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SM-40.403, RADIOLOGICAL CONTROLS MANUAL: CONDUCT OF RADIOLOGICAL WORK, JULY 13, 2012, JAMES BARNES

DOCUMENT CHANGE SUMMARY – This document replaces issue dated November 27, 2007. It incorporates changes to SOP C-401, *Radiation Protection Program*.

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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.

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- “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 former terminology. SOP C-401, Table 8 describes terminology equivalency.

PART 1 Planning Radiological Work

311 Requirements

Technical requirements for the conduct of work, including construction, modifications, operations, maintenance and decommissioning, **shall** incorporate radiological criteria to ensure safety and maintain radiation exposures ALARA. To accomplish this, the design and planning processes *should* incorporate radiological considerations in the early planning stages. The checklist in Appendix 3A is helpful in reducing occupational radiation exposure.

312 Planning for Maintenance, Operations and Modifications

1. Maintenance and modification plans and procedures **shall** be reviewed to identify and incorporate radiological requirements, such as engineering controls and dose and contamination reduction considerations. Performance of this review is the responsibility of line management, with support and signed concurrence from Radiation Safety.

For routine tasks, performance of the above review and documentation of identified radiological requirements may be conducted as part of the Radiation Work Permit process (see Article 321).

2. [DELETED]
3. As appropriate to the activity, a review **shall** consider the following:
 - a. Inclusion of Radiological Control Hold Points in the technical work documents
 - b. Elimination or reduction of radioactivity through line flushing and decontamination
 - c. Use of work processes and special tooling to reduce time in the work area
 - d. Use of engineered controls to minimize the spread of contamination and generation of airborne radioactivity
 - e. Specification of special radiological training or monitoring requirements

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- f. Use of mock-ups for high exposure or complex tasks
 - g. Engineering, design and use of temporary shielding to reduce radiation levels
 - h. Walkdown or dry-run of the activity using applicable procedures
 - i. Staging and preparation of necessary materials and special tools
 - j. Maximization of prefabrication and shop work
 - k. Review of abnormal and emergency procedures and plans
 - l. Identification of points where signatures and second party or independent verifications are required
 - m. Establishment of success or completion criteria, with contingency plans to anticipate difficulties
 - n. Development of a pre-job estimate of collective exposure to be incurred for the job
 - o. Provisions for waste minimization and disposal
 - p. Specification of equipment configurations and settings to control the creation of radiation in surrounding areas.
 - q. Installation and use of control interlocks
4. [DELETED]
5. New authorizations for activities where the following criteria are not anticipated to be exceeded may be approved after review by the Radiation Safety Officer and the Manager; Health, Safety and Radiation Services (HSRS). For those activities that are anticipated to create radiological conditions requiring extraordinary control measures, the Manager, HSRS, *may* convene an *ad hoc* Radiation Safety Committee (RSC) for review of the proposed project.
6. Radiological requirements identified as part of the above radiological review *should* be documented in the Use Authorization, or through referenced job plans, procedures or work packages.
7. Optimization techniques, including cost-benefit analysis, represent a fundamental part of radiological design analysis and work review. For review of minor activities with low associated doses, a cost-benefit evaluation is an intrinsic part of the engineering review process and a detailed evaluation is not necessary. For review and planning of major tasks involving higher collective dose expenditures, a detailed and documented evaluation *should* be performed.

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For facility design and activity planning purposes, a cost/benefit conversion factor of \$ 1000 per man-rem is considered standard. This figure may be adjusted higher or lower with specific justification.

313 ALARA practices utilize a combination of engineering and administrative controls.

Engineering controls, because of their ability to passively inhibit or prevent situations leading to higher dose rates, are the preferred method of exposure control. Where costs of such controls are prohibitive, where such controls do not provide an adequate cost-benefit margin, or where such controls do not provide an adequate margin of safety, administrative controls, including access restrictions and the use of specific work practices designed to minimize exposure, are used as the secondary method to minimize worker dose.

314 Infrequent or First-Time Activities

At those facilities with routine, recurring process operations, special management attention *should* be directed to radiological activities that are infrequently conducted or represent first-time operations. In addition to the Use Authorization issue and review process, planning for such activities *should* include:

1. Senior management review directed toward anticipation of concerns and emphasis and specification of protective measures
2. Enhanced line and Radiation Safety management oversight during the initiation and conduct of the work.

315 Temporary Shielding

1. The installation, use and removal of temporary shielding *should* be controlled by procedure.
2. Prior to the installation of temporary shielding, a design-basis evaluation **shall** be performed to ensure that the additional weight of the temporary shielding will not degrade the performance or integrity of a system or component.
3. Installed temporary shielding *should* be periodically inspected and surveyed to verify effectiveness and integrity.
4. Radiation surveys *should* be performed during the alteration or removal of installed temporary shielding.
5. Installed temporary shielding *should* be visibly marked or labeled with the following or equivalent wording: "Temporary Shielding – Do Not Remove Without Permission from Radiation Safety."

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6. Installed temporary shielding *should* be periodically evaluated to assess the need for its removal or replacement with permanent shielding.
7. Specific procedures may identify unique shielding applications, such as the shielding of low activity sources or samples, that fall outside the recommendations of this Article.

316 Technical Work Documents

1. Technical work documents, such as procedures, work packages, or job or research plans, *should* be used to control hands-on work with radioactive materials. Technical work documents are not required for incidental or routine work activities that involve a low potential of worker exposure or workplace contamination, such as the collection of trash or used protective clothing.
2. Technical work documents used to control radiological work activities *should* be reviewed and approved by Radiation Safety.
3. Radiation Safety Hold Points *should* be incorporated into technical work documents for steps that require action by Radiation Safety to prevent radiation exposures in excess of Administrative Control Levels, high airborne radioactivity concentrations, or the release of radioactivity to the environment.

317 Minimization of Internal Exposure / Respiratory Protection

1. The minimization and control of internal exposure as discussed in Article 136 **shall** be conducted in accordance with the following hierarchy of controls:
 - a. Engineering controls, including containment of radioactive material at the source wherever practicable; and,
 - b. Administrative controls, including access restrictions and the use of specific work practices designed to minimize airborne contamination.
2. [DELETED]
3. When engineering and administrative controls have been applied and the potential for airborne radioactivity still exists, respiratory protection *should* be used to limit internal exposures. Use of respiratory protection *should* be considered under the following conditions:
 - a. During entry into posted Airborne Radioactivity Areas
 - b. During breach of contaminated systems or components

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- c. During work in areas or on equipment with removable contamination levels greater than:
 - 1) 100,000 dpm/100 cm² beta; or,
 - 2) 2,000 dpm/100 cm² alpha; or,
 - 3) 1000 times the values listed in SOP C-401, Table 2.2; "Surface Contamination Values¹ in dpm/100 cm²"
 - d. During work on contaminated or activated surfaces with the potential to generate airborne radioactivity, such as activities involving cutting, drilling, welding, grinding, blasting, or similar surface abrasive processes.
4. The selection and use of respiratory protection equipment shall be performed under the Boeing-SSFL Respiratory Protection Program. The following approaches are utilized in the radiological respiratory protection program to address the specific needs of protection against radioactive contaminants.
- a. Workplace evaluations for radiological conditions and selection of appropriate respiratory devices *for radiological protection purposes* are conducted by Radiation Safety personnel. Workplace evaluations for *non-radiological* conditions are made by Health and Safety personnel. Conflicts between Radiation Safety requirements and non-radiological requirements **shall** be resolved between Radiation Safety and EHS Respiratory prior to the issuance of the equipment.

"Dust masks" and half-face respirators are **not** permitted for protection against radioactive particles. They *may* be utilized for *non-radiological* purposes in a radiological facility.
 - b. Respirators are issued on an as-needed basis to qualified radiological workers. Respirators are used on a project specific basis, and are returned at the end of work. "Permanent" assignments of equipment are not made. Respirators provided for such issue may be stored in a location convenient to the radiological workplace.
 - c. Respiratory protection equipment **shall** be returned to the EHS respiratory laboratory for maintenance in a timely manner following use. Used respiratory protection equipment **shall** be surveyed and ensured to be free of radioactive contamination prior to return to the respiratory protection laboratory for servicing.. Masks used in radiological work must be surveyed by Radiation Safety and determined to meet contamination release limits prior to return to the respiratory protection laboratory.
5. In specific situations the use of respiratory protection may be contraindicated due to physical limitations or the potential for significantly increased external exposure. In such situations:

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- a. Written authorization **shall** be obtained from the line organization manager and the Radiation Safety Officer prior to knowingly incurring internal exposure.
- b. Specific justification of the need to accept the exposure, including a description of measures taken to mitigate the airborne radioactivity, **shall** be documented as part of the authorization process.
- c. Exposure stay time controls to limit intake **shall** be established for the entry.
- d. Evaluation of breathing zone airborne radioactivity levels **shall** be provided through the use of continuous air monitors or air-samplers. To the extent practicable, expedited assessment and analysis of results *should* be provided.

PART 2 Work Preparation

321 Use Authorizations and Radiation Work Permits

Any individual or group intending to use radiation producing equipment or radioactive materials within the Boeing - SSFL complex must first obtain a Use Authorization as described in SOP C-401, *Radiation Safety Program*.

The installation and use of radiation producing equipment may require the registration of the equipment with the State of California, and may require a building permit ("plan check") by Los Angeles County. Radiation Safety will address these requirements during the Authorization process.

The primary administrative control document of the Boeing - SSFL Radiation Safety Program is the Use Authorization. All radiological activities must first be authorized through the issuance of a Use Authorization. When permitted by Use Authorization and when a dedicated Facility Health Physicist is provided, Radiation Work Permits may be used as an additional control vehicle for complex projects involving the need to adjust to changing conditions.

The Use Authorization (UA) and Radiation Work Permit (RWP) are administrative mechanisms used to establish radiological controls for intended work activities. The documents inform workers of area radiological conditions and entry requirements and provide a way to relate worker exposure to specific work activities.

The UA/RWP includes the following applicable information:

1. Description of work
2. Work area radiological conditions
3. Dosimetry requirements
4. Protective clothing and respiratory protection requirements

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5. Special personnel frisking considerations
6. Technical work document number, as applicable
7. Unique identifying number
8. Date of issue and expiration
9. Authorizing signatures.
10. Pre-job briefing requirements, as applicable
11. Special or Unusual training requirements for entry
12. Radiation Safety coverage requirements and stay time controls, as applicable
13. Limiting radiological conditions that may void the RWP
14. Special dose or contamination reduction considerations

322 Use of Use Authorizations and Radiation Work Permits

1. When authorized by a Use Authorization, Radiation Work Permits **shall** be used to control the following activities:
 - a. Entry into High and Very High Radiation Areas
 - b. Entry into High Contamination Areas
 - c. Entry into Airborne Radioactivity Areas
 - d. Entry into Radiation Areas
 - e. Entry into Contamination Areas
 - f. Handling of contaminated materials.
 - g. Posted Radiation Work Permit Areas
2. Job-specific RWPs **shall** be used to control non-routine operations or work in areas with changing radiological conditions. The job-specific RWP **shall** remain in effect only for the duration of the job.

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3. General (or "Routine") RWPs may be used to control routine or repetitive activities in areas with well-characterized and stable radiological conditions. General RWPs *should* not be active for periods longer than one calendar quarter without review and approval by Radiation Safety.
4. Radiological surveys **shall** be routinely reviewed to evaluate adequacy of RWP requirements. RWPs **shall** be updated if radiological conditions change to the extent that protective requirements need modification.
5. A copy of an RWP *should* be posted at a location where it is readily available to workers prior to entering the applicable radiological work area.
6. Workers **shall** initial and date the RWP prior to initial entry to the area and after any revisions to the RWP. This initialing indicates that they have read, understand and will comply with the RWP.

323 Radiological Work Permit Preparation

1. The responsibility for ensuring adequate planning and control of work activities resides with line management. The lead work group responsible for the planned activity or for the area *should* initiate the preparation of the RWP.
2. The RWP **shall** be approved by the supervisor responsible for the work (e.g., a Project Engineer) or area (e.g., a Facility Manager or Person in Charge) and the appropriate Facility Health Physicist. Revisions or extensions to RWPs **shall** be subject to the same approval process.

Written procedures may be utilized to control radiological work. Use Authorizations and RWPs may reference these procedures or other work documents. If these work documents are amended ("Red-Lined"), then the Facility Health Physicist issuing the RWP shall review and concur with the amendments to the work document. If work documents are not related to a specific Radiological Work Permit, but have an impact on the conduct of radiological operations, then the Radiation Safety Officer or Manager, Radiation Safety, shall review and concur with the amendments to the work document.

3. The RWP **shall** be based on current radiological surveys and anticipated radiological conditions.

324 Pre-Job Briefings

1. Pre-job briefings ("tailgate meetings") *should* be held prior to the conduct of work involving complex or significant radiological conditions.
2. At a minimum, the pre-job briefing *should* include:
 - a. Scope of work to be performed

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- b. Radiological conditions of the workplace
 - c. Procedural and RWP requirements
 - d. Special radiological control requirements
 - e. Radiologically limiting conditions, such as contamination or radiation levels that may void the RWP
 - f. Radiation Safety Hold Points
 - g. Communications and coordination with other groups
 - h. Provisions for housekeeping and final cleanup
 - i. Emergency response provisions.
3. Pre-job briefings *should* be conducted by the cognizant work supervisor.
 4. Workers and supervisors directly participating in the job, cognizant Radiation Safety personnel, and representatives from involved support organizations *should* attend the briefing.
 5. A summary of topics discussed and attendance at the pre-job briefing *should* be documented. This documentation *should* be maintained with the technical work document.

325 Personal Protective Equipment and Clothing

1. Personnel **shall** wear protective clothing during the following activities:
 - a. Handling of contaminated materials with removable contamination in excess of "free release" levels
 - b. Work in Contamination, High Contamination, and Airborne Radioactivity Areas
 - c. As directed by Radiation Safety, or
 - d. As required by the RWP.
2. Protective clothing and shoes designated for radiological control **shall** be:
 - a. Marked in accordance with Article 461;
 - b. Used only for radiological control purposes.

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3. Protective clothing dress-out areas *should* be established directly adjacent to the work area. Workers *should* proceed directly to the radiological work area after donning personal protective equipment and clothing.
4. Personal protective equipment and clothing **shall** be selected as prescribed by the controlling RWP. General guidelines for protective clothing selection and use are provided in Appendix 3C and in Table 3-1.
5. The use of lab coats as radiological protective clothing is appropriate for limited applications, such as those discussed in SM-40.403, Appendix 3C, where the potential for personal contamination is very slight and is limited to the hands, arms, and upper front portion of the body.

Lab coats *should* not be used as protective clothing for extensive physical work activities in Contamination Areas. Lab coats **shall not** be used for High Contamination, or Airborne Radioactivity Areas.

6. Instructions for donning and removing protective clothing *should* be posted at the dress-out and step-off pad areas.
7. The use of personal protective equipment or clothing (including respiratory protection) beyond that authorized by the Radiation Safety Organization can detract from work performance and may be contrary to ALARA principles and waste minimization practices. Such use *should* not be authorized.

Workers who have a concern regarding the adequacy of protective equipment may raise their concerns with the Facility HP. If justified, the Facility HP may amend the pertinent RWP with additional or optional requirements if such requirements do not significantly increase radiological or industrial safety risks.

Use of respiratory equipment or protective gear for protection from non-radiological hazards shall be specified by Boeing - SSFL Health and Safety personnel. Conflicting requirements between industrial hazard protection and radiological protection shall be resolved between the Radiation Safety organization and the Health and Safety organization on a case basis.

8. Company-issued clothing, such as work coveralls and shoes, issued for work in non-radiological areas *should* be considered the same as personal clothing. Such company-issued clothing *should* not also be used for radiological control purposes.

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PART 3 Entry and Exit Requirements

331 General Requirements

Entry of personnel to Controlled Areas or posted Radiological Areas is limited to personnel who have been made aware of the potential radiological hazards. Successful completion of Radiological Worker Training is required for unescorted entry into Controlled Areas. Escorted access to certain areas may be provided to individuals who have completed Visitor Orientation.

Qualification requirements for entry into radiological areas are listed in Appendix E. Training requirements for these qualifications are discussed in SM-40.406. Use Authorizations may specify specific training requirements. When so specified, the Use Authorization requirements shall take precedence over the requirements listed in this Program.

Entry and Exit controls **shall not** interfere with the rapid evacuation of personnel under emergency conditions.

The following hierarchy of access controls is utilized. They are listed in order from the most effective to the least effective:

- (1) Locked entrance ways; or
- (2) Control devices on entrances;
- (3) Conspicuous visual and/or audible alarms;
- (4) Signs and barricades;
- (5) Administrative controls.

332 Radiological Buffer Areas

1. Only qualified Radiological Workers may enter a Radiological Buffer Area. Escorted personnel are not permitted access to these areas.
2. Personnel who exit a Radiological Buffer Area containing Contamination Areas, High Contamination Areas, or Airborne Radioactivity Areas *should* monitor as specified in Article 338.

333 Radioactive Material Areas

Personnel entering Radioactive Materials Areas *should* be cognizant of postings and cognizant of the location of such materials.

Entry into Radioactive Material Areas where whole body dose rates exceed 5 mr/hr or removable contamination levels exceed SOP C-401, Table 2-2 values **shall** be in accordance with the requirements of SM-40.403, Articles 334.1 and 335.1, respectively.

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334 Radiation, High Radiation and Very High Radiation Areas

1. Minimum requirements for unescorted entry into **Radiation Areas shall** include the following:
 - a. If work is controlled solely by Use Authorization, listing on the Authorization as an Authorized User.

If work is controlled by RWP, Worker's name, initials, and date on the RWP.
 - b. Personal dosimetry.
 - c. Training and qualification requirements as stipulated in SM-40.403, Appendix 3E.
2. Physical controls to prevent inadvertent or unauthorized access to High and Very High Radiation Areas **shall** be maintained in accordance with SM-403, Appendix 3B.
3. Minimum requirements for unescorted entry into **High Radiation Areas shall** include the following:
 - a. Worker's name on the Use Authorization or RWP. If a RWP is the controlling document, the worker has initialed and dated the RWP.
 - b. Personal (and possibly supplemental) primary dosimeters (e.g., film badge, TLD, or OSLD badge).
 - c. Pocket dosimeter or electronic integrating dosimeter [These devices are no longer needed in the DOE or State Programs. Dose levels are very low.]
 - d. If the individual is qualified for survey meter use, a survey meter to monitor dose rates in the area; otherwise, a passive dose rate indicating device, such as a digital dosimeter (e.g., a "digidose") or "chirper" (e.g., a "RadTad"); **or**,

An HP Technician is present and monitors dose rates in the area.
 - e. Training and qualification requirements as stipulated in SM-40.403, Appendix 3E.

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4. Minimum requirements for unescorted entry into **High Radiation Areas** where dose rates exist such that a worker could exceed a whole body dose of **1,000 mRem in one hour shall** include those items listed in Article 334.3 and the following:
 - a. A determination of the worker's current exposure, based on primary and supplemental dosimeter readings
 - b. Pre-job briefing, as applicable
 - c. Review and determination by Radiation Safety regarding the required level of Radiation Protection Technician coverage.
5. Installations where the radiation levels with the source exposed can exceed **500,000 mRem/hr at 1 meter shall** be equipped with the safety devices described in 10 CFR 835.502, "High and Very High Radiation Areas," or 10 CFR 20.1602-1603, "Control of Access to Very High Radiation Areas," as appropriate.
6. When performing operations involving the use of sealed sources for irradiation of materials, workers **shall** be prevented from entry to High Radiation Areas when the radiation source is exposed and high radiation fields are present.

In addition to the controls required in Articles 334.2 and 334.3, a survey **shall** be made prior to the first entry to the area after the source has been secured or shielded to verify the very high radiation field has been terminated.
7. Facility operations personnel **shall** be notified prior to personnel entry to areas where operational or system changes made by operations personnel could result in significantly increased area dose rates.
8. [DELETED]
9. [DELETED]
10. [DELETED]
11. X-radiographic operations shall be controlled as described in Boeing - SSFL procedures, principally SM-40.009, "Radiation Safety Requirements for Radiographic Facilities." Such operations are conducted under Use Authorizations subject to regulations promulgated by the State of California.

335 Contamination, High Contamination and Airborne Radioactivity Areas

1. Minimum requirements for unescorted entry into **Contamination Areas shall** include the following:
 - a. Enrollment and Participation in the bioassay program.

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- b. If the work is controlled solely by a Use Authorization, listing of the individual as an Authorized User.

If the work is controlled by RWP, the Worker's name and initials listed on the RWP.
- c. Protective clothing
- d. Personnel dosimetry, as appropriate.
- e. Training and qualification requirements as stipulated in SM-40.403, Appendix 3E.
2. Minimum requirements for unescorted entry into **High Contamination** or **Airborne Radioactivity Areas shall** include the following:
 - a. All requirements of Section 335.1 above.
 - b. Qualification as a respirator user.
 - c. Pre-job briefing for High Contamination or Airborne Radioactivity Areas
3. Personnel exiting Contamination, High Contamination or Airborne Radioactivity Areas **shall**:
 - a. Remove protective clothing as specified in Appendix 3C
 - b. Perform whole body frisking to detect personnel contamination in accordance with Article 338
 - c. Ensure that tools or equipment being removed from the area are monitored by Radiation Safety for release in accordance with SM-40.404, Article 421 or are retained in a contaminated tool holding area in accordance with SM-40.404, Article 442.5.
4. Exit points from Contamination, High Contamination or Airborne Radioactivity Areas *should* include the following:
 - a. Step-off pad(s), maintained free of radioactive contamination, located outside the exit point, and contiguous with the area boundary
 - b. Labeled containers inside the area boundary¹ for the collection of protective clothing and equipment

¹ Containers may be placed outside the area boundary if space limitation exist. When so positioned, a daily contamination spot check of the area surrounding the container shall be performed.

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- c. Contamination monitoring equipment located as close to the step-off pad as background radiation levels permit.
5. Multiple step-off pads *should* be used at the exits from High Contamination Areas. Use of multiple step-off pads is described in Appendix 3C.
6. Protective clothing and monitoring requirements specific to bench top work, laboratory fume hoods, sample stations and glove boxes are identified in SM-40.403, Article 347.
7. Areas accessible to individuals, and outside a controlled area, where the measured total surface contamination levels exceed, but the removable surface contamination levels are less than, corresponding surface contamination values specified in SOP C-401, Table 2.2, **shall** be controlled as follows:
 - The area **shall** be routinely monitored to ensure the removable surface contamination level remains below the removable surface contamination values specified in SOP C-401, Table 2.2; and,
 - The area **shall** be conspicuously marked to warn individuals of the contaminated status.

336 Entry Requirements for Personnel Not Qualified as Radiological Workers

1. Personnel **not** qualified as radiological workers (“non-qualified personnel”) and minor individuals (i.e., individuals under 18 years of age), with a demonstrated need to enter the following areas, may be allowed access if such access is controlled with a combination of training and the use of facility escorts:
 - a. Controlled Areas
 - b. Radiation Areas
 - c. Radioactive Material Areas
 - d. Buffer Areas
2. Unless expressly permitted by the RSO on a case-by-case basis, non-qualified personnel and minors are **prohibited** access to High Radiation Areas, Very High Radiation Areas, Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas.
3. Training requirements for visitors are identified in SM-40.406 Appendix 3E. Appendix 3E provides a summary of requirements and access privileges.

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337 Controlling the Spread of Contamination

The following measures *should* be used to prevent the spread of contamination across the boundary of Contamination Areas, High Contamination Areas, and Airborne Radioactivity Areas:

1. Use solid barriers to enclose areas wherever practicable
2. Mark and secure items such as hoses and cords that cross the boundary
3. Control and direct airflow from areas of lesser to greater removable contamination
4. Use engineering controls and containment devices such as glovebags, gloveboxes and tents.

338 Monitoring for Personnel Contamination

1. Personnel **shall** perform a whole body frisk under the following conditions:
 - a. Immediately upon exiting Contamination Areas, High Contamination Areas and Airborne Radioactivity Areas, after the removal of protective clothing and equipment.
 - b. As directed by Use Authorization, RWP, or Radiation Safety.
2. In addition to the above, personnel exiting a Controlled Work Area (CWA) containing Contamination, High Contamination or Airborne Radioactivity Areas *should*, at a minimum, perform a hand and foot frisk. This frisk is optional if the CWA exit is immediately adjacent to the location where the exiting worker has already performed a whole body frisk.
3. Where frisking cannot be performed at the exit from Contamination Areas, High Contamination Areas, or Airborne Radioactivity Areas due to high background radiation levels, personnel **shall**:
 - a. Remove all protective equipment and clothing at the exit
 - b. Proceed directly to the nearest designated monitoring station
 - c. Conduct a whole body frisk.
4. Personnel frisking **shall** be performed after removal of protective clothing and prior to washing or showering.
5. Except as provided in Article 338.8 (below), personnel frisking **shall** be performed using instruments that meet the minimum detection requirements of SM-40.402, Article 221.2.

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Guidelines for personnel frisking are provided in Appendix 3D. The Guidelines *should* be posted adjacent to monitoring instruments, or in a conspicuous area convenient for reference by workers.

6. Personal items, such as notebooks, papers and flashlights, **shall** be subject to the same frisking requirements as the person carrying them.
7. [DELETED]
8. When authorized by Use Authorization, personnel frisking requirements for isotopes that cannot be detected by currently available hand-held or automated equipment may be waived. In these situations, alternate screening techniques may be appropriate. When appropriate, these alternate screening techniques, such as bioassay, air sampling, and area monitoring, **shall** be specified in the Use Authorization, Radiation Work Permit, Engineer Work Request, or other similar document.

PART 4 Radiological Work Controls

341 Requirements

1. Radiological work activities **shall** be conducted as specified by the Use Authorization, the controlling technical work document(s), and the Radiation Work Permit.
2. Prerequisite conditions, such as tag-outs and system isolation *should* be verified in accordance with the Lock Out – Tag Out (LOTO) Program and with technical work documents before work is initiated.

342 Work Conduct and Practices

1. Contamination levels caused by ongoing work **shall** be monitored and maintained ALARA. Work *should* be curtailed and decontamination performed at pre-established levels, taking into account worker exposure.
2. Tools and equipment *should* be inspected to verify operability before being brought into Contamination, High Contamination or Airborne Radioactivity Areas.
3. Unnecessary contamination of clean equipment and facilities **shall** be minimized. The use of radiologically clean tools or equipment in Contamination, High Contamination or Airborne Radioactivity Areas *should* be minimized by the implementation of a contaminated tool control process. When such use is necessary, tools or equipment with complex or inaccessible areas *should* be wrapped or sleeved to minimize contamination.

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4. Technical Work Documents **shall** specify any required engineering controls, such as containment devices, portable or auxiliary ventilation and temporary shielding. These controls **shall** be installed in accordance with the technical work documents or standard industry practices, and inspected prior to use.
5. Hoses and cables entering the work area *should* be secured to prevent the spread of contamination or safety hazards.
6. System status controls **shall** be utilized in the performance of radiological work. For example, the identity of components and systems *should* be verified prior to work. The operational status of systems and components *should* be determined prior to the opening of any sealed system.
7. Work activities and shift changes *should* be scheduled to prevent idle time in radiation areas.
8. Where practicable, parts and components *should* be removed to areas with low dose rates to perform work.
9. Upon identification of radiological concerns, such as inappropriate work controls or procedural deficiencies, workers **shall** report the concern to line supervision or Radiation Safety in a timely manner. (also see Stop Work Orders)
10. Requirements for area cleanup *should* be included in the technical work documents. Work activities *should* not be considered complete until support material and equipment have been removed and the area has been returned to at least pre-work status.
11. To minimize intakes of radioactive material by personnel, smoking, eating, or chewing **shall not** be permitted in Contamination, High Contamination or Airborne Radioactivity Areas.

When a potential exists for personnel heat stress, drinking may be permitted within a Contamination Area under the following conditions and controls:

- a. The potential for heat stress cannot be reduced by the use of administrative or engineering controls.
- b. All drinking is from approved containers or sources.
- c. At a minimum, worker's hands and faces are monitored for contamination prior to drinking.
- d. Participating workers are routinely monitored as part of the bioassay program.
- e. The applicable requirements and controls are described in approved procedures.

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343 Logs and Communications

1. Radiation Safety personnel *should* maintain logs to document radiological occurrences, status of work activities and other relevant information.
2. During continuous or extended daily operations, oncoming Radiation Safety personnel *should* review logs and receive a turnover briefing from the personnel they are relieving.
3. Communication systems required by the Radiation Work Permit or technical work document *should* be checked for operability before being brought into the work area and periodically during work.
4. Workers *should* keep Radiation Safety personnel informed of the status of work activities that affect radiological conditions.

344 Review of Work in Progress

1. As part of their normal work review, work supervisors *should* periodically review ongoing jobs to ensure prescribed radiological controls are being implemented.
2. Radiation Safety personnel *should* conduct frequent tours of the workplace to review the adequacy of radiological work practices, posting and area controls.
3. During the performance of jobs for which a pre-job dose estimate was made, Radiation Safety, in cooperation with line management, *should* periodically monitor collective dose accumulation and compare it with the pre-job dose estimate. Differences *should* be reviewed to identify causes and assess the need for corrective actions.

345 Stop Radiological Work Authority ("Stop Work" Orders)

1. Radiation Protection Technicians, Facility Health Physicists, Radiation Safety Staff, and line supervision has the authority and responsibility to stop radiological work activities for any of the following reasons:
 - a. Inadequate radiological controls
 - b. Radiological controls not being implemented
 - c. Radiation Safety Hold Point not being satisfied.

Any worker may request a re-assessment of radiological conditions through his supervisor or Radiation Safety personnel. If it is determined that a stop work order is appropriate, one may be given by an authorized individual.

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2. Stop radiological work authority **shall** be exercised in a justifiable and responsible manner. Temporary, brief suspension of work activities to permit readjustment of protective measures or to permit correction of minor workplace issues or problems is a permitted and routine activity, and does not constitute a "stop work" situation under this Article. In general, "Stop Work" orders are justified where radiological or work controls are so inadequate that continuation of the work reasonably could be expected to result in a significant radiological occurrence that would involve unplanned, unjustified exposures of workers, unplanned contamination of facilities, or unplanned releases of radioactivity to the environment.
3. Once radiological work has been stopped, it **shall** not be resumed until proper radiological control has been reestablished.

Resumption of radiological work that has been terminated with a "stop work" order requires the approval of the line manager responsible for the work and the Radiation Safety Officer.

4. Prior to the resumption of work, Manager; Health, Safety and Radiation Services shall review any activity which involved an "Unusual Occurrence" under DOE reporting criteria, or a reportable event under 10 CFR 20.2203 (adopted by citation under CRC Title 17).

346 Response to Abnormal Situations

See Appendix 3F for responses to radiological incidents.

1. In the event of Abnormal Situations, the Boeing - SSFL Master Emergency Response Plan (MEP), in conjunction with Facility Radiation Safety Plans, shall be used as the generic guidance documents.
2. The risk of injury to those individuals involved in rescue and recovery operations **shall** be minimized.
3. Operating management **shall** weigh actual and potential risks against the benefits to be gained.
4. An individual **shall not** be required to perform rescue action that might involve substantial personal risk.
5. Each individual authorized to perform emergency actions likely to result in occupational doses exceeding the values of the limits provided at SM-40.402, Table 2-1 **shall** be trained as a DOE Rad Worker II (for DOE facilities) or RMFW II (for licensed facilities) and **shall** be briefed beforehand on the known or anticipated hazards to which the individual will be subjected.

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6. A general employee whose occupational dose has exceeded the numerical value of any of the limits specified in SM-40.402, Table 2-1, as a result of an authorized emergency exposure may be permitted to return to work in radiological areas during the current year providing that all of the following conditions are met:
 - Approval is first obtained from the contractor management and (for DOE activities) the Head of the responsible DOE field organization;
 - The individual receives counseling from Radiation Safety and medical personnel regarding the consequences of receiving additional occupational exposure during the year; and
 - The affected employee agrees to return to radiological work.
7. All doses exceeding the limits specified in § 835.202 shall be recorded in the affected individual's occupational dose record.
8. For DOE activities, when the emergency conditions under which an emergency dose was received in excess of the limits specified in SM-40.402, Table 2-1, have been eliminated, Boeing - SSFL management shall notify the Head of the responsible DOE field organization. Operations may be resumed only with the approval of DOE.

347 Special Controls for Benchtop Work, Laboratory Fume Hoods, Sample Stations and Gloveboxes

The following requirements are applicable to radiological work in localized benchtop areas, laboratory fume hoods, sample stations and glovebox operations located in areas that are otherwise contamination free.

1. A Use Authorization or Radiation Work Permit **shall** be issued to control radiological work in localized benchtop areas, laboratory fume hoods, sample sinks, and gloveboxes.
2. The following controls apply to localized benchtop and laboratory fume hood operations:
 - a. Protective clothing **shall**, at a minimum, include labcoats and gloves. Gloves *should* be secured at the wrist as necessary.
 - b. Shoecovers *should* be considered based on the potential for floor contamination.
 - c. When changing or removing their gloves, workers *should* periodically monitor their hands.
 - d. Upon completion of work or prior to leaving the area, workers **shall** monitor those areas of their body that are potentially contaminated. At a minimum, this includes hands, arms, and front portions of the body. Where work activities have been extensive, workers **shall** perform a whole body frisk.
3. The following controls apply to sample station operations:

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- a. Protective clothing **shall**, at a minimum, include labcoats and gloves. Gloves *should* be secured at the wrist as necessary.
 - b. Shoecovers *should* be considered based on the potential for floor contamination.
 - c. If there is a potential for splashing or airborne radioactivity, such as when taking pressurized samples, additional controls such as rubber aprons, face shields, full PCs, or respiratory protection *should* be instituted.
 - d. When changing or removing gloves, workers *should* periodically monitor their hands.
 - e. Upon completion of work or prior to leaving the area, workers **shall** monitor those areas of their body that are potentially contaminated. At a minimum, this includes hands, arms, and front portions of the body. Where work activities have been extensive, workers **shall** perform a whole body frisk.
4. The following controls apply to glovebox operations:
- a. Gloveboxes *should* be inspected for integrity and operability prior to use.
 - b. Gloveboxes *should* be marked with or survey measurements *should* be posted to identify whole body and extremity dose rates.
 - c. Protective clothing **shall**, at a minimum, include labcoats and gloves. Gloves *should* be secured at the wrist as necessary.
 - d. Shoecovers *should* be considered based on the potential for floor contamination.
 - e. Workers *should* periodically monitor their ungloved hands during work.
 - f. Upon completion of work or prior to leaving the area, workers **shall** monitor those areas of their body that are potentially contaminated. At a minimum, this includes hands, arms, and feet. Where work activities have been extensive, workers **shall** perform a whole body frisk.

348 Controls for Hot Particles

Hot particles are small, discrete, highly radioactive particles capable of causing extremely high doses to a localized area in a short period of time. Hot particle contamination may be present or be generated when contaminated systems are opened or when operations such as machining, cutting or grinding are performed on highly radioactive materials.

1. A "hot particle" is any small, discrete particle (usually less than 1 mm in diameter) with specific activity such that the particle is capable of producing, when in contact with the skin or clothing, a shallow dose equivalent greater than 100 mRem in one hour.

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- Assessment of hot particle dose rate potential *should* be determined using the computer program VARSKIN, Modification 2 (or later).
2. Measures for controlling hot particles, as identified in items 3 through 7 of this Article, *should* be implemented under the following conditions:
 - a. Upon identification of hot particles
 - b. During new or nonroutine operations with a high potential for hot particles, based on previous history
 - c. Upon direction of Radiation Safety.
 3. Areas or operations with the potential for hot particle contamination *should* be surveyed in accordance with Article 554.7.
 4. Contamination Area posting *should* be annotated to specifically identify the presence of hot particles.
 5. Access to hot particle areas *should* be controlled by a job-specific RWP. The following controls *should* be considered for inclusion on the RWP:
 - a. Periodic personnel monitoring during the work activity, at a frequency based on the potential magnitude of skin exposure
 - b. Additional personal protective equipment and clothing
 - c. Direct Radiation Safety coverage during work or assistance during protective clothing removal
 - d. Use of sticky pads or multiple step-off pads.
 6. Personal protective equipment and clothing used in hot particle areas *should* be segregated from other radiological protective equipment and clothing during laundering and surveyed prior to reuse.
 7. Response to hot particle skin contamination of personnel *should* include the following:
 - a. Immediate removal and retention of the hot particle for subsequent analysis
 - b. Analysis of the particle
 - c. Assessment of worker dose
 - d. Evaluation of work control adequacy.

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PART 5 Evaluation of Performance

During the conduct of radiological work and the handling of radioactive materials, abnormal events may occur which could indicate a weakness or area of programmatic breakdown of radiological controls. Prompt, consistent gathering of facts related to such events is required to satisfy reporting and investigation requirements and to formulate corrective actions to prevent recurrence. In addition, successful performance or completion of unique activities *should* be evaluated to identify and incorporate appropriate lessons learned.

Analysis of the facts *should* reveal areas where improvements can be made or identify methods to prevent the recurrence of undesired results.

SM-40.401, Article 113.5 provides references on “abnormal events.”

351 Conduct of Critiques

Critiques are meetings of the personnel knowledgeable about an event (either a success or an abnormal event) to document a chronological listing of the facts. The purpose of the critique is not to assign blame, but to establish and record the facts so that a process can be improved.

1. Critiques *should* be conducted for significant successes and abnormal events .
2. Critique leaders *should* be trained in the required elements of the critique process and the appropriate methods of conducting and controlling the critique. Methods such as Kepner-Tregoe, “Six Hats,” “Seven Management Tools,” Root Cause Analysis, etc. are appropriate types of training. Such training should be recorded in “My Learning.”
3. Critique meetings *should* be conducted as soon as practicable after the event or situation is stabilized, or after a successful evolution is completed. Critiques of abnormal events *should* preferably be conducted before involved personnel leave for the day.
4. At a minimum, the general critique process *should* include the following elements:
 - a. Formal meetings, chaired by a critique leader
 - b. Attendance by all who can contribute
 - c. Personal statements or event descriptions completed by selected personnel before the meeting. (The format and “formality” of these statements may be determined by the critique leader.)
 - d. Attendance records
 - e. Minutes, recorded and signed by the critique leader and all contributors
 - f. Personal statements, signed and attached to the meeting minutes

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- g. A listing of the facts in chronological order
 - h. Supporting materials, including documents, records, photographs, parts and logs, maintained by the critique leader.
5. Evaluation of complex evolutions or events may require multiple critiques.

352 Post-Job Reviews

Upon completion of a project phase or evolution involving cumulative exposures exceeding 10 man-rem, a Post-Job Review *should* be conducted by facility management, with assistance of the Facility HP. Such a review *should* encompass all salient points of SM-40.403, Article 351.

353 Lessons Learned

- 1. Lessons learned are available from informal job critiques, formal post-job reviews, and reports of past radiological events on site and at other facilities. These lessons may exist at various levels of significance.
- 2. Radiation Safety, in conjunction with cognizant line management, *should* evaluate lessons learned, assign an appropriate level of significance, and promulgate the information in a manner appropriate to the level of significance of the lesson.

Examples of information distribution may range across the following spectrum:

- a. Discussion at staff or work-group meetings
- b. Distribution of descriptions and discussions by email to interested personnel
- c. Incorporation into Radiation Safety Training
- d. Preparation and distribution of formal reports
- e. Preparation of Desk Instructions distributed to the Radiation Safety Team
- f. Incorporation into Use Authorizations and Radiation Work Permits
- g. Incorporation into Company-wide procedures and policies.

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PART 6 Special Applications

This Part provides supplemental information to augment the basic requirements of the Program. Written guidance and requirements contained within DOE documents, consensus standards or Federal regulations that delineate specifics for each application are referenced.

Note: Except for trace residues involved in Decontamination and Decommissioning projects, Boeing - SSFL no longer conducts work using Plutonium (Article 361), Uranium (Article 362), or Tritium (Article 363) compounds. Although further work in these areas is not anticipated at this time, these sections are provided for an overview of the necessary precautions in the use of these isotopes.

361 [DELETED]

362 [DELETED]

363 [DELETED]

364 [DELETED]

365 Radiation Generating Devices

Boeing-SSFL no longer operated Radiation Generating Devices.

366 Conduct Of Source Radiography On DOE Property Or In DOE Facilities

When conducted on DOE property or in DOE facilities, the conduct of radiographic operations utilizing sealed radioactive sources **shall** be conducted in accordance with the following requirements:

1. Radiographic operations **shall** be conducted in accordance with 10 CFR 835, "Occupational Radiation Protection." 10 CFR 835 can be viewed at the following website:

http://www.access.gpo.gov/nara/cfr/waisidx_99/10cfr835_99.html

In accordance with this requirement, radiographic operations shall be conducted under the auspices of the Boeing - SSFL Radiation Safety Program, and shall comply with written and verbal instructions from members of the Radiation Safety Group of Health, Safety and Radiation Services.

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Copies of the Radiation Safety Program are available from the online Boeing - SSFL System of Procedures (C-401 and SM-40.400 series).

2. Radiographic operations are subject to inspection by the DOE, and enforcement actions may be taken directly with the radiography vendor by DOE inspectors. These enforcement actions could include the issuance of Notices of Violations and could carry civil penalties.
3. The service vendor **shall** be appropriately licensed by the State of California or the U. S. Nuclear Regulatory Commission. A copy of the license shall be provided to Boeing - SSFL in a timely manner for review by the Radiation Safety group.
4. The service vendor **shall** have a documented radiation safety program. A copy of this program shall be reviewed and approved by the Radiation Safety group of EHS prior to the conduct of operations. In addition, radiographic operations shall comply with the following site requirements:
 - a) Barrier ropes/tape **shall** be erected and posted with warning signs at the 2 mr/hour dose-rate line. This line **shall** be established and verified by survey meter reading. Pro-rated doses are NOT permitted to establish the 2 mr/hour dose line.
 - b) Individuals **shall** be positioned on the radiography area such that no unauthorized individual can gain access to the posted area. This surveillance **shall** be by direct line of site or video monitoring. If the radiography crew cannot maintain such line of site control, the Boeing - SSFL Person-in-Charge (PIC) **shall** arrange for additional personnel to provide such surveillance. It *should* be understood that this control applies to overheads, tunnels, etc. that may traverse the radiography area.
 - c) The radiographer **shall** have primary responsibility for control of the radiographic area. The primary responsibility for operational safety shall rest with the radiographer. Boeing - SSFL will maintain control of areas outside of the radiographic barrier.

PART 7 Construction and Restoration Projects

Construction and restoration projects, including decontamination and decommissioning (D&D), remedial action, or other actions involving materials which contain low levels of radioactivity, require site-specific or program-specific control methods. Facility or project specific Radiation Safety Plans **shall** be prepared for all major projects of this nature.

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371 Requirements

Radiological operations and work activities at construction and environmental restoration projects **shall** be conducted in accordance with this Program. In light of the special nature of these activities, which typically involve low-levels of radioactivity and the use of heavy construction or earth-moving equipment, these projects require some radiological considerations different from other activities governed by this Program.

For DOE activities or for DOE facilities, for the following specific subject areas, the radiological requirements of this Program may be modified by the limited application of the provisions of SM-40.401, Article 113.3. These modifications **shall not** result in violations of 10 CFR 835 or other applicable state or federal regulations. The Radiation Safety Officer is authorized to change mandatory "**shall**" requirements to "*should*" statements in order to facilitate implementation of radiological controls in the following specific subject areas. Radiation Safety has the responsibility to document the technical equivalency of alternative solutions.

The provisions of this Program **shall** apply unless specifically waived by approved procedure or by Use Authorization. Activities performed under this section *should* be conducted in accordance with project specific procedures.

1. Performance goals and indicators appropriate to remedial activities
2. Personal protective equipment requirements and practices to accommodate other hazards on the site
3. Use of respiratory protection as normal conduct of operation due to lack of engineering controls and temporary nature of the work
4. Use of Contamination Reduction Corridors to accommodate movement of personnel and heavy equipment through a variety of decontamination stations
5. Methods to obtain representative samples for release of equipment and material from the work areas
6. Surveying of materials released from Soil Contamination Areas that exhibit significant contamination transfer properties
7. Precedence of state and Federally mandated soil cleanup criteria over surface contamination criteria that otherwise apply
8. Monitoring and survey frequency for inactive facilities or large areas that are infrequently occupied
9. Outdoor storage of uncontained, bulk radioactive materials such as contaminated soil
10. Postings of privately owned and adjacent property

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11. Evaluation of outdoor air monitoring methodologies that take into account dust loading, environmental factors, and supplemental breathing zone sampling
12. Criteria for suspension of operations under inclement conditions, such as wind or rain.

372 Environmental Conditions

Inclement weather or other environmental conditions may disrupt radiological controls. If such weather or conditions are determined to have a significant chance of disrupting radiological controls, then actions **shall** be taken to mitigate the impact. The following actions are examples of possible solutions:

1. The use of covers, wind screens and runoff collection basins to preclude the inadvertent spread of radioactive material
2. Provisions for worksite personnel to assemble and be monitored prior to release or reestablishment of work
3. Evaluation of work area to determine if a need exists for modified work controls or decontamination.

373 Other Workplace Hazards

Radiological controls **shall** be implemented in a balanced way to ensure that protection from all workplace hazards can be implemented. Other hazards to consider include:

1. General construction hazards
2. Confined spaces
3. Flammable materials
4. Reactive chemicals
5. Heat stress
6. Chemical exposures
7. Energized electrical equipment
8. Biological hazards
9. Rotating equipment
10. Noise and vibration

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11. Excavations.



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APPENDICES

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Appendix 3A: Guidelines for Reducing Occupational Radiation Exposure

Preliminary Planning and Scheduling

- Plan in advance
- Delete unnecessary work
- Determine expected radiation levels
- Estimate person-rem
- Sequence jobs
- Schedule work
- Select a trained and experienced work force
- Identify and coordinate resource requirements

Preparation of Technical Work Documents

- Prepare written work activity instructions and procedures. Include special radiological control requirements in technical work documents.
- Perform ALARA pre-job review
- Plan access to and exit from the work area
- Provide for service lines (air, welding, ventilation)
- Provide communication (sometimes includes closed-circuit television)
- Remove or shield sources of radiation
- Plan for installation of temporary shielding
- Decontaminate
- Work in lowest radiation levels
- Perform as much work as practicable outside radiation areas
- State requirements for standard tools
- Consider special tools, including robots

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- State staging requirements for materials, parts and tools
- Incorporate Radiation Safety Hold Points
- Minimize discomfort of workers
- Revise estimates of person-rem
- Prepare Radiation Work Permits (RWPs)

Temporary Shielding

- Design shielding to include stress considerations
- Control installation and removal by written procedure
- Inspect after installation
- Conduct periodic radiation surveys
- Prevent damage caused by heavy lead temporary shielding
- Balance radiation exposure received in installation against exposure saved by installation
- Shield travel routes
- Shield components with abnormally high radiation levels early in the maintenance period
- Shield position occupied by worker
- Perform directional surveys to improve design of shielding by locating source of radiation
- Use mock-ups to plan temporary shielding design and installation
- Consider use of water-filled shielding

Rehearsing and Briefing

- Rehearse
- Use mock-ups duplicating working conditions
- Use photographs and videotapes
- Supervisors conduct briefings of workers

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Performing Work

- Comply with technical work documents and RWPs
- Post radiation levels
- Keep excess personnel out of radiation areas
- Minimize radiation exposure
- Supervisors and workers keep track of radiation exposure
- Workers assist in radiation and radioactivity measurements
- Delegate radiological control monitoring responsibilities
- Evaluate use of fewer workers
- Reevaluate reducing radiation exposures
- Compare actual collective dose against pre-job estimate
- Review work practices to see if changes will reduce dose
- Coordinate personnel at the job site to reduce nonproductive time

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Appendix 3B: Physical Access Controls for High and Very High Radiation Areas

1. One or more of the following features **shall** be used for each entrance or access point to a High Radiation Area where radiation levels exist such that a person could exceed a whole body dose of **100 mRem²** in any one hour:
 - a. A control device that prevents entry to the area when high radiation levels exist or upon entry causes the radiation level to be reduced below that level defining a High Radiation Area
 - b. A device that functions automatically to prevent use or operation of the radiation source or field (with the resultant prevention of dose rates greater than 100 mRem/hr) while personnel are in the area
 - c. A control device that energizes a conspicuous visible or audible alarm signal so that the person entering the High Radiation Area and the supervisor of the activity are made aware of the entry
 - d. Entryways that are locked, except during periods when access to the area is required, with positive control over each entry
 - e. Continuous direct or electronic surveillance that is capable of preventing unauthorized entry.
2. In addition to the above requirements, additional measures **shall** be implemented to ensure personnel are not able to gain unauthorized or inadvertent access to Very High Radiation Areas.
3. Physical access controls over High and Very High Radiation Areas **shall** be established in such a way that does not prevent a person from rapidly evacuating the area.

2 For sources of radiation with small dimension, considered to be the dose rate at a distance of 30 cm from the source.

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Appendix 3C: Contamination Control Practices

Selection of Protective Clothing

Table 3-1 Guidelines for Selecting Protective Clothing (PC)

	REMOVABLE CONTAMINATION LEVELS		
	LOW	MODERATE	HIGH
WORK ACTIVITY	<u>Unidentified:</u> 1K-10K dpm beta 20-200 dpm alpha <u>Identified:</u> 1 to 10 times Table 2-2 values	<u>Unidentified:</u> 10K-100K dpm beta 200-2K dpm alpha <u>Identified:</u> 10 to 100 times Table 2-2 values	<u>Unidentified:</u> > 100K dpm beta > 2K dpm alpha <u>Identified:</u> > 100 times Table 2-2 values
	Routine	Full set of PCs or Labcoat ³	Full set of PCs
Heavy work	Full set of PCs, work gloves	Double set of PCs, work gloves	Double set of PCs, work gloves
Work with pressurized or large volume liquids, closed system breach	Full set of non-permeable PCs	Double set of PCs (outer set non-permeable), rubber boots	Double set of PCs and non-permeable outer clothing, rubber boots

Note: For “hands-off” tours or inspections in areas with removable contamination at **LOW** levels, labcoats, shoecovers and gloves may be used instead of full PCs.

- Workers **shall** inspect protective clothing prior to use for tears, holes or split seams that would diminish protection. Any defective items **shall** be replaced with intact protective clothing.

³ Labcoats are acceptable if no extensive physical effort is involved in the work (e.g., inspections, walk-throughs, support personnel, etc.).

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2. Protective clothing as prescribed by the Radiation Work Permit **shall** be selected based on the contamination level in the work area, the anticipated work activity, worker health considerations, and regard for non-radiological hazards that may be present. Table 3-1 provides general guidelines for selection. As referenced in the table, a full set and double set of protective clothing (PC) typically includes:

Full Set of PCs

- a. Coveralls
- b. Cotton glove liners or surgeon's gloves
- c. Gloves
- d. Shoe covers
- e. Rubber overshoes
- f. Hood

Double Set of PCs

- a. Two pairs of coveralls
 - b. Cotton glove liners or surgeon's gloves
 - c. Two (or more) pairs of gloves
 - d. Two pairs of shoe covers
 - e. Rubber overshoes
 - f. Hood
3. Cotton glove liners may be worn inside standard gloves for comfort, but **shall** not be worn alone or considered as a layer of protection.
4. Shoecovers and gloves **shall** be sufficiently durable for the intended use. Leather or canvas work gloves *should* be worn in lieu of or in addition to standard gloves for work activities requiring additional strength or abrasion resistance.
5. Guidance regarding the use of hard hats in Contamination Areas **shall** be provided by Health and Safety. Hard hats used in such areas **shall** be surveyed and determined to meet the release criteria of SM-40.402, Table 2-2 [Link], prior to returning to use in uncontrolled areas.

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6. Shoe covers and gloves *should* be secured or taped at the coverall legs and sleeves when necessary to prevent worker contamination. Tape *should* be tabbed to permit easy removal.
7. To simplify access by the worker, supplemental pocket or electronic dosimeters *should* be worn outside the protective clothing. Workers *should* protect such dosimeters from contamination by placing them in an outer coverall pocket or in plastic bags or pouches.
8. Outer personal clothing *should* not be worn under protective clothing for entry to High Contamination Areas or during work conditions requiring a double set of protective clothing.

Removal of Protective Clothing

Potentially contaminated protective clothing *should* be removed without spreading contamination and in particular without contaminating the skin. Workers **shall not** intentionally touch the skin or place anything in the mouth during protective clothing removal. Instructions for protective clothing removal comparable to the sequence presented below *should* be posted adjacent to the step-off pad in accordance with SM-40.403, Article 325.6.

Sequence for Removing a Full Set of Protective Clothing at the Step-Off Pad

Before stepping out of the Contamination Area or Airborne Radioactivity Area to the step-off pad, the worker *should*:

1. Approach the Step Off Pad.

[All entry and access to a Contaminated Area must be over the Step-Off Pad.

Step Off Pads are considered CLEAN surfaces.]
2. Remove all tape on outer coveralls. Place in radioactive waste container.
3. Remove outer rubber gloves. Place in radioactive waste container.
4. If an "outer" pair of coveralls is worn, remove the coveralls at this time.
5. Carefully remove hood. Place in laundry container.
6. (If respirator worn) Bend over forward at waist. Carefully remove respirator by grasping the respirator at the exhaust valve / filter area and gently pulling down and forward.

Do NOT attempt to loosen straps.

Place respirator in a plastic bag and place next to the Step Off Pad.
7. (If respirator worn) Remove skull cap. Place in radioactive waste container.

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8. Remove remaining tape.
9. Remove outer shoe covers. Place cloth covers in laundry container; plastic covers in radioactive waste container.
10. Starting at shoulders, roll coveralls off of body. Avoid touching exterior parts of coveralls. Step out of coveralls, but do not remove hi-top shoe covers at this time.
11. Remove each hi-top shoe cover, placing the uncovered foot onto step off pad. **DO NOT STEP INTO THE CONTAMINATED AREA WHEN SHOE COVER HAS BEEN REMOVED.**
12. Remove glove liners.
13. Ensure any boundaries and postings have been restored to proper position.
14. Proceed to frisk station.

Sequence for Removing a Double Set of Protective Clothing using Two Step-Off Pads

Before stepping to the inner step-off pad, the worker *should*:

1. Remove exposed tape
2. Remove rubber overshoes
3. Remove outer gloves
4. Remove hood from front to rear
5. Remove respiratory protection, as applicable
6. Remove outer coverall, inside out, touching inside only
7. Remove tape from inner coverall and sleeves
8. Remove each outer shoe cover, stepping on inner step-off pad as each is removed.

Before stepping to the outer step-off pad, the worker *should*:

9. Remove inner rubber gloves
10. Remove inner coveralls, inside out, touching inside only
11. Take down barrier closure, as applicable

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12. Remove tape or fastener from inner shoe cover
13. Remove each inner shoe cover, placing shoe on clean outer step-off pad
14. Remove cotton glove liners
15. Replace barrier closure, as applicable
16. Commence whole body frisking
17. Monitor badge and dosimeter.

The sequence for the removal of primary and supplemental dosimetry is dependent upon where the dosimetry was worn and the potential for contamination.

Use of Multiple Step-Off Pads

1. Multiple step-off pads *should* be used to control exit from High Surface Contamination Areas. These pads define interim control measures within the posted area to limit the spread of contamination. The following controls apply:
 - a. The inner step-off pad *should* be located immediately outside the highly contaminated work area, but still within the posted area.
 - b. The worker *should* remove highly contaminated outer clothing prior to stepping on the inner step-off pad.
 - c. Additional secondary step-off pads, still within the posted area, may be utilized as necessary to restrict the spread of contamination out of the immediate area.
 - d. The final or outer step-off pad *should* be located immediately outside the Contamination Area.

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Appendix 3D: Guidelines for Personnel Monitoring with Hand-Held Survey Instruments*

General Requirements

1. Verify that the instrument is in service, set to the proper scale and the audio output can be heard during frisking.
2. Hold probe less than 1/2 inch from surface being surveyed for beta and gamma contamination, approximately 1/4 inch for alpha contamination.
3. Move probe slowly over surface, approximately 2 inches per second.
4. If the count rate increases during frisking, pause for 5 to 10 seconds over the area to provide adequate time for instrument response.
5. If the count rate increases to a value greater than a preestablished contamination limit or the instrument alarms, remain in the area and notify Radiation Protection personnel.
6. The whole body frisk will generally take two to three minutes.

Performance of Monitoring for Beta Activity:

1. Place dosimetry, pens, tools, etc., on sheet of plastic, paper, towel, etc. This prevents cross-contamination of the clean area.
2. Select appropriate frisker for Beta/Gamma frisk.
3. Ensure frisker is turned on.
[Frisk the hands before picking up the probe or manipulating the instrument.]
4. (If battery operated) Perform battery check.
5. Ensure frisker calibration is still active.
6. Ensure frisker is set on "slow" response.
7. Ensure frisker audible response is "ON".
8. Establish average background count rate.
[If background count rate is greater than 300 counts per minute, a personnel frisk cannot be performed in that area. Contact Radiation Safety for guidance.]
9. Establish the permissible frisker response level for determining that the body is not contaminated.
[Average Background Rate + 100 counts]

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10. Frisk hands.
[Listen for increase in audible count rate. If rate increases, stop and check that area carefully. The meter will reflect the true count rate in 15 seconds.]
11. Frisk dosimetry.
If the dosimetry exceeds the permissible response level, it is contaminated. Contact HP to report the problem.
12. First, check areas of body most likely to become contaminated.

_____ Mouth and nose	_____ Knees
_____ Hair on head	_____ Seat of Pants
_____ Feet	_____ Under seam closures
13. Frisk all surfaces of entire body.
The frisk rate is not to exceed 2 inches/second.
The probe *should* be held about 1/2 inch from the surface being frisked.
14. If count rate exceeds 100 counts per minute over background, cease frisking and summon Radiation Safety Technician for assistance.
15. If directed by Radiation Safety, take shower after conclusion of successful frisk.

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Appendix 3E: QUALIFICATION REQUIREMENTS FOR ACCESS TO RADIOLOGICAL AREAS

Radiological Area	Unescorted Access		Escorted Access
	DOE	Boeing - SSFL	
X-ray Area	[See Use Authorization]		
Special Operations	[See Use Authorization]		
Controlled Area	DOE Rad Worker I	Radioactive Material Worker	Orientation and Escort
Radioactive Materials Area	DOE Rad Worker I	Radioactive Material Worker	Orientation and Escort
Radiation Area	DOE Rad Worker I	Radioactive Material Worker	Orientation and Escort
High Radiation Area	DOE Rad Worker II	Radioactive Material Facility Worker	NO ACCESS
Very High Radiation Area	DOE Rad Worker II	Radioactive Material Facility Worker	NO ACCESS
Contamination Area	DOE Rad Worker II	Radioactive Material Facility Worker	NO ACCESS
High Contamination Area	DOE Rad Worker II with RPD Qualifications	Radioactive Material Facility Worker with RPD Qualifications	NO ACCESS
Airborne Radioactivity Area	DOE Rad Worker II with RPD Qualifications	Radioactive Material Facility Worker with RPD Qualifications	NO ACCESS

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Appendix 3F: RESPONSES TO RADIOLOGICAL INCIDENTS

For all incidents, notify the Boeing Control Center at 2-2222 (from a Boeing phone) or 562-797-2222 (from an outside phone or cell phone). Give your name, location (Santa Susana and building number) and nature of emergency.

RADIOACTIVE MATERIALS SPILL

1. Stop or secure the operation causing the spill
2. Warn others in the area
3. Isolate the spill area, if possible
4. Minimize individual exposure and contamination
5. Secure unfiltered ventilation
6. Notify Radiation Safety personnel.

CONTINUOUS AIR MONITOR ALARM

1. Stop work activities
2. Immediately exit the area
3. Notify Radiation Safety personnel.

AREA RADIATION MONITOR ALARM

or increasing or unanticipated increase in radiation dose rates

1. Stop work activities
2. Alert others
3. Affected personnel immediately exit the area
4. Notify Radiation Safety personnel.

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EVACUATION ALARM

1. Immediately evacuate the area, without stopping to remove protective clothing or perform exit monitoring
2. Report to designated assembly area.

PERSONNEL CONTAMINATION

1. Remain in the immediate area
2. Notify Radiation Safety personnel
3. Take actions that may be available to minimize cross-contamination, such as putting a glove on a contaminated hand
4. Take follow-up actions in accordance with Article 541.

UNATTENDED RADIOACTIVE MATERIAL IN UNCONTROLLED AREA

1. Contact the Boeing Control Center (BCC) at 2-2222 for assistance.
[BCC will contact Radiation Safety for support.]