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Radiation Emergency Response in Illinois, Alabama, and Texas

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MASTER

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ENERGY DIVISION
Solar and Special Studies Section

**RADIATION EMERGENCY RESPONSE IN
ILLINOIS, ALABAMA, AND TEXAS**

D. K. Larsen
R. O. Chester

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GLOSSARY

Agreement State	Any state which has entered into an effective agreement with the Commission under Subsection 274b of the Atomic Energy Act of 1954, as amended.
By-product material	Any radioactive material, except special nuclear material, yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material (Atomic Energy Act of 1954, as amended).
Commission	The United States Atomic Energy Commission or its successors.
Critical	Capable of sustaining a chain reaction at a constant level.
Critical mass	The minimum mass of fissile material which can be made critical with a specified geometrical arrangement and material composition.
Generating station	That area of the power-producing facility encompassed by the security fence and under access control by the plant personnel. With respect to nuclear facilities, the station is the "exclusion area" as defined in Section 100.3 (a) of Title 10, Code of Federal Regulations, Part 100, and as described in the Safety Analysis Report for the respective nuclear facility on file with the Nuclear Regulatory Commission.
Offsite	The area outside of the generating station area, defined above.
Onsite	The generating station area, defined above.
Nuclear fuel cycle	The series of steps involved in supplying fuel for nuclear power reactors. It includes mining, refining, the original fabrication of fuel elements, their use in a reactor, chemical processing to recover the fissionable material remaining in the spent fuel, re-enrichment of the fuel material, and refabrication into new fuel elements.
Production facility	Any equipment or device determined by rule of the Commission to be capable of the production of special nuclear material in such quantity as to be of significance to the common defense and

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security, or in such manner as to affect the health and safety of the public; or any important component part especially designed for such equipment or device as determined by the Commission (Atomic Energy Act of 1954, as amended).

Radiation	Gamma rays and x rays, alpha and beta particles, high speed electrons, neutrons, protons, and other nuclear particles or electromagnetic radiations capable of producing ion directly or indirectly in their passage through matter; but does not include sound or radio waves, or visible, infrared, or ultraviolet light.
Regulatory authority	The power to license and inspect.
Release	The discharge of radioactive material into the environment in excess of the limits set forth in the nuclear power plant "Technical Specifications."
Restricted area	Any area for which access to that area is controlled for purposes of protection of individuals from exposure to radiation and radioactive materials.
Sealed source	Radioactive material that is permanently bonded or fixed in a manner designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling.
Source material	(1) Uranium, thorium, or any other material which is determined by the Commission, pursuant to the provisions of Section 61 of the Atomic Energy Act of 1954, to be source material, or (2) ores containing one or more of the foregoing materials, in such concentration as the Commission may by regulation determine from time to time (Atomic Energy Act of 1954, as amended).
Special nuclear material	(1) Plutonium, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of Section 51 of the Atomic Energy Act of 1954, determines to be special nuclear material, but does not include source material, or (2) any material artificially enriched by any of the foregoing, but does not include source material (Atomic Energy Act of 1954, as amended).

Utilization facility Any equipment or device except an atomic weapon, determined by rule of the Commission to be capable of making use of special nuclear material in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public or peculiarly adapted for making use of atomic energy in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public or any important component part especially designed for such equipment or device as determined by the Commission (Atomic Energy Act of 1954, as amended).

Whole body exposure A measure of the ionization produced in air by x or gamma radiation resulting in a dose to the whole body, head and trunk, active blood-forming organs, lens of the eye, or gonads, whichever is largest in value.

ACRONYMS

AEC	United States Atomic Energy Commission
ALA-REP	Alabama Radiological Emergency Plan
ALA-REP, BFNP	Alabama Radiological Assistance Plan for the Brown's Ferry Nuclear Plant
BFNP	Brown's Ferry Nuclear Plant
BWR	Boiling Water Reactor
CECC	Central Emergency Control Center
CFR	Code of Federal Regulations
DCFA	Federal Defense Civil Preparedness Agency
DOD	Department of Defense
DOE	Department of Energy
DRH	Division of Radiological Health
DPP-REP	Division of Power Production Radiological Emergency Plan
EEC	Enviorns Emergency Control Center
EEP-REP	Enviorns Emergency Plan
EOC	Emergency Operations Center
ERDA	Energy Research and Development Administration
ERP	Emergency Restoration of Power
FDA/BRH	United States Food and Drug Administration/Bureau of Radiological Health
FSAR	Final Safety Analysis Report
GAO	United States General Accounting Office
GSEP	Generating Station Emergency Plan
IE	The NRC Office of Inspection and Enforcement
JCAH	Joint Commission on Accreditation of Hospitals
JNACC	Joint Nuclear Accident Coordinating Center

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MFRP	Midwest Fuel Recovery Plant
MPBB	Maximum Permissible Body Burden
NRC	United States Nuclear Regulatory Commission
NRR	The NRC Office of Nuclear Reactor Regulation
ORAU	Oak Ridge Associated Universities
PIPAG	Procedures for Implementing Protective Action Guides
PRRP	Peacetime Radiological Response Plan
RADEF	Organization for Radiological Defense
REA	Railway Express Agency
REAC/TS	Radiation Emergency Assistance Center Training Site
RMC	Radiation Management Corporation
SITE-REP	Site Radiological Emergency Plan
TEX-REP	Texas Radiological Emergency Plan
TVA	Tennessee Valley Authority
TVA-MAP	Tennessee Valley Authority Medical Assistance Plan
TVA-REP	Tennessee Valley Authority Radiological Emergency Plan

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RADIATION EMERGENCY RESPONSE IN
ILLINOIS, ALABAMA, AND TEXAS

D. K. Larsen⁺
R. O. Chester^{**}

ABSTRACT

The purpose of this study was to determine whether existing state programs for radiation emergency response are adequate. Three states were studied: Illinois, Alabama, and Texas.

The major finding of the study is that the individual state programs for response to radiation incidents are adequate, but that an expansion of the formal mechanism for the exchange of emergency response information between states might result in increased response efficiency.

Emergency response information exchange could be facilitated by an existing organization, such as the Conference of Radiation Control Program Directors. The Emergency Planning Committee of the Conference, for example, could assume the task of assembling and distributing data for the states. One effective method of disseminating this information would be to incorporate the committee's results into Oak Ridge Associated Universities' (ORAU) Special Training Division health physics courses for state personnel, physicians, and others involved in radiation emergency planning.

The study of specific radiation incidents provided numerous examples of useful radiation emergency response information. Examination of the Brown's Ferry Plant (BFNP) fire of March 22, 1975, revealed a 3-1/2 hour delay between the start of the fire and organized fire fighting efforts, a situation which could have been avoided by adequate drills of emergency procedures. Examination of the Dresden-2 incident, June 5, 1970, showed that a state investigation led to the creation of a state Division of Nuclear Safety to study and monitor nuclear fuel cycle activities within the state.

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1. INTRODUCTION

The objective of this study was to examine state radiation emergency response and to locate any areas of emergency planning in need of improvement. This report briefly presents a summary of laws and defining documents governing radiation emergency response, describes the existing and projected need for such response, and presents the authors' analyses of the evolution of state response plans and their application to radiation incidents. Three states' programs are discussed in detail: Illinois, Alabama, and Texas. These states were selected because they have quite different emergency response programs. Therefore, these state programs provide a wide variety of approaches to state radiation emergency response.

2. LEGAL BASIS FOR STATE EMERGENCY RESPONSE

2.1 Introduction

State and local officials have both the responsibility and authority for protecting the public from hazards associated with radiation incidents. Federal agencies can provide advice and assistance at state request. In addition, federal agencies can provide any necessary radiation protection functions for a state if the state does not establish its own radiation protection program.

The legal bases for assigning radiation emergency responsibilities and authorities to the various federal, state, and local agencies are often complex and invite interpretation and clarification by the courts. As a result, state and local officials do not always have a clear understanding of their areas of authority and responsibility. Some states have established clearer lines of authority within the state by enacting laws and establishing interagency agreements of understanding. Additionally, there are unresolved questions about federal and state jurisdictions. Current understanding of state officials' authority and responsibility determines the state radiation emergency response.

Originally, radiation protection programs were instituted to protect the population from the effects of a nuclear war and were assigned to Civil Defense agencies. The Civil Defense laws and agreements pertaining to radiation protection which appear below, reflect the historical development of radiation protection in the United States. By these federal and state laws, state agencies may exercise controls over radiation-related activities within the state. These controls include licensing of individuals using or possessing sources of ionizing radiation, inspection of activities conducted under such licenses, and evacuation and other activities to insure public safety during radiation incidents.

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2.2 Federal Laws

Article VI, United States Constitution. This article states in effect that if state and federal laws conflict, federal law prevails.

The Occupational Safety and Health Act of 1970 (Public Law 596, 91st United States Congress, First Session). The purpose of this act is to assure:

. . . safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in their field of occupation safety and health; and for other purposes.

Atomic Energy Act of 1954, as amended (Public Law 703, 83rd United States Congress, Second Session). This act establishes standards and instructions to govern:

. . . possession and use of special nuclear material, source material, and by-product material as the Commission (Atomic Energy Commission) may deem necessary or desirable to promote the common defense and security or to protect health or to minimize danger to life or property.

Federal Civil Defense Act of 1950, as amended (Public Law 920, 81st United States Congress, Second Session). This act provides a plan for protection of civilian property or persons in the United States from enemy attack.

Disaster Relief Act of 1974, as amended (Public Law 288, 93rd United States Congress, S. 3062). This act provides for federal assistance to state and local governments in carrying out their responsibilities to alleviate suffering and damage which results from disasters.

2.3 State Laws and Defining Documents

Illinois, Alabama, and Texas have extensive radiation protection programs defined by the following legal documents.

Illinois

Radiation Protection Act approved July 17, 1959, as amended.¹ This act gave the Illinois Department of Public Health responsibility for all radiological health and safety programs of the state, to include responsibility for:

. . . environmental radiological surveillance, occupational radiological health, control of medical and dental x-ray exposure, supervision of all medical, industrial, and other uses of radioisotopes, and, in brief, all aspects of health protection against ionizing and nonionizing radiation.²

Three-year contract, signed October 31, 1972, between the Illinois Department of Public Health and the United States Atomic Energy Commission (AEC). According to the terms of this contract, the AEC was to provide some financial support to the Department of Public Health and the latter will conduct certain surveillance activities at the Dresden, Quad Cities, Zion, and Midwest Fuel Recovery Plant (MFRP) facility sites.³ This monitoring will verify levels of effluent radioactivity reported by the facility.

Alabama

Act 582, Regular Session, 1963. According to the terms of this act, the Alabama State Board of Health was given overall responsibility for protecting the health and safety of the general public from hazards of ionizing radiation.⁴ Whereas the State Board of Health administers its powers under this act through the Alabama Department of Public

¹ Illinois Revised Statutes, 1975, Radiation Protection Act of 1959, as amended, Chapter 111-1/2, paragraphs 211 through 228.

² Ernest C. Tsivoglou, Environmental Radiation Protection at the Dresden Nuclear Power Station, Usual and Potential Environmental Radiological Impact of Boiling Water Reactor Operation, and Responsibility of the State (Illinois Commerce Commission, November 30, 1972), p. 46.

³ Ibid., p. 48.

⁴ This act is included in the Code of Alabama, 1940 (1958 recomp.), as amended, Title 22, Sections 295 through 310.

Health, it falls to the State Health Officer to carry out the duties of this act, which include:

. . . such things as the evacuation of certain areas, the seizing of certain contaminated products, and the removal of certain food products from the food chain. In addition, he (State Health Officer) will seek assistance of other federal, state, and local agencies in minimizing the consequences of such a radiological incident at a nuclear facility.⁵

Executive Order of the Governor #14, dated June 14, 1971. This order assigned emergency preparedness functions and duties to the various state agencies and authorized the Alabama Civil Defense Department to coordinate planning activities for all types of disasters which might befall the State of Alabama.

Memorandum of Understanding between the Alabama Department of Public Health and the Alabama Civil Defense Department, signed November 30, 1971. According to the terms of this document it is agreed that the Alabama Department of Public Health will be responsible for the administration of the overall radiation emergency plan, and that the Alabama Civil Defense Department will coordinate all aspects of the radiation emergency plan dealing with other state and local agencies.⁶

Texas

Texas Disaster Act of 1975, 64th Legislature, H.B. No. 2032. This act established the Division of Disaster Emergency Services and prescribed the related functions, powers, and duties of the Governor, the legislature, the agencies created by this act, and existing agencies. This act gave the Governor the power to recommend evacuation.

Executive Order of the Governor, DB-23, dated June 21, 1975. This order designated the Director of the Department of Public Safety as Director of the Governor's Division of Disaster Emergency Services and

⁵State of Alabama Department of Public Health, "Alabama Radiation Emergency Plan," Annex II, Part 4 (1972), B-1.

⁶This memorandum is included in the Code of Alabama, 1940 (1958 recomp.), as amended, Title 37A, Sections 19(66) through 19(90).

set forth the duties of that office. This order extended all powers enumerated in the Texas Disaster Act of 1975 to the Disaster Emergency Services Council.

Radiation Control Act of 1961, as amended. This act designates the Texas Department of Health as the State Radiation Control Agency and authorizes the Commissioner of Health to establish a radiation control program.⁷

H.B. 910. This public law amends sections of the Texas Disaster Act and defines powers of local government in times of emergency.

2.4 Ultimate Authority

Ultimate authority for control of a major radiation disaster or emergency within a state is held by the Governor, who can declare martial law, thereby suspending any or all state laws, and who may, in addition, summon the state militia to support his actions. For radiation emergencies of lesser magnitude, i.e., those not requiring martial law, final authority for decision making is delineated as follows. In both Illinois⁸ and Alabama⁹ this authority is given to the Director of the Department of Public Health. In Texas this authority rests with the Mayor of each incorporated municipality and County Judge of each county, assisted by the Texas Division of Disaster Emergency Services.¹⁰

⁷State of Texas, "Emergency Operations Plan, Annex L: Radiological," draft, mimeographed (June 2, 1976), 7.

⁸Philip N. Brunner, Chief, Division of Radiological Health, Illinois Department of Public Health, personal communication (July 26, 1976).

⁹John R. Wible, Assistant Attorney General for the State of Alabama, personal communication (July 19, 1976).

¹⁰The Texas Disaster Act of 1975 specifies that the Governor, advised and assisted by the Division of Disaster Emergency Services of the Texas Department of Public Safety, is responsible for providing executive direction and coordination of State resources before, during and after the occurrence of any disaster. Notwithstanding the above, by Executive Order D.B. 23, the Governor has designated the Mayor of each municipal corporation, and the County Judge of each county as the Disaster Director/Coordinator for their respective jurisdictions.

3. STATE RADIATION EMERGENCY RESPONSE PROGRAMS AND THEIR EVOLUTION

3.1 Justification for Program Development

An increasing need for radiation emergency response capability will undoubtedly accompany the increasing nuclear generating capacity and increasing medical and industrial use of radioactive materials.

As of December 31, 1975, there were in the United States 58 operable commercial nuclear power reactors, 87 under construction, and 103 planned, for a total of 238. The above figures correspond to a total generating unit capacity of 39,595 megawatts as of December 31, 1975, and 236,729 megawatts projected for 1990.¹¹ From these figures, the number of interstate shipments of spent fuel can be expected to increase.

Table 1 presents projected increases in the number of civilian nuclear power reactors and, in addition, 1975 totals for numbers of radiation incidents to which the appropriate state personnel responded, for Illinois,¹² Alabama,¹³ and Texas.¹⁴

State radiation protection programs will have to expand and develop to meet this growing need. The direction of this development will be determined by many factors including (1) state employees' experiences with radiation incidents and drills, (2) increasing public awareness and intervention, (3) increased numbers of incidents associated with the

¹¹"Nuclear Reactors Built, Being Built, or Planned, in the United States as of December 31, 1975," ERDA Document No. TID-8200-R33, UC-80(1976).

¹²Brunner, op. cit.

¹³Aubrey V. Godwin, Director, Division of Radiological Health, Alabama Department of Public Health, personal communication (July 14, 1976).

¹⁴Edgar D. Bailey, Chief, Compliance and Inspection, Division of Occupational Health and Radiation Control, Texas Department of Health Resources, personal communication (August 1, 1976).

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Table 1
Numbers of Operable Civilian Nuclear Power Reactors and
Radiological Incidents Requiring State Response,
Presented by State

	(a)		(b)	(c)
	Number of Operable, Licensed or Authorized, Civilian Nuclear Power Reactors (Dec. 31 1975) (By 1987)		Total Number of Incidents to Which State Radiological Health Personnel Responded (1975)	Total Number of Transportation Related Incidents to Which State Radiological Health Personnel Responded (1975)
Illinois	7	15	29	12
Alabama	3	9	5	1
Texas	0	6	60	12

nuclear fuel cycle, and (4) routine procedural changes. Additionally, groups such as the Joint Commission of Accreditation of Hospitals (JCAH) have been incorporating requirements for hospital radiation emergency planning into their standards. Thus, hospital requests for state assistance in radiation emergency planning will increase in number. The Nuclear Regulatory Commission (NRC), which licenses nuclear power facilities, now requires that an applicant for a nuclear power reactor license must show plans for interfacing with local governments during emergencies. Thus, it can be expected that power companies and local government organizations will increasingly turn to state agencies for assistance in emergency planning.

In the following sections, 3.2 through 3.5, brief summaries will be given of the Illinois, Alabama, and Texas radiation emergency response programs, followed by summaries of specific incidents and procedural changes which have improved these programs. More details can be found in Appendices A, B, and C.

3.2 Illinois

In Illinois, the authority for handling radiation incidents is given to the Divisions of Radiological Health and Nuclear Safety of

the Illinois Department of Public Health. The initial notification call comes to the Emergency Services and Disaster Agency. A Department of Public Health Duty Officer, on 24-hour call, is immediately notified that an incident has occurred and will proceed to activate the Illinois Radiological Assistance Plan as described in Appendix A, Section I.

For minor incidents, e.g., reports of sources lost or reports of radioactive contamination, one or more investigators would be sent to the scene, or the matter would be handled by telephone. For major incidents, such as a nuclear power plant release of radioactive materials to the environment requiring evacuation, the Illinois Department of Public Health would, through the Emergency Services and Disaster Agency, enlist the aid of other Illinois agencies, other states' governments, and federal agencies, as needed.

3.2.1 Incident at Dresden 2, June 5, 1970

On the above date, Dresden Unit 2, a second generation [2527 MW(t) 890 MW(e)] General Electric Boiling Water Reactor (BWR) located in Grundy County, Illinois, was undergoing power testing while operating at approximately 75 percent full power. A spurious signal within the reactor pressure control system altered steam flow to the turbine, which within seconds caused a turbine trip followed by a reactor scram. In the events that followed, a water-level chart pen stuck, and the isolation condenser failed to function as needed. Water level and pressure control became erratic. The sequence of events resulted in a discharge of steam and water through safety valves into the reactor dry well, which caused damage to dry well equipment.¹⁵

The reactor remained shut down until August 8, 1970. Corrective action included replacing and improving electric cables, drying electric motors, reorienting discharge direction of safety valves, revising the pressure control system, improving the capability of the isolation condenser, and revising operating and emergency procedures.

¹⁵C. D. Cagle, "Dresden 2 Incident of June 5, 1970," Nuclear Safety, 12, No. 5 (September-October, 1971), 538-546.

No significant amount of radioactivity was released to the environment. State agencies were not alerted and the problem was handled by onsite personnel and seven AEC personnel, who had been notified the night of June 5, 1970, and who arrived the following day. The bypassing of the State, in this instance, while legal, raised the following question: Should the State of Illinois become more concerned with onsite fixed nuclear facility safety programs? A problem onsite could potentially lead to an offsite dose to the general public, a State concern.

The significance of the Dresden-2 incident of June 5, 1970, was not that it constituted a danger to the environment, but that it called attention to a lack of State involvement in fixed nuclear facility safety programs, and that it was the first of a series of events that would result in greatly increased State involvement.

A second incident, similar to the above-mentioned Dresden-2 incident, occurred on December 8, 1971, at Dresden 3. This incident also involved power transients and release of fluid into the reactor dry well. A State investigation was ordered, and the Illinois Commerce Commission hired two consultants, Ralph E. Lapp and Ernest C. Tsivoglou, to study the problems at the Dresden Nuclear Power Plant and make recommendations. The results of this study were two reports submitted to the Illinois Commerce Commission: (1) the Lapp report, dated December 7, 1972,¹⁶ and (2) Tsivoglou's report, dated November 30, 1972.¹⁷ The Lapp report recommended greater federal regulatory agency attention to power transients and more State participation in the traditionally federal domain of fixed nuclear facility safety. The Tsivoglou report also recommended greater State participation in fixed nuclear facility safety and, additionally, criticized the State emergency response plan.

¹⁶Ralph E. Lapp, Report to the Illinois Commerce Commission (Illinois Commerce Commission, December 7, 1972).

¹⁷Ernest C. Tsivoglou, Environmental Radiation Protection at the Dresden Nuclear Power Station, Usual and Potential Environmental Radiological Impact of Boiling Water Reactor Operation, and Responsibility of the State (Illinois Commerce Commission, November 30, 1972).

Within the five years following the Dresden-2 incident, the AEC organized a study group to review BWR transients and the Illinois Department of Public Health reorganized to create a Division of Nuclear Safety. In addition, the Illinois Radiological Assistance Plan was substantially revised to comply with many of the suggestions made by Lapp and Tsivoglou.¹⁸

3.2.2 Airplane Crash, May 26, 1974

On May 26, 1974, a civilian aircraft on lease to the military crashed north of Springfield. At 5:00 p.m. the Illinois Radiological Health Duty Officer was notified of the incident and informed that the cargo contained "two sources of cobalt-60, weighing 15 lb and 250 lb."¹⁹ At this time it was not known if nuclear weapons were part of the cargo. The Illinois Radiological Assistance Team arrived at the scene to find a large crater filled with approximately 150 curious bystanders, a rescue squad removing bodies, many State Police, and reporters.

An exclusion line was drawn by the Team Leader and maintained by State Police, thereby clearing an area two miles in diameter for emergency operations.

The NRC-ERDA office in Chicago was notified of the incident.

At around 1:00 a.m., the Illinois Radiological Assistance Team was joined by the Joint Nuclear Accident Coordinating Center (JNACC) teams from the Wright-Patterson and Scott Air Force bases. A JNACC team member stated that the situation was not dangerous, but it was learned that a courier had been on board. Couriers are often members of the armed forces who accompany nuclear weapons shipments and guard against their loss.

After extensive digging within the crater, the Illinois Radiological Assistance Team uncovered the cobalt-60 sources. The low

¹⁸For a more detailed discussion, see Appendix A.

¹⁹Paraphrased from Oak Ridge Associated Universities REAC/TS Seminar lecture, "State Radiological Assistance Plans," given by James A. Blackburn, Duty Officer, Division of Radiological Health, Illinois Department of Public Health, June 2, 1976.

activity of the sources (calculated to be on the order of 10^{-12} curies) led Illinois officials to conclude that the sources had been drums of primary coolant water from a naval reactor, and that the 15 lb and 250 lb referred to the weight of the water.

The airplane crash illustrates the effectiveness of the use of State Police for maintaining an exclusion line and the effectiveness of the multi-agency approach. In this instance the multi-agency approach involved cooperation among the following: Illinois Law Enforcement, the Scott Air Force Base Joint Nuclear Accident Coordinating Center (JNACC) team, and two additional agencies not appearing in the above summary, the Energy Research and Development Administration (ERDA) Chicago Operations Office, and the Illinois Emergency Services and Disaster Agency.

3.2.3 Single Telephone Number Notification System

A successful notification technique utilized by the Illinois radiation emergency response program is the use of a single telephone number (Emergency Services and Disaster Agency) for the reporting of an emergency. This single number approach is not restricted to notification for radiological emergencies but is used for all types of emergencies within Illinois. The initial notification call to the Emergency Services and Disaster Agency is immediately transferred to the appropriate state agency. Instructions for using this notification system are distributed throughout Illinois.²⁰

The national counterpart to this system is the Chemical Transportation Emergency Center (CHEMTREC).²¹ This agency, accessible to all through a single telephone number, (1) provides advice to those at the scene of a chemical shipping emergency whether radiological or non-radiological in nature and (2) notifies appropriate federal agencies.

²⁰ Ibid.

²¹ "CHEMTREC," Manufacturing Chemists Association, 1825 Connecticut Avenue, N.W., Washington, D.C. (Telephone 800-424-9300).

3.3 Alabama

In Alabama the authority to direct radiation emergency response is given to the Division of Radiological Health of the Alabama Department of Public Health. An initial call or notification comes to any staff member of the Division, thereby activating the Alabama radiation emergency response plan, described in Appendix B, Section I.

The response to the various types of radiological incidents which occur in Alabama is similar to that of Illinois. A recent incident in Alabama is highly instructive.

3.3.1 Brown's Ferry Fire, March 22, 1975

On March 22, 1975, between 12:15 and 12:25 p.m., a fire started in the cable-spreading room at the Brown's Ferry Nuclear Plant (BFNP), located near Decatur, Alabama, and owned by Tennessee Valley Authority (TVA). At the time of the fire, two of Brown's Ferry's three reactors, Units 1 and 2 were operating, each producing 1098 megawatts of electrical power.²²

The fire was caused by workers using a candle flame to test the effectiveness of an air seal around electrical cable penetrations between rooms, in this instance, between the cable-spreading room and the secondary containment building for the Unit 1 reactor. The cable penetrations were sealed with flammable polyurethane. Because of the pressure gradient from the cable-spreading room to the secondary containment building, the fire immediately spread to electrical cable trays. By 1:00 p.m., both reactors, Units 1 and 2, had been scrammed by the control room operators. Because many of the normally used components for core cooling in Units 1 and 2 had been electrically disabled by fire, alternate systems had to be used as backup for both Units 1 and 2. For Unit 1 some of the alternate systems were disabled in addition to the normally used components for core cooling. By 6:30 p.m., normal core cooling for both units was established; and by 7:45 p.m., the fire was extinguished.

²²"Regulatory Investigation Report," Office of Investigation and Enforcement, Region II, U. S. Nuclear Regulatory Commission, IE Rpt. Nos. 50-259/75-1 and 50-260/75-1 (July 25, 1975).

There was no significant release of radioactivity to the environment throughout the incident. All records of radiation and contamination surveys showed no abnormal radiation levels and no abnormal contamination levels. Damages totalled \$10 million worth of electrical equipment in the secondary containment building and \$10 million per month for power replacement for Units 1 and 2.²³

The significance of the Brown's Ferry incident was that it pointed to inadequacies within the Nuclear Regulatory Commission (NRC) programs, the Brown's Ferry Nuclear Plant (BFNP) programs, and BFNP interaction with the Alabama Public Health Department. Two major inadequacies were:

1. Reactor quality assurance programs, which are inhouse systems for finding and correcting unsafe situations, need more extensive review by the NRC during licensing. The use of a candle flame around flammable polyurethane sealant material would be an example of an unsafe but correctable situation.

2. Speedier and more efficient activation of state and nuclear plant emergency response plans is needed. It took two hours for the Brown's Ferry Emergency Plan to become activated, hence, organized fire fighting efforts did not begin until three and one-half hours after the start of the fire. It took three hours for the State of Alabama Radiation Emergency Response Plan to be activated.

Action taken by Nuclear Regulatory Commission (NRC), Alabama Public Health Department, and Brown's Ferry Nuclear Plant, which resulted from the fire was as follows:

1. NRC cited numerous items of noncompliance and areas of concern.²⁴

2. NRC issued two bulletins,²⁵ which contained information and recommendations relative to the Brown's Ferry fire, to all its licensed, operating nuclear plants.

²³For a more detailed discussion, see Appendix B.

²⁴"Notice of Violation" with appended "Areas of Concern," U. S. Nuclear Regulatory Commission, Dockets 50-259/260, IE:11:CEM (July 28, 1975).

²⁵IE Bulletins, U. S. Nuclear Regulatory Commission, No. 75-04 (April 3, 1975) and No. 75-04A (April 3, 1975).

3. An NRC Special Review Group was created to analyze the Brown's Ferry fire and submit a report containing recommendations relative to the fire.

4. NRC has issued "revised guidelines aimed at improving fire protection at new nuclear power plants." These guidelines are now a part of the NRC standard review plan, the basic document used by the NRC staff in reviewing applications to build and operate nuclear power plants.²⁶

5. TVA has agreed to notify the Alabama Division of Radiological Health immediately when an incident requiring activation of the Brown's Ferry nuclear power plant emergency plan occurs, whether or not the incident appears to be radiological in nature.²⁷

3.4 Texas

In Texas, the authority for directing radiation emergency response is given to the Division of Occupational Health and Radiation Control of the Texas Department of Health Resources. The notification call can come to the Division or to the Texas Department of Public Safety. A staff member of the Division activates the Texas radiation emergency response plan as discussed in Appendix C, Section I.

Response to incidents occurring in Texas is similar to those mentioned for Illinois and Alabama with the exception of nuclear power plant incidents. Texas presently has no commercially operating nuclear power plants.

3.4.1 Emergency Planning: An Example of State Assistance to a Utility

The Texas Utilities Generating Company, owner of the Comanche Peak Steam Electric Station, Unit 1, requested assistance from the Texas Department of Health Resources in fulfilling its interfacing requirements (NRC requires that the utility show plans for interfacing with

²⁶"The Legacy of Brown's Ferry: New NRC Fire Protection 'Guidelines,'" Nucleonics Week, Vol. 17, No. 20 (May 13, 1976), pp 1-2.

²⁷Godwin, op. cit., June 16, 1976.

local governments in times of emergency). State officials scheduled a meeting of county and city officials, hospital and ambulance company officials, representatives of the utility, and the Texas Departments of Public Safety and Health Resources, for the purpose of assisting local governments in writing their emergency plans. The resulting document for local emergency planning will be an annex to the local Emergency Operations Plan.²⁸

3.4.2 Utilization of Nonstaff Personnel During Emergency Response

A successful technique for minimizing Texas Radiation Control Branch response time is the use of nonstaff personnel throughout the state. When a radiation incident occurs so far from the Radiation Control Branch office that excessive response time would be required, a local person, considered sufficiently qualified to handle the situation, is contacted. Persons who would be considered for this type of assistance include Radiation Safety Officers of institutions licensed by Texas to possess and use radioactive materials, Civil Defense personnel, health physicists, or members of the State Department of Public Safety such as the Highway Patrol. For example, a member of the Highway Patrol might assist by locating a low-activity, sealed source, packaging it, and transporting it to the Radiation Control Branch offices, according to the prearranged procedures.²⁹

3.4.3 Utilization of the Radiation Emergency Assistance Center Training Site (REAC/TS): Incident Involving Americium-241 Ingestion

On June 10, 1976, 9:30 p.m., two Texas Department of Health Resources inspectors departed for Rohm and Haas Texas, Incorporated, in Deer Park, Texas, to investigate a report of possible americium-241

²⁸Larry J. Skiles, State Operations Officer, Disaster Emergency Service, Texas Department of Public Safety, personal communication (June 29, 1976).

²⁹Bailey, op. cit., June 30, 1976.

ingestion.³⁰ At Rohm and Haas it was learned that earlier in the day an instrument mechanic, while cleaning³¹ a source tube of a trace gas analyzer, had destroyed the integrity of a 600-microcurie americium-241 source located within the tube.³²

The Texas inspectors called the Department of Health Resources in Austin at 7:00 a.m., June 11, to report the incident status: suspected ingestion of an unknown amount of americium-241 and suspected surface contamination within the building.

The Texas Department of Health Resources staff member in Austin who received the call, immediately telephoned Oak Ridge Associated Universities (ORAU) for medical advice. ORAU provides courses on the REAC/TS program, a medical facility which provides medical assistance to victims of a radiological incident of any severity level.³³

Although the possible ingestion had occurred a day prior to the call to ORAU, hence making it too late for treatment (chelating therapy), it was decided that the instrument mechanic would be brought to the REAC/TS facility for an estimate of dose received.³⁴

On June 11, the instrument mechanic was sent to Oak Ridge, Tennessee. After a series of tests, including whole-body counts, fecus and urine sample counts, and blood counts, the ingestion was estimated to be less than 2 percent Maximum Permissible Body Burden for americium-241, and the instrument mechanic was taken to the airport for a return trip to Houston, Texas.

³⁰Rodney I. Heathcott, "Incident Investigation," mimeographed, File No. 1292, Texas Department of Health Resources (July 23, 1976).

³¹Both the manufacturer's recommendations and the Texas license conditions state that any maintenance activities, such as removal of the source tube containing the americium-241 foil for service, must be done by the manufacturer.

³²Heathcott, op cit.

³³See Appendix D for further detail.

³⁴William L. Beck, ORAU, personal communication (July 7, 1976).

The above incident and another americium-241 contamination incident have prompted the Texas Department of Health Resources to investigate all of its licensees authorized to use americium-241.³⁵

3.5 Another State

3.5.1 Notification Format

To meet the necessity for a public emergency plan for large-scale incidents, the state government of New Jersey has developed PIPAG, Procedures for Implementing Protective Action Guides.³⁶

PIPAG consists of three parts: (1) the utility's onsite emergency plan, (2) the state's offsite emergency plan, and (3) a Memorandum of Understanding between the state of New Jersey and the facility. The memorandum specifies a detailed notification system and a message format for the initial states of the notification sequence.

In the event of a reactor accident of sufficient severity to constitute a public-safety concern, the utility's emergency teams would be assembled and/or dispatched. The notification system would then be activated as follows.

The facility notifies the State Police and after verification the State Police proceed to notify other agencies (30 contacts) using a recorded telephone message.³⁷ An agreed upon format is used for all of the initial notification calls, such as the following:

This is John Doe, senior reactor operator at the Up-the-Creek Reactor, a major nuclear facility in Loschen County. I wish to report a reactor incident. Reactor scrambled at 1633 hours. Emergency teams have (or have not) been summoned. Contact the Bureau of Radiation Protection per Operations Order No. 284. End of message.

³⁵ Bailey, op. cit., August 27, 1976.

³⁶ Charles G. Amato, "Nuclear Emergency Planning in the State of New Jersey," Nuclear Safety, Vol. 14, No. 6 (November-December, 1973), pp 563-573.

³⁷ John Russo, Chief, Bureau of Radiological Health, New Jersey Bureau of Radiation Protection, personal communication (August 10, 1976).

Use of this format does not preclude the discussion of incident status or the giving of additional technical information. Such unformatted information exchange is done outside of the initial notification sequence.³⁸

The original memorandum was signed in 1968, and the PIPAG notification sequence has been tested extensively by drills, 1969-76, but not tested in a real incident to date. The drills have been successful; i.e., all first-echelon notifications (agencies which must be called in every test) are made in no longer than 28 minutes.

3.6 Summary

Each of the states selected could serve as a model for other states in certain respects. For example, one of the strengths of Illinois' program is the emphasis on a multiagency approach. This approach is shown by the numerous references to NRC, JNACC, and ERDA assistance, in the incident reports. Another strength of the Illinois program is the emphasis given to studying and monitoring the nuclear fuel cycle activities within the State. The State investigation of BWRs and the establishment of a Division of Nuclear Safety in the Illinois Department of Public Health illustrate the emphasis.

Alabama has a highly developed plan for responding to nuclear power plant incidents. This plan includes incident classification systems and notification sequences. Another feature of the Alabama radiation emergency response is the beeper notification system, which insures immediate availability of personnel.

Texas radiation emergency response is highly efficient. Nonstaff personnel are routinely enlisted to perform radiation response duties. Also, Texas is one of the few states which has incident report forms for use during the incident to assist in the recording of pertinent data. Another feature of the Texas program is its "informal inspection" of NRC license activities, as discussed in Appendix C.

³⁸ Charles G. Amato, Associate, Dames and Moore, Cranford, New Jersey, personal communication (August 10, 1976).

4. CURRENT INFORMATION EXCHANGE BETWEEN STATES

Any of the program strengths mentioned above could be adapted, all or in part, to other states' radiation emergency response programs.

The collection of useful information concerning state radiation emergency response programs, acquired during this research and summarized in the preceding chapters, demonstrates that there is a large supply of this information and that it is readily available. However, there appears to be insufficient exchange of such data between states.

There are presently numerous organizations of personnel involved in emergency response planning. For example, the Conference of Radiation Control Program Directors and the DOE-sponsored REAC/TS program are such organizations. They provide a setting for discussion of radiation emergency response planning. Thus, exchange of valuable information is occurring. However, data in this area are highly fragmented. An additional vehicle for exchange of such data is the NRC's Office of State Programs which collects from the Agreement States³⁹ summaries of all radiological incidents for which there was state response. However, these summaries generally do not include detailed discussion or evaluation of the state agency's actions. Also the program is limited to Agreement States.

³⁹For a discussion of Agreement States, see Appendix B, Section I.D.1.c.

5. CONCLUSIONS AND SUGGESTIONS

The individual state programs for radiation emergency response in Alabama, Illinois, and Texas, the three states studied, are adequate. However, to maintain adequacy during the projected growth of the nuclear industry and to improve efficiency of the state programs, a more systematic, formal mechanism should be devised for exchange of data on radiation incidents and state radiation emergency response program improvements.

1. The information exchange could be implemented by an existing organization, such as the Conference of Radiation Control Program Directors, which is composed of individuals having both experience in state radiation emergency response planning and knowledge of existing state programs. The conference could undertake, through its Emergency Planning Committee, as an example, the following:

a. Acquisition from State Radiological Health Departments, instructive information concerning radiation incidents and program improvements of the past year.

b. Analysis of the above information to extract general as well as specific information of value to states involved in radiation emergency response planning.

c. Presentation of findings at the annual meetings of state personnel.

2. It is further suggested that state radiation emergency response planning would be improved if the information thus acquired were incorporated in a radiation emergency response training program, such as the Oak Ridge Associated Universities (ORAU) Special Training Division⁴⁰ health physics courses for state personnel, physicians, and paramedical personnel. Participation by an organization such as ORAU would make the Emergency Planning Committee's findings available to physicians and other

⁴⁰For a discussion of the ORAU Special Training Program, see Appendix D.

personnel outside of state government and would, additionally, provide further opportunity for analysis of past radiological incidents.

Implementation of the above suggestions would improve state radiation emergency response plans, which are presently adequate, but which may not remain adequate if the projected growth of the nuclear industry is accurate.

APPENDIX A
RADIATION EMERGENCY RESPONSE IN ILLINOIS

I. ILLINOIS RADIOLOGICAL ASSISTANCE PLAN

A. Introduction

The history of radiation control in Illinois is of special interest because Illinois was one of the first states to develop a program for dealing with peacetime radiological incidents and because Illinois presently has a highly developed radiation emergency response plan. The following historical information has been taken from "Radiation Control in Illinois, June 19, 1973," a report written by the Illinois Public Health Department to define the role of the State in matters of radiation control.

In 1960 Illinois became the first state to have a commercial nuclear reactor operating for the production of electricity. In the interest of public safety, the Illinois Department of Public Health then established a program to measure the effect of this radiation source and its impact on Illinois citizens. In addition, Illinois was the first state to begin offsite environmental monitoring of a commercial power reactor.

Medical, industrial, and nuclear fuel-cycle-related use of radioactive materials steadily increased. The Illinois radiological health officials realized that the potential for radiation-related accidents was also increasing and in 1970 implemented Illinois' first Peacetime Radiological Response Plan (PRRP). This plan utilized the Illinois Disaster Plan and called upon seven State agencies to furnish their resources in the event of a radiation emergency. This was one of the first radiation emergency response plans written by a state government. The 1972 revision of this plan included a description of resources which the State would dedicate to assist local authorities in handling a radiological incident. The most recent Illinois Radiological Assistance Plan, still in draft form, is the latest revision of this document, and when finalized will become Chapter IV of the general Illinois Disaster Plan.

Because the radiation emergency response program in Illinois is so highly developed, considerable attention will be given to this State in the following sections.

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B. Purpose

The Illinois Radiological Assistance Plan sets forth procedures to be followed by the Department of Public Health during a radiological incident. The objective of this plan is to minimize the radiation dose received by Illinois citizens during a radiological incident.

Typical radiation incidents occurring in Illinois for which this plan would be activated include reports of radioactive material lost or stolen, radioactive contamination, significant radiation exposures of persons, transportation accidents involving radioactive materials, undesired liquid or gaseous releases of radionuclides, and so forth.

The following section is a summary of the Illinois Radiological Assistance Plan, unless footnotes referencing other sources appear. The Illinois Radiological Assistance Plan is being revised. A working draft dated October 1975 was used in preparing this summary.

C. Plan Activation

The plan is activated by an initial call of notification to the Public Health Department informing the Department that a radiation incident has occurred. For efficient notification, Illinois had circulated throughout the State a single telephone number to be used for reporting a radiation incident. This is the number of the Emergency Services and Disaster Agency Duty Officer, who will immediately transfer the call to the Department of Public Health's Radiological Assistance Duty Officer. As the plan points out, calls do not always come in as the planner intended, thus it is more accurate to say that the incoming call to the Public Health Department will probably be received by the Public Health Emergency Services and Disaster Agency Liaison, the Associate Director of Consumer Health Protection, or the Radiological Assistance Duty Officer. Any of these paths will ultimately result in notification of the Radiological Health Division, where a Radiological Assistance Team Coordinator will be selected. This Team Coordinator, in collaboration with the Associate Director of Consumer Health Protection, will decide if the team should be activated or if the matter

should be handled by telephone or other means. If there is reason to believe a radiation hazard to the public exists, a team will be dispatched to the incident scene immediately. The following procedure is initiated if a full team response is required.

1. A Team Leader is selected from either the Division of Nuclear Safety or the Division of Radiological Health. These are two Divisions within the Public Health Department, the former dealing with radioactive materials related to the nuclear fuel cycle, the latter, all other radioactive materials.

2. The Team Coordinator and Team Leader then work together: one gathers additional information on the incident while the other assembles the team and necessary instrumentation.¹

3. The team is dispatched to the scene.

If, in step 2 above, the Team Coordinator or Team Leader has the opportunity to talk with the individual who originally reported the incident, he will advise him to keep everyone away from the scene of the incident, at least 2000 feet for a weapons incident and at least 50 feet for other types of incidents.

D. Personnel Responsibilities

Radiation emergency responsibilities are assigned as follows:

1. The Associate Director, Consumer Health Protection, or his representative, upon receiving the initial notification, will (a) determine whether the team should be activated, (b) notify DOE Chicago Operations Office if nuclear weapons or other radioactive materials outside of the state's jurisdiction are involved, and (c) notify specified agencies and individuals within the Public Health Department.

¹A general duty emergency suitcase is available, containing the following:

Eberline PRM-5 (NaI detector, GM, alpha scintillation probe) and Eberline PIC 6A (ionization chamber).

This suitcase thus gives alpha, beta, and gamma capability and the ability to make contamination surveys and obtain high-range (R/hr) readings.

2. The Radiological Assistance Team Coordinator or his representative will (a) brief the team prior to departure, (b) coordinate all interagency activity during the incident, (c) debrief the team after the incident, and (d) feed all radiation incident status information to the Emergency Services and Disaster Agency.

3. The Department of Public Health Emergency Services and Disaster Agency Liaison will (a) act as communication links between the Department of Public Health and the Emergency Services and Disaster Agency and (b) assemble and dispatch a second or relief team if required.

4. The Radiological Assistance Team Leader will (a) assemble the team prior to departure, (b) direct team operations during the incident, (c) assess the radiological hazard to the public, (d) explain the team's capabilities and give recommendations to the person in charge at the scene, (e) establish a command post, and (f) remain on the scene until the hazard to the public no longer exists. The Team Leader makes all decisions of a technical nature involving the health physics aspects of the incident, such as:

Establishment of a perimeter² as follows:

- Uncontrolled zone: less than 2 mR/hr beta-gamma or 40 dpm/cm² alpha.
- Limited zone: between 2 mR/hr and 100 mR/hr beta-gamma or between 40 dpm/cm² and 4000 dpm/cm² alpha (full protective clothing required; access to and time in area limited to that necessary to save life or prevent serious further damage or injury).

The person in charge at the scene will probably be a civil official or, in the case of a nuclear weapons incident, a military representative.

5. The Public Information Officer will (a) obtain facts concerning the incident from the Associate Director of Consumer Health Protection, the Team Coordinator, and the Team Leader, and (b) relay the facts, as

²State of Illinois Department of Public Health, Radiological Assistance Plan, p V-2.

known, within the bounds of classification and legal prejudice, to the media.

Presently, the Divisions of Radiological Health and Nuclear Safety train the Public Information Officer in terminology, units, and concepts of health physics, thereby avoiding the need for explanations during each incident.

The plan stresses that, except for the Public Information Officer, Public Health Department personnel should not issue any statements to the press or public. All inquiries are to be directed to the Associate Director of Consumer Health Protection or the Public Information Officer.

E. Emergency Action Guidelines for Incidents Involving Radioactive Materials

An emergency procedure for the person in authority at the scene of a radiation incident is included in the plan on pages V-1 and V-2 of the Illinois Radiological Assistance Plan and is presented in its entirety below:

EMERGENCY ACTION GUIDELINES FOR INCIDENTS INVOLVING RADIOACTIVE MATERIAL

When incidents involve the spillage or release of radioactive material, or there are personal injuries in incidents involving radioactive materials, the following emergency actions and precautions should be applied:

1. Notify immediately the Illinois Emergency Services and Disaster Agency. The telephone number is 217-782-7860. Request radiological emergency assistance. Request medical assistance if it appears that anyone is injured.
2. Make every effort possible to rescue injured or trapped persons and remove them from the incident area.
3. Unless given by a physician, immediate first aid should be limited to those procedures necessary to save life or minimize injury.

4. When it is necessary to send an individual to a hospital or other medical facility BEFORE a radiological emergency team or physician knowledgeable in radiological health arrives, inform ambulance and other transporting-vehicle personnel who will be in contact with the individual, of the possibility of radioactive contamination. Also, inform the hospital or medical facility that the individual may be contaminated with radioactive material.
5. When in doubt that the radioactive material is still confined to its container, assume that the immediate incident area is radioactively contaminated and that anyone and anything in the area MAY BE contaminated; and take special care to minimize personal contact with the outer clothing of individuals, the surface of the ground, vegetation, and the surfaces of things within or removed from the incident area.
6. Individuals not removed to a hospital or other medical facility and who are suspected of having been exposed to radioactive material should be detained until they can be appropriately monitored.
7. Obtain the names and addresses of all persons involved, including those who cannot be detained and those removed for medical attention.
8. Restrict access to the incident area and prevent unnecessary handling of incident debris. Keep the public away from the incident area as much as possible.
9. Fight fire as though toxic chemicals are involved. To the extent possible, keep upwind and avoid smoke, fumes and dust. Segregate clothing and tools used at the fire until they can be checked for radioactive contamination before being returned to normal use.
10. When a transportation incident involves radioactive material, DO NOT move vehicles, shipping containers or wreckage except to rescue people. Detour pedestrian and vehicular traffic. If a right-of-way must be cleared before radiological emergency assistance arrives, move vehicles and debris the shortest distance required to open a pathway. Before permitting the passage of traffic, spillage on the cleared pathway should be washed, or wetted and swept, to the edge of the pathway with minimum dispersal of wash water and spilled material.
11. DO NOT eat, drink or smoke in the incident area, or use food and drinking water that may have been in contact with radioactive material.

12. DO NOT handle, use or remove from the incident area any material, equipment or other items suspected of being radioactively contaminated unless released by radiation monitoring personnel.

F. Special Procedures for Handling Incidents Involving Nuclear Weapons

Transportation of nuclear weapons or their components requires special containers, securely fastened to the transport vehicle. To decrease the probability of unintentional detonation, safety features have been incorporated into the design of nuclear weapons and into the regulations governing transportation procedures. Nonetheless, a hazard exists. The two components of a nuclear weapon that constitute the most probable hazard in the case of a transportation accident are chemical high explosives and plutonium. Nuclear explosion is considered highly improbable.

1. High Explosives

Atomic weapons may contain up to several hundred pounds of chemical high explosives. These explosives may be rendered more unstable by the impact of the accident, rough handling, or exposure to sunlight. The detonation may be a single explosion or a series of smaller explosions.

Since accidents involving nuclear weapons normally involve other volatile materials such as gasoline or other fuels, fire is a distinct possibility. If the weapon becomes engulfed in flames, the high explosives may ignite and detonate. Additional features of high explosives which complicate the response are described on page VI-2 of the plan, as follows:

When high explosives burn, "torching" (jets of white flame coming out of the weapon) may be observed but torching is not always evident before detonation. High explosives may melt at comparatively low temperatures, flow out of the weapon and resolidify. In this state, they are extremely sensitive to shock. If unconfined, high explosives may burn with the production of toxic gases and leave a poisonous residue. Ignition or detonation of the high explosives in a nuclear weapon involved in a fire can be prevented if the temperature of the explosives is kept below 300°F.

"Only personnel specially trained in high explosives disposal should attempt to clean up, recover, or dispose of high explosives."³

2. Plutonium

The accident impact, detonation of the high explosives, or fire may result in dispersion of plutonium as small, settling particles or as an aerosol. Plutonium, an alpha emitter, does not present a hazard if it remains outside of the body, in contrast to fallout from an atomic explosion, which emits beta and gamma particles. The primary danger with the spread of plutonium is that it might enter the body by inhalation and become deposited in the lungs. Survey meters with alpha capability are required for evaluation of the situation. Therefore, conventional survey meters such as Geiger-Mueller instruments, used for general detection purposes, are of little use.

Experiments indicate that the greatest source of plutonium intake occurs by inhalation during passage of the cloud resulting from the detonation of the high explosives or from a fire.

The following instructions are given to members of the Radiological Assistance Team or persons in charge at the scene pending arrival of the team, should they find themselves in a situation involving potential or actual release of plutonium:

- a. Attempt to remain uphill and upwind of the accident.
- b. Wear mechanical breathing apparatus or dust filter masks, goggles, and protective clothing.
- c. Avoid smoke which might include dispersed, fissionable material.
- d. Do not attempt to fight the fire if the presence of ammunition is suspected.
- e. Do not touch or retain objects unnecessarily. Those in buildings near the accident are advised to shut doors and windows and turn off the ventilating system.

The plan further states that DOE or the nearest military installation should be notified immediately in the event of an accident involving nuclear weapons.⁴

³Ibid., p. VI-3.

⁴For a discussion of DOE assistance, see Appendix D.

G. Recommended Emergency Exposure Guide

A recommended emergency exposure guide sets the following limits for whole-body exposure to rescue and monitoring personnel: less than or equal to 75 rem if saving of human life is involved, and less than 12 rem if saving of human life is not involved. The guide sets limits for whole-body exposure to the general public at less than or equal to 5 rem with the qualification "below 500 millirem if possible."⁵ In addition, on pages IV-1 and IV-2 of the plan, working upper limits for removable and fixed contamination are set, as shown in Tables 2 and 3. Items not directly associated with the body, which are mentioned in the third column, may include floors (not household), equipment, roads, vehicles, truck or trailer beds, or tires.

TABLE 2
Removable Contamination as Measured with a High
Accuracy Analytical Instrument

Contaminant	Items Directly Associated with the Body	Items Not Directly Associated with the Body
Alpha	110 dpm/100 cm ²	200 dpm/100 cm ²
Beta-Gamma	1100 dpm/100 cm ²	2200 dpm/100 cm ²

⁵The Illinois Rules and Regulations for Protection Against Radiation, amended May 1, 1974, Section D.101.a, gives these upper limits for persons in restricted areas in nonemergency situations:

Except as provided in paragraph (b) of this section, no licensee or registrant shall possess, use, receive, or transfer sources of radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from all sources of radiation in the licensee's or registrant's possession a dose in excess of the limits specified in the following table:

	Rems per Calendar Quarter
Whole-body; head and trunk; active blood-forming organs; lens of eye; or gonads	1.25

This limit can be raised to 3 rem if appropriate personnel exposure history is known as described in Section D.101.a.

TABLE 3

Fixed Contamination as Measured with a Portable Instrument

Contaminant	Items Directly Associated with the Body	Items Not Directly Associated with the Body
Alpha		
U^{nat}, U^{dep}	110 dpm/cm ²	220 dpm/cm ²
Other	11 dpm/cm ²	22 dpm/cm ²
Beta-Gamma	0.75 mR/hr	1.5 mR/hr

The plan gives tables of Public Health Department survey meters' characteristics and tables of upper limits for activity levels in drinking water and milk (emergency consumption).

II. FEDERAL ASSISTANCE TO THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH

A. DOE

Under the Federal Radiological Assistance Plan, DOE provides radiation incident response capabilities to the states upon request. One of the functions of this program is to provide assistance for incidents involving nuclear weapons or radioactive materials in military custody. However, DOE can provide general radiation emergency assistance, including the following: aerial radiological monitoring, medical facilities such as whole-body counting and decontamination, and availability of experts from DOE contractors such as Oak Ridge National Laboratory and Brookhaven National Laboratory.

Constructive interaction between DOE and the Illinois Department of Public Health is illustrated in the following incident.

Loss of Radium Sources, November 26, 1974

At 8:30 a.m. on November 26, 1974, the Illinois Division of Radiological Health was notified by the FDA-BRH that ten radium-226 sealed sources were missing.⁶ A package containing eleven radium sources (one 25-mg radium plaque and ten 10-mg tubes) was shipped from a hospital in Omaha, Nebraska, on November 5, and arrived in New York City November 22, empty except for the plaque.

Both the Division of Radiological Health and FDA-BRH notified DOE at Argonne, Illinois, because of the interstate nature of the incident. DOE did not send a team but gave assistance by telephone and coordinated state activity by calling agencies in several states and having the states call in status reports throughout the incident.

⁶Maury Neuweg and James Blackburn, Incident Report, mimeographed, Division of Radiological Health, Illinois Department of Public Health (November 26, 1974).

The Illinois Division of Radiological Health sent personnel to the Chicago REA truck terminal where the shipment had stopped for off-loading, storing, and reloading. Initial surveys made using an Eberline 510 GM survey meter indicated nothing above background levels. After more information concerning the route the sources had taken was obtained, a more systematic survey was made. At 12:00 p.m., November 26, the Illinois team was released from the scene. Four of the ten radium sources had been found that day. An additional source was reported found in Omaha.⁷

DOE proceeded to work with the six other states having the type truck involved and took responsibility for incident follow-through.⁸

B. NRC

An example of interaction between NRC and the Illinois Public Health Department is illustrated in the following section.

Railway Incident of March 11, 1976

A 2- to 3-millicurie cesium-137 gauge fell into a coal car carrying coke.⁹ The NRC was trying to locate all cars that might contain the sealed source and called the Illinois Division of Radiological Health for assistance. The gauge was found near Robinson, Illinois.

As illustrated in the above, cooperation exists between the Illinois Department of Public Health, DOE, and NRC. Technically, DOE is not required to assist in radium-related incidents, however, as seen in the first incident, DOE assisted Illinois in the search for the lost radium sources. Technically, Illinois is not required to assist the NRC in transportation-related cases; however, Illinois assisted the NRC in tracking the lost gauge.

⁷ Journal Star, Peoria, Illinois, November 29, 1974, p. B-4.

⁸ Philip N. Brunner, Chief, Division of Radiological Health, Illinois Department of Public Health, personal communication (July 26, 1976).

⁹ Ibid.

The Illinois Department of Public Health also utilizes the University of Chicago medical facility which has capabilities for handling radiation accident victims, similar to the REAC/TS medical facility in Oak Ridge, Tennessee.

III. COMMONWEALTH EDISON'S GENERATING STATIONS EMERGENCY PLAN (GSEP)

A. Introduction

Commonwealth Edison Company was selected for discussion in Appendix A because it owns and operates the Dresden Nuclear Power Plant. The Dresden-2 incident of June 5, 1970, is discussed throughout this paper. The purpose for including GSEP was not to do a study of Illinois' power companies' radiation emergency response plans, but rather to lay the groundwork for the discussion of the Dresden-2 incident in Appendix A, Section V.

The GSEP is a comprehensive program that Commonwealth Edison has developed for dealing with emergencies of any type occurring at its power generating facilities. The plan considers emergencies at both nuclear and fossil generating stations.

The history of GSEP reveals growth in size and scope. The GSEP originated in 1968, when the Dresden Nuclear Power Plant was the only Commonwealth nuclear power station. The GSEP was developed as a counterpart of Commonwealth's ERP Program, an emergency response plan limited to restoration of power in the event of tornado, wind storms, etc. The ERP teams, dispatched to restore power equipment, were logically extended to radiological incident response teams. With the increase in the number of Commonwealth nuclear power stations, a GSEP Command Center was established, and communications systems were improved to include radio, conference telephone systems, and strategically arranged telephone line redundancy.¹⁰

Information presented in the following sections, III-B through III-G, was taken from "Generating Stations Emergency Plan," Commonwealth Edison Company, dated January 2, 1975, unless other sources are referenced.

¹⁰ Command Center Director, Commonwealth Edison Company, personal communication (August 12, 1976).

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B. Purpose

The purpose of GSEP is to protect health and safety of the public, to minimize damage to generating facilities and surrounding property, and to restore such facilities and property in the event of an accident occurring at any Commonwealth Edison generating facility.

The GSEP, itself, includes a description of organizational structure and duties of personnel. It provides guidelines for (1) identifying and evaluating emergency conditions, (2) interfacing with offsite agencies such as federal, state, and local governments. and (3) drilling personnel in emergency preparedness functions. Content of the GSEP is summarized in the following sections.

C. Organizational Structure

GSEP personnel are divided into four groups, as follows: Command Center Group, Division Group, Station Group, and Environs Group. The Command Center is the group having final authority for GSEP decision making and will be emphasized in this section. The other three groups provide implementation of Command Center decisions. These four groups are described below. Because of the parallel nature of personnel classification in the groups, more detail on personnel emergency responsibilities will be given for the first group.

1. Command Center Group

This group, headed by a Director, consists of personnel ultimately responsible for evaluating, coordinating, and directing all activities involved in coping with the emergency. These responsibilities include final decision making in such areas as intelligence, logistics, engineering support, medical care, manpower requirements, and communications. Command Center personnel and their responsibilities are summarized below.

- a. The Command Center Director will direct overall GSEP activities.
- b. The Intelligence Director will (1) relay information concerning recovery operations status and offsite agency support to the appropriate individual within GSEP, (2) make evaluations and recommendations

to the Command Center Director, and (3) assure that all activities are documented.

c. The Medical Director will (1) make recommendations to the Intelligence Director concerning first-aid and medical health physics problems arising from the emergency and (2) specify medical needs at the site relative to care and decontamination of the accident victim(s).

d. The Information Director will collect, verify, and disseminate information to the public, as directed by the Intelligence Director. If the incident involves a nuclear station, the Information Director will coordinate the release of information with NRC and the Illinois Department of Public Health.

e. The Environmental Director will (1) direct and evaluate activities of the Environs Group, (2) make judgments as to the extent and seriousness of the emergency, (3) report these judgments to the Intelligence Director, and (4) assure that the overall plan for emergency response, i.e., the combined effort of all agencies, is satisfactory.

f. The Manpower and Logistics Director will (1) activate Directors responsible for manpower, logistics, communications, aerial assistance, and accounting personnel and (2) keep the Command Center Director informed of the activities pertaining to the above.

g. The Communications Director will (1) direct procurement of necessary communications systems as specified by the Manpower and Logistics Director and (2) maintain such systems as needed.

h. The Aerial Logistics Director will provide aerial services as required by the Manpower and Logistics Director.

i. The Accounting Director will exercise fiscal and timekeeping duties related to the emergency.

j. The Legal Consultant will advise the Command Center Director on legal matters.

k. The Engineering Director will obtain engineering services such as drafting services, design and construction of special tools, equipment, shielding, containers, or other devices needed during and after the emergency.

1. The System Power Supply Load Dispatcher will (1) carry out normal duties of power load distribution, (2) notify the Command Center Director in the event of an onsite emergency, an offsite alert, an offsite emergency, or a loss of communication during an onsite alert, and (3) alert the NRC Chicago Operations Office in the event of an offsite emergency.

2. Division Group

The Division Group will provide support services using company personnel, local agencies, and contractors. This group dispatches supplies, equipment, and manpower as requested by the Command Center Director. Division Group GSEP personnel include the following: Division Director, Food and Lodging Director, Ground Logistics Director, Manpower Director, Division Information Director, and Division Load Dispatcher.

3. Station Group

The GSEP Station Group provides onsite emergency response duties. Station Group GSEP personnel include: Station Director, Operations Director, Technical Director, Maintenance Director, Stores Director, and Administrative Director.

During an emergency, the Station Director would keep the GSEP Command Center Director fully informed of the status of the emergency situation. If a potential or actual offsite emergency exists, the Station Director will dispatch the Environs monitoring team.

The administrative Director's duties include maintenance of plant security and control of ingress and egress to and from the site.

4. Environs Group

The GSEP Environs Group, which functions under a health physicist, performs all offsite monitoring during a radiological or chemical emergency. The GSEP Environs Group personnel include an Offsite Environs Director and an Offsite Environs Assistant. The Director supervises a survey team, evaluates survey results to determine whether a hazard to the public exists and coordinates all efforts in the field with the NRC Chicago Operations Office and the Illinois or Iowa Department of Public

Health. The Director will establish an Environs Group headquarters at the Station GSEP Center or an appropriate offsite location.

Communications shall be maintained between the GSEP Command Center and the Environs Headquarters.

D. Agencies Which Provide Assistance to Commonwealth Edison During Emergencies

1. Federal Government:

The NRC is the licensing agency for nuclear power reactors, reactor operators, and special nuclear materials. Under the Atomic Energy Act of 1954, as amended, the NRC has power to establish rules and regulations governing the use of radioactive materials. In addition, the NRC has the authority to inspect its licensees to ensure that activities are conducted in accordance with the terms and conditions of the NRC licenses.

A DOE Operations Office located at Argonne National Laboratory, Argonne, Illinois, is available for immediate federal assistance. The Chicago Office has a team of radiation specialists on call for immediate dispatch to the scene of a radiological incident and the authority to enlist other necessary federal agencies. The team's primary function is to control the radiological hazard. This function does not routinely include recovery actions but might be extended to cover such actions if extreme need existed.

2. Illinois Department of Public Health

The Illinois Department of Public Health has the responsibility for activating the Illinois Radiological Assistance Plan, an emergency response to radiological incidents occurring within the state. This agency's headquarters are located in Springfield, Illinois. This agency has authority to make and enforce rules and regulations regarding use and possession of radioactive materials. Commonwealth Edison will notify the Illinois Department of Public Health during a radiological incident requiring activation of the State plan. The Illinois Department of Public Health will then consult with and request assistance as

needed from Commonwealth, the United States Coast Guard, the Illinois State Police, the Illinois Emergency Services and Disaster Agency, the NRC, and other local, State, and federal agencies. In addition, the Illinois Department of Public Health will coordinate its effort with relevant agencies in other states if required.

3. Illinois Department of Public Safety

This agency, which includes the Illinois State Police, has responsibility for law enforcement. Upon request from the Illinois Department of Public Health, the State police in cooperation with local police will conduct orderly movement of population or equipment.

4. The Illinois Emergency Services and Disaster Agency

This agency provides defense against disasters resulting from natural causes, under the Civil Defense Act of 1951. This agency works in cooperation with the Department of Public Health for peacetime radiological incidents.

5. The Illinois Environmental Protection Agency

The Illinois Environmental Protection Agency will be notified if an offsite emergency or alert condition occurs.

6. The Illinois Commerce Commission

The Illinois Commerce Commission regulates financial activities of the power companies and will be notified if an offsite emergency or alert condition occurs.

7. State of Iowa

The Iowa Department of Public Health will be notified of any off-site alert or emergency condition at a nuclear generating station which might affect the State of Iowa. Iowa agencies are responsible for orderly relocation of Iowa population should such measures become necessary.

8. Local Government

Illinois county, township, or municipal governments having jurisdiction over areas in the vicinity of Commonwealth's generating stations will become involved in emergency response. If a radiological incident occurs, the Illinois Department of Public Health will advise local government agencies on recommended protective action. Commonwealth may

also contact the local government agencies.

Commonwealth Edison maintains annual contact with non-Commonwealth organizations such as 1 through 8 above, whose services may be needed during an emergency. This contact includes the following:

- a. A request for written confirmation of availability of support from that organization.
- b. An invitation to the members of that organization to tour a generating station.
- c. An offer to provide training to organization members regarding their role in the emergency plan.
- d. Notification of the availability of an NRC course, "Emergency Response Planning for Fixed Nuclear Facilities."

In addition to interaction with government agencies, Commonwealth utilizes environmental consultants such as Biotest Industrial Laboratories, Incorporated, of Northbrook, Illinois, which does radioassay of environmental water samples, and Eberline of Santa Fe, New Mexico, which performs air monitoring.¹¹ The Radiation Management Corporation (RMC) of Philadelphia provides consulting services for Commonwealth in the area of emergency planning.

Commonwealth maintains arrangements with ambulance services and hospitals, confirmed in writing, for prompt rescue and treatment of victims of radiological or nonradiological accidents. An arrangement in writing is also maintained with a major medical facility having the capability for treatment and decontamination of victims of radiological accidents of any severity level.

The order and extent of notification of the above agencies depends to a great extent upon the nature of the incident. An example of one notification sequence is summarized below. The emergency occurred June 6, 1975, at a Commonwealth Edison nuclear generating station.¹²

¹¹ Paraphrased from "Generating Station's Emergency Plan," speech presented to the Illinois Emergency Services and Disaster Agency by GSEP Command Center Director, Commonwealth Edison Company, undated.

¹² Command Center Director, "GSEP Nuclear Power Station Unit 1 Onsite Emergency," mimeographed, Commonwealth Edison Co., June 10, 1975.

GSEP Nuclear Power Station Unit 1 Onsite Emergency

At 8:25 a.m., while talking with the Command Center Director for the morning report, a Commonwealth Generating Station Superintendent reported that a problem must have occurred because he heard the public address call for all rad-protection men to report to the control room. The Superintendent was then notified by the Shift Engineer that Unit 1 was losing reactor coolant, and the system pressure was dropping. The Superintendent proceeded to the control room. The Command Center Director immediately assembled the appropriate Command Center Directors: Manpower and Logistics, Intelligence, Environmental, News Information, and Engineering.

At 8:30 a.m., the Station Superintendent called the Command Center from the control room and reported to the assembled group of Directors that the Unit 1 reactor pressure had dropped from 2235 psig to 1500 psig, that rad-protection personnel were surveying around the containment and taking gas samples, that the Unit 1 area was being evacuated, and that the reactor operator had started safety injection manually before automatic action occurred. In the events that followed, a sump high-level alarm and a stack high-activity alarm were triggered, and instruments indicated reactor coolant pump-seal failure. Isolation of the pump resulted in recovery of the system pressure.

At 8:40 a.m., the NRC was notified that at approximately 8:20 a.m. loss of some reactor coolant had occurred.

At 8:42 a.m., the Station Superintendent called the Command Center and reported a rise in reactor pressure and stated that pump-seal failure was suspected. All five containment-cooling units were operating in the accident mode. Water was accumulating on the containment basement floor.

At 8:50 a.m., the State of Illinois Emergency Services and Disaster Agency Duty Officer was notified. The Illinois Division of Radiological Health was notified.

At 9:00 a.m., the Station Superintendent reported to the Command Center that normal cooldown procedures were started for Unit 1. The

reactor containment was isolated to stop the pumping of water to rad-waste. Initial indications were that no "Technical Specifications"¹³ release limits were exceeded and that no personal injuries occurred. The Command Center Intelligence Director dispatched Command Center personnel to the Generating Station to give assistance.

At 9:08 a.m., the GSEP condition terminated and recovery was begun.

At 9:14 a.m., the NRC and the Illinois Emergency Services and Disaster Agency were notified that GSEP was terminated.

At 9:25 a.m., an Illinois Division of Nuclear Safety health physicist called the Command Center and left the message that he was leaving Springfield for the Station at the direction of the Governor's Office.

At 9:30 a.m., the Superintendent called the Command Center and stated that air sampling of the containment area would be completed by noon, and the status of equipment in the containment area would be known by 4:00 p.m.

E. Classification of Emergencies

GSEP classifies radiological and nonradiological incidents into four categories based upon their severity and whether they present an onsite or offsite hazard. The Illinois Division of Nuclear Safety uses the same classification categories when dealing with radiological incidents occurring at Commonwealth generating stations. The categories, from pages 4-1 through 4-3 of the GSEP plan, are summarized below.

1. An Onsite Alert exists if any of the following occurs:

- a. The incident is of a serious, local, and nonrecurring nature and required ambulance service.
- b. The incident presents a significant and continuing hazard to onsite personnel; i.e., it is presently uncontrolled but can be controlled

¹³"Technical Specifications" are nuclear power generating station operating restrictions, which include acceptable release levels of radioactivity. This document is part of the Final Safety Analysis Report which is submitted by the nuclear power reactor license applicant and approved by the NRC prior to licensing.

by onsite resources. Examples of such incidents are fires for which the fire brigade is activated, explosions, civil disturbances, floods, or similar incidents which can be controlled by onsite resources.

c. A significant probability exists for the onsite alert to become an onsite or offsite emergency.

2. An Onsite Emergency exists if any of the following occurs:

a. Evacuation of site personnel is required.

b. The incident presents a significant and continuing hazard to onsite personnel; i.e., it is presently uncontrolled and requires assistance from offsite agencies for control.

3. An Offsite Alert exists if any of the following occurs:

a. Special offsite monitoring is implemented to determine whether offsite areas require evacuation, restriction of entry, or confiscation of food or water.

b. Fire, medical, or police assistance is contemplated to protect offsite persons or property.

c. A radioactive or hazardous material shipment is interrupted.

d. A significant probability exists for an onsite condition to develop into an offsite emergency.

4. An Offsite Emergency exists if any of the following occurs:

a. Offsite areas require evacuation, restriction of entry, or confiscation of food or water.

b. Fire, medical or police assistance is required to protect offsite persons or property.

c. A radioactive or hazardous material shipment is interrupted and a hazard to the public results.

d. A five-foot uncontrolled loss of water occurs in the spent fuel pool, with spent fuel in the pool, and the water level decreasing.

e. A single event release in excess of "Technical Specifications" limits occurs, which could cause a dose to the public in excess of the Recommended Emergency Exposure for General Public suggested by the NRC in their General Administrative Manual, Chapter 0524.

For classification of radiological incidents, numerical dose guidelines are used in addition to the above. These guidelines, posted

in the Command Center conference room, are presented in Table 4 as they appear on page 4-5 of the GSEP plan.

F. Activation of GSEP

Activation of GSEP will occur if an Offsite or Onsite Alert or an Emergency occurs. This does not preclude activation of GSEP for incidents of lesser severity. For example, a release of radioactive material might result in a violation of "Technical Specifications" limits but result in doses well below those specified for the four categories above. For a situation of this nature the Command Center Director may activate GSEP.

Activation of GSEP may include continuing communication between the Command Center and Generating Station personnel, notification of appropriate Commonwealth personnel and outside agencies, and dispatch of GSEP radiation emergency response personnel.

If the appropriate government agencies are not available, and immediate action is deemed necessary, Commonwealth will make a reasonable effort to inform the affected members of the public of the situation and recommend to them protective action such as evacuation, taking cover, restriction of entry, and confiscation of food and water.

Effective radiation emergency response activities at the nuclear generating station are essential for GSEP success. Therefore, detailed emergency procedures have been developed for station personnel. The emergency procedure for fire fighting is presented below. This procedure was taken from the following documents: (1) Emergency Plan for Implementing Procedures (EPIP), section entitled "References for Fire Fighting Procedures," and (2) Nuclear Generating Station Action Plan, section entitled "Station Fire Fighting."

Fire Fighting Procedures

1. The person discovering the fire promptly evaluates the situation. If the fire is small and the appropriate equipment available, he will extinguish the fire and then notify the control room operator. If

TABLE 4
Guidelines for the Categorization of Radiological Incidents

Total Dose* To:	Alert Stage		Emergency Stage	
	Onsite	Offsite	Onsite	Offsite**
Whole Body***	5 rem	0.5 rem	25 rem	5 rem
Thyroid and Other Organs	15 rem	1.5 rem	75 rem	15 rem
Skin	30 rem	3.0 rem	150 rem	30 rem
Extremities	75 rem	7.5 rem	375 rem	75 rem

*Total Dose: Projected dose plus the dose already received or unavoidable due to the event. Categorization and notification should be based on total dose. Projected Dose: That dose that would be received in the future by individuals in the population group from the contaminating event if no protective action were taken. Protective actions should be based on projected dose.

**If isotopic composition of liquid discharge is not known, then the suggested 10-day average concentration of 3×10^{-3} $\mu\text{Ci/ml}$ for drinking water would be used to determine if an emergency exists.

***Whole body, gonads, active blood-forming organs, head and trunk, and lens of eye resulting from unplanned acute doses.

the fire is not small or if there is doubt, the person discovering the fire will immediately report the fire to the control room operator.

2. The control room operator announces the location of the fire over the public address and activates the fire alarm.

3. The Station Fire Brigade proceeds to the fire location.

4. An onsite Alert will be declared.

5. The Station Director or his representative will call the Command Center.

6. GSEP will be activated.

The action from this point depends upon the severity of the fire. The emergency duties list for the Production Management Officer, dated May 27, 1975, states that the Illinois Department of Public Health would be notified if any of the following occurred:

--The unit was shut down for a time period exceeding one day, because of failure or damages to safety-related equipment.

--A nuclear plant employee required decontamination at a hospital.

--Radiation exposure to an individual exceeded the 10 CFR 20 (Ref. 14) limits.

--There was major damage to the plant.

The above example of a fire-fighting procedure is not intended to give a complete description of the station-level response for all types of incidents, but only to illustrate one possible sequence of events for a fire. More information on GSEP generating-station procedure is provided in the EPIP's and Action Plans cited above. These documents give complete procedures for fires and many other types of generating-station emergencies, both radiological and nonradiological in nature.

G. Drills

Drills of GSEP are conducted four times per year.¹⁵ A drill consists of a simulated incident requiring full Commonwealth GSEP response.

¹⁴This refers to Title 10, Part 20, of the Code of Federal Regulations and establishes Standards for Protection Against Radiation.

¹⁵News and Information Director, Commonwealth Edison, personal communication (August 12, 1976).

Outside agencies will not necessarily be activated but will be called upon to confirm their readiness.

The following is a briefly summarized drill of GSEP.

Radiation Emergency Drill, May 16, 1975¹⁶

At 9:34 a.m., a nuclear power generating station control-room operator was handed the "drill," a written description of the incident that was to have occurred, thus signaling the beginning of the exercise. The operator was told that a source giving radiation levels of 20 R/hr, being carried in a cask by two men, had been released from the cask as the men tripped on the stairs. One of the men suffered a sprained ankle, and the other suffered a compound fracture. The control-room operator immediately notified the Shift Engineer. GSEP notification proceeded.

At 9:38 a.m., the Rad-Protection Department was dispatched to the accident area, and shortly thereafter the drill was announced over the public address system.

At 9:43 a.m., the local police dispatcher was notified of an Onsite Emergency. The ambulance service was called, and arrangements were made to have the station security meet the arriving ambulance driver and to provide escort to the accident scene.

At 9:45 a.m., the appropriate hospital was notified.

Activity at the scene of the accident included applying a makeshift splint to the compound fracture, transporting the victims to the decontamination room, and shielding the source with lead blankets and lead bricks.

At 10:11 a.m., the ambulance driver was escorted to the decontamination room.

At 10:20 a.m., the ambulance left the site.

At 10:32 a.m., the Station Director notified the Command Center Director that the drill was terminated.

¹⁶Health Physicist, "GSEP Drill at a Nuclear Power Generating Station on May 16, 1975," mimeographed, Commonwealth Edison Co., June 4, 1975.

In accordance with Commonwealth Edison drill procedure, a videotape was made of the drill and on June 10, representatives of Radiation Management Corporation, a consulting service which provides medical advice and other assistance for handling radiation emergencies, joined Commonwealth personnel to view the drill videotape and prepare a critique. Their "Comments on the Station Emergency Drill"¹⁷ were issued May, 1975, and included comments such as the following:

1. The prompt application of extemporized pressure dressing to the wound and splinting of the leg was commendable. The constant concern for the maintenance of breathing was also evidence of good training.
2. Failure to strap the victim in the stretcher was quickly recognized by the rescuers as an oversight that could have had lamentable consequences.
3. Preparation for taking nasal smears showed cool presence of mind and good health physics training. Deferring the smears when the ambulance arrived showed good judgement.

GSEP drills provide exercise in emergency response practices for Commonwealth and outside agency personnel and also provide a means for locating areas in GSEP in need of improvement. Examples of GSEP improvements which resulted from drills are as follows:¹⁸

1. The GSEP written plan was revised and reduced in size by 60 percent as of November 1975.
2. A single sheet, "Command Center Activity Log,"¹⁹ was developed at this time for use during an incident or drill. This log provides spaces for recording relevant incident information and also provides a checklist of names and telephone numbers of agencies to be notified by Commonwealth during an incident.
3. Name and title tags were made for GSEP Directors for use during conference calls.

¹⁷"Comments on the Nuclear Power Generating Station Radiation Emergency Drill--May, 1975," mimeographed, Commonwealth Edison Co., undated.

¹⁸Command Center Director, op. cit.

¹⁹Commonwealth Edison Co., "Command Center Activity Log," mimeographed form.

4. Guidelines for classification of radiological incidents (Table 4, p. 56) and notification flow charts were posted in the Command Center conference room.

The information provided by these drills is made available to various organizations. For example, The present Command Center Director is a member of the American Nuclear Society's Standards Committee, which prepares American National Standards Institute (ANSI) Standards on selection and training of nuclear plant personnel. Topics discussed at the meetings of the society include quality assurance programs and emergency planning.²⁰

²⁰

Command Center Director, op. cit.

IV. INTERFACING BETWEEN THE ILLINOIS DEPARTMENT OF PUBLIC HEALTH AND NUCLEAR POWER PLANTS

A. Legal Restraints

1. Introduction

A state can exercise certain police powers to protect public safety, health, and welfare. Legal restraints that limit these police powers are of two types: (1) laws prohibiting state actions or (2) absence of laws authorizing state actions. In the area of federally owned nuclear power plants, Illinois' legal restraints are laws prohibiting state action.

The phrase "regulatory authority" as used in Section IV is defined as the power to license and inspect, which in Illinois includes the power to impose a monetary penalty and/or shut down a facility.

The term "Commission" as used in Section IV refers to the AEC or its successor.

2. Federally Owned Nuclear Power Plants

The "Supremacy Clause" in Article VI of the United States Constitution prohibits state regulation of federal projects, such as DOE-owned nuclear power reactors.²¹

By the above, the State of Illinois has been prohibited from licensing or inspecting any onsite activity at any of its federally owned nuclear facilities, such as its three DOE-owned nuclear power reactors listed in Appendix A, Section IV.B.

If a radiological hazard were present or imminent at any of its federally owned nuclear power reactors, Illinois' emergency response would be limited to offsite activities to protect the public, such as:

a. Offsite surveillance monitoring to determine if a "release"²² had occurred, i.e., the extent to which the facility is dumping materials into the environment.

²¹Article VI of the United States Constitution states that if there is a conflict between federal and state law, the federal law prevails. This is currently interpreted to include federal projects. Thus, federal laws which regulate federal projects preempt state laws attempting to regulate federal projects.

b. Activation of the Illinois Radiological Assistance Plan (Appendix A, Section I) if the Illinois Department of Public Health judges that a radiological hazard to the public exists.

Thus, Illinois government cannot regulate onsite activities at a federally owned nuclear facility, but can take steps to protect the public from radiological hazards resulting from onsite activity.

3. Privately Owned Nuclear Power Plants

The Atomic Energy Act of 1954, as amended,

—Gives to the Commission full regulatory authority over all possession and use of special nuclear material, source material, and by-product material.

—Gives the state limited regulatory authority over by-product, source, and special nuclear materials in quantities not sufficient to form a critical mass, if the state enters into an agreement with the Commission in accordance with Subsection 274b of the above act.

Although Illinois does not have an agreement with the Commission as mentioned above, i.e., it is not an Agreement State, the Illinois Radiation Protection Act of 1959, as amended, has given Illinois powers to regulate by-product, source, and special nuclear materials, similar to those powers which are customarily given under Subsection 274b mentioned above.

Thus, by the above acts, the State of Illinois has not been denied, but rather has not been given authority to regulate activities associated with quantities of fissionable materials sufficient to form a critical mass, e.g., privately owned nuclear reactor operation.

To date no state has legislated for itself regulatory powers over use of special nuclear materials in quantities sufficient to form a critical mass. If such action were taken, it might be challenged under Article VI of the United States Constitution.

²²A radioactive "release" or "dumping" refers to any release of radioactive material into the environment in excess of the limits set forth in the nuclear power plant "Technical Specifications." This can refer to release into water, air, or any environmental medium.

If a radiological incident occurred or threatened to occur at a privately owned nuclear power reactor, the Illinois Department of Public Health is empowered to take the following actions to protect the public:

a. As with federally owned facilities, any offsite activities to protect the public from the hazard, such as:

—Surveillance monitoring to determine existence and extent of any release.

—Activation of the Illinois Radiological Assistance Plan (see Appendix A, Section I) which would include evacuation, restrictions on food and water, and other protective actions deemed necessary by the Illinois Department of Public Health.

b. Additionally, immediate inspection of onsite activities, records, and safety programs associated with calibration sources and other sources of ionizing radiation, excluding special nuclear materials of sufficient quantity to form a critical mass.

B. Division of Nuclear Safety

The Illinois Department of Public Health has established a Division of Nuclear Safety, specifically concerned with nuclear fuel-cycle safety programs at facilities within the State. The reasons for establishing this Division and its present status are discussed below.

Following the incidents at the Dresden Nuclear Power Plant of June 5, 1970, and December 8, 1971, State involvement in matters of the nuclear fuel cycle was increased. The Illinois Commerce Commission hired two consultants, Ralph E. Lapp and Ernest C. Tsivoglou, to study the operations of BWRs in Illinois and make recommendations to the State. The Lapp and Tsivoglou reports were submitted December 7, 1972, and November 30, 1972, respectively. Both consultants recommended greater State involvement in fixed nuclear facility safety programs.²³ This recommendation was prompted in large measure by the NRC's demonstrated failure to prevent a repetition of the Dresden 2, June 5, 1970, incident.

²³ For greater detail, see Appendix A, Section V.

As recommended in the reports mentioned above, the Illinois Public Health Department reorganized to form a Division of Nuclear Safety headed by a single coordinator. This Division's functions include the following:

1. To act as a central point for communications with NRC and to be a focus of all state activities related to fixed nuclear facility safety programs.
2. To provide a State investigator to collaborate with NRC inspectors in investigation of abnormal reactor occurrences.
3. To follow-up on all NRC citations of noncompliance and prepare a summary report on each citation.
4. To prepare an annual nuclear safety report to the Governor including:
 - a. A summary and evaluation of nuclear incidents at fixed nuclear facilities within Illinois.
 - b. Itemization of each NRC citation for noncompliance in the nuclear power field with summary of action taken.

The Division of Nuclear Safety is primarily concerned with matters of safety involving the entire nuclear fuel cycle. Nuclear-fuel-cycle facilities presently located in Illinois are shown in Table 5.

Of the above facilities, only the Argonne Research Reactor, the Argonne Thermal Source Reactor, and the Biological Research Reactor are federally owned.

C. State Inspections of Nuclear Power Plants

The Illinois Department of Public Health performs quarterly health and safety inspections of nuclear power plants,²⁴ done in the same manner as routine Radiological Health inspections. Citations have been given, but no monetary penalties imposed to date. The inspection of a nuclear power plant covers such areas as the following: (1) personnel

²⁴Gary Wright, Chief, Division of Nuclear Safety, Illinois Department of Public Health, personal communication (May 19, 1976).

TABLE 5

Nuclear Fuel Cycle Facilities Located in Illinois

Facility	Unit	Owner	MW(e)	MW(t)
Dresden Nuclear Power Station	1	Commonwealth*	200	700
Dresden Nuclear Power Station	2	Commonwealth*	809	2527
Dresden Nuclear Power Station	3	Commonwealth*	809	2527
Quad Cities Station	1	Commonwealth**	800	2511
Quad Cities Station	2	Commonwealth**	800	2511
Zion Station	1	Commonwealth*	1050	3250
Zion Station	2	Commonwealth*	1050	3250
Argonne Research Reactor		DOE	-	5000
Argonne Thermal Source Reactor		DOE	-	10
Biological Research Reactor		DOE	-	200
Westinghouse Nuclear Training Center			-	10
University of Illinois			(not available)	
Midwest Fuel Recovery Plant, presently Midwest Fuel Storage Facility			(not applicable)	
Allied Chemical Facility			(not applicable)	

*Commonwealth Edison Company.

**Commonwealth Edison Company and Iowa-Illinois Gas and Electric Company.

monitoring, (2) training programs, (3) posting requirements,²⁵ such as "High Radiation Area" signs, and (4) security of calibration sources.

The Divisions of Radiological Health and Nuclear Safety do not inspect or become involved in any way with onsite programs of federally-owned fixed nuclear facilities.²⁶ The Divisions would only become involved with such facilities if an offsite problem existed. Thus, onsite nuclear safety inspections, as described above, are not made of the three DOE-owned reactors shown in the above list of Illinois nuclear fuel cycle facilities. State regulations in this area are preempted under the "Supremacy Clause" of Article VI of the United States Constitution.

All commercial nuclear power stations in Illinois are privately owned, and these power companies have in all instances cooperated fully with the Illinois Department of Public Health in its inspection requirements.

²⁵ Illinois Department of Public Health, Rules and Regulations for Protection Against Radiation, Section D.203, May 1, 1974.

²⁶ Brunner, op. cit.

V. INCIDENT AT DRESDEN 2

A. Incident Chronology

Dresden Unit 2 is a second-generation 2527 MW(t) [809 MW(e)] General Electric Boiling Water Reactor (BWR) located within the Dresden Nuclear Power Plant, operated by Commonwealth Edison Company, Chicago, Illinois.²⁷

On June 5, 1970, while Unit 2 was undergoing power testing and operating at approximately 75 percent full power, a power transient within the reactor pressure control system altered steam flow to the turbine. Within seconds the turbine tripped and caused a reactor scram; and in minutes, a primary-coolant, water-level-indicator chart pen, being observed by the reactor operator, stuck. The operator, not knowing the correct rising-water-level status and not knowing that the pen was stuck, initiated inappropriate actions which resulted in further increase of flow rate and subsequent erratic water level and pressure control. The isolation condenser which might have alleviated the resulting pressure-increase problems did not function as needed due to a "too low trip setting" of the condensate-return-line flow, required by an erroneous "Technical Specification" (higher condensate-return-line capability was needed).²⁸

This sequence of events led to a discharge of steam and water through safety valves into the reactor dry well.

Water-level control was established at 1-1/4 hr after the initial transient, and dry-well-pressure control, at 2 hr.

Radiation surveys made June 5, 6, and 7 revealed that no significant release to the environment had occurred. Dry-well air samples taken June 5 showed 100 times maximum permissible concentration for iodine-131 and dry-well radiation-level readings of 1 R/hr were obtained June 6. Therefore, contamination resulting from the incident was confined to the site.

²⁷ C. D. Cagle "Dresden-2 Incident of June 5, 1970," ed. W. R. Casto, Nuclear Safety, Vol. 12, No. 6 (September-October, 1971), pp 538-46.

²⁸ Ibid.

B. Damage and Corrective Actions

The discharge of steam and water resulted in damage to electric cables and low-resistance problems in electric motors. Damages were confined to equipment within the dry well.

The total outage of approximately two months involved a power replacement cost of \$5.6 million.²⁹ The reactor remained shut down until August 8, 1970.

Corrective actions taken immediately included the following:

- Replacing some electric cables with improved cables having higher temperature ratings.
- Rerouting other electric cables.
- Drying electric motors.
- Reorienting the discharge direction of safety valves.
- Revising the reactor pressure control system to conform to design.
- Improving the capability of the isolation condenser, i.e., raising the trip point and revising the "Technical Specifications" accordingly.
- Revising operating and emergency procedures to place greater emphasis on the dangers of high-water-level situations.
- Revising the electrohydraulic control system in which the spurious signal that triggered the incident occurred.³⁰

C. Critiques and Recommendations

Several documents containing analysis and criticism of the Dresden-2 incident appeared. The critiques in four such documents will be summarized below. Action taken by the appropriate agency on a given criticism is shown.

1. Items of Noncompliance Cited by the AEC³¹

In a letter dated November 19, 1970, the AEC Division of Compliance cited three items of noncompliance related to the incident at Dresden 2

²⁹Ralph E. Lapp, Report to the Illinois Commerce Commission (Illinois Commerce Commission, December 7, 1972), II-10.

³⁰Cagle, op. cit.

³¹Lapp, op. cit., p. II-13.

of June 5, 1970. Items 1 and 2 cited numerous instances of failure of the licensee to provide or adhere to procedures set forth in the Dresden 2 "Technical Specifications" such as:

(2c) There was no procedure for venting the dry well atmosphere under accident conditions.

(2d) Containment-spray-system operation was not initiated in accordance with emergency procedures.

In addition, item 1 stated:

(3) Contrary to 10 CFR 20.201 (b) (AEC Standards for Protection Against Radiation) licensee did not make surveys to:

- a. Determine the radioactivity concentrations of the containment atmosphere prior to venting the dry well to the environs via the stack.
- b. Determine the radioactivity concentrations of the water in the dry well prior to pumping it out to radwaste tanks which are located outside the containment.

Commonwealth Edison responded in a letter dated December 14, 1970, stating that operating procedures were being revised to correct the items cited in the AEC letter of November 19, 1970.

2. "Dresden-2 Incident of June 5, 1970," by C. D. Cagle

Commenting on the stuck pen on the water-level indicator, Cagle states "The incident reports . . . fail to say whether more than one readout instrument has been provided or the reliability of the instruments has been improved."³²

Cagle also states that the cables in the dry well have been made less vulnerable to moisture and temperature damage but that there is no clear evidence that the electric motors in the dry well have been made less vulnerable.

Cagle points to the necessity of complete redundancy. Though a number of dry-well-temperature monitors were present at Dresden, there was only one temperature recorder, which ran out of paper during the incident. As a consequence, no temperature history was obtained for the incident.

³²Cagle, op. cit.

3. The Lapp Report

The Dresden Unit-2 incident and a similar incident occurring on December 8, 1971, at Commonwealth Edison's BWR, Dresden Unit-3, also involving transients and release of contaminated fluid into the dry well,³³ resulted in a State investigation. One product of this investigation, the Lapp Report, suggest the following:³⁴

a. The State of Illinois should establish an Office of Nuclear Energy Coordination headed by a single coordinator, with the following functions:

1. Act as a central point for communications with the AEC.
2. Provide as state investigator to collaborate with the AEC inspectors in vestigation of abnormal reactor occurrences.
3. Maintain an inventory of high-level radioactive waste shipments within the state.
4. Follow up on all AEC Regulatory citations of noncompliance and prepare a summary report on each citation.
5. Prepare an annual Nuclear Safety Report including: (a) summary and evaluation of nuclear incidents at both reactor sites and fuel reprocessing centers, (b) an inventory of fuel-rod shipments and an account of any accidents related to such shipments, and (c) itemization of each AEC citation for noncompliance in the nuclear power field with summary of action taken.

Action on items 2.a.1 through 2.a.5:

The Division of Nuclear Safety has been created to perform the functions suggested by Lapp. The main goal of this group is to overview and coordinate State activities regarding nuclear safety and to submit a³⁵ single, annual report to the Governor on nuclear safety status.

³³ William R. Casto, "Safety Related Occurrences Reported in December 1971-January 1972," Nuclear Safety, Vol. 13, No. 3 (May-June 1972), p 236.

³⁴ Ralph E. Lapp, Report to the Illinois Commerce Commission (Illinois Commerce Commission, December 7, 1972).

³⁵ Wright, op. cit.

b. The Illinois Commerce Commission should:

1. Exercise oversight responsibility with respect to Commonwealth Edison and General Electric investigation of feedwater control systems and safety valve performance.
2. Study feasibility of modifications in Dresden 2 and Dresden 3 control rooms to permit more expedient display of transient data.
3. Require Commonwealth Edison to maintain more extensive records of investigations of transients.
4. Keep informed of technical developments in nuclear reactor safety (listed as two items).
5. Study recommendations of the AEC's Regulatory Study Group ordered implemented November 28, 1972; follow through as relevant.
6. Require that AEC permission to start up a power reactor be obtained in writing whenever a transient accompanied by damage to safety-related equipment occurs.
7. Request from the AEC technical guidance on Class 9 nuclear accidents to aid in future reactor siting.

Action taken on items 2.b.1 through 2.b.7:

The Illinois Commerce Commission has maintained contact with the utility regarding the feedwater control systems and water-safety-valve performance. However, the Commission did not have the technical expertise to exercise oversight responsibility. The Illinois Commerce Commission continues to examine technical problems associated with nuclear reactor operations. The most recent example is the evaluation of the stress/corrosion pipe cracking problem for BWR's.³⁶

The Lapp Report, together with many other studies, has increased the sensitivity to nuclear power problems in Illinois.

The AEC had been notified within 24 hours of the Dresden-2 incident of June 5, 1970, and issued the letter of citation for violation of proper plant operations procedures on November 19, 1970. The Lapp Report criticized the length of the above time interval and suggested

³⁶ Robert Podlasek, Administrative Assistant for Energy, Illinois Commerce Commission, personal communication (May 19, 1976).

that firm enforcement proceedings following the June 5, 1970, incident might have prevented the Dresden-3 occurrence of December 8, 1971.

According to the Lapp Report, the AEC gave greater emphasis to the problems leading to the Dresden incidents after the second incident; however, it was not until the Governor of Illinois announced plans for the Lapp investigation that the AEC organized a study group to review BWR transients.

4. The Tsivoglou Report

The incidents at Dresden 2 and Dresden 3 prompted another report to the Illinois Commerce Commission, the Tsivoglou Report.³⁷ This report was a full explanation of the Dresden incidents, a treatise on the BWR, and a series of recommendations to agencies within Illinois. These recommendations are summarized as follows:

a. Commonwealth Edison should submit a detailed summary of its effluent radioactivity measurements to the State on a quarterly basis.

b. The State of Illinois, taken to mean the appropriate State agency, should undertake a program of effluent monitoring at Dresden, possibly monthly unannounced visits. Samples of current liquid wastes and offgas would be collected.

c. Routine telemetering of offgas or stack radioactivity by the State is also recommended.

Note: For monitoring purposes, both the State and Commonwealth Edison should view the Dresden Nuclear Power Plant and the Midwest Fuel Recovery Plant, which is owned and will be operated by the General Electric Company as a single site.

d. The State and Commonwealth Edison should expand their offsite dose-monitoring programs.

e. Commonwealth Edison should expand its milk-monitoring program, which presently includes only two dairy farms; and the State should conduct an independent milk-monitoring program.

f. The State should implement a comprehensive and independent statewide program of radiological environmental monitoring to include:

³⁷ Ernest C. Tsivoglou, Environmental Radiation Protection at the Dresden Nuclear Power Station, Usual and Potential Environmental Radiological Impact of Boiling Water Reactor Operation, and Responsibility of the State (Illinois Commerce Commission, November 3, 1972).

--Surface water monitoring (beyond gross radioassay).

--Radioassay of milk, food crops, aquatic life, and other environmental media.

--Expanded air-particulate monitoring.

g. The State should issue regular, possibly quarterly, public reports of plant radioactivity discharge and environmental radiation levels and concentrations.

h. The State should review the radiological monitoring contract between the AEC and the Illinois Department of Public Health, Contract No. AT(49-24)-0012, from a legal standpoint to determine whether it is consistent with State pollution policy. In Tsivoglou's words, "Certain of the requirements and procedures specified in the contract appear to imply rather far-reaching agreements on the part of the State, and could be interpreted as restricting the State's right of entry and its right to release information to the public."

i. The State should consider developing and implementing a computerized system for maintaining accurate data on all spent fuel shipments currently in transit within the State.

j. The State should not relax restrictions on overweight trucks or movement of shipments during high-accident periods. By this policy, rail transport of spent fuel will be encouraged.

k. The State should require that all nuclear generating stations have rail sidings and facilities to handle the larger rail shipping casks and the State should encourage railroads to accept such shipments.

l. The State should consider special licensing of drivers of trucks carrying spent fuel.

m. Commonwealth Edison should purchase its own rail shipping cask for spent fuel.

n. The Illinois Department of Public Health's PRRP is inadequate because:

--More detail is needed.

--Notification list contains only two telephone numbers.

--Notification list does not contain outside agency contacts.

--It contains no detailed list of duties of personnel. A more detailed, improved State plan should be developed.

o. Drills of the response plan should be held.

p. The State should delineate responsibilities for interstate protective actions in its PRRP.

q. The State should determine and clarify the extent of remaining State authority to regulate discharges from nuclear facilities other than power plants. This refers to the United States Supreme Court ruling, February, 1972, case of Northern States Power Company versus Minnesota, which denied the right of a state to regulate radioactive waste discharge from nuclear power plants.

r. The State should establish a Nuclear Protection Board or Commission to provide the following functions:

- Regulation of radioactive waste discharges from nuclear facilities other than power plants.

- Environmental monitoring in the vicinity of all State nuclear facilities.

- Monitoring of radioactive waste discharges from nuclear facilities for purposes of verifying reports of the industry and of providing public information.

- Regulation of high-level waste shipments within the State.

- Development of a radiation emergency response plan for a major nuclear accident.

- Participation in planning for the siting of future nuclear facilities in the State and regulation of such siting.

- Maintaining of records of radioactive discharges and associated environmental activity and radiation levels of all State nuclear facilities.

- Providing information to the public on the above items.

- Establishing a liaison with federal agencies involved in regulatory radioactive waste releases from nuclear plants.

Illinois Department of Public Health's "Radiation Control in Illinois"³⁸ states "Dr. Tsivoglou's report contains several items which the Department feels should be implemented and immediate steps are being

³⁸ State of Illinois Department of Public Health, "Radiation Control in Illinois," June 19, 1973.

being taken to implement these recommendations." The above Illinois document also refutes many of the claims and conclusions drawn by Dr. Tsivoglou.

Action taken on the Tsivoglou recommendations:³⁹

Item g is being implemented, specifically, quarterly reports on environmental surveillance around the nuclear sites are being generated for the general public. In accordance with item n, a more detailed State emergency response plan has been developed. The plan is entitled "Radiological Assistance Plan, ILLIRAT."

D. Summary

The significance of the Dresden-2 incident was that it was the beginning of a sequence of events that led to greater State involvement in what is legally considered to be federal domain, namely, onsite nuclear power plant safety status, specifically:

1. Illinois Public Health Department investigators' presence at the scene of a reactor incident.
2. Illinois Public Health follow-through on items of noncompliance cited by the NRC, which result from reactor incidents.
3. Annual report of nuclear safety submitted to the Governor by the Illinois Public Health Department.
4. Increased attention paid to matters of nuclear safety by the Illinois Commerce Commission in its process of approving nuclear plant financial activities.

In addition, the Dresden-2 incident of June 5, 1970, and the resulting reports by Lapp and Tsivoglou undoubtedly provided impetus for the expansion and improvement of the Illinois Radiological Assistance Plan.

³⁹ Ibid.

APPENDIX B

RADIATION EMERGENCY RESPONSE IN ALABAMA

I. ALABAMA RADIOLOGICAL ASSISTANCE PLAN

A. Introduction

Alabama State government gives authority for radiation emergency response to a single agency, the Division of Radiological Health, within the Alabama Department of Public Health. This agency has the responsibility for determining the course of action to be taken by the State's agencies during a radiological incident.

The Alabama radiation emergency response includes procedures for responding to all types of radiological incidents. The response has two parts: one for coping with incidents not involving nuclear power plants and another for dealing with nuclear power plants incidents. The latter, a written plan entitled "State of Alabama Radiation Emergency Plan" (ALA-REP), is adapted to each nuclear power plant, thereby creating an Alabama plan for each nuclear power plant. An example of such a plan is the "State of Alabama Radiation Emergency Plan for Brown's Ferry Nuclear Plant, Annex II, Part 4 to TVA Radiological Emergency Plan for Brown's Ferry Nuclear Plant" (ALA-REP, BFNP). A more complete discussion of this plan is presented in Section I.E. of Appendix B.

B. Purpose

The objective of Alabama radiation emergency response is to protect personnel, the general public, and property from the hazards associated with ionizing radiation. A beeper notification system is used to obtain immediate availability of Division of Radiological Health personnel.¹

C. Activation of Alabama Radiation Emergency Response

1. Incidents Not Related to Nuclear Power Plants

For an incident not related to nuclear power plants, Alabama response is activated by a notification call to the Alabama Division of

¹Aubrey V. Godwin, Director, Division of Radiological Health, Alabama Department of Public Health, personal communication (June 16, 1976).

Radiological Health. If the incident is judged to require immediate action, one or more division personnel are dispatched to the scene. Typical incidents for which Alabama Division of Radiological Health personnel are sent to the scene include reports of lost or found radioactive sources, transportation accidents involving radionuclides, reports of radioactive contamination, and so forth. If the incident is minor, the situation might be handled by telephone and possibly followed by investigation held during the next scheduled routine inspection of the licensee involved. An example of a minor incident which might be handled by telephone and follow-through at the next inspection would be a report of an overexposure to xray, only slightly above the recommended limits.

The following incident illustrates the Alabama Division of Radiological Health response to a typical radiation incident not involving a nuclear power plant.

Transportation-Related Incident, May 3, 1974

On May 3, 1974, the Alabama Division of Radiological Health received notification of possible radioactive contamination at St. Margaret's Hospital in Montgomery, Alabama.² A Division of Radiological Health employee was dispatched to the scene. According to the nuclear-medicine technician at St. Margaret's, two packages of radiopharmaceuticals had been delivered to St. Margaret's on May 3: one containing 106 millicuries of iodine-131 and another containing a 100 millicurie Technetium-99m generator. A routine smear test made by the technician revealed iodine-131 contamination on both packages. The Division of Radiological Health employee verified the contamination on the packages and found contamination on the technician's hands as well.

The Division of Radiological Health employee attributed the contamination to a faulty closure of one of the iodine-131 vials.

²Kirksey E. Whatley, "Report of Incident at St. Margaret's Hospital, Montgomery, Alabama, on May 3, 1974," incident report, mimeographed, Alabama Department of Public Health, undated.

A survey subsequently made at Baptist Hospital, which had received radiopharmaceuticals on May 3 from the same courier, revealed slight iodine-131 contamination on a sulfur colloid kit delivered May 3.

The Bureau of Environmental Health in Birmingham, which had been contacted for assistance, reported that surveys of the courier's truck and the airline baggage area indicated no levels above background.

Follow-through for the above incident was considered complete when surveys at the two hospitals indicated no further contamination and when the contaminated packages were stored in accordance with license conditions.

2. Incidents Related to Nuclear Power Plants

For a nuclear power plant related incident, Alabama response is again activated by a notification call to the Division of Radiological Health. From this point, however, special procedures are followed, specifically, the ALA-REP for that particular nuclear plant. A plan of this type, the ALA-REP, BFNP, will be discussed in Appendix B, Section I.E.

Incidents related to nuclear power plants include any onsite power-plant event which could result in a hazard to the general public, e.g., undesired liquid or gaseous releases of radioactive material, onsite fires, and so forth. The Brown's Ferry fire of March 22, 1975, is discussed in Appendix B, Section III.

**D. Interfacing Between the Alabama Department of Public
Health and Nuclear Power Plants**

1. Legal Restraints

a. Introduction

The phrase "regulatory authority" as used in Appendix B, Section I.D, is defined as the power to license and inspect. This includes, for Alabama's Department of Public Health, the power to shut down a facility but does not include the power to impose monetary penalties.

The term "Commission" as used in Appendix B, Section I.D, refers to the AEC or its successor.

A state can experience legal restraints of two types: (1) a law prohibiting certain actions or (2) the absence of a law authorizing certain actions. Alabama's legal restraints concerning federally-owned nuclear power plants are of the former type. Alabama's legal restraints concerning privately-owned nuclear power plants are of the latter type.

b. Federally-Owned Nuclear Power Plants

Under Article VI of the United States Constitution, Alabama is prohibited from exercising any regulatory authority over a federal project. By this restriction, Alabama cannot regulate any onsite activity at any of its three TVA-owned nuclear power reactors listed in Section I.D.2. of Appendix B.

If a radiological incident occurred or threatened to occur at one of Alabama's federally-owned nuclear power plants, Alabama's emergency response activities would be limited to offsite monitoring and other offsite activities to minimize radiation dose to the public, such as evacuation or restrictions on food and water.

Like Illinois, Alabama's actions to protect the public from radiological incidents occurring at federally-owned nuclear power plants are after the fact and not preventative in nature.

c. Privately-Owned Nuclear Power Plants

Under Subsections 274b and 274c(1) of the Atomic Energy Act of 1954, as amended, Alabama, by virtue of its Agreement State status,³ is given authority over certain radioactive materials, i.e., all radioactive materials except those directly concerned with the nuclear fuel cycle and except those fissionable materials in quantities sufficient to form a critical mass.

In addition, under the Alabama Act 582 as discussed in Chapter II, Alabama is given powers to protect the public from ionizing radiation sources other than radioactive materials, such as x-ray machines.

The net result is that Alabama has only been given authority over "certain sources of ionizing radiation," those not directly associated with the nuclear fuel cycle and those fissionable materials in quantities insufficient to form a critical mass. Alabama could regulate activities associated with a cobalt-60 calibration source but not those associated with spent fuel.

³ Alabama has entered into an agreement with the Commission in accordance with Subsection 274b and 274c(1) of the Atomic Energy Act of 1954, as amended, given below:

b. Except as provided in Subsection c, the Commission is authorized to enter into agreements with the Governor of any State providing for discontinuance of the regulatory authority of the Commission under Chapters 6, 7, and 8, and Section 161 of this Act, with respect to any one or more of the following materials within the State--

- (1) by-product materials,
- (2) source materials, and
- (3) special nuclear materials in quantities not sufficient to form a critical mass.

During the duration of such an agreement it is recognized that the State shall have authority to regulate the materials covered by the agreement for the protection of the public health and safety from radiation hazards.

c. No agreement entered into pursuant to Subsection b shall provide for discontinuance of any authority and the Commission shall retain authority and responsibility with respect to regulation of--

- (1) the construction and operation of any production or utilization facility;

If a radiological incident occurred or threatened to occur at a privately-owned nuclear power plant, the Alabama Department of Public Health is empowered to take the following actions to protect the public:

1. As with federally-owned facilities, any offsite activities to protect the public from the hazard, such as:

--Surveillance monitoring to determine existence and extent of any release.

--Evacuation.

--Restrictions on food and water.

2. Additionally, immediate inspection of records, activities, and safety programs associated with "certain sources of ionizing radiation" within the facility.

2. Interaction between the Alabama Department of Public Health and Nuclear Power Plants

The Alabama Department of Public Health presently does not exercise any regulatory powers over nuclear power plant onsite activity. The Alabama Department of Public Health would only become involved with nuclear power plant activity if an offsite hazard to the general public resulted. The Department would then activate the offsite activities of ALA-REP for that specific facility.

Nuclear fuel-cycle facilities presently located in Alabama are shown in Table 6. Of these facilities only the BFNP are federally-owned.

E. The Alabama Radiation Emergency Plan For Brown's Ferry Nuclear Plant (ALA-REP, BFNP)

1. Purpose and Scope

The purpose of ALA-REP, BFNP, is to provide administrative procedures to be followed by State and local agencies in responding to radiological incidents occurring at the Brown's Ferry Nuclear Plant (BFNP).

The plan includes sections describing organizational structure, classification of radiological incidents, notification, Civil Defense procedures for coordinating State agencies, environmental surveillance,

TABLE 6
Nuclear Fuel Cycle Facilities Located in Alabama

Facility	Unit	Owner	MW(e)	MW(t)
Brown's Ferry Nuclear Plant	1	TVA	1067	3293
Brown's Ferry Nuclear Plant	2	TVA	1067	3293
Brown's Ferry Nuclear Plant	3	TVA	1067	3293
Joseph M. Farley Nuclear Plant	1	Alabama Power Co.	829	2652
Joseph M. Farley Nuclear Plant	2	Alabama Power Co.	829	2652
Tuskegee Institute Reactor			negligible	

local governments' procedures for orderly evacuation, press release formats, and training of State personnel in emergency response.

ALA-REP, BFNP, will be summarized in the following, unless otherwise indicated.

2. Organizational Structure

The Alabama Department of Public Health is responsible for decision making during a radiological emergency. The hierarchy is:

State Health Officer
 Director, Bureau of Environmental Health
 Director, Division of Radiological Health
 1st Alternate
 2nd Alternate
 3rd Alternate

The Alabama Civil Defense Department is responsible for coordinating the various State agencies required for implementing the above decisions.

3. Classification of Radiological Incidents

The Alabama Division of Radiological Health classifies radiological incidents by severity, based upon projected whole-body exposure and dose to the thyroid of a one-year-old child, as calculated for the site perimeter. The health physicist on duty, upon receiving notification that an incident has occurred, will take release information contained in the notification message (activity of release, duration of release, wind velocity, etc.) and graphs provided by the nuclear-facility operator and thus obtain whole-body exposure and/or dose to the thyroid of a one-year-old child (perimeter values). Once the health physicist has obtained these values, the incident can be classified using the procedures on pages B-5 and B-6 of ALA-REP, BFNP, as follows:

Classification of Incidents

All incidents shall be calculated using the number of graphs provided by the respective facility operators. In the absence of other information, use the initial or highest release rate and extend this release rate for a period of four hours, then cut this release rate in half and extend it for a period of twenty hours. Then half the release rate again in half and extend it to 30 days. This gives you the initial projected population dose; use this value until definite information is available from the facility. As information is developed by the facility providing more accurate release rates, then the projected dose to the population will be

corrected reflecting the corrected release rates. It is recognized that an initial release rate may initiate protective actions in excess of those actually necessary when population dose is actually measured from the actual release of contaminants.

Using the same graphs, determine the distance from the facility within which protective actions are required.

Using the area map for the facility (Appendix B-IV), determine the affected section. A section is totally affected if the projected exposure and associated action is in any way within the section.

You should now be able to report:

1. The classification of the incident.
2. The areas affected.
3. The initial protective actions.

<u>Classification</u>	<u>Lower Limits of Projected Individual Exposure of Release Rate for 30 Days</u>	<u>Organ or Media Involved</u>
Class A Incident	> 5 rems	Whole body exposure including eyes, gonads, and blood-forming organs
	> 10 rems	Thyroid of a 1-year-old child
Class B Incident	1.25 rems	Whole body including eyes, gonads, and blood-forming organs
	2.5 rems	Thyroid of a 1-year-old child
Class C Incident	0.5 rem	Whole body including eyes, gonads, and blood-forming organs
	1.5 rem	Thyroid of 1-year-old child
Class D Incident	1 millirem/hr at the facility boundary	For gaseous releases
	10^{-7} microcurie/cc of water	For liquid releases

Once the incident has been classified, action plans can be initiated in accordance with the guide presented on page B-6 of ALA-REP, BFNP, as follows:

Actions to be taken

Class A Incident	Evacuation of the population from the area of exposure, in the cases of liquid release, control of the water supply so that the population does not receive exposure, and Class B actions.
Class B Incident	Control of food and water supply to prevent exposure in excess of these levels, and Class C actions.
Class C Incident	Intensive environmental sampling program to confirm that exposure is not in excess of these levels with minor alterations in food supply considered to assure levels are not exceeded.
Class D Incident	Extra laboratory samples taken in area to confirm level not exceeded.

4. Notification Sequence

If any incident requiring NRC notification⁴ were to occur at Brown's Ferry Nuclear Plant, TVA personnel would call the Alabama Department of Public Health, thereby triggering the Alabama emergency response notification sequence. This sequence appears on page B-3 of ALA-REP, BFNP, as follows:

1. Initial Notification. Reactor operator notifies personnel of Alabama Department of Public Health. See Appendix B-VII (sic).
2. The individual receiving the notification will determine the classification of the incident in accordance with Appendix B-III.
3. The individual will notify the State Health Officer or Bureau Director if available, otherwise issue any necessary health order.
4. The individual will notify the Civil Defense Department, and inform of any health order issues.

⁴Situations requiring NRC notification are defined by 10 CFR 20 and discussed in Section X of SITE-REP, contained in the TVA-REP document.

5. Go to the step indicated for each class of incident: Class A - Step 13, Class B - Step 9, Class C - Step 8, and Class D - Step 6.
6. For Class D incident, prepare incident report. As soon as practicable notify the Director, Division of Radiological Health.
7. The next working day or in any case not to exceed three (3) calendar days have samples collected in the reactor area. See Appendix B-VI for details.
8. For Class C incidents notify Environmental Surveillance personnel and follow Appendix B-VI.
9. For Class B incidents have one person contact water supplies or dairies as appropriate and control as indicated in Appendix B-VI.
10. Notify other available Division of Radiological Health personnel and have report to office.
11. Recontact reactor operator to revise classification of incident if necessary.
12. Report to office or elsewhere if appropriate and prepare to advise other agencies of recommended corrective actions. Requests for inter-agency assistance should be handled in accord with Appendix B-IV. See also Step 17.
13. For Class A incidents notify all available Division of Radiological Health personnel. Send at least one individual to reactor emergency facility. Environmental surveillance shall follow appendix B-VI.
14. Recontact reactor operator to revise incident classification if necessary.
15. Advise Civil Defense of the current classification. If evacuation is no longer required, so inform that the evacuation order has been modified.
16. Report to emergency operation center and prepare to advise officials on protective actions and make recommendations for such.
17. When reactor operator has controlled releases, start preparing re-entry projections. See Appendix V.

5. Civil Defense Agency Procedures

One section of the ALA-REP, BFNP, gives procedures to be followed by the Alabama Civil Defense Agency upon notification by the Alabama Department of Public Health that a radiological incident has occurred. This section, written for Civil Defense personnel, includes descriptions of hazard situations that might arise, definitions of the incident

classifications, and notification procedures to be followed by Civil Defense personnel for each incident classification.

The Civil Defense Agency notifies the necessary agencies and coordinates the response. A list of agencies which could be notified follows:

<u>Agency</u>	<u>Functions</u>
a. Department of Public Health	To provide technical information regarding the incident; to determine course to be taken; to provide medical support.
b. Department of Agriculture and Industries	To condemn and seize food unwholesome for human consumption; to impose restrictions on feeding of farm animals.
c. Department of Public Safety	To provide local security and road-blocks,
d. Department of Pensions and Security	To provide emergency welfare services for persons in affected areas.
e. State Highway Department	To provide road barricade material and signs.
f. Alabama National Guard	To support local governments as needed.
g. Department of Conservation	To provide water patrol support to local governments.

The Civil Defense Plan provides a notification procedure including names, titles, and phone numbers, to be followed by Civil Defense personnel during a radiological incident at BFNP. The notification message will state class of incident and action to be taken.

The Civil Defense Plan includes emergency response plans from all the State and local agencies which might be affected by a radiological incident at BFNP. A typical county plan might, for example, contain detailed plans for evacuation and emergency procedures to be followed by sheriffs, police, and other local officials. The Civil Defense Plan is signed by all agencies involved and becomes a part of the State of Alabama Radiological Assistance Plan.

6. Environmental Surveillance

The type and extent of environmental surveillance⁵ depends to a great extent upon incident classification. ALA-REP, BFNP, provides detailed procedures for collection of samples of vegetation, milk, air, water, and aquatic life. For example, actions required regarding vegetation for a Class A incident are (1) collect daily grass samples, (2) stop public use of garden vegetables until lab reports indicate the vegetables are safe.⁶ Specific instructions on the preparation of the vegetation samples are given:

Cut grass and other vegetation at one (1) inch above the ground. Collect at least a No. 12 grocery sack full. Collect in open areas unless informed otherwise. Label or tag to identify:

1. Location
2. Time and date
3. Weather conditions
4. Name of collector.⁷

A map showing sampling areas for BFNP is provided.

8. Training of Personnel

Provision is made for seminars on the Radiological Emergency Plan for the specific nuclear facility. Additional provisions require that each newly-elected or appointed public official be briefed on the above plan.

Drills are to be held at intervals no greater than one year. Drills are complete tests of the notification system. The most recent drill is described as follows.

Drill Conducted by the Alabama Department of Public Health, February 28, 1976

A simulated evacuation of 6000 people was held. This drill consisted of telephone notification and a walk-through of door-to-door, personally-delivered instructions on evacuation to people living in the area. The

⁵In addition to emergency environmental surveillance, the Alabama Division of Radiological Health performs routine collection and analysis of samples of air, vegetation, milk, water, and fish from the BFNP site and surrounding locations.

⁶State of Alabama Department of Public Health, "Alabama Radiation Emergency Plan," Annex II, Part 4, 1972, B-153.

⁷Ibid., p. B-154.

door-to-door notification was completed in two hours and fifteen minutes.⁸ The entire drill lasted for approximately eight hours. The drill involved active participation of TVA and other agencies, such as the National Guard, local sheriffs, and police.

9. Press Releases

To provide for rapid dissemination of accurate information to the public, sample press release formats are given for each of the incident classifications. The releases clearly and briefly describe the incident, recommend action to be taken, and specify means for obtaining additional information.

For the more severe accidents, action to be taken is described in great detail. For example, the press release for a Class A Air Release includes the following instructions to evacuees:

- A. Take the following items with you:
 - 1. Change of clothes
 - 2. Medicine, particularly special medication
 - 3. Important papers (checkbooks, etc.)

DO NOT TAKE FOOD OR PETS
- B. Lock your home. Turn off gas and electricity.
- C. Tie a white cloth or towel on your front door so that civil defense officials will know that you have gone.
- D. Go to (state where to report). Follow the evacuation route nearest you. Do not move against traffic.
- E. Time is important, but move safely.
- F. Persons not having transportation should notify the (give appropriate instructions).

⁸ Godwin, op. cit.

⁹ Alabama Radiation Emergency Plan, op. cit., p. B-158.

II. TENNESSEE VALLEY AUTHORITY RADIOLOGICAL EMERGENCY PLAN (TVA-REP)

A. Introduction

TVA was selected for discussion in Appendix B, because it owns and operates the Brown's Ferry Nuclear Plant. The Brown's Ferry fire of March 22, 1975, is discussed throughout this paper. The purpose for including TVA was not to do a study of all of Alabama's nuclear power plants' radiation emergency plans, but rather to lay groundwork for the discussion of the Brown's Ferry fire in Appendix B, Section III.

TVA gives to each of its nuclear power plants a TVA-REP document. This document consists of the general TVA plan for handling radiological incidents occurring at any of its nuclear power plants, plus two annexes containing medical and other special emergency procedures specifically adapted to each nuclear plant. The structure of the TVA-REP document is as follows:

Tennessee Valley Authority Radiological Emergency Plan (TVA-REP)

Annex I

Nuclear Emergency Medical Assistance Plan (TVA-MAP)

Annex II

Part 1, Division of Power Production Radiological Emergency
Plan (DRP-REP)

Part 2, Site Radiological Emergency Plan (SITE-REP)

Part 3, Environs Emergency Plan (EEP-REP)

Part 4, State of Alabama Radiation Emergency Plan (ALA-REP)

All information presented in Appendix B, Section II.A through F was summarized from the TVA-REP document unless other sources are referenced.

A brief discussion of each of the above sections follows.

The TVA-REP contains a summary of the entire document, followed by specific guidelines for incident classification, procedures to be followed during the various phases of the response effort, and organizational charts for TVA-REP and TVA.

The DPP-REP outlines the plan for making available on short notice manpower, equipment, materials, and services, as required by the emergency. This includes the provision of aircraft, catering, and lodging for TVA personnel.

The SITE-REP contains all notification sequences and emergency procedures to be performed by onsite TVA personnel during the radiological incident. This section additionally provides discussion of training programs, drills, plant evacuation plans, and routes to hospitals.

The EEP-REP contains lists of resources and emergency procedures to be used by the Environs Emergency Staff. The function of this group is to perform all TVA offsite monitoring during a radiological emergency.

The ALA-REP contains the Alabama procedures for coping with any offsite hazard to the public resulting from any radiological incident occurring at the nuclear power plant.

B. Purpose

In accordance with 10 CFR 20, 50, and 100, and all applicable State laws, TVA developed this emergency plan to protect the health and safety of TVA employees and the public, to limit damage to TVA facilities and property, and to restore damaged facilities and property in the event of a radiological incident at a TVA facility.

The TVA-REP is applicable to all TVA operations that involve radioactive materials or radiation-producing devices; however, the plan is primarily concerned with nuclear generating stations.

C. Organizational Structure

The TVA-REP staff is divided into four groups: the Central Emergency Control Center (CECC) Staff, the Division Emergency Staff, the Site Emergency Staff, and the Environs Emergency Staff.

Many similarities exist between the above four groups and the Command Center Group, Division Group, Station Group, and Environs Group, of Commonwealth Edison GSEP, discussed in Appendix A, Section III. Therefore, the TVA staff responsibilities will be given in summary rather than detailed form, as follows:

1. The Central Emergency Control Center Staff will direct all TVA-REP activities.
2. The Division Emergency Staff, a resource group, will be responsible for providing manpower and equipment as required by the emergency.
3. The Site Emergency Staff will be responsible for performing all onsite activities required for coping with the incident.
4. The Environs Emergency Staff will perform all of the TVA offsite emergency environmental monitoring. This staff will also evaluate the results of such monitoring.

D. Classification of Incidents

TVA classifies radiological incidents by severity into categories called Protection Action Levels. The procedures to be taken by TVA personnel for these classifications are extensive and detailed and appear in Section III of TVA-REP and Section V of SITE-REP. The Protective Action Levels as given in Section III of TVA-REP are as follows:

Gas Condition I shall exist if a large, unexplainable step increase in radioactive gaseous discharge occurs after the plant release rate has reached 10 percent of the plant technical specification release limit.

A large step increase is considered as an increase of 50 percent or more above the average release rate for the 15 minutes before the event occurred.

Gas Condition II shall exist if the radioactive gaseous release rate from the main stack or vents in the roof of the building causes the radiation level at the site boundary to equal or exceed 1 mR/hr.

Gas Condition III shall exist if the radioactive gaseous release rate from the main stack or vents in the roof of the building causes the radiation level at the site boundary to equal or exceed 2 mR/hr.

Gas Condition IV shall exist if the radiation level at the site boundary reaches 25 mR/hr or if the duration of any radiation level is such that any member of the public will receive a dose of 500 mrem to the whole body during the course of the emergency.

Liquid Condition I shall exist at any time the liquids in the discharge canal at the site boundary contain a concentration of

unidentified radionuclides other than tritium greater than 1×10^{-7} $\mu\text{Ci}/\text{cm}^3$ or a concentration of tritium greater than 3×10^{-3} $\mu\text{Ci}/\text{cm}^3$.

Liquid Condition II shall exist at any time the liquids in the discharge canal at the site boundary contain a concentration of unidentified radionuclides other than tritium greater than 1×10^{-6} $\mu\text{Ci}/\text{cm}^3$ or a concentration of tritium greater than 3×10^{-2} $\mu\text{Ci}/\text{cm}^3$.

Pre-Action Alert shall exist at any time the Site Emergency Director in his judgment deems it necessary because of existing abnormal nonradiological conditions that have the potential to lead to a radiological emergency. Examples are fire, earthquake, sabotage, etc.¹⁰

The TVA-REP contains several other radiological incident classification systems to be used by TVA personnel during emergencies. The overall purpose for all the TVA classification systems is to facilitate an organized response to radiological incidents or potential incidents and thereby keep exposure to the public well below 10 CFR limits.¹¹ Application of all of these classification systems results in the TVA radiological incident notification sequence which appears in Section IV of the TVA-REP. This notification sequence will be summarized in Appendix B, Section II.E.

A guide to the various TVA radiological incident classifications is given as follows:

1. Section III of TVA-REP, dated June 1, 1972, presents definitions and recommended actions for Gas Conditions I, II, III, and IV, and Liquid Conditions I and II. A revision of page 15 of Section III, dated March 5, 1976, includes a Pre-Action Alert category.

2. Section IV of TVA-REP, dated June 1, 1972, presents notification actions to be taken for on-site and offsite emergencies and transportation accidents.

¹⁰Category "Pre-Action Alert" appeared in revision of TVA-REP, page 15, dated March 5, 1976.

¹¹Section 20.105 of 10 CFR 20 gives permissible levels of radiation for unrestricted areas, such as the following:

Whole-body dose to any individual in any calendar year	≥ 0.5 rem
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Concentration of soluble or insoluble tritium in water	$\geq 3 \times 10^{-3}$ $\mu\text{Ci}/\text{ml}$
--	--

3. Sections IV and V of SITE-REP, dated June 1, 1972, present definitions and recommended actions for Gas Conditions I, II, III, and IV, Liquid Conditions I and II, and Condition RADIATION-ABNORMAL.

4. Section IV of EEP-REP, dated June 1, 1972, presents definitions and recommended actions for Class A, B, C, and D incidents, a classification system also used by the State of Alabama Department of Public Health and set forth in Annex II, Section 4 of the TVA-REP document.

E. Notification

Prior to activation of any notification sequence, the emergency situation must be identified. For this purpose, TVA maintains extensive and redundant monitoring systems for detecting undesirable movement of fluids or levels of radioactivity within the plant system. These include monitoring effluents from the main stack and other vents. In addition, wind speed and direction and other meteorological data are available from each facility's meteorological tower.

The facility Shift Engineer has access to the above information. Unless circumstances dictate otherwise, the Shift Engineer evaluates the above information and determines whether an emergency situation exists as defined in either of the following:

Onsite Nuclear Emergency: A situation resulting in a radiological hazard to personnel only within the site boundary.

Offsite Nuclear Emergency: A situation resulting in release or potential release of radioactive materials that would result in radiation levels for unrestricted areas in excess of 10 CFR 20 limits and that could affect the health and safety of the public.

If the Shift Engineer determines from monitoring, meteorological, or other information, that a nuclear emergency exists or that there is a potential for such a situation, he immediately notifies the Site Emergency Director. Then:

1. If an Onsite Nuclear Emergency exists or if there is a potential for such an emergency:

- a. The Site Emergency Director will notify the Central Emergency Control Center (CECC) Load Coordinator and the Environs Emergency Director.

b. The Site Emergency Director will then notify law enforcement agencies if required and then notify the CECC Load Coordinator that this has been done.

c. The CECC Load Coordinator will notify the CECC Director that the law enforcement agencies have been notified.

2. If an Offsite Nuclear Emergency exists or if there is a potential for such an emergency:

a. The Site Emergency Director will notify the CECC Load Coordinator and the Environs Emergency Director.

b. The CECC Load Coordinator will notify the CECC Director.

c. The CECC Director will notify, as needed, the Division Emergency Director, the AEC Operations Office, the State Department of Public Health, law enforcement agencies, and the AEC Division of Compliance.

3. If a transportation accident occurs, the CECC Load Coordinator, upon receiving notification of such an accident, will notify the CECC Director and the Division Emergency Director.

The CECC Load Coordinator is a central figure in the notification process. He and the duty officers for law enforcement and the AEC Operations Office are on 24 hour call.

F. Interfacing with Outside Agencies

TVA maintains working cooperation with the following federal, state, and local agencies, for coping with radiological incidents.

1. Federal Agencies

a. Interagency Radiological Assistance Plan (IRAP), a DOE plan, provides for assistance from federal agencies having radiation-related functions as required by the emergency.¹²

b. DOE Operations Offices (Savannah River Operations Office for Georgia, Alabama, and Mississippi, and the Oak Ridge Operations Office for Tennessee and Kentucky) will provide radiological assistance teams¹³ with capabilities for coping with radiological incidents of any severity.

¹²For greater detail, see Appendix D.

¹³Ibid.

c. The DOE-sponsored Radiation Emergency Assistance Center Training Site (REAC/TS) program, in Oak Ridge, Tennessee, will provide facilities and staff for decontaminating and treating one or more victims of a radiological incident of any severity level.¹⁴

2. State Agencies

a. The Department of Public Health will provide direction of State plans for radiation emergency response, which, in the case of TVA incidents, involves control of offsite efforts to minimize radiation dose to the public.

b. Department of Public Safety, Civil Defense, and Other State Agencies, as required by the emergency, will provide assistance in the radiological emergency response effort.

3. Local Agencies

Local government agencies will assist as needed under their respective statutory authority. This arrangement is usually prearranged and in accordance with a written pledge of assistance on the part of the local agency. These agencies include police, fire, and other relevant local government agencies.

4. Hospitals and Ambulance Services

Hospitals and ambulance services in the vicinity of the TVA nuclear power plants, by written agreement with TVA, will provide their services for the treatment of radiological accident victims.

G. A TVA Nuclear Generating Station Fire Procedure

Many supporting documents on emergency procedures are used in conjunction with the TVA-REP document. For example, each nuclear generating station has over 30 specialized emergency procedures for tornado, flood, fire, and other specific emergencies which may or may not have radiological significance. One such procedure is the "Brown's Ferry Nuclear Plant Fire, Explosion, and Natural Disaster Plan," approved June 15, 1976. This document gives detailed procedures to be followed during a fire or event which could result in a fire, such as explosion or natural disaster. This document also described pre-fire

¹⁴ Ibid.

(fire readiness) planning, TVA's requirements for notification of NRC, and procedures to be followed after the fire. The procedure for fire was selected because of its relevance to the Brown's Ferry Nuclear Plant fire of March 22, 1975, which is discussed in Appendix B, Section III.

The following is a summary of the "Brown's Ferry Nuclear Plant Fire, Explosion, and Natural Disaster Plan" and its two attached documents: letter dated June 24, 1976, from the Mayor of the City of Athens, pledging Athens Fire Department support during an emergency, and the "Brown's Ferry Nuclear Plant Pre-Fire Plan No. 001," dated June 1, 1976:

1. Personnel Action

TVA personnel fire emergency responsibilities are given as follows:

a. The person discovering the fire will (1) dial 299, thereby activating the fire alarm and ringing the control room phone, (2) give caller's name, the exact location and nature of the condition to the Control Room Operator, (3) return to the scene of the fire, and (4) take corrective action with equipment available, or if in doubt, wait for instruction.

b. The Control Room Operator will (1) switch on a "communication turret" thereby continuing the fire alarm, (2) announce the location of the condition over the public address system at intervals, (3) notify the Plant Supervisor on duty and the Public Safety Supervisor, and (4) give pertinent information to persons who call.

c. The Shift Engineer, upon notification, will (1) direct all plant activities during the emergency, (2) determine if total or partial evacuation of the plant is necessary, and (3) determine if outside assistance is necessary and obtain such assistance as needed.

d. The Fire Brigade will (1) report to the emergency with fire equipment at the sound of the fire alarm, (2) keep the Shift Engineer informed of the status of the situation and any emergency needs, (3) remove equipment from service if necessary, (4) start necessary pumps, (5) lay hose, and (6) activate portable and/or fixed fire extinguishing systems as needed. The Fire Brigade includes a Health Physics Technician, who will survey, establish requirements for respiratory equipment, and

recommend occupancy times as needed, in accordance with limits set forth in the BFNP Radiological Hygiene Manual. The Fire Brigade also includes an employee of the BFNP chemical laboratory to advise and assist the Fire Brigade Chief as needed.

e. All supervisors, their assistants, foremen, dual rate foremen, and job stewards will report to the designated assembly area, except for the Operations Supervisor and the Public Safety Supervisor, who will report to the scene of the emergency. The assembly area group will act as a support unit.

f. Public Safety service personnel will (1) respond to the scene upon hearing the fire alarm, (2) control the access post, (3) assist the Fire Brigade Chief by keeping personnel other than Fire Brigade members away from the emergency area, and (4) assist the Fire Brigade Chief as he deems necessary.

g. Other plant personnel will remain at their work locations unless instructed to do otherwise.

2. Special Emergency Notification Systems

At least three walkie-talkies will be maintained for emergency use. During an emergency, the Shift Engineer will carry one, and the Assistant Shift Engineer will transport one to the scene. If such communication proves unsuccessful, the PAX telephone circuit (a Chattanooga telephone circuit) will be utilized.

3. Outside Agencies

a. The Athens Fire Department will, in accordance with a written agreement with TVA, dispatch firemen and equipment to the scene of the fire. The senior Athens Fire Department fireman at the scene will work with and under the direction of the BFNP Fire Brigade Chief.

b. Wilson Dam, Colbert Steam Plant, and Gallatin Steam Plant will make available additional fire truck pumpers if necessary.

4. Drills

Drills are to be scheduled in such a way that each shift operating crew will participate no less than once per quarter. Once a year a report on one of these drills will be prepared by the Safety Aide and reviewed by the Plant Operations Review Committee.

The fire alarm and paging system will be tested once a year.

5. Training

TVA employees will receive training in the latest fire fighting techniques at the regular safety meetings, drills, and special courses.

TVA will provide annual training sessions for the Athens Fire Department personnel. Such training will include general orientation information about BFNP, principles of radiation, and potential hazards at BFNP.

6. Pre-Fire Planning Procedures

Pre-fire (fire readiness) planning procedures are written for each of twelve locations at BFNP which contain possible fire hazards. One such plan, "The Brown's Ferry Nuclear Plant Pre-Fire Plan No. 001," for the 1 and 2 Standby Diesel Generating Building, is summarized as follows. The plan contains (1) a description of the flammable materials in the area, (2) an inventory of all fire equipment in the area (type and specific location), and (3) instructions for using the fire equipment. In addition, the pre-fire plan includes precautionary instructions to plant personnel. One such instruction concerns the Cardox fire extinguishing system, which floods the area with CO₂:

—Work in a CO₂ flooded area necessitates the use of self-contained breathing apparatus.

—The Chemox self-contained breathing apparatus is approved for one-hour use and the air pack, for 30-minute use; however, extreme exertion may reduce use times.

The "Brown's Ferry Nuclear Plant Fire, Explosion, and Natural Disaster Plan" requires that BFNP personnel be tested on the pre-fire plans during drills.

III. THE BROWN'S FERRY FIRE

A. Incident Chronology and Damages

On March 22, 1975, between 12:15 and 12:25 p.m., a fire started in the cable-spreading room of the Brown's Ferry Nuclear Plant (BFNP), located near Decatur, Alabama, and owned and operated by TVA. At the time of the fire, two of Brown's Ferry's three reactors, Units 1 and 2 were operating, each producing 1098 megawatts of electrical power.¹⁵

The fire, which was to result in millions of dollars of damage, was caused by a flame from a ten-cent candle. The candles were used at the Brown's Ferry Plant in testing for air leakage through electrical cable penetrations between rooms. The fire started in the cable penetration between the cable-spreading room and the secondary containment building for the Unit 1 reactor. The candle technique is as follows: a candle flame is held near the hole, and if the candle flame flickers, leakage is indicated. The TVA employee, at that point, puts sealant material into the hole and holds the candle flame near to test again. During this operation on the day in question the polyurethane sealant material, a known fire hazard,¹⁶ ignited. Because of the pressure gradient from the cable-spreading room to the secondary containment building, the fire immediately spread. The TVA employee attempted unsuccessfully to beat out the fire with a flashlight. This maneuver was extremely difficult, because of the cramped quarters in the cable-spreading room. The geometry of the cable-spreading room drew later criticism from the NRC. Sporadic fire fighting commenced with people coming from many areas of the plant, and it was not until three and one-half hours later¹⁷ that

¹⁵"Fire Knocks Out Brown's Ferry -1, -2 in Probably Worst Incident Yet," Nucleonics Week, Vol. 16, No. 13 (March 27, 1975), 1.

¹⁶"Brown's Ferry Nuclear Plant Fire," Hearings Before the Joint Committee on Atomic Energy, Congress of the United States, Ninety-Fourth Congress, First Session, Part 1 (September 16, 1975), 15-16.

¹⁷"Regulatory Investigation Report," Office of Investigation and Enforcement, Region II, USNRC, IE Report Nos. 50-259/75-1 and 50-260/75-1 (July 25, 1975), 8.

any organized fire fighting effort began, all of this in marked contrast to the smooth behavior suggested by the TVA emergency procedures.

To continue with the sequence of events, at 12:35 p.m., the Shift Engineer dialed 299, which activated the fire alarm and rang the control room phone. This should have been done by the person discovering the fire, as described in the BFMP fire procedure.

At 12:45 p.m., the CO₂ Cardox fire extinguishing system was automatically activated, flooding the area with CO₂. Prior to the automatic release, there had been two abortive attempts to activate the CO₂ system manually. One failed because there was no electrical power to the unit, and the other failed because metal plates had been screwed between the manual controls and the breakout glass for the CO₂ system. These plates had been installed during construction and had never been removed. Further, there was no documentation or review of their installation.

At 12:54 p.m., The Central Emergency Control Center (CECC), TVA's center of authority during emergencies, located in Chattanooga, Tennessee, was contacted. Although the Director of the CECC could not be located, personnel at the CECC began making the appropriate calls. By 1:00 p.m., both Units 1 and 2 were "scrammed" by the control room operators, and the procedure for core cooling was begun. This procedure was nonroutine, because much of the electrical equipment was not operating due to fire damage, and backup core cooling systems had to be used. What specifically was "not operating"? For Unit 1, all normally-used components for core cooling and some Emergency Core Cooling System (ECCS) components were disabled; and for Unit 2, which was less of a problem, some of the normally-used components for core cooling were disabled. It is to be stressed that alternate systems were always available.¹⁸

At 1:45 p.m., the Athens Fire Department, responding to a call from TVA, entered the plant. After learning the status of the fire, the Fire Chief recommended the use of water to put out the fire. The Plant Superintendent did not think the use of water was wise, due to the possibility of electrical shorting and its adverse effect on core

¹⁸ Congressional Hearings, op. cit., p. 29.

cooling procedures. He, therefore, did not accept this outside recommendation and ordered continued use of the CO₂ and dry chemical extinguishers, another action that was to be highly criticized at a later time.

At 2:40 p.m., the BFNP Emergency Plan was activated, which resulted in the creation of the Environs Emergency Control Center (EEC) in Muscle Shoals, Alabama, a group whose function was to coordinate radiological monitoring data and take any necessary action. One of the things the EEC did was to notify the Alabama Division of Radiological Health (DRH), and, as a result, at 3:20 p.m., the State of Alabama Radiation Emergency Plan for Brown's Ferry Nuclear Plant was activated. In accordance with this plan, DRH notified Alabama Civil Defense, which in turn notified the county Civil Defense departments and local sheriffs. DRH also notified the Alabama Environmental Health Lab, which proceeded to take offsite air samples.

At 4:00 p.m., the NRC was contacted, and shortly thereafter the NRC Region II Duty Officer in Atlanta was dispatched to the Brown's Ferry site. The trip took him approximately six hours, another subject of later criticism.

At 6:30 p.m., normal procedures for core cooling were begun, and the Plant Superintendent could now focus his attention on fire fighting. Prior to this time, he had been primarily concerned with the status of the reactor core.

At 7:00 p.m., the Plant Superintendent agreed to the use of water, and at 7:45 p.m., the fire was completely extinguished.

At 8:15 p.m., the State of Tennessee Division of Occupational and Radiological Health was informed that Units 1 and 2 were "wiped out," and the Assistant Director put his staff on alert for the night. The above message was an example of the deterioration of the telephone system of notification.

It should be brought out that the BFNP and the Alabama Radiation Emergency Plans had been tested prior to the fire, and that both plans had placed emphasis on notification procedures. In light of Brown's Ferry, it appears that the above tests were inadequate.

To overview the sequence of events, the reactor core was adequately cooled at all times, so there was no damage to fuel and no release of radioactive material, hence no danger to the public. Damages were as follows:

1. \$10 million worth of electrical equipment in a 20-ft by 40-ft area in the equipment room located in the secondary containment building.
2. \$10 million per month for power replacement for Units 1 and 2.
3. Increased public skepticism concerning nuclear reactor safety.

B. Critiques and Recommendations

1. Items of Noncompliance Cited by the NRC

The NRC cited three violations plus numerous "Areas of Concern."¹⁹ The violations were the major problem areas and, therefore, will be described in detail as follows:

a. A change in the facility with no written record of the change and no written safety evaluation.

The change referred to operation of the reactor with containment penetrations unsealed while concurrently sealing and testing these penetrations.

b. Failure to comply with the "Technical Specifications," a document included in the Brown's Ferry "Final Safety Analysis Report" (FSAR) which was submitted as part of the original license application.

Contrary to the "Technical Specifications":

--Procedure checklists were missing for the sealing and testing operation mentioned above.

--BFNP Emergency Procedures were not followed by persons discovering the fire in that they did not initiate the fire alarm.

--BFNP Emergency Procedures were not followed by the Shift Engineer in that he did not properly delegate his authority to his assistant when he left the scene of the fire.

--And also under Violation 2, there were metal plates screwed between the manual controls and the breakout glass for the CO₂ system.

¹⁹"Notice of Violation" with appended "Areas of Concern," USNRC, Dockets 50-259/260, IE:11:CEM (July 28, 1975).

These plates had been installed during construction and had never been removed. Further, there was no documentation or review of their installation.

c. Perhaps the most extensive violation, inadequacy of the Quality Assurance Program.

A Quality Assurance Program is an in-house system for finding and correcting unsafe situations. The Brown's Ferry program was inadequate for the following reasons:

--A dangerous situation, specifically, use of the flame technique in an area with flammable material, was not identified and corrected; consequently, causes of the hazard were not determined, and no action was taken to prevent its repetition.

----Drawings of the fire area were not compatible with the real structure.

--No documentation was made of the two previous fires resulting from the flame technique.

--The employees who performed the testing and sealing of cable penetrations also inspected the work.

--No audits had been made of the sealing and testing operation.

--And finally, there were two instances of failure to follow the Cable Separation Criteria as set forth in the FSAR. An explanation of this is in order.

There are two redundant circuits for the safety functions, Division I and Division II, and they are to be electrically independent, such that failure in one circuit would not result in loss of a safety function, i.e., one circuit serves as a "backup" to the other. Further, the two circuits are never to be in the same room or space where a fire hazard exists. Contrary to the above, (1) BFNP had power cables from Division I and Division II in the same cable tray, surrounded by flammable polyurethane, and (2) BFNP had core cooling pumps and their associated valves in Divisions I and II, respectively, thereby failing to establish redundancy.

2. Recommendations Made by the NRC Special Review Group

After the Brown's Ferry fire, the NRC appointed a Special Review Group to review the BFNP fire and make suggestions for change on the

part of BFNP, the State of Alabama agencies, and the NRC. The suggestions made by the NRC Special Review Group²⁰ are summarized below. The structure of this list will be a statement of the problem followed by the NRC Special Review Group suggestion. There are eight suggestions.

a. Due to inadequacy of the BFNP Quality Assurance program, relative to fire hazards in particular, the Special Review Group suggests that the NRC pay more attention to Quality Assurance programs both from a licensing and from an inspection standpoint.

b. There was confusion over "lead responsibility." Explanation: There are two sections within the NRC, one involved with licensing and the other, with inspection and enforcement. When an incident occurs, individuals from both sections are sent to the site to investigate, and "lead responsibility" is given to one section. For this incident, the "lead responsibility" was given to the inspectors. As a result, the licensing people did not take the initiative, hence certain technical aspects of the investigation were neglected until a much later time. In light of the above, the Special Review Group recommends (1) that the NRC put one person in charge of incidents and (2) that the NRC clarify "lead responsibility."

c. Due to the excessive time it took for the NRC Region II duty officer to get from Atlanta to BFNP, the Special Review Group suggests that the NRC do a study on "transportation during an emergency."

d. The telephone communication between NRC Region II and the site was unsatisfactory. To remedy this, the Special Review Group suggests that these groups consider alternative forms of communication, such as radio, and revision of "Who calls whom, when, and why."

e. And a similar suggestion, directed at Alabama and local governments, notification at all levels was generally inefficient; so it is recommended that the State of Alabama and local governments should reassess and strengthen their notification procedures. Note: This is only a suggestion, because the NRC holds no authority over the State of Alabama.

²⁰ Special Review Group, USNRC, Recommendations Related to Brown's Ferry Fire, NUREG-0050 (February, 1976).

f. Also, there was an inability to classify the fire in its initial stages because the routine monitors that would yield data for such classification were electrically disabled. To eliminate the atmosphere of confusion which resulted, the Special Review Group suggests a "stand-by" category pending the arrival of data.

g. The emergency procedures did not function efficiently. The Special Review Group recommends drills of the emergency plans and stresses that they be held annually at least.

h. Last, due to the departure from cable separation criteria, the Special Review Group suggests that the NRC improve its Separation and Isolation Criteria.

3. Recommendations made by Nuclear Energy Liability and Property Insurance Association (NELPIA)

NELPIA, an organization which provides nuclear liability insurance and all-risk property insurance for nuclear facilities, conducted an investigation of the BFNP fire.²¹ BFNP is self-insured, and NELPIA's interest in investigating the fire was to acquire information applicable to its nuclear plant policies.

The NELPIA investigation report listed 36 recommendations for fire protection improvements. These recommendations emphasized the need for (1) improvement of cable-spreading-room design to eliminate the congestion which made fire fighting virtually impossible and (2) installation of an automatic, fixed, fire-extinguishing system.

4. New NRC Fire Protection Guidelines

The NRC has issued "revised guidelines aimed at improving fire protection at new nuclear power plants."²² These guidelines, largely the result of the Brown's Ferry fire of March 22, 1975, are now part of the NRC standard review plan, a document used by the NRC staff during their review of applications to build and operate nuclear power plants.

²¹Ray L. Scott, "The Fire at Brown's Ferry Nuclear Power Plant on March 22, 1975," Nuclear Safety, Vol. 17, No. 5 (September-October, 1976).

²²"The Legacy of Brown's Ferry: New NRC Fire Protection 'Guidelines,'" Nucleonics Week, Vol. 17, No. 20 (May 13, 1976), 1-2.

These new guidelines only apply to fire protection for safety-related systems and equipment in nuclear power plants.

The new guidelines include the following requirements:

—Early involvement and assigned responsibilities for upper management in the plant's fire protection program.

—A management system for implementing (1) administrative controls related to fire protection, (2) quality assurance revisions, (3) fire brigade training, and (4) fire-protection-system testing and maintenance.

NRC "branch technical position APCS 9.5-1" presents the new guidelines. This position paper justifies the need for good fire protection with the following statements:

With approximately 250 operating reactor years of experience, one may infer a frequency on the order of one fire per 10 reactor years. Thus, on the average, a nuclear power plant may experience one or more fires of varying severity during its operating life.

The position paper states that the BFNPP fire, the worst fire in the history of United States power reactor operation, and subsequent events have pointed to inadequacies in fire protection. The position paper further states that (1) water should be used on electrical fires if initial attempts using other means prove unsuccessful and that (2) the use of automatic water sprinklers rather than hand-held hoses would reduce damage to equipment.

C. Remarks

Reading of the many documents on the Brown's Ferry fire gives to the reader an overwhelming sense of "A MULTIPLICITY OF THINGS GOING WRONG." Examples taken from the Regulatory Investigation Report.²³

—Metal plates screwed between the controls and breakout glass to prevent damage during construction had never been removed and prevented manual activation of the CO₂ and Cardox System.

—The guard reporting the fire called the Shift Engineer's office. The BFNPP Emergency Procedure lists two different numbers, neither of which is the Shift Engineer's office.

²³Regulatory Investigation Report, op. cit., pp. 7-9 and I-13.

--Lights (display) in the control room were giving anomalous indications.

--Smoke and fumes were present in the control room for a brief period of time.

--Some of the self-contained, breathing apparatus units brought to the scene did not have facemasks and others were not fully charged.

--The BFNP fire hoses and nozzles could not be interchanged with those belonging to the Athens Fire Department due to a difference in thread.

Opinions regarding the radiological significance of the Brown's Ferry fire vary considerably. Many of these opinions concern meltdown, for example, William A. Anders, Chairman of the NRC, in response to a statement from Senator Case, stated ". . . I would disagree with your statement that it came pretty close to meltdown."²⁴ Bernard C. Rusche, Director, Office of Nuclear Reactor Regulation, NRC, added the minimum number of alternate systems for a given function was five.²⁵ David Coney, Environmental Research Director for Business and Professional People for the Public Interest, stated that if there had been a simultaneous loss-of-coolant accident at Brown's Ferry Nuclear Plant, there would have been no way to prevent a core meltdown.²⁶

A study of the Brown's Ferry fire incident chronology leads to the conclusion that a safety program on paper can bear little resemblance to the same safety program in action. There is little doubt that NRC and BFNP written safety programs relative to the BFNP fire are being improved. Since the Brown's Ferry fire, 46,000 sheets of official NRC reports related to safety at Brown's Ferry have been generated.²⁷ A written notice of violation sent to TVA required that TVA respond in writing

²⁴ Congressional Hearings, op. cit. p. 19.

²⁵ Congressional Hearings, op. cit., p. 29.

²⁶ "Fire Knocks Out Brown's Ferry-1, -2 in Probably Worst Incident Yet," Nucleonics Week, Vol. 16, No. 13 (March 27, 1975), 1.

²⁷ Congressional Hearings, op. cit., p. 97.

within 20 days. TVA's responses were adequate, and the reactor units resumed generation of electrical power. Thus NRC inspectors will return to, in the words of Readers' Digest, "spend virtually all their time not in the plant, but in its administrative office, spot-checking its records . . ." ²⁸

Whether the safety programs in action have improved remains to be seen.

²⁸ James Nathan Miller, "The Burning Question of Brown's Ferry," Readers' Digest (April, 1976), 104.

APPENDIX C
RADIATION EMERGENCY RESPONSE IN TEXAS

I. TEXAS RADIOLOGICAL EMERGENCY PLAN

A. Introduction

In Texas, authority for radiation emergency response is given to the Texas Division of Occupational Health and Radiation Control of the Texas Department of Health Resources.

The Texas radiological emergency plan (TEX-REP) is a radiological annex to the State of Texas Emergency Operations Plan.¹ This annex, presently in draft form, consists of two sections.

The first section is the basic Texas radiation emergency response plan for dealing with the majority of radiological incidents which occur in Texas. Such incidents include lost sources, radioactive contamination, loss of control over or unauthorized release of radioactive materials, unintentional radiation exposure of individuals, and transportation accidents involving radioactive materials. Since many well logging operations² are located in Texas, lost sources are occasionally well logging sources.

The second section is a special procedure for coping with major nuclear disasters such as those resulting from flood, earthquake, or war.

A third section is currently being developed for nuclear power plant incident response. Since there are presently no commercial nuclear power plants in Texas, this section will not be discussed.

¹"State of Texas Emergency Operations Plan, Annex L: Radiological."

²Well logging or nuclear geophysical well logging as used in this context, is the use of a sealed radioactive source and a radiation detector or, in some types of logging, the detector alone, to determine physical characteristics of well sections. A gamma or neutron source, typically cobalt-60, cesium-137, or americium-241/beryllium, is lowered down the well to a fixed position. A radiation detector probe shielded from the sealed source is then lowered into the hole, and readings of radiation intensity and energy versus well depth are obtained. The data obtained can be used in determination of characteristics of the well wall, such as porosity, permeability, moisture and mineral content, and determination of well diameter and water level. A comprehensive source on this subject is Nuclear Well Logging in Hydrology, Technical Reports Series No. 126, International Atomic Energy Agency, Vienna, 1971, STI/DOC/10/126.

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All information in Appendix C, Section I, is a summary of TEX-REP, working draft, July 2, 1976, unless otherwise indicated.

B. Purpose

The purpose of TEX-REP is the protection of the people of Texas from all hazards associated with radioactive materials or radiation-producing devices.

C. Radiological Incident Response

1. Introduction

The term "incident" when used in this section (Appendix C, Section I.C) refers to peacetime radiological incidents.

TEX-REP, Part 1, page 1, defines a radiological incident as:

any occurrence which results in or presents the imminent possibility of resulting in:

- (a) The loss of control over or unauthorized release to the environment of radioactive materials, or
- (b) The unintentional exposure of individuals to radiation.

2. Plan Activation

Any individual discovering a radiological incident in Texas is instructed to report the incident by the following procedure:

- a. Telephone the Texas Division of Occupational Health and Radiation control of the Texas Department of Health Resources.
- b. If the above agency cannot be reached, notify the Texas Department of Public Safety.
- c. If neither of the above Texas agencies can be reached, notify the nearest law enforcement agency and instruct the official to relay the notification to the Texas Department of Public Safety.

TEX-REP provides more detailed notification procedures for persons who routinely come in contact with radiation sources. Such procedures, classified by incident type, are summarized below. The term "report" refers to the procedure given above, Appendix C, Section I.C.2.a-c.

Licensee and Registrant Incident. Incidents involving activities conducted under a Texas radioactive materials license or an x-ray machine

registration document will be reported in accordance with Section 21.403 of the "Texas Regulations for Control of Radiation."

Transportation Incident. Transportation incidents involving radioactive materials will be reported immediately by the person responsible for the vehicle involved. Law enforcement and other officials having knowledge of the incident will confirm that proper notification has been made.

Department of Defense Incidents. Any incident occurring at a United States military installation resulting in potential offsite radiological hazard will be reported immediately. In addition, the Joint Nuclear Accident Coordinating Center (JNACC) in Albuquerque, New Mexico, will be notified.

United States Government Incident. Any incident occurring at a federally-owned facility resulting in a potential offsite radiological hazard to the public will be reported immediately.

Other. Any radiological incident not specifically described above will be reported immediately.

3. Classification of Incidents

Radiological incidents are classified by severity based upon the guide, "Criteria for Assigning of Incident Level," which appears on page 5 of TEX-REP, Part 1, and which is given in Table 7. The Director, Division of Occupational Health and Radiation Control, has final responsibility for assignment of incident level.

An action guide entitled "Response Actions" appears on page 10 of TEX-REP, Part 1, and is presented in Table 8.

4. Responsibilities

TEX-REP provides guidelines for actions to be taken by various Texas agencies and individuals, to prevent and/or cope with incidents.

a. Any individual in a radiation emergency situation will (1) perform life-saving and first aid for victims, (2) make necessary notifications, (3) seal off area, (4) obtain names and addresses of persons involved, (5) remain upwind of fires, and (6) prevent removal of objects from the area.

b. Licensees will establish radiation emergency plans for their facilities and test these plans.

TABLE 7
Criteria for Assigning of Incident Level
(DRAFT)

Incident Level	External Exposure (Whole Body)		Radioactive Material Release*	Due to Iodine**		Time Loss	Property Damage
	Occupational	General Public		Inhalation	Milk		
A	≥ 100 rem	> 1 rem	$> 10,000 \times L$	> 15 rem	> 15 rem	≥ 1 month	$> \$1,000,000$
B	< 100 rem	≤ 1 rem	$> 5,000 \times L$	≤ 15 rem	≤ 15 rem	≥ 1 week	$> \$100,000$
C	< 25 rem	≤ 500 mrem	$> 500 \times L$	≤ 5 rem	≤ 5 rem	≥ 1 day	$> \$1,000$
D	< 5 rem	≤ 125 mrem	$> 2 \times L$	≤ 1 rem	≤ 1 rem	Negligible	$> \$100$
E	< 100 mrem	≤ 5 mrem	$\leq 2 \times L$	0	0	0	$\leq \$100$

*Where "L" is the limit specified in Appendix 21-A, Table II, Texas Regulations for Control of Radiation. (These limits are identical to those specified in 10 CFR 20.) For purposes of this Annex, the numerical limits shall be concentrations averaged over a period of 24 hours.

** All thyroid doses based upon thyroid of one-year-old child.

Note: Examples of 10 CFR 20 limits are given in Appendix B, Footnote 11.

TABLE 8
Response Actions
(Draft)

Incident Level	Response Actions
A	Full scale field site investigation by teams of Radiation Control Program Staff members with intensive environmental sampling program if the incident involves the introduction of radioactive material into the environment. At this incident level, with the exception of incidents involving exposure to occupationally exposed individuals, the Defense and Disaster Relief Council would be activated. Implementation of plans for the evacuation of the general population and control of food, milk, and water supplies would be affected if dose savings could be realized by such actions. Requests for assistance from outside the State of Texas would be made if instate resources required supplementation to effectively deal with the incident.
B	Field site investigation by a team of at least two Radiation Control Program staff members with detailed environmental sampling program if the incident involves the introduction of radioactive material into the environment. This is normally the lowest level incident for which consideration would be given to the activation of the Defense and Disaster Relief Council, the requesting of assistance from outside the State of Texas, the evacuation of the general population, and the control of food, milk, and water supplies to prevent exposure.
C	Field site investigation by a team of at least two Radiation Control Program staff members with specific environmental sampling program if the incident involves the introduction of radioactive material into the environment.
D	Field site investigation by one Radiation Control Program staff member who may conduct limited environmental sampling if the incident involves introduction of radioactive material into the environment.
E	Will be handled by letter with no field site investigation.

c. Division of Occupational Health and Radiation Control will (1) request activation of any or all of the Defense and Disaster Relief Council (selected State and local government officials who advise on radiation emergency response), (2) request through this Council, personnel and supplies from State and federal agencies and other states as required, (3) order through this Council, evacuation, impounding of human or animal foodstuffs or radiation sources, as required, (4) order the decontamination of facilities or equipment, as needed, (5) provide staff and equipment for coping with the incident, and (6) supervise the response effort.

d. Other Texas agencies will act in accordance with their respective annexes to the State of Texas Emergency Operations Plan and the recommendations made by the Defense and Disaster Relief Council.

5. Incident Report Forms

TEX-REP, page 11, provides a report form for recording relevant incident information, such as the following:

- Date and time of notification.
- Name, address, and telephone number of person calling.
- Date and time incident began and expected duration.
- Isotope, form, activity, etc., of the radioactive material involved.
- Description of incident.

This form, similar to the Commonwealth Edison Activity Log discussed in Appendix A, Section III.G, is for use during the emergency.

D. Special Procedures for Major Nuclear Disaster

1. Introduction

The term "incident" when used in Appendix C, Section I.D, refers to major nuclear disaster such as that which might result from earthquake or war.

Originally, the radiological response plan for Texas was a plan for dealing with the threat of nuclear war. The special procedures for major nuclear disaster, discussed in this section, are a revision of this original plan, and have the appearance of being a separate radiation

emergency response plan dealing solely with war and of being unrelated to the first section of TEX-REP (Appendix C, Section I.C). In current use, these special procedures for major nuclear disaster are applied to any major wartime or peacetime radiological incident and would be used in conjunction with the first section of TEX-REP (Appendix C, Section I.C).

2. Emergency Responsibilities

The following state and federal agencies would be involved in the incident and its recovery.

a. Federal Government Responsibilities

Texas is within Region V of the DCPA. The DCPA Regional Office in Denton, Texas, will direct all nuclear disaster response activities.

b. State Government Responsibilities

Organization for Radiological Defense (RADEF)³ is an organization of State government personnel from selected State agencies, who will perform radiological monitoring and other necessary services during and after the incident.

The Texas Department of Health will be responsible for preparing and maintaining a State Emergency response plan for postattack recovery. This agency will also provide personnel and monitoring equipment for RADEF, as needed.

Emergency Operations Center (EOC) will provide a central base for emergency communication and operations.

Other State agencies will provide support functions for the State government fallout monitoring plan. Such agencies include the Department of Health, the Highway Department, the Texas Forest Service, the Department of Public Welfare, the State Parks and Wildlife Department, the Texas Aeronautics Commission, and the State and Regional Defense Airlift Plan.

c. Local Government Responsibilities

Local officials will direct emergency operations in their respective areas. This will include decisions affecting length of shelter

³Detailed RADEF procedure is given in the Texas State Base Plan referenced throughout TEX-REP, Part 2.

occupancy, restoration of services, and relocation of people. In addition, local governments will establish local EOCs. Recommendations to local governments include:

- Prepare a local RADEF plan.
- Organize and train a radiological defense staff.
- Obtain RADEF instrumentation.
- Establish monitoring stations at selected police, fire, welfare, and other government offices.

3. Incident Report Form to be Used by Texas Department of Health Resources Personnel

A form for recording relevant incident information is provided on page 12 of TEX-REP, Part 2. Questions listed on the form include the following:

- Is the radioactive material under control?
- Did fire or explosion occur? Is there still a fire or explosion hazard?
- Were there injuries or fatalities? (Specify names, description of injury, present location of victim, names of hospitals involved.)

II. AN EXAMPLE OF FEDERAL ASSISTANCE TO THE TEXAS DEPARTMENT OF HEALTH RESOURCES

Texas, like the other states, can obtain various forms of federal assistance if a radiation emergency develops for which state capabilities are inadequate. These forms of assistance will be discussed in greater detail in Appendix D.

An example of one instance of federal assistance to Texas will be given in this section for the purpose of demonstrating (1) the ready accessibility of DOE and NRC assistance and (2) how the Texas Department of Health Resources utilized this federal assistance. The incident is as follows:

Americium-241 Contamination and Possible Ingestion

On June 10, 1976, 9:30 p.m., two Texas Department of Health Resources inspectors departed for Rohm and Haas Texas, Incorporated, in Deer Park, Texas, to investigate a report of possible americium-241 ingestion.⁴ At Rohm and Haas, it was learned that an instrument mechanic had been cleaning⁵ the source tube of a trace gas analyzer.⁶ This source tube contained a 600-microcurie americium-241 foil.⁷ According to the mechanic, the cleaning of the tube normally involves flushing the tube with a solvent and then cleaning the inside with detergent and a stiff-bristled, test-tube brush. On this particular cleaning, the tube appeared unusually dirty, so the mechanic obtained a rod from the welding shop and proceeded to "poke out" obstructions in the tube. Shiny pieces of metal foil came out in the process, and at that point

⁴Rodney I. Heathcott, "Incident Investigation," mimeographed, File No. 1292, Texas Department of Health Resources (July 23, 1976).

⁵Both the manufacturer's recommendations and the Texas license conditions state that any maintenance activities, such as removal of the ion chamber containing the americium foil for service, must be done by the manufacturer.

⁶The analyzer is part of the Mine Safety Appliance "Billionaire" analyzer. According to information from Bernard Singer, NRC Materials Branch, dated May 31, 1974, the analyzer measures concentrations in air of some toxic or explosive gases.

⁷Heathcott, op. cit.

the mechanic set the tube on the bench and, without washing his hands, went to lunch.⁸

Later, the instrument mechanic reported the incident to the Maintenance Manager. The Maintenance Manager, suspecting that the integrity of the source had been destroyed, telephoned Gamma Industries, a company which performs leak testing of sealed sources for Rohm and Haas. Gamma Industries recommended that the Texas Department of Health Resources be called and sent a Gamma Industries team to the scene. The Gamma Industries team had the mechanic shower several times due to the presence of alpha activity around the eyes and mouth, and roped off the shop area involved.

Texas Department of Health Resources personnel had arrived at this point and proceeded to do an investigation, which included:

- A status report by telephone to the Department of Health Resources office in Austin, on June 11, at 7:00 a.m.

- Extensive interviews with Rohm and Haas personnel.

- Contamination surveys of the building surfaces which could have become contaminated.

- Contamination surveys of all personnel who had been in the shop area or in contact with the mechanic on the day of the incident.

- Performance of leak tests on all Rohm and Haas sealed sources in operation.

Americium-241 contamination was found on numerous surfaces, including benches, clothing, and skin. Shortly after 5:00 p.m. on June 11, the Texas Department of Health Resources personnel departed.

Shortly after receiving the June 11 call (7:00 a.m.) concerning the incident, the Texas Department of Health Resources staff member in Austin had telephoned ORAU to report the case of ingestion of an unknown quantity of americium-241 and to seek medical advice.⁹ After a series of telephone calls, it was decided that the instrument mechanic should be brought to the REAC/TS medical facility in Oak Ridge, Tennessee, a

⁸William L. Beck, Oak Ridge Associated Universities, personal communication (July 7, 1976).

⁹Ibid.

facility which provides medical treatment for radiation accident victims.¹⁰ Although the ingestion had occurred a day prior to the ORAU notification, thereby obviating the main treatment, chelating therapy, needed within hours, the REAC/TS Director advised in favor of the trip.

The instrument mechanic was met at the airport, June 11, by the ORAU staff member who had received the initial call, and was taken to ORNL for whole-body counting. The ORNL facilities were used in preference to REAC/TS facilities because the REAC/TS facility was in the process of being moved from one building to another.¹¹

Fecal and urine samples had been counted earlier. The results of all tests indicated that the patient had received less than 2 percent Maximum Permissible Body Burden (MPBB). The MPBB for americium-241 is 0.05 microcuries.

On June 12, routine blood counts were taken, and the patient was taken to the airport for the return trip to Houston, Texas.

Since the REAC/TS facility is an DOE facility, NRC had received notification of the incident.¹² On June 15, an NRC Agreements and Exports Branch representative called the Texas Department of Health Resources and made inquiries concerning the incident. The NRC representative mentioned that a press release might be issued. The Texas Department of Health Resources representative indicated that his department would give full cooperation.

The incident described above and another case of americium-241 foil contamination which was reported August 16, 1976, and involved contamination of a parking lot, have resulted in a Texas Department of Health Resources investigation of all its licensees authorized to use americium-241.¹³

¹⁰For greater detail, see Appendix D.

¹¹Beck, op. cit.

¹²Edgar D. Bailey, Chief, Compliance and Inspection, Division of Occupational Health and Radiation Control, "Continuation of Am-241 Contamination Incident," File No. 1292, report, mimeographed, Texas Department of Health Resources (June 22, 1976).

¹³Edgar D. Bailey, Chief, Compliance and Inspection, Division of Occupational Health and Radiation Control, Texas Department of Health Resources, personal communication (August 27, 1976).

The incident illustrates the free exchange of information between the Texas Department of Health Resources, DOE, and NRC, and careful state follow-through of an incident.

III. INTERFACING BETWEEN THE TEXAS DEPARTMENT OF HEALTH RESOURCES AND NUCLEAR POWER PLANTS

A. Legal Restraints

1. Introduction

Texas presently does not have any commercially operating nuclear power plants; however, two nuclear power plants are scheduled to come on line 1980-81: Comanche Peak, operated by the Texas Utilities Generating Company, and South Texas Project, operated by the Houston Lighting and Power Company.¹⁴

As will be explained in the following paragraphs, Texas' legal restraints concerning nuclear power plants are very similar to those of Alabama. Texas is an Agreement State (see Appendix B, Section I.D.1.c), and Texas state laws (see Chapter II, Section C) extend the Agreement State powers to include the regulation of sources of ionizing radiation other than radioactive materials. The Texas Department of Health Resources, like the Alabama Department of Public Health, does not have the authority to impose monetary penalties.¹⁵

A legal dissimilarity exists between Texas and Alabama state government powers: in Texas, local municipalities have considerable authority over matters affecting the health and safety of their population.¹⁶

"Regulatory authority," when used in Appendix C, Section III.A, refers to the power to license, inspect, and/or shut down.

"Commission" refers to the Atomic Energy Commission or its successor.

2. Federally-Owned Nuclear Power Plants

Under Article VI of the United States Constitution, Texas government is prohibited from exercising any regulatory authority over onsite activities of any federally-owned facility.

¹⁴ Bailey, op. cit., June 30, 1976.

¹⁵ Bailey, op. cit., August 17, 1976.

¹⁶ Texas H.B. 910, Section 7, states "Such cities or towns shall have full power and authority to provide by ordinance for the exercise of all powers reasonably necessary to protect the health, security, peace, life and property of the city and its inhabitants, during the period of such civil emergency."

Texas presently has no federally-owned nuclear fuel cycle facilities. If such a federal facility, e.g., a DOE-owned nuclear power plant, were to be built in Texas, and if a radiological incident occurred or threatened to occur, Texas' emergency response activities would be limited to offsite monitoring and other offsite activities to minimize radiation dose to the public.

3. Privately-Owned Nuclear Power Plants

By Texas' Agreement State status and the Texas state laws mentioned in Chapter II, the Texas Department of Health Resources is empowered to do the following to protect the public in the event of a present or imminent radiological incident:

a. As with federally owned facilities, any offsite activities to protect the public from the hazard, such as:

—Surveillance monitoring to determine existence or extent of any release.

—Evacuation.

—Restrictions on food and water.

b. Additionally, immediate inspection of records, activities, and safety programs associated with all radioactive materials excluding those directly concerned with the nuclear fuel cycle and excluding those fissionable materials in quantities sufficient to form a critical mass.

4. Comparison of Texas, Alabama, and Illinois Legal Restraints

Barring subtle legal dissimilarities regarding such things as names of state agencies, distribution of power among state and local agencies, and the imposing of monetary penalties, the legal restraints on Texas and Alabama with respect to federally-owned and privately-owned nuclear power plants are identical:

a. Federally-Owned Nuclear Power Plants. Both states are prohibited from exercising any powers which would interfere with any onsite activity at a federally-owned nuclear power plant.

b. Privately-Owned Nuclear Power Plants. Neither state is prohibited from interfering with onsite activity. However, the states are only authorized to regulate certain onsite and offsite activities, specifically those activities which are not directly associated with the

nuclear fuel cycle and those activities which do not involve fissionable materials in quantities sufficient to form a critical mass.

Illinois' restraints are very similar to the above, except that since Illinois operates under its State law, the Radiation Protection Act of 1959, as amended, rather than Subsection 274b of the Atomic Energy Act, it can inspect activities directly associated with the nuclear fuel cycle at privately-owned nuclear power plants, excluding only those activities associated with fissionable materials in quantities sufficient to form a critical mass. This point is academic because Illinois intends to become an Agreement State.

B. Present Interaction Between the Texas Department of Health Resources and Nuclear Power Plants

Texas currently inspects all facilities within the State which possess radioactive material of any kind. These facilities may be of three types:

1. Facilities possessing only Texas licenses, i.e., facilities which use only sources which do not equal or exceed critical mass quantities and sources which are not associated with the nuclear fuel cycle.
2. Facilities possessing only NRC licenses, i.e., facilities which use only sources directly associated with the nuclear fuel cycle.
3. Facilities possessing both Texas and NRC licenses, "dual license facilities."

Nuclear power plants can be "type 2 or 3." Well logging operations can also be "type 2 or 3."

When inspecting a facility of "type 2," one possessing only NRC license, a Texas Department of Health Resources inspector will perform a routine inspection. If any violations of State law are found, the Texas Department of Health Resources will handle the matter by issuing a citation to the facility with a carbon copy to the NRC or by calling the NRC. This is done in an informal manner.

When inspecting a facility of "type 3," a "dual license facility," the Texas inspector will do a complete formal inspection of those

activities conducted under the Texas license(s) and an informal inspection, as described above, for those activities conducted under the NRC license.

There is never any question over which areas within a facility are Texas' and which areas are NRC's domain. Some facilities provide painted lines on the floor, clearly distinguishing these areas.

Of the three states discussed in detail in this paper (Texas, Alabama, and Illinois), Texas is the only state which finds and corrects activities conducted under the NRC license which violate state law.

Nuclear fuel cycle facilities presently located in Texas are shown in Table 9.

TABLE 9

Nuclear Fuel Cycle Facilities Located in Texas

Facility	MW(t)
Texas A and M University	Negligible
Nuclear Science Center Reactor	1.000
University of Texas	0.250

In preparation for the Comanche Peak and South Texas Project, the Texas Department of Health Resources has begun a program for assisting local governments with their radiation emergency plans, thereby helping the utility companies with their NRC licensing requirements for showing interfacing with local governments (see Chapter III, Section D).

When Comanche Peak and South Texas Project come on line, the Texas Department of Health Resources plans to implement an environmental monitoring program of offsite areas and a program of regular "informal" tours of the plants. Edgar Bailey of the Texas Department of Health Resources, foresees a beneficial, active relationship between the utilities and the Texas Department of Health Resources. Among reasons for

this, he cited (1) the states' rights posture, i.e., the desire to let the state lead, on the part of the utilities, and (2) the absence of Federal Power Commission facilities and the associated prohibitions of Article VI.¹⁷

¹⁷Bailey, op. cit., June 30, 1976

APPENDIX D

**FEDERAL ASSISTANCE TO THE STATES:
DEPARTMENT OF ENERGY (DOE) AND
UNITED STATES NUCLEAR REGULATORY COMMISSION (NRC)**

I. INTRODUCTION

Federal government agencies provide many types of radiation emergency assistance to the states. Both DOE and NRC provide for such assistance, and examples are given below.

NRC has the regulatory responsibility to determine that a reactor is safe to operate. NRC's licensing program requires that all its license applicants demonstrate adequate safety programs. NRC provides "cadres" (Appendix D, Section III.B) to evaluate states' radiation emergency response plans and drills of these plans. DOE assistance is primarily provision of personnel and instrumentation for coping with a radiation incident once it has occurred. However, NRC is becoming increasingly involved with assistance during and after the incident.

Federal assistance to the states in the area of radiation control is fairly recent. Prior to 1957, radioactive materials were used primarily for defense purposes. Most of the radioactive materials were held by the AEC¹ or the Department of Defense (DOD); therefore, there was little need for assistance to the states. In 1957, radioactive materials began to be extensively used for peaceful purposes. At that time, the AEC established the Radiological Assistance Plan, which was the origin of the programs to be discussed in this appendix.

Although the detailed federal agency structures and interagency interactions are interesting and informative, Appendix D emphasis is placed upon specific functions of each federal program of assistance and upon the ways of obtaining the assistance.

¹The Energy Reorganization Act of 1974 (Public Law 93-438) abolished the AEC and established in its place ERDA and NRC. The law took effect January 19, 1976.

II. DOE

A. Purpose

The DOE is one federal agency which provides advice and assistance for protecting the public from hazards associated with certain types of ionizing radiation.²

The DOE Radiological Assistance Program provides for many types of assistance to federal, state, or local governments or to private organizations or individuals. This assistance includes DOE teams, IRAP activation, JNACC teams, medical programs such as REAC/TS, and guidelines on radiation emergency response, all available on request.

The DOE radiological assistance mentioned above does, however, have limitations. For example, DOE assistance is only to be requested if existing private, state, and local agencies' capabilities are lacking. However, no caller would be turned away: at the very least, referral would be given. Weapons-related incidents are an exception, as discussed in Appendix D, Section II.D. Another limitation is that unless a DOE-owned facility or DOE contractor is responsible for the facility involved in the incident, DOE radiological assistance will be limited to eliminating the radiological hazard and terminated when control of the situation has been established. Thus, post-incident recovery (action taken to restore the property or situation to normal, such as decontamination of property or restoring of equipment) is the responsibility of the private, state, or local agency.³

The DOE personnel when responding to a radiological incident not involving a DOE site will not "abridge state or local government authority, or the authority of other federal agencies, or take precedence over legitimate private jurisdiction."⁴

²Wayne L. Smalley, "The ERDA Radiological Assistance Program," Nuclear Safety, Vol. 16, No. 3 (May-June, 1975), 345.

³Energy Research and Development Administration, Division of Operational Safety, "Energy Research and Development Administration Radiological Assistance Plan" (July, 1975), 14.

⁴Ibid., p. 15.

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B. DOE Teams

1. The DOE Team

Radiological assistance given by DOE may be (a) advice given by telephone, (b) referral to a person or agency nearer to the scene of the incident, or (c) dispatch of a DOE team.⁵

A DOE team sent for minor incidents consists of one or two individuals. For larger incidents, the DOE team may include the following: Team Leader, Radiation Monitors, Medical Officer, Public Information Officer, Security Officer, and other specialists.

2. Resources Available to the Team⁶

The DOE resources for handling radiological incidents include:

- a. Monitoring equipment for all types and levels of radiation.
- b. Analytical instruments for radioassay of air, water, and food.
- c. Shielded containers for various shapes and sizes.
- d. A mobile shielded whole-body counter, mounted on a tractor-trailer rig.
- e. A robot, equipped with television and cable, capable of retrieving 200-pound objects.
- f. A trailer equipped with emergency dosimetry, including equipment for film processing, glass dosimeters, and other types of personnel monitoring dosimetry.
- g. A trailer equipped with shower facilities and protective clothing.
- h. An airplane equipped with air sampling and aerial surveying equipment.
- i. Experts in the areas of health physics and medicine.

3. Activation of the DOE Team

A DOE team can be obtained by telephoning the nearest DOE Regional Coordinating Office.⁷ Table 10 provides locations and telephone numbers for these offices.

⁵Energy Research and Development Administration, Oak Ridge Operations, "ORO Emergency Preparedness Program," Section III, Radiological Assistance Plan, Region 2 (May, 1976), 3.

⁶Ibid., p. 2.

⁷Ibid., p. 7.

TABLE 10

**Department of Energy Regional Coordinating
Offices for Radiological Assistance**

Regional Coordinating Office	Post Office Address	(Area Code) Telephone No.)
Brookhaven Area Office	Upton, L. I., New York 11973	(516) 345-2200
Oak Ridge Operations Office	P. O. Box E Oak Ridge, Tennessee 37830	(615) 483-8611 Ext. 3-4510
Savannah River Operations Office	P. O. Box A Aiken, S. C. 29801	(303) 824-6331 Ext. 3333
Albuquerque Operations Office	P. O. Box 5400 Albuquerque, New Mexico 87115	(505) 264-4667
Chicago Operations Office	9800 S. Cass Ave. Argonne, Illinois 60439	(313) 739-7711 Ext. 2111 (duty) Ext. 4451 (off hours)
Idaho Operations Office	P. O. Box 2108 Idaho Falls, Idaho 83401	(208) 526-0111 Ext. 1515
San Francisco Operations Office	1333 Broadway Oakland, California 94612	(415) 273-4237
Richland Operations Office	P. O. Box 550 Richland, Washington 99352	(509) 942-7381

When requesting DOE assistance, the following information should be given:⁸

1. Name, location, and telephone number of person requesting assistance;
2. Location of incident and type of surroundings;
3. Time of incident;
4. Nature of incident;
5. Type and amount of material involved;
6. Personal injuries;
7. Possible hazard to public;
8. What is being done at site of incident to protect people and property;
9. Who else has been notified; and
10. What public information action has been taken, if any.

C. Interagency Radiological Assistance Plan (IRAP)

1. IRAP

The IRAP is an agreement between signatory federal agencies pledging multiagency radiological emergency action to protect the public when such action is required.⁹ The IRAP signatory agencies and some of the capabilities they have agreed to contribute to IRAP are given below:¹⁰

a. Defense Civil Preparedness Agency will provide (1) the National Warning System, (2) large quantities of radiological survey meters and dosimeters, (3) communications systems, and (4) a large network of federal, state, and local government personnel trained in natural disaster response.

b. Department of Agriculture will provide (1) family feeding programs, (2) livestock feed, and (3) loans and other financial assistance to farmers and other rural residents.

c. Department of Commerce will provide (1) weather forecast and warning advisory services, (2) gamma level readings from National Weather Service field offices, (3) consultants from the National Oceanic

⁸ Ibid., p. 5.

⁹ Radiological Assistance Plan, op. cit., p. 10.

¹⁰ Ibid., Annex V, p. 8.

and Atmospheric Administration, and (4) the Maritime Administration capabilities from National Defense Reserve Fleet Sites (marine equipment, such as power barges, tugs, and cranes).

d. Department of Defense will contribute (1) personnel to serve at JNACC, a command center and communications center for dealing with radiation incidents involving nuclear weapons (see Appendix D, Section II.D), and (2) radiological emergency response teams and equipment from the nearest military base.

The Army has seven major nuclear emergency teams, each having two Explosive Ordinance Disposal teams. The Army also has a smaller radiation emergency team at Edgewood Arsenal, Maryland, and three smaller teams located at Army hospitals in San Francisco, San Antonio, and Washington, D. C.

The Navy has Explosive Ordinance Disposal teams and radiation monitoring teams at Naval bases throughout the United States. In addition, the Navy has special radiation emergency teams which specialize in particular types of Naval radioactive materials.

The Air Force has a Major Accident Response Team and response teams at each of its bases.

e. Department of Health, Education, and Welfare will provide (1) Public Health Service hospitals' assistance for health emergencies, (2) Food and Drug Administration services to confirm that foods and drugs are safe and pure, (3) Bureau of Radiological Health advice to (1) and (2) above on radiological matters, plus the Bureau of Radiological Health's radiological assistance team.

f. Department of Labor will provide (1) monitoring equipment and (2) personnel with occupational health and safety experience.

g. Department of Transportation will provide (1) notification of appropriate federal and local agencies, (2) transportation as needed, and (3) assistance in contacting consignors and consignees of shipments involved in the incident.

h. Environmental Protection Agency will (1) by agreement with the Bureau of Radiological Health, coordinate all response to requests for

radiological assistance, (2) provide teams for collection and radioassay of environmental samples, and (3) give advice regarding contamination levels.

i. Interstate Commerce Commission will expedite the emergency transportation of people or property across state or national boundaries to or from distressed areas by domestic transportation.

j. National Aeronautics and Space Administration will contribute (1) radiological, environmental health, and medical personnel, (2) monitoring instruments, (3) laboratory support, (4) fire-fighting capability, (5) generators and communication equipment, (6) motor pool vehicles, (7) earthmoving equipment, and (8) aircraft and satellite heat-sensing surveillance.

k. Postal Service (information not available).

l. The DOE will contribute its personnel and physical resources. These include facilities for coping with radiological hazards as outlined in the DOE Radiological Assistance Plan (see Footnote 2) and discussed throughout this section.

m. The NEC will perform investigations of incidents and will provide personnel to the IRAP as needed.

2. Activation of IRAP

The DOE administers and coordinates IRAP. Thus, radiation emergency assistance from any of the signatory agencies given above, can be obtained by contacting any of the eight DOE Regional Coordinating Offices (Table 10, p. 139).

D. Joint Nuclear Accident Coordinating Center (JNACC) Teams

1. JNACC

The JNACC is an interfacing center between DOE and the Department of Defense (DOD), created by an agreement between these two agencies. JNACC is composed of employees from both DOE and DOD.

The JNACC can provide;

--JNACC teams (see Appendix D, Section II.D.2) to respond to radiological incidents involving DOD or DOE installations.

--Fast information exchange between DOE and DOD.

--A center for maintaining information about the current location of specialized DOD or DOE teams.

The following is an example of a JNACC function. If during a radiological incident, DOE desired information from a military base, DOE would contact the base through JNACC thereby bypassing lengthy protocol.¹¹

2. JNACC Teams

A JNACC team is technically a DOE team. In this appendix, "JNACC team" refers to the team which responds to radiological incidents involving nuclear weapons; and "DOE team" refers to the team described in Appendix D, Section II.B.1, which responds to all other types of radiological incidents.

The JNACC teams, like DOE teams, consist of experts in health physics and other areas needed for radiation emergency response. Additionally, JNACC teams include nuclear weapons experts and personnel trained in explosives disposal. The DOE resources are available to both teams.

The JNACC teams are to be used if it is suspected that a military installation, the Department of Defense, and/or any nuclear weapon is involved in a radiological incident.¹²

3. Activation of the JNACC Team

JNACC team assistance can be obtained by contacting any of the eight DOE Regional Coordinating Offices (Table 10, p. 139).

In Appendix D, Section I, it was stated that DOE assistance is to be obtained only after exhausting State and local capability. JNACC assistance is an exception to this. For any radiological incident involving the Department of Defense, any military installation, or nuclear weapon, JNACC is to be activated immediately.

¹¹Wayne L. Smalley, Assistant for Emergency Preparedness, ORO, ERDA, personal communication (August 26, 1976).

¹²Greater detail on procedures to be taken during a radiological incident involving nuclear weapons is given in "ORO Emergency Preparedness Program" cited in Footnote 5 of this appendix.

E. Radiation Emergency Assistance Center Training Site (REAC/TS)

1. The REAC/TS Program

The REAC/TS is an DOE-sponsored program which provides medical facilities for handling victims of any type of radiation exposure accident.

The REAC/TS facility, located in Oak Ridge, Tennessee, is available to anyone in the United States. The patient, brought to Oak Ridge, is first brought to the emergency entrance, the "Triage Station," to be monitored.¹³ From there the patient is taken to a treatment room, a decontamination room, or whole-body-counting area, as required. The decontamination room contains special equipment, e.g., shielding for physicians,¹⁴ for doing major surgery in the presence of high levels of radioactive contamination. All surgical equipment in the decontamination room consists of exact duplicates of Oak Ridge Hospital surgical equipment so that summoned Oak Ridge Hospital physicians will be familiar with all equipment.¹⁵ The REAC/TS facility also has a holding room where highly contaminated material can be stored, such as a radioactive cadaver. Another REAC/TS capability is the Laminar Flow Ultra Sterile Facility (part of Oak Ridge Hospital) which is a treatment facility for patients who have lost their ability to fight infection. After treatment in REAC/TS, the patient can be transferred to the adjoining Oak Ridge Hospital for conventional medical treatment, if necessary.

The REAC/TS courses for health physicists, physicians, and paramedical personnel are provided on a routine basis.¹⁶ Health physicists are taught how to handle a radiation accident victim, how to estimate

¹³William L. Beck, Special Training Division, ORAU, personal communication (July 7, 1976).

¹⁴Shielding for physicians was designed for patient contaminated with four curies of Cobalt-60 and a limit of three rem to the physician.

¹⁵Beck, op. cit.

¹⁶Roger J. Cloutier, Chairman, Special Training Division, ORAU, personal communication (July 7, 1976).

dose received, and how to present information to the physician. Physicians and paramedical personnel are taught how to handle radiation related medical problems.

The REAC/TS stores, on computer, data on human radiation effects from accidental and medical exposure to radiation (worldwide). This data serves as a basis for epidemiological studies and as useful information to those involved in radiation accidents.

Only a few physicians in the United States are authorized to perform certain experimental therapeutic procedures involving radionuclides, such as chelating therapy for radiation ingestion. The REAC/TS upon request will refer the requester to such a physician.¹⁷

Throughout the REAC/TS program, emphasis is placed upon medical aspects of radiation incidents, e.g., clinical symptoms of victims and therapy for victims.

2. REAC/TS Activation

The REAC/TS assistance as described in this appendix can be obtained by contacting the REAC/TS facility located at the Oak Ridge Hospital in Oak Ridge, Tennessee.¹⁸

There are medical facilities similar to the REAC/TS facility discussed above in other locations in the United States.¹⁹ There is a large facility in Hanford, Washington; and smaller facilities are available at Argonne National Laboratory, Brookhaven National Laboratory, and near the Savannah River DOE Operations Office.

¹⁷ Ibid.

¹⁸ Beck, op. cit.

¹⁹ Cloutier, op. cit.

III. NRC

A. Purpose

The NRC is the federal agency which regulates (licenses and inspects) the possession and use of special nuclear material, source material, and by-product material. The NRC's primary regulatory functions are (1) to require that a license applicant demonstrate safe conditions prior to licensing and (2) to inspect the activities conducted under the license periodically to insure that these safe conditions continue.

One of the major facilities licensed by the NRC is the commercial nuclear power plant. The NRC staff, during licensing, requires, among other things, that the nuclear power plant license applicant demonstrate:²⁰

1. Reliable design and construction to reduce probability of failure or malfunction which could result in a radiation emergency.
2. Safety systems which cope with the above failures and malfunctions in the unlikely event that they do occur.
3. Programs to cope with a series of highly unlikely, major incidents of plant component failures called design basis accidents.²¹

To satisfy the above requirements, the nuclear power plant license applicant must develop plans for dealing with radiation emergencies on or near the site. Such a plan must include agreements with and procedures for notifying federal, state, and local agencies for emergency assistance in such areas as law enforcement, fire fighting, and medical services.²²

B. Cadres

State and local authorities have the responsibility of coping with offsite radiation hazards which may result from onsite problems at

²⁰United States General Accounting Office (GAO), "Report to the Congress by the Comptroller General of the United States, Stronger Federal Assistance to States Needed for Radiation Emergency Response Planning," RED-76-73 (March 18, 1976), 1.

²¹Related material is discussed in 10 CFR 100.

²²GAO Report, op. cit., p. 2.

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nuclear power plants. Also state and local authorities must deal with radiation incidents not associated with nuclear plants. To help state and local officials cope with these incidents, the NRC has published guidelines and offered courses on radiation emergency planning to state and local officials. Additionally, the NRC has made available a Federal Interagency Field Training Cadre, which will, upon request, provide on-the-job assistance to state and local officials in interpreting federal radiation emergency guidelines and in developing and testing their radiation emergency plans.

NRC has given priority for cadre visits to the following states:²³

1. States which have operating nuclear facilities and had their radiation emergency plans reviewed by the NRC.
2. Other states with operating nuclear facilities.
3. States contiguous to states with operating facilities.
4. States with nuclear facilities under construction.

On March 24, 1976, a cadre was sent to Orlando, Florida, to observe and evaluate a drill of the Florida radiation emergency response plan. The resulting critique²⁴ included numerous evaluations such as the following:

There was no central coordination of police resources. Diffusion of the police effort could result in serious misallocations. Measures should be taken to authorize the sheriff to temporarily direct police efforts if the emergency is confined to one county. If more than one county is affected, the state patrol would be appropriate . . .

While this operation was very well executed, more formal control procedures should be developed as should evacuation route maps. Existing evacuation plans had neither . . .

Future exercises can be improved by the input of more simulated radiation injuries, use of radiation sources for monitors, and the element of surprise. Further involvement of the utility as well as Hernando and Levy counties would also be desirable . . .

²³GAO Report, op. cit., p. 15.

²⁴Office of International and State Programs, Nuclear Regulatory Commission, "An Evaluation of the State of Florida's (and Citrus County Government) Emergency Response to a Simulated Accident at Florida Power Corporation's Crystal River Plant, Citrus County, Florida, March 25, 1976," May 14, 1976.

Approximately one year before the above drill evaluation, the cadre had made a trip to Florida to review the Florida radiation emergency response plan and make recommendations. This resulted in a revision of the Florida plan to incorporate the Environmental Protection Agency's "Protective Action Guides." These guides recommend certain actions for certain radiation emergency dose levels.²⁵

To obtain assistance from an NRC cadre, contact the NRC Office of State Programs or any of the NRC Regional Offices, shown in Table 11.²⁶

²⁵United States Environmental Protection Agency (EPA), "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents," EPA-520/1-75-001.

²⁶Op. cit., p. 27.

TABLE 11

**U. S. Nuclear Regulatory Commission Regional Inspection
and Enforcement Offices**

Region	Address	(Area Code) Telephone No.
I	Region I, Inspection and Enforcement, USNRC 631 Park Avenue King of Prussia, Pennsylvania 19406	(215) 337-1150
II	Region II, Inspection and Enforcement, USNRC Suite 818 230 Peachtree Street N.W. Atlanta, Georgia 30303	(404) 526-4503
III	Region III, Inspection and Enforcement, USNRC 799 Roosevelt Road Glen Ellyn, Illinois 60137	(312) 858-2660
IV	Region IV, Inspection and Enforcement, USNRC Suite 1000, 611 Ryan Plaza Drive Arlington, Texas 76012	(817) 334-2841
V	Region V, Inspection and Enforcement, USNRC Suite 202, Walnut Creek Plaza 1990 N. California Boulevard Walnut Creek, California 94596	(415) 486-3141
	Office of State Programs USNRC 7735 Old Georgetown Road Bethesda, Maryland 20014	(301) 492-7210

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