APPENDIX A
TIER I RADIOLOGICAL INCIDENT MANAGEMENT PLAN

Appendix A

Tier I Radiological Incident Management Plan For Natural Gas Exploration and Production Activities Near Project Rio Blanco

Revision 1

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1 Introduction

This Tier I Radiological Incident Management Plan was developed to support natural gas drilling, completion, and production operations near Project Rio Blanco, the site of a previous underground nuclear detonation in 1973. The plan provides guidance concerning the mitigation, response, and recovery in the unlikely event of a radiological release during gas well drilling, completion, or production operations within the Tier I monitoring zone. The Tier I monitoring zone presently includes gas wells whose bottom-hole locations are between the ½-mile voluntary drilling exclusion zone and a 1-mile radius of the Project Rio Blanco monument at surface ground zero. This plan is not applicable for well sites within the Tier II monitoring zone, i.e., within a one- to two-mile radius of the Project Rio Blanco monument at surface ground zero.

1.1 Rio Blanco Site Background

The Rio Blanco test site is located on the north flank of the Roan Plateau in the Fawn Creek valley. The site is located about 36 miles northwest of Rifle, Colorado, 31 miles southeast of Meeker, Colorado, and about 35 miles north of Project Rulison, a similar Plowshare Program project conducted in 1969. The Plowshare Program was a joint industry-government project designed to demonstrate the peaceful use of nuclear weapons.

Project Rio Blanco is the site of the nearly simultaneous subsurface nuclear detonation of three 30 ± 3-kiloton nuclear devices at depths of 5,838, 6,230, and 6,689 feet below ground on May 17, 1973 in a single emplacement well, RB-E-01. The test was performed by the the U. S. Energy Research and Development Administration (ERDA), formerly the U. S. Atomic Energy Commission (AEC), both predecessor agencies to the United States Department of Energy (DOE) and industry partners Equity Oil Company (Equity), Continental Oil Company (Conoco), and CER Geonuclear Company (CER). The Rio Blanco nuclear test was conducted in an effort to fracture an approximately 1,300-foot section of low-permeability sandstones in the Paleocene Fort Union Formation and Cretaceous Williams Fork Formation of the Mesaverde Group to stimulate release of commercially marketable quantities of natural gas.

In September 1973, two wells were subsequently drilled into the nuclear chimneys created by the blast in the RB-E-1 well, followed by gas flow testing to determine the cavity sizes, their interconnectivity, and post-test production characteristics. The initial re-entry drilling through RB-E-1 occurred four months after the detonation so that the short-lived radioactive materials decayed prior to re-entry to minimize radiation exposures. Re-entry drilling was initiated on September 23, 1973 and completed on October 12, 1973. A subsequent re-entry well, RB-AR-2, was drilled between June and November 1974 to facilitate testing of the lower

chimneys. Post-detonation gas production tests were conducted between 1973 and 1974. Based on a number of factors, including declining gas pressures, a smaller than predicted blast fracture radius, and isolated chimneys from each of the three detonations, the wells were shut-in and subsequently plugged and abandoned in 1976.

The principal radionuclides found in the chimneys created by the nuclear blasts are thought to be mixed radioactive fission products, plutonium, uranium, and gaseous radionuclides (^{3}H, ^{14}C, and ^{85}Kr [Smith, Esser, and Thompson 1995]). Gaseous radionuclides ^{14}C, ^{85}Kr, and ^{3}H are likely to be the most mobile in the environment, as the radioactive fission products (^{99}Tc, ^{90}Sr and ^{137}Cs) and fissile materials (plutonium and uranium) are predominantly bound in glass formed in the cavity during the blast. However, these more mobile gaseous radionuclides are likely no longer present in appreciable amounts in the cavity because they have decayed substantially since the test occurred (^{3}H and ^{85}Kr), were not initially present in substantial quantity (^{14}C), or were vented during re-entry drilling and gas flow production tests in 1973 and 1974. Of these gases, ^{3}H that may remain in the cavity is considered more likely than any other gaseous radionuclide to have the most potential to migrate to producing gas wells (Cooper et al. 2005). However, the initial ^{3}H inventory in the chimneys was about one third less than that at Project Rulison and subsequent decay ^{3}H has reduced the amount to about 13 percent of the original amount.

Radiation activities above background have not been detected in the area of the Rio Blanco test site. The surface facilities, equipment, and contaminated soils at Project Rio Blanco were subsequently decontaminated, removed, and/or remediated by the AEC and its industry partners (EIC 1978). DOE performed a corrective action investigation (DOE 2002) and found no evidence of Project Rio Blanco radionuclides in the surface and shallow subsurface soils. DOE determined that the shallow soils required no further remedial action and the CDPHE concurred (Stoner 2003). DOE studies of the test site, including numerical modeling of tritium transport (Chapman et al. 1996; Cooper et al. 2005), have predicted that significant migration of ^{3}H and other Project Rio Blanco-related radionuclides is not expected to occur outside of the current subsurface intrusion exclusion zone. DOE has established an exclusion zone that prohibits subsurface intrusion within a 100-foot radius of the Rio Blanco monument (surface ground zero) to a true vertical depth of 1,500 feet and within 600 feet of the monument to a true vertical depth between 1, 500 and 7,500 feet without permission of the U. S. Government.

The purpose of this plan is to supplement the Companies existing incident management plans to mitigate, recognize, and respond to potential radiological incidents that might conceivably occur during gas well drilling. This plan is designed to facilitate a swift and appropriate response in the unlikely event of an unexpected radiological release incident during drilling, completion, or production activities at gas wells within Tier I whose bottom-hole

locations are between the ½-mile voluntary drilling exclusion zone and a 1-mile radius of the Project Rio Blanco monument at surface ground zero.

1.2 Radiological Incident Management Plan Organization

This Tier I Radiological Incident Management Plan is comprised of five sections, including this introduction (Section 1). Section 2 discusses radiological incident mitigation measures. Section 3 discusses radiological incident preparedness and response. Section 4 briefly describes incident recovery measures. Section 5 lists the references cited in this plan. Attachment A-1 includes personnel decontamination procedures. Attachment A-2 provides a description of the U. S. Department of Energy's Radiological Assistance Program (DOE RAP).

2 Radiological Incident Mitigation

2.1 Risk Assessment

Natural disasters and events (e.g., flash floods, high winds, electrical storms, fires, blizzards, freezing) or man-made events (e.g., structural collapse, vehicle accidents, fires,) that might occur in the Project Rio Blanco area are not likely to affect the natural gas drilling operations so that a radiological release could occur. The potential source of radiation is located between depths of approximately 5,838 and 6,689 feet below ground surface, thus natural disasters occurring at ground surface will not result in a radiation release. Furthermore, drilling will not occur into areas that are expected to contain elevated radiation levels. Additionally, standard drilling operations maintain sufficient head in a borehole, using drilling muds and fluids, so that an uncontrolled release of subsurface material at the surface is not expected, unless well control is lost (i.e., a blowout occurs). Real-time radiation monitoring will be conducted to measure radiation in drilling fluid returns so that any elevated radiation levels will be immediately detected and appropriate responses taken. Otherwise, radiologically-contaminated materials will not be stored at the surface, so they are very unlikely to be affected by natural or man-made events.

2.2 Mitigation of Releases from Man-Made Events

Although very unlikely to result in a release of radiological material, man-made events or incidents will be mitigated by the implementation of health and safety programs and management systems that specify engineering controls, administrative controls, and personal protective equipment (PPE). Controls include (but are not limited to) barricades, lockout procedures, fire protection systems, equipment inspections, worker training, and appropriate

PPE. These procedures are part of the day-to-day operations at all drilling sites and are detailed in Company-specific safety plans and programs. This radiological incident management plan is designed to supplement existing Company incident response plans in the unlikely event of a radiological release.

2.3 Mitigation of Releases During Natural Events

Although natural events are unlikely to result in a release of radiological material at the surface, the potential of a release during a natural event (e.g., flash floods, high winds, electrical storms, fires, blizzards, freezing) will be mitigated in several ways. Site design standards and other regulatory requirements incorporate prevention or mitigation of potential contaminant releases; this may include berms around reserve pits during drilling, secondary containment berms or steel rings around tanks during production as required by Spill Prevention Control and Countermeasures (SPCC) requirements, and stormwater controls to divert runoff away from the well pad. Structures will be constructed to withstand expected wind events. Well pad locations will be located outside of flash flood zones. In the event of a significant natural event, work will be stopped until equipment damage and the potential for an unexpected release of radiological materials can be assessed.

3 Radiological Incident Preparedness and Response

3.1 Radiation Safety Briefing

A one-time radiation safety briefing will be conducted for the drilling crews and Company personnel before initiating drilling at a Tier I well pad. All drill site and production personnel will be required to attend the briefing and their attendance documented. The briefing may include the following:

- Review of the history of Project Rio Blanco;
- Radiation awareness training and an overview of this Tier I Radiological Incident Management Plan;
- Recognition of a radiological incident, discussion of procedures that are in place to minimize the potential for exposure if an unexpected radiological incident occurs, radiological screening methods, decontamination methods, action levels, and incident communication procedures.

- What personnel should do if a radiological incident occurs to determine if they have been exposed to radiologically-contaminated materials.

- Basic radiation safety, emergency procedures, alarms, rallying points, and other relevant site information.

The radiation safety briefing will also be offered to, but not required for, community responders including fire departments, law enforcement, emergency medical services (EMS), and hospitals identified to respond to site incidents regarding the contents of this plan. A radiological briefing packet will be prepared that can be shared with community responders. The briefing packet will include community notification information for a radiological incident. The location of well pads within the Tier I monitoring zone will be available as a map to the community responders to facilitate rapid emergency response in the event of an incident.

3.2 Potential Radionuclides of Concern

The most likely radionuclide that might be encountered during a radiological release incident is ^{3}H, because it is potentially mobile in both the produced water and natural gas. ^{3}H is a weak beta emitter and poses little or no health threat at low doses. Other radionuclides, such as ^{99}Tc, ^{137}Cs, and ^{90}Sr or their decay products, that are more abundant but considerably less mobile that could conceivably be encountered may emit alpha, beta, and/or gamma radiation of various energies. Beta and gamma radiation are primarily external exposure hazards. Alpha radiation is an internal exposure concern because it does not normally penetrate the outer layer of skin. Both alpha and low-energy beta particles are shielded by thin rubber gloves or other protective equipment.

3.3 Site Safety and Radiation Safety Officer

A Site Safety Officer (SSO), or a designated representative, will be on site at all times for the **closest well** drilled within a Tier I monitoring sector and locally available for all other wells drilled within Tier I. The SSO, or designated representative, will be properly trained to understand the requirements of the Rio Blanco Sampling and Analysis Plan (RBSAP) and this Tier I Radiological Incident Management Plan and will have the authority to implement all actions to comply with this plan. The SSO, or designated representative, will be supported as needed by the Radiation Safety Officer (RSO) or a designated alternate RSO, who will be available by phone on a 24-hour basis. The RSO will be a trained and experienced health physics professional. The RSO and alternate RSO are subject to approval by the Colorado Oil and Gas Conservation Commission (COGCC). The RSO's and alternate RSO's resumes will be submitted

to the COGCC for review and approval prior to initiating drilling within the Tier I monitoring zone.

3.4 Background Radiation Survey

A one-time background radiation survey will be performed by the Companies, or designated representative, at the well pad with the **closest well** within each Tier I monitoring sector prior to drilling the first Tier I well on the pad. If the pad with the closest Tier I well in a sector has been previously constructed and drilled prior to the implementation of this SAP, a background radiation survey will also be conducted at the pad to document the existing background radiation conditions prior to drilling additional Tier I wells.

The background survey will be performed by screening each well pad area using hand-held radiation survey equipment to measure the background activities of alpha, beta, and gamma radiation. Alpha, beta, and gamma radiation screening will be performed using a hand-held Thermo Scientific RadEye B-20 multipurpose survey meter with filters, or equivalent. Photographs of the survey meter is shown in Figure A-1.

Background radiation screening will be performed on a 9-point grid over the area of the well pad. The 9 points will include measurements at each corner of the pad (4), at the midpoint of the sides of the pad (4), and at the center of the pad (1). Figure A-2 is a sketch showing the typical background radiation survey measurement locations.

The alpha, beta, and gamma radiation screening will be performed by placing the survey meter detector within 1 inch of the ground surface and recording the radiation response. A radiation measurement will also be collected by holding the survey meter detector about 3 feet ("waist high") above the ground surface and recording the reading. The measurements will be repeated to determine gamma radiation by placing the alpha-beta filter on the survey meter and repeating the above measurements. The radiation measurements will be recorded in a field logbook or on sample forms (Appendix C) as microRoentgen per hour (microR/hr) or counts per minute (cpm). Radiation survey equipment will be operated and calibrated in accordance with the manufacturer's instructions. The equipment will be tested to document its performance before and after the each survey using a radiation check source (e.g., ^{137}Cs; Figure A-1) and the response for each instrument recorded in the field logbook (Section 3.10). Radiation survey instruments must be calibrated by the manufacturer or a certified service center annually.

3.5 Recognizing a Potential Radiological Incident

There are over 100 drilling rigs presently running in Colorado and over 30,000 active oil and gas wells. Generally, these daily drilling and production operations are conducted without

incident. However, incidents do occasionally occur, and the Companies have their own individual incident management plans to address a wide range of possible incidents. Common steps that apply to any incident response include the following:

- Sounding of a general alarm to alert all on-site personnel. All site activities will be stopped when the alarm is sounded and work will not resume until it is confirmed safe;

- Activating emergency shutdown procedures to stop the incident or associated releases;

- Accounting for all personnel and providing medical and other emergency support as needed. Community first responders and hospitals will be notified if medical care or other emergency support is occurring or needed; and

- Assessing the type and extent of a given incident and implementing appropriate follow-up actions, including containment or remedial actions as well as notifications to regulatory agencies, local governments, and the public.

While the above four steps are common operational responses to any incident, the specific operational responses will be governed by each Company's incident management plan. This Tier I Radiological Incident Management Plan will supplement existing Company incident management plans and focuses on the radiological aspects of potential incidents. Three types of potential radiation incidents are addressed in this plan and include loss of well control, release of drilling fluids (i.e., drilling muds, natural gas, or produced water) or drill cuttings to the environment, or elevated radiation measurements in subsurface fluid or solid media brought to the surface. The Companies recognize that the Colorado Department of Public Health and Environment (CDPHE) will be involved if a radiological incident occurs and that a radioactive materials license may be required if contaminated materials are detected above regulated activities.

3.5.1 Loss of Well Control

Company emergency response procedures will be implemented in the event of loss of well control (i.e., an uncontrolled flow of natural gas or well fluids, typically referred to as a "blowout"). As a supplement to the well loss emergency response procedures, the radiological response procedures outlined in Section 3.9 of this plan will be implemented to determine

whether a radiological release has occurred at the site so that the appropriate radiological response procedures can be implemented if necessary.

In the unlikely event that a loss of well control occurs, the area will be secured by the Companies. Once well control has been re-established and the area is safe, the SSO, or designated representative, will contact the RSO, or designated representative, for guidance and direction. If warranted, the RSO, or designated representative, will mobilize to the site to direct the radiological response measures. The RSO, or designated representative, will consult with Company management to determine the appropriate actions. The Companies will immediately inform the COGCC, the CDPHE, the DOE Office of Legacy Management (OLM), DOE Radiological Assistance Program (RAP) office in Idaho Falls, Idaho (Table A-3 and Attachment A-2), and other government agencies (e.g., Rio Blanco County Sheriff and Emergency Management Office) of a Project Rio Blanco-related radiation incident.

Once the well is controlled and prior to resuming drilling, completion, or production operations, the RSO, or designated representative, will perform a radiation survey of the area affected by the blowout to verify that residual radiation above action levels (Table A-1) is not present in the area. If residual radioactively contaminated soils or other media are found, those areas will be secured by flagging the area with radiation tape, rope, and/or signs to warn against the radiological hazard and discourage entry. The RSO, or designated representative, will also inspect the continuous radiological monitoring equipment to determine that it was not damaged during the blowout and is operating as designed.

3.5.2 Release of Drilling Fluids or Cuttings

Company spill response procedures will be implemented in the event of a release of drilling fluids or cuttings to the environment. Typically, the initial operation response focuses on containment of the release as well as protecting the safety of on-site personnel. To supplement the operational spill response procedures, the radiological response procedures outlined in Section 3.9 will be implemented to determine whether a radiological release has occurred at the site so that the appropriate radiological response procedures can be implemented, if necessary. If a verified radiological release occurs above the action levels, the SSO, or designated representative, will contact the RSO, or designated representative, for guidance and direction. If warranted, the RSO, or designated representative, will mobilize to the site to direct the radiological response measures. The RSO will consult with Company management to determine the appropriate actions. The Companies will immediately inform the COGCC, the CDPHE, DOE OLM, DOE RAP, and other government agencies (e.g., Rio Blanco County Sheriff and Emergency Management Office), as appropriate, of a verified Project Rio Blanco-related radiation occurrence.

The amount of radioactively contaminated material released to the environment will be minimized, as warranted, using drilling and engineering controls, with particular focus on limiting the volume of the release and minimizing the potential for released materials to be dispersed via uncontrolled storm runoff into local surface water drainages. Uncontrolled runoff may be contained using existing stormwater controls. However, depending on the size of the release, additional engineering measures (e.g., diversion ditches, hay bales, straw wattles, silt fences, etc.) may be needed to prevent widespread dispersal of radiologically contaminated drilling fluids or cuttings.

Once a release of drilling fluids and cuttings is controlled and prior to resuming drilling or production operations, the released radiologically contaminated materials will either be removed or cordoned off, depending on their location, areal extent, and potential threat to water sources. The RSO, or designated representative, will perform a radiation survey of the area affected by the release to verify that residual radiation in the materials does not pose a threat to workers, the public, or the environment. Cordoned areas will be delineated using radiation tape, rope, and/or signs, or equivalent to warn against radiological hazard and discourage entry.

3.5.3 Elevated Readings on the Continuous Gamma Radiation Monitor

Continuous gamma radiation measurements will be conducted at the drill cutting and fluid returns outfall (e.g., shale shaker) during drilling of the **closest** Tier I well within each monitoring sector to screen for Project Rio Blanco-related radionuclides (e.g., ^{137}Cs). These measurements will be routed electronically to the drilling control station, where an alarm system will notify the driller of radiation levels of concern (see Section 4.1.2). If an alarm is triggered on the continuous gamma radiation-monitoring system, drilling will be suspended and all work will temporarily stop until the source of the radiation is verified or the site is confirmed to be safe. Note it is possible that a false gamma radiation alarm may occur during well logging. Well logging involves the use of a radioactive source in the logging tool which can be detected by the gamma radiation monitoring equipment used during drilling of Tier I gas wells causing a momentary increase in radiation and an alarm. The alarm can be triggered when the tool is either lowered into or removed from the gas well during the logging operation.

To confirm a positive radiation measurement above the action levels, the SSO, or designated representative, will contact the RSO, or designated representative, for further guidance and direction. If warranted, the RSO, or designated representative, will mobilize to the site to direct the radiological response measures. The RSO will consult with Company management to determine the appropriate actions. The Companies will immediately inform the COGCC, the CDPHE, DOE OLM, DOE RAP, and other government agencies (e.g., Rio Blanco

County Sheriff and Emergency Management Office), as appropriate, of a verified Project Rio Blanco-related radiation occurrence.

3.6 Emergency Response Drills

Emergency response drills will be conducted on a monthly basis at Tier I drill sites with active drilling operations to familiarize the drilling crews and on-site personnel with the radiation incident emergency procedures outlined in this plan. At a minimum, the emergency response drill should include sounding of the radiation alarm, location and function of the wind sock, and assembly of the drilling crews and on-site personnel in the specified upwind assembly areas. The emergency response drill will also include a brief discussion of the radiation emergency response procedures for personnel that may have been exposed to radiation or injured during an actual incident. The emergency response drills will be conducted by the Site Safety Officer (SSO) and recorded as indicated in Section 3.10.

3.7 Radiological Incident Response Communication

The radiological action levels provided in Table A-1 have been set at radiation activities well below recommended exposure limits; however, any confirmed elevated radiation measurements above these action levels will be immediately reported to Company management by the RSO, or designated representative. This approach will maintain exposure to radiation as low as reasonably achievable and allow for early agency notification if unexpected radiological conditions are confirmed to have occurred at the site.

In the event of a radiological incident, the SSO, or designated representative, is responsible for immediately calling the following:

- 911 and/or the local hospital immediately if site personnel are injured and need medical attention; and
- Contacting the RSO, or designated representative, and Company management in the event of a radiological incident, as directed in Table A-1. Table A-2 provides a list of Company emergency contact telephone numbers for the appropriate Company managers and the RSO.

Company management, or a designated representative, will contact the COGCC, CDPHE, DOE OLM, DOE RAP, and other government agencies (e.g., Rio Blanco County Sheriff and Emergency Management Office), as appropriate, if any confirmed radiological condition is encountered that exceeds the action levels in Table A-1, regardless of whether the

exposure is estimated to be in excess of the 100-millirem-per-year standard for any member of the public. The agency emergency contact telephone numbers are provided in Table A-3.

Satellite phones are generally the primary means of outside communication available at a drill site. Should these communication channels fail, a designated site representative will drive to the nearest phone to call the emergency responders (if needed), the RSO, and Company management.

3.8 Radiological Incident Site Access Control

The Rio Blanco site is located in a relatively remote area that is sparsely populated and not readily accessible by public roads. Access to each drill pad within Tier I is controlled by the Company representative at each location. However, inadvertent access to a drill site during a radiological incident could occur. In the unlikely event of a verified radiological incident, the Rio Blanco County Sheriff and Emergency Management Office will be notified so that public access to the affected site can be controlled. The controlled area dimensions will be specified and a map provided of the exclusion zone so that radiation exposures to the sparse local community are kept as low as reasonably achievable.

3.9 Radiological Incident Response Procedures

If a confirmed radiological incident occurs that has or may potentially expose personnel or the public to radiation or has or may release radioactively contaminated media to the environment, the following procedures will be followed as applicable to the specific incident:

- If a radiation release above the action levels specified in Table A-1 is verified, work will be immediately suspended and the actions listed below and in Table A-1 implemented. The RSO, or designated representative, and Company management will provide guidance and direction. The Companies will immediately inform the COGCC, CDPHE, DOE OLM, DOE RAP, and other government agencies (e.g., Rio Blanco County Sheriff and Emergency Management Office), as appropriate, of a Project Rio Blanco-related radiation incident.

- Suspend operation of all equipment and moving vehicles in the vicinity of the site as quickly as possible. Do not allow any vehicles involved in the incident to leave the site.

- Rescue and provide first aid to injured personnel, and secure emergency services if necessary. If injured personnel are potentially contaminated, keep them on site until emergency assistance arrives. The SSO, or designated representative, or RSO (if

present) will brief emergency response personnel on the situation and personnel radiation exposure levels.

- The SSO, or designated representative, or RSO (if present) will screen (i.e., frisk) any potentially contaminated site personnel with a hand-held Geiger-Mueller detector with pancake probe to determine if they are radiologically contaminated. Each individual at the site during the incident will be screened for radioactivity by passing the pancake probe over the person's clothing at a distance of about 0.5 inches or less and the radiation readings observed. The frisking results will facilitate notification of emergency response teams if personnel are radiologically contaminated.

- If personnel are contaminated above the action levels in Table A-1, non-injured personnel will be decontaminated by having the affected individuals remove their outer clothing and shower with soap and water (see Attachment A-1). All potentially contaminated personnel, whether injured or not, will be kept on site until emergency assistance arrives. Personnel who have been exposed to significantly elevated levels of radiation will be referred to a medical provider for evaluation.

- The SSO, or designated representative, or RSO (if present) will cordon off the area having the elevated radiation measurements with flagging, rope, and/or signage to discourage access. The perimeter of the cordoned area should be established at a minimum distance of 100 feet from areas with elevated radiation readings.

- Keep personnel away from and upwind of the potential radiological release until the situation is assessed by the RSO, or designated representative, and the radiation levels are known.

- If equipment or vehicles are involved in an incident, keep all equipment or vehicles in the area until they can be thoroughly screened for radioactivity and released by the RSO, or designated representative.

- For most incidents, the RSO, or designated representative, will mobilize to the site; conduct a radiation survey; and recommend, develop, and implement appropriate response actions.

3.10 Radiological Equipment Calibration and Testing

3.10.1 Radiological Equipment

The following radiation survey instruments will be kept on site and used during drilling operations of the **closest** Tier I well within each monitoring sector to screen for radiation:

- Thermo Scientific RadEye B-20 multipurpose survey meter with filters, or equivalent, capable of detecting alpha, beta, and gamma radiation for frisking personnel or surveying potentially contaminated areas
- Quantum Products Instadose™ dosimetersLandauer InLight environmental dosimeters or Mirion Technologies DMC 2000XB electronic dosimeters, or equivalent, for ambient radiation dosimetry
- ICX Technologies Stride 200 gamma spectrometer system, or equivalent, for real time radiation monitoring
- Check source(s) (e.g., ^{137}Cs) for performance testing of alpha, beta, and gamma radiation monitoring equipment

These instruments are not required at Tier II drilling sites.

3.10.2 Equipment Calibration and Testing

Instruments used for radiation monitoring must be properly maintained, calibrated, and documented. Instruments should be calibrated by the manufacturer or a certified service center at intervals not to exceed 12 months (6 CCR 1007-1 Part 4.17.2). Calibration will be performed in accordance with industry standard procedures.

Per industry standards, at least two of each hand-held radiation survey instruments specified for the project will be maintained on site or locally available. Each instrument's performance will be verified each day the instrument is used. Instrument performance will be tested using a radiation check source (e.g., ^{137}Cs) prior to and following the use of the instrument. A record of the performance tests will be maintained in an instrument logbook indicating the date and time of the performance test, the radioisotope and activity of the check source used for the test, and the measured instrument result.

Radiological emergency response instruments (e.g., hand-held radiation screening instruments and the Bioscan Triathler LSC) will be practiced once each quarter when the instruments are deployed to ensure that the operator is familiar with the operation and use of the

instruments in the event of an emergency. During these practice sessions, the operator will also verify that the instruments have been annually calibrated (if required) and that the analytical media (e.g., LSC cocktail, working standards) have not expired. Documentation of the instrument practice sessions will be maintained in the project files.

3.11 Radiobioassay Procedures and Equipment

In the unlikely event of a radiological incident that exposes workers, bioassays may be performed, as necessary, by the Company's medical provider to determine radiation exposures. Bioassays involve the direct counting of exposed individuals to determine their exposure to radiation and/or the collection of urine samples for radiochemical analysis. Radiobioassay results will be evaluated using the dosimetry models in NUREG-4884 (Lessard et al. 1987).

3.11.1 Radiobioassay Sampling Procedures

For a radiologically contaminated individual, radiobioassay sampling will be conducted through each Company's medical provider using established methods. However, if contaminated personnel are not able to see a medical provider quickly, then urine samples may be collected in bottles maintained on site for radiobioassay analyses. The timing and volume required for urine collection depends on the type of radionuclide to which an individual is exposed. The procedures for urine sample collection are discussed in detail in USACHPPM (1998) and summarized below.

In the event of an exposure to ^{3}H, the most likely radionuclide that one might be exposed to during an incident, it is critical that the urine specimen collected for analysis be representative of the ^{3}H concentration in the body water. A specimen collected too soon after exposure will not be representative, because the ^{3}H will not have equilibrated throughout the body. Therefore, urine samples obtained for ^{3}H analysis should follow the procedure outlined below:

- Discard the initial void of the bladder following exposure. This should occur within 2 hours following the exposure.

- Discard any additional voids that occur prior to 4 hours post exposure.

- Allow a minimum of 4 hours to elapse following the exposure, wash hands, then collect a urine specimen following this post-exposure (4 hour) waiting period. The sample should be collected in a pre-cleaned, leak-proof, 125 milliliter (mL), high-density polyethylene (HDPE) environmental sample bottle. At least 100 mL of urine should be collected for analysis.

- **Do not** add any chemicals or preservatives to the sample.

In the event of an exposure to radionuclides other than ^{3}H, a 24-hour urine specimen is typically required and can be analyzed for ^{3}H, uranium, gross alpha, gross beta, and gamma-emitting radionuclides. The instructions for collecting a 24-hour urine specimen are provided below:

- For radionuclides other than ^{3}H, collect a 24-hour urine specimen **as soon as practical after exposure**;
- Discard the initial void of the bladder following exposure and note the time. This time is the start of the 24-hour collection period.
- Completely void all urine during the 24-hour time period into a pre-cleaned, 1,000 mL, HDPE environmental sample bottle. Two 1,000 mL sample bottles may be necessary, because a 24-hour void for the average adult is 1,500 mL. The final specimen should be voided just prior to the end of the 24-hour period.
- **Do not** add chemicals or preservatives to the sample.

All radiobioassay samples will be labeled with the employee's name, date and time of collection, type of specimen, and type of analysis required. The bottles will be double-bagged in a Ziploc® or similar bag and subsequently handled, packaged, and shipped in accordance with the instructions in Section 7 of the SAP.

3.11.2 Radiobioassay Sample Analyses

Urine samples collected for radiobioassay analyses will be analyzed by GEL Laboratories, LLC in Charleston, South Carolina. The samples collected will be shipped under standard chain-of-custody procedures by overnight carrier (e.g., FedEx) to GEL for analysis. GEL's sample shipping address and telephone number is:

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
(843) 556-8171

3.12 Plan Modifications

Depending upon the severity of any radiological incident encountered, the Companies and the COGCC, CDPHE, and DOE staff will meet to discuss modifications to this Tier I Radiological Incident Management Plan that may be necessary.

4 Radiological Incident Recovery

Company procedures and federal, state, and local guidance will be followed in the event of a radiological release incident. DOE, trained company personnel, contractors, and the RSO, or designated representative, may be involved in cleanup after a radiological incident. These entities will delineate the boundary of any elevated levels of radioactivity, develop appropriate cleanup procedures, and conduct the cleanup activity. Any cleanup activity and waste disposal will be conducted in accordance with all applicable regulations. DOE will be responsible for managing and disposing of any radioactive waste encountered during an incident.

Routine briefings will be conducted with the COGCC, CDPHE, DOE, other government agencies (e.g., Rio Blanco County Sheriff and Emergency Management Office), and local hospitals and responders, as appropriate, by designated Company representatives during incident recovery until it is confirmed that no radiation exposure hazards remain.

Typical cleanup activities would likely consist of screening, identification, excavation, and disposal of contaminated soils, drilling fluids, or drill cuttings. Confirmation samples will be collected for laboratory analysis to verify that all contaminated materials are removed below action levels that are protective of workers, the public, and the environment. Cleanup procedures for equipment will include hand washing or pressure washing of equipment (with overspray collected) and field screening to ensure the radiological contamination is removed.

Following a radiological incident, an incident review and root cause analysis will be conducted by the Companies, the RSO, or designated representative, COGCC, CDPHE, and DOE to identify additional mitigation opportunities and to improve response planning.

5 References

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Figure A-1
Hand-Held Radiological Instrument Photographs

Thermo Scientific RadEye B-20 Multipurpose Survey Meter

Example Check Source

Figure A-2

Well Pad Background Radiation Survey Pattern

Numbers represent background survey measurement locations at well pad

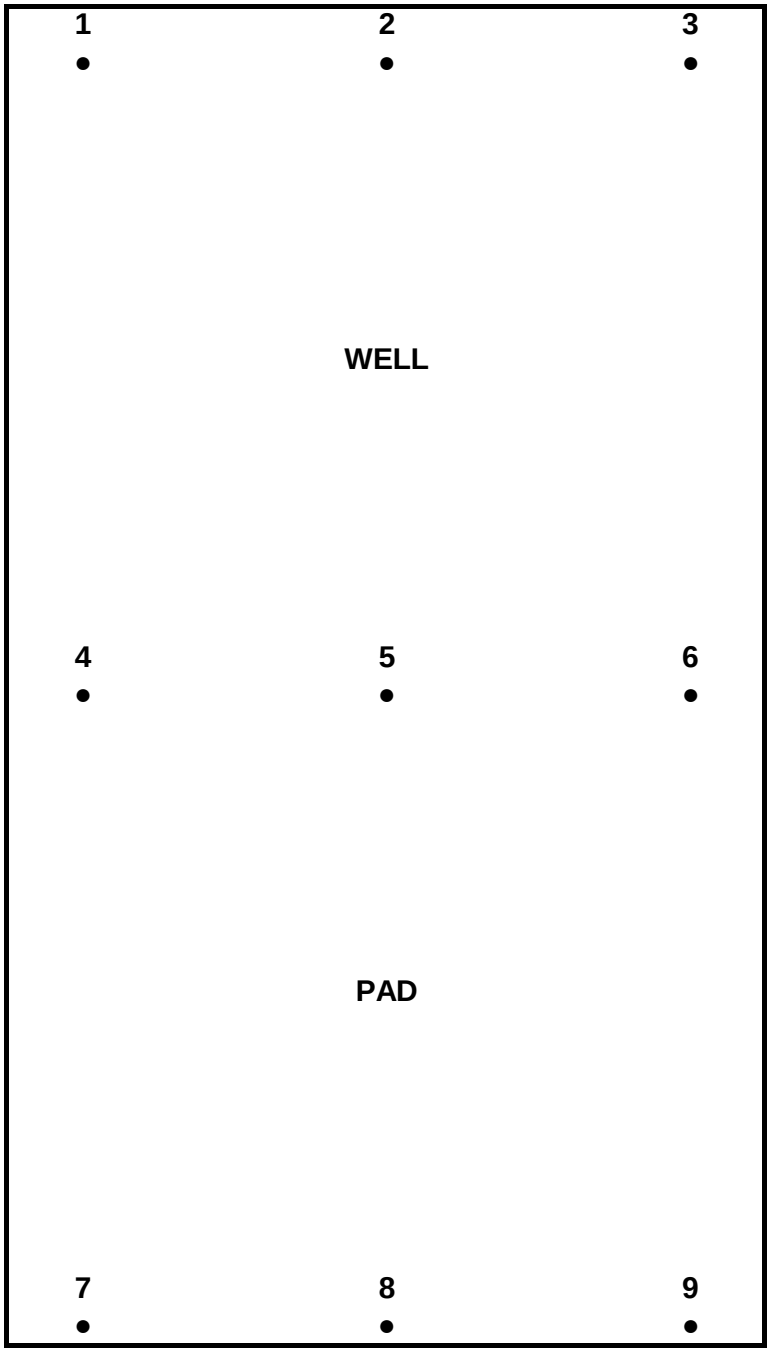


Table A-1
Action Levels for Tier I Radiation Monitoring

Instrument Reading/Location	Action
Well Pad Area Screening	
Microrem survey meter (Thermo Scientific RadEye B-20 multipurpose survey meter, or equivalent) – survey readings greater than twice background[1] at 1 foot distance but less than 100 microrem/hour at 1 foot distance.	Contact RSO, or designated representative, for guidance and direction and to identify appropriate radiological controls; continue work. Contact Company management.
Microrem survey meter (Thermo Scientific RadEye B-20 multipurpose survey meter, or equivalent) – survey readings greater than 100 microrem/hour at 1 foot distance	Suspend work, cordon off the area and do not allow access. Contact RSO, or designated representative, for guidance and direction. Contact Company management.
Pancake meter (Thermo Scientific RadEye B-20 multipurpose survey meter, or equivalent) - count rate readings greater than twice background at 1 inch but less than 1,000 cpm at 1 inch distance	Contact RSO, or designated representative, for guidance and direction and to identify appropriate radiological controls; continue work; frisk personnel that may have contacted radiologically contaminated materials (e.g., drilling mud or fluids). Contact Company management.
Pancake meter (Thermo Scientific RadEye B-20 multipurpose survey meter, or equivalent) - Count rate readings greater than 1,000 cpm at 1 inch distance	Suspend work, cordon off the area and do not allow access. Contact RSO, or designated representative, for guidance and direction. Contact Company management.
Frisking For Potentially Contaminated Personnel	
Pancake meter (Thermo Scientific RadEye B-20 multipurpose survey meter, or equivalent) - Count rate readings greater than twice background at ½ inch distance	Wash the affected area of the person's body soap and plenty of water. Contain the rinse water. Contact RSO, or designated representative, for guidance and direction. Contact Company management.
Screening Areas with Public Access	
Pancake meter (Thermo Scientific RadEye B-20 multipurpose survey meter, or equivalent) - Count rate readings greater than twice background at 1 inch distance	Cordon off the area and do not allow public or media access. Contact RSO, or designated representative, for guidance and direction. Contact Company management.

[1] Twice background allows for natural variability in ambient radiation while providing a low action level to identify potential releases.

Table A-2
Company Emergency Phone Numbers

Contact	Phone Number
URS Radiation Safety Officer (RSO) Larry Luckett, CHP	(210) 481-5338 (o) (210) 872-3812 (c)
URS Project Manager/Alternate RSO Richard Henry, PG	(303) 740-3978 (o) (303) 994-1747 (c)
Williams Production RMT Company Manager, Environment, Health & Safety Mike Paules	(303) 606-4396 (o) (303) 638-7385 (c)
Williams Production RMT Company Piceance Project Rio Blanco Environmental Lead Gretchen Kohler, PG	(303) 260-4531 (o) (303) 217-0534 (c)
Williams Production RMT Company Piceance Highlands Drilling Jim Jackson	(970) 285-8914 (o) (970) 930-5396 (c)
Williams Production RMT Company Piceance Highlands Completions Jim Lake	(970) 285-2761 (o) (970) 270-7356 (c)
Williams Production RMT Company Piceance Highlands Production Jim Lake	(970) 285-2761 (o) (970) 270-7356 (c)
Williams Production RMT Company Piceance Highlands Environmental Mike Gardner	(970) 285-2760 (o) (970) 623-4875 (c)
Williams Production RMT Company Piceance Highlands Safety Brian Gingrich	(970) 285-2705 (o) (970) 216-6820 (c)
EnCana Oil & Gas (USA) Inc. Health, Safety, and Environment	To Be Determined
EnCana Oil & Gas (USA) Inc. Drilling	To Be Determined
EnCana Oil & Gas (USA) Inc. Completions	To Be Determined
EnCana Oil & Gas (USA) Inc. Production	To Be Determined
Other Companies	To Be Determined

Table A-3
Local, State, and Federal Agency Emergency Contacts

Agency Contacts	Phone Number
Local Emergency Response	911
Grand River Medical Center 501 Airport Road, Rifle, Colorado 81635	(970) 625-1510
Pioneers Medical Center 345 Cleveland Street, Meeker, Colorado 81641	(970) 878-5047
Colorado Department of Public Health and Environment Radiation Control Division	(303) 692-3300 or (877) 518-5608 (after hours)
Colorado Department of Public Health and Environment Radiation Control Division	(303) 877-9757 (24-Hour Radiation Incident)
U.S. Department of Energy Office of Legacy Management Grand Junction, Colorado	(970) 248-6070 (o)
Colorado Oil and Gas Conservation Commission	(303) 894-2100 or (888) 235-1101
Alex Fischer, PG Colorado Oil and Gas Conservation Commission	(303) 894-2100 x5138 (o)
David Andrews, PE, PG Colorado Oil and Gas Conservation Commission	(970) 625-2497 x1 (o) (970) 302-1024 (c)
Chris Canfield, PG Colorado Oil and Gas Conservation Commission	(970) 625-2497 x3 (o) (970) 216-6832 (c)
Lt. John Hutchins, Emergency Operations Commander Rio Blanco County Sheriff and Emergency Management Meeker, Colorado	(970) 878-9623

Attachment A-1

Personnel Radiological Decontamination Procedures

All personnel potentially exposed to suspected radiological contamination must be decontaminated prior to leaving the contaminated area unless they are injured and require immediate medical attention or an emergency rig condition (e.g., fire, explosion, etc.) occurs.

Potentially contaminated personnel will be decontaminated using the following steps:

Step 1. Personnel leaving the contaminated area must remove the gross soil from their outer clothing and boots.

Step 2. Personnel will remove their coveralls and gloves, their hard hats, and their boots and/or boot covers before leaving the contaminated area

Step 3. All individuals will be frisked by the SSO, RSO, or designated representative, for radioactive contamination using a pancake meter (Figure A-1) as they leave the contaminated area.

A. All positive findings (instrument readings twice background) will be further evaluated by the SSO, RSO, or designated representative. The presence of contamination confirmed to be above the guidance for skin surfaces (Table A-1) will be reported to the RSO, or designated representative, who will advise/assist with decontamination.

B. Areas found to be contaminated above the levels in Table A-1 will be decontaminated using the methods described below. In brief, the skin will be gently scrubbed with soap and water and subsequently frisked for any remaining radiation. The following procedure is recommended:

1. Survey the worker to determine the contaminated areas of the skin.
2. Wipe, using a gloved hand, loose contamination with a gauze sponge or cotton applicators dipped in mild antiseptic detergent. Do not spread contamination to uncontaminated areas.
3. Rub the skin lightly with the applicators to produce good sudsing.

4. Use soft bristle scrub brushes for fingernails and other difficult-to-clean areas as long as the skin barrier is maintained intact. It may be difficult to decontaminate the cuticles and under the nails.
5. Dry the skin area with cleansing tissue.
6. After the skin is thoroughly dry, survey it for any remaining contamination.
7. If no contamination is detected, apply a good-quality hand cream to prevent chapping.

Successful decontamination will be confirmed by the SSO, RSO, or designated representative. Those individuals not successfully decontaminated to levels below the skin contamination guide will be referred to the nearest hospital for further decontamination efforts. Prior to the beginning of fieldwork, the RSO will confirm the nearest local hospital that is equipped and trained to treat patients who may be radiologically contaminated.

The following personnel decontamination equipment will be maintained on site:

- Hand-held radiation survey instruments to frisk potentially contaminated personnel
- Disposable protective clothing (e.g., disposable coveralls, overshoes, gloves)
- Standard first aid kit, including cotton swabs, nail clippers, etc.
- Shower facility in on-site trailer
- Portable eye wash station
- Soft bristle scrub brushes (e.g., fingernail brush, etc.)
- Soap and shampoo (e.g., baby shampoo, antibacterial soap)
- Hand cream
- Trash bags
- Radioactive waste labels

Attachment A-2

U. S. Department of Energy Radiological Assistance Program

RESPOND ASSESS ADVISE

U.S. DEPARTMENT OF ENERGY

NATIONAL NUCLEAR SECURITY ADMINISTRATION

RADIOLOGICAL ASSISTANCE PROGRAM (RAP)

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) has the world's leading scientists, engineers and technicians from over 50 years of managing the nation's nuclear weapons program. When the need arises, DOE is prepared to respond immediately to any type of radiological accident or incident anywhere in the world with the following seven radiological emergency response assets.

AMS (Aerial Measuring System) detects, measures and tracks radioactive material at an emergency to determine contamination levels. **ARAC** (Atmospheric Release Advisory Capability) develops predictive plots generated by sophisticated computer models. **ARG** (Accident Response Group) is deployed to manage or support the successful resolution of a U.S. nuclear weapons accident anywhere in the world. **FRMAC** (Federal Radiological Monitoring and Assessment Center) coordinates Federal radiological monitoring and assessment activities with those of state and local agencies. **NEST** (Nuclear Emergency Support Team) provides the nation's specialized technical expertise to the Federal response in resolving nuclear/radiological terrorist incidents. **RAP (Radiological Assistance Program)** is usually the first NNSA responder for assessing the emergency situation and deciding what further steps should be taken to minimize the hazards of a radiological emergency. **REAC/TS** (Radiation Emergency Assistance Center/Training Site) provides treatment and medical consultation for injuries resulting from radiation exposure and contamination, as well as serving as a training facility.

INTRODUCTION

The Radiological Assistance Program (RAP), established in the late 1950's, is one of the emergency response resources, or assets, administered by NNSA. RAP is NNSA's first-responding resource in assessing the emergency situation and advising decision-makers on what further steps could be taken to evaluate and minimize the hazards of a radiological emergency. Specific areas of expertise include assessment, area monitoring, and air sampling, exposure and contamination control.

U.S. DEPARTMENT OF ENERGY

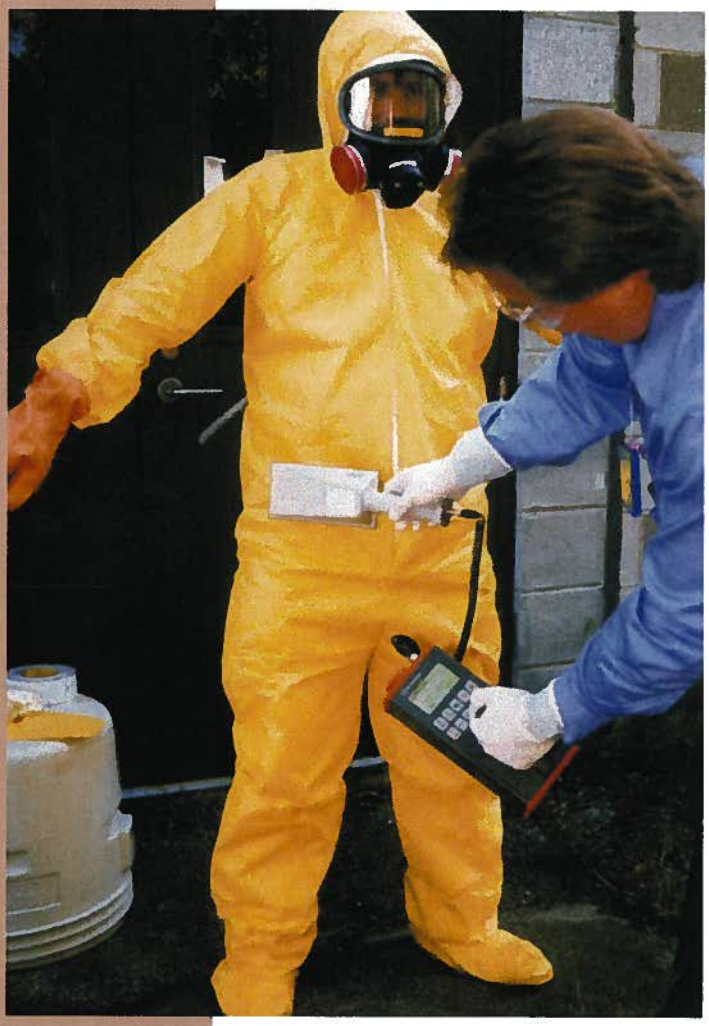
NATIONAL NUCLEAR SECURITY ADMINISTRATION

MISSION

The RAP mission is to provide a flexible, around the clock response capability to Federal agencies, state, Tribal, and local governments, and to private businesses or individuals for incidents involving radiological materials. RAP provides around the clock response capability to radiological emergencies.

CAPABILITIES

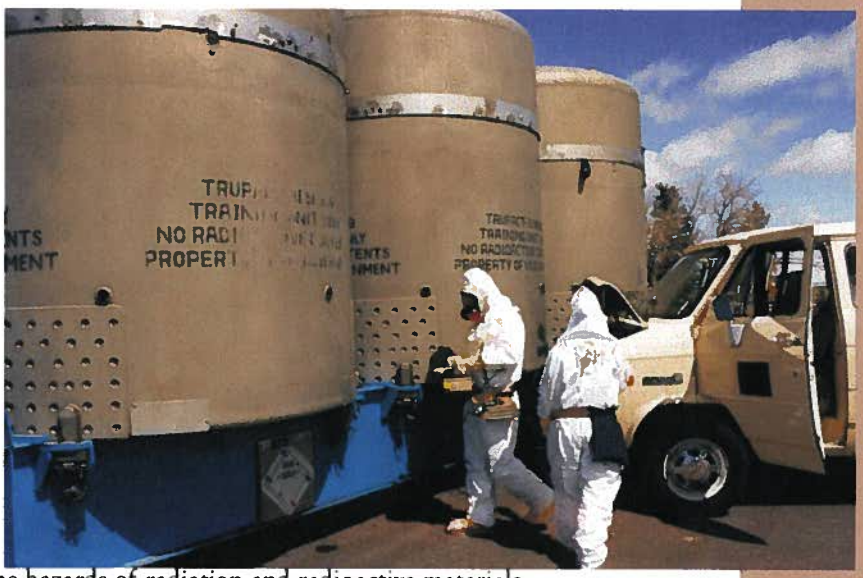
RAP is capable of providing assistance in all types of radiological incidents. Requests for assistance may relate to facility or transportation accidents involving radiation or radioactive material. The accident may involve fire, personal injury, contamination, and real or potential hazards to the public. RAP's support ranges from giving technical information or advice over the telephone to sending highly trained people and state-of-the-art equipment to the accident site to help identify and minimize any radiological hazards.



Survey equipment is used to detect and measure radiation.

RAP is implemented on a regional basis and has eight Regional Coordinating Offices (RCOs) in the U.S. The eight RAP regional offices (Regions 1 through 8, respectively) are: Brookhaven, NY; Oak Ridge, TN; Savannah River, SC; Albuquerque, NM; Chicago, IL; Idaho Falls, ID; Oakland, CA; and Richland, WA. RAP teams from one region can integrate into and assist RAP teams from other regions. Each RCO has a minimum of three RAP teams. A full RAP team consists of seven members: a team leader, a team captain, four health physics support personnel, and a public information officer. RAP teams may deploy with two or more members; one member is the DOE team leader.

STEPS IN THE RAP EMERGENCY RESPONSE



If an emergency occurs, RAP team members normally arrive at the scene within four to six hours after notification and conduct the initial radiological assessment of the area. A RAP response is tailored based on the scale of the event and additional RAP teams and resources can be deployed as necessary. RAP team members are trained in the hazards of radiation and radioactive materials to provide initial assistance to minimize immediate radiation risks to people, property, and the environment. RAP may utilize other NNSA assets, such as AMS, ARAC, or REAC/TS in their response. RAP is able to quickly assess the affected area and advise decision-makers on what actions to take and determine if additional resources are necessary to manage the emergency.

respond
assess
advise

ABOUT THE EQUIPMENT

RAP's highly trained teams have access to the most advanced radiation detection and protection equipment available. The RAP teams' capabilities and resources include portable field radiation monitoring instrumentation (alpha, beta, gamma, and neutron), generators, mobile laboratories, air sampling and decontamination equipment. Communications and personnel protective equipment and supplies are also available to support the response.

U.S. DEPARTMENT OF ENERGY

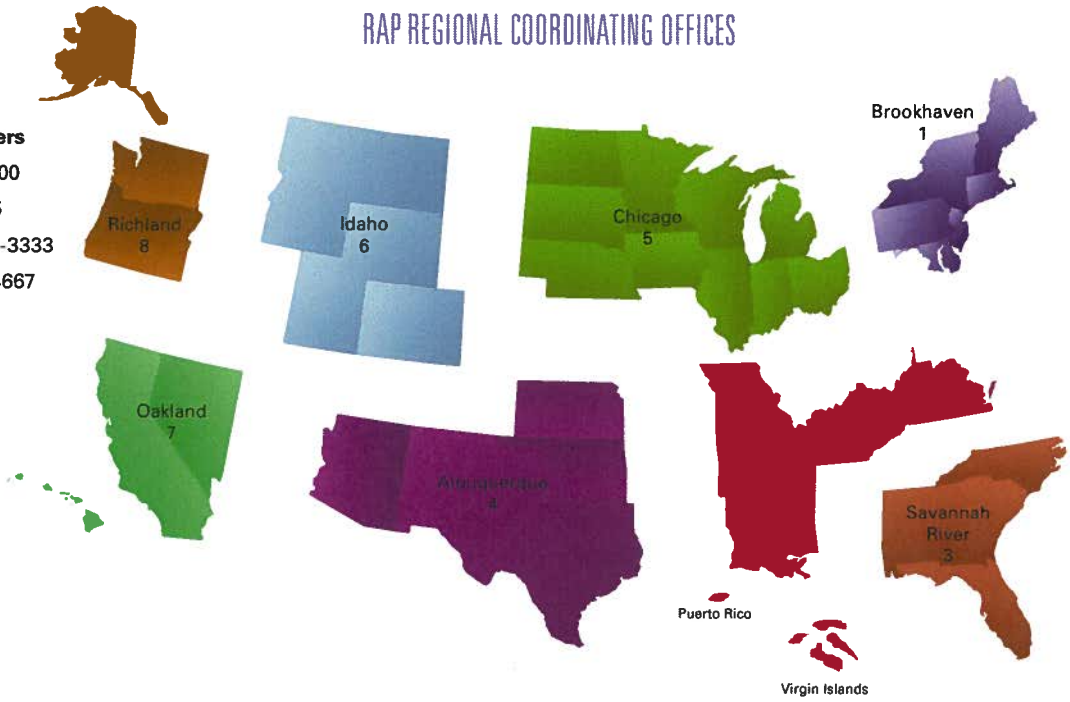
NATIONAL NUCLEAR SECURITY ADMINISTRATION

Regional Offices — 24 hour numbers

1. Brookhaven, NY — (631) 344-2200
2. Oak Ridge, TN — (865) 576-1005
3. Savannah River, SC — (803) 725-3333
4. Albuquerque, NM — (505) 845-4667
5. Chicago, IL — (630) 252-4800
6. Idaho Falls, ID — (208) 526-1515
7. Oakland, CA — (925) 422-8951
8. Richland, WA — (509) 373-3800

Headquarters — (202) 586-8100

RAP REGIONAL COORDINATING OFFICES



WHEN THE JOB IS DONE

RAP's mission is complete when the need for assistance ends or when there are other resources (state, local, Tribal, or commercial services) able to handle the situation. The primary responsibility for an emergency involving radioactive materials remains with the party responsible for the material. Assistance provided by RAP teams does not preempt state, Tribal, or local authority.

OTHER RAP ACTIVITIES

In addition to providing radiological emergency assistance, RAP can provide emergency response training to state and local first responders, upon request. Since 1996, RAP has been involved in the Weapons of Mass Destruction First Responder Training Program with the objective of preparing the United States for responding to a terrorist attack involving nuclear, biological or chemical weapons of mass destruction. RAP's unique qualifications make it an integral partner in the success of the Domestic Preparedness Program.

For more information, contact:
Office of Emergency Response
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874
301-903-3558

PARTNERS IN EMERGENCY RESPONSE