

U.S. GEOLOGICAL SURVEY  
RESEARCH REACTOR  
LICENSE NO. R-113  
DOCKET NO. 50-274

EMERGENCY PLAN  
REVISION 16  
OCTOBER 25, 2017

REDACTED VERSION\*

SECURITY-RELATED INFORMATION REMOVED

\*REDACTED TEXT AND FIGURES BLACKED OUT OR DENOTED BY BRACKETS



Department of the Interior  
US Geological Survey  
Box 25046 MS-974  
Denver CO, 80225

October 25, 2017

Document Control Desk  
U.S. Nuclear Regulatory Commission  
Washington DC 20555

Sirs:

Enclosed is Revision 16 of the Emergency Plan for the U.S. Geological Survey TRIGA Reactor (GSTR) Facility (License R-113, Docket 50-274). The plan was revised without prior NRC approval per 10 CFR 50.54(q). The individual changes are detailed and discussed on the following page of this letter. All of the changed sections are marked with vertical lines in the margins of the Emergency Plan.

These changes were reviewed and approved by the facility's Reactor Operations Committee on October 20, 2017. The committee's evaluation was that all changes submitted do not decrease the effectiveness of the Emergency Plan, and they do meet the requirements of appendix E. It is our belief that all changes submitted herein are permitted by 10 CFR 50.54(q) without prior NRC approval. Please contact me at (303) 236-4726 if you have any questions regarding the revision or need further details.

Sincerely,

A handwritten signature in cursive script that reads "Brycen Roy".

Brycen Roy

USGS Reactor Supervisor

A020  
AX45  
NRR

All references to "Health Physicist" were changed to "Reactor Health Physicist." The USGS has multiple NRC licenses, and most of those have either a health physicist or radiation safety officer. The term "Reactor" was added to provide clarity that the Emergency Plan was specifically referring to the Reactor Health Physicist.

All references to "DOE contractor" were changed to "DOE RAP team" to clarify specifically which DOE team would provide assistance.

Title Page: the revision number and date were changed on the title page.

Page 1, Section 1, paragraph 2. The word "are" was added to correct a grammatical error.

Page 1, Section 1, paragraph 3. The average annual thermal power generation was changed to 850 MWH to more accurately reflect current power numbers.

Page 8, Subsection 3.2.2. More information was provided to clarify who the DOE Region 6 RAP team is and why they could provide assistance in the case of an emergency.

Page 8-9, Subsection 4.2.1 and 4.2.2. The action levels for the classification of an Unusual Event or an Alert were changed match the verbiage in ANSI/ANS-15.16-2015, Table 1. The one exception is that the sentence "Where EC is the value from 10 CFR 20 Appx B, Table 2." was added below the calculations in 4.2.1.1 and 4.2.2.1 for additional clarity.

Page 10, Subsection 4.4.3. The term "remote" was removed to note that a direct or remote readout was permissible for observing radiological monitoring instruments.

Page 11, Subsection 4.4.5.3. The word "are" was changed to "is" to correct a grammatical error.

# EMERGENCY PLAN

FOR THE

U.S. GEOLOGICAL SURVEY  
TRIGA REACTOR FACILITY

Approved:

Bayen R Roy  
Reactor Supervisor

Revision No. 16

DATE: October 2017

## 1. Introduction

The United States Geological Survey (USGS) research reactor facility (GSTR) consists of a TRIGA Mark I, 1000 KW reactor. The GSTR is a light water cooled, graphite reflected, reactor utilizing standard TRIGA U-ZrH fuel moderator elements. The reactor is operated by the U.S. Geological Survey, Department of the Interior, under License R-113. The reactor is installed in Building 15 in the Denver Federal Center, Lakewood, Jefferson County, Colorado. Within the city of Lakewood, the Federal Center is 7 miles southwest of the central Denver business area, 3 miles west of the Denver city limits, and about 6 miles southeast of Golden, Colorado (Figure 1). No residences are within the Federal Center boundaries.

Building 15 is occupied by professional and technical personnel, most of whom have experience in handling, using, and measuring radioactive material, and are authorized to do so by NRC licenses held by the Geological Survey.

The reactor is an integral part of the research effort of the Department of the Interior, U.S. Geological Survey, in their basic studies to improve methods and techniques to enhance scientific knowledge about water and earth materials. The GSTR is operated on a one shift, 40 hour/week basis. The annual thermal power generation is approximately 850 MWH.

The purpose of this Plan is to identify radiological emergencies applicable to the GSTR and describe the measures to be taken to minimize the consequences of such emergencies.

## 2. Definitions

Assembly Area. The grass strip on the southeast side of the Building 15 parking lot.

Emergency. A condition which calls for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

Emergency action levels. Specific instrument readings, or observation; radiological dose or dose rates; or specific contamination levels of airborne, waterborne, or surface-deposited radioactive materials that may be used as thresholds for establishing emergency classes and initiating appropriate emergency measures.

Emergency classes. Emergency classes are classes of accidents grouped by severity level for which predetermined emergency measures should be taken or considered.

Emergency plan. An emergency plan is a document that provides the basis for actions to cope with an emergency. It outlines the objectives to be met by the emergency procedures and defines the authority and responsibilities to achieve such objectives.

Emergency procedures. Emergency procedures are documented instructions that detail the implementation actions and methods required to achieve the objectives of the emergency plan.

Offsite. The geographical area that is beyond the site boundary.

Onsite. The geographical area that is within the site boundary.

Operations boundary. That portion of the reactor facility designated as the "Secured Area". (Figure 3)

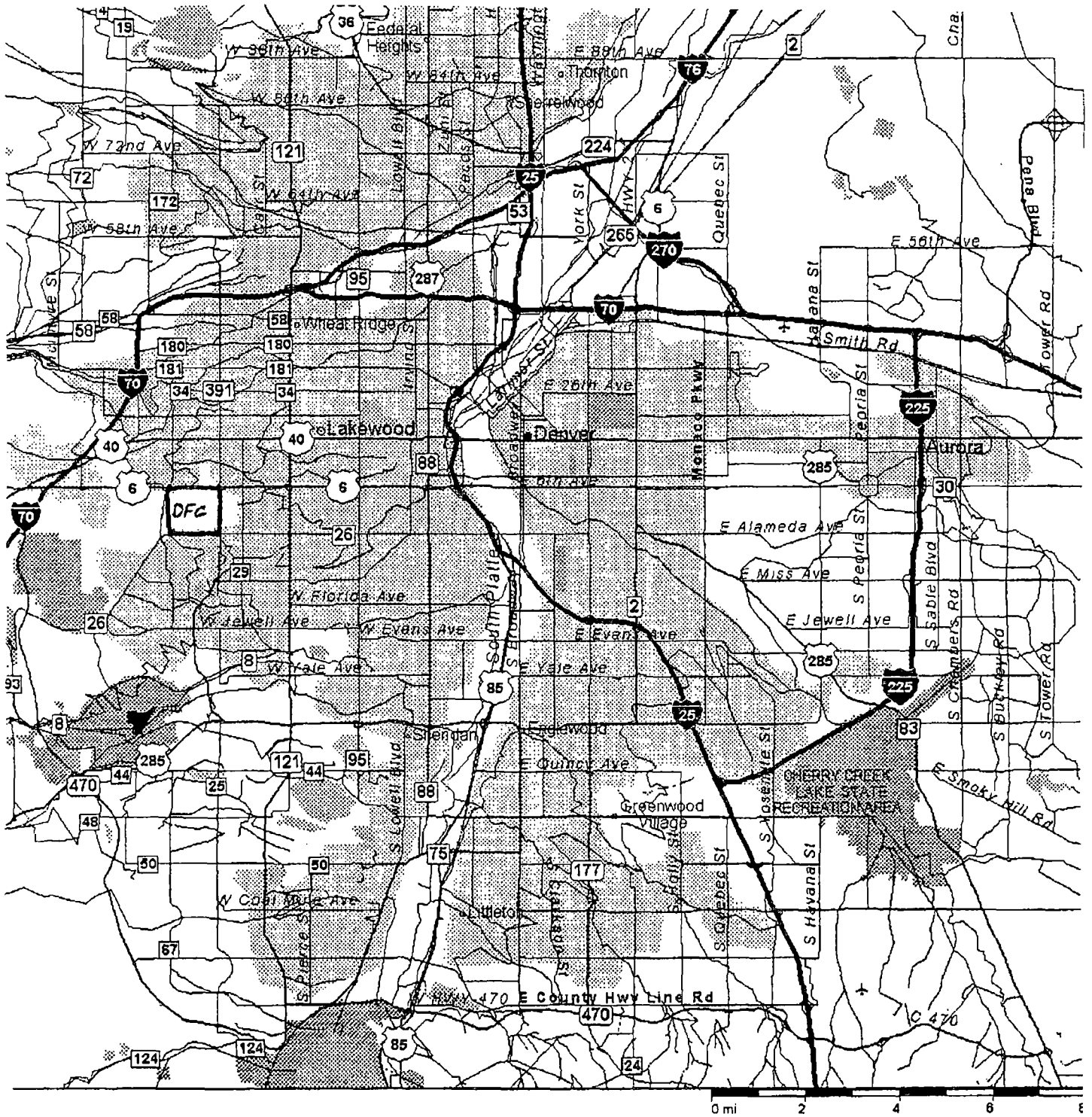


Figure 1. Area Map

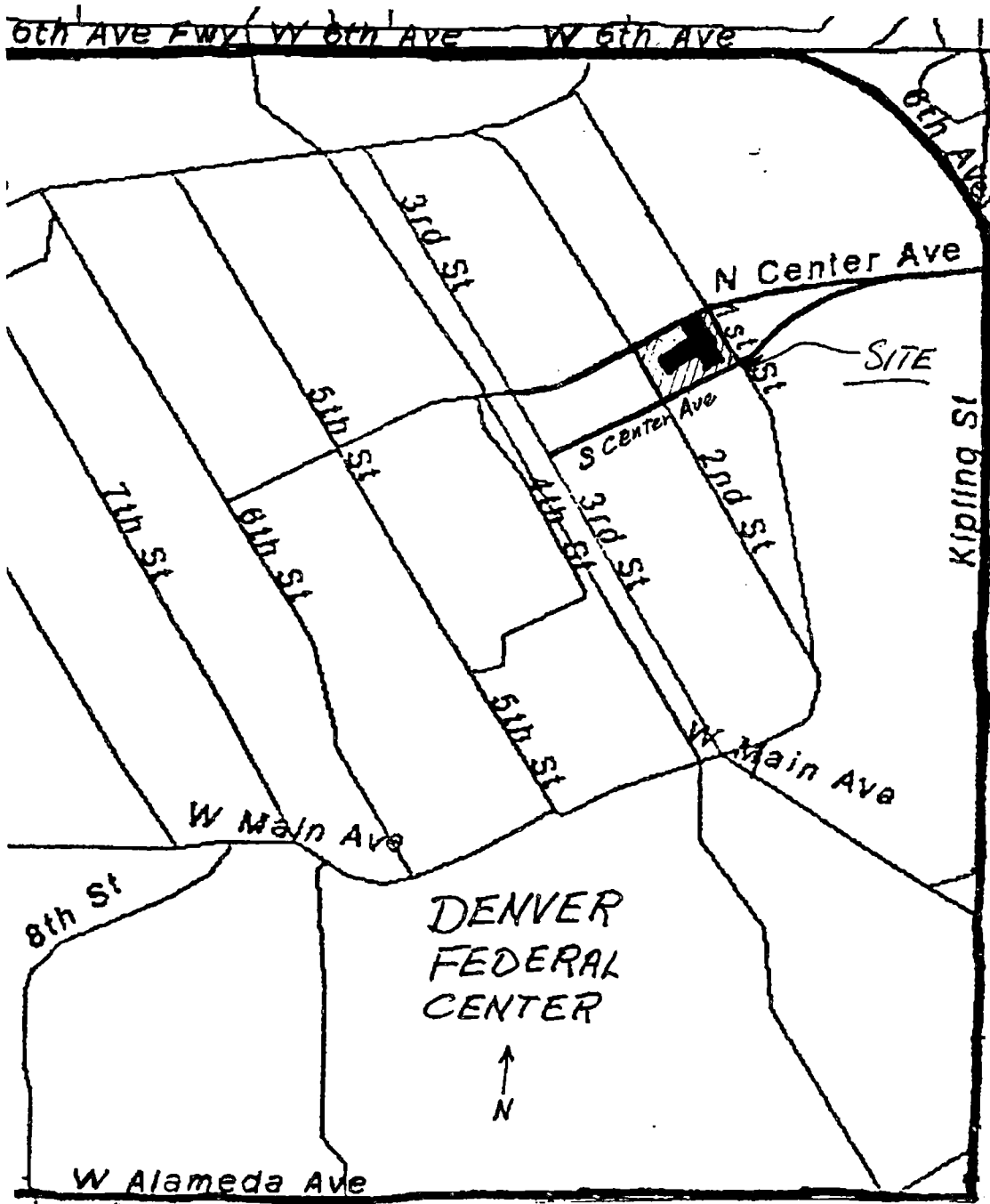


Figure 2. Site Boundary

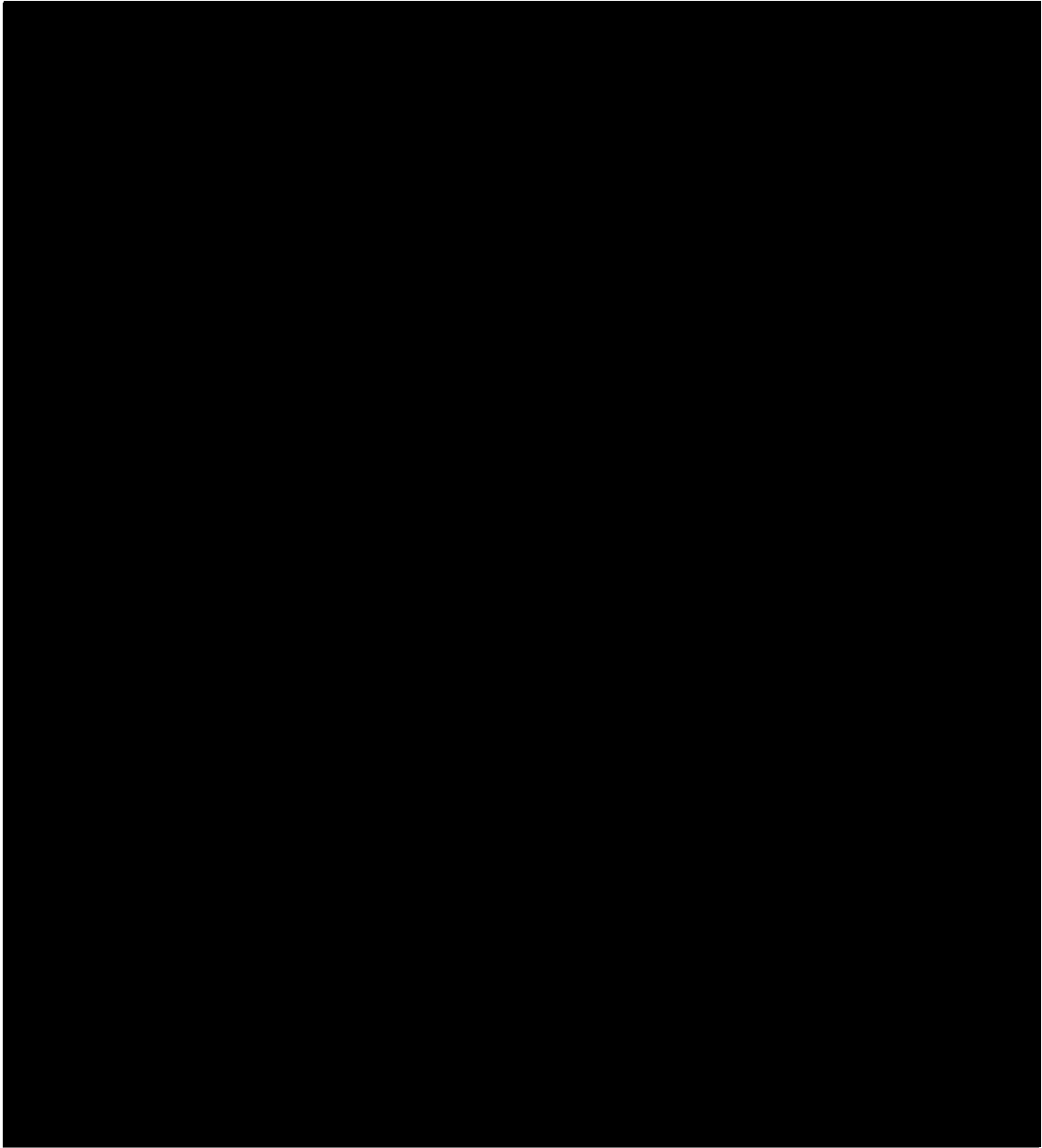
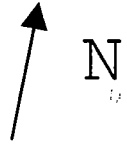
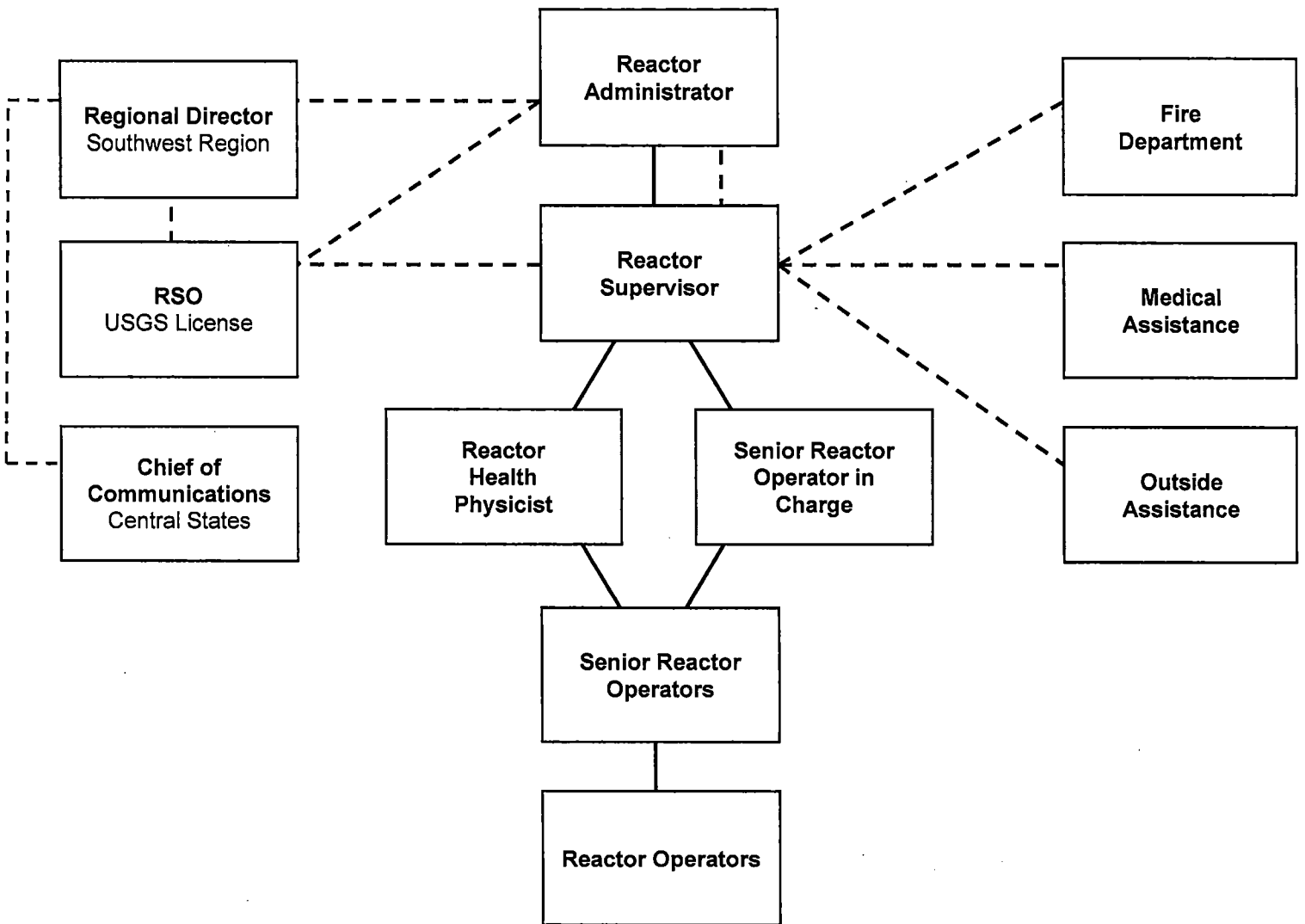


Figure 3. US Geological Survey TRIGA Reactor Facility - Secured Area





— Line of responsibility  
 - - - Line of communication

Figure 4 GSTR Facility Emergency Organization

Protective action guides (PAG). Projected radiological dose or dose commitment values to individuals that warrant protective action following a release of radioactive material. Protective actions would be warranted provided the reduction in individual dose expected to be achieved by carrying out the protective action is not offset by excessive risks to individual safety in taking the protective action. The projected dose does not include the dose that has unavoidably occurred prior to the assessment.

Reactor facility. All areas which contain reactor physical plant or reactor offices.

Research reactor. A device to support a self-sustaining neutron chain reaction for research, developmental, education, training, or experimental purposes, and which may have provisions for production of nonfissile radioisotopes.

Site boundary. The site boundary is that area within the Denver Federal Center bounded on the north by North Center Avenue, on the east by First Street, on the south by South Center Avenue, and on the west by Second Street. Building 15 is the only structure within that area. (Figure 2)

Shall, should, and may. The word "shall" is used to denote a requirement; the word "should" to denote a recommendation; and the word "may" to denote permission, neither a requirement nor a recommendation.

### 3. Organization and Responsibilities

#### 3.1 Geological Survey

The Regional Director, Southwest Region, Geological Survey, Denver, Colorado, is responsible for the Occupant Emergency Plan for the protection, preparedness and control in emergency situations in buildings at the Denver Federal Center where the Geological Survey is the prime tenant agency.

The Chief of Communications, Central States is responsible for relaying information about the emergency situation to the news media and the public.

##### 3.1.1 Reactor Facility

###### 3.1.1.1 Reactor Administrator

The Reactor Administrator will be informed of any emergency condition in the Reactor Facility. The Administrator will provide the Regional Director's Office with current information on the status of the emergency.

###### 3.1.1.2 Reactor Supervisor

The Reactor Supervisor or, if absent, the Senior Reactor Operator-in-Charge is responsible for dealing with any emergency condition that arises at the facility, including personnel (both Geological Survey and outside personnel) who subsequently arrive at the facility to assist in controlling an emergency. (see Figure 4)

Transfers of responsibility during emergency conditions at the facility will be made only when a senior person actually arrives on the

scene and personally informs the individual in charge that he is assuming responsibility.

The individual in charge will be responsible for notification of the Nuclear Regulatory Commission, if required. This individual will also notify the Regional Director, Southwest Region of any conditions that might affect any personnel outside Building 15 and will request assistance from support organizations, if required.

Protective action decisions will be made by the individual in charge, in consultation with the Reactor Health Physicist.

The Reactor Supervisor is responsible for emergency preparedness planning for the GSTR facility, including updating of emergency plans and procedures and coordinating plans with other organizations. The Supervisor is also responsible for coordinating the activities of radiological assistance teams.

Termination of an emergency will be ordered by the Reactor Supervisor, or the Senior Reactor Operator-in-Charge, and this individual will be in charge of recovery operations.

Authorization of volunteer emergency workers to incur radiation exposures in excess of normal occupational limits will be made by the Reactor Supervisor or the Senior Operator-in-Charge, in consultation with the Reactor Health Physicist.

#### 3.1.1.3 Reactor Health Physicist

The Reactor Health Physicist, or if absent, the senior reactor staff member present will be in charge of radiological assessments, including onsite and offsite dose assessments. Protective actions will be recommended to the Reactor Supervisor.

#### 3.1.2 Augmentation of Facility Emergency Organization

##### 3.1.2.1 Fire Protection

Fire protection is provided by the Fire Department. The stations are manned on a 24-hour basis.

An automatic sprinkler system is installed in Building 15 with the exception of Room 149, [REDACTED]. Smoke detectors are also employed in the reactor facility to provide an early warning of fire conditions.

##### 3.1.2.2 Medical Facilities

Initial treatment of injured personnel that does not involve radioactive contamination is the responsibility of the Fire Department. The decision to transfer victims to area hospitals would be made by the ambulance team under the direction of emergency room personnel at a local hospital.

##### 3.1.2.3 Security

Security and traffic control for the Denver Federal Center is provided by the Federal Protective Service (FPS). There is no automatic

response by the Federal Protective Service in the event of a radiological emergency unless a [REDACTED] alarm is actuated. Assistance may be requested by the person in charge based on an evaluation of the particular circumstances.

#### 3.1.2.4 Other Personnel

Laboratory personnel who will handle radioactive materials have received basic instructions in radiation monitoring and decontamination procedures. These personnel could be used to augment the radiation monitoring teams and assist in the recovery activities if the situation exceeded the capabilities of the reactor staff.

### 3.2 Support Organizations

#### 3.2.1 Medical Assistance

Injured personnel who are contaminated with radioactive materials shall be transported to St Anthony Hospital, Lakewood, Colorado, for treatment under an agreement with that organization. An emergency call list for St Anthony Hospital is maintained in the Reactor Facility.

Transportation of contaminated personnel to St Anthony Hospital is the responsibility of the Fire Department and/or reactor staff.

#### 3.2.2 Radiological Control Assistance

As part of the mission of the Department of Energy, NNSA, the DOE Region 6 Radiological Assistance Program (RAP) coordinating office will furnish radiological control assistance in the event of an emergency beyond the capability of the reactor staff.

The DOE RAP teams are prepared to provide Health Physics personnel and a mobile unit containing survey instruments and other radioactive control supplies.

### 4. Classification of Emergencies

#### 4.1 Unusual Event and Alert

#### 4.2 Emergency Action Levels

##### 4.2.1 Unusual Event

4.2.1.1 Actual or projected radiological effluent at the site boundary that is calculated (or measured) to result in either of the following conditions, both of which are based on an exposure of 24 hours or less:

(1) A deep dose equivalent of 0.15 mSv (15 mrem)

OR

(2) A committed effective dose equivalent of 0.15 mSv (15 mrem) based on the following considerations:

•100 EC x 24 hours =  $2.4 \times 10^3$  EC-hour  $\approx$  0.15 mSv (15 mrem) (for radionuclides other than noble gases)

•50 EC x 24 hours =  $1.2 \times 10^3$  EC-hours  $\approx$  0.15 mSv (15 mrem) (for noble gases)

Where EC is the value from 10 CFR 20 Appx B, Table 2.

4.2.1.2 Report or observation of a severe natural phenomenon affecting the reactor site.

4.2.1.3 Receipt of bomb threat affecting the reactor facility.

4.2.1.4 Credible security threat affecting the reactor facility.

4.2.1.5 Fire within the reactor facility not extinguished within 15 minutes.

#### 4.2.2 Alert

4.2.2.1 Actual or projected radiological effluent at the site boundary that is calculated (or measured) to result in either of the following conditions, both of which are based on an exposure of 24 hours or less:

(1) A deep dose equivalent of 0.75 mSv (75 mrem)

OR

(2) A committed effective dose equivalent of 0.75 mSv (75 mrem) based on the following considerations:

•500 EC x 24 hours =  $1.2 \times 10^4$  EC-hour  $\approx$  0.75 mSv (75 mrem) (for radionuclides other than noble gases)

•250 EC x 24 hours =  $6.0 \times 10^3$  EC-hours  $\approx$  0.75 mSv (75 mrem) (for noble gases)

Where EC is the value from 10 CFR 20 Appx B, Table 2.

4.2.2.2 Actual or projected radiation levels at the site boundary of 0.2 mSv/hour deep dose equivalent (20 mrem/hour) for 1 hour or 1.0 mSv (100 mrem) to the thyroid (committed dose equivalent).

4.2.2.3 Security breach affecting the reactor facility.

#### 4.3 Emergency Planning Zone

The EPZ shall be the area within the operation's boundary.

#### 4.4 Emergency Response

##### 4.4.1 Communications

Primary communication will be by telephone or intercom. An evacuation horn, located in the reactor room, can be manually activated from the reactor console or from within the reactor room. Other evacuation horns are located at several points in the building, and these horns are activated automatically by the fire alarms or a high radiation alarm from the reactor facility.

There is a radiation alarm system connected directly to the FPS and is activated automatically in the event of radiation levels exceeding preset alarm points.

Fire Department and FPS units are equipped with 2-way radios and will provide a communication link in the event the telephone system is unavailable. Mobile phones may also be used to provide communication.

#### 4.4.2 Activation of Emergency Organization

The Reactor Supervisor, or the Senior Operator-in-Charge, will be responsible for activation of those portions of the emergency organization required for the class of emergency existing. Emergency notification lists are posted within the operation's boundary and at several other locations on site. Notification lists are also available at the FPS control center.

The person in charge is also responsible for asking for radiological control assistance from the DOE RAP team or for medical treatment of contaminated personnel at St Anthony Lakewood Hospital. The NRC will be notified of the occurrence of emergency conditions at the facility as required by 10 CFR.

#### 4.4.3 Assessment Actions

Assessment of the emergency situation would be a continuing process based on visual observations and information from reactor instrumentation; readout from radiological monitoring instruments; and portable radiation monitoring instruments.

Multichannel analyzer systems are available on site for use in the identification of radionuclides. Alpha and beta counting systems are available on site to evaluate air samples and contamination wipes.

#### 4.4.4 Corrective Actions

The declaration of any class of emergency shall be cause for the shutdown of the reactor. Reactor staff members will take corrective actions that will limit or reduce the release of radioactive materials and confine physical damage to as small an area as possible. Corrective action may include local fire suppression, securing of the ventilation system, or other damage control actions.

Certain members of the reactor staff have received first aid training and may render assistance to injured personnel until the arrival of the medical personnel.

#### 4.4.5 Protective Actions

4.4.5.1 Personnel that are not needed for immediate corrective action shall be evacuated from the area involved in the emergency. Evacuation routes have been established for Building 15 (Figure 5), and these instructions are posted at several locations in the building.

The parking lot on the south side of Building 15 has been designated as the primary assembly area. An alternate assembly area will be designated by the Reactor Supervisor or designee if wind conditions or other considerations dictate.

4.4.5.2 Monitors are assigned responsibility for specific areas of the building. The monitors will assure that all personnel are evacuated from their assigned area. Visitors to the reactor area are escorted by reactor staff members.

Personnel who may have been contaminated will be monitored before being allowed to depart the assembly area. Fixed and portable radiation monitors are available to determine contamination of individuals and allow their movements to be restricted. Contaminated areas will be restricted to personnel as rapidly as the emergency situation allows.

4.4.5.3 Personnel entering the area to remove injured persons should be limited to an exposure of 25 rem to the whole body. Personnel engaged in corrective actions, including volunteers, should be limited to 5 rem. First-aid, ambulance, and/or medical personnel should also be limited to 5 rem. Protective clothing is available to emergency personnel.

The above guidelines would be implemented under the direction of the Reactor Health Physicist or the senior reactor staff member present. In all cases, the exposure should be kept as low as reasonably achievable.

4.4.5.4 Building walls and ropes will be the principal means of isolation and control of areas to minimize exposures and the spread of radioactive contamination. The FPS will assist in traffic and crowd control.

4.4.5.5 Radiation dose rates will be measured by both fixed area monitors and portable survey instruments capable of detecting neutron, gamma, beta and alpha radiation. Contamination will be monitored with hand and foot monitor (if available), sensitive survey instruments, and the use of swipes.

Information and data will be transmitted from Health Physics personnel to the senior reactor staff member in charge by messenger, email, or telephone.

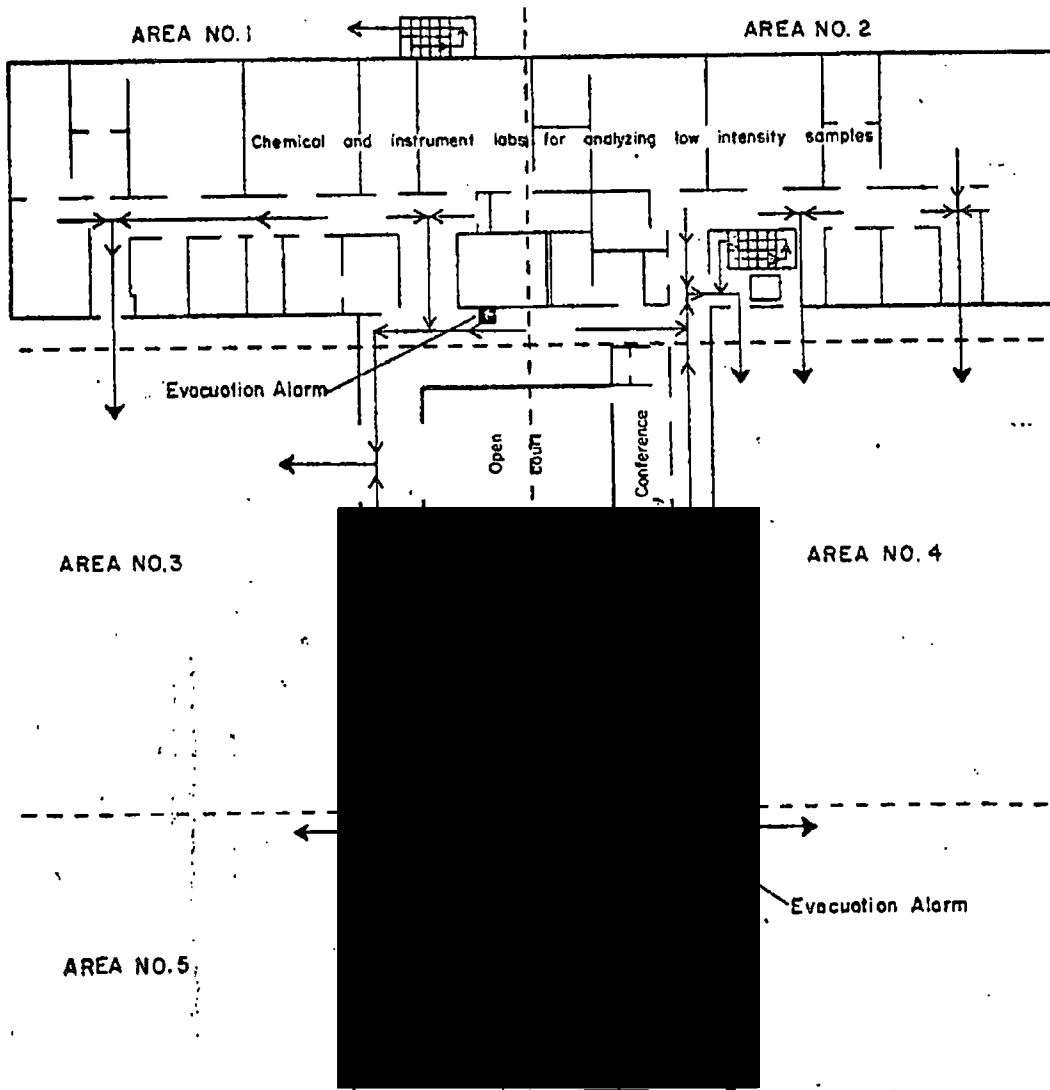
#### 4.5 Emergency Facilities and Equipment

##### 4.5.1 Emergency Support Center

The primary emergency support center will be located in the reactor facility office area. Secondary support centers will be located in Building 15 or the assembly area if the building is evacuated.

#### 4.5.2 Assessment Facilities

Fixed gamma area monitors are mounted throughout the reactor facility and Building 15. A fixed neutron monitor is located in the reactor room. Remote readouts of the monitors are provided in the reactor office area, and, in addition, remote readout of those monitors in the reactor room is provided at the reactor control console.





## Figure 5. Evacuation routes

A hand and foot monitor is also located in the reactor facility.

### 4.5.2.1 Radiological Monitors

Portable survey meters capable of measuring alpha, beta, gamma, and neutron radiation are available at the reactor facility. Other portable monitors are also available from the Geological Survey's Radiation Safety Officer.

A fixed air sampling device is mounted in the emergency exhaust stack to sample air from the exit side of the HEPA filter. A portable air sampler is available for sampling the air at other locations on or off site.

### 4.5.2.2 Facilities for Radionuclide Identification

Multichannel analyzer systems are available on site for specific radionuclide identification.

### 4.5.2.3 Nonradiological Monitors or Indicators

Reactor instrumentation and ventilation system instrumentation provide readouts that may be used to assess certain conditions in the reactor room.

### 4.5.2.4 Fire Detection Devices

An automatic sprinkler system is located throughout Building 15, with the exception of the [REDACTED]. Smoke detectors are located in the reactor office area and in the reactor control console area.

## 4.5.3 First Aid and Medical Facilities

### 4.5.3.1 Decontamination

Facilities for decontamination of uninjured personnel are available in Building 15. Decontamination of personnel and/or equipment will be under the direction of the Reactor Health Physicist. Injured personnel who are contaminated will, if feasible, be wrapped in plastic to limit the spread of contamination during transfer to the hospital.

### 4.5.3.2 First Aid

Certain members of the reactor staff have received first aid training. The Fire Department provides ambulance services and would provide first aid to injured personnel. Firefighters have received first aid and CPR training, and some are Emergency Medical Technicians.

Injured personnel who are also contaminated shall be transported to St Anthony Lakewood Hospital by the Fire Department ambulance or reactor staff.

#### 4.5.3.3 Medical Treatment

First aid personnel may transfer victims to a local hospital for more extensive treatment.

Medical treatment of personnel who are injured and contaminated with radioactive material will be provided by St Anthony Lakewood Hospital, Lakewood, Colorado. The hospital has an Emergency Department that is trained and prepared to handle victims of radiation accidents.

Notification to the hospital that injured personnel are being transported to the emergency room will be by telephone, internet, or radio. A telephone number of the hospital emergency department to be notified in the event of an emergency is maintained at the reactor facility and other locations in Building 15.

#### 4.5.4 Communications Equipment

There are multiple telephones, on multiple lines, within the operation's boundary. There is also an intercom system in the same area. There are other telephone lines in Building 15.

Fire Department and FPS personnel have 2-way radio equipment in their vehicles and also are equipped with hand-held 2-way radios which provide communication to their respective dispatch centers.

Very loud horns are used within Building 15 to signal evacuation of certain areas.

#### 4.6 Recovery

For recovery from any of the classes of emergencies described in the Plan, the Reactor Health Physicist and the Reactor Supervisor, or their designated alternates, will determine if it is safe to return to the facility and resume operations. If fire was involved, the Fire Chief or the incident commander will be consulted concerning reentry procedures. The individuals making the determination shall consider the severity of the incident and review which reactor safety systems or health physics systems may have been affected adversely, and those systems will be checked for proper operation prior to resumption of routine operations.

The Reactor Supervisor shall comply with the reactor facility Technical Specifications and Title 10, Code of Federal Regulations requirements.

#### 4.7 Maintaining Emergency Preparedness

##### 4.7.1 Training and Drills

USGS personnel assigned to Building 15 are given instructions regarding evacuation procedures. Reactor staff members are required to

review emergency procedures on an annual basis, not to exceed 15 months. The Reactor Health Physicist trains the first-responding fire and rescue crews in the radiation hazards that might be encountered during an emergency, and conducts retraining sessions at biennial intervals not to exceed 30 months. Other fire fighters will be trained by their training dept. and will be offered a tour of the reactor facility. Firefighter training is given by the Fire Department.

Ambulances are manned by members of the Fire Department. The training program for Emergency Medical Technicians is under the direction of a local hospital. Emergency Medical Technicians are certified by the State of Colorado.

The Reactor Health Physicist assists the reactor staff or ambulance crew if transportation of injured, contaminated personnel is required.

St Anthony Lakewood Hospital, which provides medical treatment for injured personnel who are contaminated, has an internal training program for their personnel.

The radiological assistance teams from DOE are trained through the DOE Radiological Assistance Program.

An operational check of the [REDACTED] alarm circuit from the Reactor Facility to the FPS is made during the monthly check of reactor equipment.

A simulated incident requiring evacuation of the Reactor Facility will be conducted annually, not to exceed 15 months. As part of the exercise, the Building 15 alarm system to the FPS will be actuated to test the response of that group. Biennially, not to exceed 30 months, the simulated incident shall test communication links and notification procedures with the fire department, hospital, and DOE RAP team.

A critique of each drill will be conducted by the reactor staff and deficiencies will be identified and corrected.

#### 4.7.2 Plan Review and Update

All changes to the Emergency Plan must be approved by the Reactor Supervisor. The Reactor Supervisor shall be responsible for the revision and update of the Plan. A review and audit of the Emergency Plan will be conducted by the Reactor Operations Committee as specified in the Technical Specifications. The Plan and Procedures will be modified as needed to incorporate results of training exercises and to account for changes in the facility or in the environs. Written agreements, as needed, with outside organizations will be renewed and call lists will be updated on a biennial basis, not to exceed 30 months.

Members of the emergency organization will be advised in writing of changes in the Plan that affect their organization.

#### 4.7.3 Equipment Maintenance

The Reactor Health Physicist is assigned responsibility for ensuring the readiness of emergency equipment and supplies. A calibration schedule has been established for monitoring instruments where appropriate.