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AMERICAN NATIONAL STANDARDS

FACILITIES AND MEDICAL CARE FOR ON-SITE NUCLEAR POWER PLANT RADIOLOGICAL EMERGENCIES

EMERGENCY CONTROL CENTERS FOR NUCLEAR POWER PLANTS

RADIOLOGICAL EMERGENCY PREPAREDNESS EXERCISES FOR NUCLEAR POWER PLANTS

Prepared by

Working Groups of ANS-3.7

Of The

American Nuclear Society Standards Committee

Chairman: Ernest A. Belvin, Jr.
Tennessee Valley Authority
River Oaks Building
Muscle Shoals, Alabama 35660
(205) 383-4631 Ext. 2575

FOREWORD

These standards were developed by a Writing Group on Emergency Planning of the American Nuclear Society Standards Committee consisting of the following individuals:

Ernest A. Belvin, Jr., Chairman
Tennessee Valley Authority

Harold E. Collins
Nuclear Regulatory Commission

Robert L. Craig, M.D.
Tennessee Valley Authority

Aubrey V. Godwin
Alabama Department of Public Health

Dorsey C. Holsinger
Yankee Nuclear Services Division

Lionel Lewis, Subcommittee Chairman, N-682
Duke Power Company

Thomas Lincoln, M.D.
Oak Ridge National Laboratory

Roger E. Linnemann, M.D.
Radiation Management Corporation

John J. Mauro
Ebasco Services Inc.

H. Richard Payne
Environmental Protection Agency

Sidney W. Porter
Porter-Gertz

Fred Olson
Defense Civil Preparedness Agency

Margaret A. Reilly
Pennsylvania Bureau of Radiological Health

Donald Stands
Northeast Utilities Service Company

Eldon D. Testa, Subcommittee Chairman, N-684
Pennsylvania Power & Light Company

Billy Webster, Subcommittee Chairman, N-685
Carolina Power & Light Company

FACILITIES AND MEDICAL CARE FOR ON-SITE NUCLEAR POWER PLANT RADIOLOGICAL EMERGENCIES

1. Purpose and Scope

1.1 Introduction and Purpose. The operation of a nuclear power plant introduces risks of injury or accidents that could also result in the exposure of personnel to radiation or radioactive materials. It is important in such an event to have adequate first-aid and medical facilities, supplies, equipment, transportation capabilities, and trained personnel available to care for these persons.

The purpose of this standard is to give practical guidance to those persons responsible for preparing and implementing emergency plans at nuclear power plants for the care and handling of personnel involved in radiation accidents. This standard also provides a general guide for the extent of care which may reasonably be expected to be available at the plant site and at an off-site location, such as a local hospital.

The guidance contained in this standard for control of contamination, radiation, and exposure shall not be interpreted to preclude or inhibit life-saving efforts which is the prime consideration.

Emergency care may require treatment at a First Aid/Decontamination Facility on-site, or at the local hospital where initial medical care and follow-up or long-term definitive care is given. Definitive care, if needed, may require the services of a large medical center or a specialized definitive care facility. Emergency medical care requires a prepared plan involving on-site and off-site facilities and personnel, as well as communications and transportation. As such, it involves plant health physics and first aid personnel, ambulance and local hospital personnel, physicians and possibly consultant physicians.

Although this standard is intended primarily for those who operate nuclear power plants, it may also be useful to hospital administrators, as well as to local, state, and Federal agencies concerned with, or responsible for, public health and safety.

1.2 Scope. This standard provides guidance for first aid during an emergency and for initial medical care of those persons on-site who are overexposed to penetrating radiation (irradiated). It also provides guidance for medical care of persons contaminated with radioactive material or radionuclides who may also be irradiated or injured as a result of an accident at a nuclear power plant. It provides recommendations for facilities, supplies, equipment, and the extent of care both on-site where first aid and initial care may be provided and off-site at a local hospital where further medical and surgical care may be provided. This initial care continues until either the patient is released or admitted, or referred to another, possibly distant, medical center for definitive care. Recommendations are also provided for the transportation of patients and the training of personnel.

Recommendations for specialized care are considered to be beyond the scope of this standard on emergency medical care; however, since emergency and specialized care are related, a brief discussion of specialized care is provided in the Appendix.

This standard should be used by personnel responsible for planning facilities and implementing services to integrate the various capabilities at the on-site and off-site locations. A logical transition through first aid, transportation, initial medical care, and continued hospital care should be provided to be certain that quality services will be available at any time during such an emergency.

1.3 Exclusions

1.3.1 Radiation Accidents Not

Directly Relating to Nuclear Power Plants. Medical problems associated with nuclear warfare, medical administration of radionuclides, fuel fabrication and reprocessing, and all other uses of radiation or radioactive materials, other than those involved in the operation of a nuclear power plant, are excluded from this standard.

1.3.2 Managerial Prerogatives. The level of care that is provided at any specific location is a managerial prerogative, and is not specified in this standard. In some locations where specific facilities have been provided at a designated local hospital, there may be less need for an elaborate initial medical care facility on-site. The specific design and description of instrumentation is also excluded.

1.3.3 Quality or Details of Treatment. This standard does not provide the means by which the quality or the details of treatment at any facility or location may be judged.

1.3.4 Care Provided by Public Health or Civil Defense Authorities. This standard is not intended to provide guidance for the development of county and state disaster plans for the facilities, equipment, or extent of care which should be provided by public health or civil defense authorities for radiation accidents.

The circumstances under which medical attention would be required or useful for any off-site victims of a radiological accident should be determined by guidance provided by the state or local government public health officer in consultation with Federal health authorities, private physicians, and hospitals.

1.3.5 Preventive Radiation Protection Practices. This standard is not intended to substitute as a guide for proper radiation protection practices that may possibly have prevented or mitigated the radiation exposure of people involved in the accident.

It is assumed that trained radiation protection (health physics) personnel will perform the evaluation of radiation dose, the measurement of internal and external contamination for individuals involved in an accident, and assistance to medical and paramedical personnel treating an accident victim. It is also assumed that guidance will be provided by health physics personnel in delineating and evaluating the affected area and thus assisting public health authorities in deciding what action, if any, they may need to take for the protection of the general public.

1.3.6 Responsibilities for Providing Treatment. This standard does not provide guidance as to who is responsible for providing care both on-site and off-site. It is essential that these responsibilities be clearly defined before an accident occurs. Groups likely to be involved in the care of injured, irradiated, or contaminated patients should have participated in joint planning and in practice exercises, and rapport should have been developed.

1.3.7 Physical Injury or Illness Not Involving Radiation or Contamination. The management of injury or illness not involving radiation or contamination is excluded from this standard.

2. Definitions

absorbed dose. The amount of energy absorbed per unit mass of irradiated material. Measured in rads (radiation absorbed dose).

bioassay. Radioanalytical measurement to determine the absence of or the kind and amount of radioactive materials present in the body or body organs.

body burden. The total quantity of a radionuclide present in the body/organ.

body-burden analysis/whole body counting. Measurement of the

amounts(s) of radioactive material(s) in the whole body or body organs.

definitive care. The complete medical and surgical treatment of persons exposed or contaminated as a result of a radiation accident. If the exposure or injury was minor, definitive care would conceivably be completed at the time of first aid. With more severe exposures, it will require referral to either a designated local hospital or to a medical center with medical and surgical specialists knowledgeable in care of radiation accident patients.

designated local hospital. A hospital near the nuclear plant location where arrangements have been made in advance for the emergency care of personnel who have been injured, contaminated, or exposed. Definitive care may also be provided at this hospital if appropriate facilities and staff are available.

dose equivalent. A term used to express the amount of biologically-effective radiation when absorbed dose and modifying factors have been considered (i.e., the product of absorbed dose multiplied by a quality factor and by a distribution factor). Expressed numerically in rems (roentgen equivalent man), called more simply, "dose."

dosimeter. A device used for the estimation of radiation dose equivalent, such as a film badge or ionization chamber or thermoluminescent dosimeter (TLD).

exclusion area. The property immediately surrounding a nuclear power plant which meets the requirements of Title 10 CFR Part 100 for a specific plant.

off-site. Those areas outside of the nuclear power plant exclusion area.

on-site. The nuclear power plant buildings and grounds within the exclusion area.

personnel monitoring. Determination of dose rate and estimation of the dose equivalent of ionizing radiation which an individual has received, usually through the means of survey instruments, dosimeters or personnel monitoring badges.

personnel monitoring badge. A device worn by personnel containing film, thermoluminescent, or other material used to evaluate the dose equivalent which a person has received.

3. On-Site Facilities and Management

3.1 On-Site Medical Facility. The facility could be a first aid room or a more elaborately equipped dispensary. The facility shall contain first-aid equipment and personnel decontamination supplies. Provisions shall be made to also include a shower and clothing change room where a contaminated accident victim could be decontaminated and given appropriate first aid for injuries.

Persons irradiated, contaminated, or injured as a result of the accident situation may be brought to the on-site first aid facility. This facility should be located near the Radiation Control Area. The physician or trained medical personnel should always assume responsibility as soon as possible. Under certain circumstances, the initial medical care and radiation dose evaluation may be done on-site or it may be done in a special decontamination facility at the designated local hospital.

3.2 Monitoring and Dosimetry

3.2.1 Monitoring - Persons involved shall be monitored to estimate the extent of contamination of skin, hair, and wounds and dosimeters shall be collected and processed as soon as possible to estimate the dose.

3.2.2 Collection of Materials. If the need for immediate medical attention does not preclude this action, efforts to determine radi-

ation contamination or exposure should be started as soon as possible. Contaminated clothing should be removed. Surface contamination of the skin and hair can usually be located and a rough estimate of the amount made with the use of field instruments. Smears of associated tools, protective clothing, or the work area may be collected and analyzed, if necessary, in an attempt to identify the specific radionuclides, when internal contamination may have occurred. Nasal swabs, if collected within the first 5-10 minutes, can be used to assess the likelihood of internal respiratory tract contamination. Radioanalysis of urine and fecal samples as well as whole body counting may provide a better, although delayed, estimate of the amount of internal contamination and should be performed when appropriate as soon as body surfaces have been decontaminated. Instructions for the collection of these samples and the containers shall be provided. If the patients medical condition permits, removal of gross skin contamination should be performed before the patient is transported to another facility.

3.2.3 Dosimetry - Evaluation of External Dose for Diagnostic Purposes. Estimates of dose equivalent from dose rate and working time information shall be made if necessary.

3.3 Decontamination

Use of agents and methods in addition to showering and washing, to remove surface contamination and to reduce internal uptake and deposition of radionuclides should be started at the nuclear plant. Adequate preplanning and delegation of medical responsibility shall be done.

3.4 Communications and Records.

3.4.1 Communications. Effective communications shall be provided to advise personnel of any on-site emergency situation. Means for communications shall be provided within the

station, and with the physician and the hospital, to advise all concerned of the situation and the need for required emergency help and care. Plant personnel knowledgeable of the injury shall remain available for consultation until initial medical care has been completed.

3.4.2 Records - Records of Exposure and First Aid Treatments. A complete record of the history of the accident, names of personnel involved, physical findings, radiation measurements, treatment, and decontamination shall be kept. A brief but complete summary should accompany the patient when he is referred to the next location for further care. This information should accompany the individual through the initial care period at the designated local hospital and to the definitive care level.

3.5 Assistance by Health Physics Personnel for Initial Care at local Hospital. Health physics personnel shall be available for assistance in contamination control and consultation both at the plant and at the next level of care which is the local hospital. An experienced health physicist shall be available for consultation with the physician in regard to the radiological aspects.

4. Transportation

Transportation arrangements for site vehicles or ambulance services shall be preplanned. Life saving should receive first priority. Means should be provided to prevent or limit the spread of contamination during transportation to, and initial handling at, the local hospital.

Health physics personnel shall be available to assist ambulance and local hospital personnel in handling the contaminated patient, as necessary.

5. Initial Medical Care and Patient Evaluation

5.1 Off-site Facilities and Capabilities. The designated local hospital shall be capable of providing initial medical care and of evaluating the consequences of the radiation dose or the contamination that the patient has received.

5.1.1 Supplies. Decontamination and medical supplies, including protective clothing (coveralls, lab coats, shoe covers) and surgeons gloves, shall be available.

5.1.2 Radiation Monitoring Instruments. Either portable radiation monitoring instruments shall be brought into the facility at the time of need, or an instrument maintenance program shall be established to assure operability of instruments if stored at the facility.

5.1.3 Contamination Control Facility. Unless the patient's medical condition precludes this, a significantly contaminated patient should not be brought into the normal emergency room but into a special reception/decontamination/treatment area that has been preplanned. The special area should have direct access to the outside and should be immediately adjacent to the emergency room. Capabilities shall include at least the minimum described in this section (5.1) for the decontamination facility with surgical equipment available to carry out wound debridement if necessary. Such a facility should include a shower and a wash sink which can be accessible with a stretcher. It shall also include a table with a plastic grid on top, or metal tray upon which a contaminated and injured patient could be placed with minimal discomfort during a potentially prolonged washing-rinsing decontamination effort. The table should be at a comfortable working level for a surgeon, and access to all sides should be available for initial medical care if

required. Warm water should be supplied through a flexible hose regulated at the nozzle. Provisions should be made for collecting high-level contaminated water for appropriate later disposal; however release of rinsings through the sanitary system may be appropriate depending on existing regulations. Adequate lighting should be provided. Heating or air conditioning should be available to keep the patient comfortable. Steps should be taken to reduce excessive exposure of medical personnel as long as it does not impede life-saving events.

5.1.4 External Decontamination. External decontamination can usually be accomplished by simple washing. Complete decontamination is seldom possible but the residual level can usually be reduced so there is no hazard to the patient or health care personnel, and should be performed as soon as the patient's medical condition permits. Contaminated wound debridement and decontamination requires close cooperation between the surgeon and the health physicist who should be available to monitor tissue specimens for residual contamination. The physician responsible for the care of the patient shall make all treatment decisions and must not depend on health physicists for other than radiation exposure estimates. Advice from competent specialists shall be sought when the physician is uncertain of proper methods or the extent of decontamination procedures.

5.1.5 Internal Decontamination. Following immediate external decontamination and wound care, initial medical care should, if required, include the administration of agents which will reduce the uptake by body organs of radionuclides that have entered the patient's body via inhalation, ingestion, or wound contamination during the accident situation.

5.1.6 Coordination of Care. Provisions made for handling radiation injuries at the designated local hospital shall be closely coordinated with those of the plant and the ultimate definitive care center. The coordinator at the local hospital shall be a physician specially trained for the treatment of radiation injury.

In the great majority of instances, for those patients who require hospital treatment, all of the medical care required will likely take place at this hospital. It can be anticipated that even personnel with severe radiation exposure, which may require eventual transfer to a medical center or to a specialized medical facility for definitive care, will remain at this hospital for a day or two until the initial status evaluation is made and the immediate medical conditions stabilized.

The key person for handling radiation accidents at the designated local hospital should be a local physician on the hospital staff. He should already be a contract physician with the utility company involved. He should coordinate the hospital staff in handling radiation injuries and oversee the preparations and the establishment of plans for the initial care facility.

5.2 Radiation Dose Status Evaluation. The evaluation of the radiation dose requires an estimate of the time of exposure, length of exposure, type of exposure, and amounts and kinds of radioactive materials involved. Careful attention to the initial signs and symptoms of radiation exposure and the time of their occurrence shall be given to enable the physician to provide a dose estimate. Dose estimates shall be obtained as soon as possible from the health physicist at the nuclear power station. Previously taken bioassay samples shall be analyzed

or initial samples taken for these purposes. In addition, in vivo counting or followup in vivo counting shall be done as soon as the patient's condition warrants and as required based on estimates of internal contamination and uptake.

5.2.1 Laboratory Evaluation

Procedures should be developed which provide for the following:

5.2.1.1 Hematological Evaluation. Serial white blood cell and differential counts, including platelets, should be performed on all patients suspected of accidental whole body overexposure to penetrating radiation to evaluate the amount of exposure.

5.2.1.2 Collection and Evaluation of Nasal Swab, Nose Blow Samples, and Face Swabs. Mucus contaminated with particulate radioactive material in the anterior nares is cleared to the throat within 60 minutes, where it is swallowed and in the upper nasopharynx within 10 minutes; therefore, nasal swabs and nose blows should be taken as soon as possible after the accident and may not be of value if taken several hours after the accident.

5.2.1.3 Serial Collection of Excreta. If internal contamination may have occurred, all urine and feces excreted should be separately collected and refrigerated for possible bioassay until no longer needed. The time of collection shall be noted, and each container carefully labeled.

5.2.1.4 In Vivo Counting. In vivo counting shall be performed, as necessary.

5.2.1.5 Wound Monitoring. Monitoring of any wound should be performed to determine the extent of contamination and to assist in decontamination.

5.2.1.6 Additional Samples. Samples of additional specimens should be collected, such as blood for sodium-24 analysis after neutron exposure.

5.2.1.7 Chromosome Analysis. Chromosome analysis from white cells in whole blood is an extremely valuable biological dosimeter and should be performed for acute whole body over-exposures. Such analyses will require advance arrangements with a qualified laboratory. Ideally, blood specimens for white cell analysis should be collected as soon as possible after the exposure, heparinized, and shipped for analysis.

5.2.1.8 Tissue Specimens for Radionuclide Assessment. Material from the debridement of contaminated wounds can be counted and analyzed for the radionuclide involved.

5.3 Communications. Effective Communications among the plant, hospital, ambulance service, and the attending physician are absolutely necessary. The hospital contact point, such as a switchboard, should be available 24-hours per day. The persons staffing the contact point shall be familiar with the plans and procedures for handling radiation injuries.

Provisions shall be made for the coordinating physician at the local hospital to have access on a 24-hour basis to expertise on radiation injuries and radiation effects. The consultation may be required within a matter of hours to assist in the radiation status evaluation of the patient. Help on contamination or exposure control and evaluation of dose shall be available through the health physicist at the plant or elsewhere on the utility staff or from previously identified equivalent espertise.

6.0 Training

Personnel handling emergency patients on-site shall be trained in first aid and in the use of radiation monitoring and measuring instruments, and shall be familiar with procedures

for the handling of contaminated patients.

The ambulance service in the area of the plant shall be acquainted with the requirements for the transportation of radiation injury patients in general, with emphasis on contamination control for the contaminated patient.

Professional personnel, such as physicians, nurses, and emergency medical technicians, shall have appropriate training and periodic retraining provided by knowledgeable instructors in the handling of radiation accident victims.

One or more specially trained back-up or consultant physicians acquainted with emergency treatment of radiation injury and with the plans and procedures for initial care are also required. The coordinating physician should receive advanced training and retraining every 3-5 years in emergency treatment of radiation injuries; other hospital staff should receive basic and annual refresher training in the handling of contaminated patients. An annual exercise should be conducted in order to maintain interest and proficiency and shall be considered as part of the training and retraining. Emphasis in these training exercises should be on the emergency treatment of radiation injuries, reception and preparation of the patient, contamination and dose control, and training in the procedures and the use of the initial care facility.

APPENDIX (This Appendix is not a part of this stand , but is presented for information purposes only.)

Definitive Care

1. Evaluation and Treatment

The definitive evaluation and treatment of certain radiation injuries may have to be done at a large medical center having capabilities for various medical specialties. As such, this center would be the third level of care and would not be immediately required in the event of an accident. Distance from the plant site to the center is not an important factor. This center should be capable of evaluating and treating any type of radiation injury or illness.

2. Plans and Procedures

A large medical center acting as a definitive care facility should be coordinated with the plant and local hospital procedure. A single physician or designated alternate at the center should be the contact point for referral of patients from the various local hospitals. The local hospital coordinator should be aware of the mechanism for referral of patients.

3. Facilities and Capabilities

The most likely radiation injuries that would be referred to this medical center are those with localized high external exposures, whole body external exposures, and internal contamination. In order to evaluate and treat these types of injuries, a center should have expertise in the fields of health physics, radiobiology, surgery, internal medicine, and radiation medicine. This should include access to a well-equipped radiobioassay laboratory. In addition to the normal large hospital clinical laboratory, the center should have the capability to do lymphocyte chromosomal analysis.

The center should be experienced and equipped to recognize and care for bone marrow depression.

4. Staff, Personnel, Training, and Exercises

Any medical center that is going to serve as a definitive care center for radiation accident patients should have a committee that meets periodically to discuss the nature of radiation accidents and stay abreast of the latest developments in the field. This committee should consist of staff in internal medicine, hematology, radiology, radiobiology, health physics, radiochemistry, and surgery. Training and exercises in handling radiation accident patients are necessary, and should be conducted on an annual basis.

5. Back-up Support

Ideally, the center, staffed and equipped as described above, should be available to provide back-up support for the local hospital. Bioassay laboratories equipped to perform the functions listed above are important backup facilities. Most medical centers do not have this entire capability; consequently, if they are going to treat radiation accident patients, they should have access to utility or outside laboratories that have this capability. This coordination should be done during the initial planning phase.

6. Surgical

Surgical treatment is required for removal of contaminated foreign objects that have penetrated the skin. Generally this will and should be done at local hospitals. However, it may happen that the contaminated foreign body is in such a location that a more sophisticated surgical approach is required. It may be desirable to allow a continuing irradiation in order to transfer the patient to the medical center for this type of surgical treatment. The other type of radiation injury that would require surgical intervention at some point in time is severe external local irradiation, for example, to the hands or feet.

EMERGENCY CONTROL CENTERS FOR NUCLEAR POWER PLANTS

1. Purpose and Scope

1.1 Purpose

This standard provides guidance for the development and implementation of emergency control centers for nuclear power plants. The principal objective is to define the types of emergency control centers needed, as well as to delineate the minimum requirements needed to carry out the control centers' mission.

1.2 Scope

This standard provides requirements and recommendations for the mission, communications, instrumentation, and equipment associated with each type of control center. The decisional aids, manning requirements, and resources are also enumerated. The communications section covers the normal and alternate means of communications. The decisional aids cover both the accident assessment and the protective action area.

1.3 Esclusions

1.3.1 Public warning systems, instrumentation and equipment performance standards, education and training, and control center habitability, are not within the scope of this standard.

1.3.2 Recommendations and requirements for state and local emergency operating centers are not within the scope of this standard, however, guidance for the establishment of emergency operating centers for use by support agencies is included in Appendix A.

2. Definitions and Acronyms

corrective actions. Those measures taken to lessen the degree of consequence of, or to terminate an emergency situation at or near the source of the problem in order to prevent an uncontrolled release of radioactive material, or to reduce the magnitude of a release.

emergency control center (ECC). A facility operated by the licensee for the purpose of evaluating and controlling emergency situations and coordinating emergency responses.

exclusion area. That area surrounding the reactor in which the reactor licensee has the authority to deter-

3. Types of Emergency Control Centers

3.1 Nuclear Plant Control Room

3.1.1 Mission and Location. The Nuclear Plant Control Room shall be the initial on-site center of emergency control. The Nuclear Plant Control Room must be designed to evaluate and effect control over

communications with the emergency control center, and with appropriate off-site support agencies responsible for initial actions. At a minimum, the communications with the various emergency control centers shall include normal telephone communications and an alternate means. The alternate method may include, depending on the distances involved, sound-powered telephones, two-way radios, microwave, or the National Warning System (NAWAS).

3.1.3 Instrumentation and Equipment. The instrumentation and equipment requirements for the Control Room shall include (1) instrumentation to evaluate the principal plant variables indicative of the plant status and future conditions, (2) instrumentation to evaluate the release rate of radionuclides and the meteorological conditions (i.e., wind speed, wind directions, and stability) at the site, (3) access to instrumentation for radiological surveillance, and (4) equipment necessary to ensure the habitability of the Nuclear Plant Control Room during the course of an accident.

3.1.4 Decisional Aids. The emergency personnel shall have access to prepared isopleth dose curves (or their equivalent) for a broad range of representative release rates or source terms. Given a monitored or calculated source term and the meteorological conditions, the information from these curves can assist in providing an early estimate of the projected on- and off-site radiological impact and the time available to implement protective actions.

3.2 The Nuclear Plant Company Headquarters (i.e., home office). The headquarters shall provide the broad range of support which is not immediately available to the nuclear power plant. This shall

include (1) consultation regarding engineering and health physics concerns, (2) logistic support, (3) interfacing with government radiological assistance programs (i.e., Interagency Radiological Assistance Plan), and (4) legal, medical, and public information services.

3.3 Emergency Control Center (ECC).

3.3.1 Mission and Location. An Emergency Control Center (ECC) shall be designated to coordinate effectively all aspects of an emergency. The ECC shall receive data and recommendations from the Nuclear Plant Control Room, dispatch and direct all mobile emergency monitoring teams (see 4.1), receive data from the mobile teams, evaluate the data, and make recommendations to the Nuclear Plant Control Room and/or the Nuclear Plant Company Headquaters personnel and to off-site agencies regarding protective and restorative actions.

The ECC shall be at a location which facilitates the deployment of the emergency teams.

3.3.2 Communications. The communications network of the ECC shall have redundancy to assure communication links with the Nuclear Plant Control Room and off-site agencies.

3.3.3 Instrumentation and Equipment. All the instrumentation and equipment necessary for the ECC to perform its mission shall be located either within this center or at strategic locations which are readily accessible. Appendix B presents a detailed list of the recommended types of equipment.

3.3.4 Decisional Aids. The ECC shall have readily available the information needed to deal with all aspects of an emergency condition including controlled copies of the emergency plan and procedures. In addition to the isopleth dose curves or equivalent, this center should

have, for example, the documentation in support of these curves, detailed maps of the site and the area included in the detailed emergency plan, access to meteorological forecast data, drawings of the plant general arrangements, and copies of the Environmental Report and the Final Safety Analysis Report and other applicable up-to-date references.

3.4 Nuclear Plant Alternate Emergency Control Center. The alternate ECC shall be established and shall have the same minimum capabilities as the Emergency Control Center (ECC). It may be either fixed or mobile. This center is established if it becomes necessary to evacuate the primary center. The alternate emergency control center should be located outside of the exclusion area, yet conveniently close to the site. It should be located in the least prevalent wind direction, and should be located near the site of local agency emergency operations center (or near the area where the state will position a mobile EOC). The alternate ECC may be located in a mobile van, information center, or meteorological tower facility.

4.0 Manning Requirements. The emergency centers shall be manned by sufficient personnel to (1) coordinate the activities of the mobile emergency monitoring teams, (2) compile and evaluate the information and recommendations transmitted by the Nuclear Plant Control Room personnel, (3) communicate with each of the control centers, and (4) coordinate the overall emergency plan. Each individual shall be proficient in his area of responsibility.

4.1 Mobile Emergency Monitoring Team. The mobile emergency monitoring team members shall be predesignated and shall have the capability to perform radiation surveys, obtain

samples for radionuclide analysis, establish and post radiation and/or contamination area boundaries, monitor plant personnel, and determine personnel radiation exposures.

4.2 First Aid Teams and Personnel Decontamination. Team members shall be predesignated and qualified to carry out their responsibilities. Team responsibilities shall include evaluating the nature and extent of injuries to personnel, administering first aid, monitoring personnel for contamination, implementing personnel decontamination procedures, collecting bioassay samples, and preparing seriously injured personnel for transportation to a hospital.

4.3 Personnel Accountability. Personnel shall be provided to ascertain that all personnel in an affected area have been evacuated and to aid in locating missing personnel.

APPENDIXES (Th Appendixes, which are included for information purposes only, are not a part of this standar)

Appendix A

The content of this Appendix is not considered to be a requirement for state and local agencies. It is intended to be a guide for the establishment of emergency operation centers. Existing facilities and equipment should be used to the extent possible.

A1. Local Emergency Operating Center (EOC) (if applicable).

The establishment of the Local EOC depends upon the resources and political structure of the off-site support agencies. The local EOC houses the capabilities of the radiation assessment organization, and in some cases it will also house the Civil Defense capabilities. The facility(s) selected for the EOC should have the basic accommodations necessary for human habitation over an extended time period.

A1.1 Mission and Location

The Local EOC serves as a coordinating point for local agencies. It is the location at which raw data is collected and tabulated.

For nuclear power stations sited along rivers or other elongated bodies of water, alternate EOC's should be located on either side of the waterway.

The selection of a location for the Local EOC should be on a thoroughfare which is likely to be passable in foul weather and in the least prevalent wind direction.

A1.2 Communications.

Redundant communication links should connect the Local EOC to the central state authority. These links include a suitable mixture of telephone and radio.

A1.3 Instrumentation and Equipment.

A. Radiation Field Assessment:

(1) G-M and ion chamber rate meters for each survey team with an additional 50% for replacement due to failure or contamination.

(2) Pocket dosimeters or TLD badges for posting in the environs for unattended monitoring; TLD reader

as required, dosimeter charger as required.

(3) Prepared forms for each of the above considerations.

B. Inhalation Assessment:

(1) Two calibrated (AC-DC) air samplers to accept particulate filter and iodine collection media; a generous supply of filters and canisters.

(2) Availability to a pulse height analyzer (AC-DC) and suitable detector.

(3) Prepared forms for each of the above considerations.

C. EOC Protection:

(1) Protective clothing.

(2) Self-contained breathing apparatus or full-face respirators with a generous supply of replacement cartridges.

(3) Air sampler as per B(1) above.

(4) G-M and ion chamber rate meters.

(5) Integrating dosimeters (pocket dosimeters or TLD) for EOC surveillance as per A(2) above.

(6) Personnel dosimeters for the EOC staff and team members.

(7) Thyroid blocking agent supply sufficient to last a week to be provided for teams and EOC staff if the use has been previously approved.

(8) Prepared forms for recording measured exposure of team members and EOC staff.

D. Miscellaneous Items:

(1) Calculator.

(2) Flashlights.

(3) Tags, labels, etc.

(4) Rope.

(5) Masking tape.

(6) Plastic trash bags.

(7) Signs.

(8) Soap or detergent.

(9) Cash.

(10) Emergency generator.

(11) Tool kit.

(12) Batteries.

A1.4 Decisional Aids - Accident Assessment.

The decisional aids used by this EOC should be the same as those used by the nuclear power plant and by other Emergency Operating Centers. Items should include:

(1) Topographic maps covering the Emergency Plan Area.

(2) Transparent plastic to cover maps.

(3) Prepared isopleths.

(4) Meteorologic charts for estimating ground level concentrations by source height and stability class.

(5) Wind roses for the site.

(6) Guidance for selection of stability class.

(7) Written procedures.

(8) Written policy.

(9) Charts for conversion of dose rate to dose commitment.

(10) Prepared forms for data management.

A1.5 Decisional Aids - Protective Actions.

The assignment of responsibility for the selection of protective actions for the public will vary considerably depending on political structure and resource organization in the plant environs. Decisional aids used by all organizations should be consistent.

A1.6 Resources.

Resources available to the Local EOC will include some part of the human and material resources which county and state government would deploy in times of conventional crisis. Similar resource augmentation from Federal agencies having responsibilities for radiation protection is available. Planning activities should include consideration of these resources and the written procedure through which the resources can be made available and effectively used.

A2. County Emergency Operating Center (CEOC) (if applicable). If the selection of protective actions is part of the mission of the County EOC, the decisional aids described in section A3.5 should be available to the County EOC.

A2.1 Mission and Location.

The mission of the County EOC is one of coordinating the effort of local agencies and organizations in the emergency response. The mission should include coordination of dissemination of warnings, traffic control, shelter, feeding, transportation, security, and fire protection.

A2.2 Communications.

Reliable, alternate communication links should exist with the facility, the state or state area EOC, and with the EOC for each surrounding county.

A2.3 Instrumentation and Equipment.

Instrumentation and equipment for the assessment of radiation levels should be available.

A2.4 Decisional Aids - Accident Assessment.

The assessment of accident consequences should be provided by the facility, or by agencies having that responsibility.

A2.5 Decisional Aids - Protective Action.

The assessment of protective actions should be provided by the organization which recommendes the protective action.

A2.6 Resources.

Resources available to the County EOC will include the human and material resources which the county government has available to meet conventional crises. Similar resource augmentation is available from state and Federal agencies and from private organizations having interest in public health and welfare. Written procedures through which the resources can be accessed and effectively used should be developed.

A3. State Emergency Operating Center (SEOC) (if applicable).

State EOC's may include the State EOC facility in or near the state capital as well as State Area EOC's.

A3.1 Mission and Location.

The State EOC is a facility which provides state government with a central location from which the emergency functions of state government may be carried out in response to emergency conditions. The State EOC should be the center from which: (1) assistance to county and local government is coordinated; (2) radiological data and accident analysis information are sent for evaluation and decision; and (3) instructions for taking protective actions, for recovery and for other appropriate directions will originate.

The State EOC is a facility which is already in existence. It is usually situated in the state capital or in a location convenient to the state's chief executives and key staff.

A3.2 Communications.

The State EOC should have redundant communications systems with each County EOC, with the nuclear plant emergency control center, with the State EOC in each neighboring state, and with key Federal EOC's. In the event that the Local EOC is not in routine operation, the communication links (redundant) between that facility and State EOC should be establishable in a time period consistent with the arrival time of the staff of the Local EOC. These communications links may include:

National Communication Voice System (CDNAVS)*

National Communication Teletypewriter System (CDNATS)*

National Radio System (CDNARS)*

* These are available at the state level for interstate and state-Federal-communication.

National Warning System (NAWAS)

Federal Telecommunications System (FTS)

Wide Area Telephone Service (WATS)

Radio Amateur Civil Emergency Service (RACES)

Emergency Broadcast System (EBS)

State Radio Services: for example: State Police, Highway Department, Fish and Game Commissions, Forest Fire Network, National Guard, etc.

A3.3 Instrumentation and Equipment.

The State EOC ordinarily needs no specialized instrumentation and equipment beyond that needed for conventional emergencies.

A3.4 Decisional Aids - Accident Assessment.

The decisional aids used in the State EOC for accident assessment should be the same as those used by the nuclear power plant emergency control center and by the Local EOC. The State EOC should also have ready access to the Final Safety Analysis Report for each facility. The State EOC should have available a written procedure for the reconciliation of the various kinds of incoming data and information so as to allow effective decision-making in accident assessment and dose projections.

A3.5 Decisional Aids - Protective Actions.

The State EOC should have available a written procedure for the selection and implementation of specific protective actions. This procedure should take into consideration dose projection, weather, population distribution, and any pertinent demographic or geographic constraints.

A similar procedure for removal of restrictions should be available.

A3.6 Resources.

The resources available to the State EOC will include the human and material resources which are organized to meet conventional

crises. Resource augmentation from Federal agencies and private organizations should be assured through preplanned procedures.

Appendix B

Instrumentation and Equipment for the Emergency Control Center

B1. Emergency Supplies

B1.1 Instrument Kit

(1) Survey Meter ($\beta\gamma$) Low Range (capable of measuring < 0.2 mR/hr) and thin window (≤ 5 mg/cm^2).

(2) Survey Meter (γ) High Range (capable of measuring at least 25 R/hr).

(3) Air Sampling Equipment (capable of drawing >10 cfm). Operated by either battery (auto battery is good) or by a portable generator which is included with the kit. Wet strength filter paper plus charcoal (or equivalent media) canisters must be supplied for each type of air sampling equipment.

(4) Alpha Survey Meter (only needed if α emitters are a substantial portion of the source term).

(5) Sample Counting Equipment. A single channel analyzer (battery/AC operated is preferable) and NaI crystal for counting charcoal cartridges for ^{131}I. (The probable high ratio of noble gases to halogens make it impossible to interpret the charcoal cartridge with a survey meter). The NaI crystal should be stabilized so that the single channel analyzer does not drift.

(6) Personnel Dosimetry (enough for each emergency team member plus personnel manning the control room and ECC). Each person should have a TLD or film badge plus a high range (0 - 20 R) pocket dosimeter. Low range pocket dosimeters (0 - 200 mR) are optional. Pocket dosimeter chargers are also needed.

(7) Stopwatch.

(8) Check or Calibration Sources for Instruments.

B1.2 Data or Reference Kit (available for use).

(1) Utility Emergency Plan and Implementing Procedures.

(2) State Nuclear Emergency Plan and Implementing Procedures.

(3) Site Specific Area Maps (marked with cardinal polar coordinates, 22-1/2° sectors, with sector #1 splitting north). Additional road maps may be needed. All maps should have preselected monitoring points marked on them.

(4) List of Directions to Preselected Monitoring Points.

(5) Emergency Assignment Board (team lists, assignments, etc.).

(6) Forms for Surveys, Sample Counts, Exposure Records, Emergency Log Book.

(7) Telephone Notification Lists.

(8) Applicable Sections of Final Safety Analysis Report (FSAR) and Environmental Report (ER) (demography, land use, milch animal census, environmental monitoring program, meteorology).

(9) Isopleths or equivalent for Calculating the Expected Doses from Airborne Releases.

(10) Plant Layout Drawings (buildings and overall site).

(11) Note Pads, Pencils, Pens, Marking Pens.

B1.3 Protective Clothing Kit

(1) Coveralls

(2) Gloves (heavy and light).

(3) Head Covering.

(4) Shoe Covers.

(5) Respirators.

(6) Plastic Suits.

(7) Tape (wide, masking).

(8) Plastic Bags for Clothing.

B1.4 First Aid Kit and Skin Decontamination Kit.

(1) First Aid Supplies.

(2) Stretchers and Blankets.

(3) Decontamination Supplies.

B1.5 Communications Kit.

(1) Walkie-Talkies (or vehicle radios) for Emergency Teams.

(2) Two Way Radio for Control Room and ECC.

(3) Emergency Power Supply.

B1.6 Sample Collection Kit.

(1) Plastic Bags (various sizes).

(2) Plastic Bottles (various sizes).

(3) Masking Tape.

(4) Grease Pencil.

(5) Marking Pen.

B1.7 Miscellaneous Supplies.

(1) Spare Batteries for all Instruments and Equipment.

(2) Signs, Ropes, Flares.

(3) High Intensity Portable Lanterns.

(4) Flashlights.

(5) Smears and Envelopes.

(6) Fuses for Autos.

(7) Coins for Telephones.

(8) Syphon and Gas Cans.

B1.8 Decisional Aids - Accident Assessment.

(1) US Geological Survey topographic map scale covering the emergency plan areas is required. It should be marked in $22\text{-}1/2^{\circ}$ polar coordinates with sector 1 centered on north.

(2) Up-to-date meteorological data is required (a preplanned form).

(3) Up-to-date source release term data (a preplanned form).

(4) Site specific isopleths or equivalent for varying meteorological conditions for estimation of off-site dose commitment.

(5) Calculational tables for water release dose commitment.

B1.9 Decisional Aids - Protective Actions.

(1) Demographic data from FSAR and ER.

(2) Land use data from FSAR and ER (especially farm and milch animals locations).

(3) Lists of downstream water users, marinas, and other hydrological data.

(4) Meteorological data from FSAR and ER.

7. Medical Treatment

Radiation injuries that would be referred to the center for medical treatment include the patient who receives a high total body exposure in which an eventual bone marrow depression is expected, and the high level internal contamination which may require specialized bioassay and decorporation therapy.

RADIOLOGICAL EMERGENCY PREPAREDNESS EXERCISES FOR NUCLEAR POWER PLANTS

1. Purpose and Scope

1.1 Purpose. The development of emergency plans and procedures should provide for testing and evaluating the emergency response organization and decision making processes. To test and evaluate emergency plans and procedures, exercise scenarios should be used for drills or exercises. Emergency exercises are training activities that require a substantial effort to plan and coordinate effectively. The exercise trains personnel who would be expected to participate in the emergency response.

Emergency exercises should be conducted as realistically as possible. A real emergency will naturally impart stress on emergency response personnel and their organizations. Exercises should be designed to duplicate this sense of stress insofar as practical. An important element of testing the emergency response is to ensure that provisions have been made for observation, evaluation, and critiquing each exercise. These evaluations and critiques should be used to improve and revise emergency plans and procedures where required.

1.2 Scope. This standard provides requirements and recommendations for emergency preparedness exercises involving the initial action required to gain control of the emergency situation and to protect plant personnel and the general public. Although this standard does not include detailed accident scenarios, it does provide criteria regarding the frequency, type, and scope of exercises needed and extent of realism necessary for the exercise

to be effective and educational. Detailed accident scenarios shall be developed by the participating organizations for each facility for each exercise to include the guidance provided by this standard. This standard includes emergency exercises involving the facility itself, other utility support groups, as well as off-site agencies and criteria for the critique of an exercise.

1.3 Exclusions

The following are excluded:

Detailed Accident Scenarios. It is not the purpose of this standard to develop detailed accident scenarios to be followed in emergency preparedness exercises.

Post-Accident Restoration and Recovery. This standard does not deal with the post-accident restoration and recovery operations associated with the emergency.

2. Definitions

2.1 Drill. A supervised instruction period aimed at developing and maintaining skills in a particular operation. A drill is often a component of an exercise.

2.2 Exercise. An event that tests a major portion of the basic elements existing within an Emergency Preparedness Plan/Organization. This event should demonstrate the capability of the emergency preparedness organization to cope with a radiological emergency which could result in off-site consequences.

3. Training

3.1 General. Individuals having emergency assignments, for example, emergency coordinators; plant operations staff responsible for accident assessment, dose projection, and decision making; radiological monitoring teams; fire brigades; repair and damage control teams; first aid and rescue teams; local services including fire fighting support personnel; medical support personnel; and headquarters support personnel, shall be trained

in the performance of their duties, know the location and operation of equipment in order to effectively perform during an emergency. Such training shall be accomplished by formal instruction and conducting periodic drills to test segments of the overall plan. Off-site organizations who are to provide support in the emergency response should also be trained with respect to the organization's interface with the licensee's emergency plan and any specialized radiological training as it relates to their response role.

3.2 Types of Training

3.2.1 Formal Instruction. The formal instruction method is designed to instruct individuals to accomplish their mission as it relates to the emergency plan. The amount of time required for formal instruction will depend on the material to be covered and the needs of individuals participating in the training.

3.2.2 Drills. Drills involving varying numbers of personnel and organizations shall be used to provide practical training. When conducting such a drill, emphasis should be on the effectiveness of procedures and use of actual emergency equipment. Observers shall be assigned to evaluate the performance of the participants.

3.2.3 Lesson Plans. Lesson plans shall be developed (outline or detail) for both formal and drill instruction.

3.2.4 Records. Records of plant and off-site personnel who have participated in emergency response training shall be maintained.

4. Conduct of Exercises

4.1 General. Advance planning will maximize the benefits that can be obtained by personnel participating in the exercise. Exercises are a form of on-the-job training and testing of skills and equipment

that personnel will require in the event of emergencies.

4.2 Frequency

4.2.1 Exercises. An exercise shall be conducted at least annually to test and evaluate on-site and off-site emergency capability (personnel and equipment) to execute the respective portion of the emergency plan.

4.2.2 Drills. Drills to test smaller segments of the plan should be held more frequently than exercises.

4.3 Planning

4.3.1 Planner. A planner shall shall be appointed to accomplish the advance planning required to conduct a successful exercise. The Planner shall coordinate the exercise with representatives of the involved nuclear facility, off-site support agencies, and individuals from another nuclear facility or from corporate management as appropriate. The number of individuals contacted should be consistent with the scope of the exercises to be conducted.

4.3.2 Function of Planner. The planner shall select the exercises, define the objectives, prepare a detailed exercise scenario, and determine that adequate resources to conduct the exercise are available.

4.3.3 Participation by Off-site Support Agencies. The planner shall contact appropriate off-site support agencies to determine their level of participation and their agreement on the date and time when the exercise is of preannounced type. A complete list of off-site support agencies should be prepared indicating which of these agencies has agreed to participate and the extent of their participation in the exercise. This listing should become part of the scenario.

4.3.4 Public Information. Local news media personnel should be contacted during the planning stage and

should be informed of the drill or exercise plans.

4.3.5 List of Simulated Events. The planner shall prepare a listing of events to be simulated which are recognized as events that could occur during an actual emergency.

4.4 Scenarios

4.4.1 Preparation of Scenarios. A scenario for each exercise shall be prepared. The scenario shall include, but is not limited to, the following:

(1) The basic objective(s) of each exercise.

(2) The date(s), time period, place(s), and participating organizations.

(3) The simulated events required in Section 4.3.4.

(4) A time schedule of real and simulated initiating events.

(5) A narrative summary describing the conduct of the exercise to include such things as simulated casualties, off-site fire department assistance, rescue of personnel, utilization of protective clothing, deployment of radiological monitoring teams, public information activities.

(6) Arrangements for qualified observers and identification of observers.

4.5 Conducting the Exercise

4.5.1 Observers. In order to determine whether the on-site and off-site emergency plans and the organizations that are described in the plans are operable, the exercise shall be observed by personnel familiar with the emergency plans.

The planner should provide for the appropriate number of observers to evaluate and critique the exercise. Observers should include representatives of participating off-site agencies.

4.5.2 Duties of Observers. Observers shall perform the following functions before, during, and after the exercise:

(1) Develop a scenario critique sheet for their specific area of observation.

(2) During the exercise, the observers should distribute simulated information provided by the planner necessary for the participants to effect actions appropriate to the simulated accident.

(3) Throughout the entire exercise, the observers shall note pertinent individual, group, and equipment performance.

(4) Upon completion of the exercise, the observers shall meet with the planner to review and discuss the performance and complete the scenario critique sheets listing comments and recommrecommendations.

5. Critique and Documentation

5.1 Critique of Exercise. A critique shall be scheduled at the conclusion of the exercise to evaluate personnel performance. The critique should be conducted as soon as practicable after the exercise, and a formal evaluation should result from the critique. The evaluation should be in written form and should include, but not be limited to, the following:

(1) Individual, group, and equipment performance.

(2) Specific comments and recommendations to improve operations.

(3) Brief summation of the overall exercise.

Participating off-site agencies should conduct a similar critique of their performance following the exercise, where appropriate.

5.2 Documentation. Upon completion, the evaluation shall be submitted to plant management and to those responsible for updating the emergency plan and procedures.

Sufficient information to document the exercise shall be retained.