Boeing - SSFL
EHS Manual

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SM-40.405, RADIOLOGICAL CONTROLS MANUAL: RADIOLOGICAL HEALTH SUPPORT OPERATIONS, JULY 13, 2012, JAMES BARNES

DOCUMENT CHANGE SUMMARY – This document replaces issue dated October 31, 2003.

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APPLICABILITY

This procedure applies to radiological activities conducted at the Boeing Santa Susana Field Laboratory (SSFL) campus ("Boeing - SSFL").

The terms "shall," "should," "may," etc. indicate procedural requirements or suggestions for good practices. These terms are intended to convey meanings typically used in quality assurance or standards documents (e.g., ANSI).

- "Shall" in this procedure denotes a mandatory requirement.
- "Should" denotes a recommended practice, but which is not required. "Should" is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required.
- "May" denotes an option. "May" indicates a course of action permissible within the limits of the procedure.

This procedure implements the requirements of SOP C-401, *Radiation Safety Program*. This procedure is intended to provide additional guidance to the requirements of the SOP. Stipulations of this procedure are to be interpreted in light of the SOP C-401 requirements.

Note that DOE dosimetry terminology has been changed. This procedure utilizes the *updated* terminology. SOP C-401, Table 8 describes terminology equivalency between the former and revised nomenclatures.

PART 1 External Dosimetry

511 Requirements

1. Primary dosimetry[1] shall be issued in accordance with SOP C-401, Section 5.8.3.

2. Primary Dosimetry **shall** be worn only by those to whom the devices were issued.

3. Dosimetry **shall** be issued only to personnel who are qualified Radiological Workers; or, who, while in a radiologically controlled area, are being escorted by personnel so qualified.

4. Primary dosimetry is processed periodically to obtain results of exposure. Personnel **shall** return primary dosimetry for processing as scheduled or upon request. Unless authorized by Radiation Safety, personnel with expired or recalled primary dosimetry may not continue radiological work until replacement dosimetry is provided. The nominal issue period for personnel dosimetry is currently one calendar quarter.

[1] Primary dosimetry refers to dosimetry that generates a permanent dose of record (e.g., TLDs, OSLDs, film badges, etc.).

5. Personnel **shall** wear their primary dosimeters on the chest area, on or between the waist and the neck, in the manner prescribed by Radiation Safety personnel.

6. Primary dosimetry issued at the Boeing--SSFL complex **shall** be used for dose monitoring at the SSFL campus. Individuals working at other locations **shall** surrender their primary dosimetry to Radiation Safety prior to leaving the Boeing--SSFL complex[2].

   Unless specifically authorized by the RSO, primary dosimetry **shall not** be used to measure occupational dose received outside of the above listed campuses.

7. Personnel arriving from offsite facilities **shall** be badged with a Boeing--SSFL primary dosimetry when required. For service or regulatory personnel who are issued dosimetry by their own employer, the issuance of a Boeing--SSFL badge may be waived on a case-by-case basis by the RSO.

8. Dosimeters are provided in order to determine dose to individuals from their occupational activities. Personnel **shall** not confound dosimetry results by exposing their dosimeters to other sources of radiation, such as security x-ray devices, excessive heat, or medical sources of radiation.

9. A person whose dosimeter is lost, damaged, inadvertently exposed, or contaminated **shall** place the work area into a safe condition, immediately exit the area, and report the occurrence to Radiation Safety.

   Reentry of the person into Controlled Areas *should not* be made until a review has been conducted and the RSO has approved reentry.

10. The process for the issue of dosimetry is described in SM-40.405; Exhibit 5B.

512 Technical Requirements for External Dosimetry

The Boeing--SSFL dosimetry program uses a third party vendor who maintains a National Voluntary Laboratory Accreditation Program (NVLAP) for the dosimeter types used by Radiation Safety. All primary dosimetry of record **shall** be NVLAP accredited. Personnel external dosimeters of record include but are not limited to TLDs, OSLDs, beta/gamma sensitive films, track etch dosimeters, and neutron sensitive film.

1. A technical basis for the program is described in RS-00024, *External Dosimetry Technical Basis Document.*

2. Personnel exposures to the skin, lens of the eye, and extremities **shall** be reported separately when monitored.

[2] In certain situations, supplementary dosimetry may be issued specifically for an offsite assignment. The dosimetry routinely worn for Boeing--SSFL dose monitoring should NOT be used for such offsite monitoring.

3. Multiple dosimeters *should* be issued to personnel to assess whole body exposure in non-uniform radiation fields or as required on Controlled Work Permits. Non-uniform radiation fields exist when the dose to a portion of the whole body will exceed the dose to the primary dosimeter (generally the chest location) by more than 50 percent and the anticipated whole body dose rate at the monitored location exceeds 100 mrem/hr.

   Assignment of dose from multiple dosimeters **shall** be determined by an evaluation of results of all pertinent dosimetry.

4. The RSO, or a designated alternate, **shall** assess each instance of a lost, damaged or contaminated personnel dosimeter, and **shall** assign a dose of record for that individual.

513 Pocket and Electronic Dosimeters

Pocket and electronic dosimeters are supplemental dosimeters that provide real-time indication of exposure to radiation and assist in maintaining personnel doses less than Administrative Control Levels.

1. Supplemental dosimeters **shall** be issued to personnel:

   A. prior to entry into a High Radiation Area; or,

   B. when a person could exceed 10 percent of an Administrative Control Level from external radiation in 1 work day; or,

   C. when operating, setting up shots for, or performing maintenance on shielded room or field X-radiography equipment; or,

   D. when required by a Controlled Work Permit (CWP); or,

   E. when required by Use Authorization.

   Pocket dosimeters *should* be selected with the lowest range applicable (typically 0-200 mR) for anticipated personnel exposures.

2. Supplemental dosimeters **shall** be worn simultaneously with the primary dosimeter and located on the body in accordance with Article 511.5.

3. Supplemental dosimeters **shall** be read periodically while in use and *should* not be allowed to exceed 75 percent of full scale. Where a "hierarchy" of dosimeters is worn simultaneously (e.g., 0-200 mr, 0-500 mr, 0 - 1 R, etc.), lower scaled dosimeters may be allowed to discharge as long as a higher-scale dosimeter is being worn and will report the dose received.

4. Routine work on a Controlled Work Permit **shall** be stopped when supplemental dosimeter readings indicate total exposure or rate of exposure substantially greater than planned. Radiation Safety **shall** be consulted prior to continuation of work.

5. The energy dependence of supplemental dosimeters, particularly to low-energy beta radiation, *should* be considered in determining their applicability.

514 Area Monitoring Dosimeters

1. Area monitoring dosimetry **shall** be used to record and document radiation levels in routinely occupied, uncontrolled areas adjacent to Controlled Areas where an individual could reasonably be expected to receive more than 25 mrem above natural background in a calendar year.

2. Area monitoring dosimeter results are used to support dosimetry investigations where personnel express concerns about their work environments and exposure to ionizing radiation.

3. Area monitoring dosimeters *should* be used in Controlled Areas to supplement existing monitoring programs and to provide data in the event of an emergency.

4. Area monitoring badges are marked for a nominal issue period of 1 calendar quarter. Notwithstanding this, at the discretion of Radiation Safety, the badges may be posted for longer or shorter periods as long as the badge is returned for processing within the “use period” specified by the vendor. For the typical OSLD/TLD device, the use period is one calendar year from the start date displayed on the badge.

515 [DELETED]

PART 2 Internal Dosimetry

521 Requirements

1. The following categories of personnel are required to participate in an internal dosimetry program (e.g., routine bioassay) under the following conditions:

   A. Radiological workers who enter Contaminated Areas; Airborne Radioactivity Areas; or Radiological Buffer Areas, and who, under typical conditions, are likely to receive an intake or intakes of radioactive materials resulting in a committed effective dose of 100 mrem or more in a calendar year.

   Airborne monitoring may be used to verify these assumptions. Routine bioassays are not required where air sampling results indicate that an individual has not exceeded the following guidelines:

   - 10 mrem Committed Effective Dose (4 DAC[3]-hours) in a specific event;
   - 25 mrem Committed Effective Dose (10 DAC-hours) in a calendar quarter; or,
   - 50 mrem Committed Effective Dose (20 DAC-hours) in a calendar year.

[3] "Derived Air Concentration" -- See SM-40.408.

B. Declared pregnant workers who are likely to receive an intake or intakes resulting in a equivalent dose to the embryo/fetus in excess of 10 percent of the limit stated at SM-40.402, Table 2-1 (i.e. 50 mrem CEDE);

C. Occupationally exposed minors[4] who are likely to receive a dose in excess of 50 percent of the applicable limit stated at Table 2-1 (i.e., 50 mrem CEDE) from all radionuclide intakes in a year; or

D. Members of the public[1] who are entering a controlled area and are likely to receive a dose in excess of 50 percent of the limit stated at SM-40.002; Table 2-1 (i.e. 50 mrem CEDE) from all radionuclide intakes in a year.

2. Internal dose monitoring programs implemented to demonstrate compliance with 10 CFR 835.402(c) shall be adequate to demonstrate compliance with the dose limits described in 521.1 and shall be:

   A. Accredited, or excepted from accreditation, in accordance with the DOE Laboratory Accreditation Program for Radiobioassay; or

   B. Determined by the Department of Energy to have performance substantially equivalent to that of programs accredited under the DOE Laboratory Accreditation Program for Radiobioassay.

3. Personnel **shall** participate in followup bioassay monitoring when their routine bioassay results indicate an intake in the current year with a committed effective dose equivalent of 100 mrem or more.

4. Personnel whose routine duties may involve exposure to surface or airborne contamination or to radionuclides readily absorbed through the skin, such as tritium, *should* be considered for participation in the bioassay program.

5. Personnel **shall** submit *in vitro* bioassay samples, such as urine or fecal samples, and participate in *in vivo* bioassay monitoring, such as whole body or lung counting, at the frequency required by the bioassay program.

6. Workers **shall** be informed of the results of bioassay sampling on an annual basis. Personnel **shall** be notified promptly of bioassay results exceeding the criteria of Article 521.1.A. The results of any subsequent dose assessments and subsequent refinements **shall** also be reported in a timely manner.

   Dose assessment results **shall** be provided in terms of mrem. Reporting *de minimis* values shall be (where feasible) 10 mrem CEDE prior to 1 January 2000, and 1 mrem CEDE after 1 January 2000[5]. These values may be determined by simplified screening or formal dose assessment procedures at the discretion of the Radiation Safety Officer.

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[4] See restrictions on minor, visitor, and member of the public access at SM-40.003, Article 336.

[5] This guideline is based upon the detection limit for external dosimetry devices; 10 mrem for TLDs, and 1 mrem for OSLDs.

522 Technical Requirements for Internal Dosimetry

1. Rocketdyne Procedure RS-00007, *Internal Dosimetry Technical Basis Document and Procedure,* provides the technical description and basis for the Internal Dosimetry program.

2. Baseline bioassay monitoring of personnel who are likely to receive intakes resulting in a committed effective dose equivalent greater than 100 mrem CEDE in a calendar year **shall** be conducted before they begin work that may expose them to internal radiation exposure.

3. Periodic bioassay monitoring methods and frequencies **shall** be established for personnel who are likely to receive intakes resulting in a committed effective dose equivalent greater than 100 mrem CEDE in a calendar year. See RS-00007 for the technical basis for the methods and frequency of bioassay monitoring.

4. Management *should* require termination bioassay monitoring when a person who participated in the bioassay program terminates employment or concludes work involving the potential for internal exposure.

5. Bioassay analyses **shall** also be performed when any of the following occurs:

   A. Facial contamination is detected that indicates a potential for internal contamination; or,

   B. Nasal contamination is detected; or,

   C. Airborne monitoring indicates that intakes exceeding the guidelines of Article 521 may have occurred; or,

   D. An intake is suspected for any reason.

6. Levels of intakes that warrant the consideration of medical intervention **shall** be established for site-specific radionuclides. The effectiveness of medical intervention, such as blocking or chelating agents, **shall** be documented using bioassay results.

7. A preliminary assessment of any intakes detected *should* be conducted prior to permitting an employee to return to radiological work.

8. The vendor of bioassay sample evaluation services **shall** receive a quality evaluation in accordance with applicable QA&SS guidance. The vendor *should* demonstrate traceability to NIST laboratory standards as part of this evaluation process.

9. Internal dosimetry program personnel *should* participate in the conduct of intercomparison studies.

10. The basis of determination of internal doses shall comply with SOP C-401, Section 5.8.6.

523 Technical Requirements for Dose Assessment

Interpretations of bioassay results and subsequent dose assessments *should* include the following:

1. Characteristics of the radionuclide, such as chemical and physical form;

2. Bioassay results and the persons previous exposure history;

3. Exposure information, such as route of intake and time and duration of exposure;

4. Biological models used for dosimetry of radionuclides;

5. Models to estimate intake or deposition and to assess dose; and,

6. Intradepartmental coordination between Radiation Safety and the medical organization for doses that may require medical intervention.

PART 3 Respiratory Protection Program

Respiratory protection equipment includes respirators with particulate or gas-filtering cartridges, supplied air respirators, self-contained breathing apparatus and airline supplied-air suits and hoods.

Control of respiratory protection equipment is governed by the Boeing-SSFL Respiratory Protection Program.

531 Requirements

1. Use of respiratory protection **shall** be reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source.

2. DOE 5480.4 mandates the requirements contained in ANSI Z88.2 and 29 CFR 1910.134 for implementation of the Respiratory Protection Program and associated training of personnel. These requirements are also applicable to 10 CFR 20.1703, "Use of Individual Respiratory Protection Equipment."

3. Respirators **shall** be issued only to personnel who are trained, fitted and medically qualified to wear the specific type of respirator. Training and qualification testing **shall** be performed annually.

4. Positive controls **shall** be maintained for the issue, use and return of respirators to ensure that only qualified personnel wear respirators.

5. Breathing air **shall** meet the specifications of ANSI/CGA G-7.1 Grade D breathing air as specified in 29 CFR 1910.134.

Compressed air supplied to respirators **shall** be tested quarterly, and after major maintenance of the equipment.

Compressors **shall** be of the breathing air type and **shall** not allow oil or other chemicals and fumes to enter the breathing air supply.

To prevent the introduction of toxic gases into breathing air supplies, special attention **shall** be focused on the proper location of compressor air supply intakes, and on the prevention of cross-connections to other non-breathing air compressed gas systems.

6. Facility safety analyses *should* not take credit for the use of respiratory protection for routine work involving potential exposure to airborne radioactive materials.

   Engineering controls *should* be designed to control radioactive materials at the source, so that use respiratory protection devices and systems can be reduced.

532 Medical Assessment

Respiratory protection devices can place additional stress on the body. The medical department has the responsibility for ensuring an individual is physically capable of using respiratory protection equipment. Examinations are scheduled and conducted through the Medical Department. Guidance regarding the frequency and content of such exams is provided in ANSI Z88.6.

In accordance with the Boeing-SSFL Respiratory Protection Program, each prospective respirator wearer **shall** have a medical assessment prior to being fit-tested.

533 Use of Respiratory Protection

Personnel using respiratory protection **shall** comply with the Boeing-SSFL Respiratory Protection Program.

534 Heat Stress

Heat stress may result from working in areas of high heat, humidity and radiant heat; working in protective clothing; and using respirators, particularly where other protective equipment is required. Heat stress has occurred at ambient temperatures less than 70°F when multiple sets of anti-contamination clothing or plastic suits were in use or strenuous work was required.

The following planning actions are recommended where heat stress could be present:

1. Designate and describe heat stress controls.

2. Recommend work time limits and use of body cooling devices to reduce heat stress.

3. **I**nform personnel of heat stress precautions prior to work on job assignments in hot environments.

4. IF SYMPTOMS OF HEAT STRESS APPEAR:

   A. Immediately **notify** the nearest co-worker;

   B. **Exit** the area;

   C. **Remove** personal protective equipment;

   D. **Notify** the supervisor; and,

   E. **Rest** in a cool area.

   In such cases, medical assessment **shall** be conducted, and further treatment provided as indicated.

535 Half-Face Respirators

Half-face respirators are not used at SSFL. The current 10 CFR Part 20 states that half-face respirators are:

". . . not satisfactory for use where it might be possible (e.g., if an accident or emergency were to occur) for the ambient airborne concentrations to reach instantaneous values greater than 10 times the.[*appropriate DAC values*]. This type of respirator is not suitable for protection against plutonium or other high-toxicity materials."

1. The use of half-face respirators for radiological protection is discouraged. Use of half-face respirators for radiological protection shall not be permitted without the express authorization of the RSO.

   When so used, a radiological protection factor of 1 shall be assigned to all half-face respirators used in radiological areas, i.e., they shall be assumed to provide no radiological protection.

2. Notwithstanding the above, Health and Safety may continue to specify the use of half-face respirators for protection against *noxious or toxic materials*. Such use of half-face respirators in radiological areas is permissible.

3. Half-face respirators **shall not** be used on a routine basis as a precautionary measure for protecting workers from *potential* airborne radioactive materials.

<u>Part 4 Handling Radiologically Contaminated Personnel</u>

541 Skin Contamination

1. Survey techniques **shall** be established to determine the extent of skin contamination.

2. When personnel detect skin contamination, they **shall** notify Radiation Safety.

3. The extent of skin contamination *should* be determined prior to initiating decontamination procedures.

4. Personnel decontamination methods are summarized in the Radiological Health Handbook (Bureau of Radiological Health, 1970). A copy of this listing is provided in Exhibit 5A.

   Exercise caution in order to avoid skin abrasion during the decontamination process. Intrusive decontamination methods, such as tissue removal, require medical assistance.

5. Skin dose *should* be calculated when skin contamination could result in a dose greater than 100 mrem. VARSKIN, Mod 2 shall serve as the basis for calculations.

   An assessment of skin exposure requires time to conduct a detailed evaluation. Assessments **shall** be conducted in accordance with SM-40.402; Exhibit 2C and, promptly after completion, the results *should* be explained to the persons affected.

   Personnel with skin contamination that triggers the need for dose assessment *should* be informed of the initial dose estimate to their skin as soon as practicable, preferably prior to the end of their work day.

   Personnel with skin contamination for which dose assessment was not performed *should* be informed of the nature of the contamination and an upper estimate on the potential dose (such as less than 10 mrem) as soon as practicable, preferably prior to the end of their work day.

542 Contaminated Wounds

1. Emergency medical care **shall** be administered immediately for injuries involving radioactive materials. National Council on Radiation Protection and Measurements, Report Number 65, "Management of Persons Accidentally Contaminated with Radionuclides," provides guidance for such medical care.

   Medical treatment of injuries takes precedence over radiological considerations.

2. The treatment of contaminated injuries could include the following:

   A. Treatment of contaminated wounds by medically qualified personnel

   B. Monitoring of wounds and associated bandages for contamination, including alpha emitters if applicable

   C. Identification of the radionuclides involved

   D. Medical determination of the need for therapeutic intervention such as blocking or chelating agents

   E. Initiation of appropriate bioassay monitoring

F. Determination of need for work restrictions.

3. An injured person *should* be counseled promptly on the medical and radiological implications resulting from contaminated wounds that result in internal doses greater then 2 percent of the SOP C-401; Table 5 limits.

   The counseling *should* be performed by senior Radiation Safety and medical professionals, as appropriate.

543 Exposures to Airborne Radioactivity

Potential intakes of radioactive material are indicated when personnel without respiratory protection are exposed to airborne radioactivity or when respiratory protection has been compromised.

If intakes of radioactive material are indicated that could result in a committed effective dose equivalent greater than 100 mrem in a calendar year, the following actions *should* be taken:

1. Identify personnel potentially exposed to airborne radioactivity;
2. Obtain nasal smears for qualitative indication of intakes where appropriate;
3. Analyze air samples to determine airborne concentrations where appropriate;
4. Determine duration of potential exposure to airborne radioactivity;
5. Perform bioassay appropriate for radionuclides involved; and,
6. Evaluate dose prior to permitting the worker to return to radiological work.

PART 5 Radiological Monitoring and Surveys

551 General Requirements

1. Monitoring of individuals and areas shall be performed to:
   A. Demonstrate compliance with applicable regulations;
   B. Document radiological conditions;
   C. Detect changes in radiological conditions;
   D. Detect any gradual buildup of radioactive materials;
   E. Verify the effectiveness of engineering and process controls in containing radioactive material and reducing radiation exposure; and,
   F. Identify and control potential sources of individual exposure to radiation and/or radioactive material.

2. Radiological monitoring of radiation exposure levels, contamination, and airborne radioactivity **shall** be conducted to characterize workplace conditions and to identify areas requiring postings. Surveys may be performed when deemed appropriate by Radiation Safety personnel.

3. Monitoring **shall** be performed only by trained and qualified personnel using properly calibrated instruments.

4. When radiologically significant events are anticipated in processes or activities, the associated Technical Work Documents or Controlled Work Permits *should* specify that a survey be conducted. When so specified, surveys for radiation, contamination and airborne radioactive materials **shall** be performed.

5. Radiation Safety **shall** perform and document a review of the adequacy of sampling and monitoring systems as part of any facility or operational changes affecting radiological control.

6. Instruments and equipment used for monitoring shall be:

   A. Periodically maintained and calibrated on an established frequency (See Part 6).

   B. Appropriate for the type(s), levels, and energies of the radiation(s) encountered;

   C. Appropriate for existing environmental conditions; and

   D. Routinely tested for operability.

7. Instruments used to perform radiation surveys **shall** be response-checked daily or prior to operation. When response checks are not within ± 20 percent of the expected value, the instrument *should* be taken out of service.

   When daily response checks are not feasible, such as with instruments used to measure neutrons or tritium, compensatory actions *should* be established on a case-by-case basis to ensure proper instrument performance.

8. Assessment of radiological conditions *should* include a sufficient number of survey points to characterize the radiation present and to verify boundaries.

9. Surveys *should* be performed before, during, and at the completion of work that has the potential for causing changes in levels of radiation and radioactivity.

10. Periodic surveys *should* be conducted to determine the radiological conditions in an area, and to establish the level of stability of these conditions.

Survey frequencies *should* be established for periodic radiological surveys. These frequencies should be established balancing the need to determine radiological conditions in an area against the cost and exposure of obtaining the data. Frequencies may additionally be modified based upon the ease of accessibility to the area by survey personnel, the general trends of radiological conditions in an area, the likelihood of sudden deterioration of conditions in an area not being detected in a timely manner, the frequency of personnel access to the area, etc. Survey frequencies for specific situations are specified in Article 552, 554, and 555.

Survey frequencies *should* be increased based on potential radiological conditions, probability of change in conditions, and area occupancy factors. Survey frequencies *should* be specified in the Use Authorization or in the Facility Radiation Safety Plan for the particular facility or activity.

11. Survey results *should* be reviewed. The review *should* ensure that all required surveys have been performed and that the documentation is accurate and complete.

    Effluent monitoring data in each building or area *should* be periodically compiled and reviewed by the Facility Health Physicist. Such reviews *should* be conducted at least once per quarter.

12. Results of current surveys or survey maps *should* be conspicuously posted (or otherwise promulgated) to inform personnel of the radiological conditions.

13. Monitoring results *should* be made available to line management and used in support of pre- and post-job evaluations, ALARA preplanning, contamination control, and management of radiological control operations.

    Significant changes or trends *should* be documented and actions taken on the basis of these changes or trends described.

14. Typical survey techniques are described in Boeing--SSFL procedures. Survey techniques that use non-standard equipment, techniques, or procedures *should* be described in writing on the survey documentation.

15. Document retention requirements are described in SM-40.407, Radiological Records.

552 Radiation Exposure Surveys

1. In addition to the requirements of Article 551, routine radiation surveys *should* be performed at a frequency determined by the Radiation Safety Officer. Frequency should be determined commensurate to the historical stability of conditions in the area and radiological hazards in the area.

2. Performance of radiation surveys *should* include:

   A. Dose rate measurements of the general area;

B. Dose rates at a distance of 30 centimeters from a source or surface of interest to evaluate potential whole body exposures, and;

C. Dose rates on contact with potential sources of radiation where there is a potential for hands-on work.

3. [DELETED]

4. [DELETED]

553 Area Radiation Monitors

1. In addition to the requirements of Article 551, area radiation monitors (not to include area monitoring dosimeters discussed in Article 514) *should* be installed in frequently occupied locations with the potential for unexpected increases in dose rates and in remote locations where there is a need for local indication of dose rates prior to personnel entering remote locations.

2. Area radiation monitors *should not* be substituted for radiation exposure surveys in characterizing a workplace.

3. The need and placement of area radiation monitors *should* be assessed when changes to facilities, systems or equipment occur.

4. Area radiation monitors *should* be tested at least quarterly to verify audible alarm system operability and audibility under ambient working conditions and operability of visual alarms when so equipped.

5. If installed instrumentation is removed from service for maintenance or calibration, a radiation monitoring program providing at least equal detection capability *should* be maintained, consistent with the potential for unexpected increases in radiation dose rates.

6. Where an area radiation monitor is incorporated into a safety interlock system the circuitry **shall** be such that a failure of the monitor **shall** either prevent entry into the area or prevent operation of the radiation producing device.

554 Contamination Surveys

1. In addition to the requirements of Article 551, routine contamination surveys should be performed at a frequency determined by the Radiation Safety Officer. Frequency should be determined commensurate to the historical stability of conditions in the area and radiological hazards in the area.

   In addition, contamination surveys should be conducted in the following situations:

   A. Prior to transfer of equipment and material from one location to another location;

B. Prior to transfer of equipment and material from Contaminated Areas unless precautions such as bagging or wrapping are taken prior to transfer;

C. During initial entry into a known or suspected contamination area, periodically during work, at completion of job, or as specified in a Controlled Work Permit; and,

D. After a leak or spill of radioactive materials.

2. Survey requirements for the release of radioactive materials **shall** be conducted in accordance with SM-40.404; Articles 421 and 422.

3. Contamination surveys *should* incorporate techniques to detect both removable and, where conditions permit, fixed contamination.

4. Items with inaccessible surfaces that were located in known or suspected contamination areas and had the potential to become contaminated at levels likely to exceed free-release values *should* be treated as potentially contaminated and subject to administrative controls unless the items are dismantled and monitored or special survey techniques are used to survey all surfaces.

5. The requirements for assessing representative samples of bulk material, such as sand, sweeping compounds, or plate steel, that are not suitable for normal loose and fixed contamination-level assessment techniques, are specified in DOE 5400.5. The guidelines given in this document **shall** be applied in these release situations.

6. Swipe (smear) surveys for removable contamination **shall** be reported in units of disintegrations per minute per 100 cm^2 (dpm/100 cm^2). For swipe (smear) surveys of small items covering less than 100 cm^2, the results **shall** be reported in units of dpm per area swiped.

   Source leak tests shall additionally report results in uCi per sample.

7. Large area wipes are encouraged and *should* be used to supplement standard swipe techniques in areas generally assumed not to be contaminated, such as areas proximate to Contamination, Airborne Radioactivity, Radiological Buffer Areas, or Radioactive Materials Areas. If an evaluation indicates that an area wiped is contaminated, a thorough contamination swipe (smear) survey *should* be performed.

8. Areas identified as either contaminated with, or having the potential for being contaminated with, highly radioactive particles ("hot particles") *should* be surveyed at a frequency commensurate with the potential hazards in the area.

   Special swipe (smear) techniques to collect hot particles, such as tape and large area wipes, *should* be used.

555 Airborne Radioactivity Surveillance

1. In addition to the requirements of Article 551, air monitoring equipment *should* be used in situations where airborne radioactivity levels can fluctuate and early detection of airborne radioactivity could prevent or minimize inhalation of radioactivity by personnel.

   Air monitoring equipment includes "grab" or "drop" air sampling equipment and continuous air monitors (CAMs). Selection of air monitoring equipment *should* be based on the specific job being monitored. CAMs are capable of providing near immediate indications of airborne radioactivity. Air sampler filters require analysis, thus provide delayed results.

2. Air sampling **shall** be performed:

   A. In occupied areas where, under normal operating conditions, a person is likely to receive an annual intake of 2 percent or more of the specified Annual Limit of Intake (ALI). This is equivalent to 40 Derived Air Concentration (DAC) hours, and represents a committed effective dose equivalent to a person of approximately 100 mrem. For continuous occupational exposure, this corresponds to 0.02 DAC-hours. A person exposed continuously to a concentration of radioactivity in air of 1 DAC for 1 work week would generally receive a committed effective dose equivalent of approximately 100 mrem (40 DAC-Hours).

   B. As necessary to characterize the airborne radioactivity hazard where respiratory protective devices for protection against airborne radionuclides have been prescribed.

3. Air sampling *should* be performed such that exposure to airborne radioactive material of 4 DAC-hours per exposure, 10 DAC-hours in a calendar quarter, and 20 DAC-hours in a calendar year can be determined (see Article 521 for basis). From a practical perspective, this means that sampling *should* be conducted during entries into airborne radioactivity areas, and during any operations that would be likely to generate airborne radioactive contamination (e.g., welding, drilling, grinding, abrading, etc., on radioactively contaminated surfaces or components).

4. Air sampling **shall** be conducted in such a fashion as to sample air that is representative of the air being respired by workers. This may be conducted by fixed location air samplers positioned in such a manner as to obtain representative air sample results, or by a program of personal breathing-zone air sampling.

   A. Preliminary assessments of air samples utilizing field survey techniques *should* be performed promptly upon removal. In situations where background levels of radon and thoron daughters interfere with evaluation of alpha air samples, prompt field assessments may not be possible.

   B. Air sample results may need to be evaluated as quickly as practicable for evaluation of the need for respiratory protection, area evacuation (if necessary), worker intake and worker relief from respirator use.

5. Real Time Air Monitoring **shall** be used in occupied areas:

A. Where a person without respiratory protection is likely to be exposed to a concentration of radioactivity in air exceeding 1 DAC; or,

B. Where there is a need to alert potentially exposed workers to unexpected increases in the airborne radioactivity levels, or,

C. Where significant, sudden fluctuations of airborne contaminants could create conditions requiring posting and control of an airborne radioactivity area in a work area not normally so posted, or,

D. Where fluctuations of airborne activities could result in respiratory equipment or engineering controls being rendered inadequate for protective purposes.

Continuous Air Monitors (CAMs) may be used for real time monitoring. If used:

A. CAMs *should* have alarm capability and sufficient sensitivity to alert personnel that immediate action is necessary in order to minimize or terminate inhalation exposures.

B. CAM equipment **shall** be routinely calibrated and maintained at a frequency of at least once every six months. CAMs *should* be capable of measuring 1 DAC when averaged over 8 hours (8 DAC-hours) under laboratory conditions.

C. When used for general monitoring and logging of airborne levels, CAM equipment operation *should* be verified weekly by checking for instrument response with a check source or with ambient levels of radon and thoron daughters.

   When used for the detection of changes in airborne contamination levels for ongoing radiological work activities, the proper operation of CAM equipment **shall** be verified daily by performing an operational check.

   Operational checks *should* include positive air-flow indication, non-zero response to background activity, and internal check sources or 60 Hz electronic checks when available.

Exhibit 5A
Techniques for Personnel Decontamination[6]

Begin with the first listed method and then proceed step by step to the more severe methods.

Method	Surface	Action	Technique	Advantages	Disadvantages
Soap and water	Skin and hands	Emulsifies and dissolves contaminant	Wash 2-3 minutes and monitor. Do not wash more than 3-4 times.	Readily available and effective for most radioactive contamination	Continued washing will defat the skin. Indiscriminate washing of other than affected parts may spread contamination
Soap and water	Hair	(Same as above)	Wash several times. If contamination is not lowered to acceptable levels, shave the head and apply skin decontamination methods.		
Pumice soap (e.g., "Lava"), soft brush, and water	Skin and hands	Emulsifies, dissolves, and erodes	Use light pressure with heavy lather. Wash for 2 minutes, 3 times. Rinse and monitor. Use care not to scratch or erode the skin. Apply lanolin or hand cream to prevent chapping.	(Same as above)	Continued washing will abrade the skin.

[6] This table is derived from USDHEW, *Radiological Health Handbook*, "Personnel Decontamination, " 1970.

Method	Surface	Action	Technique	Advantages	Disadvantages
Sweating	Skin of hands and feet	Physical removal by sweating	Place hand or foot in plastic glove or booty. Tape shut. Place near source of heat for 10 - 15 minutes or until hand or foot is sweating profusely. Remove glove and then wash using standard washing techniques. Alternately, gloves can be worn for hours using only body heat.		If glove or booty is not removed shortly after profuse sweating starts and body part washed with soap and water immediately, contamination may seep into pores and be extremely difficult to remove.

The following techniques are aggressive and can cause significant irritation or damage to the skin if not properly applied.

DO NOT PROCEED WITH FOLLOWING DECONTAMINATION METHODS UNLESS PERFORMED UNDER SUPERVISION OF A QUALIFIED MEDICAL PRACTITIONER

Powdered laundry detergent (e.g. “Tide”), plain	(Same as above)	(Same as above)	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.
Mixture of 50% powdered laundry detergent and 50% cornmeal	Skin and hands	Emulsifies, dissolves, and erodes	Make into a paste. Use with additional water with a mild scrubbing action. Use care not to erode the skin.	Slightly more effective than washing with soap.	Will defat and abrade skin and must be used with care.
5% water solution of a mixture of 30% powdered laundry, 65% water softener (e.g., Calgon), and 5% carbose (carboxymethyl -cellulose)	(Same as above)	(Same as above)	Use with water. Rub for a minute and rinse.	(Same as above)	(Same as above)
A preparation of 8% Carbose, 3% powdered laundry detergent, 1% Versene, and 88% water homogenized into a cream	(Same as above)	(Same as above)	Use with additional water. rub for 1 minute and wipe off. Follow with lanolin or hand cream.	(Same as above)	(Same as above)

Titanium dioxide paste. Prepare paste by mixing precipitated titanium dioxide (a very thick slurry, never permitted to dry) with a small amount of lanolin. If not successful, go on to next step.	Skin, hands, and extremities. Do not use near face or other body openings.	(Same as above)	Work the past into the affected area for 2 minutes. Rinse and wash with soap and warm water. Monitor.	Removes contamination lodged under scaly surface of skin. Good for heavy surface contamination of skin.	If left on too long, will remove skin.

Mix equal volumes of a saturated solution of potassium permanganate and 0.2 N sulfuric acid (Saturated solution of $KMn0_4$ is 6.4 grams per 100 ml of H_20). After application of permanganate, Apply a freshly prepared 5% solution of sodium acid sulfite. (Solution is made by dissolving 5 gm of $NaHSO_3$ crystals in 100 ml distilled water.)	Skin, hands, and extremities. Do not use near face or other body openings.	Dissolves contaminant absorbed in the epidermis (i.e., “fixed” contamination in skin) Removes the permanganate stain.	Pour over wet hands (or affected skin surface), rubbing the surface and using hand brush for not more than 2 minutes. Rinse with water. Apply in same manner as above. Apply for not more than 2 minutes. [The above process may be repeated.] Apply lanolin or hand cream when completed.	Superior for stubborn skin contamination. May be used in conjunction with titanium dioxide.	Will remove a layer of skin if left in contact with the skin for more than 2 minutes. (Same as above)

Flushing	Eyes, ears, nose and mouth	Physical removal by flushing	Flush with large amounts of water. *For eyes:* Roll back the eyelid as far as possible. If isotonic irrigants are available, obtain them without delay. Apply to eye continually and then flush with large amounts of water. Isotonic irrigant can be purchased from drug stores, etc.	If used immediately will remove contamination. May also be used for ears, nose, and throat.	When using for nose and mouth, contaminated individual should be warned not to swallow the rinse.

Flushing	Wounds	Physical removal by flushing	Wash wound with large amounts of water *If bleeding is NOT profuse,* spread edges to stimulate bleeding *If bleeding is profuse,* stop bleeding first, clean edges of wound, bandage. If any contamination remains, it may be removed by normal cleaning methods listed above.	Quick and efficient, if wound not severe	May spread contamination to other areas of body if not done carefully

Exhibit 5B
Dosimetry Issue Process

1. The individual arrives at Radiation Safety and requests a TLD.
2. Dosimetry determines the training status of the individual.

   If the individual has the appropriate radiological qualifications, then he is issued a TLD (as described below).

   If he does not have the appropriate radiological qualifications, then Dosimetry arranges for the necessary training to reinstate his qualifications.
3. The individual completes a TLD Issue Sheet, providing the requested information on the form.

   This form requires the individual to disclose his prior radiation exposure history. A request is made both for current year and for prior years' exposure.

   If the individual does not exceed 100 millirem per year, then the disclosure on this form is considered acceptable documentation of exposure history, and no further documentation requests are required.

   If the individual exceeds 100 millirem in a year, then Dosimetry will make a reasonable attempt to obtain documentation of prior exposure history. These documents are then placed in the individual's exposure history file.
4. The individual is placed on the Rocketdyne dosimetry system.

   If the individual is a qualified radiological worker, then he is reissued a new TLD each quarter as a routine action.

   If the individual is a visitor, then he is not routinely reissued a new TLD, and must repeat the issue process each quarter.