4.3 Use of Full Face Mask with Cartridge
 - 4.3.1 Obtain full face mask with appropriate cartridge from mask storage or health physicist technician.
 - 4.3.2 Perform visual inspection of mask, insuring all valves and straps are in perfect working order.
 - 4.3.3 Proceed to work area and don protective clothing, as required.
 - 4.3.4 Loosen mask webbing.
 - 4.3.5 If the cartridge is not attached to the mask, screw the cartridge to the mask and tug on it to ensure that it is fastened tightly and not cross threaded to mask.

-
- 4.3.6 Grip the webbing with both hands, insert chin in the mask, and pull the webbing over head.
 - 4.3.7 Place one hand against face plate to position the mask on face and tighten the webbing straps with the other hand. Adjust the webbing straps from bottom to top.
 - 4.3.8 Once the mask is on, perform the negative pressure test by covering the cartridge openings and inhaling. The mask will collapse against face and stay collapsed until exhalation if a proper seal is obtained.
 - 4.3.9 If the above test fails to ensure a proper fit, repeat Steps 4.3.7 and 4.3.8.
 - 4.3.10 When a proper seal is obtained, enter work area.
 - 4.3.11 Upon egress, place the mask in a plastic bag, seal, and place bag in the appropriate used mask container.
 - 4.3.12 To verify PAPRs are providing the NIOSH-approved air flow rate, test the PAPRs weekly using a flow check meter according to Step 4.3.13 through 4.3.15.
 - 4.3.13 Attach flow check meter to the PAPR blower unit. Engage blower unit, read check meter, and compare reading to the NIOSH-approved flow rate for the PAPR.
 - 4.3.14 If the above test fails, replace filter cartridges with new cartridges and increase frequency of flow meter tests as warranted.
 - 4.3.15 If flow test fails with new cartridges, replace the blower motor and retest.
- 4.4. Mask Cleaning
- 4.4.1 Collect used masks and cartridges.
 - 4.4.2 Wear required anti-contamination clothing to unpackage masks.
 - 4.4.3 Transport masks to the cleaning area; carefully open each bag and survey for contamination. Remove cartridge from mask.
 - 4.4.4 To prevent cross contamination, separate and repackage any masks reading greater than 20,000 dpm/100 cm² beta-gamma and/or 500 dpm/100 cm² alpha smearable. Clean these later in a separate batch.
 - 4.4.5 Wash masks in a solution of warm water (120-140°F) and cleaner/sanitizer.
 - 4.4.6 Rinse masks completely in warm or hot water (140°F maximum).

4.4.7 After masks have completely dried, survey each mask for residual radiation/contamination. Dispose of masks that cannot be decontaminated to background levels.

4.4.8 Dispose of used cartridges.

4.5 Health Physicist Technician Mask Inspection

Note: All masks and related equipment shall be inspected before being returned to service.

4.5.1 After the masks have been cleaned and monitored for radiation/contamination, inspect each mask for the following:

4.5.1.1 Straps, webbing, suspension - in good working order; no cuts, cracks, etc.

4.5.1.2 Facepiece or nosepiece - no tears, defects; or cracks.

4.5.1.3 Cartridge mounts - threads in good condition; rubber seal in place.

4.5.1.4 Lens (if full face) - no large scratches; no cracks.

4.5.1.5 Exhalation valve - still supple; no damage.

4.6 Respirator Protection Training

Note: A general Respirator Protection Training program shall be established and presented to all personnel requiring respiratory protection.

4.6.1 This training program shall cover, at a minimum, the following:

4.6.1.1 Why and when respiratory protection is required

4.6.1.2 Discussions of respiratory protection, operating principles, and limitations

4.6.1.3 Procedures used to ensure proper fit and use

4.6.1.4 Use, care and maintenance of respiratory protection devices

4.7 Respirator Fit Test Procedure

4.7.1 Purpose

To provide guidance for respirator selection and qualitative and/or quantitative fit testing of selected respirators for use at site. At a minimum, full face negative pressure respirators with a protection factor of 50 times the PEL or DAC will be used.

4.7.2 Procedures

4.7.2.1 Equipment

- 4.7.2.1.1 A selection of respirators including various sizes from different manufacturers.
- 4.7.2.1.2 Irritant ventilation smoke tubes containing stannic oxychloride and a low pressure pump.
- 4.7.2.1.3 Fit test chamber similar to a clear 55-gallon drum liner suspended inverted over a 2-foot frame so that the top of the chamber is about 6 inches over the test subject's head.
- 4.7.2.1.4 Organic vapor cartridges or cartridges offering protection against organic vapors.

4.7.2.2 Respirator Selection

- 4.7.2.2.1 The test subject shall be allowed to choose the most comfortable respirator from a variety of sizes and different manufacturers.
- 4.7.2.2.2 The selection process shall be conducted in a room separate from the fit test chamber to prevent odor fatigue.
- 4.7.2.2.3 The test subject shall conduct the conventional positive and negative pressure fit checks before fit testing. Failure of either check shall be cause to select another respirator.
- 4.7.2.2.4 The employee shall be given the opportunity to select a different face piece if the chosen face piece becomes increasingly uncomfortable at any time.
- 4.7.2.2.5 Respirators shall be equipped with high efficiency particle filter cartridges, MSA HE Optifilter XLs or equivalent.

4.7.2.3 Fit Test Using Irritant Fume Testing Agent as an Example

- 4.7.2.3.1 The test subject shall be allowed to smell a weak concentration of the irritant smoke to familiarize the subject with the characteristic odor.
- 4.7.2.3.2 The test subject shall properly don the respirator selected as above, and wear it for at least 10 minutes before starting the fit test.

- 4.7.2.3.3 The test conductor shall review this protocol with the test subject before testing.
- 4.7.2.3.4 Break both ends of a smoke tube containing stannic oxychloride. Attach a short length of tubing to one end of the smoke tube. Attach the other end of the smoke tube to a low pressure pump.
- 4.7.2.3.5 The test conductor shall direct the stream of irritant smoke from the tube towards the face seal area of the test subject. The person conducting the test shall begin with the tube at least 12 inches from the face piece and gradually move to within 1 inch, moving around the whole perimeter of the mask.
- 4.7.2.3.6 The test subject shall be instructed to do the following exercises while the smoke is challenging the respirator. Each exercise shall be performed for 1 minute.
1. Breathe normally.
 2. Breathe deeply; be certain breaths are deep and regular.
 3. Turn the head all the way from one side to the other; inhale on each side; do not bump the respirator against the shoulders.
 4. Nod head up and down; be certain motions are complete and made every second; do not bump respirator against the chest.
 5. Talk aloud and slowly for several minutes; a wide range of facial movements should be used to satisfy this requirement.
 6. Grimace.
 7. Bend and touch toes.
 8. Breathe normally.

4.7.2.4 Quantitative Fit Test

- 4.7.2.4.1 Quantitative fit testing shall be accomplished by modifying the face piece to allow sampling inside the breathing zone of the user, midway between the nose and mouth.

- 4.7.2.4.2 This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate face piece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the face-piece.
- 4.7.2.4.3 Any modifications to the respirator face piece shall be completely removed, and the face piece restored to NIOSH-approved configuration, before it is reused.

5.0 ATTACHMENTS

5.1 Fit Test Record

FIT TEST RECORD

Name _____ Date _____

Location _____ Type of fit test _____

Test administrator _____ Testing agent _____

Type of mask _____

Manufacturer _____

Model _____

Size _____

Fit Test Exercise:	Pass or Fail
Normal breathing	_____
Breathe deeply	_____
Turn head side to side (inhale at each side)	_____
Nod head up and down (inhale with head up)	_____
Read rainbow passage	_____
Grimace	_____
Bend and touch toes	_____
Normal breathing	_____
Overall fit factor	_____

Recommendations: _____

Clean Shaven? _____ Spectacle Kit Requested? _____

I hereby certify that the above named individual has been quantitatively fit-tested and that the above information reflects the results of the test.

Test subject _____

Test administrator _____

Fit-test expiration date _____

APPENDIX C
QUALIFICATIONS OF SITE RADIATION SAFETY OFFICER

KENNETH R. BAKER, PH.D.

EDUCATION: Ph.D., Experimental Nuclear Physics -- Vanderbilt University (1972)
M.S., Physics -- Indiana State University (1966)
B.S., Mathematics -- Indiana State University (1964)

**PROFESSIONAL
TRAINING:**

- AEC Health Physics Fellow (three-year program)
- Hazardous Materials Workers 40-hour Training (current)

**CAPABILITY
SUMMARY:**

Twenty years experience in environmental, health, and safety-related activities. Experience includes: principal consultant for very large site remediations for industrial clients, managed RI/FS activities for DOE sites, established and managed a radiological services department to support the cleanup of 24 uranium mill tailings sites. Currently principal of company specializing in planning and supporting the decommissioning of radiologically contaminated property. Fields of competence include remediation of radiological sites, regulatory analysis, radiation dose and risk assessment, site characterization, decontamination and decommissioning, hazardous waste management, remediation planning, radiation measurement techniques, health physics practices and procedures, environmental sampling and analysis.

**FUNCTIONAL
SUMMARY:**

- **Principal Consultant and Radiation Safety Officer for the decommissioning of two Michigan Sites owned by Dow Chemical Company.** Prepared all radiation protection and operating procedures. Established two on-site laboratories for sample analyses. Responsible for all environmental health and safety activities and the 15 radiation technicians working on site. This \$25 million dollar project was completed in 1997.
- **Principal Consultant for Pathfinder Mines Corporation.** Conducted site characterization studies and prepared verification plans and other reclamation planning documents for submittal to the Nuclear Regulatory Commission for two uranium mill sites currently being decommissioned. ERG is supporting the cleanup by conducting GPS-based radiological surveys, excavation control surveys, and soil sampling and analyses for these sites. ERG established and is operating an on-site laboratory. This large program was completed in 1999.
- **Principal Consultant and Radiation Safety Officer for the remediation of a large industrial radioactive waste storage facility owned by Dow Chemical Co and Consolidated Aluminum Corporation where 90,000 cubic yards of slag and soil contaminated with Th-230/Th-232 and PCBs were removed.** Tasks include conducted a groundwater study for organic, radiological, and chemical contaminants; conducted a chemical/radiological site characterization of the 40-acre site; developed remediation alternatives and associated risks; represented client interests at meetings with the Illinois Department of Nuclear Safety, developed remedial concept designs; prepared the remediation management plan, remedial action operations plan, and the health and safety plan; served as Corporate Radiation Safety Officer for client; established an on-site laboratory, and managed

various remedial action activities including removal of radiological and PCB contaminated materials.

Prepared site verification reports for submittal to the regulatory agencies. This work was completed in the fall of 1992 and the radioactive materials license was terminated in January 1993. Regulatory approval of the PCB cleanup was also received in January 1993.

- **Principal Consultant for Remediation of the Bluewater Uranium Mill** owned by Atlantic Richfield Company. Developed and implemented a site characterization plan for the facility with emphasis on disposal alternatives for buildings and process system components. Samples from process tanks and residual materials, were taken and analyzed for use in the disposal alternatives assessment. Several risk assessments were performed to support the unrestricted release of material and to obtain exemptions from regulations and the reclamation plan. Assisted the client in preparing remedial designs and in presenting the reclamation plans to the Nuclear Regulatory Commission (NRC). Prepared a Supplemental Environmental Report for submission to the NRC and a Petition for Redesign of the Main Tailings Pile Cover System. Innovative changes to the design have resulted in savings to the client of approximately \$6 million. Currently serves as Principal Consultant and Quality Assurance Specialist for all Environmental Health and Safety Functions for this \$75 million project. This work was completed in 1996.
- **Principal Consultant and Environmental Contractor for Remediation of the Homestake Mining Company Mill Site.** Characterized mill tailings pile and cover material for parameters necessary to model the radon flux from the pile. Developed tailings pile cover design for this NRC regulated site. Developed soil verification procedures for the site. Serves as principal technical liaison between client and the NRC regarding cover design. Made radon flux measurements on pile and old mill site.
- ERG provided radiological survey services and verification measurements associated with the decontamination of the large windblown tailings contamination around the mill tailings pile. A global positioning system coupled to radiological survey equipment was used to support the cleanup of approximately 1000 acres of windblown tailings contaminated property. Prepared the Completion Report. This work was completed in 1996.
- **Project Manager for the DOE Environmental Restoration Program Activities.** Managed RI/FS work assigned to WESTON for the Mound Plant and LANL facility. Prepared scoping documents, sampling and analysis plans, standard operating procedures for sampling and handling of radioactive samples, and a baseline risk assessment. Conducted audits of laboratory radioactive analytical and sample handling procedures. Worked closely with EPA Region V in developing the Mound Plant Documents.
- **Manager of Radiological Services for DOE's UMTRA project, which involves the cleanup of 24 abandoned uranium facilities.** Responsible for supervising a staff of nine health physicists for five years, defining the data necessary for determination of source term and extent of contamination, managing over \$2

million annually for four years of subcontractor radiological data acquisition, developing measurement procedures and requirements for use by all subcontractors, developing and implementing a QA program to ensure data quality, managing and participating in the radiological design efforts, establishing the environmental monitoring program around the 24 processing sites, developing the project health and safety program, and performing the risk assessments for the NEPA documents.

- **Under contract to the Office of Radiation Programs, U.S. EPA, performed several studies to support EPA rulemaking.** Designed and managed a large site characterization and radiological risk assessment associated with exposure of the public to open-pit uranium mines. Also participated in a literature review of radiological impacts associated with diffuse naturally occurring radioactive wastes. This work was used in developing the National Emissions Standards for Hazardous Air Pollutants. Other work included collecting soil-gas permeability, soil Ra-226 concentration, and soil-gas radon concentration data near homes with elevated indoor radon concentrations. Correlations were done in order to develop and test models to predict the indoor radon concentration. Other work included conducting a literature search and review of treatment technologies for mixed radioactive wastes.
- **Responsible for preparing portions of the RI/FSs for the Montclair/West Orange and Glenridge radioactively contaminated sites in New Jersey under the EPA REM II SARA contract.** Specific areas of responsibility included preparing the project operations plan, health and safety plan, QA plan, laboratory data evaluation, conducting property screening surveys, interpreting design data, and assessing health risks associated with the various alternatives. Similar tasks were performed for the New Jersey U.S. Radium site.
- **Managed and participated in the radiological site characterization of six radium-contaminated properties in Denver, Colorado.** Interim mitigative design alternatives were developed for each of the properties as part of the overall feasibility study.
- **Served as Principal Technical Advisor to WESTON at Rockwell International, Rocky Flats RCRA permitting on radiation-related issues, and supervised additional radiological specialists as needed.** Developed and implemented radiological screening procedures for the removal of mixed-waste samples from the production area.
- **Radiological Engineering Group Leader.** Responsible for serving the nuclear power industry while employed by INPO by identifying radiation protection, waste management, or environmental problems, and proposing or developing solutions to the problems. Notable accomplishments include developing a new method for estimating doses from beta radiation, developing a method for evaluating portal monitors, and publishing the Radiological Experience Notebook, a new periodical for member utilities containing articles on safe radiological practices or other items of interest to radiological protection personnel.

- While employed by DOE, initiated programs leading to the development of environmental and occupational safety standards and policies applicable to DOE waste management, decontamination and decommissioning, and radiation protection programs. Appraised the performance of DOE field offices and contractors in health protection and environmental matters. Developed cleanup criteria for sites to be decommissioned and released to the public. Reviewed decommissioning plans and reports for technical accuracy and adequacy. Provided technical assistance and reviews for the DOE remedial activities in the South Pacific and Formerly Utilized Sites Remedial Action Programs. Participated in selecting the best decommissioning options. Special interest work was done in the areas of transuranics in the environment and natural radioactivity.
- Research and faculty assignments, Georgia Institute of Technology and Bradley University. Performed research in the areas of atomic and nuclear physics employing gamma ray, x-ray, and electron spectrometers using radioactive sources and particle accelerators.
- Special short-term assignments at Los Alamos National Laboratory, Argonne National Laboratory, and the National Council on Radiation Protection and Measurements.

**PROFESSIONAL
EXPERIENCE:**

Environmental Restoration Group, Inc., Principal, Albuquerque, NM - 1992 - Present

Roy F. Weston, Inc., Vice President, Project Director, Project Manager, Albuquerque Office - 1982 - 1992

Institute of Nuclear Power of Operations, Radiological Protection and Emergency Preparedness Division - 1980 - 1982

U.S. Department of Energy, Division of Operational and Environmental Safety - 1974 - 1980

Georgia Institute of Technology, School of Chemistry - 1972 - 1974

Bradley University, School of Applied Sciences and Engineering - 1966 - 1968

**PROFESSIONAL
REGISTRATIONS/
AFFILIATIONS:**

- Member, Health Physics Society
- Member, American Nuclear Society

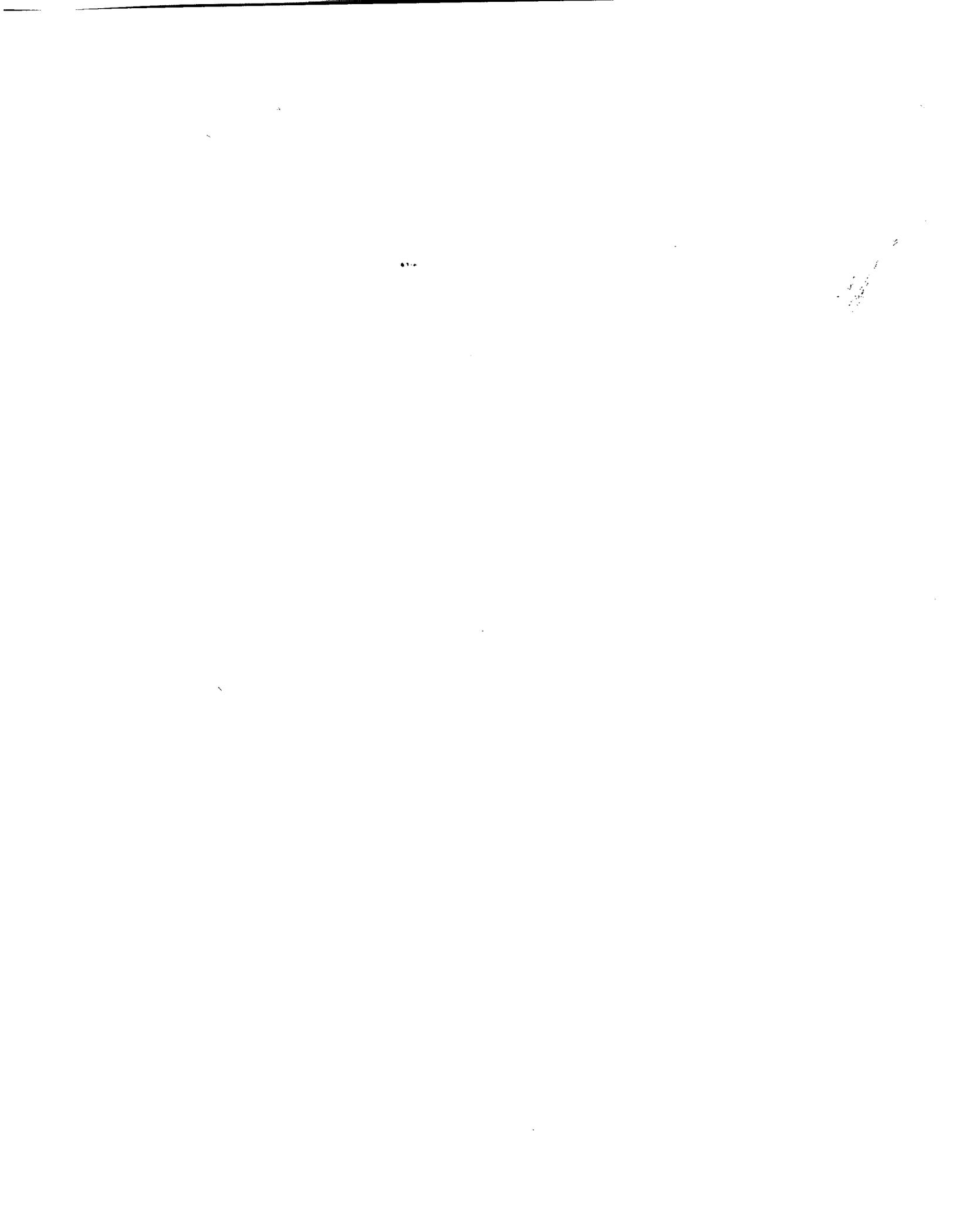
PUBLICATIONS:

Published more than 30 publications in professional journals in the areas of waste management, health physics, nuclear physics, and atomic physics.

CLEARANCES:

DOE Q, inactive

**APPENDIX D
CALCULATIONS OF SOIL VOLUME**



D1.0 CONTAMINATED OT-10 LAND AREA AND VOLUME ESTIMATES

Land areas impacted above the OT-10 Derived Concentration Guideline Level (DCGL) of 5.9 picocuries per gram (pCi/g) thorium-232 are estimated in this appendix.

Contaminated Land Area Estimates

An investigation level was developed for each training site using the gamma radiation count rate that corresponds to the Derived Concentration Guideline Level of 5.9 pCi/g thorium-232 above background. The investigation levels were originally presented in Table 2-28 in Section 2.4.5.7 of the Decommissioning Plan and are reproduced below.

Table D-1. Site-Specific Evaluation of Investigation Levels for Installation Restoration Program Site OT-10

Data Set	Collimated Detector			Bare Detector		
	Linear Equation	r ²	IL ^a (cpm)	Linear Equation	r ²	IL ^a (cpm)
All	$Gamma = 977 \times C_{thorium-232} + 4099$	0.67	11,000	$Gamma = 2596 \times C_{thorium-232} + 15427$	0.61	33,000
TS5	$Gamma = 1059 \times C_{thorium-232} + 6172$	0.55	13,000	$Gamma = 3121 \times C_{thorium-232} + 22835$	0.44	44,000
TS6	$Gamma = 808 \times C_{thorium-232} + 5583$	0.71	11,000	$Gamma = 2060 \times C_{thorium-232} + 22081$	0.54	36,000
TS7	$Gamma = 642 \times C_{thorium-232} + 4526$	0.77	9,000	$Gamma = 1652 \times C_{thorium-232} + 15024$	0.79	26,000
TS8	$Gamma = 1320 \times C_{thorium-232} + 1947$	0.75	10,000	$Gamma = 3547 \times C_{thorium-232} + 8990$	0.75	33,000

Notes:

^a Residential investigation level is rounded to the nearest thousand.

c = concentration

cpm = counts per minute

DCGL = derived concentration guideline level

IL = investigation level

r² = Pearson's correlation

Bare detector investigation levels were used to estimate soil volumes because the bare detector gamma radiation scanning data provides 100 percent coverage of each training site. The investigation levels for each site are 44,000 counts per minute (cpm) at TS5, 36,000 cpm at TS6, 26,000 cpm at TS7, and 33,000 cpm at TS8.

ArcView Geographic Information System software was used to draw polygons around areas where gamma radiation counts were greater than an investigation level and around hot spots. Hot spots were assumed to occur where gamma radiation counts exceeded 50,000 cpm. The area inside each of the polygons, which were then used to calculate the contaminated land area. "Holes" in the hot spots; that is, polygons within hot spots that surround gamma counts *less than* 50,000 cpm, were observed at Training Site 6. The areas of these polygons were subtracted from the total hot spot area.

Volume Estimates

Training site-specific volumes were determined for two areas: hot spots and dispersed areas.

For a particular training site, hot spot volumes were calculated by totaling the areas of polygons surrounding gamma radiation counts greater than 50,000 cpm. This area was multiplied by the average depth of contamination observed in the hot spots during the 1996/1998 investigation at Site OT-10 (USAF, 1999a). The resulting volume was increased by a bulking factor of 1.3 to estimate a loose volume for transport and disposal.

For a particular training site, dispersed area volumes were calculated by subtracting the areas of polygons surrounding gamma radiation counts greater than 50,000 cpm from the areas of polygons surrounding gamma radiation counts greater than the investigation level. This area was multiplied by 0.5 feet, the maximum observed depth of contamination observed in the 2000/2001 investigation at Site OT-10 (USAF, 2002a). The resulting volume was increased by a bulking factor of 1.3 to estimate a loose volume for transport and disposal.

The area and volume estimates follow. There is one table for each of the four training sites and a site-wide summary table.

Area and Volume Estimates Using Site-Specific Investigation Levels - 6 inch depth in dispersed areas

Training Site 5		sq. feet
Areas		
Area >44,000 cpm investigation level		73,395
Total Area Impacted above the TS5 Investigation Level= sum(Area>44,000)		73,395
Area >50,000 cpm		52,598
Area >50,000 cpm		50
Total Area >50,000 cpm = sum (Area >50,000 cpm)		52,648
Contaminant Depth (assumed average depth based on soil profile data collected in 1997/1998)		2.0 ft
Volumes		
Soil Volume in Dispersed Areas = (Total Impacted Area - Total Area >50,000 cpm) * 0.5 ft * 0.03704		384
Total Volume in Dispersed Areas (30% bulking) = (Soil Volume in Dispersed Areas * 1.30)		500
Soil Volume in Hot Spots = (Total Area >50,000 cpm * Max Contaminant Depth) * 0.03704		3,900
Total Volume in Hot Spots (30% bulking) = (Soil Volume in Hot Spots * 1.30)		5,070
Note:		
Contaminant depth is assume to be 0.5 ft outside hotspots.		
0.03704 is a conversion factor for cubic feet to cubic yards.		

Training Site 6		sq. feet
Areas		
Area >36,000 cpm investigation level		293,098
Total Area Impacted above the TS6 Investigation Level= sum(Area>36,000)		293,098
Area >50,000 cpm		53,817
Area >50,000 cpm		113,141
Area >50,000 cpm (area between 18,000 and 50,000)		-2,455
Area >50,000 cpm (area between 18,000 and 50,000)		-2,953
Total Area >50,000 cpm = sum (Area >50,000 cpm)		161,550
Contaminant Depth (assumed average depth based on soil profile data collected in 1997/1998)		2.0 ft
Volumes		
Soil Volume in Dispersed Areas = (Total Impacted Area - Total Area >50,000 cpm) * 0.5 ft * 0.03704		2,436
Total Volume in Dispersed Areas (30% bulking) = (Soil Volume in Dispersed Areas * 1.30)		3,167
Soil Volume in Hot Spots = (Total Area >50,000 cpm * Max Contaminant Depth) * 0.03704		11,968
Total Volume in Hot Spots (30% bulking) = (Soil Volume in Hot Spots * 1.30)		15,558
Note:		
Contaminant depth is assume to be 0.5 ft outside hotspots.		
0.03704 is a conversion factor for cubic feet to cubic yards.		

Area and Volume Estimates Using Site-Specific Investigation Levels - 6 inch depth in dispersed areas

Training Site 7

	sq. feet
Areas	
Area >26,000 cpm investigation level	11,076
Area >26,000 cpm investigation level	14,522
Area >26,000 cpm investigation level	96
Area >26,000 cpm investigation level	276
Total Area Impacted above the TS7 Investigation Level= sum(Area>26,000)	25,970
Volumes	
Area >50,000 cpm	988
Area >50,000 cpm	4,255
Total Area >50,000 cpm = sum (Area >50,000 cpm)	5,243
Contaminant Depth (assumed average depth based on soil profile data collected in 1997/1998)	1.0 ft
Volumes	
Soil Volume in Dispersed Areas = (Total Impacted Area - Total Area >50,000 cpm) * 0.5 ft * 0.03704	384
Total Volume in Dispersed Areas (30% bulking) = (Soil Volume in Dispersed Areas * 1.30)	499
Soil Volume in Hot Spots = (Total Area >50,000 cpm * Max Contaminant Depth) * 0.03704	194
Total Volume in Hot Spots (30% bulking) = (Soil Volume in Hot Spots * 1.30)	252
Note:	
Contaminant depth is assume to be 0.5 ft outside hotspots.	
0.03704 is a conversion factor for cubic feet to cubic yards.	

Training Site 8

	sq. feet
Areas	
Area >33,000 cpm	15,316
Total Area Impacted above the TS8 Investigation Level= sum(Area>33,000)	15,316
Volumes	
Area >50,000 cpm	5,040
Total Area >50,000 cpm = sum (Area >50,000 cpm)	5,040
Contaminant Depth (assumed average depth based on soil profile data collected in 1997/1998)	2.0 ft
Volumes	
Soil Volume in Dispersed Areas = (Total Impacted Area - Total Area >50,000 cpm) * 0.5 ft * 0.03704	190
Total Volume in Dispersed Areas (30% bulking) = (Soil Volume in Dispersed Areas * 1.30)	247
Soil Volume in Hot Spots = (Total Area >50,000 cpm * Max Contaminant Depth) * 0.03704	373
Total Volume in Hot Spots (30% bulking) = (Soil Volume in Hot Spots * 1.30)	485
Note:	
Contaminant depth is assume to be 0.5 ft outside hotspots.	
0.03704 is a conversion factor for cubic feet to cubic yards.	

Total of Impacted Areas at OT-10	
Total Impacted Area at OT-10 = sum(Total Impacted Area)	407,779 sq ft
Total Area in Hot Spots = sum(Total Area >50,000 cpm)	224,481 sq ft
Total Volume in Dispersed Areas = sum(Total Volume for Alternative Disposal with 30% bulking)	4,413 cu yds
Total Volume in Hot Spots = sum(Total Volume in Hot Spots with 30% bulking)	21,366 cu yds
Grand Total Contaminated Soil Volume	25,779 cu yds

APPENDIX E
QUALITY ASSURANCE PROJECT PLAN

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ACRONYMS

AFB	air force base
AFCEE	Air Force Center for Environmental Excellence
AFIERA	Air Force Institute for Environmental, Occupational and Safety Risk Analysis
AFMOA	Air Force Medical Operations Agency
ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
bgs	below ground surface
°C	degrees Celsius
CCV	continuing calibration verification
CFR	<i>Code of Federal Regulations</i>
cm ²	square centimeters
DCGL	derived concentration guideline level
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
dpm	disintegrations per minute
DQO	data quality objectives
ECD	electron capture detector
EICP	extracted ion current profile
EMC	elevated measurement comparison
EMR	environmental management restoration
EPA	U.S. Environmental Protection Agency
ERG	Environmental Restoration Group
FID	flame ionization detector
ft	foot/feet
GC	gas chromatograph
HAZWOPER	hazardous waste site operations and emergency response
hr	hour
HSO	health and safety officer
HSP	health and safety plan
ICAL	initial calibration
IRP	installation restoration program

ACRONYMS (CONTINUED)

lb/ft ³	pounds per cubic foot
LCS	laboratory control sample
LIMS	laboratory information management system
m/m ²	meters/square meters
MARSSIM	<i>Multi-Agency Survey and Site Investigation Manual</i>
MCAWW	<i>Methods for Chemical Analysis of Water and Waste</i>
MDC	minimum detectable concentration
MDL	method detection limit
mg/kg	milligrams per kilogram
ml	milliliter
mR	milliRoentgen
MS	matrix spike/mass spectrometer
MSD	matrix spike duplicate
MWHA	MWH Americas, Inc.
MWHC	MWH Constructors, Inc.
NA	not applicable
NAS	National Academy of Sciences
NIST	National Institute of Standards and Technology
nm	nanometer
NRC	U.S. Nuclear Regulatory Commission
OSHA	Occupational Safety and Health Administration
PARCC	precision, accuracy, representativeness, completeness, and comparability
pCi/g	picocuries per gram
PQL	practical quantitation limit
QA	quality assurance
QAM	quality assurance manager
QAO	quality assurance officer
QAPP	quality assurance project plan
QC	quality control
RCRA	<i>Resource Conservation and Recovery Act</i>
RER	replicate error ratio
RESRAD	residual radiation
RPD	relative percent difference
RSO	radiation safety officer
SDRH	Surveillance Directorate Radiation Surveillance Division
SOP	standard operating procedure
SRM	standard reference material

ACRONYMS (CONCLUDED)

STL	Severn Trent Laboratories
SVOC	semivolatile organic compound
SW	solid waste
TBD	to be determined
TCLP	toxicity characteristic leachate procedure
TRM	technical/remediation manager
TS5	Training Site 5
TS6	Training Site 6
TS7	Training Site 7
TS8	Training Site 8
$\mu\text{g/L}$	micrograms per liter
μR	microRoentgens per hour
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
VOC	volatile organic compound

E1.0 QUALITY ASSURANCE PROJECT PLAN

E1.1 Objective

This Quality Assurance Project Plan (QAPP) defines the data quality objectives (DQOs) for the remediation of Installation Restoration Program (IRP) Site OT-10 at Kirtland Air Force Base (AFB), New Mexico. It also describes the field and analytical procedures that will be used to collect data of sufficient quality to support end use. In addition, this QAPP presents the organization, objectives, functional activities, and the project-specific quality assurance (QA) and quality control (QC) procedures to be followed by the contract laboratory for completion of the remedial action.

The procedures detailed in this QAPP comply with the Kirtland AFB base-wide plan, U.S. Environmental Protection Agency (EPA) Region VI requirements, applicable professional technical standards, and the project-specific DQOs. It was prepared in accordance with the following guidance:

- *Kirtland AFB Base-wide Plans for the Installation Restoration Program* (USAF, 1996a);
- *Guidance for the Data Quality Objectives Process*, EPA QA/G-4 (EPA, 1994a);
- *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (EPA, 1994b);
- *Multi-Agency Radiation Survey and Site Investigation Manual*, NUREG-1575, EPA 402-R-97-016 (EPA, 2000);
- *Guidance for Data Quality Assessment, Practical Methods for Data Analysis*, EPA QA/G-9 (EPA, 1998a);
- *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5 (EPA, 1998b); and
- *EPA Requirements for Quality Assurance Project Plans*, EPA QA/G-5 (EPA, 1999).

E1.2 Project Tasks/Organization

MWH Americas (MWH) will conduct the decommissioning of Site OT-10, under the direction of the Air Force Center for Environmental Excellence (AFCEE). MWH's responsibilities include preparing this QAPP and all other related project plans associated with this project and conducting the decommissioning field activities. The project organization, QA, and management responsibilities of Air Force, regulatory, and MWH essential project personnel and subcontractors are described in the following paragraphs.

Table E-1 lists the key OT-10 project personnel. Key project organizations and personnel are described in the following paragraphs.

Table E-1. Organizations, Project Roles, and Key Personnel for the Remedial Action at OT-10

Organization	Project Roles	Key personnel and duties
AFCEE	Client	
Kirtland AFB Environmental Management	<ul style="list-style-type: none"> Environmental Compliance Kirtland AFB Project Management 	Jerroll Sillerud – Project Manager/ QAO
Kirtland AFB Bioenvironmental Engineering	Radiation safety oversight	Captain Eugene Sheely – Base RSO
AFIERA/SDRH	Radioactive waste control	Major Daniel Caputo
NRC	Regulatory oversight	Rachel Browder – NRC Project Manager
MWHA	<ul style="list-style-type: none"> Prime contractor Project management Construction oversight Engineering designs Planning and reporting Health physics and air monitoring support Radiological surveys direction 	Rik Lewis – Program Manager Jeff Johnston – Delivery Order Manager/Project Manager Don Carpenter – QAM Reid Olson – Site TRM and Site HSO Beth Darnell – Health and Safety Manager Craig Moore – Project Chemist
MWHC	<ul style="list-style-type: none"> Construction oversight Health and Safety Oversight 	Richard Valdez – Construction Supervisor
ERG	<ul style="list-style-type: none"> Radiation training Health physics and air monitoring Radiological surveys Radiation protection oversight Onsite laboratory analysis for waste manifesting and remedial action support surveys Waste packages and equipment release 	Ken Baker – Site RSO
TBD	<ul style="list-style-type: none"> Excavation/Packaging Contractor Waste brokering 	TBD – NRC-licensed contractor and DOD-certified waste broker
TBD	Waste transportation and disposal	TBD – Transportation subcontractor

Table notes:

AFB = Air Force Base

AFCEE = Air Force Center for Environmental Excellence

AFIERA = Air Force Institute for Environmental, Safety and Occupational Risk Analysis

DOD = U.S. Department of Defense

ERG = Environmental Restoration Group

HSO = Health and Safety Officer

MWHA = MWH Americas, Inc.

MWHC = MWH Americas Constructors, Inc.

NRC = Nuclear Regulatory Commission

QAM = Quality Assurance Manager

QAO = Quality Assurance Officer

RSO = Radiation Safety Officer

SDRH = Surveillance Directorate Radiation Surveillance Division/Health Physics Branch

TBD = to be determined

TRM = technical/remediation manager

E1.2.1 Nuclear Regulatory Commission

The U.S. Nuclear Regulatory Commission (NRC) is the lead agency for this project and will provide regulatory agency review and approval of the work plans and reports prepared for the decommissioning of OT-10. The NRC has final approval authority over the fieldwork performed for this project. The NRC Project Manager will verify that NRC requirements are met.

E1.2.2 U.S. Air Force

E1.2.2.1 Air Force Center for Environmental Excellence

The Contracting Officer's technical representative for this project (Team Chief) is Mr. Rodney Arnold. Mr. Arnold will implement the project. He has the authority to commit the resources needed to meet project objectives and requirements. His specific duties include the following:

- Overseeing the technical aspects of the work and schedule on behalf of the AFCEE;
- Acquiring and applying technical and USAF resources to maintain high performance within budget and schedule constraints, as needed;
- Representing the Air Force at meetings and public hearings;
- Defining project objectives and developing a detailed work plan schedule;
- Establishing project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task;
- Reviewing the quality, responsiveness, and timeliness of each task performed, which must meet Air Force objectives;
- Reviewing and analyzing overall task performance with respect to planned requirements and authorizations; and
- Approving all reports (deliverables) before their submission to the NRC.

E1.2.2.2 Kirtland Air Force Base Project Manager

Mr. Jerroll Sillerud is the Kirtland AFB Project Manager for the decommissioning of OT-10. Mr. Sillerud's specific responsibilities will include oversight of the technical aspects of the work and schedule on behalf Kirtland AFB. He will be actively involved in planning the project and making decisions regarding the technical approach and project direction. When appropriate, he will coordinate technical

issues with AFCEE, the NRC, and MWH. He will review all documents prepared by MWH for the remedial action. Mr. Sillerud also will coordinate activities at OT-10 and represent Kirtland AFB at meetings and public hearings.

E1.2.2.3 Kirtland Air Force Base Radiation Safety Officer

Captain Sheely is the Kirtland AFB RSO. Captain Sheely will be actively involved in auditing the remedial action at OT-10 for compliance with Air Force Instruction 40-201, *Managing Radioactive Materials in the USAF* (USAF, 1996b).

E1.2.3 MWH

E1.2.3.1 MWH Program Manager

Mr. Richard S. Lewis will be the Program Manager for MWH for this project. He has the overall responsibility for the direction, coordination, technical consistency, and review of this project. Mr. Lewis will monitor the performance of project staff and will have the authority to select or dismiss MWH staff and select or terminate major subcontractors. He will oversee budgets and schedules, stop work, and communicate with the NRC and Kirtland AFB to evaluate the progress on any task and expedite the early resolution of high-level problems.

E1.2.3.2 MWH Project Manager

Mr. Jeff Johnston will be the Project Manager for this project and will report directly to the Program Manager. Mr. Johnston will be responsible for contractual activities and will serve as the focal point and main channel of communication between the NRC, AFCEE, Kirtland AFB, and the MWH project team regarding technical, financial, and scheduling matters. He will establish and interpret contractual policies, monitor schedule and costs, coordinate reporting, dedicate necessary resources, prepare long-range program plans, identify and resolve potential problems or conflicts, and provide for high-quality work under safe working conditions. His other duties will include

- Allocating work assignments, budgets, and schedules to members of the project team and orienting the staff to the goals and objectives of the project;
- Evaluating the qualifications of project staff and critical subcontractor personnel;
- Tracking the performance of the project;

- Reviewing, approving, and consistently implementing the contract planning documents;
- Assessing specific delivery orders for compliance with federal, state, and local regulations/laws and directives;
- Providing overall technical, quality, and performance consistency throughout the project;
- Interacting with regulatory or public agencies at the request of Kirtland AFB and the AFCEE;
- Distributing project-related information to the project team;
- Preparing technical reports and presentations at progress meetings between AFCEE, Kirtland AFB, and the NRC;
- Reporting any significant conditions adverse to quality and obtaining concurrence by the Project Quality Assurance Manager (QAM) on proposed resolutions; and
- Reviewing QA audit reports and corrective actions.

E1.2.3.3 MWH Project Quality Assurance Manager

Mr. Don Carpenter will be the Project QAM. He will report directly to the Program Manager. Mr. Carpenter's responsibilities include

- Determining project-specific QC requirements with the Project Manager, including the selection of appropriate SOPs required to support project activities;
- Assigning criteria committee staff and providing quality orientation training (the criteria committee consists of senior MWH staff not otherwise associated with the project that meet with the project team at critical junctures to provide an outside perspective on the project direction and/or review project documents);
- Stopping work that fails to comply with the project-specific DQOs or contract;
- Identifying the need for corrective actions and initiating, recommending, and coordinating solutions for contract-wide quality issues;
- Concurring with the disposition of contract-related nonconformance reports and non-routine occurrence reports and verifying appropriate corrective actions have been taken; and
- Providing adequate QA/QC documentation.

E1.2.3.4 MWH Project Health and Safety Officer

Ms. Beth Darnell will be the Project Health and Safety Officer (HSO) and is responsible for the oversight of the preparation of the site-specific health and safety plan (HSP). She will provide overall direction regarding matters of environmental protection, fire protection, occupational safety and health, industrial hygiene, personal protection from hazardous chemical exposure, and permitting for this project. She has the organizational freedom and authority to require changes to work practices, identify problems and proposed solutions, and if necessary, stop work activities that could pose a threat to personnel or the environment. Ms. Darnell will coordinate major health and safety activities with the Kirtland AFB RSO, the Site RSO, the Site HSO, and the MWH Project Manager and field personnel. Other duties include

- Maintaining regulatory and operational compliance with NRC and OSHA requirements, the HSP, and MWH's health and safety requirements;
- Maintaining current health and safety training and medical monitoring;
- Working with the Project Manager and field personnel to verify that all health and safety requirements outlined in the SSHP are implemented in the field;
- Performing assessments, monitoring, document reviews, and other health and safety functions as required to determine the continued effectiveness of the HSP;
- Performing random health and safety assessments in the field and verifying resolution of any resulting corrective actions.

E1.2.3.5 MWH Site Technical/Remediation Manager

Mr. Reid Olson will be the Site Technical/Remediation Manager for this project.

E1.2.3.6 MWH Project Chemist

Mr. Craig Moore is the Project Chemist for this project. Mr. Moore will report to the MWH Project Manager, interface with field personnel, and provide direction and support for all project sampling activities, including sample collection, handling, storage, preservation, and shipment. Other responsibilities include

- Interfacing with the laboratory on matters concerning chemical sampling and analysis, laboratory readiness, sampling schedules, sample containers, laboratory reports, verification and validation of data, and the resolution of nonconforming activities or data.;

- Reviewing analytical data to check their conformance with QA testing and standards, overseeing data validation, and approving analytical data;
- Identifying, reporting, and recommending solutions for nonconforming sampling, analytical activities, or data; and
- Serving as a point of contact on issues related to environmental chemistry.

E1.2.3.7 MWH Project Staff

The MWH project staff consists of experienced professionals who possess the degree of specialization and technical competence required to complete their respective tasks effectively and efficiently. Field team members will review and thoroughly understand the procedures presented in the *Initial Survey Work Plan* (USAF, 2001) and site-specific SOPs before starting any field activity.

E1.2.4 Subcontractors

All subcontractors will have the necessary skills and certifications to provide the services for which they are contracted. QAPP-related services provided by subcontractors at OT-10 include radiological surveys, health physics, analytical laboratory, and data validation services. ERG of Albuquerque, New Mexico, will conduct radiological surveys and provide health physics support. Severn Trent Laboratories (STL) of St. Louis, Missouri, will provide laboratory services. Laboratory Data Consultants of Carlsbad, California, will provide data validation services. The subcontractors will be under the direct supervision of MWH. The AFCEE, Kirtland AFB, and the NRC will be notified if there are any changes or additions to subcontractors prior to project mobilization.

The following paragraphs describe the health physics and analytical laboratory organizations.

E1.2.4.1 Site Radiation Safety Officer

Dr. Kenneth Baker of ERG will be the Site RSO for the project. Dr. Baker will conduct radiological surveys, maintain as low as reasonably achievable (ALARA) considerations, direct the radiation safety program, manage to onsite laboratory, and release waste packages and samples for shipment.

E1.2.4.2 Laboratory Project Manager

The laboratory will assign a Project Manager for this project. This individual will be the primary contact for MWH and will expedite project requirements related to the laboratory. This individual will schedule

sample analysis and verify that all analyses are conducted as specified in this QAPP. He or she also will monitor the progress and timeliness of the work, review work orders and laboratory reports, and process changes in the scope of work. This individual will take project-specific corrective action when necessary to address problems identified by the QC sample results or QA audit results. He or she will approve final analytical reports before they are submitted to MWH.

E1.2.4.3 Laboratory Quality Assurance Officer

The laboratory will have a project quality assurance officer (QAO) who will maintain laboratory QA/QC activities in accordance with the requirements specified in both this QAPP and the laboratory's internal QAPP. His or her responsibilities will include preparing QA documents that define QA/QC procedures, reviewing and approving laboratory QC procedures, and overseeing inter-laboratory testing programs and laboratory certifications. This individual also will monitor method operations through periodic data reviews and technical system audits. He or she will report unacceptable findings to the appropriate individuals for corrective action.

E1.2.4.4 Laboratory Sample Custodian

The laboratory sample custodian will report directly to the laboratory Project Manager and will

- Receive and inspect samples,
- Record information regarding sample condition and sign appropriate forms,
- Review the chain-of-custody forms and document any discrepancies,
- Notify the laboratory Project Manager or other appropriate laboratory personnel of sample receipt and inspection,
- Assign a unique identification number and customer number to each sample and log it in the sample receiving logbook and laboratory information management system (LIMS),
- Transfer samples to the appropriate laboratory sections, and
- Control and monitor access and storage of samples and extracts.

E1.2.4.5 Laboratory Technical Staff

Laboratory staff involved with sample preparation and analysis will consist of experienced professionals who possess the degrees of specialization and technical competence required to perform the work effectively and efficiently.

E1.2.5 Project Training Requirements

E1.2.5.1 MWH Training Requirements

All MWH field staff associated with this project will have sufficient training to perform their assigned tasks safely, effectively, and efficiently. All personnel working onsite will have completed Occupational Safety and Health Administration (OSHA) 40-hour hazardous waste site operations and emergency response (HAZWOPER) training in accordance with 29 *Code of Federal Regulations* (CFR) § 1910.120 guidance. All workers entering potentially contaminated areas will have attended a formal radiation safety-training program conforming to 10 CFR § 19.12. Emphasis will be placed on site-specific operations and radiological safety practices, including personal decontamination. Records of this training, including written exams for each employee, will be maintained in the onsite project file.

E1.2.5.2 Subcontractor Training Requirements

Subcontractor staff on this project will have sufficient training to perform their assigned tasks safely, effectively, and efficiently. MWH will review the training records of subcontractors before project mobilization. The Site Technical/Remediation Manager (TRM) will maintain these training records in the onsite project files.

E1.2.6 Schedule

The remedial action is planned to start in November 2002 and end in March 2004.

E1.3 Quality Assurance Objectives for Measurement Data

Data quality refers to the level of reliability associated with a particular data set or point. The quality associated with environmental measurement data is a function of the sampling plan rationale, sample collection procedures, and analytical methods and instrumentation used in making the measurements. The overall QA objectives of this QAPP are to develop and implement procedures for field sampling, chain of custody, laboratory analysis, and data reporting; provide legally defensible data; and meet the OT-10 DQOs.

DQOs are qualitative and quantitative statements that specify the field and laboratory data quality necessary to support specific decisions or regulatory actions. The DQOs describe what data are needed, why the data are needed, and how they will be used to meet the needs of the project. DQOs also establish

numeric limits for the data to allow the data user (or reviewers) to determine whether the data collected are of sufficient quality for their intended use. Table E-2 presents the DQO process for the remedial action at OT-10.

The DQOs for this project were developed in accordance with the *Guidance for Data Quality Objectives Process* EPA QA/G-4 (EPA, 1994a) and *Guidance for Data Quality Assessment, Practical Methods for Data Analysis* EPA QA/G-9 (EPA, 1998a). The remainder of this section defines how the data will be assessed to meet the project DQOs. It also defines the criteria that will be used to define acceptable limits of uncertainty.

E1.3.1 Data Types

The data types required for this project are based on the type of investigation, the project-specific DQOs, the end use of the analytical data, and the level of documentation. Both screening and definitive data will be collected during the remedial action. Methods of sample collection, preparation, and analysis determine whether data are considered screening or definitive.

Screening data are those collected using non-standard sampling methodology or collected using methods of analysis with limited means to assess their accuracy and precision. Screening data provide analyte identification and quantitation; however, analyte identity and/or quantity confirmation may not be possible.

Definitive data are those collected using standard sampling and analytical methodology of known precision and accuracy. The data are analyte-specific, with confirmation of both the analyte identity and concentration. The analytical methodologies provide tangible raw data or electronic files that can be stored or recovered. Table E-3 lists the types of data that will be collected to support the OT-10 DQOs and their end uses.

Table E-2, Data Quality Objectives Process

DDO Step	Characterization Survey	Removal of Radioactive Wastes	Remedial Action Support Survey	Final Status Survey
State the Problem Problem statement	Soils, vegetation, and debris at each of the four inactive radiation training sites at IRP Site OT-10 have been contaminated with low-level radioactive materials. From 1981 to 1990, the sites were used to train radiological response personnel to detect dispersed contamination resulting from simulated nuclear weapons accidents. Known quantities of thorium ore were applied and tilled into soils to simulate dispersed plutonium contamination. Elevated concentrations of thorium have been identified in OT-10 soils. These concentrations pose an excess cancer risk under a residential land-use scenario.	Remove soil, vegetation, and debris from MARSSIM Class 1 land areas in approximately 3- to 6-inch lifts. Remove debris and clean interior surfaces of Buildings 28005 and 28010, if warranted. Scan and collect wipe samples from waste packages. Collect and analyze samples of wastes to be shipped by truck and/or rail and disposed of in a landfill.	Scan OT-10 soils after each major stage of excavation to determine the extent and magnitude of residual thorium-232 contamination. Identify and delineate areas characterized by elevated levels of radioactivity. Collect soil samples from low-activity soils to determine statistical parameters for final status survey design. Scan interior surfaces of Buildings 28005 and 28010 to determine the extent and magnitude of residual contamination, if warranted.	Survey each of the MARSSIM Class 1 (scan and sample) and Class 2 (scan only) survey units at OT-10. Characterize areas of elevated radioactivity that were identified in the remedial action support surveys. Compare radioactivity in these areas to elevated DCGLs as determined by BESRAD modeling. Perform Wilcoxon Rank Sum test on soil sample results to compare them to the DCGL. Scan and sample the interior surfaces of Buildings 28005 and 28010, if warranted. Perform Wilcoxon Rank Sum test on sample results to compare them to the DCGL for removable contamination.
Planning team members	Members listed on Table E-1 AFCEE Team Chief AFMOA AFIERA AFBIEMR Project Manager ERG Senior Health Physicist MWHHA Project Manager MWHHA Project Chemist MWHHC Construction Manager	Planning team as indicated for the characterization survey efforts.	Planning team as indicated for the characterization survey efforts.	Planning team as indicated for the characterization survey efforts.
Primary decision maker	None - Decisions will be made by consensus	None - Decisions will be made by consensus	None - Decisions will be made by consensus	The NRC will review the final status survey to determine whether OT-10 can be released to unrestricted residential use and whether the radioactive materials license can be terminated.
Relevant deadlines	The characterization survey was conducted in October 2000, January 2001, and April 2001 (USAF, 2002)	Mobilization to start 90 days after USAF approval of the OT-10 technical plans.	None - these surveys will be conducted as part of the remedial activities.	Results of final survey to be reported prior to 24 months after submittal of the revised decommissioning plan to the NRC.
Identify the Decision Principle study question	What is the current extent and magnitude of thorium-232 and thorium-230 contamination in OT-10 soils? What is the relationship between field gamma-ray counts and thorium-232 and thorium-230 concentrations in soil? What is the distribution of thorium-232 and thorium-230 in reference areas? What is the extent and magnitude of alpha and beta contamination on the interior surfaces of storage buildings at TS8 and a reference bunker?	Does the waste meet the waste acceptance criteria of the disposal facility(ies)? Does the waste meet transportation requirements of the U.S. Nuclear Regulatory Commission and U.S. Department of Transportation?	is OT-10 ready for a final status survey?	Are the ranks of residual radioactivity on land surfaces below the DCGL and are elevated radioactivity levels in small, localized areas lower than their associated elevated DCGLs? Is the average residual radioactivity on building surfaces below the DCGL and are radioactivity levels in small, localized areas lower than their associated elevated DCGLs?
Alternative actions	None - the characterization survey was conducted to establish updated maps and a correlation between field exposure rates and actual thorium-232 and thorium-230 concentrations and to characterize the nature and extent of contamination in two storage bunkers at TS8.	None - OT-10 has been shown to pose an increased cancer risk.	None - The purpose of this step is to support remediation.	Average residual radioactivity exceeds the DCGL and radioactivity in elevated areas exceeds the elevated DCGL. Continue excavating (or cleaning building surfaces) until residual radioactivity is below the DCGL and radioactivity in elevated areas is below the DCGL _{Exc} . If building surfaces cannot be cleaned, demolish entire building and dispose of it in an appropriate landfill.
Identify the Inputs to the Decision Physical inputs	Radiological scans of land surface (using a 2-inch by 2-inch sodium iodide detector) and storage bunkers at TS8 (using an alpha scintillation detector, Geiger Mueller detector, and μ R meter). Alpha tray counts of wipe (smear) samples collected from interior surfaces of storage bunkers at TS8.	Radiological scans of transport packages using a Geiger Mueller and/or alpha scintillation detector. Alpha tray counts of wipe (smear) samples collected from waste packages and vehicles.	Radiological scans of land surface using a 2-inch by 2-inch sodium iodide or alternate detector. Radiological scans of interior surfaces of buildings using an alpha scintillation detector.	Radiological scans of land surface using a 2-inch by 2-inch sodium iodide or alternate detector. Radiological scans of interior surfaces of buildings using an alpha scintillation detector and alpha tray counts of wipe (smear) samples collected from this medium.

Table E-2. Data Quality Objectives Process (continued)

DOQ Step Identify the Inputs to the Decision (continued) Chemical inputs ¹⁸	Characterization Survey	Removal of Radioactive Wastes	Remedial Action Support Survey	Final Status Survey
	Soil analytical results from the following methods: Gamma spectroscopy (EPA 901.1 modified) Isotopic thorium (NAS/DOE 3004/RP modified)	Soil analytical results from the following methods: Onsite gamma spectroscopy (SOP 1-10) Gamma spectroscopy (EPA 901.1 modified) Isotopic thorium (NAS/DOE 3004/RP-725 modified) Isotopic uranium (NAS/DOE 3050/RP-725 modified) TCLP VOCs (SW-846 1311, 8260B) TCLP SVOCs (SW-846 1311, 8270C) TCLP pesticides (SW-846 1311, 8081A) TCLP herbicides (SW-846 1311, 8151A) TCLP metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, mercury, copper, zinc (SW-846 1311, 6010B, 7470A) Soil pH (SW-846 9045B) Paint filler liquids test (SW-846 9095A) Reactive cyanide (SW-846 Section 7.3.4) Reactive sulfide (SW-846 Section 7.3.3) Ignitability (SW-846 1030) Corrosivity (SW-846 9045C) Particle size distribution (ASTM D422 with hydrometer) Moisture content (ASTM D2216) Soil bulk density (ASTM D2937) Proctor Test (ASTM D695-91)	Soil analytical results from the following methods: Onsite gamma spectroscopy (SOP 1-10) Gamma spectroscopy (EPA 901.1 modified)	Soil analytical results from the following method: Gamma spectroscopy (EPA 901.1 modified)
Action levels (DOGLs)	Land areas (concentrations above background): 5.9 pCi/g thorium-232, 0.33 pCi/g uranium-238, 0.014 pCi/g uranium-235 Building surfaces: 250 dpm/100 cm ² total surface activity 34 dpm/100 cm ² removable surface activity as alpha particles	Same as those established for the characterization survey.	Same as those established for the characterization survey.	Same as those established for the characterization survey.
Define Study Boundaries Horizontal boundary	Inside fenced areas at TS5, TS6, TS7, and TS8. Limited areas outside of fences at each training site. Storage bunkers at TS8.	Same as described for the characterization survey.	Same as described for the characterization survey.	Same as described for the characterization survey.
Vertical boundary	Assumed at an average of 2 ft bgs at TS5, TS6, and TS8; an average of 1 ft bgs at TS7. Ceilings and floors of storage bunkers at TS8.	Same as described for the characterization survey.	Same as described for the characterization survey.	Same as described for the characterization survey.
Develop Decision Rule Parameter of interest	Thorium-230 and thorium-232 concentrations in individual samples and field gamma-ray counts. Alpha-counts of building surfaces and alpha particle activities in wipe samples.	Natural thorium and natural uranium concentrations in individual samples. Other analyses as listed above for waste acceptance.	Thorium-232 concentrations in individual samples and field gamma-ray counts. Alpha counts of building surfaces and alpha particle activities in wipe samples.	Thorium-232 concentrations in individual samples and field gamma-ray counts. Alpha counts of building surfaces and alpha particle activities in wipe samples.

Table E-2. Data Quality Objectives Process (concluded)

DDO Step	Characterization Survey	Removal of Radioactive Wastes	Remedial Action Support Survey	Final Status Survey
Develop Decision Rule (cont'd)				
Scale of decision making	None for land surfaces; to be established during the evaluation of characterization survey results.	Class 1 Land Areas: Survey Units up to 2,000 m ² Class 2 Land Areas: Survey unit areas between 2,000 and 10,000 m ² . Class 1 Building Surfaces: up to 100 m ² Class 2 Building Surfaces: 100 to 1,000 m ²	Same as those selected for removal activities.	Provisionally the same as those selected for removal activities.
Action level	DCGLs as listed above.	DCGLs as listed above.	DCGLs as listed above.	DCGLs as listed above.
Alternative action	None	None	None	See previously defined alternative actions (previous page).
Specify Tolerance Limits on Decision Errors				
Maximum/average value for parameter of interest (data from 1994/1995 investigation for soil and 2000/2001 surveys for building surfaces)	Concentrations of thorium-232 in soil (pCi/g maximum/average): TS5: 421.6/67.9, TS6: 683.4/100.8, TS7: 466/55.4, and TS8: 1,047.9/76.4 Building 28010: Gamma exposure rate max = 250 µR/hr and surface contamination max = 800 dpm/100 cm ² Building 28005: Gamma exposure rate max = 4.5 mR/hr Surf. Cont. max = 200,000 dpm/100 cm ²	Same as described for the characterization survey.	Same as described for the characterization survey.	Same as described for the characterization survey.
False positive – Type I	Not applicable	Not applicable	Not applicable	5 percent
False negative – Type II	Not applicable	Not applicable	Not applicable	5 percent
Null hypothesis	Not applicable	Not applicable	Not applicable	The mean concentration of residual activity in a survey unit exceeds that in the reference area by more than the DCGL.
Governing error	Not applicable	Not applicable	Not applicable	Type I (incorrect release of survey unit) because it is more protective of long-term human health and the environment than Type II (incorrectly fail to release survey unit).
Gray region	Provisionally set at 50 percent of the DCGL.	Not applicable	Not applicable	To be established during the remedial action support surveys.
Optimize the Design for Obtaining Data	The data collection design is described in the 2000/2001 investigation work plan (USAF, 2001).	Removal of wastes as described in Section 3.2.1 of the Decommissioning Plan	Remedial action support surveys as described in Section 3.2.2 of the Decommissioning Plan	Final status surveys as described in Section 5.0 of the Decommissioning Plan

Table notes:

AFB = Air Force Base
 AFCEE = Air Force Center for Environmental Excellence
 AFIERA = Air Force Institute for Environment, Safety, and Occupational Health Risk Analysis
 AFMOA = Air Force Medical Operations Agency
 ASTM = American Society for Testing and Materials
 bgs = below ground surface
 cm² = square centimeter
 DCGL = derived concentration guideline level
 DOE = U.S. Department of Energy
 dpm = disintegrations per minute
 DQO = data quality objective
 EMC = elevated measurement comparison
 EMR = environmental management restoration
 EPA = U. S. Environmental Protection Agency
 ERG = Environmental Restoration Group
 hr = hour
 IRP = Installation Restoration Program
 m² = square meter
 MARSSIM = Multi-Agency Radiation Site and Survey Investigation Manual (EPA, 2000)
 mR = milliRoentgens
 MWA = MWH Americas, Inc.
 MWHC = MWH Americas Constructors, Inc.

NAS = National Academy of Sciences
 NRC = U.S. Nuclear Regulatory Commission
 pCi/g = picocuries per gram
 QAPP = quality assurance project plan
 RESRAD = residual radiation
 SOP = standard operating procedure
 STL = Severn Trent Laboratories
 SDRH = Surveillance Directorate Radiation Surveillance Division/Health Physics Branch
 SVOC = semi-volatile organic compound
 SW = solid waste
 TCLP = toxicity characteristic leachate procedure
 TS5, 6, 7, 8 = training sites 5 through 8
 µR = microRoentgens
 VOC = volatile organic compound

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Table E-3. Data Quality Objectives, Types, and Uses

Remedial Action	Data Quality Objectives	Data	Method	Data Type	Data Uses	
Characterization survey	Delineate the extent of radiological contamination and establish MARSSIM survey units and a reference area. Determine a relationship between field gamma-ray counts and actual concentrations, characterize the relationship between the thorium-232 and uranium-238 decay series, and characterize the distribution of thorium-232 and thorium-230 in a reference area.	Gamma-ray scanning	SOP 1-10	Screening	Site characterization and support remediation	
		Gross alpha/beta scanning	SOP 1-02	Screening		
		Gamma spectroscopy	EPA 901.1 modified	Definitive		
		Isotopic thorium	NAS/DOE 3004/RP modified			
Removal of waste	Clean release of transport containers from OT-10. Acceptance of waste by disposal facilities. Compliance with local, state, NRC, and DOT transportation requirements. DOT transportation requirements.	Gross alpha/beta scanning	SOP 1-02	Screening	Waste acceptance Waste manifesting	
		Onsite gamma spectroscopy	SOP 1-10			
		Onsite gross alpha counts of wipe samples	SOP 2-01			
		Isotopic thorium	NAS/DOE 3004/RP-725 modified	Definitive		
		Isotopic uranium	NAS/DOE 3050/RP-725 modified			
		TCLP VOCs	SW-846 1311 8260B			
		TCLP SVOCs	SW-846 1311 8270C			
		TCLP pesticides	SW-846 1311 8081A			
		TCLP herbicides	SW-846 1311 8151A			
		TCLP metals (arsenic, barium, cadmium, chromium, lead, selenium, silver, mercury, copper, zinc)	SW-846 1311 6010B 7470A			
		Soil pH	SW-846 9045B			
		Paint filter liquids test	SW-846 9095A			
		Reactive cyanide	SW-846 Sec. 7.3.4			
		Reactive sulfide	SW-846 Sec. 7.3.3			
		Ignitability	SW-846 1030			
		Corrosivity	SW-846 9045C			
		Moisture content	ASTM D2216			Screening
		Soil bulk density	ASTM D2937			
		Proctor test	ASTM D698-91			
		Particle size distribution	ASTM D422 with hydrometer			

Table E-3. Data Quality Objectives, Types and Uses (concluded)

Remedial Action	Data Quality Objectives	Data	Method	Data Type	Data Uses
Remedial action support survey	Determine the extent and magnitude of residual thorium-232 contamination; identify and delineate hot spots. Determine statistical parameters for final status survey design.	Onsite gamma spectroscopy	SOP 1-10	Screening	Support remediation
		Gamma spectroscopy	EPA 901.1 modified	Definitive	Support final status survey planning
Final status survey	Confirm levels of radioactivity on land and building surfaces are below the DCGL. Identify and characterize areas of elevated radioactivity.	Gamma spectroscopy	EPA 901.1 modified	Definitive	License termination and unrestricted use

Table notes:
 The analytical methods are based on those in the following documents:
 EPA, 1986
 EPA, 1980
 NAS/DOE, 1994
 ASTM = American Society for Testing and Materials
 DCGL = derived concentration guideline level
 DOE = U.S. Department of Energy
 DOT = U.S. Department of Transportation
 EPA = U. S. Environmental Protection Agency
 MARSSIM = Multi-Agency Radiation Site and Survey Investigation Manual
 NAS = National Academy of Sciences
 NRC = U.S. Nuclear Regulatory Commission
 SOP = standard operating procedure
 SVOC = semivolatile organic compound
 SW = solid waste
 TCLP = toxicity characteristic leachate procedure
 VOC = volatile organic compound

E1.3.2 Data Quality Definition and Measurement

The results of QC sample analysis will be evaluated in terms of precision, accuracy, representativeness, completeness, and comparability (PARCC) to determine the overall quality of definitive data. Table E-4 presents a summary of the chemical data quality control evaluation program in terms of the PARCC parameters. The remainder of this section describes the PARCC criteria and the QC samples that will be analyzed as part of this project.

Table E-4. Chemical Data Quality Control Evaluation in Terms of PARCC Parameters

PARCC Parameter	Quality Control Program	Evaluation Criteria
Precision	Field replicate sample pairs	Relative percent difference
	Matrix spike/matrix spike duplicate sample pairs	Relative percent difference
	Investigative sample/matrix duplicate sample pairs	Relative error ratio/relative percent difference
Accuracy	Matrix spike	Percent recovery
	Matrix spike duplicate	Percent recovery
	Laboratory control sample	Percent recovery
	Standard reference material	Percent recovery
	Surrogates	Percent recovery
	Tracers	Percent recovery
Representativeness	Holding time	Qualitative, degree of confidence
	Method blanks	Qualitative, degree of confidence
	Field replicates	Quantitative/qualitative, degree of confidence
Comparability	Standard field procedures	Qualitative, degree of confidence
	Standard analytical methods	Qualitative, degree of confidence
	Standard units of measure	Qualitative, degree of confidence
Completeness	Valid data	Percent acceptable data

Table notes:
PARCC = precision, accuracy, representativeness, completeness, and comparability

E1.3.2.1 Precision

Precision is the reproducibility of measurements under a given set of conditions. The precision of large data sets is expressed as the variability of a group of measurements compared to their average value. The precision of replicate measurements for gamma spectrometry, isotopic uranium, and isotopic thorium analyses is expressed as the relative percent difference (RPD) when the sample concentration is greater than five times the minimum detectable concentration (MDC), or the replicate error ratio (RER) when the sample concentration is less than five times the MDC. The RPD is calculated as follows:

$$RPD = \frac{|A - B|}{\frac{(A + B)}{2}} \times 100, \quad \text{Eq. E-1}$$

where:

A and B are the reported concentrations for duplicate sample analyses.

The RER is determined as follows:

$$RER = \frac{(S - R)}{\left[\left(\sqrt{0.15 * S} \right)^2 + E^2 \right] + \left[\left(\sqrt{0.15 * R} \right)^2 + ER^2 \right]}, \quad \text{Eq. E-2}$$

where:

RER = replicate error ratio,

S = sample value,

E_S = sample counting error (at 2 standard deviations),

R = replicate value, and

E_R = replicate counting error (at 2 standard deviations).

Field precision for this project will be assessed through the analysis of field replicate soil samples.

Analytical laboratory precision will be assessed using the RPD or RER between the following data:

- Matrix spike (MS) and matrix spike duplicate (MSD) sample data,
- Investigative sample and associated matrix duplicate sample data, and
- Investigative and associated field replicate sample data.

E1.3.2.2 Accuracy

Accuracy is the degree of agreement of a measurement or an average of measurements with an accepted reference or "true" value, and is a measure of bias in the system. The accuracy of a measurement system is affected by the sample matrix or by errors introduced during sample collection, preservation, handling, preparation, and analysis. Accuracy will be calculated using the following equation:

$$\text{Percent Recovery} = \frac{(A - B)}{C} \times 100 \quad \text{Eq. E-3}$$

where:

A is the target analyte concentration determined analytically from the spiked sample,

B is the background level determined by a separate analysis of the unspiked sample, and

C is the concentration of spike added.

A qualitative accuracy assessment for field data will be conducted by reviewing the sample collection, preservation, handling, and shipping procedures for compliance with the specifications presented in the *Initial Survey Work Plan* (USAF, 2001), the site-specific SOPs, and this QAPP. Accuracy of the field program cannot be assessed quantitatively.

Laboratory accuracy will be assessed quantitatively through the analysis of MS/MSD samples, tracers, surrogates, standard reference materials (SRM), laboratory control samples (LCS), response factors for calibration standards, and internal standard recoveries.

E1.3.2.3 Representativeness

Representativeness is a qualitative expression of the degree to which sample data accurately and precisely represent a characteristic of a population, a sampling point, or an environmental condition. The project will achieve representativeness by selecting appropriate numbers and locations of samples and sample collection and analysis techniques to provide information reflecting "true" site conditions.

Representativeness of field data depends on the proper design of data collection procedures. The selection of sampling and field measurement procedures described in the *Initial Survey Work Plan* (USAF, 2001) and site specific SOPs was based on knowledge of the site's physical setting, past land use, and operational history. Representativeness of the field data will be evaluated by assessing whether the sampling procedures defined in the *Initial Survey Work Plan* (USAF, 2001) and this QAPP were followed during sample collection. In addition, the analytical results from field replicate samples will be used to evaluate the representativeness of field sampling procedures.

Laboratory data will be evaluated for representativeness by assessing whether the laboratory followed the specified analytical criteria in this QAPP and their SOPs, assessing compliance with holding time criteria, and evaluating the results of method and instrument blank samples and field replicate samples.

E1.3.2.4 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is achieved by using standardized methods for sample collection and analysis and standardized units of measure, normalizing results to standard conditions, and using the standard and comprehensive reporting formats defined in this QAPP.

Field data comparability depends on the use of similar and standard sampling and analytical methodology and the use of standard units of measure between different projects at a site. Field data for this project

will be collected using standard sampling and measurement procedures. Comparability of field data will be evaluated by reviewing the field documentation to determine whether the field data collection procedures and sample collection, handling, and shipping protocols specified in this QAPP and the *Initial Survey Work Plan* (USAF, 2001) were followed.

Laboratory data comparability also depends on the use of similar sampling and analytical methodology and standard units of measure between different projects at a specific site. Standard sampling and analytical methodologies for this project will be similar to those used for previous sampling activities (to the extent possible). Laboratory data comparability will be assessed by comparing data collected during the remedial action to historical data and assessing whether the analytical methodology presented in this QAPP was followed.

E1.3.2.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system relative to the amount of data scheduled for collection under correct, normal conditions. Completeness measures the effectiveness of the overall investigation in collecting the required samples, completing the required analyses, and producing valid results. Completeness will be calculated using the following equation:

$$\text{Completeness} = \frac{\text{Number of valid data points}}{\text{Total number of measurements}} * 100 \quad \text{Eq. E-4}$$

where the number of valid data points is the total number of valid analytical measurements based on an evaluation of precision, accuracy, and representativeness.

Field completeness is a quantitative measure of the actual number of samples collected compared to those samples scheduled for collection. The field data completeness goal for data collected under this QAPP is 95 percent.

Laboratory data completeness is a quantitative measure of the percentage of valid data for all analytical data as determined during the precision, accuracy, and representativeness evaluation. Completeness will be calculated using the completeness equation. The laboratory completeness goal for this project is 95 percent.

AFCEE, Kirtland AFB and NRC project managers will be notified immediately if the 95 percent completeness goal is not met for field or laboratory data. The determination regarding the need for corrective action will be based on how critical the data are to the project DQOs and will be made by AFCEE and Kirtland AFB in conjunction with the NRC.

E1.3.2.6 Method-Specific Control Procedures, Frequency of Quality Controls Sample Analysis and Acceptance Criteria, and Laboratory Corrective Action

The tables in Attachment 1 to this QAPP list the accuracy and precision control limits, method-specific quality control procedures, frequency of QC sample analysis and acceptance criteria, and laboratory corrective action summaries that will be used as guidance for this project. The guidance presented in these tables is based on the criteria listed in the analytical methods.

E1.3.3 Quality Control Samples

Table E-5 describes the QC samples that will be used to evaluate analytical data in terms of the PARCC parameters for the remedial action at OT-10.

These include QC samples prepared both in the field and by the laboratory (Table E-5 presents a summary of QC sample evaluation in relation to the PARCC parameters). The following paragraphs provide a brief description of the QC sample requirements for both the field and laboratory programs and describe the sample holding time criteria assessment.

E1.3.3.1 Field Program

Quality control samples for field sampling are used to assess sample collection techniques and to assess environmental conditions during sample collection and transport. Field QC samples for this project only will include field replicates (submitted blind to the laboratory).

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Table E-5. Field and Laboratory Quality Control Sample Descriptions

Field/Laboratory QC Samples ^a	QC Sample Type ^b	Rationale	Frequency	Description	QC Sample Data Assessment
Field QC samples	Field Replicates	Assess sampling and analytical precision.	Ten percent of the total number of samples for each media and for each analytical method for site characterization and confirmation samples. Replicate samples will not be submitted with waste characterization samples.	A field replicate consists of a discrete sample split into two equal portions. One sample is labeled with the correct field identification, the other is submitted "blind" to the laboratory with a fictitious sample identification.	The RPD will be calculated for each analyte (reported above the project practical quantitation limit) between the sample and its replicate. Replicate sample data will not be used for data qualification, because these samples assess both sampling and analytical precision. The data will be used qualitatively.
	Temperature blank	Assess sample temperature criterion. Applicable to all samples that have specified temperature criteria.	Each sample cooler.	A 40-milliliter (ml) amber glass bottle filled with reagent-grade water. The temperature of this sample is measured at the time samples are received by laboratory.	Assess whether the temperature criterion of 4°C ± 2°C has been met, and if not to assess whether corrective actions are necessary.
Laboratory	Method blank	Identify target analytes that may have been introduced into the sample during analysis.	Each sample- or extraction-batch (≤20 samples) for each analytical method.	Reagent-grade water that is carried through the same analytical process as native samples.	All target analyte detections will be evaluated in accordance with the principles for data validation outlined in the <i>National Functional Guidelines for Organic and Inorganic Data Validation</i> (EPA, 1994b) and the criteria specified in Attachment 1 to this QAPP.
	Surrogate spikes	Assess analytical accuracy.	Each sample for organic analysis including both investigative and QC samples for each method.	Each sample will be spiked in the laboratory with surrogate spikes in accordance with the laboratory's SOPs for the respective methods.	Percent recovery is calculated for each spiked analyte and compared to the acceptance criteria for surrogate accuracy specified in Attachment 1 to this QAPP.
	Chemical recovery and calibration QC sample ^c	Assess analytical accuracy.	Each investigative and QC sample for isotopic thorium and isotopic uranium analysis.	Each sample will be spiked in the laboratory with a tracer in accordance with the laboratory's SOPs and the analytical method.	The percent recovery is calculated for the tracer and compared to the acceptance criteria for accuracy specified in Attachment 1 to this QAPP.
	Internal Standards	Assess analytical accuracy for gas chromatography/mass spectrometry analysis.	Each initial calibration standard (ICAL), the continuing calibration verification standard (CCV), and all samples (field and QC) prior to analysis.	The internal standard will be prepared in the laboratory using a standard of known concentration in accordance with the analytical method and laboratory's SOPs for VOC and SVOC analyses.	The retention time and EICP area criteria are determined and compared to the method specific acceptance criteria (Attachment 1 to this QAPP).
	Matrix spike/matrix spike duplicate	Assess analytical accuracy and precision and identify media interference during analysis.	Each sample- or extraction-batch (≤20 samples) for each analytical method for each media type, except for isotopic thorium and gamma spectrometry, and for waste characterization samples. A matrix spike will be analyzed only for TCLP waste characterization samples.	The samples for MS/MSD analysis are prepared in the laboratory by adding a standard of known concentration to the samples in accordance with the laboratory's SOPs for the respective methods.	Percent recovery and the RPD for each spiked analyte is calculated and compared to the acceptance criteria for accuracy and precision specified in Attachment 1 to this QAPP.
	Matrix duplicate	Assess analytical precision and identify media interference during analysis.	Each sample- or extraction-batch (≤20) for isotopic thorium, isotopic uranium and gamma spectrometry analysis.	The MD consists of one discrete sample split into two fractions and analyzed as two samples in accordance with the laboratory's SOPs for the respective methods.	The percent recovery for each spiked analyte in the MS is calculated and compared to the acceptance criteria for accuracy specified in this QAPP. The RPD is calculated between the MD and its parent sample and is compared to the acceptance criteria for precision specified in Attachment 1 to this QAPP.
	Laboratory control sample	Assess analytical accuracy. Applicable to all media.	Each sample- or extraction-batch (≤20 samples) for each analytical method.	The laboratory control sample is prepared by the laboratory and consists of reagent-grade water or sand spiked with a standard (either from a source other than, or the same source used for the initial calibration standard) in accordance with analytical method and the laboratory's SOPs for each respective method.	Percent recovery for each spiked analyte is calculated and compared to the acceptance criteria for accuracy specified in Attachment 1 to this QAPP.

Table notes:

- ^aLaboratory methods from the following references: (EPA, 1996) (EPA, 1980)
^bMatrix duplicate will be analyzed for isotopic thorium, isotopic uranium and gamma spectrometry.
^cC = degrees Celsius
 CCV = continuing calibration verification standard
 EICP = extracted ion current profile
 ICAL = initial calibration standard
 MD = matrix duplicate
 ml = milliliter
 MS = matrix spike/mass spectrometer
 MSD = matrix spike duplicate
 QC = quality control
 RPD = relative percent difference
 SOP = standard operation procedure
 TCLP = toxicity characteristic leachate procedure

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E1.3.3.2 Laboratory Program

At a minimum, the laboratory will analyze internal QC samples at the frequency specified by the analytical method and in this QAPP. Method-specific QC procedures, frequency of QC sample analysis, acceptance criteria (control limits), and corrective actions are provided in Section E1.12.

E1.3.3.3 Sample Holding Time

Sample holding time reflects the length of time that a sample or sample extract remains representative of environmental conditions. The length of time from sample collection to analysis will be evaluated for methods not requiring sample extraction. The length of time from sample collection until sample extraction and the length of time from sample extraction to sample analysis will be evaluated for methods requiring sample extraction prior to analysis. These holding times will be compared to the method-specific holding times. Samples will not be analyzed outside of these holding times without approval by the MWH Project Chemist. Table E-6 presents the holding times for each analytical method.

Table E-6. Analytical Method, Sample Container, Preservative, Unit of Measure, and Holding Time Criteria

Analytical Methods for Soil	Sample Container	Preservative	Unit of Measure	Holding Time
TCLP VOCs (SW-846 1311/8260B ^a)	4-oz glass wide-mouth bottle with a Teflon™ lined cap	Chill to 4°C	µg/L	14 days from sample collection to TCLP extraction. 14 day from TCLP extraction to analysis.
TCLP SVOCs (SW-846 1311/8270C ^a)	8-oz glass wide-mouth bottle with a Teflon™ lined cap	Chill to 4°C	µg/L	14 days from sample collection to TCLP extraction. 7 days from TCLP extraction to preparative extraction 40 days from preparative extraction to analysis.
TCLP pesticides (SW-846 1311/8081A ^a)	8-oz glass wide-mouth bottle with a Teflon™ lined cap	Chill to 4°C	µg/L	14 days from sample collection to TCLP extraction. 7 days from TCLP extraction to preparative extraction 40 days from preparative extraction to analysis.
TCLP herbicides (SW-846 1311/8151A ^a)	8-oz glass wide-mouth bottle with a Teflon™ lined cap	Chill to 4°C	µg/L	14 days from sample collection to TCLP extraction. 7 days from TCLP extraction to preparative extraction 40 days from preparative extraction to analysis.
Metals ^b except mercury (SW-846 1311/6010B ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	mg/l	180 days from sample collection to TCLP extraction. 180 days from TCLP extraction to analysis.

Table E-6. Analytical Method, Sample Container, Preservative, Unit of Measure, and Holding Time Criteria (concluded)

Analytical Methods for Soil	Sample Container	Preservative	Unit of Measure	Holding Time
Mercury (SW-846 7471A ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	mg/l	28 days from sample collection to TCLP extraction 28 days from TCLP extraction to analysis.
Soil pH (SW-846 9045B ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	pH units	As soon as possible
Paint filter liquids test (SW-846 9095A ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	NA	As soon as possible
Reactive cyanide (SW-846 7.3.4 ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	NA	As soon as possible
Reactive sulfide (SW-846 Section 7.3.3 ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	NA	As soon as possible
Ignitability (SW-846 1030 ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	°C	As soon as possible after removal of sample from sample container
Corrosivity (SW-846 9045C ^a)	4- or 8-ounce wide-mouth glass bottle with a Teflon™ lined cap	Chill to 4°C	NA	As soon as possible
Isotopic thorium (NAS/DOE 3004/RP Modified ^d)	1 quart wide-mouth glass bottle with a Teflon™ lined cap or 1 quart ZipLoc™ bag	None	pCi/g	180 days from sample collection to analysis
Isotopic uranium (NAS/DOE 3050-RP 725 Modified ^d)	1 quart wide-mouth glass bottle with a Teflon™ lined cap or 1 quart ZipLoc™ bag	None	pCi/g	180 days from sample collection to analysis
Gamma spectrometry (EPA 901.1 Modified ^c)	1 quart wide-mouth glass bottle with a Teflon™ lined cap or 1 quart ZipLoc™ bag	None	pCi/g	180 days from sample collection to analysis
Total moisture (MCAWW 160.3 modified ^e)	NA	None	%	None
Sieve analysis (ASTM D422)	NA	None	%	None
Proctor test (ASTM D698)	NA	None	lb/ft ³	None
Soil bulk density (USACE EM-1110-2-1906 ^f)	Undisturbed core sample	None	lb/ft ³	None

Table notes:

^aEPA, 1986^bArsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc^cEPA, 1980^dNAS/DOE, 1994.^eEPA, 1983^fUSACE, 1970.

ASTM = American Society for Testing and Materials

°C = degrees Celsius

DOE = U.S. Department of Energy

lb/ft³ = pound per cubic foot

MCAWW = Methods for Chemical Analysis of Water and Waste

mg/L = milligrams per liter NA = not applicable

mg/kg = milligrams per kilogram

NAS = National Academy of Sciences

pCi/g = picocuries per gram

RCRA = Resource Conservation and Recovery Act s

SW = solid waste

SVOCs = semivolatle organic compounds

TCLP = tox. char. leachate procedure

USACE = U.S. Army Corps of Engineers

µg/L = micrograms per liter

VOCs = Volatile organic compounds

E1.3.4 Laboratory Batch Quality Control Logic

The frequency of instrument calibration and QC sample analysis for the analytical methods for the remedial action are batch-controlled. All site sample data for this project will be associated with sample batch QC samples, extracted concurrently with the site samples, and analyzed in the same analytical batch (analyzed on the same instrument relative to the primary sample results). The following paragraphs define sample and instrument batches.

A sample batch for this project is a group of 20 or less environmental samples of the same matrix that are extracted within the same time period (concurrently) or in limited, continuous, sequential time periods. Keeping batches "open" for more than 2 hours will not be accepted; samples and their associated QC samples (method blank, LCS, and MS/MSD) will be prepared in a continuous process. The sample batch will be analyzed sequentially on a single instrument (as practicable).

The instrument batch is a group of 20 or less environmental samples that are analyzed together within the same analytical run sequence, as defined by the method calibration criteria, or in continuous, sequential time periods.

E1.4 Sample Collection and Sample Handling Procedures

E1.4.1 Sample Collection Procedures

Sample collection procedures are detailed in the *Initial Survey Work Plan* (USAF, 2001). All sample collection and sample identification procedures were designed to meet the project DQOs. The following guidance was used in the development of sample collection procedures:

- *Kirtland Air Force Base Base-wide Plans for the Installation Restoration Program* (USAF, 1996a)
- *American Society for Testing and Materials*

Samples will be placed in contaminant-free containers as specified in the *EPA Specifications and Guidance for Obtaining Contaminant-Free Sample Containers* (EPA, 1992). Containers will be stored in clean areas to prevent exposure to fuels, solvents, radionuclides, and other contaminants. Table E-6 lists the containers that are recommended for sample collection, the required preservatives (if applicable), and sample holding times.

E1.5 Sample Custody

Field personnel will use the sample documentation and custody procedures outlined in this section during the sampling program to maintain and document sample integrity during collection, transportation, storage, and analysis. Field sampling personnel will properly document and maintain custody procedures at the time of sample collection; and track individual samples from the time of sample collection until custody of the samples is transferred to the laboratory. The laboratory will maintain sample custody and documentation from the time the laboratory receives the samples until final sample disposal.

Detailed procedures for properly recording sample information and analytical requests on chain of custody records, for preserving samples as appropriate, and for sample packaging and shipment are described below. These procedures will minimize common problems such as labeling errors, chain of custody errors, transcription errors, and preservation failures,

E1.5.1 Chain-of-Custody

Chain-of-custody procedures provide an accurate written record of the possession of each sample from the time it is collected in the field through laboratory analysis. A sample is considered in custody if one of the following applies:

- It is in an authorized person's immediate possession.
- It is in view of an authorized person after being in physical possession.
- It is in a secure area after having been in an authorized person's physical possession.
- It is in a designated secure area, restricted to authorized personnel only.

E1.5.2 Chain-of-Custody Field Procedures

Chain-of-Custody procedures for this project are described in the *Initial Survey Work Plan* (USAF, 2001).

E1.5.3 Sample Packaging and Shipping Procedures.

All samples will be handled as specified in the *Initial Survey Work Plan* (USAF, 2001). The samples will be shipped as described in the *Initial Survey Work Plan* (USAF, 2001) in accordance with applicable State and U.S. Department of Transportation (DOT) requirements. Specific DOT requirements associated with shipping radioactive soil samples are described in the *Initial Survey Work Plan* (USAF, 2001).

E1.5.4 Laboratory Chain-of-Custody Procedures

The laboratory will perform the following tasks upon receipt of samples:

- check the integrity of the shipping container by verifying that the custody seal is not broken;
- open the cooler and individual sample containers and check for breakage, damage, or leakage;
- compare the contents of the shipping container to the chain-of-custody.
- document discrepancies between the container contents and the chain-of-custody on the sample custody form(s) and notify the Project Chemist;
- place the shipping receipts with the chain-of-custody records and store them in the project file;
- assign a unique laboratory identification number to each sample container;
- enter sample information into a sample tracking system;
- record the date and time of sampling, sample description, due dates, and required analyses;
- transfer samples to limited-access storage areas after they are logged;
- store samples requiring refrigeration in storage areas (coolers, refrigerators) at $4 \pm 2^{\circ}\text{C}$;
- store samples suspected of containing high concentrations of organic compounds in refrigerators dedicated to such samples;
- record storage area temperatures daily with thermometers calibrated against National Institute of Standards and Technology (NIST) thermometers; and
- assess the cleanliness of sample storage areas using storage blanks.

The Site Technical/Remediation Manager or his designee will document the fate of all samples sent offsite. The laboratory will maintain sample custody within the laboratory's secure facility until the

samples are disposed. The laboratory will return samples to personnel onsite at OT-10, who will ultimately dispose of them with outgoing OT-10 waste.

E1.5.5 Final Project Files Custody Procedures

MWH will maintain the final project files for the remedial action at OT-10 in a secure area, under the custody of the MWH Project Manager. At a minimum, the project file will contain all relevant records including:

- field logbooks,
- field data and data deliverables,
- photographs,
- design drawings,
- all original field logs,
- all construction details,
- laboratory data deliverables,
- data validation reports,
- data assessment reports,
- progress reports, QA reports, interim project reports, and
- all custody documentation (such as tags, forms, airbills).

E1.6 Calibration Procedures and Frequency

E1.6.1 Field Instrument Calibration

The Site RSO will calibrate all field equipment and instruments, in accordance with manufacturers' directions and expected field conditions. The equipment and instruments will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of resulting data can be assessed. Field equipment calibration is specific to the type of instruments or equipment that will be used for this project. Specific instructions for calibrating field equipment will be maintained onsite as SOPs.

E1.6.2 Laboratory Instrument Calibration Procedures

Instrument calibration is necessary to verify that the analytical system is operating correctly and functioning at the proper sensitivity to meet the project-specific practical reporting limits (that is, practical quantitation limits [PQLs] and MDCs). Calibration establishes the dynamic range of an instrument, establishes response factors to be used for quantitation, and demonstrates instrument sensitivity. Criteria for calibration are specific to the instrument and the analytical method. The following paragraphs describe laboratory instrument calibration procedures.

E1.6.2.1 Calibration Standard Preparation

All instruments will be calibrated in accordance with the laboratory's SOPs. The laboratory will use primary reference standards obtained from the NIST, EPA Cooperative Research and Development Agreement vendors, American Association of Laboratory Accreditation vendors, or other reliable commercial sources. The laboratory will record the date received, the supplier, and its lot number, purity, concentration, and expiration date in a standards logbook when it receives standards. Vendor certifications for the standards will be retained in project files and made available upon request.

Standards will be obtained in their pure form or in a stock or working standard solution. Dilutions will be made from the vendor standards. All records regarding standards will unambiguously trace their preparation, use in calibration, expiration dates, and quantitation of sample results. All standards will be given a standard identification number, and the following information will be recorded in the standards logbook:

- source of standard,
- initial concentration of the standard,
- final concentration of the standard,
- volume of the standard that was diluted,
- solvent and the source and lot number of the solvent used for standard preparation,
- expiration date of the standard, and
- preparer's initials.

The identity and concentration of the standards will be verified after preparation and before routine use. Verification procedures include a check for chromatographic purity (if applicable) and verification of the standard's concentration by comparing its response to a standard of the same analyte prepared or obtained from a different source. Reagent purity will be assessed by analyzing an aliquot of the reagent lot using the analytical method in which it will be used; for example, every lot of dichloromethane (for organic extractables) is analyzed for undesirable contaminants prior to use in the laboratory. Standards will be routinely checked for signs of deterioration; that is, discoloration, formation of precipitates, and changes

in concentration. Standards will be discarded if deterioration is suspected or the expiration date has passed. Expiration dates may be taken from vendor recommendations, analytical methods, or from internal research.

E1.6.2.2 Instrument Calibration

Criteria for calibration are specific to the instrument and the analytical method. Each instrument will be calibrated according to the analytical methods following manufacturer's guidelines, using standard solutions appropriate to the type of instrument and the linear range established for the method. All reported analytes will be present in both initial and continuing calibrations, which must meet the method-specific acceptance criteria summarized in Attachment 1 to this QAPP. The instrument calibration will be from lowest to the highest calibration standard and the lowest calibration standard concentration will be at the PQL or MDC for each target analyte. Analyte concentrations will be determined using either calibration curves or response factors.

All instrument calibration information will be documented and, at a minimum, include the equipment to be calibrated, the reference standards used for calibration, the calibration techniques, actions, acceptable performance tolerances, frequency of calibration, and calibration documentation format. The laboratory will maintain records of standards preparation and instrument calibration. Calibration records will include daily checks using standards prepared independently of the calibration standards, and instrument response will be evaluated against established criteria. The analysis logbook, maintained for each analytical instrument, will include at least the date and time of calibration, the initials of the person performing instrument calibration, and the calibrator reference number and concentration

E1.7 Analytical Procedures

This section describes the analytical procedures that will be used to acquire data for the remedial action. It includes the relevant aspects of field and laboratory procedures (sample preparation and extraction procedures, instrumentation, method detection limits (MDLs), MDCs, and PQLs). Analytical quality control requirements, evaluation criteria, acceptance criteria, calibration procedures, preventive maintenance, and corrective actions are discussed in following sections.

E1.7.1 Field Analytical Procedures

Field analytical procedures are planned for the waste removal, remedial action support surveys, and final status survey portions of the remedial action.

Onsite gamma spectrometry will be performed in accordance with SOP 1-10, which will be maintained onsite during the remedial action. Site personnel will adhere to the procedure as far as possible.

E1.7.2 Laboratory Analytical Procedures

Table E-7 provides synopses of the analytical methods included in this QAPP. Samples will be prepared and analyzed in accordance with the referenced analytical method, the laboratory's SOPs, and this QAPP.

**Table E-7. Summary of Laboratory Analytical Procedures,
Installation Restoration Program Site OT-10**

Method ^a	Analytical Procedure
SW-846 1311 TCLP Extraction	After the solid phase is separated from the liquid phase of the sample, the solid phase is extracted by tumbling with a buffered extraction fluid. The liquid extract is separated from the solid phase by filtration, combined with any liquid separated earlier and analyzed as a water sample.
SW-846 8260B VOCs by GC/MS	VOCs are introduced onto a 30-m capillary column in a GC, temperature programmed to separate the analytes, which are then detected with an MS interfaced with the GC. Quantitation is accomplished by comparing response of a major (quantitation) ion relative to an internal standard using a 5-point calibration curve.
SW-846 8270C SVOCs by Gas Chromatography/Mass Spectrometry	SVOCs are introduced onto a 30-m capillary column in a GC, temperature programmed to separate the analytes, which are then detected with an MS interfaced with the GC. Quantitation is accomplished by comparing response of a major (quantitation) ion relative to an internal standard using a 5-point calibration curve.
SW846 8081A, 8151A, Organochlorine Pesticides and Herbicides, by Gas Chromatography	Organic compounds are introduced onto a 30-meter capillary column in a GC, temperature programmed to separate the analytes, which are then detected by an ECD or an FID. Concentrations are calculated by comparing the response of a compound to a 5-point calibration curve.
SW-846 6010B or SW-846 6010B Trace for Major Cations or Metals by Inductively Coupled Plasma	The inductively coupled plasma method measures element-emitted light by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element-specific atomic-line emission spectra are produced by a radio-frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer and the intensities of the emission lines are monitored by photo-sensitive devices.
SW-846 7470A/7471A Mercury by Cold Vapor Atomic Adsorption	Mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic adsorption spectrophotometer. Absorbency (253.7 nm) is measured as a function of mercury concentration.

**Table E-7. Summary of Laboratory Analytical Procedures,
Installation Restoration Program Site OT-10 (concluded)**

Method ^a	Analytical Procedure
EPA 901.1 Gamma Spectrometry	A homogeneous aliquot of sample is put into a standard geometry for gamma counting. Samples are counted long enough to meet the required sensitivity of measurement.
NAS/DOE 3004/RP-725 modified Isotopic thorium	The digestate is passed through an ion-exchange column. Thorium is eluted from the column with hydrochloric acid and is mounted on a stainless steel planchet for counting by alpha spectrometry.
NAS/DOE 3050/RP-725 modified Isotopic uranium	The digestate is precipitated with calcium phosphate. Uranium is separated by chromatographic resins and is mounted on a stainless steel planchet for counting by alpha spectrometry.
SW-846 1030 Ignitability	A Setaflash Closed Cup Tester to determine whether waste materials have flash points between 0° and 110°C and viscosities (for liquid wastes) lower than 150 stokes at 25°C.
SW-846 Sections 7.3.3 & 7.3.4 Reactivity	This method identifies waste materials that are unstable, have a tendency to react violently, generate toxic gases or vapors, are capable of detonation and explosive reaction, or are capable of reaction at standard temperature and pressure.
SW-846 9045C Corrosivity	Corrosivity is assessed by exposing steel to waste materials.

Table notes:

^aLaboratory methods from the following references:

EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW 846, EPA Third Edition, September 1986; Final Update III, December 1996)

Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032. U.S. Environmental Protection Agency, Environmental Monitoring and Support

Laboratory, Cincinnati, OH, August.

NAS/DOE, 1994. *DOE Methods for Evaluating Environmental and Waste Management Samples*. NAS/DOE 3004/RP-725 and 3050/RP-725. National Academy of Sciences and U.S. Department of Energy. October.

°C = degrees Celsius

DOE = U.S. Department of Energy

ECD = electron capture detector

EPA = U.S. Environmental Protection Agency

FID = flame ionization detector

GC = gas chromatograph

m = meter

MS = mass spectrometer

NAS = National Academy of Sciences

nm = nanometer

SVOC = semi-volatile organic compound

SW = solid waste

TCLP = Toxicity Leachate Characteristic Procedure

VOC = volatile organic compound

E1.7.2.1 Method Detection Limit

The MDL is an empirically derived value that is used to estimate the lowest concentration a method can detect in a matrix-free environment. The MDL is defined as the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. MDLs will be developed and updated as scheduled in the laboratory's SOPs, following guidance in 40 CFR § 136 Appendix A.

E1.7.2.2 Minimum Detectable Concentration

The MDC is used for radioisotopes. The MDC is the lowest concentration that can be detected reliably within the limits of precision and accuracy during routine operating conditions. The MDCs for the analytical methods included in this QAPP are presented in Attachment 1 to this QAPP.

E1.7.2.3 Practical Quantitation Limit

The PQL is the lowest concentration that can be achieved reliably within limits of precision and accuracy during routine operating conditions and is based on the MDL for each analyte. The PQLs for the non-radiological analytical methods included in this QAPP are presented in Attachment 1 to this QAPP.

E1.7.2.4 Data Reporting Requirements

The following criteria for reporting data apply to all samples except method blanks:

- The values of target analyte non-detections less than the PQL and above the MDC will be reported and flagged with an "F" qualifier.
- Target analytes detected at or above the PQL or MDC will be reported as quantified.
- Non-detections in method blanks will be reported as less than the MDC, MDL, or PQL.

E1.7.2.5 Additional Reporting Requirements for Definitive Data

The data for both the initial and reanalysis will be reported with the appropriate notations in the case narrative if a sample must be diluted and reanalyzed for the concentration of a single compound of interest to be within the linear calibration range of the instrument, and this results in non-detect values for

other originally detected target analytes. The Project Chemist will be notified immediately regarding the failure of target analytes to meet PQLs or MDCs to assess potential corrective action. The decision to implement corrective action will be based on whether there are any analytical alternatives or clean-up steps that would improve the detection limits and whether the elevated detection limits will adversely affect data use. Data not meeting the PQLs or MDCs due to sample dilution will be included in the case narrative and the supporting documentation will be included in the data packages.

E1.8 Internal Quality Control Checks

Internal quality control checks are used to evaluate whether field measurements and sampling procedures and laboratory analytical method performance is within acceptable limits of precision and accuracy. The following paragraphs describe the internal QC that will be followed for both field and laboratory activities.

E1.8.1 Sample Collection

The internal quality control measures that will be used to assess the accuracy and precision of the field measurements are described in the *Initial Survey Work Plan* (USAF, 2001) and site-specific SOPs. They include performing replicate sample analysis and calibrating the field instruments.

The accuracy and precision of the field procedures will be assessed as described in Section E1.3.2. Sample representativeness will be assessed by the analysis of field replicate samples.

E1.8.2 Laboratory Analysis

The general objectives of the internal laboratory QC program are to provide a system in which:

- all procedures are documented, including any changes in administrative and/or technical procedures;
- all analytical procedures are validated and conducted according to method guidelines and laboratory SOPs;
- the performance of the laboratory is monitored using a systematic inspection program; and
- all data are properly reported and archived.

The laboratory will conduct internal quality control checks for analytical methods in accordance with their SOPs, the individual method requirements, and this QAPP. The laboratory will notify the Project

actions to the project-specific work plans, this QAPP, or analytical methodology.

Laboratory quality control consists of two distinct components: a laboratory component and a matrix component. The laboratory component measures the performance of the laboratory analytical process during sample analyses, while the matrix component measures the effects of a specific media on the method performance. The QC samples that will be used to assess the laboratory component and the media component of analysis are described in Table E-5. The criteria against which the QC data will be evaluated and the corrective actions for instrument calibrations or QC sample data out of compliance are listed in the corrective action summary are listed in Attachment 1 to this QAPP.

E1.9 Data Reduction, Reporting, and Validation

E1.9.1 Data Reduction

Field data will be used as reported from the direct reading instruments.

The laboratory will reduce all analytical data in accordance with the analytical methods and the guidance presented in Section E1.3.2. Sections E1.3.2.1 and E1.3.2.2 contain the equations that the laboratory will use to assess precision and accuracy, respectively. In addition, Sections E1.6 and Attachment 1 to this QAPP address instrument calibration and target analyte quantitation.

E1.9.2 Data Review

The MWAH QAM or his or her designee will review all field data prior to use. The data will be reviewed to assess whether the procedures specified in the *Initial Survey Work Plan* (USAF, 2001), the field SOPs, and this QAPP were followed; and to identify inconsistencies and/or anomalous values. Inconsistencies will be resolved immediately, if possible, by seeking clarification from those personnel responsible for data collection. At a minimum, the information contained in field notes, field-sampling forms, and chain of custody records, as applicable, will be included in the review process. All changes or corrections to this field documentation also will be reviewed. Any deviations from the procedures, any qualifications for data quality, and any significant problem identified during the review process will be explained and described in a narrative.

The laboratory will review the data (in-house) under the direction of the laboratory Project Manager and/or the laboratory QAM and will prepare and retain full analytical and QC documentation. All data will be reviewed prior to release by the laboratory. In general, the laboratory data review will be conducted as described in the following paragraphs:

The bench analyst will be the first person to review the data. This review will be based on established

protocols specified in laboratory SOPs, analytical method protocols, and project-specific DQOs. This review will include at least the following:

- An assessment of sample preparation procedures and documentation for accuracy and completeness.
- An assessment of sample analysis procedures and documentation for accuracy and completeness.
- Assessments of whether the appropriate SOPs were followed.
- An assessment of analytical results for accuracy and completeness.
- An assessment of whether QC samples are within established control limits and method blank data are acceptable.
- An assessment of whether documentation is complete (that is, all anomalies in the preparation and analysis have been documented, out-of-control forms, if required, are complete, and holding times are documented).

The calculations that will be used to evaluate precision and accuracy are defined in Sections E1.3.2.1 and E1.3.2.2, respectively. The acceptance criteria for calibration, precision, and accuracy; and the corrective action summaries are provided in Attachment 1 to this QAPP.

The analyst will immediately notify appropriate designated QC staff (QAO, Project Manager, Section Leader, and so on) when an analysis of a QC sample (blank, spike, internal standard, or similar sample) indicates that the analysis of that batch of samples is not in control. This individual will determine if the analysis can proceed, if selected samples should be rerun, or specific corrective action needs to be taken before analyzing additional samples. Out-of-control analyses and information justifying accuracy or precision outside acceptance criteria will be documented. A Nonconformance Report will be prepared for all laboratory analysis out-of-control events requiring documentation. The MWH Project Chemist will be notified as soon as feasibly possible to determine appropriate corrective actions for out-of-control events resulting in unacceptable data.

The analyst will sign the applicable control documentation associated with the analytical batch and forward to the appropriate reviewer, after this review is complete. The reviewer (such as a department manager or QAO) will review and approve the analytical control documentation associated with each analytical batch, as well as any corrective action explanations provided by the analyst. This individual will determine whether the analytical data meet quality control criteria established by the analytical methods and by this QAPP and for identifying QC problems that require further resolution. A permanent record of any corrective actions will be maintained in the laboratory files.

The laboratory Project Manager will provide the final review and approval of the analytical data that have been approved by the analyst and other designated reviewer. The Project Manager also will be responsible for reviewing all final data reports for proper format and reporting consistency prior to releasing the reports to MWH. This review will include the following as a minimum:

- Laboratory name and address.

- Sample information (includes unique sample identification, sample collection date and time, date of sample receipt, and date(s) of sample preparation and analysis).
- Analytical results reported with an appropriate number of significant figures.
- Reporting limits reflecting dilutions, interferences, and corrections for dry weight as applicable.
- Method references.
- Appropriate QC results and correlations for sample batch traceability and documentation.
- Data qualifiers with appropriate references and narrative on the quality of results.
- Confirmation that project-specific requirements have been met.

The laboratory Project Manager and/or the laboratory QAO will also qualify data that may be unreliable. Data qualifications will be based on the laboratory SOPs, the analytical method, and the principles outlined in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (EPA, 1994b) and the *Air Force Center for Environmental Excellence (AFCEE) Quality Assurance Project Plan (QAPP) Version 3.0* (USAF, 1998b). Table E-8 lists the qualifier flags that will be used by the laboratory for data qualification.

Table E-8. Laboratory Data Qualifiers

Qualifier	Description
F	The analyte was positively identified, but the associated numerical value is below the practical quantitation limit and above the method detection limit; represents an estimated value.
U	The analyte is not detected.
B	The analyte was positively detected in a sample and in an associated blank.
E	The reported concentration is estimated; outside the linear calibration range of the instrument.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
D	This indicates that the concentration was calculated using a secondary dilution factor (that is, the result is calculated from the analysis performed by diluting the sample).
G	The reporting limit is elevated due to matrix interference.

E1.9.3 Data Reporting

Field data will be reported as described in Table E-9 and presented in a format that will facilitate data review and evaluation. Tables, graphs, or figures will be used to present the data in an associated project report. Onsite gamma spectrometry results will be reported with error.

The analytical data will be reported in a format organized to facilitate data validation. Table E-9 lists the information that will be included in the laboratory data packages.

Table E-9. Data Reporting Requirements

Data Type	Analysis Type ^a	Data Reporting Requirements	Data Report Format
Screening: Gamma-radiation field counts; gross alpha, beta, and gamma radiation exposure rates, gross alpha radiation counts	Radiological data collected in the field using portable instruments coupled to ratemeters and scalars.	Location, date, and time sample collected Calibration information Test results	Log book or field form for all
Definitive chemistry and radiochemistry data generated by a laboratory.	Level III data package for standard methods of analysis ^b or modified standard methods of analysis for organic or inorganic compounds.	Case narrative (including samples not meeting QC criteria, out of control conditions, corrective actions, and matrix effects with justification) Completed chain-of-custody and sample receipt and log in forms Initial calibration summary form Continuing calibration summary form (if applicable)	Hard copy for all
		Tracer recovery	Hard copy
		Run logs	Hard copy
		Target compound results for all samples, including field QC samples, reanalysis, batching information, and bracketing information	Hard and electronic copy
		Method blank results MS/MSD results (spike concentration, actual values, and percent recovery) LCS results (spike concentration, actual values, and percent recovery)	Hard and electronic copy for all
		Matrix duplicate data	Hard and electronic copy
		Raw data for all samples where matrix interference is invoked as the reason for MS/MSD or tracer failure Holding time summary	Hard copy and electronic copy for both

Table notes:

^aLaboratory methods from the following references:
 EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW 846, EPA Third Edition, September 1986; Final Update III, December 1996) Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH, August.
 DOE Methods for Evaluating Environmental and Waste Management Samples. NAS/DOE 3004/RP-725 and 3050/RP-725. National Academy of Sciences and U.S. Department of Energy. October.
 DOE = U.S. Department of Energy
 EPA = U.S. Environmental Protection Agency
 LCS = laboratory control sample
 MS/MSD = matrix spike/matrix spike duplicate
 NAS = National Academy of Sciences
 QC = quality control

E1.9.4 Data Validation

The validity of the field and analytical data will be evaluated using the PARCC parameters, which are quantitative and qualitative statements that describe data quality (see Section E1.3.2). The PARCC parameters will be used to determine whether the DQOs of this investigation have been met by comparing QC sample results and standard procedures with acceptance criteria established for the remedial action. All definitive data for this project will be validated by Laboratory data Consultants. Validation will be based on the principles outlined in the *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, 1994b) and the criteria listed in Attachment 1 to this QAPP.

The MWH QAM or designee will assess the quality of field data. There are no formal data validation requirements for screening data, as discussed previously. Field data will be quantitatively evaluated in terms of the PARCC parameters as described in Section E1.3.2, because there are no formal quantitative procedures for validation of screening data (includes field data).

Laboratory Data Consultants will validate laboratory data. The following discussions regarding data validation are specific to definitive data; screening data will not be included in this process.

The objective of the definitive data validation is to provide a data review that verifies the laboratory QC results. This validation will be based on the principles outlined in the *USEPA Contract Laboratory Program National Functional Guidelines for Organic and Inorganic Data Review* (EPA, 1994b) and structured to assess whether the acceptance criteria for instrument calibration and QC sample analysis (Attachment 1) are met. The PARCC parameters will be used to validate the quality of analytical data and determine whether the DQOs of the project have been met. Table E-4 describes how the QC samples will be used to assess PARCC parameters. The calculations that will be used to assess data quality are presented in Section E1.3.2 and the criteria that will be used to assess data quality are described in Attachment 1.

Data validation techniques include accepting, rejecting, or qualifying the data based on acceptance criteria defined in Attachment 1. Table E-10 lists the data validation qualifiers.

The data validation will be documented on a Data Validation Form provided by Laboratory Data Consultants; it will include the signature of the reviewer and the date of the validation. Data will not be released for use prior to completion of the data validation.

Table E-10. Data Validation Qualifiers

Qualifier	Description
UB	The analyte is not detected at or above the indicated concentration due to blank contamination.
B	The analyte was positively detected in a sample and in an associated blank.
UK	The analyte is not detected at or above the indicated concentration based on the data validation.
UJ	A possible false negative result based on QC problems identified during the data validation.
J	The result is estimated based on QC problems identified during the data validation.
R	The data are considered unusable based on the results of the data validation and/or field procedures evaluation.

Table notes:
QC = quality control

E1.9.5 Data Management

The individuals responsible for data management for this project include all personnel responsible for identifying, reporting, and documenting activities affecting data quality. In general, the qualifications of the individuals associated with data management activities will be commensurate with the level of expertise necessary to accomplish the intended level of evaluation.

All project files will provide a traceable record for all data management activities. The laboratory will maintain a project file that includes at least following; formulas used for data reduction, computer programs, which data transfers are electronic or manual, data review protocol, and so on. All data acquired electronically will be transferred and manipulated electronically to reduce errors inherent in manual data manipulation. Data entered, transferred, or calculated by hand will be spot-checked for accuracy by someone who did not perform the original entries or calculations.

The laboratory will maintain a project-specific file such that the analytical process can be completely reconstructed. The laboratory will maintain all information regarding sample analyses (such as, correspondence, sample custody forms, raw data [hard copies], results, and calibration records) in the project file. Data storage and documentation will be maintained using logbooks and data sheets that will be included in the project file. Computer-acquired data will also be stored on magnetic tape, disks, or other media that can be accessed using industry-standard hardware and software for data processing, retrieval, or reporting. The laboratory will maintain all data collected for this project for a minimum of nine years following submission of the data reports.

E1.10 Performance and System Audits

Independent technical systems and performance audits of field and laboratory activities will be conducted to assess whether sampling and analysis protocols conform to the criteria specified in the *Initial Survey*

Work Plan (USAF, 2001), the site specific SOPs, and this QAPP. The systems audit is a qualitative review of the overall sampling or measurement system, whereas the performance audit is a quantitative assessment of a measurement system and includes both internal and external audits. These audits will be used to assess whether the resulting data meet the project-specific DQOs and comply with QC criteria; and to identify the need for corrective action. Definitive data validation is also a quantitative check of the analytical process, where documentation and calculations are evaluated and verified. Section E1.9.4 details the data validation procedures. MWH or the laboratory's QAO will conduct internal audits.

E1.10.1 Field Performance and System Audits

Oversight of field procedures will be the direct responsibility of the MWH Project Manager, who will review all elements of the project-specific work plans and this QAPP to verify that the objectives of the project are met. In addition to an initial review, the sampling procedures will be reviewed as the fieldwork progresses so that any necessary modifications are made.

MWH America's QAM or designee will conduct internal audits of field activities (sampling and measurements) to assess the performance and effectiveness of the existing quality management systems in accordance with this QAPP. The intent of these audits is to identify, correct, and prevent management problems that hinder the achievement of the project DQOs.

The audits will include examining field equipment calibration and documentation records; field instrument operation records, field measurement records, field sampling records including log books and field sampling forms; sample collection, handling, storage, and transportation procedures including organization and minimization of potential contamination sources; and chains-of-custody and procedures. Field activities will be audited at the beginning of the project to verify that all of the procedures outlined in the *Initial Survey Work Plan* (USAF, 2001), the site specific SOPs, and this QAPP are followed.

A debriefing session will be held for all participants to discuss the preliminary audit results, after the internal audit is completed. The auditor will prepare an audit evaluation report that includes observations of any deficiencies and the necessary recommendations for corrective actions. MWH will note compliance with the specifications presented in this QAPP and will address noncompliance or deviations in writing. This information will be forwarded to appropriate management with corrective actions and a time frame to implement the corrective actions. Follow-up audits will be performed prior to completion of the project to verify corrective actions have been implemented.

External field audits are the responsibility of the NRC. Field audits can be conducted at any time during the field operations and will be based upon the information presented in the *Initial Survey Work Plan* (USAF, 2001), site specific SOPs, and this QAPP. The audits may or may not be announced, at the discretion of the NRC.

E1.10.2 Laboratory Performance and Systems Audits

In-house and regulatory agency audits of laboratory systems and performance will be a regular part of the laboratory's QA program. Internal audits will be conducted by the laboratory's QAO or designee, and consist of a review of the entire laboratory system and at a minimum include: examination of sample receiving, log-in, storage, and chain-of-custody documentation procedures; sample preparation and analysis; and instrumentation procedures.

An internal audit of the laboratory may be performed by MWH within six months of project start up and will include a review of the laboratory approval agency audit results and review of the following items:

- sample custody procedures,
- calibration procedures and documentation,
- completeness of data forms, notebooks, and other reporting requirements,
- data review and validation procedures,
- data storage, filing, and record keeping procedures,
- QC procedures, tolerances, and documentation,
- operating conditions of facilities and equipment,
- documentation of training and maintenance activities,
- systems and operations overview, and
- security of automated laboratory systems.

MWH will forward audit results to appropriate management. Deficiencies and corrective action procedures will be clearly documented in the audit report.

AFCEE and/or the NRC may perform external audits prior to or during the project to verify proper implementation of laboratory procedures and adherence to this QAPP. These audits may or may not be announced. External audits will include (but not be limited to) review of laboratory analytical procedures, onsite laboratory audits, and/or submission of performance evaluation samples to the laboratory for analysis

E1.11 Preventive Maintenance Procedures

A preventive maintenance program is necessary for the timely and effective completion of a measurement effort for either field or laboratory programs. The preventive maintenance program for the radiological survey will be designed to minimize the downtime of crucial sampling and/or analytical equipment due to unexpected component failure. In implementing this program, efforts will be focused on establishing maintenance responsibilities; maintenance schedules for major and/or critical instrumentation and apparatus; and an adequate inventory of critical spare parts and equipment.

E1.11.1 Field Equipment/Instruments

The field equipment that will be used will be maintained and used according to the manufacturers' directions and as specified in the site specific SOPs. The Site RSO will regularly check the operational condition of each instrument. Any preventive maintenance or repair conducted in the field will be recorded in the field logbook or other appropriate field forms. Backup instruments and equipment will be available onsite or within a short time to avoid field schedule delays.

Field instruments will be checked and calibrated before they are shipped or carried to the field, and will be checked and calibrated daily before use. Calibration check procedures are specified in the *Initial Survey Work Plan* (USAF, 2001) and site-specific SOPs and will be performed in accordance with the manufacturer's directions.

In addition to scheduled maintenance activities, an adequate inventory of spare parts will be maintained by MWH to minimize equipment downtime. The inventory includes those parts (and supplies) that are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner should failure occur.

E1.11.2 Laboratory Equipment

Preventive maintenance of all laboratory equipment and instruments is essential to verify the quality of the analytical data produced. The objective of preventive maintenance is to verify that instrument operation is appropriate for both project and method DQOs. The laboratory will have a routine preventive maintenance program to minimize the occurrence of instrument failure and other system malfunctions and will have designated individuals who perform routine scheduled maintenance for each instrument system and required support activity. The following paragraphs focus on maintenance responsibilities, maintenance schedules, record keeping, and inventory of spare parts and equipment.

E1.11.2.1 Maintenance Responsibilities

Maintenance responsibilities for laboratory equipment will be assigned to designated personnel. These individuals will establish maintenance procedures and schedules for each major equipment item. The instrument manufacturer service engineers will perform instrument maintenance and repair, as scheduled/needed. The analysts will perform other routine preventive maintenance tasks. Only qualified individuals will perform any maintenance activities.

E1.11.2.2 Maintenance Schedules

Maintenance schedules are based on the manufacturers' recommendations and/or sample load. Maintenance activities for each instrument will be documented in a maintenance logbook, as described below.

E1.11.2.3 Record Keeping

All instrument maintenance will be documented in instrument-specific bound logbooks, which will be kept with the instrument. The date, initials of the individual performing the maintenance and the type of maintenance will be recorded in this logbook. Receipts from routine maintenance performed by the manufacturer's representative will be filed in the appropriate laboratory department. This logbook will serve as a permanent record that documents any routine preventive maintenance performed, as well as any service performed by external individuals such as manufacturers' service representatives. In addition, all receipts from routine maintenance performed by manufacturers' representatives will be maintained in the laboratory's file. These records will be made available upon request during external audits.

E1.11.2.4 Spare Parts

An adequate inventory of spare parts will be maintained to minimize equipment down time. This inventory will include those parts (and supplies) which are subject to frequent failure, have limited useful lifetimes, or cannot be obtained in a timely manner.

E1.11.2.5 Contingency Plan

Every effort will be made to analyze samples by an equivalent alternate means within holding times, if an instrument fails. MWH will be notified immediately and the corrective action to be taken will be determined by the MWH Project Manager and the laboratory, if the redundancy in equivalent instrumentation is insufficient to handle the affected samples.

E1.12 Corrective Actions

E1.12.1 Corrective Action Requirements

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-quality control performances that may affect data quality. All proposed and implemented corrective action will be documented in the regular QA reports to the appropriate project management defined in Section E1.11. Corrective action will be implemented only after approval by the Project Manager or designee, and the field team leader. Approvals secured by telephone from the Project Manager will be documented in an additional memorandum, if immediate corrective action is required.

A formal corrective action program will be established for each incidence of noncompliance and implemented when the problem is identified. The individual who identifies the problem will be responsible for notifying the MWH Project Manager, who in turn will notify other project managers (as defined in Section E1.11). Implementation of corrective action will be confirmed in writing as described previously.

Any nonconformance with the established QC procedures specified in the *Initial Survey Work Plan* (USAF, 2001), the site specific SOPs, or this QAPP will be identified and corrected in accordance with the QAPP. Corrective actions will be implemented and documented in the field logbook. No staff member will initiate corrective action without prior communication of findings through the proper channels.

E1.12.1.1 Field Corrective Action

The field staff will be responsible for documenting and reporting all suspected technical and QA nonconformances, and suspected deficiencies during any field activity. The nonconformances and/or deficiencies will be documented in the field logbook and reported to the MWH Project Manager. The field staff will take the appropriate steps to correct them, if particular problems are associated with field measurements or sampling equipment. Typical field procedures to correct problems include the following:

- repeat measurement to check for error,
- properly adjust the meters or instruments for ambient conditions, such as temperature,
- check, replace, or recharge batteries,

- recalibrate instruments,
- replace the meters or instruments, and
- stop work (if necessary) until the problem is corrected.

If a nonconformance or problem requires a major adjustment to the field procedures outlined in the *Initial Survey Work Plan* (USAF, 2001), site specific SOPs, or this QAPP (such as changing sampling methodology or sampling schedule), the MWH, AFCEE, and Kirtland AFB Project Managers will be responsible for initiating corrective actions and notifying the NRC. The MWH Project Manager will be responsible for the following:

- Evaluating the reported nonconformance.
- Controlling additional work on nonconforming items.
- Determining the appropriate corrective actions in conjunction with appropriate project managers and the NRC.
- Maintaining a log of all nonconformances and corrective actions.
- Approving all changes in writing or verbally prior to field implementation, if feasible. The action taken during the period of deviation will be evaluated to determine the significance of any departure from established program practices, if deemed unacceptable.
- Explaining nonconformances and corrective actions in an appendix to the report of this survey.
- Stopping additional work that depends on the nonconforming activity until the appropriate corrective actions are completed.
- Reporting all changes to all affected parties, including the NRC.

E1.12.1.2 Laboratory Corrective Action

Corrective actions are required whenever unreliable analytical results prevent the quality control criteria from being met, as specified by the analytical method; the laboratory's SOPs, or this QAPP. The corrective action taken depends on the analysis and the nonconformance. Attachment 1 provides summaries of corrective actions that will be undertaken for problems associated with specific laboratory analyses.

Corrective action will be undertaken if one of the following occurs:

- Blanks consistently contain target analytes above acceptance levels.
- Undesirable trends are detected in spike recoveries, spike recoveries are outside the QC limits, or RPDs and RERs between replicate analyses are consistently outside QC limits.
- There are unusual changes in detection limits.
- Deficiencies are detected during QA audits.
- Inquiries concerning data quality are received from MWH America's Project Chemist.

The analyst who reviews the sample preparation or extraction procedures, and performs the instrument calibration and analysis will primarily handle corrective actions at the bench level. The matter will be referred to the department supervisor or QA department for further investigation if the problem persists or its cause cannot be identified. Once resolved, full documentation of the corrective action procedure will be filed with the appropriate laboratory QA department. A summary of the corrective actions will be included in the data reports.

E1.12.1.3 Data Validation Corrective Actions

Corrective action may be initiated during data validation or data assessment. Potential types of corrective action include resampling by the field team or reanalysis of samples by the laboratory.

Corrective actions that will be taken depend on the ability to mobilize the field team, how critical the data are to the project DQOs, and whether the samples are still within holding time criteria. The MWH, Kirtland AFB, and AFCEE Project Managers will be notified when the Project Chemist identifies a corrective action situation. The AFCEE Project Manager will have the final responsibility for authorizing the implementation of the corrective action, including resampling and documenting the corrective action, and notifying the NRC.

E1.13 Quality Assurance Reports to Management

Deliverables associated with the remedial action will contain separate QA sections in which data quality information collected during specific tasks is summarized. Those reports will be the responsibility of the Project Manager and will include the QAM or Project Chemist's report on accuracy, precision, and completeness of the data as well as the results of the performance and system audits, and any corrective action needed or taken during the project.

E1.13.1 Contents of Project Quality Assurance Reports

QA reports will be included in the Final Status Survey reports or technical memoranda. These reports will contain the following information:

- project progress and schedule, ...
- summary of QA/QC problems and corrective actions and their effect on the project,
- recommendations for management solutions for unresolved corrective actions,
- audit findings,
- data quality assessments,
- updates on training and changes in key personnel, and
- detailed references to QAPP modifications.

E1.13.2 Frequency of Quality Assurance Reports

QA Reports will be included in the final status survey report.

QA reports will be called in to the MWH Project Manager if an emergency should occur or if it is essential to implement corrective action immediately. These events and their resolution also will be detailed in the final status survey report.

E1.13.3 Distribution of Quality Assurance Reports

QA reports will be distributed to key project personnel.

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- USAF, 1996a. *Kirtland Air Force, Base-Wide Plans for the Installation Restoration Program*. Kirtland Air Force Base, New Mexico. May.
- USAF, 2001. *Initial Survey Work Plan for Installation Restoration Program Site OT-10*, Kirtland Air Force Base, New Mexico. March.
- USAF, 2002. *KAFB Instruction 40-201. KAFB Ionizing Radiation Safety Program*. USAF Medical Command. 15 March 2002.

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- ASTM D-422. Standard Test Method for Particle-Size Analysis of Soils. West Conshohocken, PA.
- ASTM D-698. Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m<sup>3

ASTM D-2216. Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. West Conshohocken, PA.

ASTM D-2937. Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method. West Conshohocken, PA.</sup>

CODE OF FEDERAL REGULATIONS

- 10 CFR § 19.12. "Instruction to workers." *Code of Federal Regulations*. Office of Federal Register National Archives and Records Administration. Washington, D.C. 1 January, 2001.
- 29 CFR § 1910.120. "Hazardous waste operations and emergency response". *Code of Federal Regulations*: Office of Federal Register National Archives and Records Administration. Washington, D.C. 1 January, 2001.