

MEDICAL

1. GENERAL. This page provides guidance on the medical requirements resulting from a nuclear weapon accident or incident. Recommended procedures and available resources, their location, and how to get them are also discussed.

a. Radioactive and other types of contamination may result from a nuclear weapon accident or incident. The accident or incident itself (traffic accident, aircraft accident, storage facility fire, terrorist attack, etc.) may generate a large number of casualties that may be compounded by the detonation of the weapon's high explosives and the presence of noxious fumes. These casualties may have a variety of injuries ranging from inhalation of hazardous materials to severe trauma from the accident or incident. Specifically, emergency life-saving procedures in any major disaster are applicable to a nuclear weapon accident or incident. These procedures should not be delayed because of the presence of radioactive materials. Other weapon-specific non-radioactive hazards (fire, presence of explosives, etc.) should be considered before emergency care is rendered. In instances when radioactive contamination is not dispersed (for example, the September 1980 TITAN II explosion at Damascus, AR), the medical requirements, while greatly simplified, may still be significant.

b. If radioactive contaminants are dispersed, medical personnel must treat people who may be contaminated externally or internally. Treatment of contaminated patients requires special handling similar to universal precautions commonly used by medical care providers. For externally deposited radioactive material, decontamination involves removal and proper storage of clothing, as well as a standard washing procedure using mild soap and lukewarm water. Significant decontamination (greater than 90 percent) may be achieved by removing contaminated clothing. Contaminated wounds are surveyed and lavaged or debrided based on standard wound care management techniques, as well as the amount of radiological contamination. On other occasions, sophisticated treatment available only at special medical facilities may be required. If an explosion occurred, the potential exists that patients may have embedded fragments that may or may not be radioactive. Standard fragment removal procedures should be used initially. Once the nature of the fragment is determined, the need to remove the fragment should be reassessed by a competent medical authority. If embedded fragments are removed, they should be forwarded to the U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) for evaluation. As with any response function, training must be conducted before an accident or incident.

c. For a more detailed discussion of specific radiological and non-radiological hazards which may be encountered during nuclear weapon accident or incident response, see section 6. of the Health and Safety page.

2. SPECIFIC REQUIREMENTS. Medical personnel will assist in accident- or accident-related emergency medical treatment. Rescue will be accomplished by trained fire and hazard materials responders. In general, medical personnel will work with personnel from Emergency Support Function #8 (if present) to assess the public health and medical needs (to include behavioral health), conduct surveillance of public health, provide medical care personnel, and provide medical equipment and supplies. Specifically, medical personnel are required to:

- a. Promptly treat accident casualties, injuries, or illnesses.
- b. Assess and report the magnitude of the accident or incident. This report will include as much specific medical and personal identification information that can be obtained, such as the names and Social Security Account Numbers of the fatalities, identifying information and the categories of injuries, suspected contamination, and priority for transport to a medical facility for each patient, including ambulatory, from the accident. Normal patient-regulating procedures and accident or incident site to medical treatment facility communications will be established to ensure appropriate patient transport and treatment.
- c. Advise medical facilities receiving casualties, in coordination with radiological personnel, of the possibility of internal and external contamination and measures that may be taken to prevent its spread as well as to treat the patient. Medical personnel should ascertain whether the treatment facility has the ability to administer standard drugs that are used to facilitate excretion of radioactive materials and treat the chemical toxicity that may occur. Medical personnel should also provide advice and assistance on the bioassay procedures that may be required to ascertain the level of radioactive and non-radioactive materials that may have been internalized by the patient that are specific to nuclear weapons.
- d. Establish health and safety programs to support response operations over an extended period of time.
- e. Implement the collection of bioassay samples from personnel who were in the area and response personnel and ensure that bioassay and external exposure data become part of the health records. Bioassays are procedures that estimate the amount of radioactive material deposited in the body, either by direct measurement, using sensitive X-ray detectors placed over the chest (lung counting) and/or other organs, or by detecting radioactivity in excreta (feces and urine). Bioassays should not be performed until the individual has been decontaminated due to the possibility of cross contamination. Also, skin contamination might cause instruments to indicate a potentially large intake of radioactive materials when none may be present. See section 4.e. for a discussion of collection procedures for bioassay samples. In addition, actions should be taken to identify any retained embedded fragments to determine if they are radioactive or unusually hazardous if allowed to remain embedded.
- f. Establish a heat- and/or cold-exposure prevention program and other environmental prevention measure programs.
- g. Assist in casualty decontamination.
- h. Manage remediation of internal contamination.
- i. Help obtain and maintain radiation health history of all personnel involved in accident or incident response, including civilians in the surrounding community exposed to radiation or contamination because of the accident or incident.
- j. Record and track all information germane to personnel, evacuees, and casualties for hand-off to the Radiological Advisory Medical Team (RAMT) or the Medical Radiobiological Advisory Team (MRAT) for follow-up. RAMT policies and procedures are outlined in AR 40-13 (reference (bg)). MRAT policies and procedures are outlined in AFRRI Instruction 5100.52.

- k. Update the IC periodically on the extent and condition of casualties.

3. RESOURCES

Medical support assistance, specializing in radiological health matters, is available from the Department of Defense and DOE/NNSA. Although many resources are available, all may not be required for response to a given accident or incident. When an accident or incident occurs, assets should be requested when needed.

- a. The DoD IC may elect to have a medical advisor on his special staff. The medical advisor's role is to provide advice and recommendations to the DoD IC in the context of a nuclear weapon accident involving medical and mental health services to those personnel working at the accident or incident site. The medical advisor will work closely with the Safety Officer.

- b. IRF. The IRF will have a medical element. If possible, the medical element will include a medical officer trained in radiological health matters, preferably by completion of the Medical Effects of Ionizing Radiation (MEIR) course.

- c. RTF. The RTF medical officer will assess the medical requirements and ensure that adequate medical resources are available. The RTF medical officer will be proficient in radiological health matters, preferably by completion of the Medical Effects of Ionizing Radiation (MEIR) course.

4. CONCEPT OF OPERATIONS. The medical response to a nuclear weapon accident or incident involves the emergency treatment of casualties, liaising with civil medical authorities, processing fatalities, establishing a medical clearing facility, collecting bioassay samples, and providing base camp medical support.

- a. Emergency Treatment. Treating casualties is a high priority at any accident or incident. The likelihood of response force involvement in the initial rescue and treatment procedures depends on response time. The longer it takes to get to the accident or incident, the greater the likelihood that casualties will have been treated and removed by civilian authorities. If possible, EOD personnel and/or radiation monitors should mark a clear path, or accompany fire/rescue personnel into the accident or incident site to help avoid radioactive, explosive, and toxic hazards. However, weapon render safe operations may prevent EOD personnel from accompanying fire/rescue personnel into the accident or incident site. Fire/Rescue personnel will wear protective clothing, appropriate for the medical risk to the patient and the radiological risk to the provider. Respiratory protective devices will be worn based on the non-radiological hazards (smoke or fumes) when entering the accident or incident area. Respiratory protection will not be required when treating patients outside the contaminated area, but patients' clothing should be removed and handled carefully. Suggested casualty handling procedures for emergency response to a nuclear weapon accident or incident include:

- (1) Assess and assure an open airway, breathing, and circulation of the victims. Administer cardiopulmonary resuscitation, if necessary, using a bag-mask, positive pressure ventilator, or mouth-to-mouth resuscitation.

(2) Move victims, if possible, away from the contaminated area. Take routine precautions. Do not delay customary life-saving procedures (drugs, Military Anti-Shock trousers, etc.) because of radiological contamination.

(3) Administer intravenous (IV) fluids, as necessary. Prophylactic IVs are not recommended.

(4) Control hemorrhaging and stabilize fractures.

(5) If a victim is unconscious, consider medical or toxic causes. While supra-lethal doses of radiation exposure can cause rapid unconsciousness, this is not possible without at least a partial nuclear yield.

(6) When required, patients should be triaged using standard triage procedures that divide patients into the categories of immediate, delayed, expectant, and minimal.

(7) After the immediate medical needs are met, coordinate with appropriate radiological response personnel to monitor the victims for possible contamination before transporting to the hospital. Note and record the location and extent (in counts per minute (cpm)) of the contamination, and the instrument used, on a field medical card, then place this card in a plastic bag and attach to the patient's protective mask or in another fashion that prevents loss. Also, ensure that open wounds are covered with a field dressing to keep out contamination if the wound is uncontaminated or to contain the contamination if the wound is contaminated. Removal of contaminated clothing is advisable if the medical authority decides that its removal is not contra-indicated. Clothing should carefully be cut, not torn, and rolled to keep the outside of clothing away from the skin. Finally, wrap the patient in a clean sheet to contain any loose contamination during evacuation. Casualty decontamination, particularly wound decontamination, of seriously injured patients is best performed in a medical treatment facility.

(8) Determine if corrosive materials were present at the accident scene, since these materials may cause chemical burns. Take all possible precautions to prevent introduction of contaminated materials into the mouth.

(9) No medical personnel or equipment should leave the contaminated area without monitoring for contamination; however, transporting seriously injured victims should not be delayed for monitoring or decontamination. It is important that medical personnel positively identify each patient before transport and permanently attached personal identification to each patient. This is especially important if the patient is unconscious and the clothing has been removed. For conscious patients, it is still important to positively establish identity prior to transport or during the transport process.

(10) Attendant medical personnel shall then process the patients through the Contamination Control Line. As long as the patient stays wrapped in the sheet, he or she does not pose a threat of spreading contamination and compromising the CCL. Hence, these patients should be evacuated without decontamination. The patient shall then be transferred to the "clean" side of the hot line and placed in the charge of "clean" medical personnel residing on the uncontaminated side of the CCL. The patient may then be loaded into the ambulance or evacuation vehicle and be transported to the receiving medical facility. The procedures listed in subparagraphs 4.a.(11)(c). through 4.a.(11)(e) below may be determined en route to the medical

facility if radiation detection instruments are available, but not at the expense of medical care. Consider using a single medical facility for contaminated casualties if a facility has sufficient capacity.

(11) To ensure that the receiving facility is prepared for the arrival of the victims, notify the facility of the following:

- (a) Number of victims.
- (b) Types or nature of injuries, vital signs, and triage category.
- (c) Extent of contamination, if known.
- (d) Areas of highest contamination.
- (e) Any suspicion of internal contamination.
- (f) The radionuclide and the chemical form, if known, and by what instrument it was measured.
- (g) Any exposure to non-radiological toxic materials.

(12) On arrival at the hospital, take patients immediately to the area designated for receiving contaminated patients. If no such area exists, then take the patients to the emergency room. Under no circumstances should life- or limb-saving treatment be delayed because of concerns for the spread of contamination in the hospital. En-route to the hospital, attendant medical personnel should advise the hospital to institute contamination control precautions to the greatest extent possible. These precautions include, but are not limited to:

- (a) Covering the area with butcher paper, non-slip plastic sheeting, or absorbent-lined plastic diapers to contain loose contamination. Tape seams to prevent trip hazards.
- (b) Ensuring that personnel have the appropriate radiation detection instrumentation, i.e., alpha scintillation detectors or GM counters with pancake probes, and that they are versed in the use of this equipment.
- (c) Ensuring personnel are wearing proper protective clothing. For this type of accident, surgical gowns, gloves, shoe covers, and masks should be appropriate protection against contamination.

(13) The decontamination of the patients may then begin. An autopsy table is a very suitable decontamination platform. These measures include:

- (a) Carefully opening the sheet or blanket wrapped around the patient to avoid spreading any contamination.
- (b) Removing clothing by cutting away the sleeves and trouser legs and folding the contamination in on itself. This method parallels the standard methods of removing patient clothing in a NBC environment. These articles of clothing shall then be bagged to contain the

contamination. Removing contaminated clothing may remove up to 90 percent of the contamination.

(c) Remaining contamination may be located with the use of monitoring equipment and then removed by washing with mild soap and warm water. Several washings may be required, but do not expect decontamination to be 100-percent effective. Suspect areas include the hair, face, neck and hands, as well as other exposed areas of the body due to injuries or torn clothing. Hair is extremely difficult to decontaminate because of its oil content. If shampoo or lemon juice are not effective in decontaminating hair, then clipping the hair and collecting it in marked zip-locked bags for analysis is an appropriate alternative.

(d) Except in life-saving emergencies, the ambulance or evacuation vehicle shall not be returned to normal service until it is monitored and decontaminated and such efforts have been confirmed by attending radiological monitors.

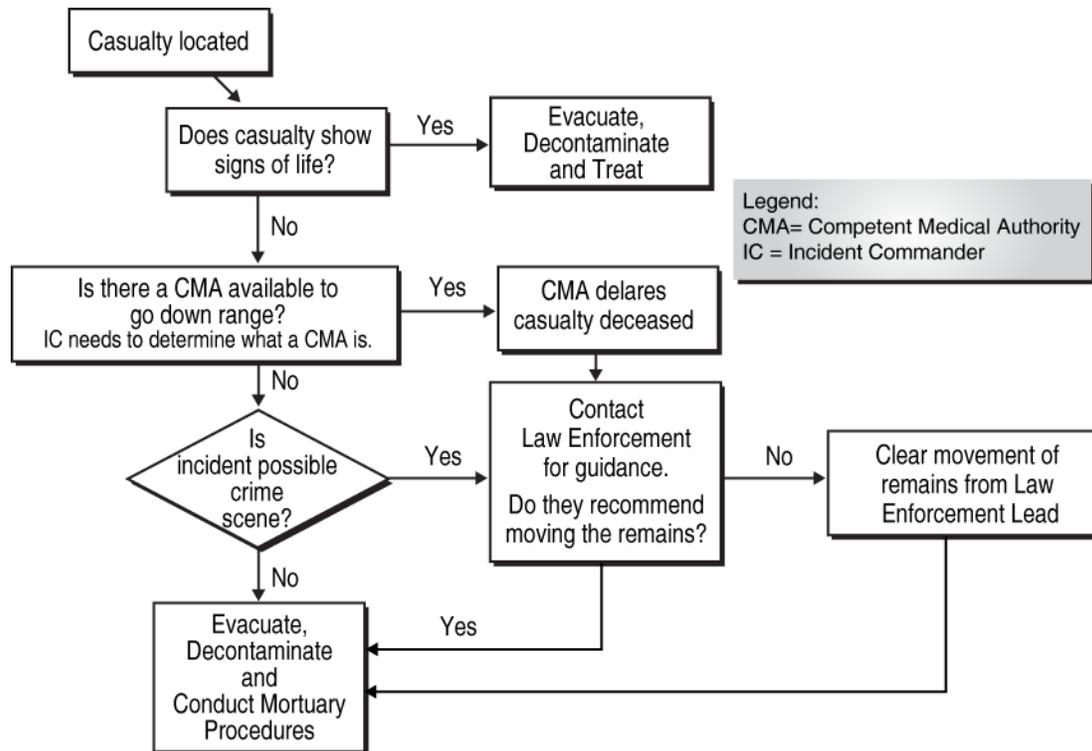
b. Liaison with Civil Authorities. Emergency evacuation of contaminated casualties may have occurred before response force personnel arrived at an off-base accident or incident. Additionally, some response force personnel may have returned from the contaminated area before appropriate controls were implemented; if so, follow-on responders must liaise with area medical facilities to ensure that proper procedures are taken to prevent the spread of contamination. It must be determined if local medical facilities are able to monitor and decontaminate their facilities or if assistance is required. The following procedures may be used by medical facilities not prepared for radiological emergencies to reduce the spread of contamination:

- (1) Use rooms with an isolated air supply, if possible.
- (2) Use scrub clothes, shoe covers, and rubber gloves, and bag them and any other clothing, sheets, or materials that may have come in contact with the patient when leaving the room.
- (3) Get radiation monitoring assistance for detecting alpha emitters.
- (4) Use non-slip plastic sheeting, butcher paper, or absorbent pads on floors to ease decontamination and cleanup.
- (5) Use isolation-control procedures.

c. Processing of Fatalities. The remains of deceased accident or incident victims will be treated with the same respect and procedures used in any accident; however, all fatalities must be monitored for contamination, and decontaminated if necessary, before release for burial. The determination of whether decontamination is to be done before an autopsy will be made by the examining authorities. Any radiological support for autopsies will be arranged on a case-by-case basis. Service procedures for handling casualties are in AR 600-8-1; Air Force Instruction (AFI) 36-3002; and Naval Military Personnel Manual, Article 1770-010 (references (bh) through (bj)). Civil authorities must be notified of any civilian casualties as quickly as possible, and if required, help identify the deceased before decontamination. Additional technical guidance on handling radioactively contaminated fatalities may be found in the National Council on Radiation Protection and Measurements Report, Number 65; Joint Pub 4-06; and U.S. DHS, "Working

Group on Radiological Dispersal Device (RDD) Preparedness, Medical Preparedness and Response Sub-Group” (references (bj) through (bm)).

Figure 1. Contaminated Casualty Flowchart



d. Medical Clearing Facility. A medical clearing facility will be established near the Contamination Control Station (CCS) with supplies for medical treatment of response force injuries and to assist in decontamination. Minimum response force medical staffing after the initial emergency response should include a medic with a physician and health physicist, on call. If an injury occurs within the contaminated area or exclusion zone, and if injuries allow, the injured person should be brought to the CCS and clearing facility by personnel and vehicles already in the area. A separate first aid station may be needed to support the base camp.

e. Collection of Bioassay Samples. Medical personnel usually collect required bioassay samples from response force personnel. Procedures for collecting and marking samples will be coordinated with the ASHG. The ASHG will also guide where samples should be sent for analysis. Depending on Service procedures, urine and fecal samples may be required of all personnel who enter the exclusion zone or of those suspected to have internalized radioactive material.

(1) Bioassays are procedures that estimate the amount of radioactive material deposited in the body, either by direct measurement, using sensitive X-ray detectors placed over the chest (lung counting) and/or other organs, or by detecting radioactivity in excreta (feces and urine). Therefore, many factors must be known in addition to the quantity and isotopic distribution of the material to accurately estimate the dose. These factors include chemical form, route of intake, elapsed time from intake, organ(s) containing the material, distribution pattern, organ(s) mass(es),

biological half-life, particle size of the original material, and decay scheme of the radioisotope. Complex mathematical models have been developed that take each of these factors into account.

(2) Three methods are used to determine the amount of material present in the body. Each method has specific advantages and disadvantages and the specific methods used in any given situation shall be determined by the health physicists.

(a) Fecal Sampling. Fecal sampling may be an effective means of detecting inhaled insoluble material that has been transported from the lungs to the gastrointestinal (GI) tract and excreted. Fecal samples may be quickly screened using low-energy gamma detectors such as the FIDLER to estimate the plutonium or americium content. For more definitive results, chemical separation and low-level counting techniques (which may take days or weeks) must be used. Fecal samples should not be collected until at least 48 hours after exposure to allow the contamination to pass through the GI tract. (Samples collected sooner than this may not be representative and may, in fact, give a false sense of security.) The optimal time for sampling is between two and three days after the inhalation; however, samples collected weeks or months after an intake may still be useful, depending on the size of the intake. Samples should be collected in well-sealed bags. Local medical supply houses or medical facilities should have collection kits (which fit onto a standard toilet seat) which may make sample collection easier. Figure 1. below may be used to roughly estimate the committed effective dose equivalent (CEDE) from inhaling weapons-grade plutonium based on contamination detected in a single fecal sample.

(b) Urine Sampling. Urine sampling is a less sensitive indicator of plutonium exposure; only a tiny fraction of the amount inhaled is excreted through urine. This fraction also depends on the solubility of the plutonium in the original aerosol. Samples taken during the first five days after the exposure may not reflect the quantity of plutonium inhaled due to the time required for movement through the body. Large-volume samples collected for 24 hours are preferred. Urine samples must be processed in a chemistry laboratory before quantification is possible, but screening for very high levels (by gamma-scanning for Am-241) may sometimes be done in the field. Samples should be submitted in plastic or glass bottles with well-sealed tops. Figure 1. below may be used to roughly estimate the CEDE from inhaling weapons-grade plutonium based on contamination detected in a single urine sample. Samples taken for several years after exposure may be used, since plutonium is insoluble in the lung. Material is usually released from the lung into the bloodstream over a very long period of time. Some material may be so insoluble that it may not even show up in the urine for several years.

1. Single-voiding urine samples should be collected from all personnel suspected of being exposed (through inhalation) to significant quantities of uranium. The optimal time for such samples is from 24 to 48 hours after exposure, although samples collected for days or weeks after an intake may be useful depending on the size of the intake. Such samples must be processed by a radiochemical laboratory. These analyses typically take several days to several weeks. Since uranium from normal environmental sources is always present in the urine, care must be taken to determine whether the level of uranium detected is significantly greater than this "background" level.

2. Single-voiding urine samples should be collected from all personnel suspected of being exposed to significant quantities of tritium. Exposed workers should void their bladders immediately after exposure to avoid collection of a non-representative sample. Subsequent voids

are collected for analysis. The optimal time for such samples is from four to eight hours after exposure, although samples collected for days or weeks after exposure may still be useful. Samples collected sooner than 90 minutes after exposure may not be representative. Usually such samples must be processed in a radiochemistry laboratory (using liquid scintillation counters) but portable liquid scintillation counters are available in some emergency response organizations. Urine sampling is the main way of determining tritium uptake.

(c) Lung Counting. Lung counting is the direct measurement of emitted X rays and gamma radiation (typically Am-241 in a weapons accident) from the body with a sensitive low-energy photon detector. Lung counters are used at DOE/NNSA national laboratories, commercially, and at some hospitals and universities. Most lung counters are immobile systems using large shielded rooms (special trailer-mounted systems may be obtained through the DOE/NNSA in a few days), and the patient must be sent to the facility. Inhaled plutonium stays in the lungs for extended periods of time. Portable FIDLER (or similar) detectors may be used for rough screening measurements but have poor sensitivity. However, such measurements may be easily distorted by small amounts of surface contamination, and should only be performed by experienced and qualified personnel. Figure 2. may be used to roughly estimate the CEDE from inhaling weapons-grade plutonium based on the results of a lung scan for Am-241. Note that a negative lung count measurement obtained with a FIDLER or other portable instrument does not rule out a significant intake of transuranics.

(3) Interpretation of Single Bioassay Results: Weapons-Grade Plutonium. Figure 2. may be used to make a rough initial estimate of the dose significance of a single bioassay measurement (Am-241 gamma scan) obtained after acute inhalation of weapons grade plutonium. The curves represent the 50-year CEDE implied by a 24-hour urine or fecal sample result of 1 microcurie of Am-241, or a lung count of 1 microcurie of Am-241, on a given day after inhalation. Note that these curves are using the Am-241 result from a gamma count as a "marker" for the entire mix of plutonium and americium found in weapons-grade plutonium. Accordingly, these curves may not be used directly for plutonium results; they must be used with Am-241 results. Note also that Figure 2. may not be used to interpret uranium or tritium bioassay results.

(a) The following steps are used:

1. Move right along the horizontal (X) axis to the number of days between inhalation and sample collection.
2. Move up to the curve of interest (urine sample, fecal sample, or lung count).
3. Move left to read the dose-per-microcurie on the vertical (Y) axis.
4. Multiply this dose-per-microcurie by the actual sample or measurement result.

(b) Example of use.

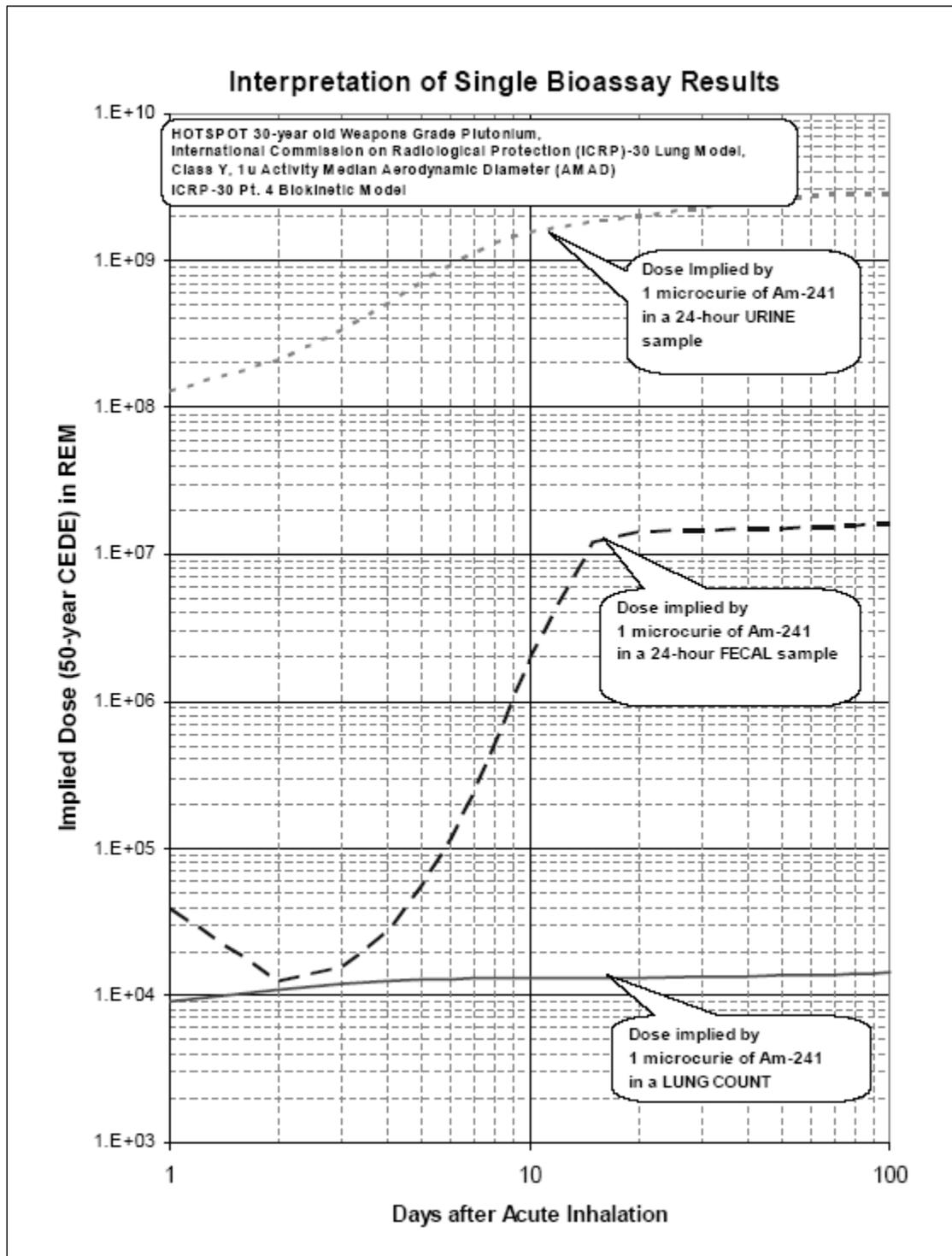
1. A fecal sample was collected about a week after a person was exposed to a fire involving weapons-grade plutonium. The plutonium involved in the fire is known to be about 30 years old. A "screening" gamma scan was performed on this sample, giving a result of 5.0 x

10^{-5} μCi (about 110 dpm) of Am-241. What is the approximate dose implied by this single result?

2. The fecal sample dose curve is represented by the heavy dashed line. At 7 days after inhalation, the dose-per-microcurie value is about 2×10^5 rem. Multiplying this value by the actual fecal sample result of 5.0×10^{-5} μCi gives an implied 50-year CEDE of about 10 rem.

(c) Cautions about Use. This information is intended for use by individuals with expertise in internal radiation dosimetry. There are many potential sources of uncertainty and error in using a single bioassay measurement to estimate dose. Different exposure or intake scenarios, individual biological differences, and sample collection and analysis uncertainties all contribute to this overall uncertainty. Accordingly, such “single-point” dose estimates should be viewed as rough indicators at best.

Figure 2. Estimated 50-Year Committed Effective Dose Equivalent



(d) Technical Notes for Figure 2.

1. These curves are generated by estimating the fraction of an inhaled intake that would be excreted through the urine or feces, or kept in the lungs, on any particular day after intake. Dividing the actual bioassay result by these “intake excretion fractions” or “intake retention fractions” gives an estimate of the initial intake. Multiplying this estimated intake value by a “dose conversion factor” (DCF) (dose per unit intake) gives an estimate of the dose.

2. The material inhaled is assumed to be a 30-year-old mixture of “weapons grade” plutonium, as characterized by the LLNL “Hotspot” Health Physics Codes (The Am-241 concentration is about 4,300 parts per million). The material is assumed to have “Class Y” (very insoluble) lung solubility characteristics and to have a particle size distribution of 1 micrometer Activity Median Aerodynamic Diameter (AMAD). Since the Am-241 is assumed to have “grown-in” to the plutonium matrix, the Am-241 is assumed to have the same lung solubility characteristics as the plutonium. It is also assumed that this Am-241 has the same systemic retention and excretion characteristics as the “parent” plutonium. These assumptions are somewhat simplistic but are likely to provide a conservative estimate of dose.

3. For consistency with current guidelines and regulations, the following models were used to generate the intake excretion and retention fractions used in Figure 1.:

a. ICRP-30 Respiratory Tract Model.

b. ICRP-30 GI Tract Model.

c. “Jones” Plutonium Excretion Model.

4. The intake, excretion, and retention fractions were computed, but are essentially the same as those published in NUREG/CR-4884 [http://www.nrc.gov/reading-rm/doc-collections/reg-guides/occupational-health/active/8-09/ - book8#book8](http://www.nrc.gov/reading-rm/doc-collections/reg-guides/occupational-health/active/8-09/-book8#book8) (reference (bn)).

5. DCFs were taken directly from Federal Guidance Report 11 (reference (bx)). This report uses the ICRP-30 Respiratory Tract and GI Tract Models, the ICRP-48 Systemic Model for Plutonium and Americium, and the tissue weighting factors of ICRP-26.

6. Newer Biokinetic Models. The ICRP has recently introduced a new Respiratory Tract Model (ICRP-66) and new biokinetic models for plutonium and americium (ICRP-67.) Use of those models, coupled with corresponding DCFs (ICRP-71) produces dose estimates that are usually from two to five times lower than those of Figure 2. Thus, the curves of Figure 2. probably provide a conservative estimate of doses from such an intake.

(4) Bioassay Procedures. The Federal agency, State agency, or affected country may administrate a bioassay program for affected civilians. The guidelines in table 1. below are provided to assist the response force or civilian authorities conducting initial screening in advising contaminated individuals when requested to provide urine or fecal samples for analysis. Advisors explain that sample analysis determines if the individual received a detectable radiation dose when contaminated. The bioassay procedures used shall be established by health physicists responding to the accident. If possible, all follow-up bioassay monitoring or sampling protocols

should be established by a health physicist who has specific experience and expertise in the internal dosimetry of plutonium, uranium, and/or tritium. The DOE ARG usually has such dosimetry assets available. When bioassay samples are collected, try to keep samples and their containers free of contamination from the environment, clothing, or skin. Since tritium contamination may not be detected by CCS monitoring, anyone suspected of having been exposed to tritium should follow the guidelines in table 1. A bioassay program is recommended for all individuals without respiratory protection who are found to be contaminated. This program shall determine if any dose was received, and assure those who did not receive a dose that their health was not affected. To provide similar assurance to all people in the contaminated area, bioassays may be appropriate even for people who were not found to be contaminated; moreover, some people never in contaminated areas may request tests to ensure they were not affected by the accident or incident.

Table 1. Guidelines for Bioassay Sampling

Suspected Radioactive Material	Feces Optimum Sampling Time After Exposure	Urine Optimum Sampling Time After Exposure	Sample Quantity
Plutonium	2 to 3 days	2 to 3 weeks	24 hours total
Uranium	2 to 3 days	24-48 hours	24 hours total
Tritium	N/A	4 to 8 hours	1 voiding

(5) Bioassay Priorities. If a nuclear weapon accident or incident occurs near a populated area, getting bioassay samples from large numbers of people may be necessary. Accurate identification of all bioassay samples (full name, ID and/or Social Security Account Number, age, gender, address, phone number, and date and time of collection) is imperative. The specific reason for sampling (e.g., “facial contamination: 50,000 CPM alpha using X instrument” or “1 mile downwind during initial plume passage”) should also be included to aid in later prioritization of processing. Considering the potential for public concern for their possible exposures, it may probably be better to err on the side of collecting too many samples, rather than too few samples. Note that samples may be collected from large numbers of people during the optimal collection time period and then stored for later analysis on a prioritized basis. Fecal samples should be frozen, and urine samples should be refrigerated (not frozen).

(a) Since it is very difficult for a significant amount of plutonium to be incorporated into the body without gross contamination of skin or clothing also occurring, initial alpha monitoring that identifies contaminated personnel may also provide a method for assuring that those with the greatest possibility of radiation exposures (that may affect their health) are given priority treatment.

(b) Table 2., applicable only to people not wearing respiratory protection, provides recommended guidelines for assigning priorities for bioassay analysis. Response force personnel shall usually be equipped with protective clothing and respirators, when required. Bioassays for response force personnel shall be performed in accordance with Service regulations and as directed by the IC.

Table 2. Guidelines for Assigning Priorities for Collecting and Processing Bioassays

Priority	Alpha Contamination Level on Clothing or Skin			
	60 cm ² (45% eff)	17 cm ²	100 cm ² (50% eff)	100 cm ² (20% eff)
HIGH	> 300,000 cpm	> 85,000 cpm	> 550,000 cpm	> 222,000 cpm
MEDIUM	30,000-300,000 cpm	8,500-85,000 cpm	55,000-550,000 cpm	22,200-222,000 cpm
LOW	< 30,000 cpm	< 8,500 cpm	< 55,000 cpm	< 22,200 cpm

Table 3. Sample Instrument Readings to Determine Bioassay Priority in Table 2.

Instrument	Probe (area in square cm)	Activity (microCurie/100 square cm)	Instrument indication
AN-PDR-56	*DT224B (17)	0.5	~85,000 cpm
ADM-300	#ASP 100 (100)	0.5	~222,000 cpm
E-600	‡SHP 380 (100)	0.5	~550,000 cpm
AN-PDR-56	*DT224B (17)	0.05	~8,500 cpm
ADM-300	#ASP 100 (100)	0.05	~22,200 cpm
E-600	‡SHP 380 (100)	0.05	~55,000 cpm

“High” contamination should be defined as “at or above 0.5 uCi/100 cm²” (or similar)

“Medium” contamination should be defined as “between 0.05 and 0.5 uCi/100 cm²” (or similar)

“Low” contamination should be defined as “below 0.05 uCi/100 cm²” (or similar)

*assumed α efficiency (4π) for DT224B is 45%

#assumed α efficiency (4π) for ASP 100 is 20%

‡assumed α efficiency (4π) for SHP380 is 50%

If α efficiencies are different from those assumed above, instrument indications must be re-calculated. Additionally, the use of activity, instead of instrument-specific count rates, will eliminate problems associated with inconsistencies in instrument calibration from facility to facility or from service to service (Air Force, Navy, National Lab, etc.).

(c) Personnel falling in the HIGH priority category in table 2. may have had a substantial plutonium intake. Conversely, exposure to airborne contamination that produces a surface contamination level in the LOW category would be less likely to result in a significant deposition in the lungs. To ensure alpha meter readings provide a valid guide for assigning priorities, individuals should be asked, during screening, if they have bathed or changed clothes since the time of possible contamination. The results of both alpha meter screening and bioassays for all personnel screened must be recorded and kept for future reference. Use of the Radiation Health History and Bioassay Screening Forms should be considered.

(6) Nasal Smears. Contamination on a wipe (e.g., a cotton swab) from inside the nasal passage is a possible indicator of plutonium inhalation. If initial alpha meter screening indicates probable plutonium or uranium inhalation, a nasal smear shall be collected for analysis by medical personnel trained in nasal swab bioassay procedures. However, due to the biological half-life of nasal mucus, a nasal smear is a reliable indicator only if collected during the first hour after the exposure. Accordingly, prompt nasal samples may be collected by any personnel, as long as they are taken carefully and labeled appropriately. Great care must be taken to avoid cross-contamination from the face, hands, or other sources while collecting nasal smear samples.

Ideally, separate swabs should be taken from each nostril. Each of these should be bagged separately, then placed in another bag labeled with name, ID number (as applicable), and collection date and time. After collection, the swabs must not be placed into any gels or liquids since this would inhibit alpha particle counting. A negative nasal smear does not rule out an intake of radioactive material. Nasal smears are only one tool of many used to determine whether an intake has occurred.

(7) Personnel Exposure and Bioassay Records. Documentation should be maintained on all personnel who enter the exclusion zone, or who may have been contaminated before an exclusion zone was established. Examples of forms used for recording data on personnel working in the exclusion zone, or who may have been exposed to contamination downwind from the accident, are in the Radiological Monitoring, Measurement, and Control Forms page. To ensure appropriate follow-up actions are completed on all exposed or potentially exposed people, a copy of all CCS logs, other processing station records, bioassay data, and other documentation identifying people who were or were not contaminated should be provided to the ASHG for consolidation into a single data file. This data file is subject to Privacy Act Regulations (section 552a of reference (bo)), and must be kept as part of the permanent accident records; therefore, procedures for handling data obtained on non-DoD personnel should be coordinated with the IC's legal officer. Data obtained on DoD personnel will need to satisfy Service-specific requirements in AR 11-9, BUMED P-5055, and AFI 48-125 (references (bp) through (br)). These records shall be kept and become part of the individual's permanent medical record.

f. Base Camp Medical Support. Base camp support requirements include treating on-the-job injuries and illness, inspecting field billeting and messing facilities, evaluating the adequacy of restroom facilities and sewage disposal, and supplying water. Personnel suffering cuts or open sores should be prohibited from entering the contaminated area until the wound is properly protected to exclude possible contamination. Their supervisors should be notified of the restriction.

5. PUBLIC AFFAIRS CONSIDERATIONS. All medical staff personnel should be aware of the sensitive nature of issues surrounding a nuclear weapon accident or incident. All public release of information should be approved by the IC and coordinated with the JIC/CIB. Medical personnel should ensure that public affairs personnel are informed of medical information provided to medical facilities receiving potentially contaminated patients. Hospitals shall provide medical information to the public and the news media in accordance with their policies. USG military and civilian responders should refer media and public queries for information to PA personnel. Additionally, medical personnel should make themselves available for participation in any news conferences held by the DoD IC.