


UNIVERSITY OF CALIFORNIA-IRVINE
NUCLEAR REACTOR FACILITY
LICENSE NO. R-116
DOCKET NO. 50-326

EMERGENCY PLAN
REVISION 4.2
JANUARY 29, 2019

REDACTED VERSION*

SECURITY-RELATED INFORMATION REMOVED

*REDACTED TEXT AND FIGURES BLACKED OUT OR DENOTED BY BRACKETS



UC Irvine Nuclear Reactor Facility *Emergency Plan*

FACILITY LICENSE R-116 – DOCKET NUMBER 50-326
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Revision History

Version 1.0: January 14th, 1985

Revision 2.0: April 1991

Revision 2.1: May 1996

Revision 3.0: May 2000

Revision 4.0: January 2009

Revision 4.1: March 7th, 2014

Revision 4.2: January 29th, 2019

Front Matter

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Implementation: This plan was first implemented in January 1985 when fully approved by the U.S. Nuclear Regulatory Commission. Certain provisions are able to be changed where the change clearly improves the capability for emergency response. Update revisions were made in 1991, 1996, 2000, 2008, 2012, 2013, and 2014 to correct changes in UCI Campus emergency plan structure, agency references and structures, and administrative organizations made in accordance with 10 CFR §50.54(q). No substantive changes have been made to the basic plan principles. Annual examination of this plan is done in conjunction with exercises to assure continuous implementation. Copies of key portions of this plan are made available to all agencies and personnel associated with its implementation and execution.

Applicable Regulations and Guidelines: This plan has been developed in accordance with Title 10 of the Code of Federal Regulations, Part 50, under which the facility is licensed by the U.S. Nuclear Regulatory Commission. In addition, Regulatory Guide 2.6, Revision 1, March 1982: "Emergency Planning for Research and Test Reactors", and American Nuclear Society Standard: ANS-15.16-2008, "Emergency Planning for Research Reactors" have been followed where applicable. Additional guidelines are contained in NUREG-0849, "Standard Review Plan for the Review and Evaluation of Emergency Plans for Research and Test Reactors", published by the U.S. Nuclear Regulatory Commission.

Additional information regarding the facility, and regarding general emergency planning for the UCI Campus may be found in the latest revisions of the following documents:

1. Standard Operating Procedures (SOPs) for the UCI Nuclear Reactor Facility.
2. Safety Analysis Report (SAR) for the UCI Nuclear Reactor Facility, updated November 1999 and with subsequent revisions.
3. UCI Radiation Safety Manual, available online at:
<https://www.ehs.uci.edu/programs/radiation/RadiationSafetyManual.pdf>
4. Emergency Radiological Procedures, available online at:
<http://www.ehs.uci.edu/programs/radiation/Emergency%20Procedures%20Rad%202004.pdf>

5. Emergency Management and Preparedness for UCI Campus, with general links to emergency response procedures at: <http://police.uci.edu/em/procedures/>
6. Emergency Operations Plan, available online at:
<http://police.uci.edu/em/EmergencyManagementPlan.pdf>

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Section 1

Introduction

1.0 Scope

The Emergency Plan is designed to provide a basic planning document for anticipated emergencies arising in connection with operation of the UC Irvine Nuclear Reactor Facility. Where possible, it integrates with standard campus procedures that are established for dealing with a variety of emergency situations. This plan focuses emergencies that are specific to the facility and the credible accidents that might arise as a result of facility operation or disaster related incidents. Detailed procedures for anticipated events are not included in this document, but are separately maintained as part of the facility's Standard Operating Procedures (SOPs).

This plan is not intended to preclude the need for professional and independent judgment by members of the operating team. In particular, while the plan does not address this specifically at every step, it is a basic principle of this plan that:

WHERE NO NEED EXISTS FOR URGENT ACTION IN A SIGNIFICANT EMERGENCY SITUATION, FULL CONSULTATION SHALL BE MADE WITH ALL INTERESTED GROUPS BEFORE INITIATING FURTHER ACTION.

Such consultation may include safety personnel of the School of Physical Sciences, the Environmental Health and Safety Office (EH&S), members of the Reactor Operations Committee (ROC), and the Radiation Safety Committee (RSC).

1.1 Reactor Information

Licensee: The Regents of the University of California.

Operator: Department of Chemistry, University of California, Irvine.

Location: Room B54, Rowland Hall.

Reactor Type: TRIGA, Mark I (General Atomics Company, San Diego).

Fuel: Uranium / zirconium hydride alloy, 19.9% enriched in Uranium-235, 8.5% by weight uranium, stainless steel clad.

Type: Non-power reactor, 250 kilowatts steady state power maximum.

Operating License: R-116, Docket: 50-326 issued November 1969, renewed July 7th, 2016.

Schedule of Operations: As needed, no fixed schedule.

Operation Frequency: Variable, usually 1-10 hours a week, mostly during daytime hours.

Uses: Isotope production for tracer experiments and irradiation of specimens for chemical analysis by neutron activation analysis.

Education and training of students in radioisotope uses and techniques in radiochemistry.

Training of reactor operators for this facility and others.

1.2 Facility Description and Emergency Access

Maps showing the location of the facility with respect to the surrounding community, local buildings, and within Rowland Hall are separately available on a “need to know” basis. Complete details of the reactor installation are included in the UCI Nuclear Reactor Facility Safety Analysis Report (SAR) (March 1968, updated November 1999, and subsequent amendments). The reactor facility comprises a suite of rooms in the basement level of Rowland Hall. Normal access to the facility is controlled in accordance with the facility Physical Security Plan (PSP). Emergency vehicle access is provided at the loading docks for Rowland Hall and Reines Hall, from which the facility is also accessible. The service road to the primary Rowland Hall loading area is an extension of Bison Avenue leading directly from the freeway (State Highway 73). This loading area is well marked for emergency use as it is the access used by fire protection equipment responding to the building, and dry standpipe connections are provided at this location.

1.3 Credible Incidents for the UCI TRIGA Reactor

The TRIGA type of reactor, with its unique type of fuel, has been operated successfully at over sixty facilities world-wide, many of which have been in operation for more than thirty years. Considerable experience has been gained, therefore, with the system and the fuel. There have been no major incidents or any need for extensive emergency response. The engineering estimations for this reactor are well established and systems have been shown to behave as predicted.

Hypothetical accidents for this facility are discussed in the SAR, based on analyses conducted at existing facilities up to 1968, confirmed in 1999, and re-examined in recent years. These are:

1. Complete loss of reactor pool water, and
2. Leakage of fission products from a single fuel element into the pool water.

All more severe possibilities are considered to be incredible. Both of the above concerns are analyzed in the SAR using conservative assumptions. Two of these assumptions should be reexamined here:

1. A continuous, long operating schedule prior to the incident was assumed.

In its years of operation, the UCI reactor has never operated for more than a few hours per week, nor is a heavier operating schedule likely to be established. Thus, actual maximum fission product inventories will be much lower than those estimated in the SAR.

2. Fission products were assumed to leak from a single fuel element completely stripped of its cladding.

In the history of operation of this and all other TRIGA reactors, with records on several thousand fuel elements, no cladding failure of greater magnitude than a pin-hole has ever occurred. No detailed causal explanation for complete cladding loss can be envisioned. The computations presented in the SAR are thus included only for illustrative purposes and are considered to be orders of magnitude in excess of any realistic incident. The conclusions made in the most recently revised SAR were:

1. That several hours would elapse following a water leak from the bottom of the reactor tank before a significant radiation level would exist at any adjacent location, and
2. Fission product release from a fuel element in water would create significant maximum radiation levels in the reactor room but allow for prompt evacuation and much lower doses to nearby external laboratories, and the ventilation system operation in an emergency would result in minimal release, and thus exposures, to the surroundings.

Additionally, a potential emergency incident, radioactive material diversion, is included in the considerations of this plan, which is defined as the diversion (theft) of radioactive materials (source) from the facility. The PSP includes details of a response plan for such an incident, however, source identification and recovery procedures are included as part of this standard radiological emergency response plan.

Section 2

Definitions

This section lists the definitions for terms used in this plan that are not specifically defined in the body of the plan.

EH&S STAFF. The Assistant Vice Chancellor of Environmental Health and Safety and other personnel employed by UCI Office of Environmental Health and Safety who have qualifications in the area of Radiological Health and / or who have received training in procedures relating to emergencies with potential radiological consequences who will respond to the reactor facility in the case of emergency situations.

EMERGENCY. An emergency is a condition that calls for immediate action, beyond the scope of normal operating procedures, to avoid an accident or to mitigate the consequences of one.

EMERGENCY CLASSES. Classes of events grouped by severity level, in increasing order of severity for which predetermined measures should be taken or considered.

EMERGENCY ACTION LEVELS. Specific values of observations from instruments, or otherwise, that may be used as thresholds for establishing emergency classes and initiating predetermined emergency procedures.

OPERATIONS BOUNDARY. The area within Rowland Hall known as the Nuclear Reactor Facility, comprising five Rooms: B54, B54A, B54B, B62 and B62A on the service floor, over which the Reactor Supervisor has direct authority. This area has predetermined evacuation procedures. This area is under the general authority of the Vice Chair for Facilities of the UCI Department of Chemistry. General maintenance is the responsibility of the Facilities Manager of the School of Physical Sciences.

EMERGENCY PLANNING ZONE (EPZ). The operations boundary for this facility. Planning for emergencies within this zone is accomplished to protect the public outside of this zone in the event of an accident.

UCI PD. The Police Department directly under the authority of the Chancellor, UCI.

OFF-SITE. The area beyond the Site Boundary.

OFF-CAMPUS. The area beyond that under the direct authority of the Chancellor, UCI.

ON-SITE. Synonymous with the area within the Site Boundary.

ON-CAMPUS. The area of UCI, including the Reactor Facility, under the direct authority of the Chancellor of UCI.

REACTOR OPERATIONS COMMITTEE (ROC). An administrative committee of faculty and staff established by authority of the Chancellor and reporting to the Dean of the School of Physical Sciences to oversee operation of the Reactor Facility.

RADIATION SAFETY COMMITTEE (RSC). An administrative committee of faculty and staff established by authority of the Chancellor to oversee all uses of radioactivity and radiation on the UCI Campus.

REACTOR STAFF. Personnel employed on a full time, part-time, or occasional basis to assist in the overall operations of the facility. This staff may include personnel with experience as health physics technicians or technologists employed part-time at the facility to assist with the radiological safety program.

SITE BOUNDARY. The area immediately surrounding and including the Operations Boundary that may be controlled by the Emergency Responders during an emergency. This includes all the hallways and the loading dock immediately surrounding the Operations Boundary. This area is frequented normally by people who are unacquainted with reactor operations, and is fully open to public access during working hours.

Section 3

Organization and Responsibilities

3.0 Introduction

The UCI reactor is operated by the Department of Chemistry in the School of Physical Sciences. Operations are in support of the overall academic program. An organizational chart for the associated relevant administration is shown below.

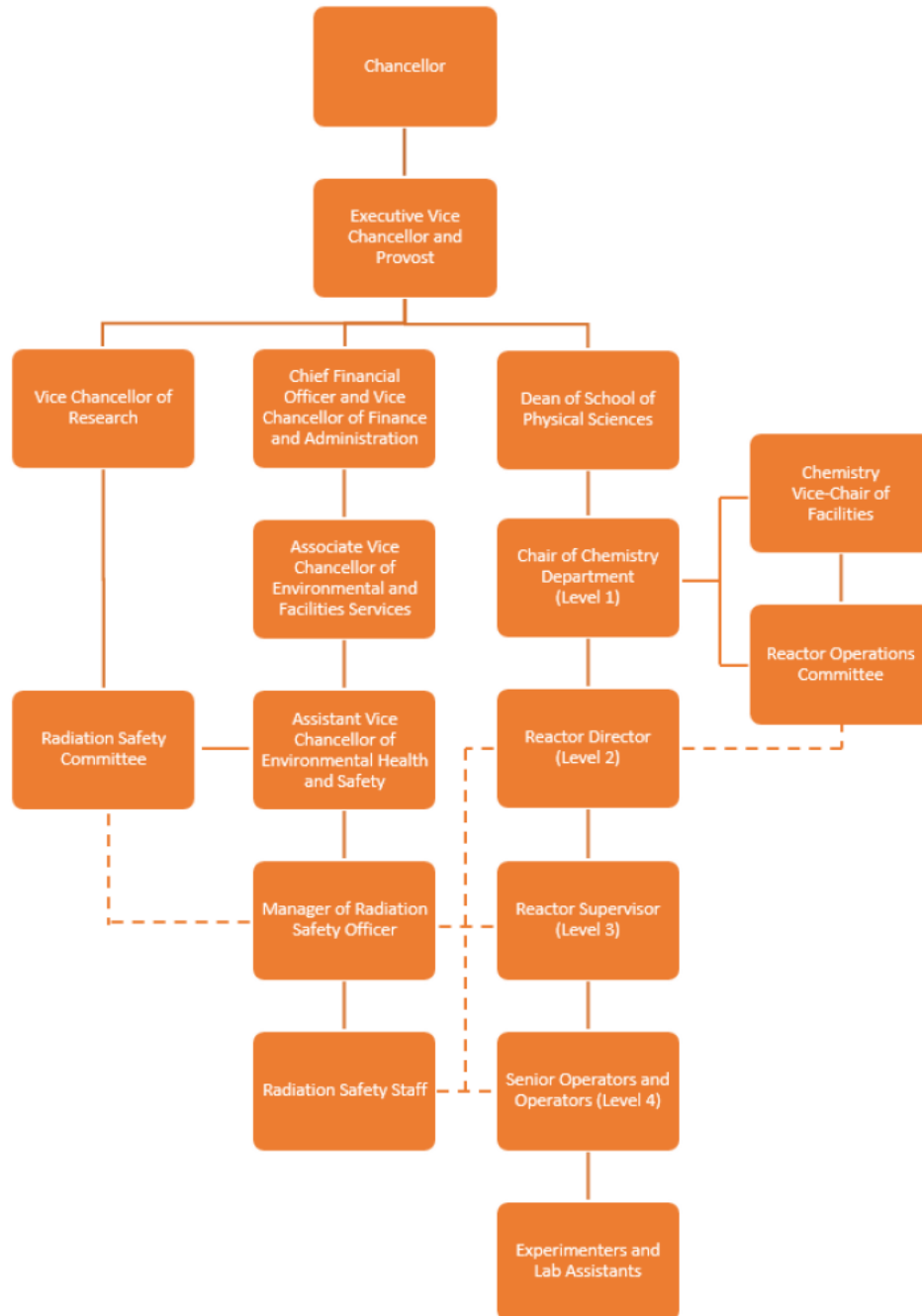


Figure 1 - Organizational Chart

3.1 Interactions with Government Organizations

It is not anticipated that an emergency will arise which will require direct immediate interaction with off-site government agencies. The University of California, Irvine is a quasi-governmental agency with its own fully authorized police department responsible for campus emergency planning and communication with off-campus agencies. UCI PD is fully cognizant of special situations regarding the reactor and emergency procedures specific to it are incorporated into campus-wide emergency and disaster response plans.

Fire protection and para-medical assistance is provided for UCI by Orange County Fire Authority. Response times to Rowland Hall are in the range of 5 to 15 minutes. The UCI Police Department maintains 24 / 7 contact with all off-campus emergency and back-up services.

Hospital resources to be used are determined by the para-medical group. Local hospitals and fire authorities undergo training in emergency preparedness for radiological emergencies in association with response for the San Onofre Nuclear Generating Station (SONGS) located south of UCI.

UCI Student Health personnel may be available for assistance with minor injuries during regular working hours.

3.2 Reactor Emergency Organization

The emergency personnel include the Reactor Supervisor, Associate Reactor Supervisor, licensed senior reactor operators and operators (if any), reactor staff (if any), EH&S staff, including the Manager, Radiation Safety Division (RSO), and members of the UCI Police Department.

A flexible emergency organization is needed because of the small size of the reactor staff and the probability of absences because of illness, vacation, or leave. Because of the expertise of the EH&S staff, it is likely that they will be part of the emergency response team. Emergencies having radiological implications will most likely arise during experiments or fuel handling operations, when there will be a Senior Reactor Operator present, but such emergencies can also be handled / effectively by EH&S staff. During off-hour emergencies and in the case of catastrophic disasters in which the whole campus is alerted, procedures are established whereby the UCI PD dispatcher will locate and advise at least one reactor staff member and one EH&S staff member, using Emergency Call Lists maintained at the dispatch desk. The first reporting staff member will be the Incident Commander (see below) until a higher designated individual on the succession list responds.

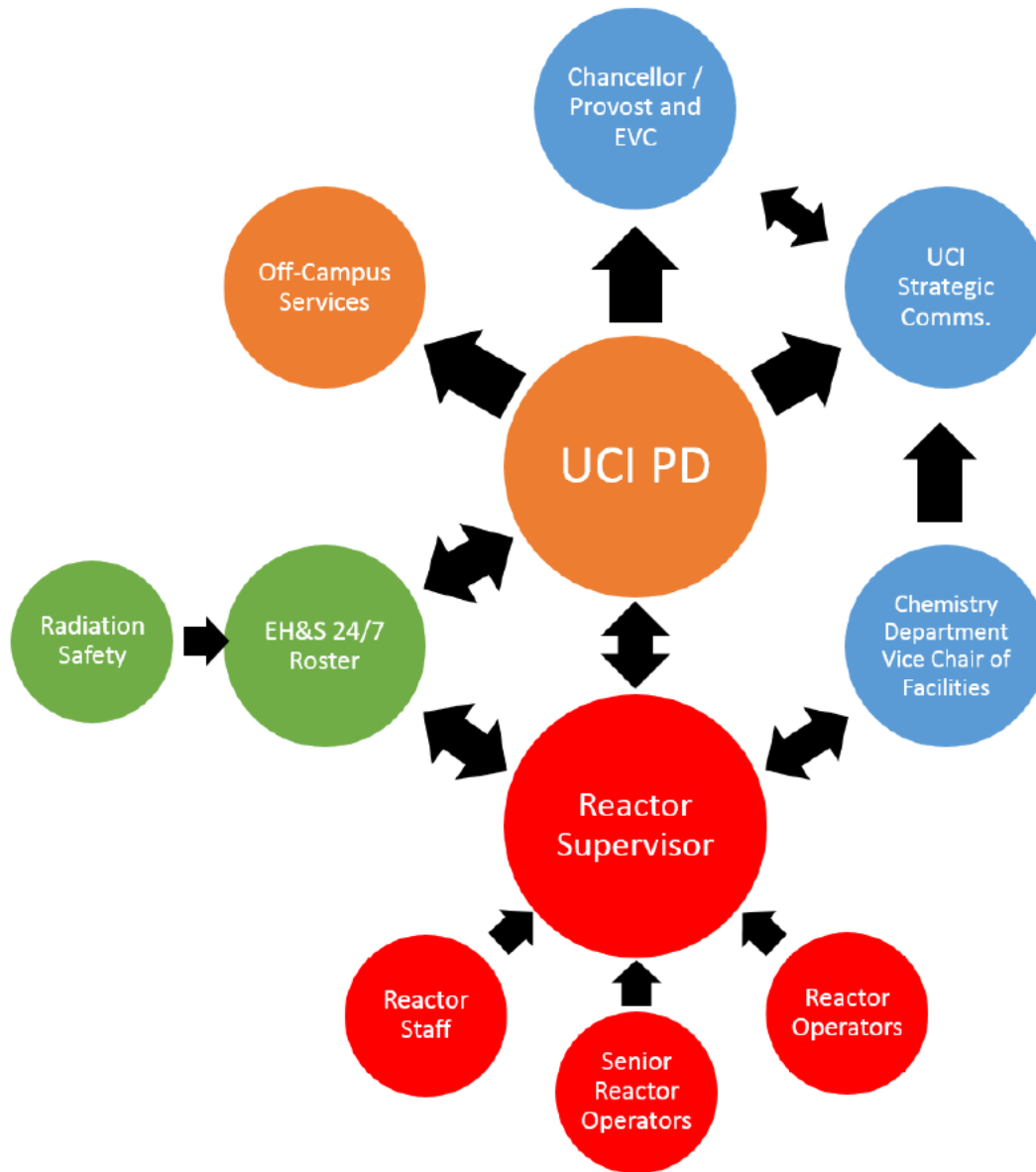


Figure 2 - Reactor Emergency Organization

3.3 Interface and Communication

In an emergency on campus, all communications are routed through the UCI PD dispatch desk by regular telephone, special direct lines ("Emergency Telephone"), or mobile communication maintained by all police officers and EH&S staff. Verification methods are developed and performed by the Police Department. Officers are normally dispatched to the site to verify every report, whether believed to be false or not. If off-campus agencies become involved, with the approval of UCI PD, they will establish and staff their own Command Post for the emergency. Until such Command Post is disbanded, incident control will remain entirely with that site.

3.4 Succession of Roles

In the event of the absence or incapacity of a specified individual represented on the above reactor emergency organization chart, the succession for each role of the next available individual is described in the following sections.

3.5 Reactor Incident Commander

The Incident Commander has responsibility for situation assessment, directing actions, and discharging of other duties as outlined in this section unless and until superseded by off-site agency(s). To provide for orderly authority, the following line of succession shall be followed:

1. Reactor Supervisor
2. Other Senior Reactor Operator (if any)
3. Reactor Staff – Most technically experienced on-site member
4. Manager, Radiation Safety Division or designee from EH&S staff
5. Facilities Manager for School of Physical Sciences

Standard Operating Procedures (SOPs) of the reactor facility provide for persons next in line on the facility staff to assume acting titles during absence or incapacity of more senior personnel.

When Orange County Fire Authority (OCFA) is summoned, they assume command of any incident until authority is handed back to UCI personnel. The OCFA Battalion Chief will normally be in charge, but will be advised by UCI emergency personnel as listed in the chart.

3.6 Reactor Emergency Coordination

The Manager, Radiation Safety Division, and the Reactor Supervisor as the Emergency Coordinators have joint responsibility for the Reactor Emergency Plan and its maintenance, assisted closely by EH&S staff and reactor staff.

An Emergency Management Director is responsible for maintaining liaison with off-campus agencies and for planning exercises and drills involving both on-campus and off-campus personnel. This responsibility may be delegated to UCI PD or EH&S staff.

3.7 Public Information Releases

Responsibility for release of UCI information to the media and the public rests with UCI Strategic Communications. All information will be transmitted to that office by the Vice-Chair for Facilities of the Chemistry Department. The Incident Commander will ensure that necessary information is provided. Other emergency personnel will communicate through these individuals, or directly to

the Reactor Supervisor. In the absence of the Chemistry Vice-Chair for Facilities, the following are designated UCI alternatives, in order:

1. Chair, Reactor Operations Committee
2. Assistant Vice-Chancellor, Environmental Health and Safety
3. UCI Campus Fire Marshall
4. Reactor Director
5. Reactor Supervisor
6. Manager, Radiation Safety Division

When off-campus agencies are involved, public information officers (PIO) from the agencies will partner with UCI Strategic Communications PIO in a Joint Information Center (JIC). All communications with the public will be drafted by the JIC, approved by the Incident Commander and Chemistry Vice-Chair Facilities, and subsequently released by the JIC.

3.8 Radiological Assessment

Responsibility for radiological assessment rests with the Incident Commander. Assistance will be provided by EH&S staff supported by reactor staff. This responsibility may be delegated to EH&S. Capability for radiation monitoring at low and high levels is maintained at EH&S which has capability for on-campus monitoring independently of the reactor facility. No requirement for off-campus monitoring is anticipated by this plan, although OCFA maintains radiological assessment equipment and will perform its own assessments during any incident to which they have responded.

3.9 Recovery Operations

Recovery operations will be performed under the joint direction of the Reactor Supervisor and the Manager, Radiation Safety Division (RSO). This responsibility MAY NOT BE DELEGATED other than to personnel in approved acting capacities. Assistance will be provided by:

1. Reactor Operators and Reactor staff (for physical assistance)
2. EH&S Radiation Safety staff (for assessment and decontamination)
3. EH&S other staff (for general support)
4. Facilities Manager and staff for School of Physical Sciences (all planning and liaison)
5. Facilities Management Personnel (general maintenance and reconstruction)

6. Contractor, Emergency Support (as described in the UCI Campus Emergency Operations Plan aka “Red Book”)

3.10 Termination of Emergency, Recovery, and Facility Re-entry

Responsibility for determining termination of emergency operations, as far as the nuclear reactor is concerned, rests with the Incident Commander. General campus emergencies are dealt with in the Campus Emergency Operations Plan and may supersede actions by the Reactor Incident Commander. This MAY NOT BE DELEGATED beyond the normal succession list.

Involvement of off-campus agencies will require that they release authority back to UCI personnel for the above action to be permitted.

Once a determination has been made that the emergency incident is closed, authorization for facility re-entry and resumption of normal operations may only be given by the Reactor Supervisor or in her or her absence / incapacity, a licensed Senior Reactor Operator, with the concurrence of the Manager, Radiation Safety Division (RSO). Extensive recovery operations, if needed, shall also be authorized with the concurrence of the Reactor Operations Committee, and School of Physical Sciences facilities and emergency personnel.

3.11 Authorization of Exposures beyond Normal Occupational Limits

The Incident Commander, with the consent of the Manager, Radiation Safety Division or his / her delegate, may authorize deliberate and predictable exposure to UCI-based workers in excess of normal exposure limits in extreme circumstances with the informed consent of the individuals involved (see Section 7.4 below for guidelines). THIS RESPONSIBILITY MAY NOT BE DELEGATED beyond the normal succession of authority. Careful documentation of the justification and the resultant actual exposure measurements must be made and maintained. Off-campus agencies retain complete authority over their own personnel at all times, and will follow their own procedures.

Section 4

Emergency Classification

4.0 Introduction

To aid in systematic emergency response, classifications are established for anticipated credible conditions that may lead to the need for special actions. These classifications are intended to be consistent with guidelines contained in 10 CFR §50, Appendix E, Section IV.c, 10 CFR §20, and ANSI Standard 15.16-2008.

4.1 Class 0 – Events Less Severe than the Lowest Category

Events of this category include conditions that may indicate a need for temporary interruption of normal operations but which are very unlikely to lead directly to increased exposure of individuals or more than trivial release of radioactive materials. Notification to the Reactor Supervisor or to EH&S is required. This class includes such events as:

1. Civil disturbances or bomb threats non-specific to the reactor.
2. Personnel injury with no radiological involvement.
3. Accidental dropping of small items into the reactor pool.
4. Failure of a sample transfer container and subsequent inability to retrieve a sample from an in-core irradiation facility during the conduct of an experiment.
5. Intrusion, or threat of intrusion of water into the facility.

4.2 Class 1 – Notification of Unusual Events

Notification of unusual events may be initiated by man-made 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 precautions and corrective steps to prevent the escalation of the event and / or to mitigate the possible consequences. No releases of radioactive materials requiring off-site response are expected. Interruption of normal activities is expected. Conditions which may lead to an unusual event include:

1. Threats to or breaches of security.
2. Fire or minor explosion in the reactor room.
3. Unplanned intrusion of large amounts of water into the facility.
4. Significant seismic activity felt in the facility.

5. Noticeable abnormal loss of pool water.
6. Indications of possible fission product release from a fuel element.
7. Indications of significant release of radioactive material or unexpectedly high radiation levels from an experiment that could result in significant overexposure of personnel.

4.3 Class 2 – Alert

Events leading to an alert condition are such that response is required to control or limit a serious radiological hazard. Radiation releases are expected to be limited to small fractions of EPA Protective Action Guideline exposure levels. Normal operations will be suspended and evacuation of the reactor room is likely. Monitoring at facility (site) boundaries will be initiated to anticipate the need for offsite protective actions. Conditions which might require such alert include:

1. A fuel handling accident in which major damage to fuel cladding occurs.
2. Large releases of radioactive materials from an experiment or creation of a high radiation area for more than a few minutes.
3. Explosion in the region of the reactor core.
4. Reduction in the level of pool water to below five feet above the reactor core.

4.4 Class 3 – Site Area Emergencies

For this facility, the site area has been established as the operations boundary of the facility for emergency purposes. Imminent danger to the public is anticipated. If complete loss of shielding pool water were to occur, radiation levels in excess of 100 mrem / hr could exist in the rooms and corridors over the reactor room for an extended period. While this is a serious off-site situation, it is inconceivable that the incident would not have been detected and treated as a Class 2 incident. Protective action in the form of additional water and building evacuation would already have been accomplished since adequate time is available for such response. Thus, no separate, unique site area emergencies are anticipated. All credible incidents will begin as Class 2 or lower.

4.5 Class 4 – General Emergencies

This class, which involves core degradation or meltdown and loss of containment / confinement integrity with large radioactivity releases, is not considered credible at this facility.

Section 5

Emergency Action Levels

5.0 Introduction

Emergency action levels are based on conservative alarm level settings established to provide early warning of the need for special action. The element of time is important. Brief excursions of instrumentation during power surges or during experiment handling may be considered normal. Many events, by their nature, provide their own action level, such as a telephone call regarding a bomb threat, and are not separately treated below. Action levels are not intended to preclude independent judgment on the part of an individual that an emergency really exists. They are merely upper limits beyond which no doubt should exist that the emergency procedures should be initiated. Protective action is taken in response to action levels being exceeded that will minimize exposure to on-site personnel to well below 1 rem whole body or 5 rem thyroid exposure.

5.1 Class 1 – Notification of Unusual Events

Section 4.2 lists seven conditions, which are also listed here with their proposed action levels.

<u>Event</u>	<u>Action Level</u>
1. Threats to or breaches of security.	<ul style="list-style-type: none"> • Alarm, telephone, verbal, or written report. • Interception of unknown intruder, discovery of forced entry, etc.
2. Fire or minor explosion in reactor room.	<ul style="list-style-type: none"> • Observation. • Fire alarm.
3. Unplanned intrusion of large amounts of water into the facility.	<ul style="list-style-type: none"> • Observation. • Notification of Facilities Manager.
4. Significant seismic activity felt in the facility.	<ul style="list-style-type: none"> • Noticeable disturbance. • Objects falling in pool. • Water in pool splashing over side of tank.
5. Noticeable abnormal loss of pool water.	<ul style="list-style-type: none"> • Unexpected finding of pool water level below 1 inch below slots on rod drive barrels or water level detector. • Actuation of pool water level alarm.
6. Indications of <u>possible</u> fission product release from a fuel element.	<ul style="list-style-type: none"> • Sharply increasing air monitor indication following full power operation or pulse by more than twice background. • Air monitor alarm (5000 cpm)

7. Indications of significant release of radioactive material or unexpectedly high radiation levels from an experiment that could result in significant overexposure of personnel.	<ul style="list-style-type: none"> ● Actuation of any fixed area radiation alarm (10 mr / hr) and failure to reset within 5 minutes. ● Air monitor alarm (5000 cpm) and failure to reset promptly ● Portable monitor indication of 1 R / hr or greater and failure to shield the source within 2 minutes. ● Actuation of the LS or PT fixed area radiation alarm (100 mr / hr) and failure to reset within 5 minutes.
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5.2 Class 2 - Alerts

Section 4.3 lists four events which require alert status:

<u>Event</u>	<u>Action Level</u>
1. Fuel cladding damage.	<ul style="list-style-type: none"> ● Visual observation. ● Consistent bubbling from fuel element in water.
2. Large radioactive materials release or high radiation area establishment.	<ul style="list-style-type: none"> ● Air monitor reading of >10,000 cpm. ● Fixed area radiation monitor reading of >100 mr / hr for more than 5 minutes.
3. Explosion in reactor core.	<ul style="list-style-type: none"> ● Auditory and / or visual indications.
4. Very low pool water level, within five feet of reactor core.	<ul style="list-style-type: none"> ● Pool fixed area radiation monitor alarm (10 mr / hr) for more than 5 minutes with pool water level alarm and visual observation of very low pool water level.

Section 6

Emergency Planning Zone

The Emergency Planning Zone for this facility shall be the operations boundary as identified by the area of the portion of the service floor level of Rowland Hall comprising Rooms B54, B54A, B54B, B62 and B62A. This zone is determined in accordance with Table 2 in ANSI 15.16.

Section 7

Emergency Response

7.0 Introduction

Notification, assessment, corrective action, and protective action items are designated for the main classes of emergencies at this facility. Additional information can be found in Chapter 6 of the facility Standard Operating Procedures (SOPs) for response on individual anticipated emergencies and ANSI 15.16, Table 1.

7.1 Class 0 – Events Less Severe than the Lowest Category

7.1.1 Activation of the Emergency Organization

Formal activation is not required for Class 0 events. If the reactor is in operation, the Operator-in-Charge will alert the UCI Police by telephone if a vague threat of disorder is received or if personnel injury occurs. For events 3, 4, or 5 listed in Section 4.1, the reactor will be shut down and Standard Operating Procedures followed by the operator.

7.1.2 Assessment Action

To confirm the absence of radiological hazard involvement, fixed area radiation monitor readouts and / or portable monitors, always available in the control room, will be used. Personnel should use monitoring to establish the absence of significant contamination and exit the reactor room. If contamination or release of radioactive material above the pre-event level is found, the emergency must be raised to Class 1.

7.1.3 Corrective Action

Written procedures exist in the facility SOPs for events where an object is to be retrieved from the pool, or a sample retrieved from an irradiation facility by a non-normal method.

Appropriate first aid or summoning of additional assistance via the UCI Police dispatch should be carried out in the case of injury.

7.1.4 Protective Action

Protective action in the event of a Class 0 event is mostly to ensure that no escalation occurs. Action which could promote release of radioactivity or creation of any radiation level must be avoided. Experimenters may be asked to remove samples to safe storage, or to move equipment, so that assisting an injured person, water clean-up, or retrieving objects may be accomplished easily. Persons should not be allowed to leave the facility unless fully checked for contamination. All exits from the facility shall be made through the control room unless this is impassable.

7.2 Class 1 – Notification of Unusual Events

7.2.1 Activation of the Emergency Organization

In the event that a situation judged to be in this class exists, the UCI Police Department will notify individuals on the Emergency Call List. The first to respond will assume the role of Incident Commander. A UCI PD unit will be dispatched to Rowland Hall to provide additional communications capability and support for area isolation.

7.2.2 Assessment Action

Assessment will vary with the type of emergency:

1. For threats to or breaches of security, the Incident Commander will work closely with UCI Police personnel to assess the situation. The information source will be questioned, if possible, according to posted procedures.
2. For fire or minor explosion in the reactor room, the Incident Commander will assess the possibility of prompt local control and stand by to assist with further assessment as the event proceeds.
3. For unplanned intrusion of large amounts of water into the facility, the Incident Commander will assess the possibility of prompt local control. Assuming the water is flowing from outside the facility, facilities management should be notified immediately via trouble service telephone (extension 4-5444). During working hours, additional assistance can be obtained quickly from Physical Sciences facilities staff located in the basement of Reines Hall (telephone numbers listed on Emergency Call list). Absorbent, barrier building materials and mops and buckets are available in the reactor facility and the emergency supplies closet for local control purposes. In addition, the facility has a vacuum that can be used for water, as do EH&S and UCI Facilities Management.
4. For significant seismic activity felt in the facility, such events will be assessed as to their impact on facility equipment, especially that related to safety and security. The need for prompt corrective action to mitigate the effects of continued events or aftershocks must be assessed rapidly.
5. For a noticeable, abnormal loss of pool water, rapid assessment must be performed for the rate of loss by timed observations. The availability of make-up water supply shall be ascertained from facilities management personnel.
6. For indications of possible fission product release from a fuel element, initial assessment is made by gamma ray spectrometry of the air monitor filter which has shown the unusual activity. HPGe and NaI(Tl) detector units are available for this purpose. Additional samples

may be collected using an air sampler if the release appears to be continuing. Since self-contained breathing apparatuses are not readily available at the facility, provisions have been made for air sampling of the reactor room from the control room to minimize personnel exposure. The facility may be sealed as far as possible, using masking tape around doors, while the situation is assessed.

7. For indications of significant release of radioactive material or unexpectedly high radiation levels from an experiment that could result in significant overexposure of personnel, assessment will be conducted by using portable monitors of ion chamber and / or Geiger counter type. If no abnormal level is assessed by such devices, investigation of the ARM and / or CAM control units for malfunction shall be carried out.

7.2.3 Corrective Actions

Reactor shutdown shall always be carried out immediately for suspected Class 1 events. The Incident Commander shall order evacuation of the facility by all personnel who are not directly involved in the follow-up emergency procedures. Such personnel must be checked for contamination upon exit unless the nature of the event is such that this would increase the potential hazard to personnel. The actions followed subsequently are detailed in the facility SOPs provided for such events.

In the case of fire, even if small and deemed controllable by local efforts in a very short time, the building fire alarm shall be actuated by using the pull box opposite the facility entrance door. Normal building evacuation will then proceed, and the Reactor Incident Commander should stand by at the loading dock area to provide information to fire protection personnel on their arrival. At that point, the Battalion Chief will assume incident command responsibility for the emergency and will consult with the Reactor Incident Commander until releasing authority back to UCI. Posted procedures require facility evacuation through the control room unless circumstances (such as fire) prevent this, in which case evacuation through the loading dock doors is permitted.

7.2.4 Protective Actions

1. In the event of establishment of radiation levels exceeding preset alarm levels, the reactor room will already have been evacuated by personnel responding to sounding of the alarm. The Incident Commander will visually check for personnel who have not evacuated and issue a further order over the address system. Further access to the area shall be limited to those responding to the emergency under direction of the Incident Commander.
2. Where release of significant airborne radioactive material is sufficient to activate the CAM, it will have actuated the ventilation system shutdown, and initiated the emergency exhaust. The Incident Commander will authorize the taking of samples of room gases, using the air sampler, for further assessment. To minimize the release, doors and other outlets will be

taped with masking tape. When available, knowledgeable staff may be dispatched to measure radiation levels on the roof.

3. For loss of pool water, the Incident Commander will direct addition of deionized water as make-up for loss, if the loss is observed to be less than 100 gallons per hour. For faster loss rates - considered to be essentially incredible - a hose may be used to the regular water supply. If it appears that losses cannot be made up readily, and that rapid loss continues, the Incident Commander will declare a Class 2 emergency and have the building evacuated.
4. During fire control operations, the Incident Commander shall at all times be at the Command Post for consultation to those directing the fire control. In this way, control of possible exposures to fire protection personnel can be aided, as can special needs of fire-fighting in the reactor area.

7.3 Class 2 – Alert

Events of this class are only credible when escalated from those of the previous class. Thus all of the actions in section 7.2 should be followed.

In the event of a Class 2 emergency, it is important that protective action be extended to evacuation of Rowland Hall. This will be accomplished following request from the Incident Commander to the UCI Police that the building be evacuated. If faster action is deemed necessary, the evacuation will be initiated by actuation of the building fire alarm. Evacuation route information is posted on each floor of the building. Building evacuation procedures are described in the campus Emergency Operations Plan, which specifies duties of zone crew who have been designated and trained for each floor in the building. Teaching personnel, such as laboratory instructors, also receive basic information in evacuation procedures. UCI Police Department will perform a search of the building to ensure that complete evacuation has been accomplished. History has shown that this can be accomplished within 15-30 minutes of an alarm. Assembly areas have been established for evacuating personnel.

7.4 Emergency Exposure Levels

Provision is made earlier in this plan for authority to permit individuals to exceed occupational exposure levels. Such exposures should only be permitted if it is clear that no alternative can be found, and that vital matters are to be accomplished. The usual published guidelines (U.S. Environmental Protection Agency, Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA-400-R-92-001, May 1992; NRC Regulatory Guide 8.29). However 10 CFR §20.106 limits such exposures to the annual limit (5 rem whole body, 50 rem extremities) so these lower limits shall also be followed if at all possible:

- Limit of 25 rem for emergency life saving

- Limit of 5 rem for measures to reduce severity of emergency – in terms of reduced potential hazard to individuals or the community, or protecting valuable property.

Exposures are to be on a "once in a lifetime" basis with older individuals being preferred if in good health. Personnel will not be permitted to receive such exposures merely to save equipment or experiments.

7.5 Emergency Health Physics Program

When feasible, the Incident Commander shall ensure that:

1. All emergency personnel are properly equipped with personal protective equipment and monitoring equipment.
2. An assistant, preferably from EH&S radiological safety staff, shall be assigned to monitoring and record keeping duties. This individual shall be positioned at a safe distance to:
 - a. Keep a complete log of the event, including names of all individuals and their assignments, monitors used and readings taken, sampling performed and subsequent assays.
 - b. Ensure that dosimeters or badges are worn by all participating personnel, and that dosimeters are read and reset on a frequent basis if significant personnel exposures are likely.
 - c. Assure that all calculations performed as part of the assessment process are recorded in the log.
3. The log record is reviewed by the Incident Commander and Emergency Coordinators (see Section 3.6) at the conclusion of the event before making formal reports.

In order to assist in the program, sufficient supplies shall be on hand (see later section) for all personnel, including log books to be used by the recording assistant.

The plan assumes that any off-campus emergency response teams are fully equipped and will follow their own protocols for monitoring personnel and logging of an incident.

Section 8

Emergency Facilities and Equipment

8.0 Introduction

Facilities and equipment are specified in this plan in anticipation of certain kinds of events. Unanticipated needs may arise and be supplied from other sources. For example, the Physical Sciences Storeroom in Reines Hall is a source of chemicals, towels, gloves, and other supplies, including kits for spill control. Back-up supplies and equipment are maintained by the Radiation Safety Division of EH&S. Considerable flexibility exists in maintaining supplies for emergency use at this facility. Therefore, the stock of supplies at the facility will be minimal, but adequate for handling of all small scale anticipated emergencies. Lists of emergency supplies will be maintained with the written emergency response procedures.

8.1 Command Post (CP)

If the Orange County Fire Authority has been summoned, a Command Post will be established by them. Otherwise, the CP shall be the reactor control room. Should the radiation level in that room exceed 10 mR / hr or should the glass partition between the control room and the reactor room be breached, the CP will be moved to any adjacent convenient area. Supplies are maintained in a storage closet off the hallway within easy reach.

8.2 Assessment Facilities

Permanent equipment installed in the reactor room includes a radiation area monitoring (RAM) system with several stations at the extremities of the facility, and a continuous air monitor (CAM). In addition, RAM stations, positioned to monitor samples being removed from the reactor, are installed at pneumatic load / unload termini and on the rotating specimen rack unload tube. All of these systems have audible alarm indicators and report to a central monitoring system which sends an alarm to the UCI Police dispatch desk system when a high level alarm is indicated and not silenced. In addition, a liquid scintillation counter for wipes and several portable monitors are provided. Liquid scintillation spectrometry systems are also available elsewhere on campus. In the facility are:

1. A gamma ray spectrometer with an HPGe detector or sodium iodide detector.
2. A liquid scintillation spectrometer with multiple sample carrier.
3. Portable Geiger and ion chamber monitors.
4. A small air pump and filter unit in the control room and attached to a hose leading into the reactor room used to sample particulate contaminated air without entering the reactor room.

EH&S maintains a liquid scintillation spectrometer and several portable instruments in a high degree of readiness for assay use.

In the emergency supplies closet are several auxiliary dosimeters for emergency use, as well as protective clothing, extra filters, and decontamination materials.

The pool low water alarm system actuates an alarm to the UCI Police dispatch desk system. Pool and fuel temperatures are monitored continuously at the reactor control console.

8.3 First Aid and Medical Facilities

UCI Medical Center and other local hospitals are designated radiation accident emergency centers, in association with San Onofre Nuclear Generating Station (SONGS). OCFA paramedics will arrange for transportation to the appropriate locations for medical treatment.

8.3.1 Decontamination

IF OCFA is responding, they will establish and operate a decontamination center at the loading dock area adjacent to the facility as needed. This also would be assisted by EH&S and reactor staff as part of their support action. Large polyethylene sheets are kept in the emergency store to be placed on the floors in the area to minimize spread of contamination. Decontaminated or partially decontaminated persons can be delivered to transportation directly at the loading dock. No special facilities for high level decontamination are provided, since such eventuality is not anticipated. Emergency contractor assistance will be coordinated by EH&S for additional decontamination / clean-up assistance. Written procedures are in effect for dealing with personnel contamination.

8.3.2 First Aid

Several staff personnel are qualified in first aid. Simple first aid supplies are maintained in the control room. Paramedic assistance is available locally (at OCFA) and response time is [REDACTED]. The on-campus student health center may be able to assist with emergency care to non-contaminated or mildly contaminated individuals during normal working hours.

8.3.3 Medical Care

Conceivable medical needs are met by OCFA paramedics, who will deliver patients to other facilities at their discretion.

8.4 Communications Equipment

The reactor facility is served by two telephone lines. Additional telephones are available in adjacent laboratories and offices. The UCI PD personnel are fully equipped with portable communications equipment, and a police unit responds to all emergencies in Rowland Hall. Several "panic" alarm buttons are located throughout the facility that report to the UCI PD dispatch desk. The dispatch

desk can view several camera views inside and outside of the facility. Personnel at the facility will have mobile phones and / or e-mail access.

8.5 Communication to NRC

The Reactor Supervisor is responsible for reporting emergencies to the NRC. Reporting requirements for the facility are detailed in the Technical Specifications, and in 10 CFR §20 and 10 CFR §50. NRC maintains a 24 / 7 Headquarters Operations Officer number for this eventuality. The Manager, Radiation Safety Division, will be responsible for reporting to appropriate State and County health agencies. UCI PD will maintain communication with and report to law enforcement agencies.

The report shall include the name, title, and telephone number for call-back of the caller, and the location of the facility at the University of California, Irvine. A brief description of the emergency event and the Class, if identified, shall be given, with the time and date of the initiation. If releases of radioactivity or radiation levels beyond the confines of the operations boundary have been observed or are anticipated, these levels should be reported. The probable duration of the event until secure status is achieved should be estimated.

8.6 Emergency Supplies

Immediate emergency supplies are maintained in the Reactor Storeroom. An inventory list of these supplies is maintained and verified on a routine basis by observation of items and use of a checklist.

The list is maintained by authority of the Reactor Supervisor and changes in inventory may be made with approval of the Reactor Supervisor. All instruments, where appropriate, shall be included in the regular testing and calibration program of the facility.

Additional emergency supplies for both radiological and non-radiological emergencies are maintained by EH&S at their facility. EH&S has procedures for maintenance of the emergency supplies and equipment. Responding OCFA HAZMAT teams are fully equipped for all aspects of emergencies including those with radiological aspects and are responsible for their own equipment.

8.7 Equipment Maintenance and Calibration

An appropriate schedule of equipment maintenance and calibration is used for emergency radiological assessment equipment, mostly following manufacturer recommendations. All portable instruments, including personnel dosimeters are calibrated as part of the campus-wide radiological safety program. This provides consistency among campus instruments. Instruments from the larger pool are loaned to the facility while facility instruments are being calibrated.

Section 9

Recovery

9.0 Introduction

Recovery operations are those operations designed to return the facility to normal operating condition following an emergency. For minimal but classifiable emergencies, this will mostly consist of verification that the conditions giving rise to the emergency no longer exist, and obtaining necessary approval for resumption of operations (see Sections 3.9 and 3.10).

9.1 Recovery Procedures

Section 3.10 of this plan specifies that recovery operations that are extensive must be approved in advance by the Reactor Operations Committee, and School of Physical Sciences facilities and emergency personnel. Evaluation and approval shall be documented in writing. Consideration must be given to assessment of levels of contamination and radiation which may exist after the event. If it is anticipated that personnel will be exposed to additional radiation during the course of the recovery, then careful prediction of the exposure to be received and measurement of the actual values must be documented, and ALARA principles followed. Professional contractor-based assistance is anticipated for any extensive (more than two hours) recovery operations. It should be noted that at the UCI research reactor there is no urgent imperative for restart so due consideration can be given to effectiveness in lieu of haste.

Special consideration should be given to establishing that hidden damage has not occurred to critical reactor or building components before declaring recovery complete.

Section 10

Maintaining Emergency Preparedness

10.0 Introduction

This section establishes procedures for personnel training and for continual review and update of the emergency plan. A meeting of senior personnel shall be held each year to review the plan and establish a schedule for training and exercises. This meeting may include the following personnel or their designated representative:

1. Reactor Supervisor,
2. Manager, Radiation Safety Division (RSO),
3. Emergency Management Director,
4. Chief of UCI Police Department,
5. A representative from Strategic Communications.

Other UCI and off-campus personnel shall be included as appropriate and available.

10.1 Training and Familiarization

Regular training shall be established for all personnel involved (see below). Affected personnel should receive familiarization training within 60 days of significant plan changes. New personnel should be familiarized quickly when their duties would involve them significantly in emergency operations.

10.2 Drills and Exercises

The Manager, Radiation Safety Division (RSO), and the Emergency Management Director shall, in coordination with other groups, coordinate a schedule and agenda for drills and exercises. Drills and exercises for this facility will usually be combined with training designed to refresh and prepare staff in use of procedures for handling likely emergencies. An on-site emergency exercise of such type shall be conducted annually. Over a period of time, they will include training in

1. Handling a possibly contaminated and injured individual.
2. Handling a contamination spill and / or gaseous radioactive material release.
3. Communication of reliable information among the various segments of response teams.

Where appropriate, personnel from the Orange County Fire Authority shall also be involved.

The agenda shall include observation and criticism of the exercise by at least one individual outside the immediate operating organization. A summary of this critique shall be prepared for submission to the Reactor Operations Committee for review. Serious flaws in emergency preparedness shall be brought to the immediate attention of the Assistant Vice Chancellor, Environmental Health and Safety for action to restore sufficient emergency response.

10.3 Plan Revisions.

Emergency Plan revisions shall be approved by the Reactor Operations Committee. Standard Operating Procedures relating to emergencies shall be updated to match approved changes in the plan.

The UCI Emergency Management Director or the Office of Environmental Health and Safety shall be responsible for annual verification of all agreements with off-campus agencies affected by or involved with this plan.

Emergency Call Lists and Emergency Equipment Inventory Lists shall be updated as needed, but verified annually, at intervals not to exceed 15 months.

Revisions shall be distributed on a need to know basis to all affected agencies within 60 days of authorization of the changes. Such distribution will normally be accomplished by distribution of complete copies of the revised plan and / or procedure rather than updated pages.

Emergency Plans are to be submitted to the US Nuclear Regulatory Commission as required by 10 CFR §50.54 and 10 CFR §50, Appendix E.