RUST FEDERAL SERVICES

Nuclear Remedial Services

Procedure Title/Approval

RADIOLOGICAL CONTROL PROCEDURE FOR FIELD PROJECTS

Procedure No. NRS-RP-001 Revision: 2

William D. Wing Prepared By	2/1/94 Date
Wayne Faul CHP Health and Safety	2/1/94 Date
N/A Stan Knowles Engineering	2/1/94 Date
William D. Wing ALARA	2/1/94 Date
Stan Knowles Quality Assurance	2/1/94 Date
[signature] Manager Approval	2/2/94 Date
[signature] General Manager Approval	2/2/94 Date

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page #	Revision Level	Page #	Revision Level	Page #	Revision Level
1	2	25	1	49	1
2	2	26	1	50	1
3	1	27	1	51	1
4	1	28	1	52	1
5	1	29	1	53	1
6	1	30	1	54	1
7	1	31	1	55	1
8	1	32	1	56	1
9	1	33	1	57	1
10	1	34	1	58	1
11	1	35	2	59	1
12	1	36	1	60	1
13	1	37	1	61	1
14	1	38	1	62	1
15	1	39	1	63	1
16	1	40	1	64	1
17	1	41	1	65	1
18	1	42	1	66	1
19	1	43	1	67	1
20	1	44	1	68	1
21	1	45	1	69	1
22	1	46	1	70	1
23	1	47	1	71	1
24	1	48	1	72	1

LIST OF EFFECTIVE PAGES
(Revision Level 0 = Original Document)

Page #	Revision Level	Page #	Revision Level	Page #	Revision Level
73	1				
74	1				
A-1	1				
A-2	1				
A-3	1				
B-1	1				
B-2	1				
B-3	1				
B-4	1				
B-5	1				
B-6	1				
B-7	1				
B-8	1				
B-9	1				
B-10	1				
C-1	1				
C-2	1				
D-1	1				
D-2	1				
D-3	1				
E-1	1				
E-2	1				

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

1.0 SCOPE

1.1 Purpose

This procedure describes the Radiological Control methods that shall be instituted on Field Projects at job sites. These projects typically include the survey or monitoring, analysis, and/or decontamination activities associated with fixed or temporary building structures or equipment, earthen areas, and the environment.

1.2 Applicability

This procedure applies to all RUST Nuclear Remedial Services, Inc. (NRS) personnel, contractors, subcontractors, and temporary personnel assigned to Field Project job sites.

All personnel associated with the project performing work at the operations site shall be informed of this procedure and any hazards associated with the project.

2.0 REFERENCES

2.1 Procedures

2.1.1 NRS-AD-001, "Document Preparation Procedure"

2.1.2 NRS-AD-002, " Records Management Procedures"

2.1.3 NRS-AD-005, "Field Project Administration & Control Procedure"

2.1.4 NRS-AD-006, "RUST Remedial Services - Nuclear Remedial Services ALARA Procedure"

2.1.5 NRS-AD-007, "Nuclear Remedial Services Health Physics Policy Manual"

2.1.6 NRS-AD-018, "Radiation Exposure Records and Procedures"

2.1.7 NRS-RP-002, "Portable Instrument Procedure for Field Projects"

2.1.8 NRS-RP-003, "Absolute Filter Testing of Air Filtration Systems"

2.1.9 NRS-RP-004, "Working Level Determination of Radon Daughter Products"

2.1.10 NRS-RP-006, "Radiation Exposure Rate Surveys"

2.1.11 NRS-RP-007, "Access Control Point"

2.1.12 NRS-RP-008, "Dosimetry Program"

2.1.13 NRS-RP-009, "Surface Contamination Surveys"

2.1.14 NRS-RP-011, "Airborne Particulate Monitoring"

2.1.15 NRS-RP-012, "Radiation Work Permits Application and Use"

2.1.16 NRS-RP-013, "Monitoring for Personnel Contamination"

2.1.17 NRS-RP-016, "Respiratory Protection Program"

2.1.18 NRS-SF-016, "Incident Reporting Procedure"

2.1.19 NRS-SF-017, "Incident Investigation Procedure"

2.1.20 ENWD-TN-002, "Training Procedure"

2.1.21 PL-NRS-0892-068, "Personal Protective Equipment and Clothing Program"

2.2 Regulations and Licenses

2.2.1 10 CFR 20, "Standards for Protection Against Radiation."

2.2.2 DOE Order 5480.11, "Radiation Protection for Occupational Workers."

2.2.3 10 CFR 19 "Notices, Instructions, and Reports to Workers; Inspections."

2.2.4 State Regulations (as applicable).

2.2.5 US NRC Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure."

2.2.6 RUST Federal Services U.S. Nuclear Regulatory Commission License Number 39-25250-01.

3.0 REQUIREMENTS

3.1 Permanent and temporary NRS personnel and contractors shall be trained in radiation safety, in accordance with reference 2.1.21 prior to beginning radiation work.

3.2 Radiological instruments in sufficient quantities to adequately perform the monitoring required by this procedure shall be available on the job site prior to beginning work.

3.3 An ALARA briefing, as described in references 2.1.3 and 2.1.4, shall be held prior to job mobilization.

3.4 A Health and Safety Supervisor (HSS) and/or Radiological Control Supervisor (RCS) or equivalent, designated by the Division Health Physicist (DHP), shall be responsible for the implementation of the Radiological Control (RadCon) program. The RCS shall report to the DHP or designee on radiological matters.

3.5 The RCS shall be familiar with the procedures, Federal, and State Regulations and Radioactive Material Licenses listed in Section 2.0, as applicable, prior to beginning a project. Copies of these documents should be available at the job site, as applicable.

3.6 Personnel dosimetry shall be provided, reported, and worn as specified in references 2.1.6 and 2.1.12.

3.7 Instruments shall be set up, checked, and used as specified in reference 2.1.7.

3.8 The RadCon program shall be designed and implemented in accordance with references 2.1.3, 2.1.4, 2.1.5, and 2.1.20.

3.9 Site specific RadCon procedures or work instructions, as required, shall be developed in accordance with reference 2.1.1.

3.10 Records shall be maintained in the project file throughout the duration of the project and in the permanent project file in accordance with Section 17.0.

4.0 GENERAL

This procedure presents relevant limits and protective measures applicable to ionizing radiation and radioactivity which may be associated with NRS operations at temporary job sites.

These procedures and limits may be superseded at licensed facilities that have procedures and limits meeting the intent of this document and applicable regulatory requirements.

Radioactive materials in several forms are utilized during various NRS operations. These materials must be carefully handled to avoid any inadvertent contact by operating personnel and the general public. Unnecessary radiation exposure could be caused through mishandling of radioactive materials by personnel who are either unaware of its presence or nature, or who are not instructed in the proper methods of handling.

The addition of the problems of radiation exposure and radioactive contamination to otherwise normal jobs has required the establishment of numerous radiological controls. The major purpose of this manual is to provide procedures to assure that satisfactory control is exercised over personnel radiation exposure and radioactive contamination to ensure maximum safety to occupational workers and members of the general public.

4.1 Related Instructions

This manual has been developed to provide guidance for compliance with NRS radiological control policy.

4.2 Summary of Radiological Control Procedures

Radiological controls are required by NRS in areas where radioactive materials are handled or stored, in areas traversed by potentially contaminated personnel and materials, and in other areas where radiological work is performed.

The radiological controls requirements of this manual include: (1) control of external radiation exposure of personnel by means of personnel monitoring, area monitoring, installed shielding, and planning and execution of radiological work; (2) control of internal radiation exposure of personnel by monitoring for contamination in air and on surfaces, through use of anti-contamination clothing and respiratory protective equipment, and through control of contaminated areas; (3) control of radioactive wastes by means of specified procedures (4) decontamination; and (5) instructions for receiving, transferring, storing, shipping, and accounting for radioactive materials.

The instructions in subsequent sections are those required to assure radiological safety under most situations. In unusual situations, personnel are expected to perform additional measurements and take other additional precautions as deemed necessary to provide adequate protection.

4.3 Summary of Responsibilities

The RUST-NRS Notice to Personnel, Radiological Control Standards (See Appendix A), shall be conspicuously posted in a sufficient number of places to permit employees working in or frequenting radiologically controlled areas (RCA's)(radiation area, high radiation area, and very high radiation area) to have access to a copy on the way to or from their place of work.

4.4 Radiological Control Inspections

During the performance of any field project which is expected to last more than three (3) months, and for which NRS has the responsibility for maintaining radiological controls, the NRS DHP or designee may perform an inspection of the radiological control program. The inspection shall include:

4.4.1 A review of dosimetry records of NRS personnel and NRS subcontractor personnel as applicable.

4.4.2 A review of training records of NRS personnel and NRS subcontractor personnel as applicable.

4.4.3 A review of the radiological control log.

4.4.4 An inspection of the facility and/or site.

4.4.5 A review of compliance with the radiation protection program.

4.4.6 A review of the operating license and applicable regulatory requirements.

4.4.7 Review at project completion; records and final report.

4.5 Radiological Control Training Requirements

Periodic radiological control training is necessary to ensure that each person understands the general and specific radiological aspects which they might encounter, understands their responsibility to their employer and the public for safe handling of radioactive materials, and understands their responsibility to minimize his own exposure to radiation.

The appropriate degree of training for each individual (NRS employee and NRS subcontractor) necessary for the project shall be determined during the ALARA review in accordance with references 2.1.4 and 2.1.20. Personnel need be to trained in the appropriate following categories.

4.5.1 Radiation Worker -(Personnel authorized to receive radiation exposure in the course of their work):

Personnel who routinely require access to or work in RCA's shall have met the Radiation Worker Training Standard in reference 2.1.20 prior to being issued dosimetry equipment. Personnel issued dosimetry prior to completing training shall be escorted by a qualified individual when in radiological areas.

This training shall be verified by written examination(s) which include questions concerning areas of required knowledge and questions concerning action required by the individual in event

of an unusual radiological control situation (e.g., puncture of a contamination containment area). Knowledge, understanding, and practical abilities shall be verified by signature of a designated individual in accordance with reference 2.1.20.

4.5.2 Radiological Control Technician
(Individuals responsible for maintaining the Radiological Control Program)

Qualified radiological control technicians shall have met the Radiological Control Technician Training Standard in accordance with reference 2.1.20, and shall be able to apply this knowledge to situations they might encounter during work.

4.5.3 Senior Radiological Control Technician
(Individuals responsible for maintaining the Radiological Control Program)

Qualified senior radiological control technicians shall have met the Senior Radiological Control Technician Training Standard in references 2.1.20, and shall be able to apply this knowledge to situations they might encounter during work.

4.5.4 Radiological Control Supervisor (RCS)

A Radiological Control Supervisor shall have at least the same level of technical knowledge and ability as senior radiological control technician. Qualified radiological control supervisors shall have met the Radiological Control Supervisor Training prerequisite in reference 2.1.20, and shall be able to apply this knowledge to situations they might encounter during work. In addition, all personnel assigned to a project as a RCS must receive prior approval by the DHP or designee. Experience shall also be considered in the selection of an RCS.

4.5.5 Site Safety and Health Supervisor (SSHS)

A Site Safety and Health Supervisor shall have training in the application of industrial hygiene safety to protect the health and safety of workers, the public and the environment. The SSHS may be RCS qualified and assume a dual role.

4.5.6 Visitors/Contract Workers

Management, technical, and other personnel who require occasional access to RCA's and areas where radioactive materials are stored and who enter these areas for observation or similar purposes, or to perform work not involving radioactive materials shall have the radiological control training necessary for the radiological conditions expected to be encountered or shall be escorted by appropriately qualified personnel at all times. A continuous escort is not required if the visitor/contract worker is in continuous view of facility personnel. The presence of personnel normally assigned to these areas fulfills this function. The RCS shall determine the training requirements and shall record the decision. Dosimetry shall be provided in accordance with reference 2.1.12 and Section 6.5.

4.5.7 Records

Personnel training records shall be maintained in the on-site project file throughout the duration of the project.

4.5.8 Certification of Training

Certification of radiological control training for all personnel shall be accomplished bi-annually to requalify as a Radiation Worker, Radiological Control/Senior Radiological Control Technician or Radiological Control Supervisor in accordance with reference 2.1.20.

Certification of training shall include a comprehensive written examination. Personnel shall also demonstrate that they retain the practical abilities needed to perform their specific job. Performance of practical abilities during radiological control work in the six months prior to qualification expiration is considered satisfactory demonstration of these practical abilities when witnessed by appropriate personnel.

The Training Subcommittee shall review the duties of personnel who fail to requalify and, based on this review, either disqualify these personnel or limit the duties of these personnel until they satisfactorily requalify.

4.5.9 Implementation

The RCS shall ensure that the training requirements of this Section are implemented. Personnel designated to verify practical abilities, conduct classroom and practical training, and conduct oral examinations shall be designated in writing by the DHP or designee.

4.5.10 Instruction on Radiation Exposure to the Unborn Child

The requirements of this Section apply whenever female personnel may receive occupational radiation exposure. Prior to being issued dosimetry equipment, all personnel authorized to receive radiation exposure, and all females authorized to receive radiation exposure as visitors shall be given specific instruction about prenatal exposure risks to the developing embryo and fetus. This instruction shall include both verbal and written applicable information in the appendix to U.S. Nuclear Regulatory Commission Regulatory Guide 8.13, 'Instruction Concerning Prenatal Radiation Exposure,' (See Appendix B). Instruction concerning prenatal exposure to the unborn child shall be given during initial and re-verification training. All personnel receiving instruction in accordance with this paragraph shall sign the statement found in Appendix B prior to being issued dosimetry equipment:

The signed statements shall be kept with the on site training records. Statements signed by visitors shall be retained for three years following project completion.

4.6 Radiological Incident/Investigation Reports

The procedure for incident reporting and incident investigation is located in accordance with NRS Procedures NRS-SF-016,"Incident Reporting Procedure" (Reference 2.1.18) and NRS-SF-017, "Incident Investigation Reporting" (Reference 2.1.19). These procedures describe the circumstances and reporting requirements for incidence and occurrences.

Where applicable, site specific procedures may be developed to meet further requirements specific to a field project.

NRS recognizes that many acts occur that may not be considered an incident and require further reporting, but these acts are the precursor

to larger possible incidents and accidents. All employees are encouraged to report unsafe acts or conditions on the form in reference 2.1.18. This allows the documentation and management awareness of items that may be fixed prior to expanding.

5.0 RADIATION EXPOSURE LIMITS

Exposure limits are established to control personnel exposure to ionizing radiation. Federal and State Regulations outline the maximum exposures that a person may receive. These radiation protection regulations stress maintaining personnel exposures As Low As Reasonably Achievable (ALARA).

5.1 NRS Exposure Limits

5.1.1 NRS has established administrative exposure limits which maintain exposure below the Federal and State limits. General control procedures and exposure limits for personnel working on NRS projects are found in reference 2.1.5. During a field project, a current copy of reference 2.1.5 shall be available.

5.1.2 Visitors shall not be allowed to receive exposures in excess of 10 mrem per visit at the project site and a total less that 100 mrem unless appropriate training, recordkeeping and dosimetry is provided.

5.1.3 Contract workers shall not be allowed to receive exposures in excess of 250 mrem per calendar quarter unless fully trained as radiation workers per Section 4.5.1 and fully participate in the Personnel Monitoring Program per Section 6.0.

5.2 Radiation Exposure Limits for the Unborn Child

During the entire gestation period, the maximum permissible dose equivalent to the fetus from occupational exposure of the declared pregnant worker shall not exceed 0.4 rem.

It is NRS policy that exposure of the unborn child to ionizing radiation with NRS operations be kept to the lowest practicable level.

Training shall include information on the radiation-related biological risks to the embryo and fetus from radiation in accordance with Appendix B.

5.3 Radiation Exposure to the Public

NRS personnel shall ensure that as a result of NRS operations:

5.3.1 No member of the public shall receive a total effective dose equivalent in one year exceeding 0.1 rem.

5.3.2 Radiation levels in unrestricted areas shall not occur that could cause an individual continuously present in the area to receive 2 mrem in one hour.

5.3.3 NRS is committed to the ALARA principle and shall maintain all doses to the environment and the public ALARA.

5.4 NRS shall not release suspected radioactive material outside the controlled area in excess of limits established in Section 10.0 or any applicable regulatory guidance.

6.0 PERSONNEL MONITORING FOR RADIATION EXPOSURE

6.1 NRS Dosimetry Program

The monitoring of personnel radiation exposure for all NRS activities is controlled by references 2.1.6 and 2.1.12 which provide the procedure for the issue, processing, and recording of personnel radiation exposures of all personnel working on projects.

Personnel dosimetry requirements for each project (in addition to those defined in this Section) shall be determined and approved by the DHP or designee in the ALARA briefing conducted in accordance with reference 2.1.3.

Individuals shall not enter a restricted area without the appropriate personnel dosimeter, specified by the RCS. Individuals other than visitors or contract workers, shall not be issued dosimeters unless a record of the individual's current annual exposure and total lifetime exposure is in hand.

In this procedure, "TLD" means a thermoluminescent dosimeter,and "SRD" means self-reading dosimeter.

6.2 Personnel Monitoring

6.2.1 TLD's shall be worn on the area of the body expected to receive the highest radiation dose; under most circumstances this shall be on the frontal area of the chest or waist. When the location of the body which shall receive the maximum dose is not certain, for instance, trunk of the body or head, additional TLD's shall be worn; radiological control personnel shall specify the location of these additional TLD'S. When exposure to extremities (hands and forearms below the elbow, feet and legs below the knees) is expected, or has the potential to exceed 25 percent of the administrative limits of Section 5.1, additional TLD's and pocket dosimeters shall be worn on the exposed extremity or forearm. When additional TLD's are worn, results of TLD processing for all TLD's shall be included in individual personnel exposure records. Care shall be taken to ensure separate recording of exposures for extremities or forearms and for the whole body radiation exposure.

6.2.2 In situations where beta radiation is significant, the lens of the eye shall receive special consideration. Personnel shall be shielded from the beta radiation using masks or eye protection, and/or anti-contamination clothing. If the beta radiation cannot be shielded, methods for controlling beta radiation exposure shall be evaluated and implemented to control exposures to established limits for skin exposures.

6.2.3 Certain radioactive isotopes given to personnel for medical diagnostic purposes can result in measurable radiation levels for some period after receiving the treatment. The dose received from this treatment is exempt from regulation. Badged employees shall notify the RCS if they have received such treatment. In such a situation, the person shall be restricted from wearing TLDs until the medical isotope is eliminated from the body to the extent that it shall not affect TLD measurements. The only purpose of restricting this individual from wearing a TLD is to avoid including radiation exposure from the medical isotope to that received from NRS operations. Such personnel shall also be restricted from entering areas requiring monitoring for radiation until the medical isotope is eliminated from the body to the extent that it shall not affect personnel monitoring. In such situations, the RCS shall contact the DHP or designee for guidance concerning personnel monitoring requirements. These monitoring requirements may include

bioassays, whole body counting, internal exposure tracking, etc.

6.2.4 Lost TLDs or SRDs shall be reported as specified in reference 2.1.6 and 2.1.12.

6.2.5 Personnel dosimetry data for an individual shall be made available to authorized requestors and to the individual upon written request. This information may be readily available on a project to enable the individual to keep track of their own exposure.

6.3 Self-Reading Dosimeters (SRDs)

6.3.1 Requirements

SRDs shall be worn to monitor radiation exposure accumulated between readouts of TLD's. SRD's shall be worn in accordance with the applicable Radiation Work Permit (RWP). The following personnel shall be monitored with a SRD:

6.3.1.1 All personnel entering a high radiation area or in radiation areas where they could receive a dose in excess of fifteen (15) mrem in one day shall be monitored by a SRD worn at the same location on the body as the TLD. The above does not preclude the use of SRDs for other exposure monitoring.

6.3.1.2 An individual reaching 80% of the appropriate administrative limit of reference 2.1.5 shall be placed on an Alert List and shall wear an SRD. The RCS shall closely monitor the exposure of individuals on the alert list to prevent exceeding administrative limits from being exceeded.

6.3.1.3 Additional SRDs are required if the location of the maximum dose on the body is not certain. This is discussed in paragraph 6.2.1 above for TLDs.

6.3.2 SRD Records

6.3.2.1 In addition to the requirements of the Alert System in paragraph 6.3.1.2 above, the RCS shall maintain a log of all SRD results between routine TLD read-outs. Before the pocket dosimeter is re-zeroed, the measured radiation exposure is recorded. The individual's monthly, quarterly and/or yearly exposure totals are determined. The individual is thereby prevented from inadvertently exceeding the control levels.

6.3.2.2 SRD exposure results shall be reported to the Exposure Records Technician (ERT) weekly (See reference 2.1.6).

6.3.3 Reading SRDs

6.3.3.1 SRDs, whether low or high range types, shall be read by the wearer prior to entering radiation or high radiation areas and periodically thereafter to control their own radiation exposure while in these areas.

6.3.3.2 To prevent an off-scale reading, dosimeters shall be read, recharged, and doses recorded whenever the reading exceeds three-fourths of full scale.

6.3.3.3 When a pocket dosimeter reading is off-scale or a dosimeter is lost under conditions such that a high exposure is possible, the person's TLD shall be processed immediately and the person removed from Radiological areas until their exposure has been determined. The RCS shall notify the ERT for appropriate dosimeter processing and reporting.

6.3.4 SRD Testing Requirements

SRDs in use shall be tested at least every six months to ensure accuracy. If dosimetry performance is suspected to be unacceptable due to excessive drift or fails in use, the RCS shall initiate action to correct the problem.

6.4 Exposure Records

The RCS shall keep records of personnel exposure and shall forward those records and data as required by references 2.1.6 and 2.1.12 to the Exposure Records Technician.

6.5 Visitors/Contract Workers

6.5.1 A record of visitor and contract worker exposures shall be maintained in the on site project exposure files using the form in Appendix C and in accordance with Section 17.0. Report of exposure shall be provided to the individual upon written request.

6.5.2 The radiation standards of Section 5.0 shall be shown or explained to the visitor/contract worker.

6.6 Internal Exposure Monitoring

The site specific internal monitoring requirements shall be determined during the project ALARA briefing (See reference 2.1.3).

6.6.1 Requirements

6.6.1.1 Internal contamination monitoring shall be performed when personnel are or may be exposed to airborne contamination exceeding 0.1 DAC as defined in Appendix B, Table I of 10 CFR 20 (reference 2.2.1). This requirement is in addition to the internal dosimetry program of reference 2.1.6 and 2.1.12.

6.6.1.2 Additionally, suspected intakes of radioactive materials, such as may occur when there is significant external contamination, shall be investigated by internal monitoring.

6.6.1.3 The RCS shall contact the DHP (or designee) for direction if the need for internal monitoring is uncertain. The need for routine internal monitoring shall be established during the project ALARA briefing.

6.6.2 Methods

The selection of internal monitoring technique shall be made by the DHP or designee.

6.6.2.1 Bioassay - An estimate of the amount of internal contamination can be calculated by measuring the radioactivity in collections of urine, blood, breath, or feces and relating the excretion rate to body burden by the use of biological models.

6.6.2.2 Whole body counting - An estimate of the amounts of internal contamination by gamma emitting nuclide is obtained by counting the gamma rays emitted from the body and analyzing the pulse-height spectrum. This technique can also be used to measure the bremsstrahlung from energetic beta emitters.

6.6.3 Procedures

Procedures for the collection of bioassay samples shall be specified by the DHP or designee, or an approved vendor who has contracted to perform the analysis. Sample analysis shall be performed by the Dosimetry Laboratory or by a vendor found on the NRS Approved Vendor list. Whole body counting shall be performed at the Dosimetry Laboratory or by a vendor found on the NRS Approved Vendor List.

6.6.4 Reports

All reports of internal contamination monitoring shall be maintained in the on site project file throughout the duration of the project and permanent project file in accordance with Section 17.0. Copies of these reports shall be forwarded to the DHP for evaluation, and as required by references 2.1.6, 2.1.12, and 2.1.18.

Reports of overexposure shall be performed in accordance with reference 2.2.1.

7.0 GUIDELINES FOR CONTROLLING RADIATION EXPOSURE

7.1 Minimizing Radiation Exposure

NRS activities shall maintain personnel radiation exposure ALARA. A continuing effort is required to meet this goal by developing and implementing improvements to work procedures and work performance. Procedures for managing the ALARA Policy is found in NRS Procedure, NRS-AD-006 "RUST Remedial Services-Nuclear Remedial Services ALARA Procedure." (Reference 2.1.4) The following are requirements to assist in meeting this goal:

7.1.1 In a radiologically controlled area, work shall only be performed under the direction of an approved procedure, approved work instruction, or RWP.

7.1.2 Individual work procedures shall specify applicable actions (e.g., mockup training or removal of equipment from high radiation areas) to be used to minimize radiation exposure while working.

7.1.3 Supervisory personnel and radiological control personnel shall ensure that personnel are not waiting unnecessarily in RCA's.

7.1.4 Before entering an RCA, a worker shall receive specific job training and/or briefings necessary to enable him to perform his work with minimum radiation exposure. Examples include mockup training in shops for specific jobs or periodic briefings by supervisory personnel for routine work.

7.1.5 Radiation levels in high radiation areas shall be identified by the use of signs which clearly show the areas with the high and low radiation levels, along with its radiation intensity, and last surveyed date.

7.1.6 NRS maintains records of the cumulative radiation exposure involved in performing work as necessary to improve methods to minimize personnel radiation exposure in future work.

7.2 Procedures and Work Instructions

7.2.1 Major work in an RCA shall be performed under the guidance of a task specific procedure or work instruction written and approved in accordance with reference 2.1.1. Determination of the need for a specific approved procedures or work instructions may be made by the DHP or designee.

7.2.2 Procedures or work instructions should describe the task, radiological conditions, radiological controls, and shall be approved in accordance with reference 2.1.1.

7.2.3 A pre-job briefing shall be held prior to beginning work performed under a procedure or work instruction to ensure all personnel understand the task, radiological conditions, and radiological controls.

7.3 Radiation Work Permit (RWP)

The Radiation Work Permit (RWP) shall be used to delineate conditions and protective measures to prevent inadvertent exposure of personnel to radiation or radioactive contamination. The radiological conditions associated with the work to be performed shall be recorded on the RWP. Also specified are the protective measures required by personnel entering the designated area. The following requirements are established to assist in the proper use of the Radiological Work Permit in accordance with reference 2.1.15 (See Appendix D).

7.3.1 Requirements

The RWP shall be obtained for work operations not specifically covered by an approved procedure or work instruction that are performed in an area where any of the following conditions exist or could be produced:

7.3.1.1 Airborne radioactivity resulting in greater than 0.1 DAC hours daily intake.

7.3.1.2 Surface contamination in excess of the amount specified for clean areas.

7.3.1.3 Radiation levels that would require posting of the area, as specified in Section 8.4.1, 8.4.2, or 8 .4.3.

7.3.1.4 Whenever the need for an RWP is in question, such as when soil is to be excavated adjacent to a radiologically controlled facility, the RCS shall be contacted to determine if potential radiological problems may be encountered. The RCS shall then determine if an RWP is required.

7.3.2 Signs indicating the need for the RWP should be conspicuously posted at the entrances to areas were the RWP is required.

7.3.3 It is the responsibility of supervisors proposing to conduct work activities within posted radiation/contamination areas to initiate the issuing of RWP's. Generally, the initiator shall be the supervisor in charge of proposed activities.

7.3.4 The RCS shall complete the RWP after discussion of proposed work activities with the supervisor and performance of appropriate surveys.

7.3.5 Prior to beginning work, the RCS or designee shall hold a pre-job conference with the supervisor and all personnel working under the RWP. Items discussed shall include: work scope, dosimetry and protective clothing requirements, survey results, stay time limits, and emergency actions. The workers shall sign the RWP signature form to indicate an understanding of the requirements. Workers added to the RWP after initiation of work shall be briefed by the RCS prior to starting work and shall sign the RWP signature form.

7.3.6 During operations under valid RWP's, if radiological conditions change, the scope of work is changed or expected to change, another RWP shall be required and a pre-job conference shall be held.

7.3.7 The RCS shall determine the degree of monitoring required for a specific operation. This determination should be based on the potential for radiological problems and the experience of the personnel conducting the operation.

7.3.8 An RWP shall terminate seven calendar days following its initiation. If the work is to be continued, a new RWP shall be initiated. Long term RWP's may be used in specific situations with the written approval of the DHP or designee.

7.3.9 The total whole body dose received by each individual, as indicated by SRD, shall be recorded on the RWP signature form.

7.3.10 The RCS (or designee) shall maintain an indexed project RWP log. The RWP log index shall include: RWP no., date of issuance, date of termination and reason for RWP (work scope).

7.3.11 The RCS (or designee) shall ensure that all RWP's are terminated within the time allotted by paragraph 7.3.8 above, and shall maintain copies of all terminated RWP's in the on site project file throughout the duration of the project and in accordance with reference 2.1.5 and Section 17.0.

7.4 Access Control Point

An access control point is a location on the perimeter of an RCA or surrounding area through which all entries and exits are made and where precautions are taken to prevent the spread of radioactive contamination to adjacent uncontaminated areas. The dimensions and material requirements depend on the type of work to be performed, the number of personnel involved, and the location of the work. reference 2.1.11 and the following items outline the basic considerations for establishing an access control point.

7.4.1 Determine the extent of the area to be isolated and the location where entry and exit shall be controlled.

7.4.2 Plan for physical boundaries to prevent inadvertent or unauthorized access to the contaminated area. Boundaries shall be conspicuously marked and posted. Existing walls and equipment may effectively be used as boundaries.

7.4.3 Cover the floor of the contamination control point using paper or plastic sheet or other material provided for this purpose. The intent is to provide an easily removable walking surface within the contamination control point to prevent tracking of contamination from the area. Maintain a supply of the material to replace floor covering as necessary.

7.4.4 Provide a "step-off pad" at the exit from the contamination control point. This is to be used when removing clothing during exit from the area.

7.4.5 Provide easily accessible receptacles for radioactive waste and contaminated clothing, respirators, and equipment at the contamination control point. A supply of plastic bags shall be available as necessary for receiving contaminated equipment and tools. Radiation tags or labels shall be available to identify contaminated items being removed from the area.

7.4.6 Provide radiation detection instruments for monitoring personnel and equipment. Frisking should be performed in a low radiation background and where the audible response of the frisker can be heard.

7.4.7 Provide means of recording stay times, as may be required, at the entrance of the areas for personnel. It may be necessary to provide a record of previous radiation exposure received by personnel entering an RCA so that maximum allowable time in the RCA can be determined.

7.4.8 At the entrance to the access control point, information shall be posted concerning radiation and contamination conditions, precautions for entry, precautions for exit, step-off points, clothing and waste receptacles, and personnel survey. A copy of the applicable RWP shall be posted at the access control point.

7.4.9 The control point is maintained by radiological control personnel. The RCS shall assign a qualified person to the control point to ensure that personnel and equipment are adequately surveyed prior to leaving the area and that all logging requirements of reference 2.1.5 are met.

7.4.10 In some instances where high level contamination exists, it may be necessary to wear two sets of anti-contamination clothing. The outer garments should be removed at a designated location close to the contaminated work to minimize tracking of contamination to the access control point.

7.4.11 Adequately trained personnel may be permitted to assist in frisking other personnel and themselves.

7.4.12 Contaminated individuals shall be processed in accordance with Section 14.4.

7.5 Transient Shielding

Since incorrect installation, unauthorized movement, or removal of temporary shielding can result in large changes in work area radiation levels, control of transient shielding is essential.

7.5.1 Transient shielding installation and removal should be controlled by written instructions. These instructions shall specify locations and amounts of transient shielding.

7.5.2 After installation, transient shielding shall be inspected to ensure it is properly located.

7.5.3 Periodic radiation surveys conducted in accordance with Section 8.3 shall be reviewed by the RCS or radiological engineer to ensure that shielding maintains its effectiveness in reducing radiation dose rates. In reviewing these surveys, particular attention shall be paid to components which had radiation levels greater than 1 rem/h prior to shielding, since personnel could receive high radiation exposure in a short time if the shielding has lost its effectiveness.

7.5.4 Lead shielding shall not be used in radioactively contaminated areas or in association with radioactively contaminated materials without prior approval of the NRS Project Manager or designee.

8.0 RADIATION SURVEY AND POSTING REQUIREMENTS

8.1 Calibration and Maintenance of Radiation Detection Instruments

This section provides the minimum calibration and maintenance requirements for radiation detection instruments. Only instruments with a current calibration label shall be used for conducting surveys. Instruments suspected of providing incorrect measurements shall be removed from service and tagged pending a satisfactory response check. The RCS shall be notified of suspect instruments.

The requirements for instrument set up and checks are found in reference 2.1.7. When this procedure is used, a current copy of reference 2.1.7 shall be available. Only personnel trained in the use of portable radiation monitoring equipment shall be allowed to use this equipment.

8.2 Radioactive Source Handling

The following safety precautions should be observed by personnel working in an RCA using radiation detection equipment.

8.2.1 Damage to or loss of a radioactive source may result in the spreading, inhaling, or ingesting of contamination. If a source is lost notify the RCS. Immediate steps should be taken to recover the source and minimize radiation exposure to or contamination of personnel as a result of the lost source (See reference 2.1.5).

8.2.2 To prevent sources from being lost, all sources should be held under signature custody. These procedures are in addition to and do not supersede the accountability requirements for sources controlled under the Nuclear Regulatory Commission or Agreement State Licenses.

8.2.3 Except for sources which are permanently attached to detection instruments (e.g., check sources), check sources which are not in use shall be kept in a locked cabinet. The number of keys to the cabinet and the number of personnel having access to the keys should be kept at a minimum.

8.3 Radiation Surveys

Radiation surveys are performed as necessary to ensure personnel do not exceed radiation exposure limits and to meet requirements for posting radiation areas. These surveys are performed to determine whether abnormal radiation levels exist and to determine the extent and magnitude of radiation levels. The surveys in this section shall be the minimum performed. Surveys are to be performed and documented as stated in this section and reference 2.1.10.

8.3.1 Radiation surveys shall be performed whenever operations are performed that might be expected to change existing radiation levels. Examples of such operations include movement or removal of shielding, radioactive waste processing, and relocation of radioactive materials.

8.3.2 Temporary boundaries (e.g., rope boundaries) of radiation areas shall be surveyed daily to ensure radiation areas do not extend beyond posted boundaries.

8.3.3 Gamma surveys shall be performed at least weekly in occupied posted radiation areas and in radioactive material short-term storage areas. Long-term storage areas should be surveyed at least monthly.

8.3.4 When highly radioactive equipment (i.e., radiation level at 30 cm is greater than 100 mrem/hr) is moved, gamma surveys should be performed in spaces surrounding work areas (including the spaces above and below them if applicable) where personnel are likely to be exposed to radiation.

8.3.5 Potentially contaminated ducts, piping, and hoses outside radiological controlled areas shall be surveyed at least monthly for gamma radiation when in use or at least annually when not in use (e.g., deactivated systems).

8.3.6 Beta-gamma surveys of ventilation filters shall be performed whenever work is performed on these filters.

8.3.7 Other surveys should be performed as necessary to control personnel exposure to gamma, beta, and alpha radiation. Such surveys should include: (1) a gamma survey during initial entry into a tank containing potentially radioactive piping; (2) gamma surveys in spaces where significant radiation levels might exist from an adjacent operating facility; (3) beta as well as gamma measurements when personnel might come in contact with surfaces exposed to beta-emitting contamination (use of open-window G-M detectors is acceptable).

8.3.8 Surveys shall be conducted when performing operations which could result in personnel being exposed to small intense beams of radiation. These operations include working with spent fuel handling contain. s, when removing shielding, or when opening shipping/storage containers of radioactive equipment. When surveying areas or equipment where intense small beams of radiation could be present, the instrument should be used with an audible response (e.g., earphones). An audible response is necessary since the visible meter response is usually considerably slower. The probe should be moved slowly enough so that the instrument has a chance to give an audible increase for a large radiation level increase. If an audible increase is noted, the probe should be moved to the location producing maximum response and the meter read. If general

dose rates are high such that a change in audible response is not detectable, slower surveys should be performed so that beams shall be detectable by observing the meter. The probe is moved at a speed which is determined by considering the size of the probe, the instrument response time, the possible intensity of the beam, and the general dose rates in the area. Particular attention shall be given to thoroughly scanning suspected areas such as portable shield sections and areas which are or are likely to be occupied. For equipment with complex shield design, surveyors and workers should be briefed on the equipment design so that areas most likely to have small beams can be given special attention.

8.3.9 Gamma radiation surveys shall be performed monthly on a revolving basis in the areas of the work site where radioactive materials are not stored or handled. The survey should consist of a scan of accessible areas and lockers with either a G-M dose rate meter or a portable gamma scintillation survey meter (if available).

8.4 Control of Radiation Areas

Specified below are requirements for the posting of areas where radiation or the potential for radiation may exist. Site specific posting requirements shall be identified during the project ALARA briefing (See reference 2.1.3).

8.4.1 Radiation Area

Any area within a controlled area accessible to personnel in which there exists radiation at such levels that a major portion of the body could receive a dose equivalent greater than 5 mrem (50 microsieverts) in one (1) hour at 30 cm from the radiation source or from any surface through which the radiation penetrates. To mark such areas, signs shall be conspicuously posted; signs shall contain the conventional magenta three-blade symbol on yellow background and the words "CAUTION RADIATION AREA"; signs are permitted to state the general area radiation level. In addition, "DOSIMETRY BADGE REQUIRED" shall be posted. No loitering is allowed in these areas.

8.4.2 High Radiation Areas

Any area within a controlled area, accessible to personnel where a major portion of the body could receive a dose equivalent greater than 100 mrem (0.001 sievert) in one (1) hour at 30 cm from the radiation source or from any surface through which the radiation penetrates, shall be designated as high radiation areas. Major portions of the body include any portion of the head and trunk. Such areas shall be posted and locked or guarded. The requirement to lock or guard a posted high radiation area does not apply to tanks or voids posted as high radiation areas if entry requires the removal of complex closures. Positive control shall be established for each individual entry into a high radiation area and shall be established in such a way that no individual is prevented from leaving the high radiation area. Prior to locking an unoccupied high radiation area, the area shall be inspected to ensure that no personnel remain inside. No loitering or entry by unauthorized personnel shall be allowed in these spaces. High radiation areas shall be conspicuously posted at all entrances into the area. Signs shall contain the conventional magenta three-blade symbol on yellow background and the words "CAUTION: HIGH RADIATION AREA". In addition, "CONTACT RCS PRIOR TO ENTRY" shall be posted. Instances in which high radiation areas are not controlled in accordance with the requirements of this paragraph (e.g., locking personnel in a high radiation area or failure to lock or guard a high radiation area), shall be reported to the DHP or designee (See reference 2.2.1).

8.4.3 Very High Radiation Areas/ Exclusion Areas

Any area within controlled areas, where access would result in personnel receiving an absorbed dose in excess of 500 rads (5 grays) in one (1) hour at 1 meter from the radiation source or from any surface through which the radiation penetrates shall be designated a very high radiation area. These areas shall be designated as Exclusion Areas and personnel access strictly controlled. Areas where general area radiation levels exceed one (1) R/hour shall be operated using an approved written work instruction. Posting of Very High Radiation Areas and/or Exclusion Areas shall at a minimum require the conventional magenta three-blade symbol on yellow background and the words "GRAVE DANGER: VERY HIGH RADIATION AREA". In addition, "CONTACT RCS PRIOR TO ENTRY" shall be posted.

Instances in which very high radiation areas are not controlled in accordance with the requirements of this paragraph (e.g., locking personnel in a very high radiation area or failure to lock or guard a very high radiation area), shall be reported to the DHP or designee immediately (See reference 2.2.1).

8.4.4 Radioactive Materials Area

Entrances to areas where radioactive materials are handled or stored shall be posted with signs having the conventional magenta three blade symbol on yellow background and the words "CAUTION: RADIOACTIVE MATERIAL." This posting is in addition to posting required for control of radiation areas, high radiation areas, and radiologically controlled areas.

9.0 LIMITS AND PROCEDURES FOR CONTROLLING AIRBORNE RADIOACTIVITY

9.1 General

The basic criterion used for control of airborne radioactivity is that internal radiation exposure resulting from inhalation of airborne radioactivity should be minimized. Levels of internal exposure to airborne radioactivity are measured in units of DAC-hours (Derived Air Concentration multiplied by hours of exposure).

Radioactivity in the form of airborne particulate, gases, or both can become airborne through sources such as:

(1) radioactive system leaks,
(2) grinding or welding a contaminated component,
(3) decontamination operations,
(4) disturbing surface contamination in a work area,
(5) improper use of containment enclosures,
(6) inadequate vacuum cleaner and ventilation system control,
(7) inadequate application of procedures for venting and draining radioactive systems or components,
(8) damage or defect in radioactive instrumentation calibration and check sources, and
(9) radon from radium sources and from trace amounts of natural radium impurities in construction materials.

The RCS or designee shall provide the continuous or periodic sampling required to detect and evaluate the levels of airborne radioactivity in work areas and exhaust air systems in accordance with references 2.1.09 and 2.1.14.

It should be noted that this monitoring is primarily concerned with the control of particulate airborne activity. For operations or materials which may result in the discharge of gaseous airborne activity, contact the DHP or designee for specific guidance.

9.2 Limits for Airborne Radioactivity

The NRS administrative limit for occupational exposure to airborne radioactivity is 0.1 DAC. The DAC are found in 10 CFR 20 Appendix B Table 1, air concentration limits (See reference 2.2.1). Site specific limits for occupational exposure to airborne radioactivity shall be determined during the project ALARA briefing (See reference 2.1.3).

NRS operations should be controlled so that personnel are not exposed to airborne radioactivity levels that would require use of respiratory protection equipment.

Investigation Levels

Any measurement which indicates the airborne radioactivity concentration to be in excess of 0.1 of the applicable DAC shall be investigated to determine the cause of the airborne radioactivity levels. Appropriate controls shall be implemented to maintain the airborne radioactivity levels ALARA.

9.3 Procedure for Controlling Personnel Exposure to Airborne Radioactivity

Personnel exposure to airborne radioactivity is controlled using contamination containments and respiratory equipment as required below and in accordance with reference 2.1.17. In addition, many organizations have required use of respiratory equipment for work in areas with high levels of surface contamination (e.g. 50,000 dpm/100 cm^2) because of the likelihood that this surface contamination could become airborne. In some circumstances, respiratory equipment might be necessary for work in areas where surface contamination exists at lower levels.

Requirements

9.3.1 Contamination containments shall be used to the maximum extent practicable to prevent personnel from being exposed to airborne radioactivity above the limits of Section 9.2. These containments are recommended during radiological work which has been known to cause or is expected to cause airborne radioactivity.

9.3.2 The need for personnel to wear respiratory equipment in accordance with Section 9.7 and reference 2.1.17 in areas where airborne radioactivity exceeds the applicable limits of Section 9.2 shall be evaluated and documented prior to area entry.

9.3.3 Personnel shall not be exposed to airborne radioactivity such that their daily intake exceeds 1 DAC-hour without prior approval of the DHP or designee.

9.3.4 Signs shall be posted at entrances to areas where airborne radioactivity levels exceed or have the potential to exceed 10% of the DAC. These signs shall contain the conventional three blade magenta symbol on yellow background and the words "CAUTION: AIRBORNE RADIOACTIVITY AREA." These requirements to wear respiratory equipment shall also be included on a sign with the anti-contamination clothing requirements.

9.3.5 When personnel not wearing respiratory equipment may be exposed to airborne radioactivity above the limits of Section 9.2, a ventilation system should be operated which shall remove airborne particulate radioactivity to a controlled ventilation system or other system with a high efficiency particulate air (HEPA) filter. For example, during such operations as machining contaminated surfaces, vacuum cleaners fitted with HEPA filters or flexible ducts connected to a filtered ventilation exhaust shall take suction from within about one foot of the work area. Experience has shown that some operations within containments, such as grinding on highly contaminated components, require exhausting the containment through a ventilation system with an installed high efficiency filter, to prevent high airborne radioactivity outside the containment. Exceptions to this requirement are permitted with approval of the RCS or designee when use of a ventilation system shall cause spread of radioactive contamination.

9.3.5.1 HEPA filters defined in Section 9.9 shall be installed in the ventilation exhaust from radioactive work areas in which work in progress could cause the discharge of airborne radioactivity to the environment.

9.3.5.2 HEPA filters shall be installed in the exhaust from contamination containments to prevent personnel from being exposed to high airborne radioactivity.

9.3.5.3 HEPA filters shall be installed in vacuum cleaners used around loose surface contamination.

9.3.6 Monitoring for airborne radioactivity shall be performed in accordance with Section 9.5 and references 2.1.09 and 2.1.14.

9.3.7 Positive pressure breathing apparatus, air supply masks, or hoods shall be worn when airborne particulate activity exceeds 50 times the DAC limit of 10 CFR 20, Appendix B, Table 1.

Personnel shall not enter areas where the airborne particulate activity level exceeds 1000 times the limit of DAC of 10 CFR 20, Appendix B, Table 1 without DHP approval. This restriction applies even to personnel wearing self contained breathing apparatus or air supply respirators. If personnel entry is required to these areas, containment or filtered room ventilation shall be used to reduce airborne radioactivity levels to below 1000 times the DAC of 10 CFR 20, Appendix B, Table 1.

Respirators shall be selected such that the ratio of the Protection Factor from reference 2.2.1 to the airborne level (in DAC's) does not exceed one (1).

9.4 High Airborne Radioactivity

High airborne particulate radioactivity associated with NRS operations can result from many causes. It can be indicated by a continuous air monitor (CAM), by a portable air sample exceeding the applicable limit of Section 9.2, or by an indication of a radioactive system leak or rupture. General procedures for controlling personnel exposure to airborne radioactivity are contained in Section 9.3.

The procedures in this section shall be followed for controlling high airborne radioactivity in locations as indicated below:

Particulate Radioactivity Above the Limits of Section 9.2 in Occupied Areas

9.4.1 Immediate action

These actions should be performed nearly simultaneously; however, steps 9.4.1.1 through 9.4.1.4 should be immediately emphasized with the completion of additional steps as soon as possible (i.e., as soon as the number of radcon personnel, operating conditions and time allows).

9.4.1.1 Stop operations which might be causing high airborne radioactivity until adequate control of airborne radioactivity is established.

9.4.1.2 Evacuate unessential personnel from affected areas.

9.4.1.3 Don respiratory equipment in accordance with Section 9.8.

9.4.1.4 Secure unfiltered ventilation from the affected spaces to other spaces. Secure unfiltered ventilation to the environment from affected spaces. Ventilation systems which contain high efficiency filters in exhaust ducts need not be secured.

9.4.1.5 Determine the extent of the airborne radioactivity by sampling the affected area and adjacent areas using portable air samplers.

9.4.1.6 If the high airborne radioactivity is indicated by alarm of a CAM monitoring a ventilation exhaust or a work area, check the recorder chart on the CAM panel and the meter indication to determine that the CAM alarm is not the result of circuit failure or an electrical transient. If the recorder chart shows circuit failure or if the meter indication is below the alarm setting, confirm airborne radioactivity is below the limit of Section 9.2 by taking a portable air sample.

9.4.1.7 Measure gamma radiation at the CAM to determine if the CAM alarm was caused by high radiation levels external to the CAM. If radiation levels are high, determine the source of the high levels by conducting additional surveys and confirm airborne radioactivity is below the limit of Section 9.2 by taking portable air samples. Action in the subsequent steps need not be taken if the alarm was caused by high external gamma radiation levels.

9.4.2 Supplementary Action

The subsequent actions of this procedure need not be carried out if the airborne radioactivity is confirmed to be below the limit of Section 9.2.

9.4.2.1 Attempt to identify the radionuclide causing the airborne radioactivity, for example, by promptly measuring the sample for alpha radioactivity and determining the approximate half-life or by gamma energy analysis.

9.4.2.2 In order to minimize the need for respiratory equipment, and reduce personnel exposures to airborne radioactivity, consideration shall be given to ventilating the facility with additional HEPA filtered ventilation systems. When ventilating, avoid spreading airborne radioactivity to other spaces. Periodically monitor radiation levels on ventilation filters. To minimize contamination of the ventilation system while ventilating, operate the ventilation system in accordance with applicable procedures using the minimum number of fans to achieve stable conditions in the affected spaces.

9.4.2.3 Perform gamma surveys of ventilation filters and ducts and measure surface contamination in the vicinity of the ventilation exhaust discharge point.

9.4.2.4 Measure and control surface contamination in areas affected by high airborne radioactivity.

9.4.2.5 When resuming operations, take portable air samples to verify that the cause of high airborne radioactivity is corrected.

9.4.2.6 Monitor evacuated personnel for contamination and decontaminate as necessary. A check of personnel exposed to high particulate radioactivity for internal radioactivity uptake may be required. Nasal smears may be taken.

9.4.3 Reports

A report of any occurrence involving high airborne radioactivity (above the limits of Section 9.2) in areas occupied by personnel not wearing respiratory equipment shall be made in accordance with reference 2.1.18. This report shall include the results of monitoring personnel for internally deposited radioactivity as required.

9.5 Monitoring for Airborne Radioactivity

9.5.1 The system used for monitoring airborne radioactivity shall have a Minimum Detectable Activity (MDA) not greater than 10% of the applicable DAC. Refer to reference 2.1.7 for MDA calculations. Site specific MDA requirements shall be determined during the project ALARA briefing (See reference 2.1.3).

9.5.2 Airborne particulate surveys shall be performed with portable air samplers as follows:

9.5.2.1 At least every four hours and when airborne radioactivity is expected to be maximized;

(1) In radiological areas when radiological work is performed,

(2) During radiological work which has been known to cause or is expected to cause airborne radioactivity, and,

(3) In occupied areas where removable contamination exceeds 10,000 dpm/100 cm^2 beta-gamma or 500 dpm/100 cm^2 alpha.

These portable samples are not required if continuous monitoring is performed in accordance with paragraph 9.5.5. If the installed continuous air particle detector for a ventilation exhaust is inoperative and radioactive work is being performed, portable sampling shall be performed every four hours.

9.5.2.2 Before initially entering tanks, voids, or opening systems which contain potentially radioactive piping

9.5.2.3 Whenever airborne radioactivity levels above the limit of Section 9.2 are suspected.

9.5.2.4 Personnel air samplers should be used whenever air sampling indicates levels > 0.1 DAC.

9.5.3 Records of the above airborne radioactivity surveys may be required to serve legal purposes and therefore shall be maintained neatly and retained in the on site project file throughout the duration of the project and in the permanent project file in accordance with Section 17.0. These records should include at least the following information, as specified in reference 2.1.5.

1. Date and time of measurement.
2. Location.
3. Reason for measurement (e.g., 4 hr. or CAM).
4. Instrument and probe used (e.g., portable sample measured with MS-2/HP-210).
5. Results of most recent efficiency, MDA, and background measurements.
6. Airborne radioactivity in μCi/ml.
7. Remarks.
8. Signature of surveyor.

9. Signature of persons reviewing records.

9.5.4 Portable air particulate sampling equipment shall be immediately available to sample air during abnormal conditions. Site specific airborne particulate surveys shall be performed as identified in the project ALARA briefing (See reference 2.1.3) and in accordance with reference 2.1.14.

9.5.5 Continuous Air Monitors (CAMS) shall be used to continuously monitor air particle radioactivity if low volume portable air sampling is required but not performed. Continuous air monitoring shall be conducted in accordance with reference 2.1.14.

9.6 Air Sample Counting

When handling air samples collected from areas known or suspected of containing airborne radioactivity care should be taken to prevent the spread of contamination and cross contamination of samples taken. If significant radon daughter concentrations are expected, the samples shall be counted initially and again 24 hours later to determine the actual long-lived alpha activity.

9.6.1 Counting Activities

Scaler-Counters used for counting air activity shall be set up in accordance with manufacturers instruction and reference 2.1.7.

The following steps shall be followed for calculating Air Sample Concentrations.

9.6.2.1 Determine the air volume drawn through the filter (V).

$$V = \bar{f} t_s$$

Where:

V = total air volume (ml).
$\bar{f}$ = average flow rate (ml/min).
t_s = sampling time (min).

$$\bar{f} = \frac{(f_i + f_f)}{2}$$

f_i = initial flow rate.
f_f = final flow rate.

9.6.2.2 Determine the activity on the filter (A).

$$A = \frac{(\frac{C_n}{t})}{(E)(2.22E6)(F_a)}$$

where:

A = activity on the filter (μCi)
C_n = $C_g - C_b$ = net counts on the filter.
C_g = gross counts on the filter (cpm).
C_b = average background counts (cpm).
t = counting time (min).
F_a = filter absorption factor.
= 0.8 for alpha counting with a glass fiber filter.
= 1.00 for other emitters.
E = counter efficiency
2.22E6 = conversion factor from dpm to μCi

9.6.2.3 Determine the airborne radioactivity concentration [A].

$$[A] = \frac{A}{V}$$

Where: [A] = concentration of airborne radioactivity (in μCi/ml)
A = activity (μCi)
V = air volume (ml)

9.7 Determination of DAC-Hours

A DAC-hour is a quantity of radioactive material equal to the quantity of material that would be inhaled if an individual occupied an area containing airborne activity at a concentration of one DAC (Derived Air Concentration), as found in Appendix B, Table I (air) of reference 2.2.1, for a period of one hour.

9.7.1 Before an individual enters an airborne radioactivity area, the RCS shall determine the individual's expected daily intake, in DAC-hours, to ensure that the limit of 10 percent of the Derived Air Concentration (DAC) averaged over 8 hours or a peak concentration of 1 DAC is not exceeded.

9.7.2 The airborne concentration $[A]_{DAC}$ in DAC, shall be determined by dividing the measured airborne concentration [A] by the concentration which equals one DAC.

$$[A]_{DAC} = [A] / DAC$$

9.7.3 An individual's expected daily intake (I_e) shall be determined by multiplying the planned number of hours worked (t_w) in an airborne radioactivity area by the measured airborne concentration, $[A]_{DAC}$.

$$I_e = [A]_{DAC} \times t_w$$

9.7.4 If (I_e) exceeds one (1) and [A] cannot be reduced, respiratory protection equipment shall be evaluated for use, or the working time shall be reduced.

9.7.5 The actual intake (I_a), of each individual entering a posted airborne radioactivity area shall be recorded in accordance with reference 2.1.12, the site specific ALARA briefing (See reference 2.1.3), and reviewed by the RCS.

9.8 Procedure for Use of Respiratory Equipment

10 CFR 20 Appendix B lists concentration limits for continuous exposure to airborne radioactivity for personnel occupationally exposed to radiation. Additionally, Nuclear Regulatory Commission regulations permit upward adjustment of these limits for exposure periods of less than 40 hours per week. When airborne radioactivity exists above the limits of Section 9.2, the actions of Section 9.4 limit allowed exposure durations to shorter periods of time.

NRS requires the use of respiratory equipment as a supplementary control to keep personnel exposures ALARA.

9.8.1 Requirements

Prior to the use of respiratory protection equipment, each individual shall meet the requirements described below and in accordance with reference 2.1.17.

9.8.1.1 Prior to the use of respiratory protection equipment each individual shall be certified by a licensed physician as capable of wearing respiratory protective devices.

9.8.1.2 Prior to wearing a mask, air-fed respirator, or hood in an area where airborne radioactivity exceeds the limit of Section 9.2, personnel shall be trained in the use of this equipment and shall have passed a respirator fit test as described in ANSI Z88.2, Practices for Respiratory Protection. As part of this training, personnel should demonstrate the proper procedure for putting on and removing masks, air-fed respirators or hoods, including leak checks for masks and air-supplied respirators (See reference 2.1.17).

9.8.1.3 The RCS is responsible to ensure the above requirements are met and documented for personnel using respiratory equipment. A copy of this documentation shall be maintained by the RCS in the project file.

9.8.1.4 The use, cleaning and inspection requirements for respiratory equipment shall be in accordance with reference 2.1.17.

9.9 High Efficiency Particulate Air (HEPA) Filter Requirements

9.9.1 HEPA filtered systems shall be tested prior to use, following each set up and after each filter change. Acceptance criteria is a transmission of 0.05% or less of Emery 3004 aerosol testing medium in accordance with reference 2.1.8.

9.9.2 Great care shall be used in installing HEPA filters to assure the filter material separators are in the vertical position, tight seals are made around the edges of the filters, and that filters are not damaged during installation. Minor damage shall greatly reduce the efficiency of these filters.

9.9.3 Used filters shall be disposed of as radioactive waste since loose surface contamination could be present on interior pleats.

9.9.4 Instructions in manufacturers' manuals shall be followed for use and filter change-out.

9.10 Portable Ventilation System

A portable ventilation system can be constructed by adapting a portable electric blower with a HEPA filter. Such a system can be used during maintenance in a high airborne radioactivity condition to reduce airborne radioactivity without contaminating installed ventilation systems.

A vacuum cleaner with installed HEPA filter can also be used effectively to reduce airborne radioactivity in a space by recirculating the air in the space through the high efficiency filter.

Such a system must be Emery 3004 tested prior to use as per Section 9.9.

9.11 Release of Airborne Radioactivity to the Environment

Releases of airborne radioactivity to the environment may require an Environmental Protection Agency (EPA) permit. Such releases shall be evaluated for compliance with regulatory requirements (NRC,EPA, State, etc.) and the evaluation documented. Contact the Environmental Management Division for assistance.

The site specific requirements for environmental monitoring shall be determined as part of the project ALARA briefing (See reference 2.1.3).

10.0 SURFACE CONTAMINATION LIMITS

10.1 General

Radioactive contamination of surfaces (such as floors, equipment, clothing and skin) may result from work operations, leaks of radioactive fluids, or gradual precipitation of airborne radioactive contamination onto exposed surfaces. The primary reason for limiting surface contamination is to minimize possible ingestion or inhalation of radioactivity. In addition, surface contamination is limited to minimize buildup of radioactivity in the environment. In case of very high levels of surface contamination, control of external radiation exposure from this contamination may be necessary. Surface contamination is divided into two classes in this section: (1) loose contamination can be removed from surfaces by dry swipes and may be readily dispersible, and (2) fixed contamination remains on affected surfaces and is not further reduced by normal non-destructive decontamination techniques.

Swipes are usually pieces of dry filter paper which are wiped over a surface and then measured for radioactivity. Materials which have become radioactive through exposure to neutrons are treated similarly to those with fixed contamination when performing operations (e.g., machining) which may spread radioactivity.

Contamination control procedures should be considered in planning and performance of all jobs. However, the extent of the contamination control procedures used should be consistent with the amount of radioactivity being handled. The extent of site specific contamination control procedures shall be established during the ALARA briefing required in reference 2.1.3.

10.2 Surface Contamination Limits in Uncontrolled Areas

10.2.1 Surface contamination levels for uncontrolled surfaces should be kept as low as possible.

10.2.2 Radioactive contamination limits are dependent upon (1) the scope of work to be performed, (2) Nuclide most likely to be encountered, (3) Engineering and customer considerations, (4) Applicable regulatory requirements.

10.2.3 Limits for loose and fixed contamination shall be established during the project ALARA and Regulatory Affairs briefings, usually based on release limits found in Appendix E.

10.2.4 The standard area for swipes of 100 cm^2 is used for regulatory compliance.

10.2.5 Materials received at the RUST Warehouse shall meet the transuranic requirements for surface contamination in Appendix E, unless previously approved, in writing, by the DHP.

10.3 Controlled Surface Contamination Areas (CSCA's)

10.3.1 Areas where surface contamination exceeds the established limits, areas where equipment or materials are handled with exposed parts exceeding these levels, and areas where activities may cause contamination in excess of the limits shall be designated Controlled Surface Contamination Areas (CSCA's) until such areas, equipment, or materials have been adequately covered or decontaminated to meet these limits.

10.3.2 Access to a CSCA shall be limited to allow only personnel in appropriate anti-contamination clothing and dosimetry to enter. Choice of appropriate anti-contamination clothing is discussed in Section 13.

10.3.3 Open wounds shall be adequately protected from contamination prior to a person working in a CSCA. Notify the RCS of all open wounds prior to entering the CSCA.

10.3.4 Entrances to CSCAs and potentially contaminated areas shall be posted conspicuously with signs, stating the access restrictions, requirements for anti-contamination clothing and masks, levels of loose surface contamination and radiation dose rates. These signs shall contain the conventional magenta three-blade symbol on yellow background with the words "CAUTION" or "DANGER". If the entrance to a controlled surface contamination area is not at a door, barriers shall be used to mark the affected area clearly.

10.3.5 Smoking, eating, drinking and chewing shall not be permitted in CSCAs, or potentially contaminated areas. This provision is essential to minimize the possibility of transferring contamination from the hands or other areas to the mouth. For the same reason, hands should be kept away from the face, nose, mouth, and ears when in controlled surface contamination areas.

10.3.6 Where operations such as grinding or machining are being performed without containment on contaminated components or equipment, the areas of the operations shall be considered subject to the spread of loose contamination and shall be posted as a controlled surface contamination area.

10.3.7 Where surveys for loose contamination have not been made, but contamination is suspected, the area shall be posted as a controlled surface contamination area pending the results of contamination surveys.

10.3.8 Levels and extent of loose surface contamination inside controlled surface contamination areas shall be limited to control possible airborne radioactivity,to facilitate limiting the spread of contamination, to simplify subsequent decontamination, and to minimize personnel radiation exposure.

10.3.9 Personnel leaving a CSCA shall (a) remove their anti-contamination clothing and (b) monitor or be monitored for surface contamination in accordance with reference 2.1.16. Personnel contamination limits shall be identified during the project ALARA briefing (See reference 2.1.3).

11.0 CONTROLLING SURFACE CONTAMINATION

This part identifies some of the controls to institute efficient, detailed instructions for regulation of radioactive contamination. The following describes procedures applicable inside and outside radiologically controlled areas. To ensure that personnel shall have the necessary training and skills in controlling contamination, particular attention shall be given to training personnel in operations such as working in glove bags or containments.

11.1 Ventilation

The RCS shall consider the following when using ventilation systems in a contaminated area.

11.1.1 Ventilation should be controlled during operations involving radioactivity to prevent spreading the radioactive contaminants through an area or to the environment. The basic methods of controlling contamination by ventilation are by providing clean supply air into the contaminated work area and by providing filtered exhaust ventilation close to the work or from a containment enclosure erected around it. The exhaust capability should always exceed the supply including discharges from pneumatic tools.

11.1.2 HEPA filters (and HEPA system pre-filters) are normally installed in permanent ventilation systems servicing radiological work areas. These filters may become contaminated so that handling a used filter may spread contamination. Therefore, great care should be exercised when removing used filters. Filters may require replacement because of plugging (high differential pressure), high radiation level (in some areas contamination levels may cause significant personnel radiation exposure), or lack of effectiveness in removing particulate (usually caused by damage during or prior to installation). Filters may be significantly contaminated even though never used for radioactive work. Contamination has been measured in high efficiency filters from natural radioactivity in the air. Contaminated used filters are normally removed into plastic bags. Contamination in the adjacent duct shall be decontaminated prior to the subsequent new filter installation.

11.1.3 A buildup of detectable levels of surface contamination can occur through the deposition of activity from the air without having significant levels of airborne radioactivity. Therefore, even though the air particle detector has never alarmed, ventilation exhaust ducts or ventilation system ducts from radioactive work areas should be considered potentially contaminated. When opening these potentially contaminated systems, they should be surveyed and decontaminated as practical. One method of decontamination is to use a vacuum cleaner with a HEPA filter. For similar reasons, if a portable exhaust blower is used in a contaminated space, surface contamination should be checked on surfaces exposed to the filtered exhaust of this blower.

11.1.4 HEPA filtered air supplies are used to exhaust air from many work areas, particularly when welding or grinding. It may be preferable to locate the filter inside the areas to minimize the amount of ducting which becomes contaminated. The exhaust shall be directed so as to prevent stirring up contamination in the area in which it is used. When removing these air supplies, flexible ducts and filters, precautions are required to prevent spilling contamination from them.

11.1.5 When HEPA filters are installed in ventilation systems for radiological areas, labels should be prominently affixed verifying proper installation of the filters. These labels should be located so that they are destroyed when the filters are removed. HEPA filtered ventilation systems shall be Emery 3004 tested in accordance with Section 9.9.

11.1.6 Potentially contaminated air that has not passed through a high efficiency filter should not be discharged to locations occupied by personnel or where supply ventilation can return it to an occupied area.

11.1.7 Consideration should be given to controlling contamination which has been collected in ventilation equipment and systems not normally used for radiological work including those systems in adjacent spaces which may become contaminated in event of a spill. Prior to work on these items, radiation measurements should be taken,

the items treated as contaminated, and radiological control precautions established to prevent spreading contamination.

11.2 Enclosures for Containing Contamination

The most effective means of controlling radioactive surface contamination is through use of enclosures around the contaminated item to keep the radioactive material inside. Containment should be used as much as practical when working on the surfaces of components which have been exposed to radioactive contamination. Plastic sheet, bags, or containment areas may be used to enclose clean material and prevent contamination of clean items inside the enclosure. The following specific requirements shall be followed when working or handling contaminated equipment and materials.

11.2.1 Maximum practical use shall be made of containment enclosures when working on contaminated systems or contaminated equipment and material.

11.2.2 Instructions for using containment enclosures shall be readily available.

11.2.3 Containment enclosures shall be inspected by the RCS or designee prior to use to determine if they are properly constructed and ready for use. Enclosures shall then be marked to certify this inspection was completed. In addition, containment enclosures shall be inspected daily when in use. Personnel using containment enclosures shall inform radiological control personnel of any damage to containment enclosures which occurs during work. When a containment enclosure is damaged or is unfit for use, the enclosure shall be conspicuously tagged to prevent its inadvertent use by personnel unaware of the problem. Containment enclosures shall not be removed or altered without approval of the RCS.

12.0 MONITORING FOR SURFACE CONTAMINATION

12.1 Method for Measuring Surface Contamination

A rate meter with a thin window probe (G-M) or equivalent shall detect radioactive beta-gamma surface contamination on materials and personnel by slowly scanning the probe held within about 1/2 inch of the surface. An instrument and detector should be used that has a Minimum Detectable Activity (MDA) for contamination measurements of < 90% of the applicable limit with a goal of < 10% of the limit. If background levels are higher than stated above, equipment or personnel to be monitored for release shall be relocated to an area of lower radiation levels or the area shielded to lower background levels.

Site specific surface contamination limits shall be identified during the project ALARA briefing (See reference 2.1.3).

When monitoring personnel, any indications above background shall be investigated as possible contamination.

All surface contamination surveys shall be performed and documented in accordance with Section 12.0 and reference 2.1.13.

12.2 Methods for Taking Swipes for Loose Contamination

12.2.1 A swipe should be taken by applying moderate pressure to a piece of dry swipe material over about one hundred square centimeters (an area about four inches by four inches) of the surface being monitored. In controlled surface contamination areas and where contamination is suspected, rubber gloves shall be worn when taking swipes to limit contamination of the hands. Rubber gloves need not be worn in uncontrolled areas for taking swipes if contamination is not expected.

12.2.2 The radiation detection equipment shall be set up and checked as required in accordance with reference 2.1.7. Field surveys shall be performed in accordance with reference 2.1.13.

12.2.3 When the item has less than 100 square centimeters of surface area, the pertinent levels should be reduced proportionally and the entire surface area should be swiped. Contamination levels should be reported as "dpm/area" (where area is a best estimate).

12.2.4 Dry swipes are normally used to measure loose surface contamination since the results are more representative of the spread of contamination by personnel brushing past these surfaces than if wet swipes were used. The use of wet swipes shall be avoided.

12.3 Method for Monitoring Fixed Contamination

Fixed contamination may be measured with an appropriate rate meter and detector for alpha and beta/gamma contamination. Since these survey instruments alone do not differentiate between fixed and loose contamination, the measured fixed contamination levels are actually the total radioactivity and may include some loose contamination. For fixed beta-gamma contamination, levels are usually expressed in dpm per 100 cm^2. When searching for fixed contamination, or when trying to find the most highly contaminated portion of contaminated materials or areas, earphones or audible instrument response should be used. Visual meter indications respond slower than audible indication. When surveying to demonstrate lack of residual contamination, a portable scaler is recommended to reduce the MDA for the measurement. Care must be taken that the detector used has the appropriate sensitivity (i.e., MDA) for the isotope(s) of concern.

12.4 Method for Monitoring Personnel Contamination

12.4.1 Personnel monitoring (frequently referred to as "frisking") shall be performed when leaving controlled areas. Monitoring of personnel for surface contamination should be done with an alarming rate meter and an appropriate detector in accordance with reference 2.1.16. The probe should be moved slowly over the body with the probe within about one-half inch of the body surface, giving special attention to the face, throat, chest, back, abdomen, and the hands and feet in order to obtain an indication of any internal deposited radioactivity. When monitoring personnel earphones or audible instrument response should be used.

Frisking for alpha contamination is performed using an appropriate rate meter and detector in a manner similar to that described above except that light contact between the detector and surfaces being monitored should be maintained. Alpha friskers should have an alarm set point below the applicable contamination limit.

12.4.2 Monitoring of personnel by taking swipes for loose surface contamination on the skin or clothing shall not be done since swipes may tend to imbed radioactive particles.

12.4.3 When personnel have been adequately trained in frisking procedures, requiring personnel to frisk themselves may be desirable.

12.4.4 If facial contamination is detected, or it is suspected that radioactive nuclide have been taken into the body even though no facial contamination is evident, the individual shall be monitored for internal radioactivity. Measurements of the radioactivity of nose and throat swabs may be used.

When personnel exceed the applicable contamination limits, notify the RCS and proceed with decontamination in accordance with Section 14.4.

12.5 Frequency of Surveys for Monitoring Surface Contamination

Site specific contamination survey requirements shall be determined during the project ALARA briefing (See reference 2.1.3).

12.5.1 Routine Operations

12.5.1.1 Contamination surveys shall be performed at least daily in occupied areas surrounding CSCA's and particularly in the vicinity of exits from a CSCA. Surveys shall be performed at least daily in occupied CSCA's.

12.5.1.2 Contamination surveys shall be performed at least weekly where appropriate in all occupied radioactive material areas where there is frequent handling or short-term storage of radioactive materials.

Long-term radioactive material storage areas shall be surveyed at least monthly.

12.5.1.3 Contamination surveys shall be performed monthly in work and storage areas outside areas where radioactive materials are stored or worked on.

12.5.2 Source Leak Testing Requirements

Source leak testing, if required, shall be performed as directed by the DHP or designee.

12.5.2.1 Sealed test sources containing radioactive material (licensable quantities) other than ^{3}H, with a half-life greater than thirty days and in any form other than gas shall be tested for leakage and/or contamination at intervals not to exceed six months. In the absence of a certificate from a transferor indicating that a test has been made within six months prior to transfer, the sealed source shall not be put into use until tested.

12.5.2.2 Plated sources (alpha sources) shall be integrity tested for the loss of radioactive material quarterly. The integrity test shall be performed whereby the loss of material is less than 5 nCi. (185 dpm).

12.5.2.3 If results of the leak test is greater than 5 nCi (185 dpm) the source shall be removed from service and the DHP contacted immediately.

12.5.3 Additional Survey Requirements

Operations such as the following require surveys:

12.5.3.1 Decontamination and release of equipment.

12.5.3.2 Inspection or maintenance on components and piping which are associated with radioactive or potentially radioactive systems.

12.5.3.3 Areas where radioactive liquid leaks have occurred or where airborne radioactivity has exceeded the concentrations of Section 9.2.

Surveys are required to determine the need for anti-contamination clothing and to determine the extent of contaminated areas.

12.5.3.4 Upon initial entry into tanks or voids containing potentially radioactive piping and when opening ventilation exhaust ducting from radioactive work areas.

12.5.3.5 In addition, any normally uncontaminated system which is suspected of radioactive contamination shall be surveyed when opened for inspection, maintenance or repair. Contamination control procedures should be used until the portion of the system being worked on is proven to be uncontaminated. Water drained or flushed from these systems shall be treated as radioactive and sample as appropriate.

12.5.3.6 Contamination surveys should be performed in plenums downstream of HEPA filters during routine filter replacement or at least annually, to determine radioactivity buildup in ducts downstream of filters.

12.5.3.7 Prior to replacing filters on inlet ducts to a radiological work area, filters should be surveyed to determine if radioactivity is present.

12.5.3.8 Surveys for contamination fixed in paint should be performed prior to removal of paint in potentially contaminated areas. These surveys should be performed by counting paint scrapings for gross activity.

12.6 Instructions for Controlling Radioactive Spills

12.6.1 Since each spill shall require different detailed actions for effective control and recovery, personnel shall be trained to take appropriate supplementary actions depending on the location and potential consequences of the specific incident. For locations where spills are most probable or would have the worst consequences, each facility should train appropriate personnel in controlling and recovering

from radioactive spills. Equipment for containing spills should be prepared in advance and located in work areas.

12.6.2 The following steps shall be followed in the event of a radioactive spill:

12.6.2.1 Immediate Actions

1. Stop the spill

If the spill is from a system which may have more material (either airborne particulate radioactivity or fluids) to leak out, promptly stop the leak if possible. If the spill is from an overturned container, try to set it upright if all the contents have not escaped. The amount of time spent stopping a difficult leak should depend upon the radiation levels involved, the possibility of inhaling airborne radioactivity from the spill, and the consequences of not making a prompt closure. In some cases, a prompt closure may not be necessary.

2. Warn other personnel

Other personnel who may become contaminated by the spill or who may be able to help control it shall be warned immediately. Ensure radiological control personnel and area supervisor are notified of the spill.

3. Isolate the spill

Keep unnecessary people away from the area affected by the spill to minimize spread of contamination. This action may require closing doors, roping off the area, and verbally warning approaching personnel.

4. Minimize personnel exposure to contamination and radiation

Personnel in the spill area should evacuate and contact radiological control personnel.

5. Secure ventilation in the spill area other than filtered exhausts

It may also be desirable to shut down exhaust systems in adjacent areas to ensure that air does not flow out of the spill area. Filtered exhausts in the spill area should also be shut down, if necessary, to minimize spread of high levels of radioactive contamination. Ventilation supplies should be shut down when exhausts are turned off.

12.6.2.2 If the spill is minor (for example, a few milliliters of water with low radioactivity spilled on a smooth surface), immediately cover the spill with the most convenient absorbent material available, such as absorbent paper or rags to soak up the liquid. Personnel shall be surveyed and decontaminated as necessary.

12.6.2.3 The senior person in each area is in charge until relieved by the RCS. The person in charge should organize the personnel available and initiate action to control and correct the spill. It is important that this individual makes their presence and the fact that he is in charge known to all others at the scene. On arrival of the RCS, the status of corrective action taken or in progress shall be immediately brought to his attention.

12.6.2.4 Supplementary Actions

Steps (1) and (2) below are actions to evaluate the extent of the problem and to recover from the spill. The designated supervisor shall consult with Radiological Control personnel to ensure the performance of specific portions of the steps below.

1. Measure radioactivity levels

Measure contamination on personnel who may have been affected, make contamination surveys in the area adjacent to the spill, measure airborne radioactivity inside and outside the spill area, and measure radiation levels in affected areas, particularly on ventilation filters. Monitor ventilation

systems to determine if the spill has caused them to be contaminated. If it is suspected that radionuclides have been taken into the body or if facial contamination is detected, the personnel monitoring procedures shall be followed (see Section 12.4 and 14.5 and reference 2.1.16).

2. Take subsequent radiological control and cleanup actions in accordance with appropriate radiological procedures. The designated supervisor shall minimize personnel radiation exposure and generation of radioactive waste consistent with the requirements to recover from the spill.

3. Make appropriate reports and investigations in accordance with references 2.1.18, and 2.1.19.

12.7 Records of Contamination

12.7.1 Records of abnormal spreads of radioactive contamination outside the radiologically controlled area shall be maintained in the on site project file throughout the duration of the project and in the permanent project file in accordance with Section 17.0 and be reported in accordance with reference 2.1.18.

12.7.1.1 Any occurrence which results in loose surface contamination greater than the applicable site specific free release limits for uncontrolled areas shall be reported in accordance with reference 2.1.18.

12.7.1.2 Any spread of contamination in radiologically controlled areas or CSCA's which result in work being stopped for more than four hours or take more than four hours to clean up.

12.7.2 Records of surface contamination surveys shall be retained in the on site project file throughout the duration of the project and in the permanent project file in accordance with Section 17.0. The survey information shall be recorded on a standard form in accordance with reference 2.1.13.

12.8 Criteria and Procedures for Releasing Previously Contaminated Facilities and Areas for Unrestricted Use

The criteria and procedures of this Section shall be applied when releasing previously contaminated areas or radiologically controlled facilities for unrestricted use (e.g., use of the area is not controlled by radiological control procedures). Typical areas and facilities include facilities used for decontamination and repair or assembly of contaminated equipment, radioactive waste processing facilities and systems, exhaust ventilation systems for radioactive work areas, radioactive material storage areas, and outside areas accidentally contaminated.

Site specific criteria and release requirements for previously contaminated facilities or areas shall be identified during the project ALARA briefing (reference 2.1.3).

12.8.1 Criteria

12.8.1.1 Criterion 1

A Decommissioning Plan shall be approved by the customer, the DHP or designee, and the appropriate regulatory agencies prior to beginning work.

12.8.1.2 Criterion 2

Equipment, parts, materials, and waste which have been exposed to radioactive contamination shall not be released for unrestricted use until they are surveyed and meet the requirements of the site specific ALARA briefing (See reference 2.1.3).

12.8.1.3 Criterion 3

Earth (e.g., sand or soil), ground covering (e.g., asphalt or porous concrete), paint (which may have absorbed radioactive contamination), etc., shall not be released for unrestricted use until the area is inspected and samples do not exceed a concentration in pCi/gram for the radioactivity in question using the requirements established in the approved Decommissioning Plan.

12.8.1.4 Criterion 4

Other materials (i.e., water, vegetation, etc.) shall not be released for disposal or unrestricted use until they meet the requirements in the approved Decommissioning Plan.

12.8.2 Procedures

In order to ensure compliance with the criteria above, the following procedures shall be followed as applicable:

12.8.2.1 General

Prior to initiation of final surveys, records should be reviewed and investigations made to determine if contamination existed in any area and was covered over to prevent its spread, such as by wall boarding, floor tiling, or paving. Such identified areas should be inspected, action shall be taken to decontaminate the area below the criteria of 12.8.1 above. Contaminated material shall be disposed as radioactive waste.

12.8.2.2 Facilities

Where an area may be contaminated with low levels of radioactivity covering small areas, and the contamination is not expected to have been spread to inaccessible areas, a highly detailed survey may not be warranted.

As a minimum, a complete survey should be made with particular attention to potential areas of contamination, such as along walls at shoulder and waist height, and over floor areas.

In other areas with a potential for higher levels of loose contamination deposited on larger areas, it might be expected that radioactivity could be deposited or spread to a few inaccessible locations. A thorough survey should be made of all surfaces. Selected floor tile should be removed and selected wall joints should be opened for survey along the heavy traffic routes and at the previous work stations.

For highly contaminated areas, it may be necessary to completely strip all floor coverings and open up and expose all wall and floor crevices and joints in order to perform a satisfactory survey.

12.8.2.3 Ventilation Ducting

An adequate survey of internal surfaces may consist of spot checking (1) the first few feet of the inlet and outlet duct-work, (2) a few feet upstream and downstream of a filter (after filter removal), and (3) in the vicinity of manhole openings. If contamination is found, a more complete survey is required.

12.8.2.4 Materials and Equipment

Materials and equipment such as drains, piping, tanks and hoses which have been previously exposed to radioactive liquids shall be removed and discarded as radioactive waste, if no longer useful since it is highly improbable that such equipment can be economically decontaminated.

12.8.2.5 Outside Earth or Ground Coverings

Outside earth or ground coverings should be slowly scanned over the entire area surface with a gamma survey meter. Representative samples should be analyzed per the approved Decommissioning Plan. If the contamination has been covered by other material, it should be re-exposed and properly surveyed.

12.8.3 Records

A record of these surveys shall be maintained in the on site project file throughout the duration of the project and in the permanent project file in accordance with Section 17.0.

13.0 ANTI-CONTAMINATION CLOTHING AND EQUIPMENT

Anti-contamination clothing (often referred to as anti-C clothing) is used to help keep personnel from spreading radioactive contamination outside controlled surface contamination areas and to keep the wearer's body free from contamination. Anti-contamination clothing is required when either surface contamination or airborne radioactive contamination may exceed prescribed limits. In the following section, the recommended type of anti-contamination clothing is described, and instructions for wearing it are given. In addition, miscellaneous equipment used for the control of radioactive contamination is described.

13.1 Requirements for Wearing Anti-Contamination Clothing

The RCS shall determine the appropriate requirements for anti-contamination clothing and shall be noted on the applicable RWP.

13.1.1 When first entering an area which may be contaminated, prior to determining the extent and level of contamination, full anti-contamination clothing shall be worn. Full anti-contamination clothing consists of hoods, coveralls, rubber and cloth gloves, booties and shoe covers.

13.1.2 Full anti-contamination clothing shall be worn when working in highly contaminated areas (greater than 20,000 dpm/100 cm^2 β-γ or 1,000 dpm/100 cm^2 α). Full anti-contamination clothing may be required in areas with less contamination if personnel contamination is probable. In addition, at points where contamination may enter clothing should be sealed with tape. Full anti-contamination clothing is also necessary in other situations, such as when initially opening a radioactive system without containment.

13.1.3 A face shield, waterproof apron and rubber gloves should be worn during operations such as sampling of radioactive waste tanks and processed water tanks.

13.1.4 When working in very highly contaminated areas (greater than 50,000 dpm/100 cm^2 β-γ or 5,000 dpm/100 cm^2 α) double suits of anti-contamination clothing shall be worn. Plastic or coated fabrics should be considered for use as the outer garment when double anti-C's are required. Double suits limit the contamination which may penetrate

the material during work, and they also improve the ease of controlling spread of high levels of contamination. The outer suit is normally removed prior to leaving the region of very high contamination and the inner suit is normally removed at the boundary of the CSCA.

13.1.5 When only the hands and arms are in contaminated areas such as glove box, rubber gloves attached to the glove box may substitute for the anti-contamination clothing.

13.1.6 When working in a contaminated wet area or when contaminated liquid is likely to spray on the clothing, the outer clothing shall be waterproof.

13.1.7 In certain circumstances of low contamination levels, with RCS or designee approval, it may suffice for personnel to wear shoe covers, rubber gloves and lab coats (without the other anti-contamination clothing). If wearing gloves without anti-contamination coveralls, care should be taken not to transfer contamination from the gloves to personal clothing.

13.1.8 It may be desirable to remove personal clothing before putting on anti-contamination clothing for comfort when working in high temperature spaces. Removing personal clothing is not usually required for adequate radiological control as long as the anti-contamination coveralls do not tear and the anti-contamination clothing is taken off properly after use.

13.1.9 Respiratory protection should be used in conjunction with anti-contamination clothing if the concentration of airborne radioactive particulate may exceed the limits of Section 9.2.

13.1.10 When reading a pocket dosimeter in a CSCA, provisions should be made so that the dosimeter does not become contaminated. Use of a transparent plastic bag has been effective for this purpose.

13.2 Procedure for Donning Anti-Contamination Clothing

Anti-contamination clothing shall be used in accordance with Section 13.1 and reference 2.1.20.

14.0 RADIOACTIVE DECONTAMINATION

Decontamination may be required for components, tools and equipment, work areas, clothing or personnel. Each of these subjects is discussed in the following sections. Alternatives to decontamination are also discussed in these sections. These include, in some cases, storage for decay, disposal without decontamination, or restricted use without complete decontamination. By the very nature of decontamination operations, the disposal of the waste radioactivity must be considered. Volumes of both solid and liquid wastes shall be minimized. Unauthorized chemicals shall not be used. These may cause difficulties in waste processing. Most radioactive contamination can be removed by normal cleaning. Wiping with a damp rag soaked with detergent shall usually provide satisfactory decontamination.

If large variations in surface contamination levels exist on highly contaminated surfaces, cleaning shall be from less contaminated toward more contaminated areas to prevent radioactivity from being spread to less contaminated areas. Cleaning solutions and cloths used in these decontamination operations shall be disposed of as radioactive waste. During decontamination operations, precautions shall be taken to limit the spread of contamination, such as by taking care not to splash solutions, by properly wearing anti-contamination clothing, and by wearing masks as necessary. Filtered ventilation may be required to minimize the possibility of contamination being inhaled by personnel performing the decontamination.

14.1 Decontamination of Tools and Equipment

In decontaminating tools and equipment, appropriate radiological control shall be used to prevent the spread of contamination, and to control airborne radioactivity, and radiation exposure. The following applies to the decontamination of tools and equipment.

14.1.1 Tools and equipment which may be used again in contaminated areas may be temporarily stored in the contaminated area or in a contaminated tool room without decontamination if proper radiological controls and procedures are used. If certain tools are to be used solely in CSCA's, these tools should be durable and distinctively marked to indicate they are always treated as potentially contaminated.

14.1.2 In some cases, the need for decontaminating tools may be minimized by taping some portions, such as the handles, prior to use and stripping off the contaminated

tape after use. If tape is used to cover parts of tools, after tape removal, the residual adhesive shall be removed to minimize contamination that may be picked up in future uses of the tool. Large tools are often wrapped in plastic instead of tape. These tools need to be swiped or frisked at completion of decontamination to verify the effectiveness of the treatment.

14.1.3 Heavily contaminated tools can spread surface contamination within a controlled area. Therefore, such tools should be partially decontaminated as may be necessary several times throughout a work shift. Heavily contaminated tools can be readily identified without taking swipes by measuring their radiation level. The purpose of decontaminating these tools shall usually be to reduce their radiation levels rather than to remove all loose surface contamination.

14.1.4 When only a few tools require decontamination, wiping with cloths soaked in detergent is a convenient, effective procedure. This method is also useful when only a portion of a tool is contaminated. A disadvantage of wiping procedures is the large amount of solid radioactive waste produced.

14.1.5 Mechanical decontamination methods, such as using abrasives which remove some of the surface of the tool, can be useful in special circumstances where contamination is not removed by chemical cleaning. In such cases, control of possible airborne radioactivity is essential.

14.1.6 In decontaminating oily or greasy tools or equipment, consideration should be given to the fact that oil or grease may inhibit waste processing or disposal.

14.2 Decontamination of Areas

Contaminated areas shall first be isolated and radioactivity then removed while being careful to avoid spreading contamination. In some cases, tape may be used to lift loose contamination from surfaces. If contamination levels are not sufficiently reduced, use of solvents, strong chemicals, or mechanical removal of some of the surface may be necessary. In all cases where liquids are used in decontamination, care shall be exercised to avoid spreading

radioactivity and to minimize liquid waste. The areas shall be surveyed by methods detailed in an approved plan prior to release to ensure surface contamination is below the established limits. On painted or covered surfaces, if washing shall not remove the contamination, the paint or covering shall be removed. During the process of paint removal, control of airborne and surface contamination from dust and paint chips shall be necessary.

Contaminated areas should be decontaminated as soon as practical to minimize spread of contamination and to facilitate removal before the contamination is fixed on the surface. If high radiation levels from the contamination contribute significantly to personnel radiation exposure during cleanup, it may be desirable to decontaminate the most heavily contaminated area first.

14.3 Decontamination of Clothing

Anti-contamination clothing shall be laundered and surveyed before reuse to minimize the possibility of spreading radioactive contamination to the wearer.

Site specific reuse limits for anti-contamination clothing shall be identified during the project ALARA briefing.

14.4 Decontamination of Personnel

Decontamination of personnel shall be performed in accordance with this section and reference 2.1.16.

14.4.1 The objectives of skin decontamination are to remove as much of the radionuclide as practicable in order to reduce the surface dose rate and to prevent activity from entering the body. An over-aggressive skin decontamination effort must be avoided since it may injure the natural barriers in the skin and so increase absorption.

14.4.2 An occurrence report shall be filed in accordance with reference 2.1.18.

15.0 PROCEDURES FOR HANDLING RADIOACTIVE MATERIALS

This section presents procedures applicable to radiological safety considerations for controlling radioactive material associated with NRS operations. Strict radiological control procedures are mandatory for such

material to minimize the external and internal radiation exposure received by personnel and to prevent the uncontrolled spread of radioactivity to areas where the public might be affected.

15.1 Receipt of Radioactive Material

Radioactive material shall be received in accordance with the applicable operating license.

Radioactive material received by NRS requires special control procedures to ensure that adequate radiological safety precautions are observed, both in unpacking and in subsequent use of the material. Potential radiological problems can include external exposure, surface contamination and airborne radioactivity. Some packaging material requires disposal as radioactive waste. In addition, special precautions are required if damage has occurred during shipment.

15.1.1 Requirements

The following procedures shall be used for radioactive material received at NRS work sites.

15.1.1.1 The RCS shall be familiar with the applicable radioactive material receipt conditions of the operating license.

15.1.1.2 When received, the radioactive material shall be inspected. This inspection shall be performed no later than three hours after receipt if received during normal working hours or eighteen hours if received after normal working hours. This inspection shall consist of verifying radiation and contamination levels on the outside of the package and verifying that the package was properly transferred. For packages which are shipped, this inspection shall verify that the package was shipped in accordance with US DOT, state and federal regulations, and other federal and state requirements for notification and permitting.

15.1.1.3 The package shall not be opened solely for survey purposes unless directed by the RCS. If damage to the radioactive material package has occurred, the RCS shall report the occurrence per reference

2.1.18 and investigate per reference 2.1.19.

15.1.1.4 Received packages shall be inventoried as soon as possible. Inconsistency between the observed contents and the contents indicated on the shipping document shall be brought to the attention of the shipper of the material. If the possibility exists that radioactive material has been lost in shipment, the RCS shall report this occurrence in accordance with reference 2.1.18.

15.1.1.5 Shipping containers and packing materials shall be surveyed and meet the criteria of Section 10.2 prior to release for unrestricted handling.

15.1.1.6 Following a satisfactory inventory, a receipt shall be returned promptly to the organization transferring or shipping the item if requested.

15.1.1.7 Records of the transfer of radioactive material and all associated survey documentation shall be maintained in the on site project file throughout the duration of the project and in accordance with Section 17.0.

15.2 Packaging Radioactive Materials

Radioactive materials shipped for disposal or to another location shall be appropriately packaged and treated as required by US DOT, applicable Federal and State regulations, and applicable disposal site criteria.

Site specific radioactive material handling and packaging requirements shall be identified during the project Regulatory Requirements and ALARA briefings (reference 2.1.3).

15.3 Radioactive Material Storage

Storage of radioactive materials shall be in accordance with all applicable license requirements and should be in accordance with the following:

At a minimum, all radioactive material storage areas shall be posted in accordance with reference 2.2.1.

15.3.1 Fire Protection Practices

Proper selection of a fire resistant storage area for radioactive material shall minimize release of radioactivity to the environment in the event of a fire. The safety briefing in reference 2.1.3 shall include discussion of fire protection. However, the following additional fire protection practices shall be considered for storage of radioactive material to minimize the possibility of a fire and spread of contamination in the event of a fire.

15.3.1.1 Storage of radioactive material in fire-resistant containers is desirable to minimize contamination spread. In addition, containers of highly flammable radioactive materials shall be stored in areas segregated from other storage to reduce the risk of spreading a fire.

15.3.1.2 Smoking shall not be permitted in radioactive material storage areas.

15.3.1.3 An up-to-date list of locations where radioactive materials are stored shall be available to personnel who might be called to fight a fire in such areas. This list shall also identify unusual problems which may be present.

15.3.1.4 Periodic inspections of radioactive material storage areas shall be made to identify fire hazards. Deficiencies shall be promptly corrected.

15.3.1.5 Fire drills should be performed periodically with both fire fighting and radiological control personnel participating.

15.3.1.6 Combustible materials shall be minimized inside radioactive material storage areas and should not be stored next to surrounding walls.

15.3.1.7 Welding, burning, or other operations which may cause a fire shall not be conducted inside or next to radioactive material storage areas without prior authorization of the RCS or his designated representative. A fire watch with appropriate fire

15.3.5 Minimize Radioactive Material in Storage

In order to minimize the complexities of accounting for a large amount of radioactive material and the possibility of losing radioactive material, it shall be consolidated in as few areas as practical and the amount of radioactive material in storage shall be minimized.

15.4 Shipping Radioactive Materials

All shipments or transfers of radioactive material over public areas (i.e., public highways, waterways, airways, etc.) including shipments made with private or government vehicles, must comply with US DOT, appropriate Federal and State, and local transportation regulations.

15.5 Actions and Reporting in Case of Loss of Radioactive Material

If radioactive material associated with NRS operations is suspected of being lost, this section shall be followed:

15.5.1 Immediately notify the RCS and DHP, and conduct a search for the lost material. A primary purpose of this search is to ascertain that no persons shall receive inadvertent internal or external radiation exposure from this material.

15.5.2 Follow up with the proper reports and investigation in accordance with references 2.1.18 and 2.1.19.

16.0 ENVIRONMENTAL MONITORING

Environmental monitoring consists of measurements, sample collection and analysis, and dose assessment to determine if radionuclides are being released to the environment from a facility or site and, if so, what the extent and effect is on the surrounding population. An environmental monitoring program generally consists of measurements and sample collection at the site boundary and at off-site locations. The types of samples and analyses are dependant on the radionuclides at the site and the possible release mechanisms. The DHP (or designee) and the customer shall specify the environmental monitoring requirements for the project.

extinguishing equipment and materials shall be available during welding or burning operations.

15.3.2 Contamination Control

Storage location should be considered potentially contaminated. Personnel in these areas, particularly if they handle contaminated material, shall wear necessary anti-contamination clothing. Reasonable care shall be taken in packaging and storing contaminated items to prevent the spread of contamination and to ensure that entry to areas where such storage is permitted does not result in the contamination of personnel or other areas.

15.3.3 Radiation Exposure Control

Storage of radioactive materials can result in possible personnel radiation exposure in the storage area and surrounding areas. For example, a component or bag of contaminated waste measuring one rem per hour, if stored at the entrance to the storage area would expose everyone who entered to high radiation levels. If stored in a far corner of the area, high radiation levels might be caused in surrounding areas. Facilities should store radioactive materials so as to minimize the radiation exposure of personnel entering or working in the area and of personnel in surrounding spaces. Radiation surveys of the storage area and of spaces immediately around the storage area shall be performed to ensure proper posting of radiation areas and prevent inadvertent exposure of personnel in the storage space or surrounding spaces. When necessary, temporary shielding should be used to reduce radiation levels.

15.3.4 Outdoor Storage

Radioactive materials should be stored where they are protected from adverse weather. Normally, radioactive material should not be stored outdoors except during short periods. However, protection from adverse weather should be considered in selection of these temporary storage locations. Large items which are designed for outdoor use, such as radioactive liquid collection tanks, may be stored outdoors. However, mechanical joints or capped pipes which may leak radioactive liquids shall be wrapped with weather resistant materials.

16.1 Methods

16.1.1 An environmental monitoring program may provide for monitoring of direct radiation, air, water, soil and vegetation.

16.1.2 Direct radiation may be monitored by TLDs placed at the site boundary and at off-site locations.

16.1.3 Air monitoring may consist of taking samples for airborne particulate at the site boundary and at off-site locations. The techniques may be similar to those used to monitor occupational airborne activity.

16.1.4 Water monitoring may be performed by taking water samples from surface water bodies (i.e., lakes, ponds, streams), surface runoff and from wells both on and off-site, followed by an analysis for radionuclide content.

16.1.5 Surface soil samples may be collected and analyzed for radioactivity.

16.1.6 A comprehensive program may also include sampling of flora and fauna.

16.2 Requirements

For those NRS projects where the potential exists for releases to the environment, an environmental monitoring program shall be designed and implemented. The need for an environmental monitoring program shall be discussed during the Regulatory Requirements and ALARA briefings (reference 2.1.3).

If an environmental monitoring program is required, it shall be designed and implemented with the approval of the DHP or designee and shall include:

Sampling Locations	Types of Samples
Sampling Frequency	Types of Analyses
Action Levels	Required Actions

16.3 Records

All records of samples collected, analyses performed, results and actions taken shall be maintained in the on site project file throughout the duration of the project and in the permanent project file in accordance with Section 17.0.

17.0 REPORTS AND RECORDS

17.1 The RCS shall submit a weekly written report to the DHP detailing current radiological conditions, personnel exposure, and job progress.

17.2 All radiological records generated shall be maintained in the on site project file throughout the duration of the project.

17.3 All radiological records designated for retention in the permanent project file by the Project Manager (or higher level of management) shall be prepared for release to Records Management in accordance with references 2.1.2 and 2.1.5.

17.4 Following completion of the project, the RCS shall prepare a "Lessons Learned" report describing any problems/unique situations encountered and solutions/actions taken. This report shall be submitted to the DHP, all Project Managers, all RCS's, and all Radiological Engineers.

17.5 The RCS shall prepare the appropriate sections of the project final report including the final survey results and personnel exposure summary.

APPENDIX A

1. RUST Nuclear Remedial Services, Inc.
   Notice to Personnel

2. RUST Nuclear Remedial Services, Inc.
   Notice to Personnel (Continued)

(3 PAGES)

RUST NUCLEAR REMEDIAL SERVICES, INC
NOTICE TO PERSONNEL

YOUR RESPONSIBILITY

Each individual must constantly remain aware of potential radiological problems. Each of your actions could directly affect your exposure to ionizing radiation. The following rules shall be followed by individuals to maximize radiological control and safety:

1. Obey posted, verbal and written radiological control instructions.

2. Wear TLD's and dosimeters as required by signs or if so instructed by radiological control personnel.

3. Keep track of your own radiation exposure status and avoid exceeding limits.

4. In all situations, remain in as low a radiation area as practicable.

5. Do not eat, drink, chew, or smoke in areas where radioactive contamination may be present.

6. Promptly follow health physics direction to prevent contamination spread.

7. Follow all requirements for respiratory protective devices. Wear anti-contamination clothing, including respiratory protective devices, properly whenever required by signs or when instructed to do so by radiological control personnel.

8. Remove anti-contamination clothing and respiratory protective devices properly to minimize spread of radioactive contamination.

9. Frisk yourself or be frisked with proper equipment for the detection of contamination when leaving a contaminated area.

10. Minimize the possibility of a radioactive spill by carefully following procedures.

11. For a known or possible radioactive spill, minimize its spread and notify radiological control personnel promptly.

12. Do not unnecessarily touch a contaminated surface or allow your clothing, tools, or other equipment to do so.

13. As practical, place all contaminated equipment such as tools

and sampling bottles on disposable surfaces (e.g., sheet plastic) when not in use and inside plastic bags when work is finished.

14. Follow good "housekeeping" practices to minimize the amount of material that has to be decontaminated or disposed of as radioactive waste.

15. Report the presence of open wounds to radiological control personnel prior to work in areas where radioactive contamination exists. If a wound occurs while in such an area, report immediately to radiological control personnel.

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to:

1. Provide training, equipment, and necessary measures to maintain exposures ALARA (As Low As Reasonably Achievable).

2. Maintain records of your occupational radiation exposure and, upon your written request, advise you of your recorded occupational radiation exposure.

3. Notify you immediately of any radiation exposure which exceeds the quarterly or lifetime cumulative limits.

4. Provide you, after termination of employment, upon your written request and within thirty (30) days after the request, with a written summary of your cumulative recorded occupational radiation exposure received during your employment.

5. Notify personnel of the above procedures by posting this notice conspicuously.

INSPECTIONS

Work involving radiological controls may be subject to periodic inspection by the Nuclear Regulatory Commission, State Regulatory Agency, or any Cognizant Radiological Controls Group.

INQUIRIES

Inquiries concerning radiological controls should be addressed to your supervisor, or:

RUST Nuclear Remedial Services, Inc.
140 Stoneridge Drive
Columbia, S.C. 29210
Attn: Division Health Physicist

APPENDIX B

Regulatory Guide

(10 PAGES)

U.S. NUCLEAR REGULATORY COMMISSION

Revision 2
December 1987

REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 8.13
(Task OP 031-4)

INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE

A. INTRODUCTION

Section 19.12, "Instructions to Workers," of 10 CFR Part 19, "Notices, Instructions, and Reports to Workers; Inspections," requires that all individuals working in or frequenting any portion of a restricted area[1] be instructed in the health protection problems associated with exposure to radioactive materials or radiation, in precautions or procedures to minimize exposure, and in the regulations that they are expected to observe. The present 10 CFR Part 20, "Standards for Protection Against Radiation," has no special limit for exposure of the embryo/fetus.[2] This guide describes the instructions an employer should provide to workers and supervisors concerning biological risks to the embryo/fetus exposed to radiation, a dose limit for the embryo/fetus that is under consideration, and suggestions for reducing radiation exposure.

This regulatory guide takes into consideration a proposed revision to 10 CFR Part 20, which incorporates the radiation protection guidance for the embryo/fetus approved by the President in January 1987 (Ref. 1). This revision to Part 20 was issued in January 1986 for comment as a proposed rule. Comments on the guide as it pertains to the proposed Part 20 are encouraged. If the new Part 20 is codified, this regulatory guide will be revised to conform to the new regulation and will incorporate appropriate public comments.

Any information collection activities mentioned in this regulatory guide are contained as requirements in 10 CFR Parts 19 or 20, which provide the regulatory basis for this guide. The information collection requirements in 10 CFR Parts 19 and 20 have been cleared under OMB Clearance Nos. 3150-0044 and 3150-0014, respectively.

B. DISCUSSION

It has been known since 1906 that cells that are dividing very rapidly and are undifferentiated in their structure and function are generally more sensitive to radiation. In the embryo stage, cells meet both these criteria and thus would be expected to be highly sensitive to radiation. Furthermore, there is direct evidence that the embryo/fetus is radiosensitive. There is also evidence that it is especially sensitive to certain radiation effects during certain periods after conception, particularly during the first 2 to 3 months after conception when a woman may not be aware that she is pregnant.

Section 20.104 of 10 CFR Part 20 places different radiation dose limits on workers who are minors than on adult workers. Workers under the age of 18 are limited to one-tenth of the adult radiation dose limits. However, the present NRC regulations do not establish dose limits specifically for the embryo/fetus.

The NRC's present limit on the radiation dose that can be received on the job is 1,250 millirems per quarter (3 months).[3] Working minors (those under 18) are limited to a dose equal to one-tenth that of adults, 125 millirems per quarter. (See § 20.101 of 10 CFR Part 20.)

Because of the sensitivity of the unborn child, the National Council on Radiation Protection and Measurements (NCRP) has recommended that the dose equivalent

[1] Restricted area means any area that has controlled access to protect individuals from being exposed to radiation and radioactive materials.

[2] In conformity with the proposed revision to 10 CFR Part 20, the term "embryo/fetus" is used throughout this document to represent all stages of pregnancy.

[3] The limit is 3,000 millirems per quarter if the worker's occupational dose history is known and the average dose does not exceed 5,000 millirems per year.

to the unborn child from occupational exposure of the expectant mother be limited to 500 millirems for the entire pregnancy (Ref. 2). The 1987 Presidential guidance (Ref. 1) specifies an effective dose equivalent limit of 500 millirems to the unborn child if the pregnancy has been declared by the mother; the guidance also recommends that substantial variations in the rate of exposure be avoided. The NRC (in § 20.208 of its proposed revision to Part 20) has proposed adoption of the above limits se and rate of exposure.

In 1971, the NCRP commented on the occupational exposure of fertile women (Ref. 2) and suggested that fertile women should be employed only where the annual dose would be unlikely to exceed 2 or 3 rems and would be accumulated at a more or less steady rate. In 1977, the ICRP recommended that, when pregnancy has been diagnosed, the woman work only where it is unlikely that the annual dose would exceed 0.30 of the dose-equivalent limit of 5 rems (Ref. 3). In other words, the ICRP has recommended that pregnant women not work where the annual dose might exceed 1.5 rem.

C. REGULATORY POSITION

Instructions on radiation risks should be provided to workers, including supervisors, in accordance with § 19.12 of 10 CFR Part 19 before they are allowed to work in a restricted area. In providing instructions on radiation risks, employers should include specific instructions about the risks of radiation exposure to the embryo/fetus.

The instructions should be presented both orally and in printed form, and the instructions should include, a minimum, the information provided in Appendix (Instructor's Guide) to this guide. Individuals should be given the opportunity to ask questions and in turn should be questioned to determine whether they understand the instructions. An acceptable method of ing that the information is understood is to give a simple written test covering the material included in Appendix B (Pregnant Worker's Guide). This approach should highlight for instructors those parts of the instructions that cause difficulties and thereby lead to appropriate modifications in the instructional curriculum.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this regulatory guide.

Except in those cases in which an applicant or licensee proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the NRC will use the material described in this guide to evaluate the instructional program presented to individuals, including supervisors, working in or frequenting any portion of a restricted area.

APPENDIX A

INSTRUCTOR'S GUIDE

EFFECTS ON THE EMBRYO/FETUS OF EXPOSURE TO RADIATION AND OTHER ENVIRONMENTAL HAZARDS

In order to decide whether to continue working while exposed to ionizing radiation during her pregnancy, a woman should understand the potential effects on an embryo/fetus, including those that may be produced by various environmental risks such as smoking and drinking. This will allow her to compare these risks with those produced by exposure to ionizing radiation.

Table 1 provides information on the potential effects resulting from exposure of an embryo/fetus to radiation and nonradiation risks. The second column gives the rate at which the effect is produced by natural causes in terms of the number per thousand cases. The fourth column gives the number of additional effects per thousand cases believed to be produced by exposure to the specified amount of the risk factor.

The following section discusses the studies from which the information in Table 1 was derived. The results of exposure of the embryo/fetus to the risk factors and the dependence on the amount of the exposure are explained.

1. RADIATION RISKS

1.1 Childhood Cancer

Numerous studies of radiation-induced childhood cancer have been performed, but a number of them are controversial. The National Academy of Science (NAS) BEIR report reevaluated the data from these studies and even reanalyzed the results. Some of the strongest support for a causal relationship is provided by twin data from the Oxford survey (Ref. 4). For maternal radiation doses of 1,000 millirems, the excess number of deaths (above those occurring from natural causes) was found to be 0.6 death per thousand children (Ref. 4).

1.2 Mental Retardation and Abnormal Smallness of the Head (Microcephaly)

Studies of Japanese children who were exposed while in the womb to the atomic bomb radiation at Hiroshima and Nagasaki have shown evidence of both small head size and mental retardation. Most of the children were exposed to radiation doses in the range of 1 to 50 rads. The importance of the most recent study lies in the fact that investigators were able to show that the gestational age (age of the embryo/fetus after conception) at the time the children were exposed was a critical factor (Ref. 7). The approximate risk of small head size as a function of gestational age is shown in Table 1. For a radiation dose of 1,000 millirems at 4 to 7 weeks after conception, the excess cases of small head size was 5 per thousand; at 8 to 11 weeks, it was 9 per thousand (Ref. 7).

In another study, the highest risk of mental retardation occurred during the 8 to 15 week period after conception (Ref. 8). A recent EPA study (Ref. 16) has calculated that excess cases of mental retardation per live birth lie between 0.5 and 4 per thousand per rad.

1.3 Genetic Effects

Radiation-induced genetic effects have not been observed to date in humans. The largest source of material for genetic studies involves the survivors of Hiroshima and Nagasaki, but the 77,000 births that occurred among the survivors showed no evidence of genetic effects. For doses received by the pregnant worker in the course of employment considered in this guide, the dose received by the embryo/fetus apparently would have a negligible effect on descendants (Refs. 17 and 18).

2. NONRADIATION RISKS

2.1 Occupation

A recent study (Ref. 9) involving the birth records of 130,000 children in the State of Washington indicates that the risk of death to the unborn child is related to the occupation of the mother. Workers in the metal industry, the chemical industry, medical technology, the wood industry, the textile industry, and farms exhibited stillbirths or spontaneous abortions at a rate of 90 per thousand above that of workers in the control group, which consisted of workers in several other industries.

2.2 Alcohol

It has been recognized since ancient times that alcohol consumption had an effect on the unborn child. Carthaginian law forbade the consumption of wine on the wedding night so that a defective child might not be conceived. Recent studies have indicated that small amounts of alcohol consumption have only the minor effect of reducing the birth weight slightly, but when consumption increases to 2 to 4 drinks per day, a pattern of abnormalities called the fetal alcohol syndrome (FAS) begins to appear (Ref. 11). This syndrome consists of reduced growth in the unborn child, faulty brain function, and abnormal facial features. There is a syndrome that has the same symptoms as full-blown FAS that occurs in children born to mothers who have not consumed alcohol. This naturally occurring syndrome occurs in about 1 to 2 cases per thousand (Ref. 10).

TABLE 1

EFFECTS OF RISK FACTORS ON PREGNANCY OUTCOME

Effect	Number Occurring from Natural Causes	Risk Factor	Excess Occurrence from Risk Factor
		IATION RISKS	
		Childhood Cancer	
Cancer death in children	1.4 per thousand (Ref. 5)	Radiation dose of 1000 millirems received before birth	0.6 per thousand (Ref. 4)
		Abnormalities	
		Radiation dose of 1000 millirads received during specific periods after conception:	
Small head size	40 per thousand (Ref. 6)	4-7 weeks after conception	5 per thousand (Ref. 7)
Small head size	40 per thousand (Ref. 6)	8-11 weeks after conception	9 per thousand (Ref. 7)
Mental retardation	4 per thousand (Ref. 8)	Radiation dose of 1000 millirads received 8 to 15 weeks after conception	4 per thousand (Ref. 8)
		NONRADIATION RISKS	
		Occupation	
Stillbirth or spontaneous abortion	200 per thousand (Ref. 9)	Work in high-risk occupations (see text)	90 per thousand (Ref. 9)
		Alcohol Consumption (see text)	
Fetal alcohol syndrome	1 to 2 per thousand (Ref. 10)	2-4 drinks per day	100 per thousand (Ref. 11)
Fetal alcohol syndrome	1 to 2 per thousand (Ref. 10)	More than 4 drinks per day	200 per thousand (Ref. 11)
Fetal alcohol syndrome	1 to 2 per thousand (Ref. 10)	Chronic alcoholic (more than 10 drinks per day)	350 per thousand (Ref. 12)
Perinatal infant death (around the time of birth)	23 per thousand (Refs. 13, 14)	Chronic alcoholic (more than 10 drinks per day)	170 per thousand (Ref. 15)
		Smoking	
Perinatal infant death	23 per thousand (Refs. 13, 14)	Less than 1 pack per day	5 per thousand (Ref. 13)
Perinatal infant death	23 per thousand (Refs. 13, 14)	One pack or more per day	10 per thousand (Ref. 13)

For mothers who consume 2 to 4 drinks per day, the excess occurrences number about 100 per thousand; and for those who consume more than 4 drinks per day, excess occurrences number 200 per thousand. The most sensitive period for this effect of alcohol appears to be the first few weeks after conception, before the mother-to-be realizes she is pregnant (Refs. 10 and 11). Also, 17% or 170 per thousand of the embryo/fetuses of chronic alcoholics develop FAS and die before birth (Ref. 15). FAS was first identified in 1973 in the United States where less than full-blown effects of the syndrome are now referred to as fetal alcohol effects (FAE) (Ref. 12).

2.3 Smoking

Smoking during pregnancy causes reduced birth weights in babies amounting to 5 to 9 ounces on the average. In addition, there is an increased risk of 5 infant deaths per thousand for mothers who smoke less than one pack per day and 10 infant deaths per thousand for mothers who smoke one or more packs per day (Ref. 13).

2.4 Miscellaneous

Numerous other risks affect the embryo/fetus, only a few of which are touched upon here. Most people are familiar with the drug thalidomide (a sedative given to some pregnant women), which causes children to be born with missing limbs, and the more recent use of the drug diethylstilbestrol (DES), a synthetic estrogen given to some women to treat menstrual disorders, which produced vaginal cancers in the daughters born to women who took the drug. Living at high altitudes also gives rise to an increase in the number of low-birth-weight children born, while an increase in Down's Syndrome (mongolism) occurs in children born to mothers who are over 35 years of age. The rapid growth in the use of ultrasound in recent years has sparked an ongoing investigation into the risks of using ultrasound for diagnostic procedures (Ref. 19).

APPENDIX B

PREGNANT WORKER'S GUIDE

POSSIBLE HEALTH RISKS TO CHILDREN OF WOMEN WHO ARE EXPOSED TO RADIATION DURING PREGNANCY

During pregnancy, you should be aware of things in your s ndings or in your style of life that could affect your unborn child. For those of you who work in or visit areas designated as Restricted Areas (where access is controlled to protect individuals from being exposed to radiation and radioactive materials), it is desirable that you understand the biological risks of radiation to your unborn child.

Everyone is exposed daily to various kinds of radiation: heat, light, ultraviolet, microwave, ionizing, and so on. For the purposes of this guide, only ionizing radiation (such as x-rays, gamma rays, neutrons, and other high-speed atomic particles) is considered. Actually, everything is radioactive and all human activities involve exposure to radiation. People are exposed to different amounts of natural "background" ionizing radiation depending on where they live. Radon gas in homes is a problem of growing concern. Background radiation comes from three sources:

	Average Annual Dose
Terrestrial - radiation from soil and rocks	50 millirem
Cosmic - radiation from outer space	50 millirem
Radioactivity normally found within the human body	25 millirem
	125 millirem*
Dosage range (geographic and other factors)	75 to 5,000 millirem

The first two of these sources expose the body from the outside, and the last one exposes it from the inside. The average person is thus exposed to a total dose of about 125 millirems per year from natural background radiation.

In addition to exposure from normal background radiation, medical procedures may contribute to the dose people receive. The following table lists the average doses received by the bone marrow (the blood-forming cells) from different medical applications.

X-Ray Procedure	Average Dose*
Normal chest examination	10 millirem
Normal dental examination	10 millirem
Rib cage examination	140 millirem
Gall bladder examination	170 millirem
Barium enema examination	500 millirem
Pelvic examination	600 millirem

*Variations by a factor of 2 (above and below) are not unusual.

*Radiation doses in this document are described in two different units. The rad is a measure of the amount of energy absorbed in a certain amount of material (100 ergs per gram). Equal amounts of energy absorbed from different types of radiation may lead to different biological effects. The rem is a unit that reflects the biological damage done to the body. The millirad and millirem refer to 1/1000 of a rad and a rem, respectively.

NRC POSITION

NRC regulations and guidance are based on the conservative assumption that any amount of radiation, no matter how small, can have a harmful effect on an adult, child, or unborn child. This assumption is said to be conservative because there are no data showing ill effects from small doses; the National Academy of Sciences recently expressed "uncertainty as to whether a dose of, say, 2 rad would have any effect at all." Although it is known that the unborn child is more sensitive to radiation than adults, particularly during certain stages of development, the NRC has not established a special dose limit for protection of the unborn child. Such a limit could result in job discrimination for women of child-bearing age and perhaps in the invasion of privacy (if pregnancy tests were required) if a separate regulatory dose limit were specified for the unborn child. Therefore, the NRC has taken the position that special protection of the unborn child should be *voluntary* and should be based on decisions made by workers and employers who are well informed about the risks involved.

For the NRC position to be effective, it is important that both the employee and the employer understand the risk to the unborn child from radiation received as a result of the occupational exposure of the mother. This document tries to explain the risk as clearly as possible and to compare it with other risks to the unborn child during pregnancy. It is hoped this will help pregnant employees balance the risk to the unborn child against the benefits of employment to decide if the risk is worth taking. This document also discusses methods of keeping the dose, and therefore the risk, to the unborn child as low as is reasonably achievable.

RADIATION DOSE LIMITS

The NRC's present limit on the radiation dose that can be received on the job is 1,250 millirems per quarter (3 months).* Working minors (those under 18) are limited to a dose equal to one-tenth that of adults, 125 millirems per quarter. (See § 20.101 of 10 CFR Part 20.)

Because of the sensitivity of the unborn child, the National Council on Radiation Protection and Measurements (NCRP) has recommended that the dose equivalent to the unborn child from occupational exposure of the expectant mother be limited to 500 millirems for the entire pregnancy (Ref. 2). The 1987 Presidential guidance (Ref. 1) specifies an effective dose equivalent limit of 500 millirems to the unborn child if the pregnancy has been declared by the mother; the guidance also recommends that substantial variations in the rate of exposure be avoided. The NRC (in § 20.208 of its proposed revision to Part 20) has proposed adoption of the above limits on dose and rate of exposure.

ADVICE FOR EMPLOYEE AND EMPLOYER

Although the risks to the unborn child are small under normal working conditions, it is still advisable to limit the radiation dose from occupational exposure to no more than 500 millirems for the total pregnancy. Employee and employer should work together to decide the best method for accomplishing this goal. Some methods that might be used include reducing the time spent in radiation areas, wearing some shielding over the abdominal area, and keeping an extra distance from radiation sources when possible. The employer or health physicist will be able to estimate the probable dose to the unborn child during the normal nine-month pregnancy period and to inform the employee of the amount. If the predicted dose exceeds 500 millirems, the employee and employer should work out schedules or procedures to limit the dose to the 500-millirem recommended limit.

It is important that the employee inform the employer of her condition as soon as she realizes she is pregnant if the dose to the unborn child is to be minimized.

INTERNAL HAZARDS

This document has been directed primarily toward a discussion of radiation doses received from sources outside the body. Workers should also be aware that there is a risk of radioactive material entering the body in workplaces where unsealed radioactive material is used. Nuclear medicine clinics, laboratories, and certain manufacturers use radioactive material in bulk form, often as a liquid or a gas. A list of the commonly used materials and safety precautions for each is beyond the scope of this document, but certain general precautions might include the following:

1. Do not smoke, eat, drink, or apply cosmetics around radioactive material.
2. Do not pipette solutions by mouth.
3. Use disposable gloves while handling radioactive material when feasible.
4. Wash hands after working around radioactive material.
5. Wear lab coats or other protective clothing whenever there is a possibility of spills.

Remember that the employer is required to have demonstrated that it will have safe procedures and practices before the NRC issues it a license to use radioactive material. Workers are urged to follow established procedures and consult the employer's radiation safety officer or health physicist whenever problems or questions arise.

*The limit is 3,000 millirems per quarter if the worker's occupational dose history is known and the average dose does not exceed 5,000 millirems per year.

REFERENCES

1. "Federal Radiation Protection Guidance for Occupational Exposure," *Federal Register*, p. 2822, January 27, 1987.

2. National Council on Radiation Protection and Measurements, "Basic Radiation Protection Criteria," NCRP Report No. 39, 1971.

3. International Commission on Radiological Protection, "Recommendations of the International Commission on Radiological Protection," ICRP Publication No. 26, Vol. 1, No. 3, 1977.

4. National Academy of Sciences, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation (BEIR III)," National Academy Press, Washington, DC, 1980.

5. J. L. Young and R. W. Miller, "Incidence of Malignant Tumors in U.S. Children," *Journal of Pediatrics*, pp. 254-258, 1975.

6. W. J. Blot, "Growth and Development Following Prenatal and Childhood Exposure to Atomic Radiation," *Journal of Radiation Research* (Supplement), pp. 82-85, 1975.

7. R. W. Miller and J. J. Mulvihill, "Small Head Size After Atomic Radiation," *Teratology*, Vol. 14, pp. 355-358, 1976.

8. M. Otake and W. J. Schull, "In Utero Exposure to A-bomb Radiation and Mental Retardation; a Reassessment," *The British Journal of Radiology*, Vol. 57, pp. 409-414, 1984.

9. T. L. Vaughan et al., "Fetal Death and Maternal Occupation," *Journal of Occupational Medicine*, Vol. 26, No. 9, pp. 676-678, 1984.

10. J. W. Hanson, A. P. Streissguth, and D. W. Smith, "The Effects of Moderate Alcohol Consumption During Pregnancy on Fetal Growth and Morphogenesis," *Journal of Pediatrics*, Vol. 92, pp. 457-460, 1978.

11. D. W. Smith, "Alcohol Effects on the Fetus," *Progress in Clinical and Biological Research*, Vol. 36, pp. 73-82, 1980.

12. L. P. Robe, "Alcohol and Pregnancy," The American Medical Association, Box 10946, Chicago, 1984.

13. M. B. Meyer and J. A. Tonascia, "Maternal Smoking, Pregnancy Complications, and Perinatal Mortality," *American Journal of Obstetrics and Gynecology*, Vol. 128, No. 5, pp. 494-502, 1977.

14. R. H. Mole, "Radiation Effects on Pre-Natal Development and Their Radiological Significance," *The British Journal of Radiology*, Vol. 52, No. 614, pp. 89-101, February 1979.

15. D. A. Roe, *Alcohol and the Diet*, AVI Publishing Company Inc., Westport, Connecticut, 1979.

16. Environmental Protection Agency, "Radionuclides," Background Information Document EPA 520/1-84-022-1, pp. 8-56 - 8-63.

17. G. W. Beebe, "The Atomic Bomb Survivors and the Problem of Low-Dose Radiation Effects," *American Journal of Epidemiology*, Vol. 114, No. 6, pp. 761-783, 1981.

18. W. J. Blot et al., "Reproductive Potential of Males Exposed in Utero or Prepubertally to Atomic Radiation," in *Atomic Bomb Casualty Commission Technical Report* TR-39-72, Radiation Effects Research Foundation, Hiroshima, Japan, 1972.

19. National Council on Radiation Protection and Measurements, "Protection in Nuclear Medicine and Ultrasound Diagnostic Procedures in Children," NCRP Report No. 73, 1983.

VALUE/IMPACT STATEMENT

A draft value/impact statement was published with the proposed Revision 2 to Regulatory Guide 8.13 (Task OP 031-4) when the draft guide was published for public comment in August 1981. No changes were necessary, so a separate value/impact statement for the final guide has not been prepared. A copy of the draft value/impact statement is available for inspection and copying for a fee at the Commission's Public Document Room at 1717 H Street NW., Washington, DC, under Task OP 031-4.

*U.S. G.P.O. 1987-202-292:60318

APPENDIX C

1. Visitor/Contract Worker Exposure Record Form

(2 PAGES)

VISITOR/CONTRACT WORKER EXPOSURE RECORD FORM

Date	Name (Print)	Organization	TLD or SS#	Dose

APPENDIX D

1. Radiation Work Permit

2. Radiation Work Permit Signature Form

(3 PAGES)

RUST-Nuclear Remedial Services

RADIATION WORK PERMIT (RWP)

RWP Title _____ RWP # _____
Project _____ Project # _____
Initiated by: _____ Date _____

Work Scope:

_____

_____

_____

MINIMUM REQUIREMENTS FOR WORKING IN THE AREA
Personnel Protection Equipment (PPE)

Head Covering	Body Covering	Hands	Feet
___ Hood	___ Coveralls	___ Surg.Gloves	___ Shoe Covers
___ Cap	___ Plastic Suit	___ Rubber Gloves	___ Rubbers
___ Other:	___ Other:	___ Other:	___ Other:
_____	_____	_____	_____

Dosimeters	Respirator Protection		Other Requirements
___ TLD	___ Particulate	___ Full Face	_____
___ SRPD	___ Vapor	___ Air Line	_____
___ Other:	___ Other:	___ PAPR	_____
_____	_____	_____	_____

Safety

___ Safety Shoes
___ Hard Hat
___ Safety Glasses
___ Other: _____

SPECIAL WORK INSTRUCTIONS

_____

_____

_____

_____

RADIATION/CONTAMINATION CONDITIONS IN THE WORK AREA

General Area Radiation Levels

___ mrem/hr Location _____
___ mrem/hr Location _____

"Hot Spot"

___ mrem/hr Location _____
___ mrem/hr Location _____

Typical Loose Contam. (dpm/100 cm^2)

_____ Beta/Gamma _____ Alpha

Maximum Contam. (dpm/100 cm^2)

_____ Beta/Gamma _____ Alpha

Airborne Levels (μCi/ml)
Typical _____
Maximum _____
Most restrictive DAC value _____ μCi/ml
Surveys(s) # _____
_____
_____

Location(s) _____
_____

Note(s): _____
_____
_____
_____
_____

RCS Approval _____ DATE: _____

PRE-JOB CONFERENCE HELD

Date/Time _____ HP Tech _____ RCS Approval _____

TERMINATION OF RWP

Date/Time _____ HP Tech _____ RCS Approval _____

RUST-Nuclear Remedial Services

RADIATION WORK PERMIT SIGNATURE FORM

RWP Title _____

RWP # _____

Signing this RWP indicates that you have had a pre-job conference, have read the RWP, and full understand all the requirements related to this job.

Date	Print Name	Signature	TLD # or SSN #	Time In	SRPD In	Time Out	SRPD Out

APPENDIX E

1. Acceptable Surface Contamination Levels

(2 PAGES)

ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclide [a]	Average [b,c,f]	Maximum [b,d,f]	Removable [b,e,f]
U-nat, U-235, U-238, and associated decay products	5,000 dpm/100 cm^2 α	15,000 dpm/100 cm^2 α	1,000 dpm/100 cm^2 α
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100 dpm/100 cm^2	300 dpm/100 cm^2	20 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000 dpm/100 cm^2	3,000 dpm/100 cm^2	200 dpm/100 cm^2
Beta-gamma emitters (nuclide with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 dpm/100 cm^2 β-γ	15,000 dpm/100 cm^2 β-γ	1,000 dpm/100 cm^2 β-γ

[a] Where surface contamination by both alpha and beta-gamma emitting nuclide exists, the limits established for both alpha and beta-gamma emitting nuclide should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d] The maximum contamination level applies to an area not more than 100 cm^2.

[e] The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter paper or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.