EMERGENCY PREPAREDNESS PLAN

FOR THE

RESEARCH REACTOR

Revision 8

May 2023

Facility License No. R-125

Docket No. 50-223

1.0 Introduction

This emergency plan applies to the University of Massachusetts Lowell Research Reactor (UMLRR) Facility. The reactor is licensed pursuant to Title 10CFR50 as a research and utilization reactor, License No. R-125.

1.1 Objective

The objective of the emergency plan is to establish guidelines and designate areas of responsibility for the UMLRR staff should an accident or incident occur that may affect public health and safety. Additionally, the plan identifies the off-site support organizations that may be activated if required.

1.2 Facility Description

The UMLRR is an MTR flat-plate fuel, open pool-type reactor. The UMLRR uses flat-plate fuel, enriched to 20% U-235. The license allows the reactor to be operated at a maximum power level of one megawatt thermal. In addition to the reactor, a Co-60 irradiator is housed in the reactor pool.

The reactor building is a steel/concrete structure approximately 80 feet in diameter and 80 feet high.

A more complete description of the facility is provided in the Final Safety Analysis Report.

1.3 Reactor Utilization and Operating Frequency

The UMLRR is owned and operated by the University to provide training and irradiation services to the University, other universities, Federal and state agencies, private companies, and utilities where appropriate. The reactor can operate five days per week on a single shift basis with an average annual energy output of about l0 megawatt days.

1.4 Site Description

The UMLRR is located on the North Campus of the University of Massachusetts Lowell in the city of Lowell, Middlesex County, Massachusetts. The North Campus is presently some 60 acres in size and is mainly situated on the north side of the Merrimack River. The entire complex is near the northern edge of the city. The reactor is located within the reactor building located on the south end of the Pinanski Building.

2.0 Definitions

2.1 *Site* – The UMLRR site includes the Pinanski Building and that area bounded by the chain-link fence around the Reactor Building.

2.2 *Facility* – The UMLRR Facility includes the reactor building and the adjacent labs and offices in the Pinanski Building.

2.3 *Site Boundary* - The site boundary is that boundary, not necessarily having restrictive barriers, surrounding the operations wherein the Emergency Director may directly initiate emergency activities. The area within the site boundary may be frequented by people unacquainted with the reactor operation.

2.4 *Reactor Building* – The reactor building is the structure housing the reactor.

2.5 *Operations Boundary* – The area within the site boundary where the Emergency Director has direct authority over all activities. The area within the boundary shall have pre-arranged evacuation procedures for personnel frequenting the area. The operations boundary for this plan shall be the Reactor Building.

2.6 *Emergency* – An emergency is 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.

2.7 *Emergency Actions Levels* – Specific instrument readings, or observations; radiological doses or dose rates; or specific contamination levels of airborne, waterborne, or surface deposited radioactive materials that may be used as recognized conditions that result in actions such as establishing emergency classes and initiating appropriate emergency measures.

2.8 *Emergency Director* – The Emergency Director is the individual designated to take charge of an emergency and to direct emergency control procedures.

2.9 *Emergency Classes* – Classes of emergencies grouped by severity level for which predetermined emergency measures should be taken or considered.

2.10 *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.

2.11 *Emergency Planning Zone (EPZ)* – Area for which emergency planning is performed to assure that prompt and effective actions can be taken to protect the public. The reactor building which is defined as the operations boundary is designated as the EPZ for the University of Massachusetts Lowell.

2.12 *Emergency Procedures* – Emergency procedures (EP's) are documented instructions that detail the implementation actions and methods required to achieve the objectives of the emergency plan.

2.13 *Offsite* – The geographical area that is beyond the site boundary.
2.14 *Onsite* – The geographical area that is within the site boundary.
2.15 *Assessment Actions* – Those actions taken during or after an emergency to obtain and process information which is necessary to make decisions to implement specific emergency procedures.
2.16 *Corrective Actions* – Those measures taken to correct and terminate an emergency.
2.17 *Protective Actions* – Those measures taken in anticipation of an emergency or after an emergency has occurred to protect the health and safety of individuals and to prevent damage to property.
2.18 *Protective Action Guides* – 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 occurred prior to the assessment.
2.19 *Recovery* – Those actions taken after the emergency to restore the facility to its pre-emergency condition.
2.20 *Total Effective Dose Equivalent (TEDE)* - The sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).
2.21 *Shall Should, and May* – The word "shall" is used to denote a requirement; the word "should" denotes a recommendation, and the word "may" denotes permission, neither a requirement nor a recommendation.

3.0 Organization and Responsibilities

The staff of the University of Massachusetts Lowell Radiation Laboratory is involved daily with reactor operations, technical support, and administrative activities, and through training and operating experience is capable of handling any foreseeable emergency.

3.1 Emergency Organization

Several offsite organizations are available to augment the UMLRR emergency organizations including the fire fighting, ambulance and emergency medical services, hospital facilities, and police protection. Written agreements with these organizations are renewed on a biennial basis. Figure 1 shows the interface between the elements of the emergency organization.

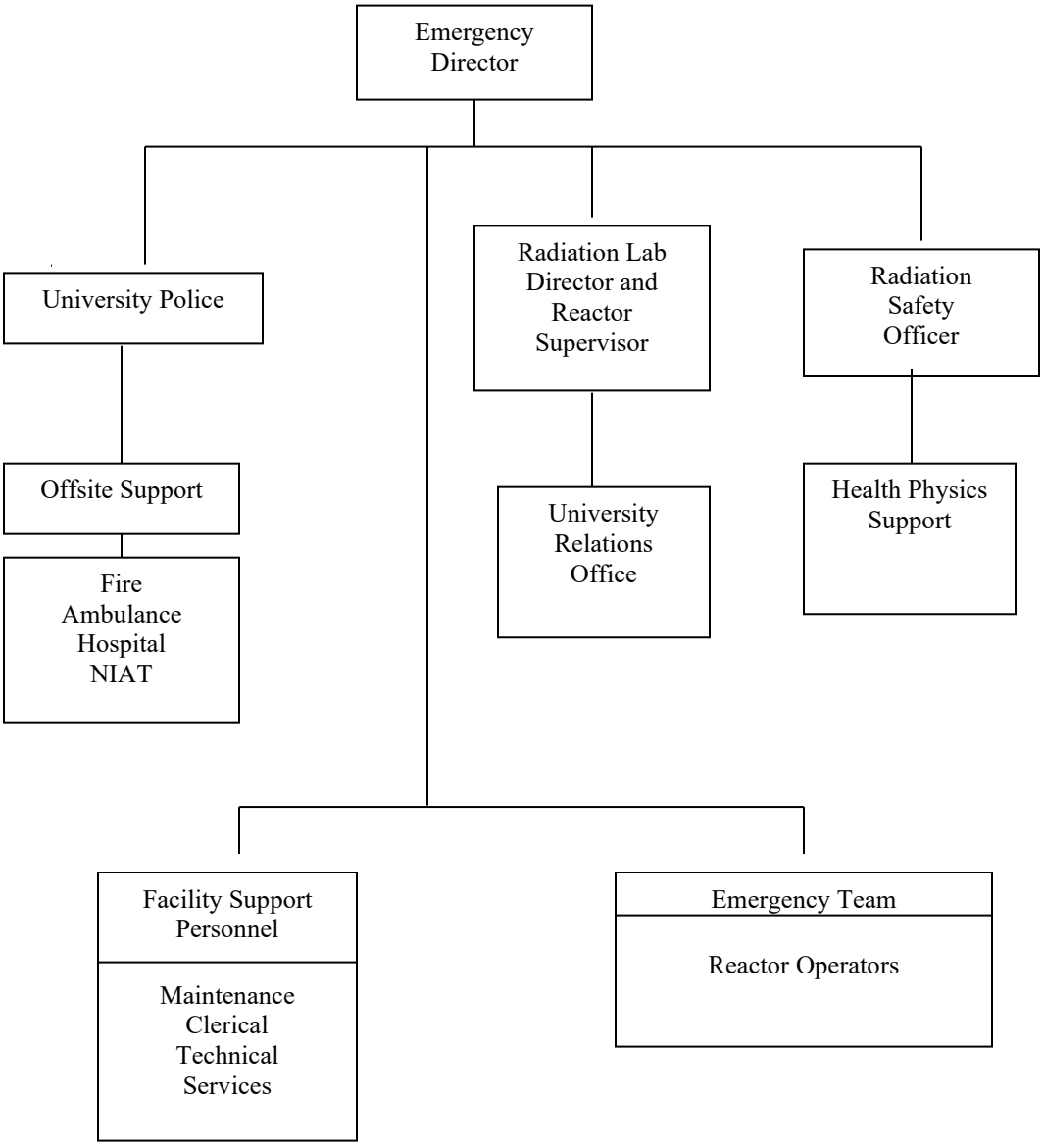

Figure 1 – UMLRR Emergency Organization

3.1.1. Emergency Director

The first Emergency Team member from the list on Table I who responds to an emergency will assume the position of Emergency Director. The Emergency Director will retain that responsibility until, upon mutual consent, that responsibility is transferred to another individual listed in Table I. The Emergency Director shall have the ultimate authority over all onsite emergency activities and personnel. The Emergency Director is responsible for minimizing accident circumstances including radiation exposure and releases and damage to equipment and facilities. The Emergency Director is also responsible for assessing the severity of the accident and summoning and coordinating offsite medical, ambulance, fire, and police assistance as appropriate.

TABLE I

UMLRR Emergency Director List

Primary Emergency Director	Secondary Emergency Director
Reactor Supervisor	Radiation Laboratory Director
Radiation Safety Officer	Radiological Sciences Coordinator
Most Senior SRO	

The first person from the Primary list who reaches the emergency assembly area (outside the first-floor airlock) will assume the responsibility of directing the Emergency Team. If no individual from the Primary list reaches the assembly area within the first few minutes of an emergency, an individual from the Secondary list may assume the position of Emergency Director until an individual from the Primary list arrives. The Emergency Director may turn over the responsibility of that position to another member from the above lists upon mutual consent of both individuals.

3.1.2 Senior Reactor Operator (SRO)

The SRO on duty will be responsible for directing the reactor staff in responding to the immediate emergency on site. The SRO will direct or perform all necessary actions in accordance with the Emergency Operating Procedures and Emergency Plan. Once the immediate emergency actions have been taken and the Emergency Team has responded, the SRO will report to and receive direction

from the Emergency Director. A licensed Senior Reactor Operator will approve reasonable action that departs from license conditions to technical specifications per 50.54(x) and (y).

3.1.3 Radiation Safety Officer

The Radiation Safety Officer (RSO) is responsible for reviewing and updating emergency plans and procedures. The RSO is also responsible for emergency training, tests, and drills. The RSO is responsible for onsite and offsite dose assessments and recommending protective actions. In the absence of the RSO, the assistant RSO or designated member of the Emergency Team will be responsible for dose assessments.

3.1.4 Reactor Operator

The reactor operator (RO) is responsible for the safe shutdown and security of the reactor in emergency situations. The RO shall make the SRO on duty aware of observed action levels and shall take immediate action in case of possible reactor damage or a substantial uncontrolled radioactivity release. The RO shall perform the duties of reactor operator as specified in the Emergency Operating Procedures.

3.1.5 University of Massachusetts Lowell Radiation Lab Management

The Management consists of the Radiation Laboratory Director and the Reactor Supervisor.

3.1.6 Emergency Team

Members of the Emergency Team may be assigned duties and responsibilities during the course of an emergency. All members of the Emergency Team receive basic instructions in radiation safety and emergency procedures on a biennial basis.

3.1.7 Radiation Safety Office

Health physics personnel from the Radiation Safety Office are available to provide additional support. The RSO for the University acts as health physics supervisor. The RSO and the health physics staff are housed in the Pinanski Building and are available to provide required support services in an emergency situation. Health physics personnel from the Radiation Safety Office, with appropriate direction from the RSO, will assist, as

necessary, in activities related to onsite and offsite contamination and dose control and evaluation.

3.1.8 University Media Relations Office

The University of Massachusetts Lowell Media Relations Office will handle all official news releases concerning emergency conditions at the UMLRR.

3.1.9 University Police

The University of Massachusetts Lowell Police (Campus Police) may be called to provide facility security assistance, ambulance escort service, emergency radio communications, and traffic control as necessary. The Campus Police are trained biennially in the basic principles of radiation protection and pertinent aspects of the Emergency Plan.

3.1.10 City of Lowell Fire Department

The City of Lowell Fire Department will serve as the primary firefighting agency. The firemen are offered training biennially in the basic principles of radiation protection and pertinent aspects of the Emergency Plan.

3.1.11 Ambulance Service

A local company will provide ambulance service and emergency medical assistance for the UMLRR as required. The emergency medical technicians and ambulance personnel are offered training biennially in the basic principles of radiation safety, contamination control, and the UMLRR emergency procedures.

3.1.12 Campus EMT's

Campus EMT's will provide emergency first aid and medical support as appropriate.

3.1.13 Medical Facilities

Lowell General Hospital will provide medical facilities and care for contaminated injured individuals and for individuals suffering from acute radiation exposure. A biennial training program including principles of radiation safety and contamination control is conducted for the involved hospital staff.

3.1.14 Offsite Law Enforcement Agencies

The Campus Police, and the City of Lowell Police Department will provide, if necessary, traffic control and crowd control at and beyond the campus boundaries within their jurisdiction. Requests for assistance and coordination with these agencies will be in accordance with the cooperative agreements with these agencies.

3.2 Coordination With and Notification of Government Agencies

The postulated credible accidents associated with the operation of the UMLRR will not result in a radiological hazard affecting the public health and safety. These emergency events may require medical, fire, and traffic control assistance from outside agencies. Notifications to outside agencies may also be necessary for regulatory and/or informational requirements.

3.2.1 U.S. Nuclear Regulatory Commission

Notification of an incident to the U.S. Nuclear Regulatory Commission Headquarters Operation Center will be in accordance with the requirements of l0CFR and as specified in the Technical Specifications of Reactor License R-125.

3.2.2 Commonwealth of Massachusetts

The Radiation Control Program of the Massachusetts Department of Public Health shall be notified of a radiation emergency classified as an Alert.

3.3 Termination of an Emergency

The Emergency Director shall make the determination to terminate the emergency and dismiss the Emergency Team.

3.4 Authorization for Reentry

The Emergency Director shall authorize reentry into the reactor building or portions thereof previously evacuated during the course of an emergency. It shall be the responsibility of the Radiation Safety Officer, or designee, to establish reentry requirements, provide personnel monitoring, and ensure that protective clothing and other safety equipment is utilized.

3.5 Authorization of Radiation Exposures in Excess of 10CFR20 Limits

The Emergency Director with concurrence of the Radiation Safety Officer or his designated alternate may authorize exposure to emergency team members and radiation workers in excess of normal occupational limits. The exposure limits are greater than 25 rem whole body for voluntary life saving or protection of large populations, 25 rem whole body for life saving actions or corrective actions that mitigate the consequences of reduce the severity of the emergency event. And up to 10 rem for the protection of property. In either case, the exposure is authorized on a once in a lifetime basis with preference given to the eldest able bodied volunteer.

4.0 Emergency Classification System

The emergency classifications described for the UMLRR are based upon credible accidents associated with reactor operations and other emergency situations which could affect the reactor. An Emergency Classification Guide is presented in Table II. Implementation Procedures for the emergency classes of credible accidents for the UMLRR are listed in Appendix B.

4.1 Non-Reactor Safety Related Events

These events are separate from reactor operations and do not necessarily indicate changing of the reactor status. Advisories to campus police may be warranted, and the condition may require such local services as ambulance and medical personnel. There may be a need to shut down the reactor or reallocate personnel because of injuries to a key individual or location of event.

Emergency Action Levels used to initiate emergency measures associated with this emergency class are listed in Table II.

4.2 Notification of Unusual Events (NOUE)

This class of an emergency situation may be initiated by either manmade events or natural phenomena that can be recognized as creating a significant hazard potential that was previously non-existent. There is usually time available to take precautionary and corrective steps to prevent the escalation of the accident or to mitigate the consequences should it occur. No releases of radioactive material requiring offsite responses are expected. One or more elements of the emergency organization are likely to be activated or notified to increase the state of readiness as warranted by the circumstances. The situation may warrant an immediate shutdown of the reactor or interruption of nonessential routine operations.

Emergency Action Levels used to initiate emergency measures associated with this emergency class are listed in Table II.

4.3 Alert

Events leading to an alert would be of such radiological significance as to require. notification of the emergency organization and its response as appropriate for the specific emergency situation. Under this class, it is unlikely that off-site response or monitoring would be necessary. Substantial modification of reactor operating status is a highly probable corrective action. Protective evacuations or isolation of certain areas within the operations boundary or within the site boundary may be necessary. Emergency Action Levels used to initiate measures associated with this emergency class are listed in Table II.

TABLE II
Emergency Classes

Non-Reactor Safety Related Events:

Possible Events or Action Levels:

- Personnel injury with or without radiological complication.
- Minor fire or explosion non-specific to the reactor or its control systems.
- Facility or individual contamination.

Summary of Actions:

1) Alert Staff to a possible escalation.
2) Initiate Assessment.
3) Provide treatment.

Notification of Unusual Events:

Possible Events or Action Levels:

- 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: (a) 100 EC × 24 hours = 2400 EC-hour ≈ 0.15 mSv (15 mrem) (for radionuclides other than noble gases)[1], (b) 50 EC × 24 hours = 1200 EC-hours ≈ 0.15 mSv (15 mrem) (for noble gases).[2]

- Credible security threat affecting the reactor building.

- Receipt of bomb threat affecting the reactor building.

- Report or observation of a tornado, hurricane, or other severe weather or natural phenomenon that could adversely affect the reactor building.

- Fire within the reactor building not extinguished within 15 minutes.

Summary of Actions:

1. Assure that emergency personnel are readily available to respond if the situation becomes more serious or to perform confirmatory radiation monitoring as required.
2. Provide offsite authorities with current status information.

Alert:

Possible Events or Action Levels:

- 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: (a) 500 EC × 24 hours = 12000 EC-hour ≈ 0.75 mSv (75 mrem) (for radionuclides other than noble gases)[1], (b) 250 EC × 24 hours = 6.0 × 103 EC-hours ≈ 0.75 mSv (75 mrem) (for noble gases).[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).

- Fire or explosion which might adversely affect the reactor or its safety system.

- Pool level alarm and visual observation indicating abnormal loss of water at a rate exceeding backup capacity.

- Security breach affecting the reactor building.

Summary of Actions:

1. Assure that response centers are manned.
2. Assure that monitoring teams are dispatched.
3. Assure that personnel required to carry out evacuation are available.
4. Provide consultation with offsite authorities.
5. Provide information to the public through UML Media Relations Office.

[1]Effluent concentration (EC) as listed in 10 CFR 20, Appendix B, Table 2 [2]. If the exposure time is <24 hours, the EC multiplier can be increased proportionately, provided that the values of 2400 and 1200 EC- hour are used to declare a notice of unusual event; the proportional increases is 5 for an alert.

[2]10 CFR 20, Appendix B, Table 2 [2] lists the concentration values that are equivalent to the radionuclide concentrations that, if inhaled or ingested continuously over the course of one year, would produce a total effective dose equivalent of 0.5 mSv (50 mrem). However, for noble gases where the submersion (external dose) is limiting, the concentration values would produce a total effective dose equivalent of 1 mSv (100 mrem).

4.4 Site Area Emergency

No credible accidents attributable to the reactor or its operation are postulated which can cause emergency conditions beyond the operations boundary; therefore, the emergency class is not addressed in this plan.

5.0 Emergency Action Levels (EAL's)

The action levels specified in Table II are the EAL's for activating the Emergency Plan and for initiating protective actions for the emergency event.

6.0 Emergency Planning Zone

The area within the operations boundary for the UMLRR (defined as the reactor building) is established as the Emergency Planning Zone (EPZ) for the facility. Emergency actions will be coordinated from the Assembly Area immediately outside the first-floor airlock.

7.0 Emergency Response

7.1 Notification

In the event of a reactor related emergency during working hours, activation of an audible alarm (squee) in the control room or in the Reactor Supervisor's Office may be used to signal the need for the Emergency Team notification in conjunction with telephone communication as needed.

A roster of primary emergency response personnel is maintained by the Campus Police. In the event of an emergency during off hours Campus Police would notify emergency response personnel by telephone.

The major support groups (including the Campus Police, Lowell Fire Department, ambulance service, and Lowell General Hospital) are accessible 24 hours per day.

7.2 Assessment Consideration

7.2.1 Fixed Instrumentation

The stack particulate and gaseous airborne radioactivity monitor provides the primary indication of releases of radioactivity from the reactor building. The particulate monitor is calibrated annually using a surface distributed Cl-36 source. The gaseous monitor is calibrated annually with either a known quantity of Ar-41 introduced into the gas monitor or by use of an external source at a fixed position with respect to the detector (the external source calibration is referenced against an Ar-41 calibration). Stack monitor channels may be read in the reactor building, or outside the reactor building adjacent to the emergency assembly area, or at the stack monitor. Release rate or integral releases are determined by interpretation of the stack monitor responses. Offsite surveys and available meteorological data may also be used to calculate offsite concentrations, dose rates, and total integrated doses.

Two fixed filter constant air monitors in the reactor building provide a measure of airborne particulate radioactivity concentration. These monitors, one on each of the first and third floor elevations are calibrated annually using a surface distributed C1-36 source. The air monitors read out both in the reactor building and adjacent to the emergency assembly area.

Response of the air monitors to airborne radioactivity will be used to interpret concentrations of airborne radioactivity in the reactor building.

Fourteen fixed external radiation monitors are in place in the reactor building and have readouts in the reactor building. These monitors also have readouts adjacent to the emergency assembly area. These monitors will provide direct indications of external gamma radiation exposure rates in the reactor building.

7.2.2 Portable Instrumentation

A number of portable radiation detectors are available both inside the reactor building and outside the building in either the Radiation Safety Office or the emergency closet. These instruments include Geiger-Mueller detectors, ionization chambers, rem-responding neutron detectors, and scintillation detectors. These instruments

are available for direct measurement of exposure or dose rates inside and/or outside the reactor building.

In addition to the above portable detectors other support equipment, which might be necessary for assessment purposes, is available in the Radiation Safety Office and emergency response area. This equipment includes AC and battery powered air pumps, filters, and charcoal cartridges for air sampling purposes. Filter paper wipes in individual envelopes are also available for use in assessment of surface contamination.

7.2.3 Assessment in the Event of the Failure of Fixed Instrumentation

If fixed instrumentation is inoperable or is reading full scale, portable instrumentation/equipment will be used to assess radiation levels, airborne concentrations, and projected doses.

Ongoing releases from the reactor stack, will be evaluated by (l) analyzing the stack monitor filter, or (2) collecting and analyzing an air particulate sample collected by a pump connected to the stack sampling line.

7.2.4 Onsite Radiation Dose Assessment

Doses to personnel onsite will be evaluated (1) by the interpretation of responses of personnel dosimetry to determine external doses and (2) by the evaluation of internal uptakes of radioactivity through in-vivo whole body counting and/or through analysis of biological excreta. Dose projections and control will be made on the basis of anticipated exposure times to external radiation and contaminated media.

7.3 Corrective Actions

Corrective actions which could mitigate or correct the problem in a particular emergency are presented in the implementing procedures as listed in Appendix A.

7.4 Protective Actions

7.4.1 Personnel Accountability

Operations staff members who enter the reactor building are controlled by security procedures and accounted for by the reactor building entry log. Other authorized entrants are required to enter their names in the visitor log, indicating that they are entering the

reactor building. Entrants are allowed access by an authorized operations staff member. Through consulting the logs, the operations staff can identify, within a few minutes after initiation of an emergency event, any individuals who remain within the reactor building.

7.4.2 Notification of Persons within the Reactor Building

A loudspeaker system operates on all floors of the reactor building. This system may be activated in the control room and used to notify occupants of possible problems. In addition, the console operator may activate a loud alarm system in the reactor building; this alarm is a warning to evacuate the building. A control room alarm may also be activated from a location outside the building in the Reactor Supervisor's Office.

7.4.3 Evacuation of Building

Evacuation of the reactor building shall be via the nearest air lock door, located on the first and third floor of the reactor. Personnel who are members of the emergency team will assemble at the primary assembly area (outside the air lock door on the first floor). If the primary assembly area is inaccessible, the alternate assembly area is outside the Pinanski Building Lobby door.

7.5 Guides for Areas Outside the Operations Boundary

No credible accidents associated with operations of the University of Massachusetts Lowell Reactor are postulated which will produce dose equivalent commitments in excess of 1 rem to the whole body or 5 rem to the thyroid gland to individuals outside the operations boundary.

7.6 Health Physics Program

The operational health physics program at the University includes facilities, equipment, and supplies appropriate to the handling of a reactor related emergency. Some descriptive information is given below:

7.6.1 Protective Clothing/Supplies

Available protective clothing includes gloves, coveralls, hoods, and booties. The University does not take credit for the use of respiratory protection in considering occupancy times in air contaminated environments; a respirator fitting program is not in place.

7.6.2 Dosimetry

Dosimetry worn by workers and assigned to other emergency personnel as necessary, would provide the official record of personnel dose. Pocket dosimeters (0-200 mR and 0-200R) or electronic dosimetry are also available for emergency use.

7.6.3 Dose Rate and Contamination Monitoring and Survey Records

In addition to the fixed monitors which read out adjacent to the emergency assembly area, a number of portable instruments, including G-M detectors, ion chambers, rem responding neutron instruments and scintillation detectors, are available for use in assessing external radiation dose rates. Supplies and equipment, including air pumps, filter charcoal cartridges, gas sampling bottles, laboratory counting systems for alpha, beta and gamma analysis are available for assessment of radioactive contamination in air or other media on surfaces. Health Physics personnel with the assistance of radiological sciences faculty are available to provide dose/contamination monitoring.

Radiation dose rate and contamination measurements will be recorded and made available to the Emergency Director and other personnel to aid in assessments of the severity of the situation and for purpose of dose projections and further planning.

8.0 Emergency Facilities and Equipment

The UMLRR emergency organization has sufficient facilities and equipment available in the UMLRR laboratory to handle any credible emergency situation at the reactor facility.

8.1 Emergency Support Center

The Emergency Support Center (ESC) is located outside the reactor building in the attached building. It includes the corridor area outside the first-floor airlock.

Emergency response personnel will report to the ESC when the reactor emergency alarm is sounded. The Emergency Director will direct emergency personnel in their response to the emergency.

Supplies and equipment are available in the emergency closet located along the first-floor corridor. First aid supplies are maintained in the emergency closet. In addition to the ESC, several laboratories with Health Physics instrumentation are available in the attached building. Facilities for decontamination are available within the operations boundary and within the ESC. Additional facilities for decontamination may be made available within the attached building as needed.

8.2 Monitoring and Sampling Equipment

Both fixed instrumentation and portable instruments, equipment and supplies to be used in radiation contamination monitoring are available in the reactor building and at or near the ESC.

8.2.1 Fixed and Portable Monitoring Equipment

The stack particulate monitor uses a beta/gamma scintillation detector to view activity collected on a glass fiber filter to monitor particulate radioactivity. Stack gaseous activity is monitored by a beta scintillation detector mounted in the shielded cylindrical volume through which the sampled stack effluent flows after removal of particulates by filtration. Readouts for these monitors are located at the stack monitor, in the control room, and adjacent to the emergency assembly area.

Two fixed filter constant air monitors operate within the reactor building with local readouts, readouts in the control room, and adjacent to the emergency assembly area.

Fourteen external radiation detectors including eleven G-M detectors, two ion chambers and one neutron detector are located at fixed positions within the reactor building, with readouts in the reactor control room. Readouts of these detectors are replicated adjacent to the emergency assembly area.

A number of portable instruments for external dose assessment are available in the reactor building, the health physics laboratory and the emergency closet. These include G-M detectors, (including one high range instrument with telescoping probe), ion chambers, scintillation detectors, and rem responding neutron instruments. A minimum of three GM detectors and three ion chambers are available in the Health Physics Laboratory and /or emergency closet to cover a range of gamma exposure rates from <0.1 mR/hr to 1000 R/hr. A neutron rem responding instrument is similarly available.

8.2.2 Sampling Equipment

One AC and DC powered air pump is available in the emergency closet. Sampling devices available include high efficiency air filters and filter holders, charcoal holder, and gas sampling bottles.

8.2.3 Laboratory Equipment for Specific Radionuclide Identification

A sensitive detector for assay of alpha and/or beta emitting radioactivity is available in the Radiation Safety Office; a germanium detector or equivalent along with computerized multi-channel gamma analyzer for identification/quantification of specific gamma emitters is available in the Radiation Safety Office. Also available are several NaI spectrometer systems, an alpha spectroscopy system, and a liquid scintillation counting system.

8.2.4 Non-radiological Instrumentation

Readouts for reactor related parameters such as primary coolant temperature, primary coolant flow rate, pool water level and reactor power level are available in the reactor control room.

8.3 Handling of Contaminated Personnel

8.3.1 Facilities and Handling Methods

Decontamination facilities within the operations boundary include the wash sinks on the third, first, and basement levels. A decontamination shower is available in the basement hot lab within the operations boundary. All drain to a holding sump. One or more sinks within the ESC may also be used if necessary for minor decontamination of personnel. Additional sinks and at least one chemical decontamination shower may be made available within the attached building if needed.

Uninjured, grossly contaminated personnel would normally be routed to the decontamination shower where contaminated clothing would be removed, and body contamination would be removed through showering. Individuals would be monitored prior to, during and after decontamination efforts.

In case of a contaminated individual with a minor injury, decontamination would be performed to the extent possible and

medical assistance would then be obtained if necessary; first aid would be administered as required.

For more serious injuries decontamination may not be advisable or possible, although removal of contaminated clothing may be possible. The medical emergency would take priority over the contamination, initial first aid would be administered, and arrangements would be made to transport the patient to a medical facility. Transportation would be by private ambulance service to a local hospital with which the University maintains a written agreement to handle contaminated injury cases.

8.4 Communications

8.4.1 Notification of Emergency Team Personnel

Activation of the radiation emergency alarm from the control room or from the Reactor Supervisor's outer office sounds alarms at these locations and is used to signal the need for the Emergency Team notification in conjunction with telephone communication as needed. The emergency team members will assemble at the emergency assembly area outside the first-floor airlock.

8.4.2 Notification of Support Personnel

Notification of support groups such as Lowell Police, Lowell Fire Department, ambulance service and medical facilities will normally be made through the Campus Police. Telephones are available in the reactor building and at least three locations in or near ESC; locations include the Radiation Safety Office, the Reactor Supervisor's Office, the Radiological Science Department Office.

8.5 Information to be Transmitted in Notification to the U.S. NRC and the Massachusetts Department of Public Health

Messages of notification to these agencies should include the following information:

1. Specifying the organization as the University of Massachusetts Lowell Research Reactor.
2. Name, title, and telephone number of caller.
3. Date and time of initiation of incident.
4. Reactor status/power level before and after the event
5. The reactor type (flat plate fuel) and max power level (1MW).

6. The event classification and description of the emergency event.
7. Type of expected or actual release (e.g., airborne, waterborne, surface spill) with estimated duration times.
8. The quantities and identities or radionuclides released or expected to be released.
9. Projected or actual dose rates outside of operations boundary.
10. Impact of releases and recommended offsite emergency actions.

8.6 Inventory of Emergency Equipment and Supplies

An inventory of emergency supplies and equipment shall be conducted quarterly. The inventory on hand in the emergency closet shall include at least the following:

l. At least two G-M detectors and ionization chambers to cover the range from at least 0.1 mR/hr to 50 R/hr.
2. Protective clothing includes gloves, coveralls, hoods, and booties.
3. .
4. Self-reading dosimeters, 0-200 mR and 0-200 R, personnel dosimetry badges (4 each).
5. One AC air pump that is AC and DC powered.
6. High efficiency filters and filter holders; charcoal cartridges and cartridge holder.
7. Absorbent paper, tape and/or rope for demarcating traffic pathways.
8. Flashlight and batteries.

8.7 Calibrations and Operation Checks on Portable Instruments

Portable health physics instruments shall be calibrated annually. Operation checks shall be performed each quarter.

9.0 Recovery Operations

Restoring the UMLRR to a safe operating condition after an emergency shall be the responsibility of the Emergency Director. The Emergency Director will direct operations necessary to restore the facility. Emergency Health Physics personnel with the assistance of E.T. Members shall survey, decontaminate, and ascertain that contamination and radiation levels within the affected areas are safe. The Reactor Operations staff makes necessary repairs, review the emergency, and authorizes continued operation of the reactor as per Technical Specifications.

10.0 Maintaining Emergency Preparedness

10.1 Training

Individuals with emergency response responsibilities will complete an initial training program and a biennial retraining program to include classroom training and practical drills. The training is designed to demonstrate an individual's ability to perform assigned functions such as accident assessment, decision making, radiological monitoring, contamination control, first aid, and rescue of personnel.

In addition, the University Police, Campus EMT's, City of Lowell Fire Department, the ambulance service, and Lowell General Hospital emergency room personnel are offered training on a biennial basis in radiation safety and emergency procedures. Attendees should include members from each of the above services who are likely to respond to a UMLRR emergency or managers who could train these first responders.

Conduct of Drills and Exercises

Onsite emergency drills will be conducted annually to test the adequacy of emergency procedures and to ensure that emergency organization personnel are familiar with their duties. These drills will be executed as realistically as possible and will include the use of appropriate emergency equipment. At least every two years provisions for coordination with offsite emergency personnel and support organizations will be tested.

Accident scenarios shall be developed for conducting drills to include:

1. Medical emergency drills involving a simulated contaminated individual.
2. Radiological monitoring including contamination control methods, dose rate measurements, nonessential personnel evacuation and record keeping.
3. Communication drills designed to ensure reliability of the system(s) and correct transmission and receipt of messages.

10.2 Critiques of Drills and Exercises

At the conclusion of each drill and critique to identify deficiencies shall be held by the drill participants and observers. Observers' and participants' comments concerning areas needing improvements shall be factored into possible changes in the Plan and procedures.

10.3 Emergency Plan Review and Update

The Emergency Plan shall be revised and updated as required based on drill results or changes in the facility. The plan shall be reviewed annually by the Reactor Supervisor and the Radiation Safety Officer to ensure the plan is adequate and up to date. Applicable portions of the plan, agreements, and implementing procedures shall be distributed to authorized agencies and support organizations as needed or upon request. Revisions to the plan and implementing procedures shall be approved by the Reactor Safety Subcommittee and sent to authorized recipients within 30 days after the revised plan and procedures have been issued.

10.4 Emergency Equipment Maintenance and Surveillance

Surveillance of emergency supplies ensures availability and proper condition for immediate use. The health physics staff is responsible for surveillance of emergency supplies. Emergency supplies are verified to be operational and complete on an annual basis, and fire extinguishers located throughout the facility are checked approximately semiannually by the University Safety Office.

End of Plan
(Procedures List Follows)

APPENDIX A

List of Emergency Plan Procedures

A. Non-Reactor Safety Related Event

EP-1 Personnel injury.

EP-2 Minor Fire or Minor Explosion at the Facility but Non-Specific to the Reactor or Its Control Systems.

EP-3 Facility or Individual Contamination.

B. Unusual Event

EP-4 Radioactive Effluents or Radiation Levels at Site Boundary projected to result in TEDE of 15 mrem accumulated over 24 hours.

EP-5 Bomb Threat or Credible Security Threat Affecting the Reactor Building

EP-6 Prolonged Fire or Minor Explosions within Facility but Non-Specific to the Reactor or its Control Systems.

EP-7 Report of Severe Weather Phenomenon Which Could Strike the Facility and Adversely Affect the Reactor Safety Systems.

C. Alert

EP-8 Radioactive Effluents and or Radiation Levels at Site Boundary Projected to Result in a TEDE of 75 mrem Accumulated over 24 hours.

EP-9 Radiation Levels and or effluents at site boundary Projected to Result in TEDE of > 20 mrem/hr for One Hour.

EP-10 Fire or Explosion Which Might Adversely Affect the Reactor or Its Safety Systems.

EP-11 Pool Level Alarm and Visual Observation Indicating Abnormal Loss of Water at a Rate Exceeding Backup Capacity.

EP-12 Security Breach Affecting the Reactor Building