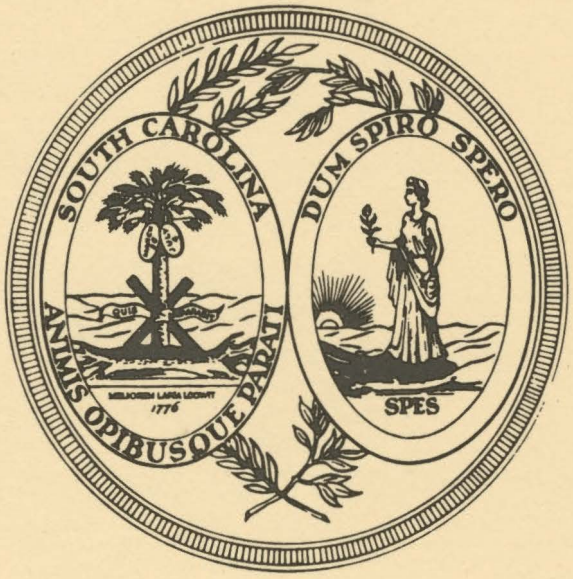
South Carolina General Assembly



Legislative Audit Council

The State of South Carolina
General Assembly
Legislative Audit Council
An Evaluation of
Nuclear Emergency Preparedness
in South Carolina
April 29, 1980

THE STATE OF SOUTH CAROLINA

GENERAL ASSEMBLY

LEGISLATIVE AUDIT COUNCIL

AN EVALUATION OF

NUCLEAR EMERGENCY PREPAREDNESS

IN SOUTH CAROLINA

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REPORT SUMMARY

In April 1979 the Legislative Audit Council was requested by 99 members of the South Carolina General Assembly to conduct a comprehensive review of the State's capabilities to respond effectively to nuclear emergencies. The request asked for a summary of the types of potential nuclear related hazards and the State's response capabilities for each, a review of the types and number of nuclear related accidents or incidents that have occurred in the State and how they were handled, and an evaluation of the adequacy of our current nuclear response capabilities.

The Audit Council coordinated efforts with the Governor's Task Force for Emergency Response Capabilities in Support of Fixed Nuclear Facilities and the Joint Legislative Committee on Energy. Both are studying nuclear emergency preparedness in South Carolina. This avoided unnecessary duplication and enhances the General Assembly's ability to provide direction to improve nuclear emergency preparedness in South Carolina.

The Council staff reviewed State and Federal laws, rules and regulations, professional literature relating to nuclear energy oversight, control, licensing, inspections and emergency preparedness. The activities of State agencies with designated responsibilities in nuclear energy and emergency preparedness were examined to assess compliance with applicable laws, rules and regulations. The records of State agencies with designated roles in nuclear emergency response were examined to inventory the types, number and level of hazard associated with radiological accidents or incidents and to review the responses to incidents that have occurred.

The Audit Council's review revealed a number of deficiencies in the overall state of emergency preparedness for a nuclear accident or incident in South Carolina. These deficiencies taken cumulatively can severely undermine the ability of Federal, State and local officials to protect public health and safety by responding to a nuclear emergency in an efficient and effective manner. These deficiencies and related problems are summarized below.

Inadequacies in State and Local Level Preparedness in the Event of a Major Accident at a Fixed Nuclear Facility in South Carolina

Because of the number of problems observed after approximately six months of fieldwork, the Governor's Task Force for Emergency Response Capabilities in Support of Fixed Nuclear Facilities expanded the scope of its work. The new scope included a statewide assessment of nuclear emergency preparedness and the development of new policies and procedures for corrective action at the State and local level.

The Audit Council observed the work of the Task Force and concurred with their findings and the corrective measures that are being recommended and those that are being implemented. In addition, testimony before the Joint Legislative Committee on Energy by public officials and nuclear industry representatives from across the State, indicated that the problems revealed in initial investigations existed statewide. These problems and additional findings developed by the Audit Council staff are summarized in the following pages.

(1) Although a Memorandum of Understanding for notification of unusual occurrences at nuclear plants exist between the nuclear facilities

and the Bureau of Radiological Health (BRH) at the Department of Health and Environmental Control, the facilities are not required to notify the BRH of all unusual occurrences which involve radioactive materials. Without prompt notification of all non-routine occurrences, the ability of the emergency response agencies to effectively advise on proper actions to be taken is eroded. (see p. 10)

(2) The Governor's Task Force found that no warning systems for notification of an emergency exist in the counties evaluated and plans and procedures for carrying out an evacuation are uncoordinated and vague. Similar problems were indicated in testimony at hearings held by the Joint Legislative Committee on Energy. The absence of public warning systems and lack of detailed plans for warning and evacuation would cause delay, inefficiency and confusion if evacuation were necessary. (see p. 14)

(3) There has been limited formal planning for coordination of evacuation among municipal, county and State law enforcement agencies. This lack of coordination could cause delay in evacuation and unnecessarily prolong public exposure to a hazard if evacuation were necessary. (see p. 16)

(4) A frequently found deficiency was the lack of detailed operational plans for emergency transportation and welfare services. Uncoordinated efforts to transport citizens away from potential hazards

could cause delay when evacuation is necessary and unnecessarily prolong exposure to potential hazards. (see p. 17-18)

(5) Federal funding for training for radiation monitor teams to measure radiation levels after an accident has declined since 1975 with the result that an effective radiation monitoring capability does not exist at the local level. (see p. 19)

(6) Serious efforts at coordination between the nuclear facilities and off-site State and local emergency response agencies have been attempted. However, a comprehensive large scale test exercise involving a nuclear power plant and State and local emergency response organizations has never been conducted in the State. In spite of coordination efforts made so far, the problems that exist with the State's nuclear emergency preparedness would inhibit the effectiveness of the level of coordination that has been achieved. (see p. 19)

(7) Although plans for emergency medical services have been developed and tested within hospitals, there is no coordinated plan for all medical response organizations within affected areas across county lines. Radiological training for medical personnel and ambulance crews has been limited or unavailable to an extent which would inhibit the effectiveness of emergency medical services in the event of a major nuclear accident. (see p. 21)

Bureau of Radiological Health (BRH) Staffing Levels Low

Staffing levels for the BRH Radiation Control Program are below NRC minimum acceptable standards for participants in its Agreement State Program. The NRC standard for staffing levels is 1-1.5 person-years per 100 licenses and 2-2.5 person-years for a major licensee, while BRH present staffing levels are .6 person-years and 1.2 person-years respectively. Because of the BRH staff shortage, 20 inspections of radioactive material licensees are overdue. With the increasing growth in nuclear activity in the State, continued inadequate staffing levels can undermine the effectiveness of the State's Radiation Control Program. (see p. 26)

Discrepancies Found in Inspections of Radioactive Material Licensees 1969-1979

In a sample of inspection records reviewed by the Audit Council, it was found that as the number of radioactive material licenses and inspections increased, the number of violations of State regulations and license conditions increased. Without adequate staff at the BRH to inspect for compliance with State regulations and license conditions, the potential for conditions that might be detrimental to public health and safety is greatly increased. (see p. 34)

Inadequate Training for Drivers Hauling Radioactive Material

There are no Federal or State regulations for standardized emergency training of drivers who haul radioactive materials in the State. In the absence of adequate driver training if an accident occurs, the

exposure to potential radiation may be prolonged until properly trained personnel arrive at the site. (see p. 46)

PSC Vehicle Inspection Program not Realizing Full Potential

The Public Service Commission vehicle inspection program does not inspect for violations of DOT radiation safety regulations. Vehicles carrying radioactive materials are inspected only for compliance with DOT regulations which relate to overall vehicle safety, mechanical condition, vehicle licensing and other non-nuclear related criteria. When a carrier with a radioactive shipment is cited by PSC for a violation of DOT regulations, the BRH is not notified of the violation. Therefore, the State is not realizing the full potential of its inspection program to inspect for compliance with radiation safety regulations and to identify carriers and/or shippers of radioactive materials with a history of DOT violations for possible corrective action. (see p. 52)

The State is Deficient in Providing Safeguards for the Transportation of Radioactive Materials

The State has been deficient in providing adequate safeguards for the transportation of highly toxic radioactive materials because it has not coordinated its existing resources in a comprehensive statewide policy to provide for route planning, prior notification of a central emergency response authority or enroute surveillance assistance. The State has not identified the types and levels of all hazardous materials which should receive all or some of these considerations. The absence of this type of preparedness can hamper the State's ability to respond

effectively and efficiently to an accident/incident involving radioactive materials or other hazardous materials. (see p. 57)

Lack of Plan for Distribution of Potassium Iodide

The State does not have a plan for the emergency distribution of potassium iodide, which can effectively block the absorption of $Iodine_{131}$ (I_{131}) by the thyroid gland in the event of a major accident at a nuclear power plant. There are also no provisions for obtaining an emergency supply of potassium iodide from the Food and Drug Administration or for distribution authority or liability. In the absence of a readily available supply of potassium iodide and plans for distribution, emergency response personnel who may encounter I_{131} could be unnecessarily exposed to a dangerous radiation dosage or emergency operations may be delayed in the presence of I_{131}. (see p. 65)

BRH Daily Inspection Program of Radioactive Material Shipments at Chem-Nuclear Systems, Inc. is an Effective Deterrent of Serious Violations

In a review of BRH records of radioactive shipment inspections at Chem-Nuclear Systems, Inc., the Audit Council found that when shipment inspection frequency increased from spot checks to daily inspection of all incoming shipments, the number of serious violations of DOT regulations with the potential for posing a health and safety hazard to the public decreased from 36 in April 1979 to 7 in December 1979. The decrease in serious violations as inspections of shipments increased indicates the effectiveness of the inspection program and its importance as a deterrent to unsafe practices. (see p. 81)

Accidents/Incidents Involving Radioactive Material in South Carolina

Through December 1979, 104 non-military nuclear accidents/incidents were reported to and investigated by the BRH. Of these incidents 63 were reported with radiation levels above normal background radiation which is .01 mr./hr. in South Carolina. However, only a small portion of these incidents posed a potential significant radiological hazard to the public health and safety. Incidents which posed a potential significant radiological hazard to the public were responded to and investigated by one or more members of the BRH Emergency Radiological Assistance Team (ERAT). None of the incidents reported to the BRH have required implementing the Peacetime Radiological Emergency Response Plan. (see p. 90)

Funds for Emergency Preparedness Declining

Total funds for overall emergency preparedness have declined from FY 77 through FY 80 at a time when the level of potentially hazardous activity is increasing rapidly as the State continues its rapid industrial growth. The State has not developed a comprehensive policy for funding and budgeting for nuclear emergency preparedness or general emergency preparedness. The absence of such a comprehensive policy has resulted in the development of deficiencies in the level of preparedness, especially at the local level. (see p. 96)

Conclusion

The Audit Council's review of the State's nuclear emergency response capabilities revealed that a number of deficiencies exist that could inhibit the overall effectiveness of the State's capabilities to respond to a nuclear emergency. Many of these deficiencies are being addressed

by the Governor's Task Force and may be further improved by pending refinements in Federal Regulations. However, the history of Federal Government involvement in oversight of the nuclear industry has been plagued with vagueness, ineffectiveness, confusion, and contradictory policies among Federal agencies. It would be a mistake for South Carolina to rely solely on Federal initiatives and actions to provide adequate protection for public health and safety relating to potential nuclear hazards in South Carolina.

As outlined on page 8, the Audit Council recommends that the General Assembly should take further action to develop a comprehensive policy for developing State nuclear emergency preparedness measures in the context of overall State disaster preparedness.

INTRODUCTION

The Legislative Audit Council was asked by 99 members of the General Assembly to conduct a review of the State's preparedness in the event of a nuclear emergency (see Appendix 1). The request specifically asked for a summary of the types of potential nuclear related hazards, the State's response capabilities for each, a review of past nuclear incidents in the State, and an evaluation of the State's current capabilities for response to a nuclear emergency.

This report does not attempt to present a case for either side of any of the many nuclear energy policy issues which are being discussed in South Carolina and elsewhere. The Council has attempted to provide an accurate and objective description of problems that were observed during the evaluation of nuclear emergency preparedness while focusing on the three specific points cited in the request. The recommendations included are intended solely to address the problems that were found to exist and to improve the efficiency and effectiveness of nuclear emergency preparedness in South Carolina.

We do wish to point out one problem of a general and widespread nature that is not addressed in the body of the report. It will be evident to anyone who begins to study any aspect of nuclear energy and its relationship to public policy that the following characteristics exist: (1) Nuclear energy, its technology, and the related policy issues are complex and are not amenable to "quick" analysis and "instant" insights. (2) There is widespread and growing concern and involvement among public citizens, government officials, and industrial representatives in many of the areas relating to nuclear energy development and

public safety. (3) In spite of the increased public awareness and efforts to educate the public about nuclear energy, there exists a great deal of misunderstanding and misinformation about nuclear energy and hazards associated with radiation. Improvement in the level of understanding about nuclear energy and its related issues, such as radiation hazards and nuclear emergency preparedness, will require a major and continuing effort to inform and educate the public and public officials.

SCOPE AND METHODS

The Audit Council began the study with an extensive review of research relating to nuclear accidents and nuclear emergency preparedness published by the United States General Accounting Office, other Federal sources, and sources not directly affiliated with government. These sources cited many types of problems which have been observed in the recent history of nuclear energy development. The Audit Council's review then attempted to identify whether these same or similar problems exist in South Carolina.

The field study began by focusing on State and local level emergency preparedness in the event of a radiological hazard involving a nuclear power plant. The Audit Council staff visited the Oconee Nuclear Power Station in coordination with the Governor's Task Force for Emergency Response Capabilities in Support of Fixed Nuclear Facilities. The staff observed the fieldwork of the Task Force and reviewed their reports. In addition, the Audit Council staff attended each of the public hearings on nuclear emergency preparedness held around the State by the Joint Legislative Committee on Energy.

State and Federal laws, rules and regulations relating to all aspects of nuclear energy oversight, control, licensing, inspections, and emergency preparedness were reviewed. The activities of State agencies with designated roles in the area of nuclear energy were reviewed to assess compliance with the applicable laws, rules and regulations. The records of State agencies which have a nuclear emergency response mandate were examined in order to inventory the types, number, and level of hazard associated with incidents or accidents involving radiological

materials that have occurred in South Carolina. This analysis also involved reviewing the types of responses to the incidents. The report is organized in three sections which correspond to the three questions cited in the request. The first section consists of the Major Finding and Recommendations which deal with the adequacy of the State's nuclear emergency response capability. This section also discusses the State's licensing and inspection program. The second section reviews the types of potential nuclear hazards in the State and the existing response capabilities for each. The third section discusses the types and number of nuclear-related incidents that have occurred and how they were handled. It also briefly discusses costs and budgeting relating to nuclear emergency preparedness.

As the Audit Council began its investigation, the Governor's Task Force for Emergency Response Capabilities in Support of Fixed Nuclear Facilities (hereinafter, Governor's Task Force), and the Joint Legislative Committee on Energy also were initiating comprehensive studies into nuclear emergency preparedness in South Carolina. These studies are still underway. The three investigations have been coordinated in areas where appropriate so as to prevent unnecessary duplication and enhance the General Assembly's ability to provide appropriate legislative support and direction to the improvement of nuclear emergency preparedness in South Carolina.

SECTION ONE

STATE AND LOCAL NUCLEAR EMERGENCY PREPAREDNESS: MAJOR FINDINGS AND RECOMMENDATIONS

This section has two parts. The first deals with State and local nuclear emergency response capabilities. The second discusses the State's licensing and inspection program for handlers of radioactive material. The Audit Council considers licensing and inspection to be related to emergency preparedness because they can be effective in preventing emergencies.

Introduction to Nuclear Emergency Preparedness

The Audit Council's review focused on nuclear emergency preparedness and related areas of oversight, licensing, inspection and control of radioactive materials. It must be emphasized that emergency preparedness for an accident or incident involving radioactive material is only one consideration or component of overall preparedness in the event of any type of emergency. The basic principles of emergency response capability are the same for almost all large-scale emergency situations including earthquakes and hurricanes, as well as man-made disasters. Therefore, it is important that nuclear emergency preparedness continue to be developed as an integral part of the State's overall emergency preparedness planning.

The problems and recommended solutions outlined below, although directed specifically toward nuclear emergency preparedness are intended to be viewed in the context of how they fit into the State's overall readiness for response to an emergency situation.

In addition, many of the problems discussed below are being addressed by the Governor's Task Force. The Task Force is made up of key State officials representing all State agencies that have a role in emergency preparedness. The Task Force has thus been able to bring together these senior officials and the personnel resources available in each of their respective State agencies to conduct a thorough evaluation of nuclear emergency preparedness. The staff observed the work of the Governor's Task Force while accompanying the Task Force into the field evaluations at the Oconee Nuclear Power Station, Oconee County and Pickens County. The Audit Council staff identified similar problems and arrived at conclusions similar to those developed by the Task Force regarding the inadequacies of the State's nuclear emergency preparedness. Their draft report, prepared by teams in the field and presented to the full Task Force, contained a detailed and candid listing and discussion of the deficiencies that were found. Detailed recommendations for corrective action also were included. The Audit Council staff concurred fully with the Task Force report and its recommendations, although a few of the recommendations have been expanded in this report.

After the draft report by the Governor's Task Force from the first field evaluation was completed, the Joint Legislative Committee on Energy held public hearings in counties where fixed nuclear facilities are located. County Disaster Preparedness officials, law enforcement personnel, county and municipal government officials, Federal officials, and nuclear industry representatives began to reveal that a pattern of the problems identified by the Task Force existed around the State. As this consistent pattern of problems emerged, the Governor's Task Force expanded its focus to develop and implement new policies and procedures. These

were designed to correct the problems that had been found to exist at both the State and local level in regard to nuclear emergency preparedness around fixed nuclear facilities. Because of the volume of corrective action being attempted and because the Audit Council is in agreement with the actions being taken and being recommended by the Task Force, it became no longer productive for the Audit Council to continue evaluating at the local level during implementation of changes. Therefore, we suspended our field evaluation at the local level and focused on the remaining questions in the audit request.

The Council feels that the inadequacies at the local level, when viewed together, are serious enough in nature to comprise a potential major problem. These circumstances inhibit the ability of the State to ensure that the public is protected from potential hazards with maximum efficiency and effectiveness. In this section we treat the inadequacies found in the evaluation of local level preparedness as a major finding. The report by the Governor's Task Force discusses the details of the deficiencies and recommendations thoroughly. Accordingly, we have attempted in this section only to summarize the general nature of the problems cited in each of the nine emergency preparedness categories examined.

The Audit Council has added certain recommendations for consideration by the General Assembly which are intended to complement the recommendations of the Task Force. Some recommendations are presented as policy options for the Legislature to consider in improving the State's overall preparedness to deal as efficiently and effectively as possible with nuclear and other emergencies. The most important of these proposals is presented immediately below. A summary of the Audit

Council recommendations relating to State and local level nuclear emergency preparedness and the recommendations from the Task Force are consolidated at the end of this section.

RECOMMENDATIONS

THE GENERAL ASSEMBLY SHOULD CONSIDER ESTABLISHING THE FOLLOWING: STATEWIDE MINIMUM STANDARDS OF NUCLEAR AND GENERAL EMERGENCY PREPAREDNESS, A TIMETABLE FOR ACHIEVING THESE STANDARDS, PRIORITIES OF EMERGENCY PREPAREDNESS NEEDS BASED ON LOCALE AND PROBABILITY OF EXPOSURE TO A HAZARD, A SYSTEM FOR ON-GOING INSPECTION TO ENSURE THAT THE STANDARDS ARE MAINTAINED AND THAT THE STANDARDS REMAIN ADEQUATE. THE FUNDING LEVELS NECESSARY TO ACHIEVE THE STANDARDS SHOULD ALSO BE IDENTIFIED.

THE GENERAL ASSEMBLY SHOULD AUTHORIZE DEVELOPMENT OF A PLAN TO PROVIDE ADEQUATE FUNDING FROM LOCAL GOVERNMENTS, STATE GOVERNMENT, THE FEDERAL GOVERNMENT, AND THE PRIVATE SECTOR TO MAINTAIN AN ACCEPTABLE LEVEL OF EMERGENCY PREPAREDNESS.

THE LEGISLATIVE AUDIT COUNCIL SHOULD BE DIRECTED TO EVALUATE THE EFFECTIVENESS OF CHANGES MADE BASED ON THE ACTIONS OF THE GOVERNOR'S TASK FORCE WITHIN ONE TO TWO YEARS FROM THE TIME THE CHANGES ARE ENFORCED.

Summary of Inadequacies in State and Local Level Preparedness in the Event of a Major Accident at a Fixed Nuclear Facility in South Carolina

There are several basic criteria which can be used to assess the quality of a general state of preparedness for a nuclear emergency or other emergencies. These criteria are listed below with a general comment as to the nature of the problems found to exist in each of these areas in South Carolina.

Is There an Effective Systematic Evaluation and Testing Program Which Periodically Measures the General State of Readiness for Emergency Response?

Prior to the activation of the Governor's Task Force the State did not have an agency or procedure requiring the conduct of a periodic comprehensive review and testing of Annex B (Peacetime Radiological Emergency Response Plan) of the Comprehensive Disaster Preparedness Plan for the State of South Carolina. The Governor's Task Force, in 1979, began a comprehensive review of Annex B and a thorough field evaluation of each of its components involving State and local level nuclear emergency response capabilities. Based on the problems revealed during this evaluation, the Task Force expanded its scope to review

and revise the entire State plan, as well as to begin work on correcting the deficiencies found in the area of nuclear emergency preparedness and other areas. As part of its corrective work the Task Force also has established direct coordination with representatives from the Nuclear Regulatory Commission (NRC). This is significant because during the Summer and Fall of 1979 the Federal Government began to implement many major changes in nuclear safety regulations and nuclear emergency preparedness requirements.

The Audit Council concluded after observation of these activities that the Governor's Task Force is carrying out an effective, well-managed and well-coordinated review process. When the Task Force also began implementing modifications to the existing plans and procedures, the Audit Council suspended its evaluation work in the area of State and local level radiological emergency preparedness around fixed nuclear facilities.

Is There a Comprehensive Up-to-date Plan for a Radiological Emergency?

The Bureau of Radiological Health (BRH) under the State Department of Health and Environmental Control (DHEC) maintains and implements the Peacetime Radiological Emergency Response Plan which is a part of the State's Comprehensive Disaster Preparedness Plan. The plan was concurred with by the Nuclear Regulatory Commission (NRC) in November 1977 and is one from only 14 states which has received NRC concurrence.

During the hearings before the Joint Legislative Committee on Energy (JLCE), Federal officials from the NRC and the Department of Energy (DOE) testified that the South Carolina nuclear emergency preparedness plan was an excellent plan and recommended that it be copied and adapted for use in other states.

However, during the field evaluation by the Governor's Task Force and during the hearings held by the JLCE certain problems were brought to light by county and municipal officials, State and local Disaster Preparedness officials, law enforcement personnel and other emergency personnel, and private citizens. These problems would inhibit the efficiency and effectiveness of response to a nuclear emergency and are summarized in the following pages. They are discussed in detail in the reports prepared by the Governor's Task Force.

In addition, the Audit Council feels that the State needs to develop a more formal and stringent requirement for immediate notification to the State of all unusual occurrences in a nuclear facility which directly relate to any operation involving radioactive material. For example, the BRH as part of the Peacetime Radiological Emergency Response Plan, has developed a Memorandum of Understanding between DHEC and six of the State's seven major handlers of bulk radioactive materials. There is a similar agreement with the seventh facility which is the Savannah River Plant. The Savannah Plant is designated as the Regional Coordinating Office for the Energy Research and Development Agency in implementing Interagency Radiological Assistance Plans for five Southeastern states including South Carolina. In discussing notification to the State, the language of the Memorandum does not require that notice be given about all non-routine incidents or occurrences which directly, or indirectly, may involve radioactive material. Appendix 2 is a sample of a Memorandum of Understanding. The specific language at issue states:

> It is further agreed that ALLIED-GENERAL NUCLEAR SERVICES will immediately notify the SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL through its DIVISION OF RADIOLOGICAL

> HEALTH in the event of a nuclear facility radiological incident or in the event of a transportation incident, within ALLIED-GENERAL NUCLEAR SERVICES' responsibility, which has the potential for or does involve the health and safety of the citizens of South Carolina outside the facility boundaries, or which may or does involve abnormal contamination levels in the environment outside the facility environment. This agreement does not prohibit the notification of local emergency organizations in the event that this is deemed an expedient measure by appropriate facility personnel. This agreement shall commence with the signing of this Memorandum of Understanding and shall continue until expressly revoked. [Emphasis Added]

The Director and staff of the BRH indicate that the managers of the State's nuclear facilities have been cooperative in this regard. However, questions about the priorities and circumstances of notification to the State of an unusual occurrence have been a consistent problem cited by the General Accounting Office and became a significant issue during and after the recent accident at Three-Mile Island in Pennsylvania.

First, precise and detailed definitions of classes of non-routine "incidents" or "occurrences" involving radioactive materials which require notification to the State should be established. The language of the Memorandum then should be modified to require immediate notification to the State of all of these unusual incidents or occurrences at the facility which involve radioactive materials. One suggested way of rephrasing the notification requirement to achieve an improved assurance of immediate notification is:

> It is further agreed that ALLIED-GENERAL NUCLEAR SERVICES will immediately notify the SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL through its DIVISION OF RADIOLOGICAL HEALTH in the event of all nuclear facility radiological accidents/incidents or in the event of a transportation accident/incident within ALLIED-GENERAL NUCLEAR SERVICES' responsibility. In addition, ALLIED-GENERAL NUCLEAR SERVICES will immediately notify the SOUTH CAROLINA DEPARTMENT OF HEALTH AND

> ENVIRONMENTAL CONTROL through its DIVISION OF RADIOLOGICAL HEALTH in the event of a nuclear facility radiological incident or in the event of a transportation incident within ALLIED-GENERAL NUCLEAR SERVICES' responsibility, which has the potential for or does involve the health and safety of the citizens of South Carolina outside the facility boundaries, or which may or does involve abnormal contamination levels in the environment outside the facility environment. This agreement does not prohibit the notification of local emergency organizations in the event that this is deemed an expedient measure by appropriate facility personnel. This agreement shall commence with the signing of this Memorandum of Understanding and shall continue until expressly revoked. [Emphasis Added]

There are several benefits to be gained from expanding the notification procedures to include all non-routine incidents or occurrences.

(1) The expanded procedures will tend to keep the emergency notification system more visible to its users and help to establish and reinforce the precedent of notifying the State immediately when problems occur.

(2) The expanded notification procedures will provide a higher level of preparedness and thus, also provide improved protection for both the State and the nuclear facility.

(3) The expansion will facilitate communication between nuclear facility personnel and emergency response personnel who might otherwise seldom have contact except in the case of an incident requiring an emergency response or during scheduled test/training exercises which are infrequent.

(4) The expanded requirement will provide more frequent unscheduled tests of the emergency communications procedures.

(5) The expansion will provide "live" training experience for the emergency response personnel, which will be beneficial even if it only entails participating in the notification process.

(6) The expanded notification requirement will help to establish a record of the volume and types of "routine" and non-routine problems which occur at each type of nuclear facility. This can be a guide for planning and ensuring the adequacy of the State's nuclear emergency response capability. In addition, this type of record-keeping allows a comparison of the volume and types of non-routine incidents or occurrences which happen at nuclear facilities within the State and nationally.

RECOMMENDATION

THE MEMORANDUM OF UNDERSTANDING BETWEEN THE STATE AND NUCLEAR FACILITIES LOCATED IN THE STATE SHOULD BE MODIFIED TO REQUIRE IMMEDIATE REPORTING OF ALL NON-ROUTINE INCIDENTS OR OCCURRENCES AT A NUCLEAR FACILITY WHICH DIRECTLY RELATE TO ANY OPERATION INVOLVING RADIOACTIVE MATERIAL.

Are There Adequate Warning and Evacuation Resources and Procedures to Effectively Alert and Evacuate the Public if Necessary in Response to a Radiological Emergency?

"Warning" is defined as providing the public initial notification that a potential or actual emergency exists and directing them to a specific (predesignated) source of information (e.g., radio and/or television) for guidance as to what action they should take. "Evacuation" refers

to the removal of all persons from an area which contains an actual hazard to the public or is imminently threatened by such a hazard.

In the field evaluation of the first two counties, it was found that there are no warning systems in either county in the vicinity of the nuclear power plant. Plans and procedures for effecting an evacuation were found to be uncoordinated and vague. Adequate State and local resources appear to be available for carrying out an evacuation if required. However, the absence of a public warning system, the failure to distribute emergency-related information to residents in the vicinity of the nuclear facility, and the lack of detailed plans for coordinating warning and evacuation steps would cause delay, inefficiency, and confusion if evacuation were necessary. Such circumstances would result in needlessly prolonging the exposure of the affected populace to the hazard or potential hazard.

Testimony before the Joint Legislative Committee on Energy from local officials in other areas of the State indicated that these problems exist throughout the State.

An additional problem may hamper efforts to improve emergency warning and/or evacuation systems. The availability of Federal matching funds for counties to purchase warning devices and other emergency equipment has been declining rapidly during the last four years. According to officials from the State Emergency Preparedness Division (EPD), there are no Federal funds available for purchase of emergency equipment in FY 80. Many local officials testified before the Joint Legislative Committee on Energy that their counties in the past had not been able to obtain Federal funds because the counties could not afford to provide their share of the money (50% match) required to obtain a Federal grant for equipment purchases.

The Governor's Task Force is developing recommendations for each county that has these problems. The recommendations suggest procedures to be initiated which will provide funding for the purchase of needed equipment.

Is There Sufficient Coordination Among Law Enforcement Agencies to Provide Adequate Evacuation Traffic Control?

Municipal, county and State law enforcement agencies are accustomed to close coordination and communication with each other on a regular basis. However, several weaknesses in preparedness for evacuation were revealed during the field evaluation and during the hearings before the Joint Legislative Committee on Energy. The problems and recommendations are discussed in detail in the report by the Governor's Task Force. The Audit Council supports the recommendations of the Task Force in this area. The problems that were found are presented in summary below.

With few exceptions, there has been no formal or informal comprehensive planning for coordination of a mass evacuation within a 5 or 10-mile radius from the State's fixed nuclear facilities among State, county and municipal law enforcement agencies. This type of planning should include steps such as establishing predesignated primary and alternate evacuation routes, traffic control points, and holding areas for contaminated persons.

The absence of this type of planning can cause delay which could unnecessarily prolong the exposure of the public to a hazard or potential hazard in the event that a mass evacuation were necessary. The problems cited previously regarding deficiencies in resources for warning the public could contribute to further delays and confusion.

In addition, the Task Force noted the potential for over-extending the locally available law enforcement personnel, in the event an evacuation is ordered, because they are expected to provide both evacuation traffic control as well as to assist in door-to-door warning to the public.

A detailed discussion of the types of problems found to exist in the area of evacuation traffic control and recommended corrective measures is contained in the Governor's Task Force report.

Are Emergency Transportation Services Adequate to Support the Movement of Personnel and Emergency Material in the Event that Evacuation Becomes Necessary?

Plans for emergency transportation services to support an evacuation depend on the use of school buses and students who currently are school bus drivers. The following deficiencies were found in the first two counties examined. First, there was no comprehensive detailed operations plan for emergency transportation. Second, since the majority of school bus drivers are students, their availability during summer months is questionable and no alternate drivers have been designated. Parental concern also may limit the availability of student drivers in the event of a radiological disaster requiring evacuation. There is only a remote possibility that allowable stay-time criteria might become a factor if an evacuation were necessary. Nevertheless, the amount of time a person can spend exposed to a radioactive source without exceeding safe exposure levels is shorter for younger people than for older people.

Third, no information has been disseminated to the public regarding plans for emergency transportation services and no test exercises or other operational training activities have been conducted.

These same deficiencies were cited to the Joint Legislative Committee on Energy by officials from other areas of the State. These problems and recommended corrective measures are discussed in detail in the report by the Governor's Task Force.

Is There an Adequate Level of Preparedness for the Provision of Emergency Welfare Services in the Event of a Nuclear Emergency?

The State Comprehensive Disaster Plan cites emergency welfare services as including (1) sheltering, (2) feeding, (3) clothing, (4) registration, (5) information and referral, and (6) emergency social services. Agencies listed in the State plan with support responsibilities for emergency welfare services are the State Department of Social Services, State Department of Education, Adjutant General, American National Red Cross, and the Salvation Army.

The field evaluation of the first two counties found that there was no detailed operational plan of action for delivery of emergency welfare services in response to a nuclear accident/incident. In addition, the local agencies which would be expected to provide these services had not been involved in development of the general county plans for delivering emergency welfare services in a nuclear emergency.

These problems also were cited as statewide problems in presentations by local officials to the Joint Legislative Committee on Energy.

The Department of Social Services in conjunction with the Task Force has begun corrective action to address these inadequacies. The problems and the recommended corrective measures are discussed in detail in the report by the Governor's Task Force.

Are the Numbers of Trained Radiation Monitors Adequate for a Nuclear Emergency?

The role of radiation monitor teams is to (1) detect and measure levels of radiation by direct monitoring with radiation detection instruments and/or collection of air, water and soil samples, and (2) prepare maps showing location, levels and types of contamination. The source of training for these personnel in the past has been from the training program for civil preparedness in the event of a nuclear attack, the Radiological Defense Program (RADEF). This is a 100% federally funded program where the available Federal funds have been reduced by approximately 20% since 1975 not including the impact of inflation. Part of the effect of the limited resources for training personnel to become radiation monitors has been that the first two counties evaluated do not have a sufficient number of trained personnel to support either a peace-time or a war-time RADEF response plan. The funds previously available to pay an instructor to teach the 40-hour Radiological Monitor training course are no longer obtainable which has significantly reduced the availability of qualified instructors.

This deficiency led the Task Force to conclude that "no effective peace-time RADEF capability exists" in the first two counties examined. This problem also was cited by local officials in the hearings held by the Joint Legislative Committee on Energy.

Is Coordination Between Nuclear Facilities and Off-site State and Local Agencies and Organizations Adequate to Effectively Deal with a Nuclear Emergency?

Close coordination and cooperation between the nuclear facility and off-site State and local agencies and organizations in preparing for

emergency operations is essential to having an effective emergency response capability.

The Nuclear Regulatory Commission (NRC) requires that nuclear facilities' emergency plans be approved before an operating license is issued. Facility emergency plans must include provisions for developing a coordinated off-site response capability with State and local agencies.

Part of the effect of NRC requirements for nuclear facilities has been that in the first two counties evaluated serious efforts have been made by the facility to assist various local organizations to develop an effective, well-coordinated emergency response capability. This assistance has included periodic training as well as financial assistance.

In addition, the facilities have cooperated with the State through signing formal agreements regarding notification and mutual assistance in the event of an emergency. Although nuclear facilities have conducted emergency training and test drills in accordance with NRC requirements, the scope of the drills and level of participation by State and local groups has been limited. A comprehensive large-scale test exercise involving a nuclear power plant and State and local emergency response organizations has never been conducted in the State.

These findings have led the Task Force to conclude that serious efforts have been made by the Oconee nuclear facility to cooperate and coordinate with State and local agencies that would respond to a nuclear emergency at the plant. Similar efforts by the managers at other nuclear facilities to help develop effective off-site emergency response capabilities were cited by local officials at the hearings held by the Joint Legislative Committee on Energy.

In spite of the coordination efforts that have been made so far, the problems that exist in the State's nuclear emergency preparedness would inhibit the effectiveness of the minimum level of coordination and cooperation that has been achieved. The Audit Council has expanded its recommendation significantly beyond that of the Governor's Task Force in this area in one specific regard. The Task Force report (draft) concluded that "notification will and should be dependent on the professional judgment of facility operators regarding the potential of an incident, in its initial stages, to escalate and cause an off-site hazard to the population." [Emphasis Added]

The Audit Council believes that off-site coordination and emergency response capabilities can be made more effective through requiring off-site notification of all non-routine occurrences involving radioactive material. This recommendation is discussed in detail on page 11.

Are the Existing Emergency Medical Resources Adequate to Provide an Efficient and Effective Response to a Nuclear Emergency?

A major component in emergency preparedness is the response capability of local medical service organizations, including hospitals, health departments, rescue squads and ambulance services. The coordination between these and other response agencies is also important for effective response to a radiological emergency. Of equal importance is the radiological emergency training that personnel of these medical response organizations receive in the treatment of contaminated patients and the use of radiation monitoring equipment. Nuclear facility emergency plans are required by the NRC to include provisions for emergency response by local medical organizations for assistance during a radiological

emergency in transporting patients, treating patients contaminated by radioactive materials and evacuating hospitals, if evacuation is required. The NRC requirement has resulted in the three hospitals, all ambulance services and rescue squads in the two counties examined having a designated role in the local plans for responding to a radiological emergency at the Oconee Station. Although plans for medical emergency response have been developed and tested within the hospitals, a comprehensive plan for the coordination of all medical services with other response activities within the two counties and provisions for the evacuation of an entire hospital, if required, does not exist. For example, Oconee Memorial Hospital is within a ten-mile radius of the Oconee Nuclear Power Station.

In addition, radiological emergency training has been received only by the hospital staff radiologists. No formal training has been received by ambulance personnel in either the care or transportation of contaminated patients and only a limited number of personnel in each county have received any training in the use of radiation monitoring equipment. This equipment has not been assigned specifically to any ambulances for use in a nuclear emergency.

In its report the Governor's Task Force has recommended that county medical response organizations and county civil defense directors work in close coordination to develop training programs and plans for guidance and assistance in emergency operation "in order to provide for greater coordination of medical response activities with the overall conduct of county emergency operations." Lack of coordination between medical response organizations and other county response organizations, as well as the need for more training and equipment for emergency

response personnel, were also cited by local county and medical services officials in hearings before the Joint Legislative Committee on Energy.

RECOMMENDATIONS

THE GOVERNOR'S TASK FORCE SHOULD COMPLETE ITS COMPREHENSIVE FIELD EVALUATION OF NUCLEAR EMERGENCY PREPAREDNESS AT THE STATE AND LOCAL LEVEL AND CONTINUE THE PREPARATION OF RECOMMENDATIONS FOR IMPROVING THE OVERALL QUALITY OF EMERGENCY PREPAREDNESS AND NUCLEAR EMERGENCY RESPONSE CAPABILITIES.

THE RESULTS OF THEIR REVIEW SHOULD BE RECORDED AS A BENCHMARK AGAINST WHICH TO MEASURE FUTURE EVALUATIONS INTENDED TO ASSESS WHETHER DESIRED IMPROVEMENTS ARE BEING ACHIEVED.

THE GENERAL ASSEMBLY SHOULD CONSIDER REQUIRING THAT THE MEMORANDUM OF UNDERSTANDING BETWEEN THE STATE AND NUCLEAR FACILITIES LOCATED IN THE STATE BE MODIFIED TO REQUIRE IMMEDIATE REPORTING OF ALL NON-ROUTINE INCIDENTS OR OCCURRENCES AT A NUCLEAR FACILITY WHICH DIRECTLY RELATE TO ANY OPERATION INVOLVING NUCLEAR MATERIAL.

THE GENERAL ASSEMBLY SHOULD MONITOR AND BE PREPARED TO PROVIDE LEGISLATIVE ASSISTANCE WHERE APPROPRIATE IN THE FOLLOWING AREAS WHERE DEFICIENCIES HAVE BEEN FOUND IN NUCLEAR EMERGENCY RESPONSE CAPABILITIES.

(1) ESTABLISHING ADEQUATE EMERGENCY WARNING SYSTEMS AND EVACUATION PROCEDURES IN A TEN-MILE RADIUS AROUND THE STATE'S FIXED NUCLEAR FACILITIES.

(2) IMPROVING THE COORDINATION AND PLANNING FOR EVACUATION TRAFFIC CONTROL AND EVACUATION WARNING ASSISTANCE IN A TEN-MILE RADIUS AROUND THE STATE'S FIXED NUCLEAR FACILITIES.

(3) IMPROVING EMERGENCY TRANSPORTATION SERVICES FOR PERSONNEL AND MATERIAL WITHIN A TEN-MILE RADIUS AROUND THE STATE'S FIXED NUCLEAR FACILITIES.

(4) IMPROVING THE CAPABILITY TO PROVIDE EMERGENCY WELFARE SERVICES AT SITES LOCATED OUTSIDE A TEN-MILE RADIUS FROM THE STATE'S FIXED NUCLEAR FACILITIES.

(5) ESTABLISHING AN EFFICIENT, EFFECTIVE RADIOLOGICAL DEFENSE CAPABILITY FOR WAR-TIME AND PEACE-TIME WITHIN A TEN-MILE RADIUS OF EACH OF THE STATE'S FIXED NUCLEAR FACILITIES.

(6) IMPROVING THE LEVEL OF COOPERATION AND COORDINATION BETWEEN THE STATE'S NUCLEAR FACILITIES AND OFF-SITE STATE AND LOCAL AGENCIES TO AID IN IMPROVING THE CAPABILITY TO RESPOND APPROPRIATELY TO AN EMERGENCY SITUATION AT A FIXED NUCLEAR FACILITY.

(7) IMPROVING THE LEVEL OF NUCLEAR EMERGENCY MEDICAL RESPONSE CAPABILITIES WITHIN A TEN-MILE RADIUS AROUND THE STATE'S FIXED NUCLEAR FACILITIES.

THE GENERAL ASSEMBLY SHOULD CONSIDER ESTABLISHING A POLICY WHEREBY THE OFFICE OF EMERGENCY PREPAREDNESS DEVELOPS A SCHEDULE OF ANNOUNCED AND UNANNOUNCED INSPECTIONS AND OPERATIONAL TESTS (WHERE APPROPRIATE) OF THE STATE'S EMERGENCY PREPAREDNESS INVOLVING LOCAL GOVERNMENTS AND PRIVATE SECTOR ENTITIES WHICH HOLD NUCLEAR MATERIALS LICENSES TO BE CONDUCTED

PERIODICALLY THROUGHOUT EACH YEAR. BIENNIALLY, A REPORT SHOULD BE SUBMITTED TO THE GENERAL ASSEMBLY BY THE OFFICE OF EMERGENCY PREPAREDNESS SHOWING THE RESULTS OF ALL INSPECTIONS AND TESTS, THE NATURE AND SCOPE OF EACH INSPECTION AND TEST, PARTIES INVOLVED, STRENGTHS AND DEFICIENCIES FOUND, AND CORRECTIVE ACTION TAKEN. THE REPORT ALSO SHOULD SHOW THE AMOUNT OF ALL FUNDS, INCLUDING STATE, FEDERAL, AND OTHER, EXPENDED IN THE STATE EACH YEAR FOR EMERGENCY PREPAREDNESS AND DISPLAY ALL REVENUE SOURCES FOR THESE EXPENDITURES. THE REPORT ALSO SHOULD CONTAIN RECOMMENDATIONS FOR LEGISLATIVE ACTION WHERE NEEDED TO PROVIDE ADEQUATE EMERGENCY RESPONSE CAPABILITIES TO PROTECT THE PUBLIC.

THE GENERAL ASSEMBLY SHOULD DIRECT A PERIODIC REVIEW OF SELECTED COMPONENTS OF THE INSPECTION AND TESTING PROGRAM CITED IN THE RECOMMENDATION ABOVE, AND SUBMIT A REPORT ON THE EFFICIENCY AND EFFECTIVENESS OF THE PROGRAM TO THE GENERAL ASSEMBLY BIENNIALLY.

The State's Licensing and Inspection Program for Handlers of Radioactive Material in South Carolina

The Audit Council reviewed the inspection criteria and procedures used by the Bureau of Radiological Health (BRH) in determining compliance by radiological material licensees with State and Federal regulations and license requirements. Included in this review was an examination of a sample of inspections conducted by the BRH of major types of licensees (1969-1979) with an inventory of the types of compliance violations.

The South Carolina Atomic Energy and Radiation Control Act of 1967, as amended, and an agreement between the State of South Carolina and the U. S. Atomic Energy Commission (now the Nuclear Regulatory Commission) in 1969 gave the authority to the Department of Health and Environmental Control to regulate the possession and use of all radiation sources. Pursuant to the Agreement with AEC, the Bureau of Radiological Health (BRH) began licensing for the receipt, use, possession and transfer of any source of ionizing radiation not reserved for NRC licensing in 1969.

Types of radioactive material licenses are grouped into four major categories: academic, medical, industrial and other. These major groups are further sub-divided into more specific categories. Medical licenses are in four categories: (1) nuclear medicine, (2) pathology, (3) teletherapy, and (4) pacemaker licenses. Industrial licenses include (1) gamma irradiator, (2) radiography, (3) gauge and device, and (4) small gauge and device licenses. Academic licenses are only defined as academic small quantity. Other licenses include (1) waste burial, (2) waste collection, (3) laundries, and (4) service licenses.

The total number of licenses in effect at the end of each calendar year has risen from 129 in 1969 to 282 in 1979 with increased usage of

radioactive materials (see Table 1). The increases in the number of licenses issued has brought with it increased responsibilities for the BRH staff as inspections of all licensees are required by the NRC of an Agreement State at specified intervals of from six months to three years.

TABLE 1

TOTAL NUMBER OF RADIOACTIVE MATERIAL LICENSES

END OF EACH YEAR

1969-1979[1]

Year	Number of Licenses
1969	129
1970	146
1971	168
1972	172
1973	179
1974	190
1975	202
1976	225
1977	258
1978	263
1979	282

[1] The number of licenses per year represents the number of licenses in effect on December 31 of that year. During the course of each year, licenses are terminated and along with termination, additional responsibilities by the BRH are required to assure that radioactive sources are disposed of in a safe manner. These responsibilities are not reflected in the workload required of the figures above. In addition to the 282 licenses in effect on December 31, 1979, 142 licenses were issued and terminated between 1969 and 1979.

Radioactive material license inspections are performed within certain time intervals based on the type of the license and priority assigned to it. Priorities for scheduling of inspections are determined by the type of material, quantity and use authorized by the license and the potential health hazard. Priority I licensees are inspected every six months with no extension in inspection frequency. The Chem Nuclear waste burial facility is the only Priority I licensee in the State at this time. Priority II licensees include gamma irradiators, radiographers, waste collection licensees and nuclear laundries. These licensees are inspected every 12 months, though inspection frequency may be extended to 18 months. Priority III licensees include all medical licensees and licenses for gauges and devices and are inspected every two years with extensions allowed of one additional year to three years. Priority IV licensees include small quantity gauges and devices, academic and service licensees. These licensees are inspected every three years, though extensions of an additional one year may be allowed to decrease frequency to four years. Inspections are overdue if extension periods are exceeded.

The BRH currently has 3.3 staff members qualified to conduct inspections. The BRH licensing and inspection program is evaluated annually by a team from the NRC Office of State Programs. The evaluation assesses whether the State inspection and licensing program is compatible with the NRC regulatory program and adequate to protect the public health and safety. Major areas reviewed in the annual inspection include organization, management and administration, personnel, regulations, licensing and compliance.

An inspection of the BRH Radiation Control Program was conducted by the NRC in February 1980. Audit Council staff attended the exit

conference in which NRC inspectors reviewed their findings with the staff of the BRH. The NRC found the BRH program to be compatible with NRC guides and adequate to protect the public health and safety. However, the inspectors found that the BRH does not meet NRC minimum requirements for personnel and person-years for the regulatory program. The staff must be adequate in number to assure timely licensing, inspection and enforcement actions of high quality to protect the public health and safety. The specific NRC standard for minimum acceptable staffing level is 1-1.5 person-years per 100 licenses in effect and 2-2.5 person-years for a major licensee, e.g., a low level commercial waste burial site. The BRH staffing levels were low in both cases with only .6 person-years per 100 licenses (excluding the waste burial site) and 1.2 person-years for the State's major licensee, Chem Nuclear Systems, Inc. waste burial facility.

The NRC inspectors stated that when three new staff members of the BRH (one health physicist, two health physicist technicians) are fully trained, the BRH will be within staff-year guidelines. However, attrition, training of new staff, and expanding regulatory activities could again reduce staff-years available for regulatory activities to below NRC guidelines. The NRC inspectors recommended that the BRH carefully monitor budget and staffing levels to avoid possible significant problems in implementing an effective radiation control program.

The NRC inspectors provided a favorable general evaluation of the BRH inspection program with the one warning regarding overextension of the inspection staff. However, the NRC evaluation process for agreement states has itself received criticism from the General Accounting Office. GAO also noted that some hazardous materials are outside the

statutory authority of the NRC. For example, naturally occurring and accelerator-produced radioactive materials (NARM) and non-ionizing sources of radiation are not under NRC regulatory control. Included in NARM is Radium (RA_{226}) which is one of the most hazardous radioactive materials. It is used, according to GAO, in approximately 85,000 medical treatments in the nation annually. It also is used in a large number of industrial and military applications and in consumer items such as smoke detectors.

At the State's initiative, through the BRH, South Carolina's licensing program was expanded to include NARM. However, this program was not evaluated by the NRC inspection team since they have no statutory authority for NARM.

Following is a summary of the criticisms GAO made of the NRC licensing evaluation process.

(1) Although State agencies are advised of NRC's determination of adequacy and compatibility with NRC's program and given general recommendations on how to improve their programs, they are not provided NRC's written evaluation reports which contain specific information on the problems identified during evaluations.

(2) "Although NRC has a guide for evaluating agreement State radiation control programs, determining adequacy and compatibility is left to the judgment of each evaluator. We (GAO) could not determine from reviewing NRC's evaluation reports how the final assessment was made for measuring adequacy and compatibility."

(3) "Several NRC evaluators said that, when deficiencies needing correction are noted in a license review, they inform the State

staff during the review. However, they do not determine whether corrective action is taken by the State."

(4) Federal support of State efforts in radiation control programs in general has been minimal. NRC, for example, provides no funding to the states and therefore has available only the extreme sanction of terminating the agreement with a state.

The NRC inspectors complimented licensing and inspection work of the BRH staff to the Audit Council. However, the entire scope of the licensing and inspection program was not evaluated and the General Accounting Office has published the criticisms cited above about the NRC evaluation process. In addition, the Audit Council has noted a significant increase in the numbers of licensees, inspections and growth in the volume of violations found as the number of inspections increases. (These are discussed in detail on pages 41 and 71.) The effect of staff shortage during the past two years is that currently there are 20 inspections of licensees overdue.

The State (BRH) is not receiving the benefit of having a comprehensive independent technical evaluation performed on the entire scope of its radioactive materials licensing and inspection program. The State receives no records of detailed deficiencies to use as benchmarks for future improvement. The Federal Government has provided no fiscal support for correcting potential deficiencies such as an overextended inspection staff. Because of the rapid growth in the numbers of licensees and the volume of nuclear activity in the State, the Audit Council believes that this combination of factors has the potential for unnecessarily exposing the public and nuclear industry employees to radioactive health and safety hazards.

The Audit Council firmly believes that a good inspection program can be an effective and economical measure for the prevention of radioactive accidents/incidents. Therefore, the Audit Council concludes that the State should consider expanding support for the current inspection program.

RECOMMENDATIONS

IN ORDER TO PROVIDE ADEQUATE PROTECTION TO THE PUBLIC FROM THE HAZARDS OF RADIOACTIVE MATERIALS USED BY LICENSEES WITHIN THE STATE, IT IS RECOMMENDED THAT ENOUGH COMPETENT, WELL-TRAINED STAFF BE MAINTAINED WITHIN THE BUREAU OF RADIOLOGICAL HEALTH (BRH) TO INSPECT LICENSEES WITHIN THE PRESCRIBED TIME PERIODS ESTABLISHED IN THE NRC INSPECTION PRIORITY SCHEDULE.

THE BRH SHOULD DEVELOP A SYSTEM FOR MAKING THREE-YEAR PROJECTIONS OF STAFF-DAY INSPECTION NEEDS AND CORRESPONDING BUDGET REQUIREMENTS SO AS TO ENSURE INASMUCH AS POSSIBLE THAT THE INSPECTION AND LICENSING PROGRAM DOES NOT SUFFER FROM INADEQUATE STAFFING DUE TO TURNOVER, ATTRITION, RECRUITING DELAYS, OR TRAINING DELAYS.

THE GENERAL ASSEMBLY SHOULD CONSIDER REQUESTING THAT THE NRC PROVIDE WRITTEN COPIES OF ALL THEIR INSPECTIONS OF STATE PROGRAMS TO THE STATE.

BRH SHOULD ATTEMPT TO ESTABLISH RECIPROCAL PROGRAMS WITH OTHER STATES (POSSIBLY THROUGH THE SOUTHERN STATES ENERGY BOARD - SSEB) WHEREBY COMPREHENSIVE TECHNICAL EVALUATIONS OF RADIOACTIVE MATERIAL INSPECTION AND LICENSING PROGRAMS ARE CONDUCTED BY QUALIFIED PERSONS FROM OTHER STATES UTILIZING COMMON STANDARDS.

Discrepancies Found in Inspections of Radioactive Material Licensees 1969-1979

The Audit Council staff reviewed the State's procedures for licensing and inspection of handlers of radioactive materials. The BRH carries out this program. South Carolina entered an agreement with the U. S. Atomic Energy Commission (now NRC) in September 1969. The agreement authorized discontinuance of certain Federal regulatory authority and responsibility within the State pursuant to Section 274 of the Atomic Energy Act of 1954, as amended. The State assumed these regulatory tasks. However, the agreement requires that the State program be compatible with the NRC's program for the regulation of radioactive materials and be adequate to protect the public health and safety. Inspection criteria used by the BRH are based on guidelines set forth

by the NRC for different types of licenses. Checks for compliance with license conditions and State regulations promulgated by the Department of Health and Environmental Control must be compatible with NRC guidelines. Inspection criteria used by the BRH may differ from NRC rules provided they meet the minimum requirements of the NRC guidelines. For example, priority schedules established by the BRH for inspecting licensees call for more frequent inspections for academic, industrial and medical licensees than required by NRC guidelines. Appendix 3 is a copy of the licensing and inspection schedule.

The Council reviewed the inspection records of a sample of 15 license holders representing the four major categories of licenses (medical, academic, industrial and other) from 1969 to 1979. Some of the licensees examined did not have licenses until after 1969. In all, the records of 56 inspections of the 15 licensees were examined.

Included in the sample were licensees of the following specific types: 3 academic licensees; 1 nuclear medicine, 1 pathology, and 1 teletherapy licensee (medical); 1 gamma irradiator, 3 gauge or device, and 3 industrial radiography licensees (industrial); 1 nuclear laundry and 1 waste burial licensee (other). A review of the inspections conducted by the BRH of these licensees from 1969 through 1979 indicated a total of 123 items of non-compliance with State regulations and license conditions. Types of items of non-compliance found included the following:

- Records not properly maintained (21 instances)
- Leaks tests not performed on devices, records not maintained (11)
- Areas not properly posted for radiation (10)
- Unauthorized radioactive material used, possessed (6)

- Contamination smears, samples not performed (5)
- Transfer, receipt records inadequate (4)
- Excessive or inconsistent radiation readings (4)
- Runoff water allowed in burial trench (4)
- Survey instruments not calibrated (4)
- Erosion over burial trenches (4)
- Inadequate emergency instructions or kits (3)
- Radiation exposure records incomplete (2)
- Unauthorized personnel install, transfer devices (2)
- Damaged monitoring wells near trench (2)
- Radioactive material packages ruptured during burial (2)
- Insufficient instructions to employees (2)
- Other (37) (include instances of non-compliance found only once)

These items of non-compliance are violations of State regulations and license conditions required to maintain a radioactive material license. When items of non-compliance are found, the licensee is notified and required to respond to the BRH stating corrective actions to be taken. In cases where a potential radiological hazard exists, follow-up inspections are conducted after the licensee has been allowed adequate time to correct the violation. Other items of non-compliance are inspected at the next scheduled inspection to ensure that violations have been corrected.

Table 2 summarizes the review of the sample of inspection records. Figure 1 is a plot showing the growth in the volume of discrepancies found in the inspections from 1969 to 1979.

TABLE 2

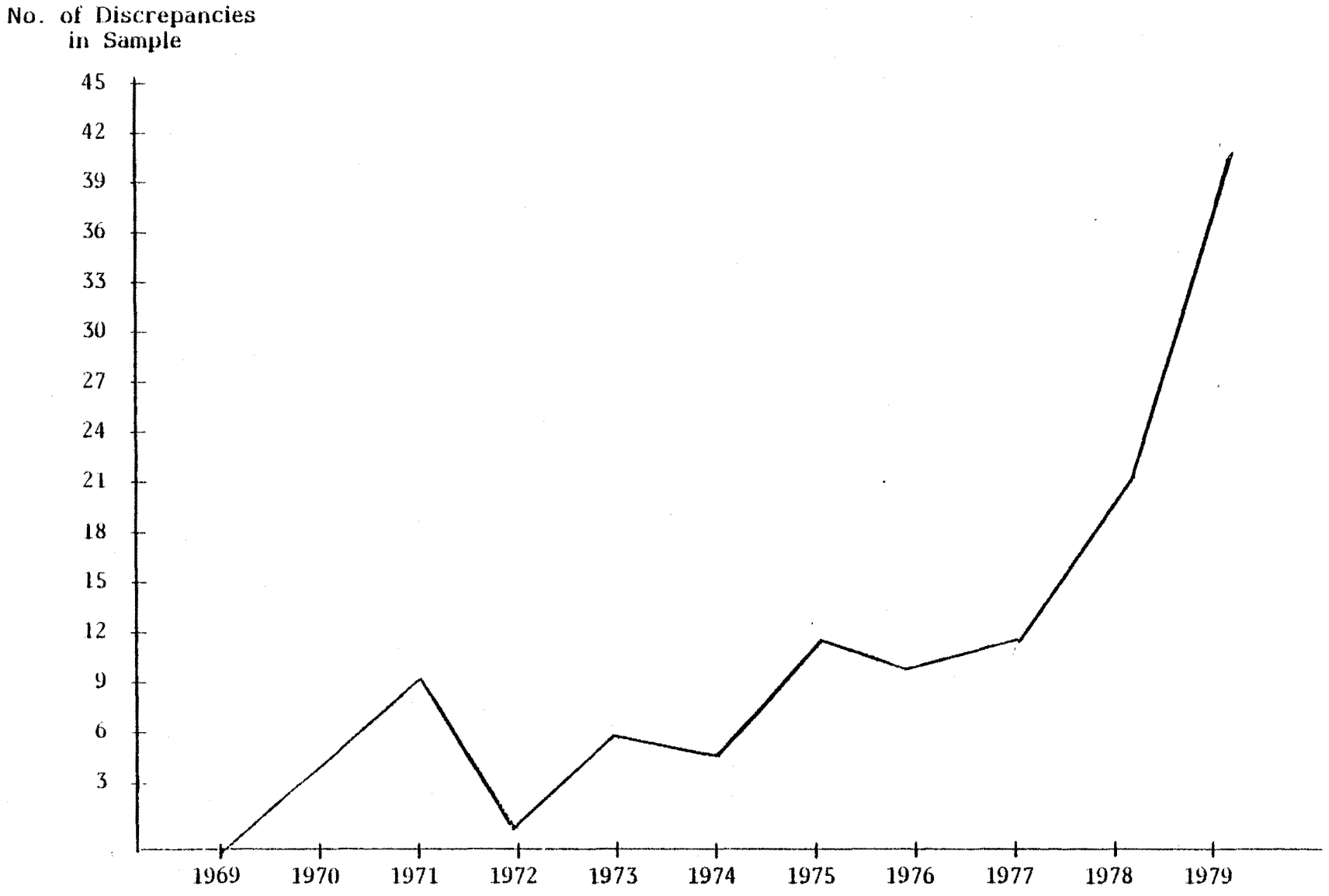
NUMBER OF DISCREPANCIES FOUND IN SAMPLE OF FIFTEEN

BRH RADIOACTIVE MATERIAL LICENSEES' INSPECTIONS

Year	Number of Licenses in State	Total Number of BRH Inspections	Total Number of Licenses in Each Year's Sample	Number of Inspections in LAC Sample	Number of Discrepancies Cited in Inspection Records' Sample
1969	129	10	3	1	0
1970	146	31	5	2	4
1971	168	26	7	4	10
1972	172	34	8	3	1
1973	179	56	10	5	6
1974	190	44	10	3	5
1975	202	65	11	4	12
1976	225	80	12	4	10
1977	258	108	13	7	12
1978	263	106	15	11	22
1979	282	74	15	12	41
TOTAL		634		56	123

FIGURE 1

NUMBER OF ITEMS OF NON-COMPLIANCE FOUND IN SAMPLE OF INSPECTIONS BY YEAR



Currently, the BRH has the authority to amend, suspend or revoke licenses or to impound radiation sources for failure to comply with the rules and regulations promulgated for radiation control. In addition, the South Carolina Atomic Energy and Radiation Control Act and its amendments provide for persons who violate any rules or regulations for radiation control, negligently or otherwise, to be deemed guilty of a misdemeanor. Upon conviction such person may be punished by a fine of not less than one hundred dollars nor more than five hundred dollars or by imprisonment for not more than one year or both fine and imprisonment for each separate violation. This penalty authority, however, is determinant upon conviction in a court of law.

Because the State does not have civil authority to assess appropriate fines for negligent or willful violations of license conditions, the effectiveness of the State's radioactive material licensing and inspection program as a deterrent to improper and potentially hazardous management of radioactive materials is severely undermined.

As expected, as the volume of inspections increased, the number of items of non-compliance also increased from 0 in 1969 to 41 in 1979. The State has only one Priority 1 licensee, the Chem-Nuclear radioactive waste burial facility. The Audit Council reviewed records of 13 BRH license inspections at Chem-Nuclear which accounted for 53 items of non-compliance. The 43 inspections reviewed among the other 14 licensees accounted for only 70 items of non-compliance. The cause for the increasing number of violations of State regulations and license conditions in part can be attributed to the annual growth in the number of licenses and the accompanying increase in the number of inspections.

During its evaluation, the Audit Council staff made an unannounced visit to observe BRH activities at the Chem-Nuclear facility. Coincidentally,

the BRH staff on this date began their semi-annual inspection of Chem-Nuclear which the Audit Council staff observed.

The BRH inspection team had prepared check lists with specific areas to be reviewed relating to health, safety, training and compliance with the technical conditions of the facility's license. The team also reviewed areas which had been cited as problems in previous inspections. In our opinion the BRH inspection was thorough, objective, and conducted in a highly professional manner. Our review of the records of all previous BRH inspections (announced and unannounced) at Chem-Nuclear indicated that thoroughness and the insistence on full and prompt compliance were characteristic of all the inspections.

Because of the potential hazards associated with the waste burial facility, BRH has maintained the inspection program at the facility as a major priority. A BRH inspector also is required at the site to inspect each waste shipment that arrives. This program is discussed on page 81. There has been a problem in the past due to a shortage of qualified staff to carry out the full scope of the radioactive materials licensing and inspection program statewide.

There is a continuing problem although additional staff positions have been approved and filled at the BRH. It takes approximately one year of additional training, much of it at out-of-state schools, before a new staff member is adequately prepared to carry a full share of the BRH inspection workload. As cited previously, this makes it essential that BRH develop a system for projecting and documenting personnel needs based on projected workload over a three-year period in order to prevent lapses in the quality of inspections.

Because of the potential implications for public health and safety and based on the other findings and recommendations relating to the need for improved State oversight, monitoring, and control over radioactive materials in the State, it may be necessary to further expand the staff at BRH. At least, emergency provisions should be established for replacing personnel in the event of sudden unforeseen position vacancies which could temporarily cripple the inspection program.

RECOMMENDATIONS

THE BRH SHOULD DEVELOP A SYSTEM FOR MAKING THREE-YEAR PROJECTIONS OF STAFF-DAY INSPECTION NEEDS AND CORRESPONDING BUDGET REQUIREMENTS SO AS TO ENSURE INASMUCH AS POSSIBLE THAT THE INSPECTION AND LICENSING PROGRAM DOES NOT SUFFER FROM INADEQUATE STAFFING DUE TO TURNOVER, ATTRITION, RECRUITING DELAYS, OR TRAINING DELAYS.

THE GENERAL ASSEMBLY SHOULD CONSIDER ESTABLISHING EMERGENCY AUTHORITY FOR BRH TO CARRY ONE PERSON IN ADDITION TO THE APPROVED NUMBER OF POSITIONS WHEN IMPENDING POSITION VACANCIES IN THE INSPECTION STAFF BECOME KNOWN IN ORDER TO PREVENT CRITICAL DELAYS IN INSPECTIONS DUE TO THE TIME REQUIRED FOR TRAINING NEW PERSONNEL. BRH SHOULD ATTEMPT TO RECRUIT PERSONNEL WHO

POSSESS ENOUGH PROFESSIONAL SKILLS AND EXPERIENCE SO AS TO REDUCE THE ONE-YEAR OF TRAINING CURRENTLY NECESSARY BEFORE NEW STAFF MEMBERS ARE FULLY QUALIFIED TO CARRY OUT INSPECTIONS. THE STATE PERSONNEL DIVISION SHOULD REVIEW CURRENT POSITION REQUIREMENTS FOR POSSIBLE UPGRADING.

THE GENERAL ASSEMBLY SHOULD CONSIDER EXPANDING THE AUTHORITY OF DHEC/BRH TO INCLUDE LEVYING CIVIL PENALTIES FOR VIOLATIONS OF LICENSE CONDITIONS WHICH POSE SIGNIFICANT THREATS TO EMPLOYEE AND/OR PUBLIC HEALTH AND SAFETY. THE EXPANDED AUTHORITY AT A MINIMUM SHOULD INCLUDE AUTHORITY TO LEVY FINES IN AMOUNTS RANGING FROM $100 PER DAY TO $10,000 PER DAY DEPENDING ON SEVERITY OF HAZARD.

SECTION TWO

SUMMARY OF THE TYPES OF POTENTIAL NUCLEAR RELATED HAZARDS AND THE STATE'S PREPAREDNESS FOR EACH

Introduction

The discussion of potential nuclear hazards in South Carolina does not include the dangers resulting from a nuclear attack. However, much of the State's peace-time nuclear emergency response capability is derived from the training, equipment and funds that have been made available for civil preparedness in the event of a nuclear war. In addition, the discussion refers generally to threats to the safety of the "unsuspecting" public. That is, persons who are not aware that they are in the immediate proximity of potentially hazardous radioactive materials or who are not specifically trained to recognize and deal with radioactive materials and hazards.

The types of potential nuclear hazards have been divided into five general categories: (1) transportation, (2) nuclear power plant operation, (3) radioactive waste storage and reprocessing, (4) nuclear materials fabrication, and (5) other radiation hazards. Discussions of the various types of hazards within each general category, the preventative measures and the State's response capabilities for each general category are presented in this section. Figure 2 is a simplified diagram of the nuclear industry which allows comparison with the five categories of nuclear hazards.

There are two important points to be remembered in reviewing the State's current level of emergency preparedness and developing steps for improvement. First, nuclear emergency preparedness should be

considered as a component of the State's plans for overall emergency preparedness. Second, steps being considered for improving nuclear emergency preparedness should acknowledge the following conditions: (1) Federal nuclear safety requirements and nuclear emergency response capability requirements are currently undergoing major revisions, (2) the State requirements, plans and level of preparedness for nuclear emergencies are undergoing major revisions as a result of the work of the Governor's Task Force, (3) the United States General Accounting Office has published within the last year, many well-documented criticisms of weaknesses in Federal support and guidance in relation to nuclear emergency preparedness which the State must consider in developing its own emergency response capability, and (4) with the publication of this report the Joint Legislative Committee on Energy will have at its disposal the work of the Task Force, the Audit Council, the Committee staff's research and the testimony from public hearings to prepare further recommendations for improvement.

POTENTIAL HAZARDS RELATED TO TRANSPORTATION OF RADIOACTIVE MATERIALS AND THE STATE'S EMERGENCY RESPONSE CAPABILITIES

The Nuclear Regulatory Commission in 1978 estimated that over two million packages of radioactive materials are shipped within the United States annually. Further, they estimated that the volume of shipments would increase to 5.5 million annually by 1985. There are several thousand shipments involving some amount of radioactive material into,

out of, or through South Carolina each year. There are no comprehensive statistics centrally maintained on the total volume of radioactive materials shipped within the State.

Radioactive materials are moved in the State by air, rail, highway carrier, and by sea if the Charleston port facilities are included. There are four types of potential sources of radioactive hazard related to transport of these materials. First, the carrier may be involved in an accident or sabotage in which the container could be damaged sufficiently to allow a release of the radioactive materials. The second potential source of radiation hazard is from insufficient packaging of the material. For example, a container may be too small. If so, there may not be enough distance between the radioactive source material and container walls to reduce the radioactivity level at the outside surface of the wall to a level within the safe exposure limits established by the NRC.

Improper packaging is a third potential hazard source. For example, an abrupt shift in load or rough handling, may cause a vial containing a radiopharmaceutical to break and leak its contents into its container package if it is not properly padded and secured within the container. Finally, improper handling of the package or its contents during loading or unloading operations may result in unnecessary exposure or spillage.

Measures to prevent unintentional exposures to or releases of radioactive material during transportation center around (1) proper training, (2) appropriate security measures, (3) effective inspection programs, and (4) establishing pre-planned routes and enroute observation procedures when and where appropriate. If an accident/incident occurs in spite of these measures, the level of hazard can be reduced by having an effective emergency response capability.

Based on the Audit Council's review in South Carolina and our review of similar evaluations conducted in other states, there are improvements that can be made in each of the areas of prevention relating to transportation of radioactive materials. These are discussed below.

Training

Highway carriers account for the majority of shipments of radioactive material. However, there are no uniform Federal or South Carolina laws or regulations requiring that drivers of all vehicles hauling radioactive material have any special training or preparation for dealing with radioactive hazards in the event they are involved in a nuclear accident/ incident. There are no Federal or State minimum standards requiring that drivers carry and know how to operate and interpret radiation detection instruments. Similarly, there are no uniform standards for wearing personal dosimeters or film badges to record their personal cumulative exposure if they do encounter radiation.

In addition, in a May 1979 report, the General Accounting Office critically pointed out that "there are no Federal regulations requiring shippers of nuclear materials to have emergency response plans." Further, although Department of Transportation regulations require carriers to instruct drivers on appropriate actions to be taken in event of an accident, there are no uniform standards as to the type and depth of instruction. Nor are there standardized training requirements for actions to be taken if the accident involves radioactive materials. For example, some carriers do provide detailed instruction for drivers including how to obtain a radiation reading, roping off the immediate accident area, and how to notify proper authorities.

Numerous State, Federal and nuclear industry officials pointed out that frequently drivers are totally uninformed as to the nature and potential hazards of their radioactive cargo. For these drivers, their primary concern is that they are in compliance with applicable DOT regulations, such as displaying the proper placard for the type of hazard. Although a driver may be fined for this type of violation, it is actually the shipper's responsibility to ensure that the load is properly placarded at the shipping point.

If a driver of radioactive shipments is adequately trained and is not injured in an accident, as the first on the scene the driver is in a position to take immediate steps to minimize his own and the public's potential for exposure to a radiation hazard.

In the absence of adequate driver training if an accident occurs, exposure to a potential radioactive hazard to the driver and the public may be unnecessarily prolonged until properly (nuclear) trained personnel arrive at the site.

RECOMMENDATIONS

THE GENERAL ASSEMBLY SHOULD CONSIDER ESTABLISHING THROUGH THE BUREAU OF RADIOLOGICAL HEALTH THE FOLLOWING REQUIREMENTS FOR DRIVERS LICENSED IN SOUTH CAROLINA WHO HAUL RADIOACTIVE MATERIALS IN LARGE QUANTITIES.

(1) MINIMUM STANDARDS OF DRIVER FAMILIARITY WITH RADIATION HAZARDS AND SAFETY.

(2) STANDARDS FOR IMMEDIATE PROTECTIVE ACTIONS TO BE TAKEN AT THE SITE BY DRIVERS WHEN ACCIDENTS/INCIDENTS INVOLVE RADIOACTIVE CARGOES.

(3) STANDARDS FOR A MODEL TRAINING PROGRAM (WITH PERIODIC REFRESHER TRAINING) TO BE GIVEN TO DRIVERS BY SHIPPING COMPANIES TO USE IN CONDUCTING THEIR OWN DRIVER TRAINING FOR NUCLEAR EMERGENCIES. BRH WOULD MONITOR AND INSPECT SUCH COMPANY TRAINING PROGRAMS AND AUTHORIZE CERTIFICATES TO BE ISSUED TO EACH DRIVER SUCCESSFULLY COMPLETING THE TRAINING.

(4) BRH SHOULD EXPLORE POSSIBLE SOURCES OF FEDERAL FUNDS FOR THE STATE TO ESTABLISH A MODEL DRIVER TRAINING PROGRAM. THE POSSIBILITY OF MAKING THE PROGRAM AVAILABLE NATIONALLY SHOULD ALSO BE EXPLORED. THIS MAY ALLOW SUCH A PROGRAM TO BE FISCALLY SELF-SUPPORTING AS WELL AS CONTRIBUTING ASSISTANCE IN SOLVING A NATIONAL PROBLEM.

Security

There are two types of security involving transportation of radioactive materials. First are physical security measures intended to protect or insulate the materials from access by unauthorized persons. This type of security generally involves protection from sabotage, terrorist acts, theft, or malicious damage. Critical defense related materials, such as plutonium, which also have high radiation toxicity, are transported with maximum security. For example, plutonium is shipped in relatively small amounts in unmarked vehicles which are constantly tracked from three sources. The vehicle drivers are armed and are specially trained in security and radiation protection measures. The shipments are escorted by armed officials with Federal Marshal police authority.

The second type of security focuses on protecting the public from an unforeseen and unplanned radiation exposure which may result from an accident/incident during shipment. For example, if radioactive materials were spilled at an accident, or a sabotage incident, an immediate objective would be to contain or isolate the material from the public. Other immediate objectives would be to recapture the spilled material and place it in a suitable container, and apply appropriate decontamination measures if necessary.

The Federal Government has primary responsibility for the safe transportation of nuclear materials. In a study published in May 1979, the General Accounting Office (GAO) concluded that "Federal agencies responsible for the safe transportation of nuclear materials have not developed and enforced policies and regulations which adequately protect the public from exposure to radiation from such shipments." Appendix 4 is a photocopy of the summary of the GAO report.

South Carolina was not one of the states visited by GAO auditors, nevertheless, the State is affected by the problems at the Federal level cited by GAO. These problems are mentioned here to emphasize that the State must look beyond mere compliance with Federal guidelines in the area of nuclear transportation in order to ensure that reasonable safeguards for public health and safety are maintained. For example, GAO found that DOT and NRC "allow levels of radioactive contamination on packages and transport vehicles which are unnecessarily high. This unnecessary radiation creates a potential hazard for transportation workers as well as the general public."

More specifically related to security from sabotage, the GAO found that current Federal regulations for protecting weapons-grade nuclear materials shipped in quantities large enough to be considered of strategic value were inadequate and needed upgrading. GAO also found that similar problems and potential hazards from sabotage relating to spent-fuel shipments existed.

Currently the Federal Government is in the process of reviewing and revising security standards for the various categories of radioactive materials and the varying levels of hazard of each category. In late 1979 the NRC published upgraded requirements for physical security at nuclear power plants.

South Carolina does not have a comprehensive program relating to security of radioactive materials being transported within the State. The State does not have a policy establishing minimum physical security standards at fixed nuclear facilities. The State has no jurisdiction over fixed nuclear facilities due to preemption by Federal Regulation (10CFR50). Nor does the State have a program for inspecting physical security during transportation or at nuclear facilities.

The Audit Council believes that physical security measures for low-level radioactive material need not be as strict as they are for high-level material because the potential hazard to the public is much less from low-level materials. Physical security of nuclear facilities and for nuclear materials during shipment may not be an appropriate area for State regulatory involvement especially in light of the new Federal initiatives regarding physical security. However, in the current circumstances the State has no comprehensive plan for coordination between nuclear facilities and State and/or local law enforcement personnel and nuclear emergency response personnel in the planning for physical security. Neither does the State have a formal comprehensive method for being advised as to the adequacy of physical security plans and procedures at facilities or during transportation. In addition, in light of the inadequacies in emergency training for drivers hauling radioactive material, cited previously, there is a weakness in securing the public from possible radiation exposure at an accident/incident site.

The effect of these conditions is that the State has limited information and guidance as to what physical security standards should be for different types of radioactive material. The State also has no systematic way of being informed if security measures during transportation and at nuclear facilities are adequate or inadequate. In addition, the lack of coordination and planning with the Federal Government means that the efficiency and effectiveness of the State's ability to provide emergency assistance if requested would be hampered.

RECOMMENDATION

THE GENERAL ASSEMBLY SHOULD REQUEST THE GOVERNOR'S TASK FORCE TO EXAMINE THE ISSUES AND STANDARDS RELATING TO PHYSICAL SECURITY AT NUCLEAR FACILITIES AND DURING TRANSPORTATION OF NUCLEAR MATERIALS AND REPORT ON WHAT PRECAUTIONS AND LEVEL OF INVOLVEMENT THE STATE MAY WISH TO IMPLEMENT IN THIS AREA.

Transportation Inspections of Radioactive Shipments

The State through DHEC has a contract jointly with DOT and the NRC "to provide inspections and surveillance of radioactive material in transport within the State."

DHEC has issued two reports based on the two contracts completed since 1976. A third contract is nearing completion with a report expected in the Fall of 1980. Below is a summary of the contract requirements taken from the report published in April 1978. Appendix 5 contains a photocopy of the inspection methodology and a summary of the findings from the 1978 report.

Scope of Contract Requirements.....

1. The State would visit selected carrier facilities at least quarterly during the period of the contract.

2. Perform radiation surveys to determine radiation levels at each work station in terminals or warehouses. Post area monitoring devices at selected terminals and document radiation exposure levels.

3. Perform contamination surveys at each work station and on radioactive material packages and transport vehicles.

4. Badge individual employees to determine personnel exposure.

5. Perform package inspections to include radiation levels, labeling, marking, contamination, and shipping documents.

6. Perform inspection on transport vehicles to document radiation levels, contamination, placarding, transport index, and shipping documents.

The inspections involved two air-freight terminals and six highway carrier terminals. One of the highway carrier terminals was the combination transportation facility and low-level radioactive waste burial facility outside of Barnwell, South Carolina. According to the staff of BRH no inspections ever have been made by State officials of radioactive materials shipped by rail. Most rail shipments of radioactive materials within South Carolina are under Federal Control since they are to or from the Savannah River Plant or are enroute to another Federal facility.

The sample of inspections conducted under the contract with the NRC and DOT are performed after shipments are in the State and at or near their final destination. In addition, all shipments of low-level radioactive waste to the Chem-Nuclear waste burial facility currently are inspected by BRH at the Chem-Nuclear facility prior to their acceptance for burial.

The Audit Council interviewed officials from the Public Service Commission (PSC) to determine if this agency's vehicle inspection program included special provisions for shipments carrying radioactive material. PSC does not inspect for violations of radiation safety regulations specifically. Their inspectors look primarily for compliance with DOT regulations which relate to overall vehicle safety, mechanical condition, vehicle licensing, and other non-nuclear related criteria.

However, when a vehicle carrying radioactive material receives an inspection, the radioactive load placards on the vehicle are compared with the manifest accompanying the shipment. The type of placard displayed must agree with the level of radioactive hazard of the material cited in the manifest.

The PSC inspectors do not have training nor instruments to inspect the actual level of radiation in a shipment. In addition, PSC only has authority to inspect "For-Hire" carriers which operate only 1.5% of all trucks registered in South Carolina. In the beginning of 1978 there were 5,560 "For-Hire" vehicles in the State. Private carrier firms and their trucks (approximately 13,750 firms in 1978) are exempt from PSC inspection by State law.

PSC has no special inspection program oriented toward shipments of radioactive materials. They have never, for example, stationed an inspector at the Chem-Nuclear radioactive waste burial facility to look for the types of DOT violations that come under their jurisdiction. (The carrier inspection program at Chem-Nuclear is discussed in more detail on page 81.)

When a carrier with a radioactive shipment is cited by PSC for a violation of DOT regulations, BRH does not receive a copy of the citation. This means that the State is not realizing the full potential of its inspection program to identify carriers and/or shippers of radioactive material who may have a history of DOT violations.

The effectiveness of the PSC inspection and their enforcement authority is hampered by the $100 limit on the amount of fine that may be charged to a carrier found to be in violation. This limit has not been changed in approximately thirty years according to PSC officials, and is ineffective as a deterrent.

The PSC inspectors also may be an under-utilized nuclear emergency resource since they have no specific role in the State's peace-time radiological disaster preparedness plan. For example, the uniformed enforcement officers could be used to assist in evacuation warning and traffic control.

From review of the State's inspection activities and from discussions with PSC officials and BRH officials, the Audit Council concluded that PSC's inspection program could be easily expanded so as to improve the State's monitoring and inspection of shipments of radioactive material. One or more of several possible actions could be taken which would expand the scope and improve the effectiveness of the inspection of radioactive shipments.

RECOMMENDED OPTIONS FOR IMPROVING THE EFFECTIVENESS OF TRANSPORTATION INSPECTIONS

(1) INCREASE THE MAXIMUM AMOUNT OF FINE WHICH CAN BE LEVIED BY PSC INSPECTORS AGAINST MOTOR VEHICLE CARRIERS FOUND TO BE IN VIOLATION OF APPLICABLE STATE AND/OR FEDERAL LAWS AND REGULATIONS. EXTRA PENALTIES SHOULD BE ESTABLISHED FOR VIOLATIONS BY CARRIERS OF HAZARDOUS MATERIALS WHERE SUCH VIOLATIONS PRESENT SIGNIFICANT POTENTIAL HAZARD TO THE HEALTH AND SAFETY OF THE PUBLIC.

(2) WHEN CARRIERS HAULING RADIOACTIVE MATERIALS ARE CITED FOR A VIOLATION BY PSC INSPECTORS, A COPY OF THE CITATION SHOULD BE FORWARDED TO BRH. BRH WILL PERIODICALLY COMPARE THESE CITATIONS WITH THEIR OWN INSPECTION FILES TO IDENTIFY CARRIERS AND/OR SHIPPERS WHO ARE REPEAT OFFENDERS FOR POSSIBLE CORRECTIVE ACTION.

(3) THE INSPECTION PROGRAM AT PSC COULD BE EXPANDED SO AS TO INCLUDE A LARGER NUMBER OF CARRIERS HAULING RADIOACTIVE MATERIAL. THIS MAY INVOLVE EXPANSION OF THEIR CURRENT STATUTORY AUTHORITY.

(4) WITH TRAINING FROM BRH STAFF, PSC INSPECTORS COULD USE RADIATION DETECTION INSTRUMENTS TO PERFORM SIMPLE TESTS TO DETERMINE WHETHER THE RADIATION LEVEL OF A SHIPMENT IS WITHIN PRESCRIBED LIMITS, IN ADDITION TO THEIR CHECKS FOR COMPLIANCE WITH DOT REGULATIONS. THIS TRAINING COULD BE PROVIDED TO EACH PSC INSPECTION OFFICER WHO IS ASSIGNED FOR ONE DAY TO CONDUCT INSPECTIONS AT THE CHEM-NUCLEAR WASTE BURIAL FACILITY.

(5) PSC INSPECTORS SHOULD HAVE A DESIGNATED ROLE IN THE STATE'S PEACE-TIME RADIOLOGICAL DISASTER PREPAREDNESS PLAN. THE EMERGENCY PREPAREDNESS DIVISION IN REVISING THE PLAN SHOULD CONSIDER USING THE PSC INSPECTORS TO ASSIST IN THE AREAS OF EVACUATION WARNING AND/OR EVACUATION TRAFFIC CONTROL.

(6) CONSIDERATION SHOULD BE GIVEN TO ESTABLISHING A PROGRAM OF INSPECTIONS OF SELECTED RADIOACTIVE SHIPMENTS INTO THE STATE AT OR NEAR THE BORDER. PSC INSPECTORS COULD BE PROVIDED THE PROPER INSTRUMENTS AND SIMPLE TRAINING TO MEASURE WHETHER SHIPMENTS ARE WITHIN EXTERNAL RADIATION LIMITS PRESCRIBED BY THE DOT. IN THE EVENT EXCESSIVE RADIATION WAS FOUND, BRH WOULD BE NOTIFIED AND A BRH TEAM WOULD TAKE APPROPRIATE ACTION.

Pre-Planned Routes and Enroute Observation

The NRC and Department of Defense employ techniques of armed escorts, pre-planned routes, predesignated radio check-points, and constant surveillance for shipments of radioactive materials which are considered of strategic value. In spite of these safeguards the General

Accounting Office in their May 1979 report cited several inadequacies in these provisions. Some of these were cited previously in the section on security. Appendix 4 contains a summmary of GAO comments.

In addition, GAO cited the vulnerability of spent-fuel shipments to sabotage and the subsequent potential hazards to the public. Their summary comments on this topic appear in Appendix 6.

South Carolina does not have a comprehensive policy for pre-planning transportation routes of hazardous materials to minimize the public's exposure to a potential major hazard from radioactive or other dangerous materials. Nor does the State have an established policy of coordination with Federal agencies in route selection nor in surveillance assistance for hazardous shipments.

The BRH requires Chem-Nuclear in its radioactive material license to provide to BRH prior notification of all low-level radioactive waste shipments which are to be received for burial at the Barnwell site. The BRH on-site inspector, five to ten days prior to arrival of each shipment, receives a copy of the notification form from the shipper. These records are maintained at the Chem-Nuclear site by BRH. They contain the arrival date, routes used, description of the material, cubic footage, shipper, and other information.

BRH is also notified in advance of spent-fuel shipments to the Savannah River Plant by telephone from the NRC. However, it is not known whether BRH is notified of <u>all</u> spent-fuel being shipped in the State. BRH has no authority to require prior notification of spent-fuel shipments.

The notifications that are provided by the NRC are kept in a log book at BRH and no other action is taken and no other State agencies

are notified of the shipment. The data recorded includes the port of entry into the country, shipment origination point and shipper name, amount of material shipped, and arrival dates. No specific information is received regarding the route of travel.

An informal notification arrangement has been established between the Carolina Power and Light Company and the local District Office of the State Highway Patrol. The NRC and the Patrol Office receive prior notification when spent-fuel rods are to be moved from the H. B. Robinson Nuclear Power Plant to a storage facility in North Carolina. These shipments are made by rail. Although Highway Patrol officers monitor the progress of the shipment, no other agency, including BRH, is notified. In addition, the Audit Council could find no provisions for coordination among local government agencies in regard to notification or surveillance of high-level (spent-fuel) radioactive shipments.

The Audit Council examined the BRH log of notifications of radioactive material shipments for the period June 2, 1977 to March 4, 1980. Of the total of 79 shipments, 63 were shipments of spent-fuel called in by NRC, and 4 were shipments of spent-fuel from the Robinson plant to North Carolina called in by Carolina Power and Light. The remaining 12 shipments involved low-level waste being transported to the Chem-Nuclear burial site. Notifications of these shipments were received from a variety of different sources including Chem-Nuclear and the South Carolina Disaster Preparedness Agency.

The GAO, the SCDHPT, the Office of Emergency Preparedness, the Governor's Task Force, the BRH, and the Audit Council agree that the threat to the public safety is reduced when shipments of hazardous materials are routed around densely populated areas. In addition,

there is general consensus that well-coordinated prior notification of a hazardous material shipment and its route, improves the emergency response capability. This information also can improve plans for physical security for the shipment.

Not all shipments of radioactive materials present a major threat to the public even in the hypothetical "worst possible" types of accidents/incidents. There is, however, potential for a major threat to public safety from the "worst possible" accident/incident involving a shipment of high-level radioactive waste or strategic nuclear materials. Based on the Federal Government's own studies the State must at least be skeptical about the adequacy of Federal safeguards for public safety in the transport of large volumes of highly toxic radioactive materials. The State has been deficient in providing better safeguards because it has not established a comprehensive statewide policy which coordinates its existing resources to provide route planning, prior notification of central emergency response authorities, or enroute surveillance assistance. Neither has the State identified specifically, the types and levels of hazardous materials which should receive all or some of these considerations.

The absence of this type of preparedness can hamper the State's ability to respond as efficiently and as effectively as possible in the event of an accident/incident involving radioactive materials.

RECOMMENDATIONS

THE GENERAL ASSEMBLY SHOULD IMPLEMENT A COMPREHENSIVE STATEWIDE POLICY REQUIRING:

(1) ESTABLISHMENT OF PROCEDURES FOR PRIOR NOTIFICATION TO A CENTRAL STATE OFFICE OF RADIOACTIVE MATERIAL SHIPMENTS PRESENTING SIGNIFICANT POTENTIAL HAZARD TO PUBLIC SAFETY,

(2) PRE-PLANNING OF TRANSPORT ROUTES FOR THE ABOVE SHIPMENTS,

(3) PRIOR COORDINATION OF SURVEILLANCE ASSISTANCE FOR THE SHIPMENTS CITED ABOVE, AND

(4) ESTABLISHMENT OF SPECIFIC HAZARD CRITERIA TO DETERMINE WHAT LEVELS OF SECURITY, ROUTE LIMITATIONS, AND SURVEILLANCE ARE APPROPRIATE FOR DIFFERENT TYPES OF HAZARDOUS SHIPMENTS.

IN ADDITION, THE GENERAL ASSEMBLY SHOULD EXERCISE VIGOROUS INITIATIVES TO ENCOURAGE IMPROVED FEDERAL SUPPORT AND COORDINATION RELATING TO TRANSPORTATION SAFETY, SECURITY, AND EMERGENCY PREPAREDNESS FOR RADIOACTIVE MATERIAL BEING SHIPPED BY ANY MEANS IN SOUTH CAROLINA.

POTENTIAL NUCLEAR POWER PLANT HAZARDS AND EMERGENCY RESPONSE CAPABILITIES

There is a massive amount of technical research published on the potential radioactive hazards associated with nuclear power plants. There is consensus among scientists, nuclear industry personnel, government officials and the public that the potential for real danger to public health and safety from an accident/incident at a nuclear power plant does exist.

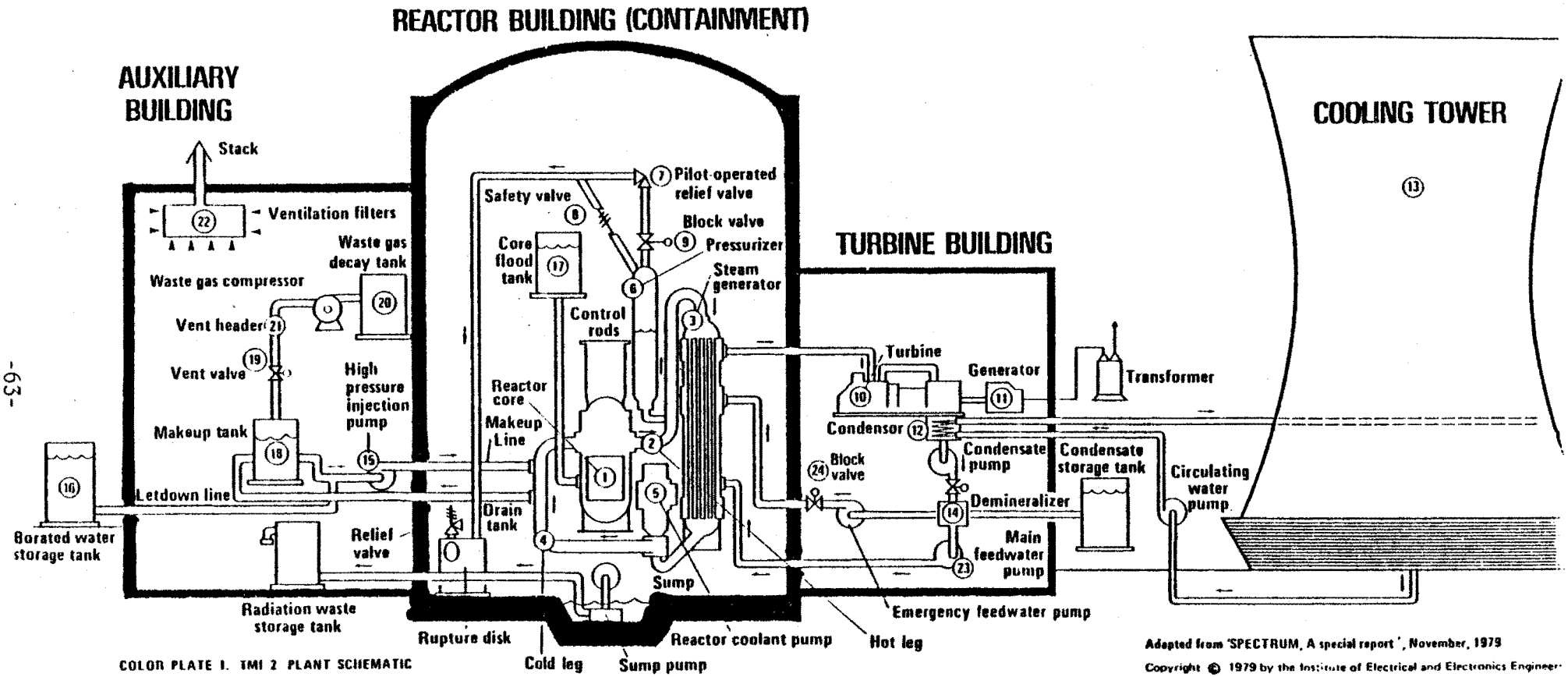
There are significant controversies in the scientific community and in the public regarding the likelihood of a major accident or incident occurring which would be a significant threat to public health and safety. There is also considerable controversy among scientists regarding the scope and duration of the hazardous effects of a major accident/incident involving a nuclear power plant.

The Audit Council has not attempted to analyze the statistical probabilities of the occurrence of a major nuclear accident/incident. Our focus has been merely to identify the types of potential hazards to public health and safety associated with the operation of a nuclear power plant. We also attempt to point out the areas where there is controversy about the danger of health hazard.

Figure 2 is a simplified diagram of a nuclear power plant. The basic principles of its operation are similar to coal powered electric generating plants. The nuclear fission activity that takes place inside the reactor vessel produces tremendous amounts of heat. The heat is used to produce the steam necessary for turning the turbines that produce electricity.

FIGURE 2

SIMPLIFIED DIAGRAM OF PRESSURIZED WATER NUCLEAR POWER PLANT REACTOR



COLOR PLATE I. TMI 2 PLANT SCHEMATIC

Adapted from 'SPECTRUM, A special report', November, 1979

Borated water is used as a coolant for the fission reaction by being circulated in a closed system around the nuclear fuel core. The most hazardous situation that can occur is for the fission reaction to burn out of control due to a loss of coolant accident (LOCA) or some other major failure in the control systems. Even under the worst accident conditions there is no possibility for a nuclear explosion to occur in a nuclear power plant which would be similar to the detonation of a nuclear bomb.

The hazards are from the possible release of an excessive amount of radioactive material from the plant. The release could be in the form of gas vented to the atmosphere or radioactive liquid could be released from the plant into the environment.

To date, no nuclear power plants in the United States have experienced an accident/incident which involved the release of radioactive material off the plant site in large enough quantity to be considered an immediate danger to public health.

The accident at the Three-Mile Island Nuclear Power Plant near Harrisburg, Pennsylvania in March 1979 has been described as the "worst" accident in the history of the nuclear power industry. The nuclear fuel core became partially uncovered due to a LOCA which resulted in a partial melting of the core. Subsequent analyses of the accident concluded that plant operators failed to correctly identify the specific nature of the accident until two days after it began. Because of this delay, a total melt-down of the nuclear fuel core came within 45 to 60 minutes of completion.

During the six days after the beginning of the accident both planned and unplanned releases of radioactive material occurred. The average radiation dose from March 28 to April 15, 1979 to a person

living within five miles of the plant was calculated to be approximately ten percent of annual background radiation and was probably less. There is a significant and hazardous amount of radiation in the buildings housing the reactors and its supporting equipment which is awaiting clean-up. This radiation poses a potential health hazard primarily to the personnel who will be involved in the clean-up operation.

There appears to be an even division among the scientific community regarding the threat to the public if a total core melt-down had occurred at the Three-Mile Island Plant. Some feel that a melt-down would necessarily cause a breech in the reactor vessel and containment structure by melting through the bottom and into the ground which would then cause a release of large amounts of radiation to the atmosphere. Others feel that the combination of the reactor vessel, the floor of the containment structure, and the solid rock under the structure are more than adequate to contain the radiation in the highly unlikely event of a melt-down penetrating the reactor vessel. The controversy regarding the consequences of a nuclear fuel core melt-down is one of longstanding.

The majority of research into the health effects of radiation has been in the area of high dose rates, primarily in assessing the effectiveness of atomic weapons. Less research has been conducted into the health consequences of low-level radiation. The Report of the President's Commission on the Accident at Three-Mile Island, commented that "The health effects of radiation dose levels of a few rems or less are not known."

One of the dangerous elements produced in large quantity during the accident was Iodine 131 (I_{131}). Only trace amounts were found to have been released to the outside which were in too small a quantity to

pose a threat to the local population. I_{131} has a radioactive half-life of ten days and after this period it decays to a non-hazardous element.

As an emergency preparedness measure, a crash effort was initiated to obtain substantial supplies of potassium iodide. Two hundred fifty thousand (250,000) bottles were delivered to Pennsylvania for possible emergency distribution to plant workers and the local population within two days after the decision was made. Potassium iodide can effectively block the absorption of I_{131} by the thyroid gland.

The blocking agent was not distributed to the local populace nor to any of the emergency workers at the plant site. Appendix 7 is a summary of the events and decisions relating to the potassium iodide.

The relevance of this event for South Carolina is that when the decision was made to obtain the iodide it was still not known that a partial melt-down had occurred. The potential for release of I_{131} was remote but nevertheless, underestimated because of the failure to accurately diagnose that a major accident was in progress. In retrospect, the decision not to distribute the iodide, even to plant emergency workers, might have been the same even with more accurate information.

The accident began on a Wednesday morning and the extensive core damage was not verified until Friday. That a melt-down had been in progress was not recognized until that point. The decision to order the iodide was made on Friday with first shipments arriving the following Sunday. The iodide was not available at all until five days after the accident began. For maximum effectiveness the iodide must be taken prior to ingestion of I_{131}. It will have some blocking effect if taken no more than three hours after ingestion of I_{131}.

South Carolina has no supplies of potassium iodide for distribution to emergency personnel or to the population in the vicinity of a nuclear facility. According to officials at the BRH, some supplies are maintained in Atlanta by the Food and Drug Administration for their Emergency Radiological Assistance Team (ERAT), but the State has no formal agreement as to when and how the supplies would be obtained if needed in an emergency. There are no provisions for emergency distribution of potassium iodide in the State's peace-time radiological emergency preparedness plan. There are no State provisions for distribution authority, liability, or distribution procedures.

In the absence of a readily available emergency supply of potassium iodide, emergency personnel who may encounter I_{131} could be unnecessarily exposed to a dangerous radiation dosage. Emergency operations may be delayed unnecessarily in the presence of I_{131} without a readily accessible emergency supply of potassium iodide.

By contrast, in the United Kingdom, there is more focus on preparing the local populace for radiation emergencies around nuclear power plants. There are heavy controls on land use. Evacuation plans and iodine pills are widely distributed.

The Audit Council concurs with the recommendations of the BRH staff that a small emergency supply of potassium iodide be maintained by the State.

Three major assessments of the Three-Mile Island accident were completed recently. One study was ordered by the President. The NRC commissioned a private firm for the second study, and the third study was conducted by a Commission established by the Governor of Pennsylvania. Each of the studies concluded that the major health effect of the accident "appears to have been on the mental health of the people living in the region..."

The following comment from the Governor's Commission summarizes the conclusions of the President's Commission.

> The TMI accident had a pronounced demoralizing effect on the general population of the TMI area... However, this effect proved transient in all groups studied except the workers, who continue to show relatively high levels of demoralization. Moreover, the groups in the general population and the workers, in their different ways, have continuing problems of trust that stem directly from the accident.

The summary of health effect findings in the report of the President's Commission included the following conclusions on the psychological stress.

> The major health effect of the accident appears to have been on the mental health of the people living in the region of Three-Mile Island and of the workers at TMI. There was immediate, short-lived mental distress produced by the accident among certain groups of the general population living within 20 miles of TMI. The highest levels of distress were found among adults a) living within 5 miles of TMI, or b) with preschool children; and among teenagers a) living within 5 miles of TMI, b) with preschool siblings, or c) whose families left the area. Workers at TMI experienced more distress than workers at another plant studied for comparison purposes. This distress was higher among the nonsupervisory employees and continued in the months following the accident.

Several studies are currently underway to provide better detail on the effects of the accident's psychological stress to the population surrounding the Three-Mile Island facility.

Much of the mental stress initially has been attributed to the widely conflicting and contradictory information provided to the public during the days of the accident. Due to a lack of candor, a lack of coordination, and the issuance of misleading information, public information officials soon lost credibility with the news media and the public. For example, within hours after the accident was declared "over" by

one official source, another official source initiated the evacuation of persons most susceptible to radiation injury within a five-mile radius of the plant.

South Carolina has no guidelines in its current medical provisions for radiological emergencies to provide initial emergency psychological treatment or counseling for mental stress incurred in the event of a major radiological accident/incident. However, the State Comprehensive Disaster Preparedness Plan, in Annex C-8, designates responsibility to the Department of Mental Health for providing psychological counseling assistance.

In addition to the potential hazards associated with an operating nuclear power plant, there are also hazards associated with inactive or decommissioned plants. The maximum operational life-span of a nuclear power plant is approximately thirty years. When the plant is retired it will be shut down and the nuclear fuel will be removed from the reactor core. The inside of the reactor vessel and certain auxiliary components will remain as a radiation hazard which must be secured from public access for an indefinite period if it is not completely removed.

There is a growing nationwide controversy about the issue of nuclear power plant decommissioning. The Federal Government has not yet established firm guidelines for methods of decommissioning, safety standards, security standards, nor funding mechanisms. Also, it has not been established which agencies (Federal, State or others) will bear responsibility for the decommissioned plants.

South Carolina currently has no comprehensive policy which addresses the issues and problems associated with decommissioning of nuclear power plants. An official of the State Public Service Commission stated

that the Commission has begun to review requirements for decommissioning, focusing on rate increases that may be needed for funding.

The State has one private nuclear plant which is "mothballed" or not fully decommissioned. It is the small experimental plant owned by the Carolinas-Virginia Nuclear Power Association which began operation in 1963 and began decommissioning in 1967. The plant is located near Parr, South Carolina on land owned by South Carolina Electric and Gas Company. The plant is fenced and locked and is posted to ward off trespassers. The BRH maintains a license on the plant and radiation monitoring equipment is located on the site's boundaries. The utility companies in the Association have sole responsibility for the plant.

RECOMMENDATIONS

THE GENERAL ASSEMBLY SHOULD REQUIRE THAT BRH ESTABLISH AN EMERGENCY SUPPLY OF POTASSIUM IODIDE AND FORMALIZE THE CRITERIA AND PROCEDURES FOR OBTAINING AND ADMINISTERING ADDITIONAL SUPPLIES SHOULD LARGE SCALE EMERGENCY POPULATION PROTECTION FROM I_{131} BECOME NECESSARY.

THE SOUTH CAROLINA PEACE-TIME RADIOLOGICAL EMERGENCY PREPAREDNESS PLAN SHOULD INCLUDE PROVISIONS FOR EMERGENCY PSYCHOLOGICAL TREATMENT AND/OR COUNSELING IN THE EVENT OF A MAJOR ACCIDENT/INCIDENT AT A FIXED NUCLEAR FACILITY.

THE GENERAL ASSEMBLY SHOULD CONSIDER ESTABLISHING AND FUNDING SPECIAL EDUCATION PROGRAMS FOR PERSONS LIVING WITHIN A TEN-MILE RADIUS OF FIXED NUCLEAR FACILITIES WHICH WOULD FAMILIARIZE PERSONS WITH RADIATION HAZARDS, EMERGENCY PREPAREDNESS PROCEDURES ESTABLISHED FOR THE VICINITY, AND INDIVIDUAL RESIDENTS' RESPONSIBILITIES. THESE CITIZENS SHOULD HAVE IDENTIFIED FOR THEM A CENTRAL INFORMATION SOURCE (SUCH AS BRH OR THE UTILITY) WHICH THEY CAN CONTACT AT ANY TIME THEY HAVE A QUESTION PERTAINING TO RADIOLOGICAL HEALTH OR SAFETY.

THE PUBLIC SERVICE COMMISSION AND THE BRH SHOULD DEVELOP JOINTLY A POLICY PROPOSAL FOR THE GENERAL ASSEMBLY TO CONSIDER IN DEVELOPING A STATE POSITION REGARDING DECOMMISSIONING OF NUCLEAR POWER PLANTS.

POTENTIAL RADIOACTIVE HAZARDS FROM NUCLEAR FUEL REPROCESSING AND RADIOACTIVE WASTE STORAGE

Introduction

This section first briefly discusses nuclear fuel reprocessing and its attendant potential hazards. It then discusses the different types, hazards and problems associated with radioactive waste storage focusing primarily on high-level waste. It concludes with the discussion of the Audit Council's review of the BRH inspection program at the Chem-Nuclear Services low-level radioactive waste burial facility.

Nuclear Fuel Reprocessing

The highly radioactive thin metal (zircalloy) rods containing nuclear fuel that is "spent" are sent to temporary storage in holding pools where they are allowed to cool for a period of several months. These spent-fuel rods may be sent to a Federal reprocessing facility such as the one at the Savannah River Plant (SRP). The rods are put through a chemical process which recovers radioactive elements that can be used in a variety of ways including for new fuel. Figure 3 is a simplified diagram of the nuclear fuel cycle taken from an international research project being conducted principally from Clark University in Worcester, Massachusetts. Table 3 provides the definitions used in identifying potentially catastrophic hazards which are presented in Figure 3.

FIGURE 3

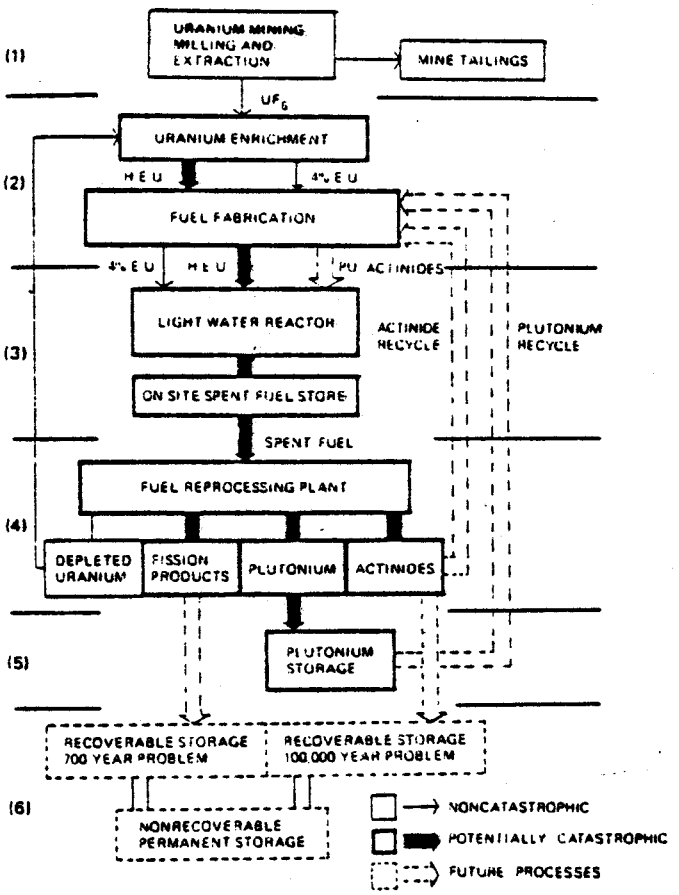


Fig. 3. The light water fuel cycle, showing portions currently operational and non-operational in the United States. The abbreviations E.U. and H.E.U. stand for enriched and highly enriched uranium, respectively.

Source: Page 30, "The Distrust of Nuclear Power," Hohenemser, Kasperson, Kates, Science, April 1977, Volume 196, pp. 25-34.

TABLE 3

Typology of catastrophic nuclear risks.

Key: T - theft; S - sabotage; and A - accident.

Fuel Cycle Stage	Hazard Type		
	Nuclear Explosion	Fission Product Release	Pu Dispersal
Mining, Milling, and Refining			
Enrichment and Fuel Fabrication	T	S,A	S,A
Light Water Reactor		S,A	S,A
Fuel Reprocessing	T	S,A	S,A
Plutonium Storage	T		S,A
Waste Disposal		S,A	S,A

The potential hazards relating to reprocessing are similar to those associated with the operation of a nuclear power plant; release of radioactive material in hazardous amounts through theft, sabotage, or accident.

Spent nuclear fuels are moved primarily by truck to SRP. In a typical year 109 shipments of spent-fuel will arrive at SRP by truck but only 10 spent-fuel shipments will leave by truck. The "typical" 99 shipments which remain are an indication of the volume of reprocessing that takes place there.

SRP is a facility managed by the Department of Energy where the main responsibility is to prepare materials for the national defense program. For this reason, details of activities, security practices, volumes of radioactive materials and related information is classified and not available to the State.

A commercial nuclear fuel reprocessing facility was built outside of Barnwell by Allied-General Nuclear Services, Inc. (AGNS). However, due to decisions by former President Ford and President Carter to delay commercial reprocessing, this plant has not been licensed to conduct reprocessing operations. It has received Federal funding to conduct research relating to (1) spent-fuel transportation, receiving, handling, and storage; (2) security and safeguards; and (3) alternative fuel cycles.

Only one commercial nuclear fuel reprocessing facility has ever operated in the United States; the plant in West Valley, New York owned by West Valley Fuel Services, Inc. It operated intermittently from 1966 to 1972 when it was closed permanently. Its operation had been halted periodically by technical problems or by legal suits brought by local residents and concerned scientists protesting that the plant's operation caused health and pollution hazards.

Reprocessing is considered the largest single source of high-level radioactive waste which has no further potential for recovery of useful materials. It must be stored securely. The closed plant at West Valley, New York has 600,000 gallons of high-level radioactive waste stored at the site in underground steel tanks.

Radioactive Waste Storage

The potential hazards associated with storage of radioactive waste are essentially the same as those associated with nuclear power plants and nuclear fuel reprocessing; release of a dangerous quantity of radioactive material to the environment. There are different types of radioactive waste which have their own unique requirements for safe storage and which present different types and levels of potential hazard.

The Audit Council has divided the types of waste into four categories based on current storage practices and plans.

(1) Permanent Storage

Defined as storage of waste materials in a manner and place that, by design, prevents future retrieval or moving of the material. The waste is intended to remain in this storage environment at least until it has experienced enough normal radioactive decay so that it no longer presents a radiation hazard. Low-level radioactive waste burial facilities are the only storage sites in this category. The Chem-Nuclear burial facility near Barnwell is a commercial site and one of only three (the others are federally operated) in the United States.

No permanent storage method for high-level radioactive waste has yet been developed and implemented. High-level wastes are stored in semi-permanent tanks at Federal facilities; the West Valley, New York tanks; or are being held at short-term or interim storage sites.

(2) Short-Term Storage

When spent-fuel is removed from a reactor core to make room for new fuel rods, it is placed in cooling pools at the reactor site or another reactor site. It is stored in a manner convenient for retrieval and transfer to another site. Initial design of these ponds assumed that the spent-fuel would stay no more than six months and then be transferred to a reprocessing facility. With the ban on reprocessing, short-term storage sites at many reactors

are becoming full and are taking on the characteristics of interim storage.

Short-term storage also refers to storage of all other radioactive materials at or near the site where the material is produced pending transfer to more permanent storage. It includes low-level waste such as gloves, booties, coveralls, and test sources.

(3) Interim Storage

Indefinite temporary storage of radioactive spent-fuel and other high-level waste while policy is being developed to either proceed with fuel reprocessing or transfer the waste material to a permanent storage site. The cooling ponds at reactor sites are being utilized as interim storage. The NRC has approved new storage configurations of spent-fuel rods which can significantly increase the holding capacity of the cooling ponds.

(4) Long-Term/Semi-Permanent

To date this type of storage facility does not exist. The Federal Government has been exploring methods for permanent underground storage of solidified high-level radioactive waste. The material would be stored in containers and in a configuration that would allow retrieval, transfer, and inspection of containers. The most recent efforts are focused on the feasibility of constructing a semi-permanent geological storage facility inside huge salt domes located in remote unpopulated areas.

This has been a highly controversial national and international policy issue primarily because the radioactive half-life of some isotopes are measured in tens and hundreds of thousands of years.

There is uncertainty as to whether the techniques, storage containers, and security mechanisms which could be implemented with current technology would be sufficiently durable to guarantee security of the stored waste for future generations.

Below are definitions of the three types of radioactive waste which would be included in this type of storage. The definitions are from a report by the General Accounting Office.

> High-level waste - has extremely high radioactivity - as much as 10,000 curies*** per gallon. This waste is characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life. High-level waste is created when reactor spent-fuel elements are dissolved in acid to recover unused uranium and plutonium for reuse as nuclear fuel. It is the acid solution remaining that is referred to as high-level waste. It contains virtually all the fission products**** and small amounts of transuranics - such as plutonium - which are not recovered during the reprocessing operations. It is one of the most hazardous and complex of all radioactive wastes to manage.
>
> Transuranic contaminated waste** - contains much lower concentration of radioactivity than high-level waste. It is generated by plutonium fuel fabrication and fuel reprocessing facilities and laboratories using transuranic elements. This waste generally consists of absorbent tissues, clothing, gloves, plastic bags, equipment, filters from effluent treatment systems, and fuel hulls which remain after fuel reprocessing.
>
> Spent-fuel - contains all the fission and transuranic elements that are found in high-level waste and all

---

**Transuranic elements are man-made, long-lived, and extremely toxic. These elements - such as plutonium - are created during the normal nuclear reaction process. They are found in several nuclear fuel cycle operations and are contained in nuclear waste in varying concentrations.

***Curie - a measure of the quantity of radioactive material. See glossary.

****Fission products - those isotopes formed during the nuclear reaction process that are not part of the transuranic elements. Some of these isotopes are hazardous for hundreds of years.

the uranium and plutonium not used during the nuclear reaction. Spent-fuel is characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life.

Low-level wastes, such as those stored at Chem-Nuclear fuel services are solid and may not contain transuranic contamination in excess of 10 nanocuries (1 nanocurie = 1 billionth of a curie) per gram of material.

The hazards to public health and safety posed by radioactive waste storage should be viewed from two perspectives, short-range and long-range.

The short-range radiation hazards will arise if a large enough quantity of the material escapes into the environment and contaminates soil and/or water. A high level of contamination would present an immediate hazard in the unlikely event of a major break in a storage tank.

The long-range radioactive hazards derive from the uncertainty of the effective life span of waste storage systems. Numerous older storage tanks have developed many cracks and leaks in their primary walls. Some radioactive wastes will remain hazardous for hundreds of thousands of years. Bearing directly on this problem is the following summary of criticisms made by the General Accounting Office in a September 1977 report on the problems of radioactive waste disposal. These problems still are being discussed and solutions are being sought but have not been resolved. The GAO found:

- Gaps in Federal laws and regulations governing the storage and disposal of nuclear waste.
- Geological uncertainties and natural resources trade-offs encountered when selecting "permanent" disposal locations.

- Lack of the Nuclear Regulatory Commission regulatory criteria for orderly waste management operations, such as solidification of waste, designing proper waste containers, and transporting nuclear waste.

- Overly optimistic schedules for demonstrating the safety of the Energy Research and Development Administration's proposed waste disposal locations and waste management practices.

- Lack of demonstrated technologies for the safe disposal of existing commercial and defense high-level waste.

Over 21 million gallons of high-level radioactive waste are stored at the SRP. There are two nuclear power plants owned by utility companies in operation in South Carolina which are filling their temporary spent-fuel storage capacity and must transfer the fuel rods to holding pools at other plants.

Other than coordination with State officials for security of the civilian movements of spent-fuel, the State has had little involvement with security and safety measures for high-level radioactive waste either for short-term considerations or for long-term considerations.

The State's emergency response capability is not geared specifically for hazards involving stored radioactive waste. The State Plan does contain provisions for emergency warning and evacuation. However, the State has no formal mechanism or policy regarding guaranteed long-term safeguards against public health and safety hazards which potentially may arise from the semi-permanent storage of high-level waste at SRP and elsewhere. This is unusual when contrasted with the carefully detailed planning and monitoring which has frequently characterized the State's preparation for storage of the much less hazardous low-level radioactive waste at the Chem-Nuclear storage facility.

Low-level Radioactive Waste Burial at the Chem-Nuclear Systems, Inc. Site

Since May 1971 when burial of low-level radioactive waste began at Chem-Nuclear, through September 1979, 8,984,496.50 cubic feet of waste material have been buried there. The activities of the burial facility are covered under DOT regulations, NRC regulations, and State regulations in addition to the conditions of the firm's State license.

The types of hazards associated with this facility, as with high-level wastes, may be divided into short-term and long-term categories. The short-term potential hazards have to do with improper packaging or handling of the waste prior to burial which may result in a dangerous exposure to the public or employees or the spread of contamination in an accident on or off the site.

The long-term hazards are related to possible degradation of the burial trenches which could possibly permit leakage of radioactive material into the ground. Erosion of the surface soil over a closed trench could result in unhealthy levels of radiation at the trench surface.

The BRH maintains two types of inspection programs at Chem-Nuclear. One program involves the inspection of operations and health and safety related management practices at Chem-Nuclear. Comprehensive semi-annual (announced and unannounced) inspections are conducted which include (1) review of the health records and radiation dosage records of all employees and the record-keeping practices, (2) radiation health safety practices, (3) physical inspection of burial trenches and decontamination facilities, (4) checks for corrective action taken to remedy problems cited in previous inspections, and (5) other areas related to radiation health and safety and compliance with all applicable regulations and license conditions. Unannounced inspections and daily routine observations

are made by BRH inspectors assigned to the site on a rotating basis. In addition, environmental surveillance equipment is located on and around the site.

These inspections have two categories of findings "items of non-compliance" and "violations." A violation is cited when the problem is of such nature and magnitude that public health and safety are jeopardized.

The BRH has authority to levy fines and if "willful violations" are found to exist they may result in a jail sentence. BRH has very strong regulatory authority at Chem-Nuclear which includes adding amendments to the license conditions when circumstances warrant.

In the past there have been no Federal Regulations or criteria for burial of low-level radioactive waste. The NRC is in the process of promulgating such regulations and they are based primarily on the license conditions established by the BRH for the Chem-Nuclear facility.

The second inspection program maintained by the BRH at Chem-Nuclear is the inspection of each waste shipment that arrives at the facility. The inspectors have the authority to forbid burial of material which violates the license conditions or require further security measures such as decontamination, further solidification, or additional packing material. Certain shippers have been denied temporarily the right to send their waste to Chem-Nuclear because of excessive violations and unsafe packaging. Shipments have been resumed after the shippers have certified to the BRH that they have improved the radiation safety of their shipping and packaging procedures.

The Audit Council observed the inspections of several shipments and reviewed the records of all inspections of shipments made from 1975 through December of 1979. In April of 1979 the BRH increased the

volume of inspections significantly. It was not until October of 1979 that the BRH established the policy of inspecting every shipment every day prior to entry into the burial facility. The yearly total of shipment inspections is shown in Table 4 below.

TABLE 4

Year	Number of BRH Inspections at Chem-Nuclear
1975	2
1976	0
1977	24
1978	32
1979	2,948

Of the 2,893 inspections conducted from April through December of 1979, a total of 394 discrepancies or violations were noted in the BRH records. One hundred fifty-nine (159) of these were of a serious nature with the potential for posing a health or safety hazard to the public. These were reported to the shipper and to the NRC for corrective action.

The Audit Council's review of the April to December 1979 inspections distinguished between discrepancies and serious violations. As a measure of the effectiveness of the inspection program, Table 5 shows that as the volume of inspections increased, the number of serious violations tended to decline. Figure 4 displays this data graphically.

TABLE 5

DISCREPANCIES FOUND ON INSPECTION OF SHIPMENTS AT CHEM-NUCLEAR SYSTEMS, INC.

April-December 1979

	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	TOTAL
Number of Inspections	294	533	434	403	239	38	118	461	373	2,893
Number of Discrepancies/ Remarks Found in Examining BRH Log at Chem-Nuclear	28(1)	103	56	65	42	2	15	55	28(2)	394
Number of Discrepancies Serious Enough to be Reported to NRC	36	35	25	23	17	3	1	11	7	158(3)

(1) Due to method of record-keeping of discrepancies found on-site at Chem-Nuclear, some discrepancies were missed and not recorded.

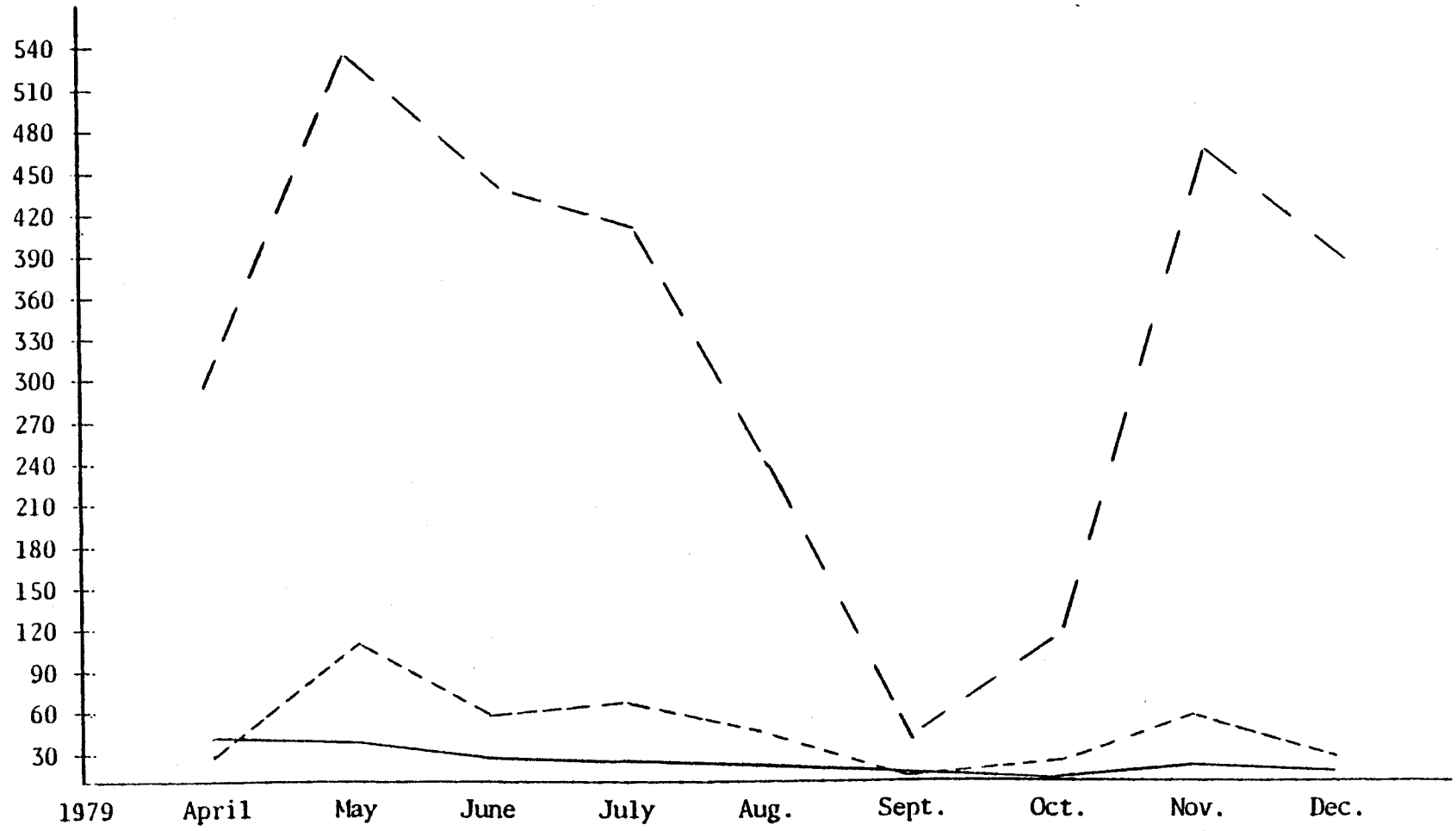
(2) Discrepancies/remarks found in December were only for December 1-17, 1979.

(3) A total of 159 discrepancies were reported. One discrepancy report was not dated.

FIGURE 4

VOLUME OF BRH INSPECTIONS AND DISCREPANCIES FOUND IN SHIPMENTS

TO CHEM-NUCLEAR RADIOACTIVE WASTE BURIAL FACILITY



— Number of inspections.
--- Number of discrepancies/remarks.
—— Number of discrepancies reported to NRC.

The types and number of violations found during these inspections are listed below:

- Free-standing liquids in cask or container (27 violations)
- Violations resulting in insecure cask or trailer (21)
- Trailer or package contamination (17)
- Placard or labeling violation (17)
- Missing or loose bolts on cask (9)
- Material not packaged in strong, tight package (9)
- Shipment forms inaccurate (9)
- Excessive radiation levels (9)
- Improper sealing of cask or container (5)
- Visible leakage of container (4)
- Lid on drum not properly fastened (4)
- Improper container for type of material (4)
- Package damage (4)
- Improper loading of trailer (2)
- Shipping cask did not meet NRC certification (2)
- Stripped threads on cask bolts (2)
- Offloading discrepancies (2)
- Other (12) (Violations reported only once to NRC.)

The Audit Council's review of the BRH inspections of shipments to Chem-Nuclear and the inspections of operations found that these inspection programs are important deterrents to unsafe practices. As was discussed and recommended in the transportation section earlier, we feel that the BRH and the General Assembly should take action to ensure that the

State maintains a rigorous inspection program for hazardous materials including an inspection of each radioactive waste shipment sent to Chem-Nuclear.

The BRH inspectors have neither the authority nor the expertise to look for serious safety violations of DOT regulations. For example, they do not inspect brake systems of trucks arriving at Chem-Nuclear. However, they have reported obvious safety violations such as worn tires and cracks in the chassis to the shipper or the motor carrier's home office. This would be a convenient area for Public Service Commission transportation inspectors to expand their inspections of radioactive materials' shipments while receiving training from the BRH in monitoring for excessive radiation.

Audit Council recommendations regarding the inspection program are cited on pages 41 and 71.

POTENTIAL HAZARDS ASSOCIATED WITH NUCLEAR MATERIALS FABRICATION AND OTHER ACTIVITIES INVOLVING RADIATION HAZARDS

Fabrication

The Savannah River Plant carries out fabrication activities for the nation's nuclear weapons program. The hazards to public health and safety from these processes are essentially the same as presented by fuel reprocessing, reactor operation, and waste storage, discussed previously. The threat resulting from sabotage or terrorist activity may be greater in this area because of the potential strategic value of nuclear weapons components, especially components containing plutonium.

As part of the security requirements for the national defense effort, the State does not have access to fabrication activities nor to shipping information about defense-related materials.

The Westinghouse Corporation has a nuclear fuel fabrication plant located near Columbia. The plant receives uranium hexaflouride which is chemically processed into nuclear fuel pellets. The pellets are hand-loaded into the fuel rods at the plant and the rods are shipped to nuclear reactors in South Carolina and elsewhere.

The most significant radiation hazard associated with fuel fabrication is the potential for workers inside the plant to ingest airborne contamination. This facility is licensed and inspected by the BRH. The Bureau also maintains airborne contamination samplers and film badges around the plant site in order to detect any releases of radiation. No hazardous releases have been detected in the plant's history and no contamination accidents involving radiation injury to employees have been reported.

Other Sources of Radiation Hazard

The other sources of radiation in the State are varied and widely dispersed around the State. Most of these sources are used in minute amounts in medical treatment, scientific research or industrial applications, which under certain circumstances could present a hazard to an individual if mishandled. However, they are not considered as being a potential hazard to public health and safety which could involve a large radiation dose to an individual or to a large geographic area.

The management of the BRH, however, unhesitatingly identifies the potential public health hazard from misuse of x-ray equipment as a greater threat than the potential hazards associated with the nuclear power industry. They consider the potential radiation hazards from a transportation accident as the second worst potential radiation danger.

The BRH staff pointed out that until 1969 there were no State regulations or licensing requirements for operation of x-ray equipment. Although BRH now is responsible for registration and inspection of x-ray equipment facilities and their operation, they continue to find problems relating to inadequate training of operators and inadequate shielding to protect the public. Because of regular exposure the health hazards tend to be greater for workers in the vicinity of inadequately shielded x-ray equipment than for patients who seldom are in the same area.

Since the potential hazards in this area are not of a magnitude to warrant a mobilization of the State's emergency preparedness agencies, they were not reviewed by the Audit Council. However, this is another area where the State's licensing and inspection program, conducted by the BRH, is an important safeguard for public health.

SECTION THREE

SUMMARY OF ACCIDENTS/INCIDENTS INVOLVING RADIOACTIVE MATERIAL IN SOUTH CAROLINA

Introduction

This section discusses the nuclear related accidents/incidents that have occurred in South Carolina and what response measures were taken. It also briefly discusses the State's budget for emergency preparedness and the costs associated with accidents/incidents.

Types and Numbers of Radiological Accidents/Incidents in South Carolina 1965-1979

State record-keeping for nuclear accidents/incidents began in February 1965. The State's nuclear emergency response plan requires that the BRH be notified of any emergency involving radioactive materials. If circumstances warrant, the Emergency Radiological Assistance Team (ERAT) will be dispatched to the scene. Appendix 8 shows the chain of command for response to a disaster as outlined in the State Plan.

In addition, the Bureau of Radiological Health has developed radiation exposure guides for protective action which require notifying the BRH of incidents involving exposure of 2 mr./hr. or more to the whole body. At this level of exposure potential harm to public health and safety could occur. Protective action guides, however, have not yet been developed by the BRH for contamination levels. Therefore, determining those incidents which could pose a potential threat to the public health is determined by the BRH on a case-by-case basis. Currently, the BRH uses DOT contamination limits to assess whether a radiological

incident could be hazardous to the public. These limits currently are 220 dpm/cm^2 for beta/gamma radiation and 22 dpm/cm^2 for alpha contamination, or a surface radiation limit of 200 mr./hr.

Through December 1979, 104 non-military nuclear accidents/incidents have been reported to and investigated by the BRH. This number represents 63 incidents that were potential radiological hazards to public or worker health and safety. Thirty-one incidents were reported to which the Bureau of Radiological Health (BRH) responded but which posed no radiological hazard to the public. Ten incidents were reported which did not require a response by the BRH.

Of the 104 reported incidents, only 33 incidents directly involved South Carolina radiological material licensees. The following chart indicates the number of incidents reported each year from 1965 through 1979.

Year	Number of Incidents Reported**	Number of Incidents Which Posed a Potential Radiological Hazard to the Public or Workers	Number of Incidents Involving Licensees
1965	1	1	-*
1966	1	1	-*
1967	2	2	-*
1968	2	2	-*
1969	3	2	0
1970	3	2	1
1971	7	7	5
1972	8	2	3
1973	4	4	0
1974	3	2	1
1975	8	5	1
1976	9	2	5
1977	16	6	4
1978	21	15	7
1979	16	10	6
TOTAL	104	63	33

*BRH did not begin licensing for possession, use, etc. of radioactive materials until 1969.

**The increase in incidents tends to correspond with the increased activity involving radioactive materials in South Carolina.

Of the 104 incidents on file with the BRH, 10 incidents were reported to which no radiological hazard to the public health and safety existed and for which no response by the BRH was necessary other than to remain on standby alert for possible action. The following types of incidents posed no radiological hazard to the public:

- Radioactive shipments reported lost, abandoned or on the wrong designated route (3 incidents)
- Bomb threats and earth tremors in areas around nuclear facilities (2)
- Accidents reported to involve radioactive material (2)
- Dosimeters off-scale (1)
- Fire at a nuclear facility (1)
- Reported Civil Air Patrol/Disaster Preparedness Agency exercise (1)

Thirty-one incidents were reported from 1969-1979 which were investigated by the BRH with radiation surveys or smears taken which showed no radiation above normal background levels. These incidents posed no radiological hazard to the public health and safety. Included in these incidents were the following:

- Loss/theft of radioactive materials (7 incidents)
- Accident involving radioactive shipments (6)
- Inadequate or damaged packaging in transportation of radioactive materials (5)
- Material found labeled contaminated or radioactive (4)
- Reported radiation in landfill (2)
- Radioactive material spilled (2)
- Suspected contamination of air or water supply (2)
- Birth defect in puppies thought caused by radiation (1)
- Injured worker thought contaminated in an accident (1)

- Radiation emissions suspected from induction heat generator (1)

The remainder of incidents (63) reported to and investigated by the BRH involved radiation measures above background radiation levels of .01 mr./hr. Although 63 incidents were reported with radiation levels above background readings, only a small portion of those incidents posed a potential radiological hazard to the public health and safety. A greater number posed a radiological hazard to workers in the immediate vicinity or handling the materials.

Using the above guides for assessing the potential radiological hazard to the public health and safety, the following types of incidents were reported which resulted in individual exposure to radiation levels in excess of 2 mr./hr.:

- Radiography overexposure (7 incidents)
- Dosimeter/badge overexposure (3)
- Exposure to staff member during treatment of hospital cancer patients (1)
- Accidental radioactive release (1)
- Overexposure at nuclear power facility (1)
- Contamination in university laboratory experiment (1)
- Radioactive material spilled (1)

Of these 15 incidents, none posed a potential radiological hazard to public health and safety. Ten incidents, however, either resulted in exposures above acceptable limits to workers handling radioactive materials or posed a potential radiological hazard to these workers.

Contamination levels of 220 dpm/cm^2 or radiation levels of 200 mr./hr. were exceeded in 5 incidents of the following description:

- Low-level waste container contamination (3 incidents)
- Contamination from radium source (1)

- Contaminated clothing from faulty packaging of radioactive materials (1)

While one of these contamination incidents did pose a potential hazard to public health and safety from possible ingestion of radioactive particles, no radiation injuries were reported. Four of the incidents posed an occupational hazard to workers handling or transporting the radioactive materials.

In addition to the above incidents which exceeded acceptable standards of radiation exposure or contamination, an additional 43 incidents were reported in which either radiation measures did not exceed protective action guides or DOT limits or radiation measures were not specified in the reports in the above stated form. These incidents, which did not pose a significant radiological hazard to the public, included the following:

- Radioactive shipments leaking or contaminated, inadequate containers (8 incidents)
- Transportation accidents (7)
- Unplanned release from nuclear facility into air or water supply (5)
- Radium leakage from source, radium contamination (6)
- Tritium or other radioactive material contamination (3)
- Radioactive shipment received by mistake, wrong order (2)
- Radioactive source lost/stolen, then found (2)
- Radioactive material found (2)
- Radiography incident (2)
- Contaminated workers (2)
- Nuclear laundry overflow into sewer (1)

- Overexposure investigation in hospital treatment of patients (1)
- Condensation atop radioactive waste containers (1)
- Fire involving radioactive materials (1)

According to officials at the BRH, seven of the above incidents had the potential to become a radiological hazard to public health and safety although public health was never actually jeopardized. Seven of these incidents posed an occupational radiation hazard to the workers handling radioactive materials.

For the incidents which involved radiation measures above background levels which had the potential for presenting a radiological health hazard to the public, one or more members of the BRH Emergency Radiological Assistance Team (ERAT) responded upon notification of each incident. Response times varied from arriving at the scene of the incident within one hour of notification to investigating one and one-half months after notification at a scheduled licensee inspection. The Peacetime Radiological Emergency Response Plan outlines procedures for notifying the BRH of an incident based on the severity of the incident and ranges from notifying immediately to notifying within 30 days of the incident. Response from the BRH to the incident is determined according to the magnitude of the incident.

Once the ERAT arrived at the scene, responses varied based on the nature of the incident. Typical responses included taking radiation surveys, smears or air and water samples to determine if potential radiological hazards to the public existed, monitoring personnel, supervising decontamination procedures when needed, inspecting shipments, giving training to prevent reoccurrence of incidents, impounding or disposing of sources, reprimanding for late notification, assisting in

locating lost or stolen sources and advising on additional actions to be taken.

None of the incidents reported to the BRH have required implementing the Peacetime Radiological Emergency Response Plan. However, in several instances the BRH was assisted by other State agencies and local agencies and organizations in handling reported radiological incidents. None of the reported incidents has resulted in a radiation casualty.

Budget and Cost Factors Relating to Nuclear Emergency Preparedness

The Audit Council reviewed the State's budgetary commitment to emergency preparedness at both the State and local level from FY 77 through FY 80. Total funds for overall emergency preparedness have declined, although the support for nuclear emergency preparedness has increased slightly in certain areas. This increase, however, has not been commensurate with the growth of nuclear industry in the State.

In general, the adequacy of the State's emergency preparedness is determined by the emergency response capability at the local level. Emergency personnel at the local level, are almost always the first officials to become involved when a hazardous situation arises. The quality of their training, degree of experience and availability of equipment are important factors in determining the effectiveness of their immediate actions. The availability of funds at the local level necessary to maintain high standards of emergency preparedness has declined significantly in recent years. Table 6 summarizes the sources and expenditures of emergency preparedness funds for FY 77 through FY 80.

TABLE 6

FUNDING AND EXPENDITURES FOR EMERGENCY PREPAREDNESS, FY 1977-FY 1980[1][2]

Recipient of Funds	Source of Funds	FY 1977		FY 1978		FY 1979		FY 1980	
		Budgeted	Expended	Budgeted	Expended	Budgeted	Expended	Budgeted	Expended[3]
Emergency Preparedness Division, Adjutant General's Office (formerly Disaster Preparedness Agency)	State Appropriations	317,881	243,415	329,920	261,690	211,567	205,353	209,299	-
	Federal Funds	998,584	969,618	538,600	489,476	489,869	433,161	536,249	-
Bureau of Radiological Health, Department of Health and Environmental Control	State Appropriations	249,062	215,654	263,535	265,933[4]	301,229	300,606	419,965	-
	Federal Funds	36,464[5]	36,464	35,040	33,754	57,274	28,794	96,329	-
Federal Funds Funneled Through EPD to Counties and Cities	Federal Funds	674,352	676,169[6]	463,138	490,710[6]	509,470	503,938	461,435	-
City and County Funds for Emergency Preparedness[7]	Local Funds	674,352	676,169	463,138	490,710	509,470	503,938	461,435	-
TOTALS	Federal, State, Local Funds	2,950,695	2,817,489	2,093,371	2,032,273	2,078,879	1,975,790	2,184,712	-

See notes attached.

TABLE 6 (CONTINUED)

Notes:

(1) Information obtained from the Emergency Preparedness Division (EPD), Department of Health and Environmental Control, Governor's Office-Division of Administration and State Budget documents.

(2) Figures for State Appropriations are based on the State fiscal year beginning July 1 and ending June 30. Federal funds are based on the Federal fiscal year beginning October 1 and ending September 30.

(3) Figures for expenditures for FY 80 will not be available until the end of the Federal and State fiscal years.

(4) Total State funds expended exceeded State funds appropriated. Overexpenditure was covered by State funds not expended in other divisions within the Department of Health and Environmental Control.

(5) DHEC records showed Federal funds budgeted at $15,465. However, a grant awarded during the fiscal year from which funds were expended was not shown in this figure. The total award figure was unavailable. Therefore, Federal funds budgeted and expended are shown to be equal.

(6) The figure for budgeted Federal funds to cities and counties reflects the amounts initially allocated. However, during the year the EPD shifted some Federal funds originally allocated to its office for personnel and administration to the counties for personnel and administration. Therefore, expenditures exceeded original allocations in FY 77 and FY 78.

(7) Actual figures for funds budgeted and expended by cities and counties for emergency preparedness were not available. However, all Federal funds to the local governments were provided on a 50-50 match basis. Therefore, the cities and counties budgeted and expended at least equal funds to those received from Federal sources.

During this period emergency preparedness at the State level has been reorganized and streamlined in ways designed to improve efficiency and effectiveness. This restructuring has resulted in cost savings with improved efficiency and effectiveness and is undergoing continued scrutiny by the Governor's Task Force. However, as reported by the Governor's Task Force and the Joint Legislative Committee on Energy, reduction in funds at the local level has hampered efforts to improve emergency preparedness which already was considered marginally adequate at best.

It is a very difficult task to establish a priority of needs for funding emergency preparedness on a statewide basis. However, in order to ensure that emergency preparedness measures are adequate to protect public health and safety, this type of planning must be done. The Audit Council emphasizes that preventive measures, such as good licensing, inspection, and training programs, can be efficient, effective and economical aids to emergency preparedness. Therefore, these programs must receive thorough consideration as a part of overall emergency preparedness.

Another consideration involves examining the past impacts and numbers of persons affected by known disasters. For example, natural disasters such as tornadoes and hurricanes have regularly caused hundreds of persons to be temporarily displaced or homeless in South Carolina history. Consequently, preparations for these types of disasters include accumulating blankets, food, clothing, and predesignating emergency shelters on a similar scale.

Attempting to assess potential economic impacts of disasters is another way of developing a perspective for establishing funding priorities. Table 7 is a summary of the estimated costs of the accident at the Three-Mile Island Nuclear Power Plant developed from a report by the Pennsylvania Governor's Commission on Three-Mile Island.

TABLE 7

ESTIMATED SHORT-TERM AND LONG-TERM COSTS OF THE ACCIDENT AT THREE-MILE ISLAND

Economic Impacts of the Accident at Three-Mile Island[1]		Short-term Costs[2]	Projected Long-Term Costs[3] Minimum	Projected Long-Term Costs[3] Maximum
Evacuation		$ 9,800,000	-	-
Manufacturing Sector	Average Loss in Value of Production	8,000,000	-	-
	TMI-related Unemployment Compensation	118,750	-	-
	Losses to Milk Juggers	60,000	-	-
Non-manufacturing Industries	Immediate Loss in Value of Output	74,000,000	-	-
	SBA Loans to Businesses in TMI-Area	510,000	-	-
Tourism		5,000,000	-	-
Residential Housing		-	-	-
Liabilities Arising from TMI Accident		1,306,055	$ 1,306,055	$ 560,000,000
Costs to Utility	Cost for Replacement Power	320,000,000[4]	576,000,000	1,644,000,000
	Plant Stabilization, Decontamination Preparations, Monitoring Radiation Exposure, TMI Investigations	110,000,000	-	-
	Expenses for TMI-2 Removed From Utility Rate Base and Not Passed to Customers	80,000,000[5]	-	-
	Replacement of Electric Generating Capacity	-	249,000,000	1,417,000,000[6]
TOTAL[7]		$608,794,805	$826,306,055	$3,621,000,000

(1) Source of information was the Report of the Governor's Commission on Three-Mile Island, Pennsylvania, February 26, 1980.
(2) Short-term costs for April 1979 through January 1980.
(3) Long-term costs represent those costs that might be incurred in coming months and years.
(4) Ten months @ $32 million a month.
(5) Ten months @ $8 million a month.
(6) Includes cost for decommissioning TMI-2, if not refurbished.
(7) Total costs must not be considered to be inclusive of all costs for the accident at TMI. Studies are still underway to determine the economic impacts and will not be completed for several years. These figures should be used only as indicators of the range of costs for a major nuclear accident.

The State has not developed a comprehensive policy for funding and budgeting for nuclear emergency preparedness nor has this been done for general emergency preparedness. In the absence of such a policy deficiencies have developed in the level of preparedness, especially at the local level. Although the existing deficiencies are relatively minor, funding support is declining and the level of potentially hazardous activity is increasing dramatically as the State continues its rapid industrial growth. For example, the State has 13 nuclear reactors including three operational, four on standby, and one decommissioned at SRP. There are four operational reactors at private utilities and the "mothballed" reactor at the Parr plant. Six more reactors for nuclear power plants are under construction. In addition, there is an unknown number of nuclear reactors in the State's ports associated with the nation's nuclear submarine fleet.

The increasing volume of potentially hazardous activity in the State will require the General Assembly to develop a policy, as outlined on page 8 of this report, to adequately protect the health and safety of South Carolina citizens.

APPENDICES

APPENDIX 1

South Carolina House of Representatives
P.O. BOX 11867 • COLUMBIA, S.C. 29211 • TELEPHONE 758-5240

April 17, 1979

Mr. Robert S. Small, Jr., Chairman
Legislative Audit Council
P. O. Drawer 10287
Greenville, South Carolina 29603

Dear Mr. Small:

The recent accident at the nuclear power plant in Pennsylvania revealed that there can be significant problems relating to the capabilities of a State to respond effectively in protecting lives and property when such accidents occur.

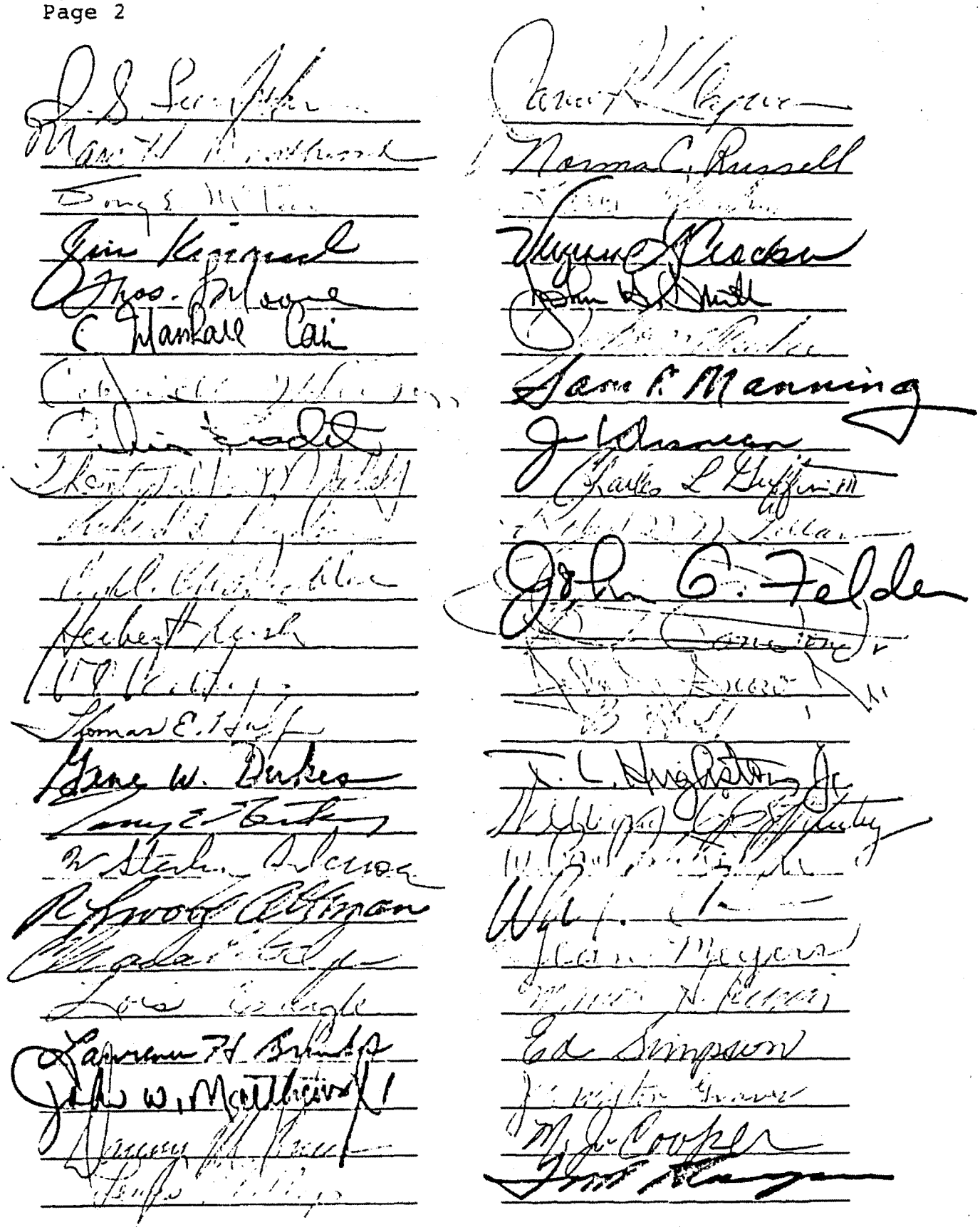
In view of the concentration of nuclear facilities in South Carolina, we are requesting that the Legislative Audit Council undertake a comprehensive review of these issues as soon as practicable and provide a report in time for the next legislative session to consider.

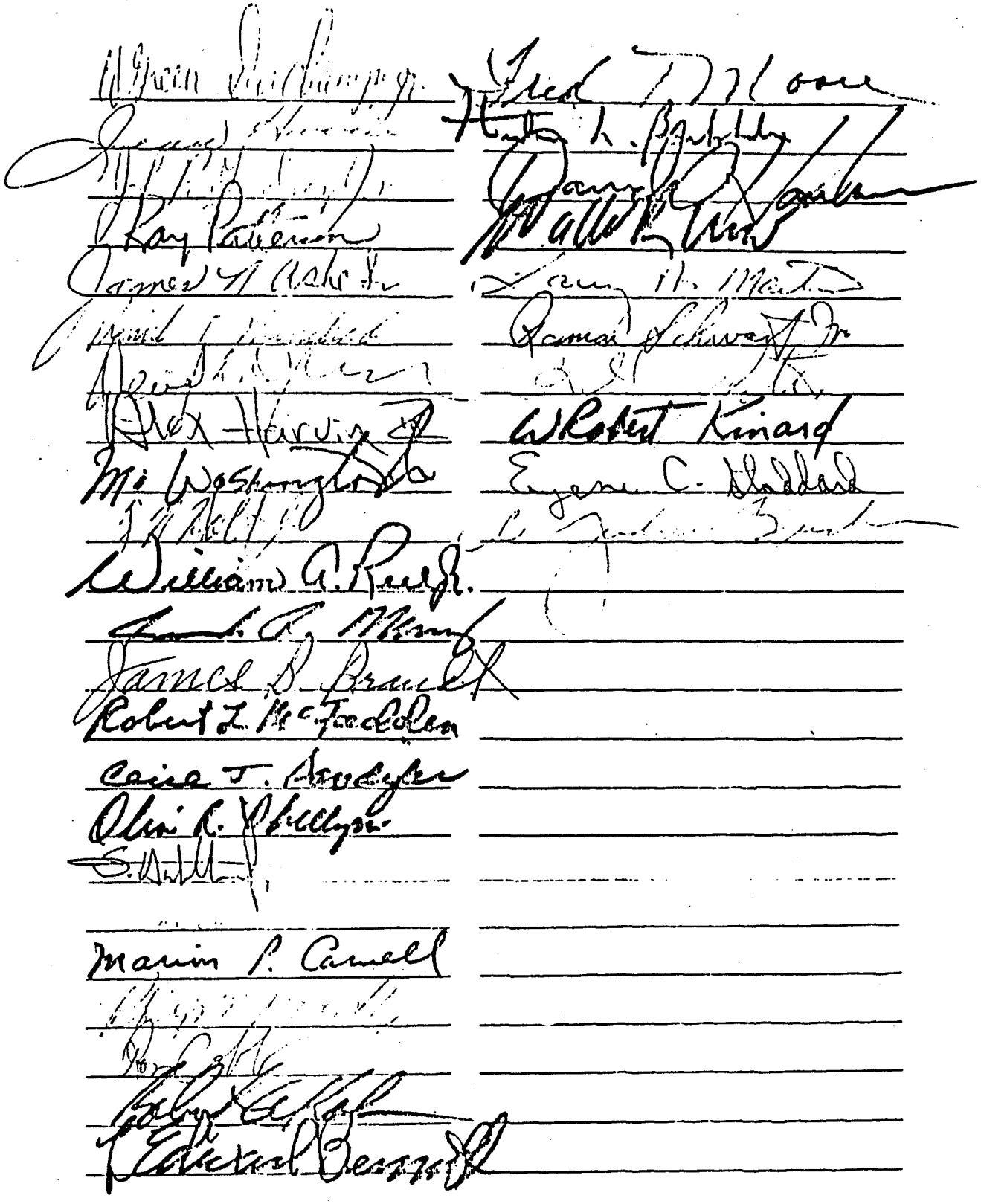
Your report should include, at a minimum, a summary of the types of potential nuclear related hazards and the State's response capabilities for each, a review of the types and number of nuclear related accidents or incidents that have occurred in the State and how they were handled, an evaluation of the adequacy of our current nuclear response capabilities and recommendations.

We will appreciate your prompt consideration of this request.

Sincerely,

/nrs





APPENDIX 2

TAB C

ATTACHMENT VI

MEMORANDUM OF UNDERSTANDING

BETWEEN

THE SOUTH CAROLINA DEPARTMENT OF HEALTH
AND
ENVIRONMENTAL CONTROL

AND

ALLIED-GENERAL NUCLEAR SERVICES

WHEREAS, the operation of nuclear industries within the State of South Carolina is of benefit to the citizens of South Carolina;

WHEREAS, prudent planning requires the development of emergency plans for nuclear industries in the unlikely event of an accident associated with these industries;

WHEREAS, the Legislature of the State of South Carolina did by ACT NO. 223 and its subsequent amendments designated the SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL (DHEC) as the agency responsible for the regulatory control of sources of ionizing radiation and empower DHEC to issue such orders or take such actions as necessary to meet emergency situations to protect the public health and safety;

WHEREAS, DHEC administers said ACT NO. 223 in accordance with an agreement executed on September 15, 1969, by the Governor of the State of South Carolina and the United State Atomic Energy Commission;

Whereas, for technical reason it is desirable to develop a single agency administration of radiation emergency plans involving peacetime radiation incidents;

WHEREAS, this normal line of communication is through DHEC;

THEREFORE, it is agreed that DHEC has jurisdiction and responsibility to control and direct the supporting off-site organizational groups in those emergency actions that may be required to protect the public health and safety as a result of a radiological incident at nuclear facilities owned and operated by ALLIED-GENERAL NUCLEAR SERVICES or a radiological transportation incident which occurs within ALLIED-GENERAL NUCLEAR SERVICES' responsibility. It is further agreed that ALLIED-GENERAL NUCLEAR SERVICES will immediately notify the SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL through its DIVISION OF RADIOLOGICAL HEALTH in the event of a nuclear facility radiological incident or in the event of a transportation incident, within ALLIED-GENERAL NUCLEAR SERVICES' responsibility, which has the potential for or does involve the health and safety of the citizens of South Carolina outside the facility boundaries, or which may or does involve abnormal contamination levels in the environment outside the facility environment. This agreement does not prohibit the notification of local emergency organizations in the event that this is deemed an expedient measure by appropriate facility personnel. This agreement shall commence with the signing of this Memorandum of Understanding and shall continue until expressly revoked.

7/11/75
Date

Deputy Commissioner for Environmental Health and Safety
For South Carolina Department of Health and Environmental Control

7/21/75
Date

For Allied-General Nuclear Services
A. E. Schubert, President

APPENDIX 3

Licensing & Inspection Schedules

Radioactive material licenses shall be issued for a specific time period as set forth in the Licensing Schedule. Generally, licenses are issued for a five year period with the exception of waste burial facilities and nuclear laundries which are issued at three year intervals. Renewals of licenses are usually made for the same period of time for which they were initially issued.

Licenses are grouped into four major types; medical, industrial, academic, and other. They are further identified in a specific category.

Radioactive material license inspections shall be performed within certain intervals based on the type of license and priority. Priorities are determined by the type material, quantity, and use authorized by the license, and the potential health hazard. The intervals of inspection are outlined in the Inspection Priority Schedule.

The following definitions shall apply:

1. Initial inspection - time after issuance of a license; for teletherapy licenses, as soon as possible after receipt of licensee's survey report.
2. Reinspection - regular complete inspection.
3. Extension - allowable interval beyond reinspection interval. No extension is applicable for Priority I licenses or active field radiographic operations.

Virgil Autry
DHEC-BRH 2/8/80

Licensing Schedule

	Type of License	Renewal Interval (years)	Inspection Priority (I-IV)
I.	Medical		
	A. Nuclear Medicine	5	III
	B. Pathology	5	III
	C. Teletherapy	5	III
	D. Pacemakers	5	III
II.	Industrial		
	A. Gamma Irradiators	5	II
	B. Radiographers	5	II
	C. Gauges & devices	5	III
	D. Gauges & devices (small quantity, GC's, portable, etc.)	5	IV
III.	Academic	5	III
	Academic small quantity	5	IV
IV.	Other		
	A. Waste Burial	3	I
	B. Waste Collection	5	II
	C. Laundries	3	II
	D. Service	5	IV
	All Broad Licenses regardless of type		II

Inspection Priority Schedule

Priority Groups	Inspection Frequencies		
	Initial	Reinspection	Extension *
Priority I Waste Burial	1 mon.	6 mon.	None
Priority II Gamma Irradiators Radiographers Waste Collection Laundries	6 mon.	12 mon.	6 mon.
Priority III Nuclear Medicine Pathology Teletherapy Pacemakers Gauges & devices	12 mons.	2 yrs.	12 mon.
Priority IV Gauges & Devices (small quantity) Academic (small quantity) Service	12 mons.	3 yrs.	12 mon.

* Become overdue at this time.

INSPECTION PRIORITY AND LICENSE INTERVAL BY CATEGORY

CODE	CATEGORY	INSPECTION PRIORITY	LICENSE INTERVAL (YRS)
BL	Broad License (Any Type)	II	5
BT	Brachytherapy	III	5
CC	Contaminated Components	IV	5
ED	Exempt Qty Distributors	III	5
FG	Fixed Gauges	III,IV	5
GC	Gas Chromatograph	IV	5
GI	Gamma Irradiator	II	5
GL	GL Distributor	III	5
IR	Industrial Radiographers	II	5
LA	Lead Analysers	IV	5
LD	Lead Detectors	IV	5
LS	Large Sealed Sources (lab)	III	5
MG	Medical Group (All Groups)	II	5
MV	Mobile Nuclear Medicine Van	III	5
NL	Nuclear Laundry	II	3
NM	Nuclear Medicine	III	5
NS	Neutron Sources	III	5
PG	Portable Gauges	IV	5
PM	Pacemakers	III	5
PT	Pathology	III	5
RP	Radiopharmacy	III	5
SA	Subcritical Assemblies	II	5
SL	Service License	IV	5
SQ	Small Quantity Lab	III, IV	5
SS	Small Sealed Sources (lab)	III, IV	5
TL	Teletherapy	III	5
WB	Waste Burial	I	3
WC	Waste Collection	II	5
WL	Well Loggers	II	5

APPENDIX 4

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

FEDERAL ACTIONS ARE NEEDED TO IMPROVE SAFETY AND SECURITY OF NUCLEAR MATERIALS TRANSPORTATION

D I G E S T

Federal agencies responsible for the safe transportation of nuclear materials have not developed and enforced policies and regulations which adequately protect the public from exposure to radiation from such shipments. Deficiencies in Federal programs coupled with poor Federal-State interaction have caused States to become concerned about the safety of nuclear materials shipments even though the safety record has been good. As a result, State and local governments have begun to pass laws and regulations which could impede, and in some cases stop, the movement of nuclear materials between different State and local jurisdictions.

Transportation of radioactive materials is vital to the Nation's use of nuclear materials for energy, medical, and other purposes. Shipments include radioactive wastes, reactor fuel, and material used for medical and industrial purposes.

The Department of Transportation, the Nuclear Regulatory Commission, and the Department of Energy have responsibilities for the safe and secure transportation of nuclear materials. All of these agencies could strengthen their safety and security procedures.

MORE ASSURANCE NEEDED THAT SHIPMENTS ARE SAFE

Safe shipping containers are the first line of defense in protecting the public from radioactive materials shipments, but inspection procedures do not adequately assure that containers meet Federal safety specifications. The Nuclear Regulatory Commission and the Department of Energy rely on container users and manufacturers to assure these containers

EMD-79-18

meet Federal safety specifications. Neither agency independently inspects these packages to assure they are constructed properly and continue to meet Federal standards after repeated use. The Department of Transportation, on the other hand, does some testing but does not test packages to see if they meet performance specifications. (See pp. 6 to 8.)

The Department of Transportation and the Commission allow levels of radioactive contamination on packages and transport vehicles which are unnecessarily high. This unnecessary radiation creates a potential hazard for transportation workers as well as the general public. (See pp. 8 to 10.)

Commission regulations do not require receivers of Type A packages to monitor radiation levels to make sure they comply with Federal regulations. Type A packages are used to ship materials such as slightly radioactive waste and radiopharmaceuticals. (See p. 10.)

Neither the Department of Transportation nor the Commission adequately inspect shippers and carriers for compliance with Federal transportation regulations. A recent Department of Transportation/Commission study confirmed the need for better surveillance, and at the same time illustrated the practicality of using State inspectors. (See pp. 10 to 12.)

The Department of Transportation and the Commission have conflicting regulations for packaging nuclear materials with a low specific activity--the measure of radioactivity in each gram of nuclear material. As a result, shippers following Transportation Department regulations are sometimes cited by the Commission for violating Commission regulations. (See p. 12.)

SECURITY NEEDS TO BE UPGRADED

The Department of Energy and the Commission require special security measures for shipments of weapons-grade plutonium and highly

enriched uranium when the amount being transported reaches a specified quantity called the "strategic level." However, current Federal regulations for protecting less than strategic quantities are inadequate and should be upgraded.

--No special security measures are required for shipments of weapons-grade materials which are only one or two grams below the strategic quantity level. The theft of multiple shipments below the strategic level could provide enough material to build a bomb. Also, plutonium of less than strategic quantities could be dispersed into the air to seriously endanger public health and safety in populated areas.

--Separate shipments of less than strategic quantities of nuclear materials can be brought together into one unprotected transportation terminal. Thus, two or more shipments of weapons-grade material, which together exceed the strategic quantity level, may be at one terminal at the same time--unprotected.

--The current safeguards criteria do not adequately consider the effect enrichment levels have on the quantity of material needed to make a bomb. As a result, shipments that would be less useful for making a bomb may be protected while more useful shipments are not. (See pp. 15 to 19.)

Spent fuel

Spent fuel is a highly radioactive material which is transported in massive, durable containers. Based on test results, its release from these containers in accidents appears unlikely. However, Federal agencies have not adequately considered the possibility of sabotage. The effects of sabotaging a spent-fuel container using high explosives cannot be accurately predicted because tests have not been done to determine the amount of spent fuel that would be released.

APPENDIX 5

INTRODUCTION.....

The S.C. Department of Health & Environmental Control entered into a contract with the U.S. Nuclear Regulatory Commission and the U.S. Department of Transportation to provide inspection and surveillance of radioactive material in transport within the state. The purpose of the contract (#NRC-06-77-020) was designed to obtain information related to the condition of shipments, handling practices, radiation levels, and other pertinent data. The period of the contract work was from January 31, 1977 through February 1, 1978.

SCOPE OF CONTRACT REQUIREMENTS.....

1. The State would visit selected carrier facilities at least quarterly during the period of the contract.

2. Perform radiation surveys to determine radiation levels at each work station in terminals or warehouses. Post area monitoring devices at selected terminals and document radiation exposure levels.

3. Perform contamination surveys at each work station and on radioactive material packages and transport vehicles.

4. Badge individual employees to determine personnel exposure.

5. Perform package inspections to include radiation levels, labeling, marking, contamination, and shipping documents.

6. Perform inspection on transport vehicles to document radiation levels, contamination, placarding, transport index, and shipping documents.

SURVEY PROCEDURES.....

Eight terminals or facilities were selected in South Carolina to be included under the contract requirements. Of these, two were air freight terminals, two were motor transit terminals, three were courier or freight forwarder type terminals, and one was a combination transportation and low-level radioactive waste burial facility. Each of the facilities contacted were given a copy of an explanation notice (page A-1, Appendix). Arrangements were made with company officials for the state inspectors to enter upon the property for the purpose of inspection, monitoring and survey. After the first initial contact with the facility, all other visits and inspections were unannounced.

Whereever possible, surveys of vehicles were made at the terminal prior to unloading of the radioactive material. An example of the vehicle inspection form is

shown on page A-2 of the Appendix.

Packages, containers and casks were inspected prior to delivery to the consignee if possible. Shipping documents were inspected at the same time. An example of the package inspection form is shown on page A-5 of the Appendix.

Contacts, inspections, surveys, and analysis of contamination smears were conducted by members of the technical staff of the Bureau of Radiological Health at the S.C. Department of Health & Environmental Control, Columbia, SC.

The following is a brief summary of work performed by the Bureau of Radiological Health during the period of this contract:

Total number of man-days spent by BRH/DHEC personnel..... 103

Total State Funds committed for contract.....$5,240

Total Federal Contract Funds received for contract..... $5,000

Number of Terminals Surveyed..... 8

Number of Contacts and interviews..... 21

Number of Vehicles inspected..... 28

Number of Packages and Containers surveyed..... 212

Number of Area and Personnel Monitoring Devices used..... 112

Contamination Smears analysed..... 80

FINDINGS.....

Air Freight Terminals.

Several air freight terminals in major cities in S.C. were visited to determine the extent of radioactive material being transported by air to and from the State. Compared to several other southeastern states, the number of radioactive material shipments carried by aircraft into S.C. was very low. Some terminals had not seen any radioactive shipments "for several months" to those that handle "about one a month". The major mode of shipments of radiopharmaceuticals into S.C. was by highway. Radiopharmaceuticals are shipped by air into Douglas Municipal Airport in Charlotte, N.C. then by highway carrier from Charlotte to a terminal in Columbia, S.C. The packages were then transported from the Columbia terminal to the consignee by courier vehicle. It is estimated that better than 90% of all radiopharmaceuticals shipped into S.C. are handled in this manner.

Total number of Packages inspected and surveyed	212
Number of Type A Packages	189
Number of Type B Packages	18
Number of Special Containers or Overpacks	5
Packages requiring No Lables	27
Packages with White I Labels	26
Packages with Yellow II Labels	35
Packages with Yellow III Labels	97
Shipments labeled RADIOACTIVE-LSA	27
Packages with security seal broken	0
Packages or Containers with improper security seal	3
Packages or Containers with no security seal	18
Number of non-specification packages	1
Type A Packages damaged (contents leaking)	0
Type A Packages damaged (no leaking)	5
Type B Packages damaged (contents leaking)	0
Type B Packages damaged (no leaking)	1
Total Transportation Index (TI)*	145.92
Greater than 50 TI in terminal at one time	0
TI not recorded on package labels	0
Surface dose rate greater than Yellow II limit*	0
Surface dose rate greater than Yellow III limit*	0

* Radiopharmaceutical Packages Only

RADIOACTIVE PACKAGE SURVEY FINDINGS

TABLE 1

No radioactive contamination was detected on any trailers inspected by the State during this survey. An example of the vehicle inspection form used is shown on page A-2 of the Appendix.

Packages and Containers

As part of this contract 212 packages were inspected and surveyed. A breakdown of package survey findings are shown in Table 1.

In general packages of radiopharmaceuticals were found to be packaged properly. Five packages were found to have seals damaged but none had actually opened during shipment. All radiopharmaceuticals inspected were shipped in approved DOT 7A packages.

Shipments from most of the major suppliers were inspected but some shipments from New England Nuclear had the highest number of discrepancies detected during the contract survey. See Table 2.

No contamination was found on any radiopharmaceutical packages. No observations were made which indicated that radioactive packages were near animals or unexposed film.

Shipments of radioactive waste into Barnwell, S.C. were inspected and several packages or containers had discrepancies.

A shipment from Nuclear Fuel Services, Inc. consisted of sixty DOT 17H 55 gal drums with rim lock bands. Several of the drums were not sealed properly and several were not stenciled RADIOACTIVE-LSA.

Part of a shipment of 96 drums of radioactive waste from the TVA Brown's Ferry Nuclear Plant were not as described in the shipping documents.

A shipment of 55 drums of radioactive waste from the LSU Medical Center was not packaged properly and not as described in the shipping documents.

Georgia Power Company shipped radioactive waste from the E. I. Hatch Nuclear Station which was not as described in the shipping documents.

Radioactive waste from the Fitzpatric Nuclear Plant in New York state consisting of 76 drums was not as described in the shipping documents.

A summary of transportation accidents involving radioactive material which were investigated by the Bureau of Radiological Health - DHEC is shown in the Appendix.

Shipping Documents

As part of the inspection and survey of Radioactive Materials in Transport, shipping documents were reviewed. In general shipping documents associated with radiopharmaceuticals were properly made out. Items reviewed included Shipper's Certification, Proper DOT Shipping Name, Transport Group, Labels Required, and Transport Index.

APPENDIX 6

GAO COMMENTS ON SPENT-FUEL TRANSPORTATION

SAFETY AND SECURITY

Spent-Fuel

Spent-fuel is a highly radioactive material which is transported in massive, durable containers. Based on test results, its release from these containers in accidents appears unlikely. However, Federal agencies have not adequately considered the possibility of sabotage. The effects of sabotaging a spent-fuel container using high explosives cannot be accurately predicted because tests have not been done to determine the amount of spent-fuel that would be released.

(sic. sentence missing from original document)

cut-off level. In establishing these levels, the dispersal hazard of plutonium should be considered. In addition, the criteria should take into account the enrichment level of uranium since smaller amounts of highly enriched uranium are needed to make a weapon.

-- Take immediate action to preclude enroute consolidation of two or more special nuclear materials shipments that together exceed the strategic levels.

-- Determine if there is a need to safeguard spent-fuel shipments from sabotage by developing experimental data on the amount of radioactive material that could be released in a sabotage attach on spent-fuel casks using high explosives.

-- If experimental data shows safeguards are warranted, develop a security system considering communication requirements, armed escort personnel, the least vulnerable transportation mode, and vehicle disabling features.

APPENDIX 7

III. COMMONWEALTH AND FEDERAL PREPAREDNESS AND RESPONSE MARCH 28 THROUGH APRIL 2, 1979

B. HEALTH PREPAREDNESS AND RESPONSE

1. Preparedness

1.1 Commonwealth of Pennsylvania

Pennsylvania Department of Health (DOH) - After the Bureau of Radiological Health transferred from the Pennsylvania Department of Health to the Pennsylvania Department of Environmental Resources (DER) in 1971, the DOH did not have any specialized capabilities in the radiation health area. It lacked personnel with appropriate competencies, equipment, and a public health library.

After the transfer, the Secretary of Health was replaced by the Secretary of Environmental Resources as an ex-officio member of the Governor's Advisory Committee on Atomic Energy Development and Radiation Control. This Committee was created by a legislative act in 1965 to promote commercial nuclear energy and to respond to radiation-related problems.

The Department of Health did not have a formal response plan for health aspects of a radiation emergency, and was not involved in developing the nuclear emergency annex to the Commonwealth's Disaster Operations Plan* which had been under preparation since 1975. As a result, the Commonwealth plan did not make adequate provision for community health needs. Designated responsibilities of the DOH included only emergency

Source: Report of the Governor's Commission on Three Mile Island Oct. 26, 1979

medical care and identification of dead and mortuary services. The plan did not designate specific responsibilities for the unique needs of hospitals and private health care facilities during an emergency or for mass public health needs, such as plans for distributing potassium iodide.*

Pennsylvania Department of Public Welfare (DPW) - The Department of Public Welfare has responsibilities in the field of mental health. Its Office of Mental Health had no special preparation for radiation emergencies, and the Department's responsibilities were not defined in the nuclear emergency annex to the Commonwealth's Disaster Operations Plan.

1.2 Federal Government

U.S. Department of Health Education and Welfare (HEW) - At the time of the accident, no coordinated federal response plan existed for meeting public health needs during nuclear emergencies. As detailed in the Emergency Management section of this report, the Federal Response Plan for Peacetime Nuclear Emergencies, which included health planning, was not completed at the time of the accident. Discussions on the availability of an approved form of potassium iodide (KI) had been held prior to the accident between DER's Bureau of Radiation Protection and the Food and Drug Administration (FDA), Bureau of Radiological Health. KI is used to prevent uptake of radioactive iodine by the thyroid gland in the event of iodine-131 releases during a nuclear power plant accident. However, an approved form was not available on March 28, 1979. The federal government did not maintain a supply of potassium iodide for expeditious distribution to large populations.

Radioactive iodine accumulates in the thyroid gland primarily during the first 12 hours after exposure, and at a

slower rate over the second 12 hour period. KI will therefore significantly decrease uptake and retention of radioactive iodine if administered before or shortly after exposure. It will not be effective if administered more than 24 hours after exposure. Use of KI was not intended for exposures below 10 rem and exposures during the TMI accident did not come close to approaching that level.

2. Response

2.1 Commonwealth of Pennsylvania

Pennsylvania Department of Health (DOH) - The Pennsylvania Department of Health's response to the TMI accident involved three major areas: providing proper technical guidance to the Governor and other public and private agencies on decisions related to health; providing useful information; and providing resources for mitigation of any population health impact.

In order to provide technical guidance, the DOH required knowledge about the potential effects of radiation, their prevention, and amelioration. Dr. Gordon MacLeod, who was the Secretary of Health at that time, established contact with the Bureau of Radiation Protection (BRP) in DER, and on March 31, arranged for Dr. Niel Wald, Chairman of the Department of Radiation Health, University of Pittsburgh, to assist the Health Department as a full-time advisor. Wald drew upon his Department's capabilities, including its library, to supplement DOH resources. Contact was maintained with the BRP and the Governor's Office to obtain information on the potential for population exposure, including information on the status of the Unit 2 reactor, and any radiation releases and dose estimates.

The Department arranged to have medical personnel and other resources available for the treatment of radiation injuries by contacting the federal Departments of HEW and Energy. In conjunction with the Governor, Lieutenant Governor and others, the Department discussed preventive measures, including: sheltering and evacuation to minimize radiation exposure; potassium iodide administration to block thyroid uptake of radioiodine; and dissemination of accurate radiation health information to minimize unwarranted psychological stress.

At BRP's request, the FDA arranged for a private firm to manufacture approximately 250,000 bottles of a super-saturated KI solution. The KI shipments, which began to arrive in Harrisburg on Sunday, March 31, 1979, became the subject of discussion between the Secretaries of Health and Environmental Resources, and led to the shift in responsibility from DER to the Department of Health for KI management and distribution. Subsequently, DOH took physical custody of the shipment and prepared procedures for potential distribution

The need for distributing KI was continuously re-evaluated, and the DOH rejected an untimely federal recommendation for its distribution and administration. The Secretary of Health advised the Governor against distribution to nearby communities for the following reasons:

- The shipments arrived at a time when reports from the site indicated an improving situation and smaller risks of additional public exposure.

- The quality of the liquid KI shipment was not good:

- Many bottles were not labeled.
- Filaments and other particulate matter were found in some samples.
- Many eye-droppers were improperly calibrated for the required dose.

- Only very low levels of radioactive iodine had been measured in milk and air samples taken frequently since March 28.

- Public awareness of KI and its use was almost non-existent prior to March 28, and reports on it after that date were not entirely accurate. Misuse of the drug could produce side effects.

- Announcement of the drug's availability at such a late date in the crisis could have produced a fearful public reaction.

The Department of Health refused to release the drug to the public and to emergency management workers, and stored the shipment in a centrally located warehouse. The FDA has since reclaimed the shipment.

As the accident continued, psychological stress on the public and on health professionals produced by the barrage of conflicting information became an increasing concern to the Health Department. Overloaded telephone exchanges contributed to significant communication problems among health organizations. Although the Health Department made attempts to coordinate the response of the private health care system with activities of Commonwealth agencies, efforts were fragmented at

V. Recommendations and Conclusions

I HEALTH

5. Health Care Capabilities

The Commonwealth should inventory and assess its emergency health care capabilities in all locations that might be affected by a nuclear accident, with the Pennsylvania Department of Health assuming the lead role in this effort.

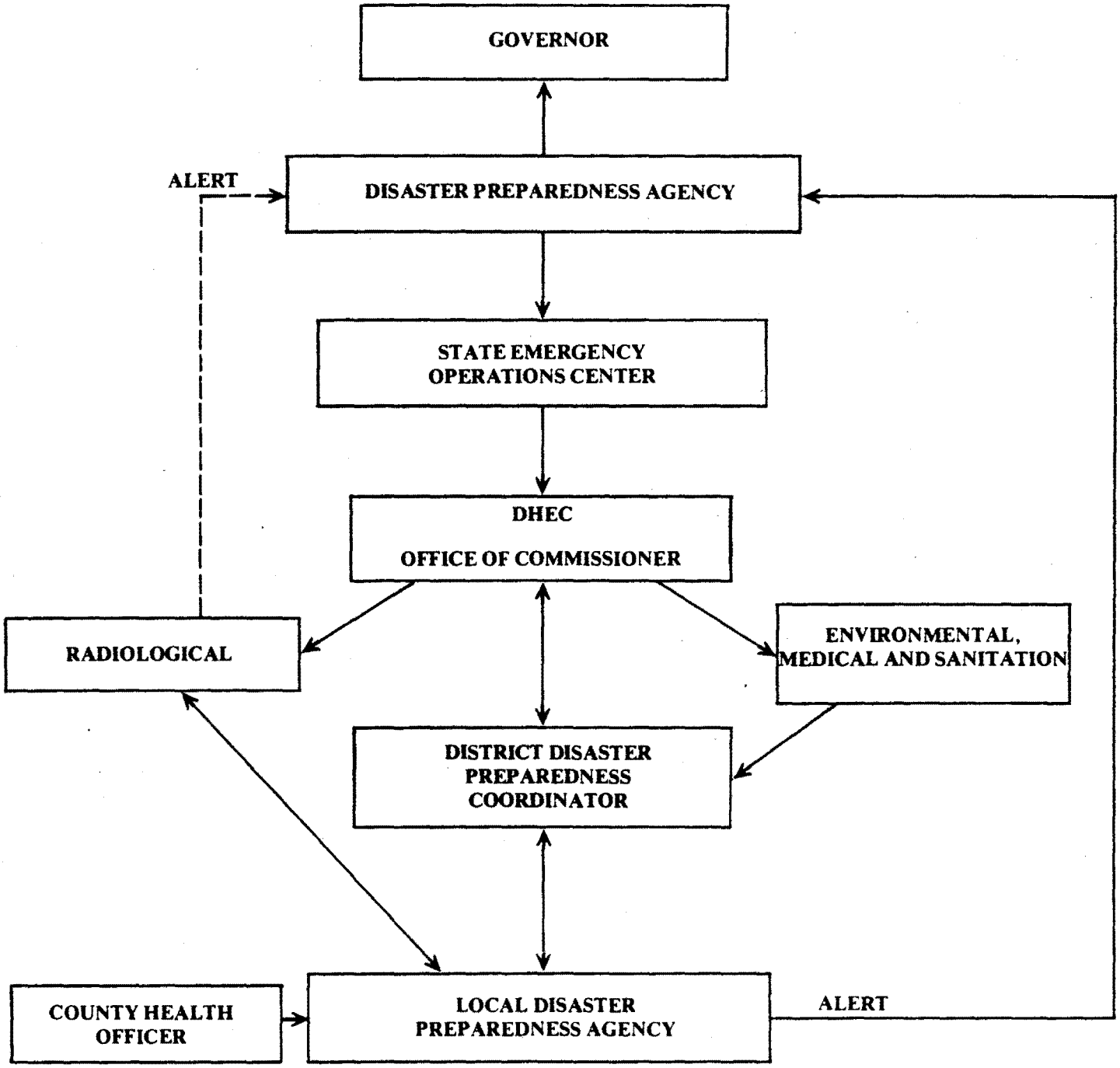
6. Iodine-131 Blocking Agent Program

A stable form of an iodine-131 blocking agent (Potassium Iodide) should be maintained in adequate supply for the general population in the emergency planning zones surrounding all nuclear power plants in the Commonwealth. In conjunction with PEMA, the Department of Health should develop a specific Potassium Iodide distribution plan as soon as possible, including provision for availability of Potassium Iodide for emergency personnel. The Health Department should also develop a specific education program for health care personnel and the public in the emergency planning zones outlining procedures for its distribution and administration.

APPENDIX 8

APPENDIX 1 TO EMERGENCY ENVIRONMENTAL AND HEALTH ANNEX, B-7

CHAIN OF COMMAND TO REPORT DISASTERS, COORDINATE RECOVERY EFFORTS, AND DEPLOY RESOURCES



——→ To report disasters and coordinate recovery efforts.

– – – – To deploy health resources.

B-7-8

APPENDIX 9

State of South Carolina

Office of the Governor

RICHARD W. RILEY
GOVERNOR

April 18, 1980

OFFICE OF EXECUTIVE
POLICY AND PROGRAMS

Mr. George L. Schroeder, Director
Legislative Audit Council
500 Bankers Trust Tower
Columbia, South Carolina 29201

Dear Mr. Schroeder:

This office has reviewed the Legislative Audit Council's draft report, An Evaluation of Nuclear Emergency Preparedness in South Carolina, and supports the principles set forth in the document's findings and recommendations. To the extent this report has addressed issues that were also a subject of study by the "Governor's Task Force for Emergency Response in Support of Fixed Nuclear Facilities", we have found the Audit Council's conclusions consistent with those of the Governor's Task Force. It is felt that this limited duplication is necessary and appropriate, as it focuses legislative attention on these vital issues and lends additional support to Task Force efforts.

We commend the Audit Council in concentrating its efforts in areas beyond the scope of current Task Force activity and find the study to be both comprehensive and thorough. This office concurs with the findings in these areas and feels that implementation of the principles of Audit Council recommendations will complement the efforts of the Governor's Task Force.

The report makes specific recommendations regarding future issues to be addressed by the Governor's Task Force. These recommendations are noted and will be incorporated into the activities of the Task Force as appropriate.

This office welcomes the opportunity to work with the Legislative Audit Council and looks forward to continued cooperation in addressing issues of mutual interest.

Sincerely,

Lee M. Thomas
Director

LMT/JM/cs

Division of Public Safety Programs
Edgar A. Brown Building, 1205 Pendleton Street, Columbia 29201

South Carolina Department of Health and Environmental Control

BOARD
William M. Wilson, Chairman
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George G. Graham, D.D.S.
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COMMISSIONER
Robert S. Jackson, M.D.
2600 Bull Street
Columbia, S. C. 29201

April 18, 1980

Mr. George L. Schroeder, Director
Legislative Audit Council
State of South Carolina
620 Bankers Trust Tower
Columbia, South Carolina 29201

Dear Mr. Schroeder:

The staff of the Bureau of Radiological Health has reviewed your draft report relative to the State's preparedness in the event of a nuclear emergency. Staff's comments were reviewed with Ms. Carol Routh and Mr. Larry Hamilton. Based on this review and follow-up action taken by your staff, we concur with your plans to publish the report.

Thank you for giving us the opportunity to review and comment on the report.

Very truly yours,

Robert S. Jackson, M.D.
Commissioner

RSJ:HGS:bo

STATE OF SOUTH CAROLINA
THE PUBLIC SERVICE COMMISSION
P. O. DRAWER 11649
COLUMBIA, SOUTH CAROLINA 29211

April 18, 1980

Mr. George L. Schroeder
Director
Legislative Audit Council
620 Bankers Trust Tower
Columbia, South Carolina 29201

RE: Report on extent of preparation
in the event of a nuclear emergency

Dear Mr. Schroeder:

I am writing to formally advise you that the South Carolina Public Service Commission has elected not to file formal, written comments in regard to the above-referenced report, which is soon to be published by the Legislative Audit Council.

At the request of your office, members of the Commission Staff reviewed the portions of the draft report relative to the role of the Commission in the enforcement of the regulations of the United States Department of Transportation relative to motor carriers of radioactive materials. That portion of the draft report was discussed with Ms. Carol Routh and Mr. Larry Hamilton of your office. As a consequence of that review and discussion, we have determined that formal comments of this Commission would not be necessary to explain or clarify the functions and responsibilities of this agency.

If I may be of further assistance, please do not hesitate to contact me.

Very truly yours,

Robert T. Bockman

Robert T. Bockman
General Counsel

RTB/kp
cc: James H. Still, Executive Director
James T. Smith, Director
Transportation Division

Emergency Preparedness Division
OFFICE OF THE ADJUTANT GENERAL OF SOUTH CAROLINA

Rutledge Building
1429 Senate Street
Columbia, South Carolina 29201

MG T. ESTON MARCHANT
The Adjutant General

BG
~~COL~~ GEORGE R. WISE
Director

Arpil 10, 1980

Mr. George L. Schroeder, Director
Legislative Audit Council
State of South Carolina
620 Bankers Trust Tower
Columbia, South Carolina 29201

Dear Mr. Schroeder:

I, and members of my staff, have reviewed your report on the State's preparedness in the event of nuclear emergency and concur with the comments contained therein; however, some of the items commented on have been or are being corrected. Some of these items are listed below, by page number, for your information.

1. Page VII - Lack of Plan for Distribution of Potassium Iodide.

The Emergency Preparedness Division and the Bureau of Radiological Health have in draft form a plan to evacuate individuals in the plume zone to a predesignated assembly area or areas outside the 10-mile radius of the Fixed Nuclear Facility where they will be administered the potassium iodide. Also, the plan indicates that emergency personnel working in the area will be administered the potassium iodide upon reporting to the forward Emergency Operating Center in the vicinity of the nuclear facility.

2. Page 16 - Mass Evacuation Plan.

Emergency Preparedness Division is presently working on an evacuation plan for the Robinson Plant in conjuction with the State Highway Patrol. Maps are being prepared of the evacuation routes and assembly areas. The same procedure is in progress for the Oconee Plant.

3. Page 96 - Funds for the State Emergency Preparedness Division.

At the present time, the Emergency Preparedness Division has been authorized by the Federal Government (FEMA) to utilize three Nuclear Planners that are on 100% Federally funded contracts to assist in the

Fixed Nuclear Facility planning; however, this authority ceases on 1 July 80 and these planners must be returned to Crises Relocation Planning under the Federal contract with the State. The loss of these three planners will decrease our Fixed Nuclear Facility planning staff to two people, which will hamper the Fixed Nuclear Facility planning cycle.

As you stated in your report, I have reorganized this division to accomplish the mission of Fixed Nuclear Facility planning, and we are making good progress but, as you can see in paragraph 3 above, the progress will be slowed down without additional help.

Thanks for the opportunity to review your report and, if I can be of further assistance to you, please call on me.

Sincerely,

GEORGE R. WISE
Director

GRW/bjb

cc: The Adjutant General

GLOSSARY

Actinide - One of a group of radioactive chemical elements from element 89 (actinium) through element 103 (lawrencium).

Acute radiation syndrome - A bodily disorder that follows exposure to relatively severe doses of ionizing radiation. It is characterized by nausea, vomiting, diarrhea, blood cell changes, and in later stages by loss of hair and hemorrhage.

Allowable stay-time - Length of time an individual may be exposed to a given source of radiation without exceeding a safe dose level. By Department of Defense standards an adult (over 21) should not receive more than 1.25 REM per calendar quarter and a maximum of 5 REM in a calendar year. The maximum acceptable accumulated dose is calculated by the equation 5 (N-18) where N = age of the individual in years.

Alpha radiation - The least penetrating of the three common types of radiation emitted by radioactive material, being stopped by a sheet of paper. It becomes dangerous to animals and man when the alpha-emitting substance has entered the body by way of the air or water.

Background radiation - Radiation arising from natural radioactive materials always present in the environment, including solar and cosmic radiation and radioactive elements in the upper atmosphere, the ground, building materials, and the human body.

Beta radiation - A form of ionizing radiation consisting of high energy electrons that are normally stopped by the skin or a very thin sheet of metal.

Containment building - The structure housing the nuclear reactor; intended to contain radioactive solids, gases, and water that might be released from the reactor vessel in an accident.

Control rod - A rod containing material that absorbs neutrons; used to control or halt nuclear fission in a reactor.

Core - The central part of a nuclear reactor that contains the fuel and produces the heat.

Curie - A unit of the intensity of radioactivity in a material. A curie is equal to 37 billion disintegrations each second. (Abbreviated Ci.)

Dose - A term used to express the amount of radiant energy (i.e. nuclear radiation) absorbed in tissue.

Dosimeter - Small device for measuring the number of roentgens or radiation dosage absorbed in a single exposure to radiation.

Fission - The splitting apart of a heavy atomic nucleus, into two or more parts when a neutron strikes the nucleus. The splitting releases a large amount of energy.

Fission products - Radioactive nuclei and elements formed by the fission of heavy elements.

Fuel damage - The failure of fuel rods and the release of the radioactive fission products trapped inside them. Fuel damage can occur without a melting of the reactor's uranium.

Fuel melt - The melting of some of the uranium oxide fuel inside a reactor.

Fuel pellet - The basic form in which the uranium is contained.

Fuel rod - A tube containing fuel pellets for a nuclear reactor.

Gamma rays - High-energy electromagnetic radiation; a form of ionizing radiation, of higher energy than x-rays, that penetrates very deep into body tissues. Requires shielding by dense material, such as lead.

General emergency - Declared by the utility when an incident at a nuclear power plant poses a potentially serious threat of radiation releases that could affect the general public.

Half-life - The time required for half of a given radioactive substance to decay.

Health physics - The practice of protecting humans and their environment from the possible hazards of radiation.

High level waste - Waste which has extremely high radioactivity - as much as 10,000 curies per gallon. This waste is characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life. High level waste is created when reactor spent-fuel elements are dissolved in acid to recover unused uranium and plutonium for reuse as nuclear fuel. It is the acid solution remaining that is referred to as high level waste. It contains virtually all the fission products and small amounts of transuranics - such as plutonium - which are not recovered during the reprocessing operations. It is one of the most hazardous and complex of all radioactive wastes to manage.

Iodine-131 - A radioactive form of iodine, with a half-life of 8.1 days, that can be absorbed by the human thyroid if inhaled or ingested and cause non-cancerous or cancerous growths.

Ionizing radiation - Radiation capable of displacing electrons from atoms; the process produces electrically charged atoms or ions. Forms include gamma rays, x-rays, and beta particles.

Isotope - Any of two or more forms of an element having the same or very closely related chemical properties and the same atomic number but different atomic weights.

LOCA - Loss of coolant accident, such as a pipe break in the primary coolant system of a reactor.

Man-rem - A unit of population radiation dose. It is the average radiation dose in rem multiplied by the number of people in the exposed group. (see rem.)

Melt-down - The melting of fuel in a nuclear reactor after the loss of coolant water. If a significant portion of the fuel should melt, the molten fuel could melt through the reactor vessel and release large quantities of radioactive materials into the containment building.

Millirem - A term used to measure absorption of radiation by humans. The average American is exposed to 100 to 200 millirems of radiation per year, including radiation from x-rays to cosmic rays. A normal chest x-ray exposes a person to between 20 and 30 millirem. A millirem (mr) is 1 one-thousandth of a rem.

Neutron - An uncharged particle found in the nucleus of every atom heavier than ordinary hydrogen; neutrons sustain the fission chain reaction in nuclear reactors.

Nucleus - The central core of an atom.

Plutonium (Pu) - A heavy, fissionable, radioactive (alpha emitter), metallic element. Plutonium-239 occurs in nature in trace amounts only. However, it can be produced as a by-product of the fission reaction in a uranium fueled nuclear reactor and can be recovered for future use.

Potassium iodide - A chemical that readily enters the thyroid gland when ingested. If taken in a sufficient quantity prior to exposure to radioactive iodine, it can prevent the thyroid from absorbing any of the potentially harmful radioactive iodine-131.

Rad - Standard unit of roentgen absorbed dose, a term that supersedes the roentgen as the unit of dosage. A millirad is a thousandth of a rad. Doses of a few millirads are now considered safe, but there is still debate over the threshold between a safe and a hazardous dose.

Radioactive decay - The spontaneous process by which an unstable radioactive nucleus releases energy or particles to become stable.

Radioactivity - The spontaneous decay of an unstable atom. During the decay process, ionizing radiation is usually given off.

Radioeffluents - Radioactive emissions released from operating nuclear power plants, either gaseous or liquid, the allowable amount of which is federally regulated.

Reactor (nuclear) - A device in which a fission chain reaction can be initiated, maintained, and controlled.

Reactor coolant system - Water that cools the reactor core and carries away heat. Also called the primary loop.

Reactor vessel - The steel tank containing the reactor core; also called the pressure vessel.

Rem - A standard unit for Roentgen Equivalent Man. A measure of the quantity of any ionizing radiation with the same biological effectiveness as one RAD of x-rays.

Roentgen - A measure of the quantity of x-ray or gamma ray radiation in the air.

Site emergency - Declared by the utility when an incident at a nuclear power plant threatens the uncontrolled release of radioactivity into the immediate area of the plant.

Spent-fuel - Potential high level waste which contains all the fission and transuranic elements that are found in high level waste and all the uranium and plutonium not used during the nuclear reaction. Spent-fuel is characterized by high levels of penetrating radiation, high heat generation rates, and a long toxic life. Spent-fuel has not yet been defined by the Nuclear Regulatory Commission as high level waste and may not be, because of its potential value as a source of fuel if reprocessed.

Thermoluminescent dosimeter (TLD) - A device to measure nuclear radiation.

Transport index - The number placed on a package to designate the degree of control to be exercised by the carrier during transportation. The transport index (TI) to be assigned to a package of radioactive materials is determined by either the highest radiation dose rate in millirem per hour at three feet from any accessible external surface of the package or by dividing the number "50" by the number of similar packages which may be transported together, whichever is larger.

Transuranic contaminated waste - Radioactive waste which contains much lower concentrations of radioactivity than high level waste. It is generated by plutonium fuel fabrication and fuel reprocessing facilities and laboratories using transuranic elements. This waste generally consists of absorbent tissues, clothing, gloves, plastic bags, equipment, filters from effluent treatment systems, and fuel hulls which remain after fuel reprocessing.

Type A package - Packaging which is designed in accordance with the general packaging requirements which is adequate to prevent the loss or dispersal of the radioactive contents and to retain the efficiency of its radiation shielding properties if the package is subject to environmental and test conditions prescribed by DOT Regulations. Environmental conditions include heat, cold, reduced pressure and vibration. Test conditions include water spray, free drop, corner drop, penetration and compression.

Type B package - Packaging which meets the standards for Type A packaging and, in addition, meets the standards for hypothetical accident conditions of transportation.

Uranium Oxide (UO_2) - A chemical compound containing uranium and oxygen that is used as a fuel in nuclear reactors.

Zircaloy - A zirconium alloy from which fuel rod cladding is made.