

10 Megawatt
Standard Operating Procedures
Volume 5
Health Physics

POOR ORIGINAL

Preface

These Standard Operating Procedures are issued as part of the radiation protection program for all operations performed at the University of Missouri Research Reactor Facility (MURR). Because a single organization, Reactor Health Physics (RHP), is assigned radiation protection responsibility for all licensed activity at the MURR, these procedures apply to each applicable license as is appropriate.

POLICY

It is the policy of the MURR to prevent unwarranted radiation exposure to any person as a result of work performed at the facility.

Work procedures are planned to comply with applicable license limits for radiation exposure and to promote the concept of "as low as is reasonably achievable (ALARA)." The words "reasonably achievable" are emphasized because the research and development nature of the work at the facility preclude total avoidance of personnel radiation exposure.

PURPOSE

The purpose of these procedures is to provide guidance and to identify situations which require additional planning before work proceeds rather than provide specific protocols. The research and development nature of work at the facility precludes the development of specific protocols except for limited situations. These procedures may specify that a specific protocol be provided for certain operations.

RESPONSIBILITY TO OBSERVE THESE PROCEDURES

It is the responsibility of each person to observe these procedures as is appropriate and it is the responsibility of supervision and management to assure observance of them.

If a situation arises for which necessary work cannot be performed because of conflicting limitations in the SOP, the work should be performed under a Radiation Work Permit to assure adequate planning for radiation control.

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Revised _____

Appv'd GF Wilson

Date 3-13-79

Request for Radiation Safety Evaluation

I. Policy

Exposure of personnel should always be under controlled conditions which assure appropriate reaction to unexpected levels of radiation.

II. Purpose

The purpose of the Request for Radiation Safety Evaluation is to provide a mechanism for any individual to report to the Manager, Reactor Health Physics, any situation that is believed to have resulted in a loss of radiation control or any situation that has the potential to result in future loss of radiation control.

III. Procedure

The person desiring to make Request for Radiation Safety Evaluation can obtain forms for that purpose from Reactor Health Physics. The report form should be completed and sent to the Manager, Reactor Health Physics, as soon as possible. The Manager, Reactor Health Physics, will investigate the situation reported and provide a written response. The response will normally be prepared in less than 30 days.

The use of this request is not intended to eliminate immediate, verbal reporting of hazardous situations, in fact, immediate, verbal reporting is often essential for the corrective action to be effective.

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Request for Radiation Safety Evaluation

No. _____

Name of Person Making Request _____

Date _____

Brief description of incident or situation:

Do you believe anyone received excessive radiation exposure?

Yes _____ No _____

Do you believe the situation could lead to excessive exposure in the future?

Yes _____ No _____

If answer is yes, explain briefly how excessive exposure did or could occur.

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Please state briefly any actions you recommend.

Response from Health Physics

Date _____ By _____

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Revised _____

Appr'd CA Wade 7/16/79

Response to Medi-Physics Hot Cell Gamma Alarm

I. Policy

When an unusual radiation situation is indicated by a radiation alarm initial actions should be to protect people from any radiation hazard.

II. Purpose

The purpose of this procedure is to assure appropriate actions are initiated if the gamma alarm system on the Medi-Physics hot cell sounds.

III. Description of system

A. The system is a two detector Area Radiation Monitor. One detector is located under the cell on the south or transfer cask side and the other detector is located under the north or 7A cask side of the cell.

1. Located on the operating face of the cell is a mr/hr readout, buzzer alarm, and yellow light alarm for each detector.
2. A remote readout under the basement stairway has a yellow alarm light and an mr/hr dial.
3. High voltage controls are also located under the stairway.

IV. Response to alarm

A. During normal working hours and other times when Health Physics Personnel are known to be on duty in the facility:

1. The person hearing the alarm should assure immediate evacuation of the basement area.

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2. That person shall call Health Physics.
 - a. Health Physics shall post the stairway entrance to the basement.
 - b. Health Physics shall analyze the situation to determine corrective action.
- B. During hours when Health Physics Personnel are not on duty in the facility:
 1. The person hearing the alarm should assure immediate evacuation of the basement area, post the stairway entrance to the basement and relate the problem to the Operations shift supervisor.
 2. The shift supervisor shall determine what actions should be taken to assure that corrective action is performed.

Transfer of Radioactive Material Within Reactor Building

I. Policy

Materials transferred within the reactor building must be packaged to prevent radiation hazards to personnel due to radiation fields and/or contamination caused by loss of radioactive material.

II. Scope

This procedure applies to radioactive samples and irradiated materials. Excluded because they are covered in other procedures are radioactive waste, tools, and equipment.

Transfer within laboratory rooms is also excluded from this procedure.

III. Purpose

The purpose is to assure that the High Radiation Area requirements of 10CFR20.203 are not violated and that exposure to personnel is minimized when transferring radioactive materials within the facility.

- A. To accomplish the stated purpose a transfer container design should include the following:
1. A lid closure that can be installed and removed quickly to minimize exposure time.
 2. Features which assure that the material being transported cannot spill out if the transfer container is dropped and/or tipped on its side or upside down.
- B. If a transfer container is to be left unattended, it must be posted as required by 10CFR20.202 (b)(2).

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Appv'd *[Signature]*
Date 11-23-78

IV. Specific Rules

- A. When transporting material via elevator personnel shall not ride with material if the exposure rate at 24 inches exceeds 10 mrem per hour.

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Revised _____

Appv'd J. L. Allen

Date 3-13-79

Medi-Physics Hot Cell

I. Policy

Operations using the Medi-Physics (MPI) hot cell are performed under licenses held by the University of Missouri, therefore, all operations are subject to the radiation program of MURR regardless of worker's employer identification.

II. Scope

This procedure applies to all operations at the cell including radioactive materials handling associated with the cell but outside the cell as part of the process.

III. Purpose

The purpose of this procedure is to provide control of potential radiation hazards in more detail than is used for research operations to assure that a gradual relaxation of control with the attendant increase in probability of error does not occur.

IV. Protective equipment

Surgeons gloves and lab coats are the minimum protective equipment required for persons working under the cell.

Health physics personnel assigned to monitor the operations will require additional protective equipment as indicated by survey data.

V. Procedures

When using these procedures to qualify new personnel, a coordinator is designated and checks off steps as they are performed.

To process a normal shipment, the transfer cask and the low level waste are bagged out and the first 7A is bagged in, before the day of the shipment. The transfer cask bag-in and the 7A bag-in and bag-out procedures are used to complete the process on the day of the shipment.

Before starting an individual procedure, the hot cell must be checked properly secured unless another evolution has just been completed.

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Appv'd O J Olson

Date 3-13-79

Each hot cell entry by a person will be covered by a radiation work permit.

Any evolution not presently covered by a written procedure requires a radiation work permit.

A. Secure the Hot Cell

Verify the Following:

1. On each port, either a cask bagged in or a bag and security band in place.
2. Transfer jacks blocked up under each port.
3. Transfer jack power off and breaker locked. (Health Physics retains key).
4. Inlet and outlet ventilation valves open and sufficient ΔP indicated on the magnehelic gauge.
5. Health Physics warning rope and appropriate signs in place.

If a Sample has been Processed in the Cell:

6. Verify all sample can waste in waste tube.
7. If "in use" waste tube is full, put the lid on it and store in waste tube rack. If "in use" waste tube is not full, position in left rear corner of cell.

B. Low Level Radioactive Material Bag-out

1. If the hot cell has been secured with a cask in the port it must first be removed by the applicable bag-out procedure.
2. Measure exposure rate under cell.
3. Lower and move transfer jack away from cell, if necessary.

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Appv'd O. F. Olson

Date 3-14-79

4. Place new "O" ring on port.
5. Remove security band from cask port.
6. Attach clear bag to port.
7. Re-attach security band.
8. Remove hot cell inlet filter.
9. Pull old bag down into new bag.
10. Transfer low level material from cell into clear bag on port.
11. Triple tie clear bag.
12. Replace hot cell inlet filter.
13. Cut clear bag above lowest tie.
14. Dispose of clear bag and contents as radwaste, or label as applicable.
15. Secure hot cell or proceed to next evolution, as necessary.

C. Material Bag-In

1. If the hot cell has been secured with a cask in the port, it must first be removed by the applicable bag-out procedure.
2. Measure exposure rate under cell.
3. Lower and move transfer jack away from cell, if necessary.
4. Place new "O" ring on port.
5. Remove security band from transfer cask port.
6. Place material in clear bag.
7. Attach clear bag to port.
8. Re-attach security band.

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Appv'd *J. Wilson*

Date 3-13-79

9. Remove hot cell inlet filter.
10. Pull old bag down into new bag.
11. Transfer material from new bag to inside of cell.
12. Triple-tie clear bag.
13. Replace hot cell inlet filter.
14. Cut clear bag above lowest tie.
15. Dispose of clear bag as radwaste.
16. Secure hot cell or proceed to next evolution, as necessary.

D. 7A Bag-in

- | | | | | | | | |
|---|---|---|---|---|---|-----|--|
| A | B | C | D | E | F | 1. | Place 7A container in MPI clear plastic bag. |
| | | | | | | 2. | Swipe floor ahead of forklift. |
| | | | | | | 3. | Position 7A on transfer jack. |
| | | | | | | 4. | Remove bolts from lid. |
| | | | | | | 5. | Verify shield plug in place. |
| | | | | | | 6. | Check exposure rate. |
| | | | | | | 7. | Put new "O" ring on 7A port. |
| | | | | | | 8. | Remove bag security band from 7A port. |
| | | | | | | 9. | Tape old "O" ring to old bag. |
| | | | | | | 10. | Position transfer jack under port. |
| | | | | | | 11. | Power off to the transfer jack. |
| | | | | | | 12. | Operator verify power off to the transfer jack. |
| | | | | | | 13. | Put new bag on port and position "O" ring. |
| | | | | | | 14. | Put security band on port. |
| | | | | | | 15. | Remove shield plug, place in left rear corner of cell. |
| | | | | | | 16. | Check exposure rate. |
| | | | | | | 17. | Run crane hook down into 7A port. |
| | | | | | | 18. | Remove old bag. |
| | | | | | | 19. | Hook "O" ring on crane hook. |
| | | | | | | 20. | Pull old bag up into cell. |
| | | | | | | 21. | Verify transfer jack is correctly positioned. |

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Appv'd B. F. Olson

Date 3-13-79

22. Verify cask (7A) is correctly positioned on transfer jack.
23. Verify all personnel clear and restore power to 7A transfer jack.
24. Raise 7A until top of cask is even with bottom of skirt. CAUTION - we care to prevent tearing the bag.
25. Power off to transfer jack.
26. Operator verify power off to transfer jack.
29. Reposition bag.
30. Verify transfer jack clear and turn power on.
31. Raise 7A to operating position.
- A B C D E F 32. Proceed to next evolution or secure hot cell as necessary.

E. 7A Bag-out

- A B C D E F 1. Position shield plug above 7A cask. CAUTION the shield plug must be above the rubber port seal during the next step. To prevent pulling the bag off the port.
2. Lower transfer jack to bottom position.
3. Power off to transfer jack.
4. Operator verify power off to the transfer jack.
5. Squeeze air out of bag and single tie.
6. Place shield plug on port.
7. Double tie bag (three ties total).
8. Cut bag above lowest tie.
9. Move transfer jack away from cell.
10. Swipe top of bag.
11. Install cleaning skirt-tape just below lip of 7A.
12. Remove tie from 7A bag. CAUTION - anticipate potential high contamination.
13. Carefully mist inside of bag and 7A top with Decon. solution.
14. Cut off and remove top of bag.
15. Decontaminate top of 7A.
16. Install bolts in lid.
17. Swipe floor ahead of forklift.
18. Lift 7A clear of transfer jack.
19. Decontaminate 7A.
20. Survey 7A for contamination.
21. Place 7A in fireshield.
22. Place pre-bag and cleaning skirt in radwaste.
23. Survey transfer jack and floor for contamination.
- A B C D E F 24. Proceed to next evolution or secure hot cell as necessary.

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Appv'd *Q. F. Olson*

Date 3-13-79

F. Transfer Cask Bag-in

1. Measure exposure rate under cell - It may be necessary to re-arrange waste tubes in the storage rack if exposure rates under the transfer case are excessive.
2. Put new "O" ring on cask port.
3. Tape old "O" ring to old bag to facilitate later removal.
4. Pre-bag transfer cask. Trim bag so there is no excess.
5. Swipe floor ahead of forklift.
6. Position transfer cask on transfer jack.
7. Remove cask lid hold down device.
8. Remove bag security band from transfer cask port.
9. Position transfer jack under cask port.
10. Power off to transfer jack.
11. Operator verify power off to the transfer jack.
12. Secure new transfer bag (containing cask) to port with "O" ring.
13. Reattach bag security band.
14. Pull old bag and "O" ring into cell.
15. Operator verify transfer jack is correctly positioned.
16. Verify position of cask.
17. Verify all personnel clear and restore power to the transfer jack.
18. Position second operator at the Hot cell window to observe raising of transfer cask.

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Appv'd O Y Olson

Date 3-13-79

19. Raise cask until top of cask is even with bottom of skirt -
CAUTION - use care to prevent tearing the bag.
20. Power off to transfer jack.
21. Operator verify power off to transfer jack.
22. Reposition bag.
23. Remove security band.
24. Verify all personnel clear and restore power to transfer jack.
25. Raise transfer jack to operating position.
26. Verify cask is properly attached, positioned, and ready for sample processing operation.

G. Transfer Cask Bag-out

1. This evolution will normally be started with the cell in the secured status. It may be necessary to re-arrange waste tubes in the storage rack if the exposure rates under the transfer cask port are excessive.
2. Place sample cup in transfer cask.
3. Replace lid on transfer cask.
4. Verify cask area clear and ready to be lowered.
5. Authorize power on to transfer cask.
6. Simultaneously lower transfer jack full down and check exposure rate.
7. Power off to transfer jack.
8. Operator verify power off to transfer jack.
9. Install safety band.
10. Triple tie bag.

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Appv'd *O Y Olson*

Date 3-13-79

11. Cut bag above lowest tie.
12. Check top of bag for contamination.
13. Move transfer jack away from cell.
14. Install cleaning skirt. Insure it is taped to the transfer cask.
15. Remove tie from transfer cask bag - CAUTION - Anticipate potential high contamination.
16. Carefully mist inside of bag and top of cask with decon solution.
17. Cut off and remove top of bag.
18. Decontaminate top of cask.
19. Attach lid hold down device.
20. Remove tape from pre-bag.
21. Swipe floor ahead of fork-lift.
22. Lift transfer cask clear of transfer jack.
23. Decontaminate transfer cask.
24. Survey transfer cask for contamination.
25. Place transfer cask in yellow bag.
26. Dispose of cleaning skirt and bags in radioactive waste.
27. Survey transfer jack and floor for contamination.
28. Proceed to next evolution or secure hot cell as necessary.

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Revised _____

Appv'd J L Olson

Date 3-13-79

Surveying Containers of Radioactive Material for Transport by Common Carrier.

I. Policy

Radioactive materials shipped from the Research Reactor Facility are to be packaged, labeled, and surveyed in compliance with applicable regulations of DOT and NRC.

II. Scope

This procedure applies to all shipments of radioactive materials except radioactive waste, fuel elements, transfer of materials within the University or other transfer for which another SOP-HP is applicable.

III. Purpose

The purpose of this procedure is to provide a standard survey method to be used by Health Physics personnel and other persons trained and approved by the Manager, Reactor Health Physics when surveying containers of radioactive materials for shipment.

IV. Procedure

1. Surveyor shall inspect container visually for any obvious defects which might make it unsuitable for transport of the radioactive material.
 - a. The surveyor is not responsible for determining that the proper packaging has been selected.
2. Surveyor shall determine the following and make appropriate entry on the Material Transfer Form (See Exhibit A).
 - a. Surface contamination as per 49CFR173.397
 - b. Surface dose rate as per 49CFR173.393(i)
 - c. Transport index as per 49CFR173.389(i)(1) and 49CFR173.393 (i)
 - d. Labels as per 49CFR173.399
 - e. Transferee authorized as per 10CFR30.41
3. When the surveyor is satisfied that all of the requirements of procedure 2 comply with the indicated regulations the surveyor shall place his/her signature on the HEALTH PHYSICS APPROVAL space and determine that the date of survey is correct.

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Revised _____

Appv'd *D. J. Olson*

Date 2-13-79

4. All radiation measurements shall be made by procedures approved by the Manager, Reactor Health Physics or designee.
5. All equipment used to make radiation measurements for this procedure shall be approved by the Manager, Reactor Health Physics or designee.



EXHIBIT A

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UNIVERSITY OF MISSOURI - RESEARCH REACTOR

MATERIAL TRANSFER FORM



SHIP TO _____

MURR ID _____
CONSIGNEE BYPRODUCT LICENSE
NUMBER _____
EXPIRATION DATE _____

TARGET MATERIAL	WEIGHT	PHYSICAL FORM	RADIONUCLIDE	ACTIVITY (IN CURIES)	TRANSPORT GROUP

IRRADIATION POSITION _____
THERMAL FLUX _____ $r/cm^2 \cdot s$
FAST FLUX _____ $n/cm^2 \cdot s$
GAMMA DOSE RATE _____ R/hr

DATE IN _____
DATE OUT _____
TIME OUT _____
TOTAL HOURS _____

TYPE SHIPMENT _____
SHIPPING CONTAINER _____
SERIAL NUMBER _____
TRANSPORT ROUTING _____
BILL NUMBER _____
TRANSPORT INDEX Surveyor

DOCUMENTATION REQUIRED
TYPE B.....
SPECIAL FORM.....
AIR CERTIFICATION..
OTHER _____
LABELS Surveyor

DOSE RATE
AT SURFACE Surveyor mR/hr
AT 3 FEET Surveyor mR/hr

SURFACE CONTAMINATION
BETA/GAMMA Surveyor dpm/100 cm²
ALPHA Surveyor dpm/100 cm²

HEALTH PHYSICS APPROVAL Surveyor DATE SURVEYOR

"This is to certify that the above named articles are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation, according to the applicable regulations of the Department of Transportation."

CERTIFIED BY _____ DATE _____

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8. Add one (1) ml sample to 10 ml liquid scintillation cocktail in scintillation vial.
9. Swirl to mix until white precipitate dissolves.
10. a. Consecutively count sample mixture, prepared standard ($1.64 \times 10^{-3} \mu\text{c/cc}$), and prepared blank (for background counts) on Searle Delta 300 Liquid Scintillation System.
- b. Delta 300 settings:
 - (1) "power" - on
 - (2) "all samples" - green
 - (3) "CPM" - white
 - (4) "ESR" - white
 - (5) time knob - 10 minutes
 - (6) 2 Sigma knob - .25%
 - (7) module 1 inserted

(Caution--do not disturb if counting of another sample is in progress.)

V. Calculation

$$\frac{\text{Sample count} - \text{blank count} \pm \text{standard count} - \text{blank count} \times 1.64 \times 10^{-3} \text{ (standard activity in } \mu\text{c/cc)} \times 250 \text{ (liquid sample volume in ml)} \pm \text{air volume (3000 ml/min} \times \text{number of minutes sample ran)} \pm .9 \text{ (efficiency)}}{\text{_____}} = \text{_____ } \mu\text{c/cc H}_3 \text{ in air}$$

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Example:

sample count	130 CPM
standard count	1450 CPM
blank count	30 CPM
time sample run	60 minutes

$$\left(\frac{100}{1420}\right) \times (1.64 \times 10^{-3}) \times (250) \div (1.8 \times 10^5) \div (.9)$$
$$= 1.8 \times 10^{-7} \mu\text{c/cc}$$

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Revision _____

Appr' [Signature] Date 7/30/79

Calibration of Geiger
Mueller Survey Instruments

I. Policy

Survey meters used for personnel radiation monitoring shall be calibrated traceable to NBS.

II. Purpose

The purpose of this procedure is to establish a standard method for calibrating the G.M. Survey Instruments.

III. Procedure

Using a known and reliable source of Cs-137.

1. Check battery test.
2. Remove meter from case to make calibration controls accessible. Use temporary electrical connection to detector.
3. Insure window is closed.
4. Place instrument to be calibrated specified distance from source.
5. Calibrate to mid-scale on each scale of the instrument.
6. Use attached form to record results.
7. Affix label to instrument with date and initials.
8. Record date and initials on Routine log in H.P. Office.
9. Instruments which cannot be calibrated satisfactorily shall be taken out of service. The instrument shall be clearly tagged to avoid use by mistake.

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Appr. [Signature] Date 7/18/79

SELF-READING DOSIMETER CALIBRATION

I. Policy

It is the policy of Reactor Health Physics to use dosimeters calibrated with radiation sources traceable to NBS, and which meet specifications of ANSI 13.5 (1972).

II. Scope

This policy applies to all self-readers in use at the Reactor Facility for personnel dosimetry.

III. Procedure

- A. Dosimeters shall be calibrated at intervals not exceeding six months.
- B. If necessary, calibrated spares will be issued when personal dosimeters are to be calibrated.
- C. Dosimeters will be calibrated in the designated rack with a Cesium-137 source.
- D. Dosimeters will be left in the rack for a pre-determined amount of time commensurate with a mid-scale reading (80-120 mR) for maximum accuracy.
- E. Exposed dosimeters should show calibration accuracy $\pm 10\%$ at mid-scale with Cs-137.

Electrical leakage of 2% per day max. at room temp.

Any dosimeters found to be outside these requirements will be rejected and the person to whom it was assigned will be issued another.

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Appr [Signature] Date 7-18-79

Report of Personnel Contamination

I. Policy

It is the policy at MURE to avoid contamination of personnel with radionuclides.

II. Purposes

The purpose of this procedure is to provide for proper handling of personnel who have become contaminated either on their person or clothing. A second purpose is to provide a record of all such events which can be used in determining corrective action to avoid future incidents of personnel contamination.

III. Persons to Notify

When personnel contamination is discovered, alert Reactor Health Physics immediately.

A. If Reactor Health Physics personnel are not readily available, alert Reactor Operations shift supervisor.

1. The shift supervisor will assure that decontamination and efforts to alert a Health Physics representative are initiated.

IV. Actions to be taken

A. When personnel contamination is discovered the following steps should be taken:

1. Determine whether the person is receiving a significant external radiation exposure to determine whether emergency showering is indicated.

2. Determine the extent of the contamination in area and activity per unit area. (For personnel contamination 1 cm² is normally considered unit area.)

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Appr' GA Date 7/18/79

3. Evaluate the probability of internal deposition by inhalation, ingestion, or via a wound.
 4. If clothing only are contaminated, determining appropriate actions.
- B. After evaluating the nature of the contamination, proceed with corrective action.
1. If external exposure rates in excess of 100 mRads/hour are indicated an emergency shower to quickly reduce the level is indicated unless localized washing is considered more appropriate.
 2. For localized skin contamination measure the contamination level quickly and as accurately as possible prior to cleaning.
 3. Cleaning with soap and water is the preferred method for cleaning. Any bath soap or hand soap is satisfactory. If it is necessary to resort to more rigorous cleaning methods they should be employed under the supervision of qualified medical personnel.
 - a. In some instances the hazard of infection from skin initiated by the cleaning process may be greater than the radiation hazard.
- V. Status required for release of clothing and personnel.
- A. Status of skin contamination for unconditional release.
1. No removable contamination.
 2. Beta-gamma radiation not to be above 100 c/m with an end-window G-M which has a 1.4-2.0 mg/cm² window. Background not to exceed 100 c/m for this measurement.

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Appr'd GJO Date 7/18/79

3. No alpha contamination.
 4. If the criteria for release above cannot be met the Health Physicist-in-charge will decide on further action.
- B. Status of clothing for unconditional release.
1. No alpha contamination.
 2. Beta-gamma contamination not to exceed 100 c/m above background.
 - a. Background must not exceed 100 c/m for this measurement.

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Appr'd JTO Date 7/18/79

Report of Personnel Contamination

Date of incident:

Date of report:

Name of person contaminated:

S.S.#

(Use additional sheets as necessary, be specific.)

Description of contaminated area(s) location, size of area, level of activity per cm².

Decontamination procedure

Status of contaminated area(s) when released by H.P.

Description of how contamination occurred

1. What happened?
2. Where?
3. Who was involved even if not contaminated?
4. Who was injured, if any?

Evaluation of radiation exposure resulting from this incident

1. External
2. Internal

957031

Signature victim

H.P. attended _____

H.P. Mgr. _____