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DRAFT FOR COMMENT

Contribution to

EMERGENCY RESPONSE PLANNING GUIDANCE DOCUMENT

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Contribution to
Emergency Response Planning Guidance Document

II PLANNING BASIS

A. Transportation Systems

It is estimated that approximately 500 billion packages of all types of commodities are shipped in the United States each year[1], and approximately 100 million (.02 percent) of the total estimated shipments involve hazardous materials such as flammables, explosives, poisons, corrosives and radioactive materials. The most recent estimate of radioactive material shipments in the US, on an annual basis[2], indicates that there are approximately 2 million shipments of radioactive materials per year. About one-third of the radioactive material packages which are shipped annually contain such small quantities of radioactive materials that they are exempt from the packaging and labeling requirements of the Department of Transportation (DOT) regulations.

A summary of the radioactive material shipments for 1975 are shown in Table I and listed by shipment type according to the primary use of the radioactive material (i.e., limited, medical, industrial, fuel cycle and waste).

Table I

Summary of Radioactive Material Shipping (1975)[1]

Shipment Type	Packages per Year	Kilometers per year	Percent of Total (packages)
Limited (exempt)	7.03×10^5	1.19×10^9	32
Medical	9.10×10^5	1.12×10^9	42
Industrial	2.15×10^5	3.01×10^8	10
Fuel Cycle	2.04×10^5	2.09×10^7	9
Waste	1.52×10^5	3.22×10^6	7
	2.19×10^6	2.64×10^9	100

The medical users of radioactive materials are found primarily in the use of radiopharmaceuticals and large teletherapy sources for radioactive treatment of cancer. The radiopharmaceuticals are usually shipped to hospitals from the supplier via air transportation and frequently consist of less than one curie of radioactive material. Teletherapy sources contain large sources (up

to 10,000 curies) and are shipped in large shielded casks which are usually transported by surface modes (truck and rail) because of their weight.

Industrial uses of radioactive materials involve the application of radioisotopes in the oil well-logging industry, the radiography industry and through the use of a multitude of radioactive gauging sources. These industrial uses of radioactive materials use surface and air transport of radioactive material packages which account for approximately 10 percent of all the packages shipped annually.

The nuclear fuel cycle involves the production of electrical energy from fission in a nuclear reactor and the transportation activities associated with the fuel cycle involve the movement of material from the uranium mine to mill and to subsequent facilities such as conversion, enrichment, fuel fabrication and to the reactors. Additional transportation operations can include the movement and ultimate disposition of irradiated fuel and the transportation of radioactive wastes.

All of the uses of radioactive materials mentioned above require the transportation of radioactive materials from its point of origin to its use location. Radioactive wastes are generated through the use of these materials and these wastes must also be transported to their final disposition location. The transportation of radioactive materials can involve the surface modes of truck, rail, ship (or barge) and air transportation. The transportation accidents which can occur during the movement of these radioactive materials are described in the next section.

B. Accident Characteristics

This section will discuss the characteristics of accidents which can occur due to the transportation of radioactive material. In order to assist the person who is responsible for the preparation of an emergency response plan for a state or local government two regimes of radioactive material transport accidents will be addressed: (1) the low hazard-relatively high probability event, and (2) the high hazard, very low probability event. One can observe from Table I that 74 percent of all radioactive material packages shipped on an annual basis involve exempt quantities of radioactive material or medical shipments which most often are radiopharmaceuticals and are shipped only in limited quantities. The industrial, fuel cycle and radioactive waste shipments involve 26 percent of the packages shipped. As a consequence there is a great probability, on a package basis, that an accident, if one occurs, will involve a limited quantity of radioactive material. Similarly, there is a smaller probability, on a package basis, that a larger quantity of radioactive material will be involved in a transportation accident.

A Review of U. S. Radioactive Material Accident/Incident Experience

Introduction

In 1971 a regulatory requirement was instituted by the Material Transportation Bureau, US Department of Transportation (49 CPR, Para 171.15) which required the reporting of a hazardous material transportation incident. These

regulations specify the reporting after each incident that occurs during the course of transportation (including loading, unloading and temporary storage) in which as a direct result of hazardous material: (a) a person is killed, (b) a person receives injuries requiring hospitalization, (c) estimated carrier or other property damage exceeds $50,000, (d) in the case of radioactive material there is suspected contamination, (e) etiologic agents are involved in the shipment and (f) continued danger of life exists at the accident scene. From this summary of the regulations one can conclude that the interpretations for reporting an incident can vary widely. Some of the reported incidents can be classified as transportation accidents because the vehicle transporting the radioactive material was involved in a transportation accident. The system for reporting these events is known as the Hazardous Material Incident (HMI) reporting system and this system forms the basis for the statistical accident information associated with hazardous material transportation.

The first analysis of this information base was performed by Grella[3] in 1975. Grella's analysis revealed that from 1971-1975 there had been 32,000 HMI reports submitted to DOT for all classes of hazardous materials and that only 144 of these incident reports were noted to involve radioactive material. The analysis of the HMI system has been extended to the current point in time and through 1979 there have been 86,500 HMI reports submitted to the DOT.

Additional information on accidents and incidents can be obtained from the US Nuclear Regulatory Commission (NRC) since the NRC also has a regulatory requirement for reporting incidents. The NRC reporting requirement has its basis primarily in lost or stolen shipments of radioactive material. If all the information available from the DOT and NRC is gathered into a single file, it presently constitutes 562 events and is summarized as shown in Table II. It can be noted that the total of 562 reported events comprise only 0.5 percent of the current total of 86,500 HMI reports.

Table II

Accident/Incident Report Summary

Transportation Accidents	64
Handling Accidents	96
Reported Incidents	402
Event Total	562

Table II makes the distinction between a transportation accident and other reported incidents. The reasoning for this distinction is as follows. If the vehicle that transports the radioactive material is involved in an accident then the incident is classified as a transportation accident. If the reported

event occurred during a handling, loading or storage operation, and there was package damage due to a package being dropped, or otherwise damaged during loading, unloading or storage, then the incident is classified as a handling accident. Handling accidents like other kinds of accidents may or may not produce package damage but the potential for such damage must be present through some abnormal circumstance such as package drop, etc.

Reported incidents exist because of the wide range of circumstances in the regulations which may require reporting. For example, the reappearance of some surface contamination on a previously decontaminated cask is a one circumstance which can require reporting. Numerous reports of surface contamination on a cask (that is not the result of any loss of radioactive contents) have been reported and such events appear to be the result of the "leaching out" of small amounts of radioactive contamination from the surface of previously decontaminated casks. From a detailed examination of HMI reports it has been concluded[4] that it is more accurate to categorize the events reported to the DOT and NRC as shown in Table II. State and local governments can be involved with responding to radioactive material transportation accidents and to the generally less severe handling accident.

Severity of Radioactive Material Transportation Accidents

As mentioned earlier, there are two probable regimes of transportation accidents: the relatively high-probability, low-hazard event and the very low-probability, high-hazard event. It has also been noted that the great proportion of radioactive material shipments involve limited quantities of the radioactive materials and, hence, represent low hazards.

The packaging regulations for radioactive materials relate the consequence of packaging failure, resulting from an accident or abnormal handling, to the quantity and radiotoxicity of the nuclide being transported. For example, there are two types of radioactive material packagings, Type A and Type B. Type A packagings contain only a limited quantity of radioactive material. Type B packagings contain larger than Type A quantities of radioactive material, they must meet the Type A packaging standards and, in addition, are subjected to the "hypothetical accident conditions" of transport (Appendix B, 10 CFR 71).

Before discussing the statistical information which will provide a view of actual transportation accident experience for the 64 transportation accidents which have occurred, two important points should be noted.

The first point is the term "hypothetical accident conditions" used to describe the regulatory qualification tests which represent licensing tests more severe (more intense) than the tests for the normal conditions of transport. Various members of the packaging design industry prefer to call these tests package damage tests. The reasons for this are as follows. The regulatory "hypothetical accident" tests include impact, thermal (fire), puncture and immersion tests. Using the impact test as an example, the impact test specification includes a 30 mph (44 fps) impact onto an unyielding target. Generally speaking, various critics have disputed the wisdom of an impact velocity as low as 44 fps to represent high speed truck, rail or aircraft accidents. It has been demonstrated experimentally[5] that the 44 fps impact onto an unyielding target has

been more damaging than a 2,000 ft drop of the same package design onto hard desert soil. Thus, package damage is the key ingredient to the "hypothetical accident" tests, and using impact as an example, it is incorrect to disassociate package impact velocity from the impact target description.

The second point that is very important is the acceptance criterion that is used to determine that a Type B packaging design has "survived" the "hypothetical accident" conditions. NRC Regulatory Guide 7.4 specifies a leak rate acceptance test for loss of radioactive contents which, in simple terms, allows the leak rate from a damaged package to be equal to the approximately equivalent loss of the contents of a Type A package in a week. It must be remembered that a Type A package could be breached and lose its entire radioactive contents with minimal radioactive consequences. Consequently, even after a very damaging test the leak rate for radioactive contents loss is specified to be very small.

The concept of "package damage" addresses the notion that the environmental specification in the regulatory tests, for example the 44 fps impact velocity, may appear relatively benign. If the unyielding target conditions are additionally specified then these regulatory tests can produce more damage than more severe accident scenarios which include less severe target descriptions. Following the regulatory testing there is, of course, the severe limitation on loss of package contents. Having used impact as an environmental example, other similar arguments can be provided for fire, etc. It must also be noted that the DOE and and the DOT have investigated Type B package response in the extra-regulatory severity regime[6] and the packagings which were originally licensed to the level of the regulatory tests have survived handily. With this as a background the type of transport accidents which have actually occurred will now be discussed.

Radioactive Material Transportation Accident Statistics

First, the 64 transport accidents that have occurred will be described in terms of the transport mode in which the accident occurred. This tabulation is shown in Table III.

Table III

Radioactive Material Transportation Accidents by Mode

Transport Mode	Number of Accidents	Number of Package Failures
Air	5	1
Rail	5	1
Highway	54	38
	64	40

Table III indicates that there were 40 packaging failures which resulted from 64 transportation accidents and there was a total of 641 packages involved in the 64 accidents. Thus, approximately 6 percent of the packages involved in the accidents had packaging failures. A summary of the packages with release of contents is shown in Table IV.

Table IV

Transportation Accident Analysis Sumary Radioactive Materials (RAM)

RAM Packages Involved In Accidents	RAM Released	Release Description	Description of Material Released
Packaging Failures (with release)	38 Type A	5 Release Events: 3 Urban	• Uranium ore • Sand (LSA) • RAM (not otherwise specified)
		5 Release Events: 2 Non-Urban	• Uranium oxide
Packaging Failures (no release)	2 Type A		
Packagings in Accidents with No Failures	601		
	641		

The 40 packaging failures involved 38 Type A packages which released radioactive material. Since multiple numbers of packages can be carried on a single vehicle, it was possible to define five separate and distinct release events. Three of the release events occurred in an urban area. Two of the release events occurred in a non-urban area. For example, the Springfield, CO, accident involved 29 packaging failures which released approximately 5400 kg of uranium oxide; this was defined as a single release event. The material released was described as uranium ore, radioactive sand (low specific activity) uranium oxide and radioactive material (RAM - not otherwise specified). It is interesting to note that an examination of the accident data reveals that 11 Type B accident resistant packagings were included in the set of 601 packagings which were subjected to accident conditions, but produced no packaging failure and, consequently, no release of radioactive contents.

The accident conditions for these 11 Type B accident resistant packagings which survived accident conditions without release are shown in Table V.

Table V

Summary of Transportation Accident Conditions - Type B Packages
Radioactive Material (RAM)

Package	Date	Mode	Package Contents	Accident Conditions	Environmental Threat
6000 lb cask	4/71	Rail	UF_6	Derailment	Impact
49000 lb cask	12/71	Truck	Spent Fuel	Truck overturned	Impact
32000 lb cask	6/72	Truck	UF_6	Truck overturned	Impact
15200 lb cask	3/74	Rail	RAM-LSA	Derailment	Impact
217 lb drum	6/74	Truck	RAM-Fissile	Trailer overturned	Impact
38000 lb cask	8/74	Truck	RAM-Waste	Trailer overturned	Impact
16000 lb cask	8/75	Truck	Y235,Y238 Bu239	Tractor-trailer ran off road and overturned	Impact
40000 lb cask	10/75	Truck	RAM-LSA	Truck ran off road and overturned	Impact
30000 lb cask	4/76	Truck	LSA-Waste	Vehicle struck overpass	Impact
28000 lb cylinders	3/77	Rail	UF_6	Derailment, close contact with burning ammonium nitrate	Impact-Fire
6800 lb cylinders	1/79	Truck	UF_6	Vehicle rear ended	Impact

There were two additional accidents that did not involved Type B packages that should be at least mentioned. One accident involved the collapse of a trailer due to an empty 23,000 lb cask. The second accident involved a railcar which overturned due to the shifting of a load of 28,000 lb of contaminated steel slabs.

The transportation accidents that have actually occurred which involved radioactive materials have been examined. Detailed analyses of the severity (intensity) of transportation accidents have been made[7,8] and the results of one of these studies are shown in Figures 1 and 2. The regulatory level of "hypothetical accident" conditions for the accident environments of impact and fire are shown superimposed in Figures 1 and 2. If one couples the information

in Figures 1 and 2 with the actual transportation accident experience that has been presented in this section one can draw the following conclusions. First, transportation accidents involving hazardous materials, in particular radioactive materials, have occurred. Second, for those radioactive material transport accidents where there have been releases of radioactive contents, these releases have involved small quantities, Type A or less, or larger quantities of low-specific-activity (LSA) materials. Third, for the larger quantities of more radiotoxic materials, Type B packages, there have been accident occurrences but no releases from the radioactive material packages. Last, the packaging design process does not lend itself to designing a package to "just meet the regulatory tests" and then provide catastrophic failure or breaching of the package. In fact, one might expect that damage increases slowly with increasing accident severity and that releases behave similarly. Further, if one accounts for the possibility that many package impact targets are not unyielding or that the packages are not fully enveloped in a fire, then the protection levels provided by the regulatory tests, as shown in Figures 1 and 2, can be moved to the right in the direction of increasing severity. That is, the existing regulations provide even more protection than indicated in Figures 1 and 2. As a result, if a Type A packaging were to fail through accident or other conditions, then the quantity limitations provided by the Type A classification would provide minimal radioactive consequence in the form of health effects to the environment and humans. Because of these limited quantities, a Type A packaging design is tested only to the environmental stresses representative of the normal conditions of transport. Type A packagings are of high quality and accident resistant to a degree but, since they can be subjected to an accident environment, their primary protection comes from the Type A quantity limitations on their contents. A great proportion of the radiopharmaceutical packagings can be classified as Type A.

A second type of radioactive material packaging is for quantities of radioactive material larger than Type A, hence the designation Type B. The Type B packaging, as in the case of Type A, can be subjected to accident environment conditions. However, for Type B, the radioactive consequences of the release of package contents would be far more severe; hence, Type B packagings are certified to more stringent environmental conditions. Type B packages are subjected to the environmental conditions of the normal conditions of transport (Appendix A, 10 CFR 71) and the "hypothetical accident conditions" (Appendix B, 10 CFR 71).

Concluding Remarks - Transportation Accident Severities

The information provided in this section about the severity of transportation accidents involving radioactive materials has been presented to provide background information to the state and/or local governments who are responsible for the planning, development and implementation of emergency response plans for such accident events. This information can be incorporated, as required, into the development of radioactive material emergency response and preparedness plans. Generally speaking, the radioactive material transportation accidents which have occurred in the past have reflected the manner in which the transport regulations are designed to work. That is, for the great proportion of the radioactive materials being shipped, the package contents are limited in magnitude. For accidents where there have been releases, the packages were Type A

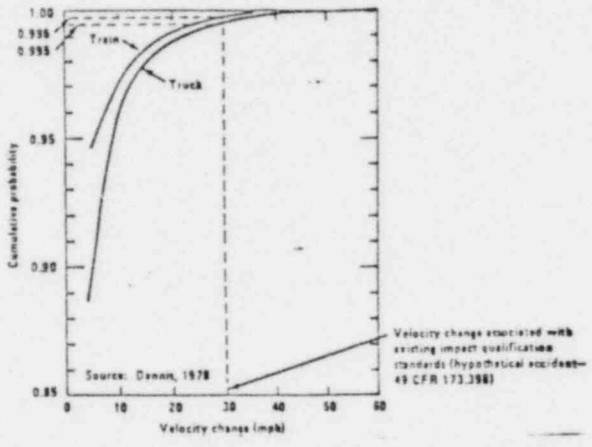

Figure 1. Cumulative probability of velocity changes due to impact, given a reportable truck accident or a reportable train accident.

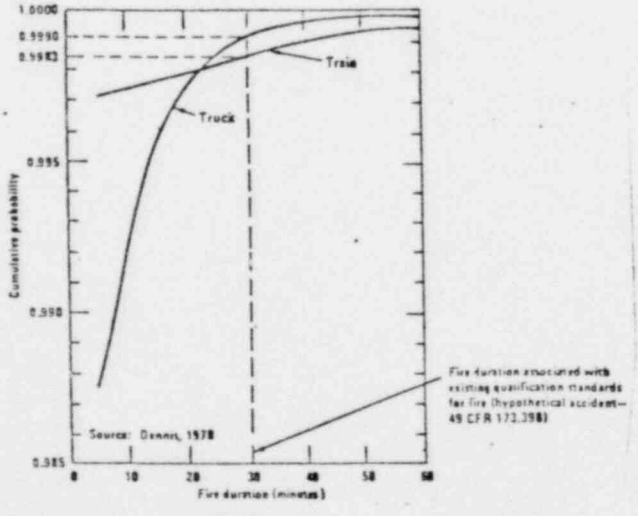

Figure 2. Cumulative probability of fire durations, given a reportable truck accident or a reportable train accident.

packages which contain limited quantities of radioactive material. For the larger packages which transport greater quantities of radioactive materials, the consequences of release are also greater and these packages have been designed to the more demanding standards of the "hypothetical accident" conditions in addition to the normal environmental conditions of transport. It is concluded that the record of no releases of radioactive material from Type B packages is a result of the regulatory practice of subjecting these package designs to transport accident conditions.

Having reviewed the actual occurrences of transportation accidents as presented above, the emergency response planner should consider the following:

(1) To date, 562 reported incidents involving transportation of radioactive material have occurred. 64 of these events were transportation accidents. From the set of approximately 86,500 total events which have been reported to the DOT for all hazardous materials, one can note that the emergency response planner is more likely to have to consider a multitude of hazardous materials other than radioactive materials.

(2) If an emergency related to the transportation of radioactive materials is encountered the emergency response planner will most probably have to contend with a handling accident or a transportation accident involving limited (Type A) quantities of radioactive materials.

(3) Large releases of radioactive material from Type B packages are unlikely. Therefore, the emergency response plan should emphasize the provision of emergency first-aid and life-saving efforts, the development of emergency communications, the notification of radiological assistance personnel and the establishment of a control perimeter at the accident site. While such large consequence events are considered unlikely, if the emergency response plan must include a "worst case" event, then the emergency response planner must provide for the communication and mobilization between state and federal radiological assistance programs.

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ORGANIZATIONAL RESPONSIBILITIES

The responsibilities for dealing with an accident in transport are divided. The Federal Emergency Management Agency (FEMA) has primary responsibility at the Federal level for planning for response to transportation accidents involving radioactive materials. As a general principle, primary responsibility for establishing a plan lies with State and local governments. In support of State emergency preparedness programs various Federal agencies maintain plans, training and technical assistance programs, and response capabilities including specialized equipment which may be mobilized in support of State emergency activities. These include:

- Department of Energy (DOE) and its Regional Radiological Assistance Teams under IRAP and RAP
- Environmental Protection Agency (EPA)
- Department of Health and Human Services through the Food and Drug Administration
- Federal Emergency Management Agency (FEMA)
- Department of Transportation (DOT)
- Nuclear Regulatory Commission (NRC)

DOT is required to provide information and advice for meeting emergencies connected with the transportation of hazardous materials to all interested parties. Also, the Federal Aviation Administration (FAA), Federal Railroad Administration (FRA), Federal Highway Administration (FHWA), Coast Guard,

and National Transportation Safety Board have responsibilities for investigating transportation accidents, and the appropriate agency may become involved at any time.

A general description of the various roles played by State and local governments, the shipper and the carrier follows:

I. State Government

The State radiation control agency (or equivalent) has responsibility to protect persons within the State from unwarranted radiation exposure. The State radiation control agency can develop and distribute a viable Radiological Emergency Response Plan; designate an Incident Response Team(s); coordinate a communications system of State, local, and Federal agencies involved in emergency radiation response; negotiate agreements with contiguous States addressing response to incidents in close proximity to a common border; and prepare (or assist in preparing) and distribute implementing instructions and operational procedures to be used by State, local, and/or other emergency response personnel in carrying out their responsibilities under this plan.

The major responsibilities of the State civil defense agency (or equivalent) are in developing State and local plans to cope with radiation hazards resulting from a nuclear war or the effects of a natural or manmade disaster. In the event that civil defense personnel are informed of a transportation incident before the State radiation control agency, or are first to arrive at the incident scene, their responsibility

may be as follows: to notify the State radiation control agency immediately; to initially handle the incident at the scene, as outlined in the State plan; and to provide civil defense radiation monitoring personnel. In most cases, law enforcement officials who arrive at the scene initially, will be in overall charge until replaced by other competent authority.

Due to its extensive communication system and the linkup with the State radio network, the State Police would serve as an alternate to be called when the radiation control agency or the civil defense agency cannot be reached. Upon receiving an initial incident report, the State Police should record all information deemed essential.

II. Local Government

Local civil defense (or equivalent) functions in a disaster until normal government can be reestablished. Its responsibility is to coordinate development of a local emergency response plan compatible with the State response plan defining the roles and responsibilities which local authorities will play in the event that an emergency occurs in their community.

In the event that civil defense or emergency management personnel are informed of a transportation accident involving radioactive materials before the State radiation control agency, or are first to arrive at the scene, their responsibilities are to notify the State radiation control agency immediately. Local law enforcement officials at the

scene would initially be the responsible authority. The local law enforcement agency may be called on to escort or provide transportation for an incident response team to the incident site and keep lines of communications open between the incident scene and control headquarters of the radiological lead evaluation agency (State radiation control agency, or DOE, NRC or DOD). Local fire departments are usually called in to fight fires or perform rescue services in which radioactive materials are involved.

III. Shipper

It is the responsibility of each shiper to know and comply with all applicable Federal, State, or local regulations pertaining to the shipment of radioactive materials. He is to be prepared to assist in an emergency response to an accident involving any of his radioactive consignments. He should designate on or append to the shipping document a list of telephone numbers of persons knowledgeable of the shipment and its characteristics at all times during the snipment. The shipper should prepare, and maintain on a current basis, an emergency response plan and procedures for transportation accidents involving radioactive materials.

Regarding emergency response actions, if the shipper is the first to be notified of a highway accident involving radioactive materials he should record all of the information given him by the caller, ask the caller for the telephone number from which he is calling, ask him to notify the State Police, and requests that he stand by

and await a call from the carrier dispatcher. If the shipper maintains emergency response personnel or equipment, he begins preparation to assist at the accident scene. The shipper assists the carrier in determining the desired level of response, based on information at hand immediately following the accident and on the shipper's response plan. Finally, if the shipper is acting in the capacity of an agent, it is vital that he keep his client currently informed of any accidents involving the latter's material.

IV. Carrier

It is the responsibility of each carrier to know and comply with all applicable Federal, State, or local regulations, pertaining to the carriage of radioactive materials. The carrier has primary responsibility for: ensuring that [illegible]nd proper response is initiated; providing appropriate resources for the resolution of the incident, when needed; and maintaining working contact with the responsible governmental authority until the latter has declared the incident to be satisfactorily resolved and closed.

The carrier is to immediately notify DOT and other governmental authorities as required by regulations; and notify the appropriate carrier official to contact the shipper and in conjunction with the shipper, using information available at the time, ascertain the maximum probable hazard associated with the incident. This will dictate the level of response until additional information is available.

The carrier has the basic responsibility for containing or confining any threat associated with his cargo. Additionally he must see that the cleanup is completed.

The cost of cleanup and any liability for damages resulting from the incident are borne, in most cases, by the carrier. The fixing of such costs and real responsibility for them will be determined by the courts.

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III. Planning Elements

A. Assignment of responsibility (Organizational Control)

Purpose: To assure that primary responsibilities for emergency response to transportation accidents involving radioactive material have been assigned, that the emergency responsibilities of the various supporting organizations have been specifically established, and that each principal response organization is staffed to respond and to augment its initial response on a continuous basis.

1. Each plan should identify the State, local, federal and private sector organizations that are intended to be part of the overall planning and response.

2. Authority and responsibility should be assigned by the Governor of a State (or head of a local government) or by legislation to agencies capable of planning for and responding to a transportation accident.

3. Each organization having an operational role shall specify its concept of operations, and its relationship to the total effort.

4. Each plan shall illustrate these interrelationships in a block diagram.

5. Each organization shall identify a specific individual by title who shall be in charge of the emergency response. Delegations of authority should be carefully considered.

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6. Authority and responsibility should be assigned for major functions, such as: command and control, warning, communications, public health and sanitation services, fire, rescue, law enforcement, traffic control, public works (engineering), public information, emergency medical services, transportation, social services, accident assessment, protective response (including authority to request Federal assistance and to initiate other protective actions), and radiological exposure control.

7. The plan shall include written agreements referring to appropriate legal instruments such as legislation, among Federal, State, and local agencies and other suport organizatins having an emergency response role. The agreements shall identify the emergency measures to be provided and the mutually acceptable criteria for their implementation, and specify the arrangements for exchange of information.

8. Each emergency organization shall be capable of continuous (24-hour) operations for a protracted period. The individual in the emergency organization who will be responsible for assuring continuity of resources (technical, administrative, and material) shall be specified by title.

9. The first on the scene emergency response organization should establish a command post at the accident scene.

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10. On scene coordination should be transferred to the lead emergency response organization upon its arrival at the scene of the accident.

11. The plan should include shipper, carrier and government responsibilities and liabilities for decontamination, reclamation and waste disposal with references to appropriate legal instruments.

12. The plan should include provisions for cost recovery.

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B. Analysis of Radioactive Material Transporation

Planning Objective

To make responders aware of the most likely places of accidents and the general types of problems they might encounter.

Guidance

1. An analysis should be made to determine the names and locations of all major shippers and receivers within the state and local community. These should be listed either in the plan or in an appendix which can be easily updated.

2. Major routes for shipments of large quantities of radioactive materials either within the State or through the State should be determined and listed either in the plan or in an appendix for easy updating.

3. Routes used for routine shipments of all radioactive materials should be determined and listed either in the plan or in an appendix for easy updating.

4. A determination should be made of the general types and quantities of radioactive materials transported either within or through the State. These should be listed in an appendix for easy updating.

5. Transportation hubs such as airport terminals and freight yards should be determined. These should be listed in an appendix.

6. Special factors which may influence transportation accidents should be determined. These factors could include, for example: accident-prone sections of highways due to topography or geopgraphy; cyclic shipping (such as may occur routinely from facilities producing nuclides used for medical diagnosis); weather.

C. Contiguous State and Local Coordination

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Purpose

To ensure that contiguous state and local political jurisdictions can adequately coordinate their responses to a radiological transportation accident.

Guidance

1. Contiguous states, adjacent local jurisdictions in contiguous states, and states and local jurisdictions in contiguous states should make formal mutual agreements.

2. These agreements should establish mutually acceptable protective action levels and protective measures, following federal guidance and showing level of support and method of obtaining support.

3. Jurisdictional agreements should delineate responsibility for emergency planning and response for accidents occurring on or near the boundaries of states and localities. Provision should also be made for resolving potential legal problems such as the liability of parties in such interstate agreements. Support agreements such as "mutual aid" contracts under interstate nuclear compacts are among the methods available for dealing with this matter.

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D. Emergency Equipment, Facilities, and Resources

PURPOSE: To assure that arrangements for requesting and effectively using assistance resources have been made and that adequate emergency facilities and equipment to support the response are provided.

1. Basic emergency equipment that is available from any source and can be put into use in a timely manner should be inventoried and maintained.

2. The plan should describe the emergency equipment, where it is located, availability details and the method of gaining access to the equipment during an emergency.

3. Types of equipment referred to here can be highly variable depending on the type of accident. The planners are encouraged to research this area carefully so that equipment is suited to specific characteristics found in various geographical areas. For example, equipment and instruments capable of use during extremely cold or snowy weather should be available in Colorado but not Southern California. Examples of such equipment are:

   a. Vehicles capable of transporting emergency teams and their equipment to the accident scene (this may include ground vehicles, aircraft and watercraft).

   b. Mobile emergency operations and communications centers.

   c. Traffic control equipment.

   d. Portable, self-contained emergency lighting equipment.

   e. Emergency barriers (e.g. snow fencing, warning signs).

   f. Portable emergency decontamination equipment (e.g. portable showers and tents).

   g. Earthmoving and construction equipment.

4. Radiation detection instrumentation available for 24-hour emergency use should be identified. The method for obtaining this equipment during an emergency should be described.

5. Environmental sampling equipment and method of access should be described. This should include air, water, soil, vegetation and food sampling equipment.

6. Inventories of portable "field" meteorological instruments and facilities available for emergency use and their access should be described.

8. WRitten mutual aid agreements with federal and state governments, institutions, and private industry should be completed. The extent and any limitations of the assistance should be clearly described in the agreement.

9. Contracts or other written arrangements for technical assistance from health physics and other specialized consultants (e.g. hazardous materials or explosives experts) should be identified.

E. Notification Methods and Procedures

Planning Objective

To assure that the federal, state, and local organizations have established appropriate procedures for contacting emergency response personnel; to assure that the carrier and shipper have appropriate procedures for notifying emergency response personnel; and to assure that accurate initial follow-up messages have been disseminated to the appropriate emergency response organizations and to the public.

Evaluation Criteria	Applicability and Cross Reference to Plans				
	Carrier	Shipper	Federal	State	Local
1. Each organization shall establish procedures which describe mutually agreeable bases for notification and exchange of information among response organizations.	X	X	X	X	X
2. Each organization shall establish procedures to include the following information:					
a. The bases (i.e. emergency action levels) for notification.	X	X	X	X	X
b. The methods of communication to be used (i.e. telephone, radio, teletype, etc.).	X	X	X	X	X
c. Call lists of specific responsible authorities to be notified.	X		X	X	X
d. A capability for 24-hour coverage in both communications and personnel.	X		X	X	

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E. Notification Methods and Procedures (continued)

Evaluation Criteria	Applicability and Cross Reference to Plans				
	Carrier	Shipper	Federal	State	Local
3. The shipper and carrier are responsible for contacting the appropriate federal, state, and local organizations and providing the following information if it is known and appropriate:					
a. Location of incident and telephone number (or communications channel identification) of caller;	X	X			
b. Date and time of accident;	X	X			
c. Class of emergency;	X	X			
d. Type of actual or projected release (airborne, waterborne, surface spill, and estimated duration/impact times;	X	X			
e. Estimate of quantity of radioactive material released or being released and height of release;	X	X			
f. Chemical and physical form of released material, including estimates of the relative quantities and concentration of noble gases, iodines, and particulates.	X	X			
g. Prevailing weather (wind velocity, direction, temperature, atmospheric stability data; form of precipitation, if any);	X	X			
h. Actual or projected dose rates at site of accident; projected integrated dose at site of accident;					
i. Projected dose rates and integrated dose at about 2.5, and 10 miles, including sectors affected.					

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E. Notification Methods and Procedures (continued)

Evaluation Criteria	Applicability and Cross Reference to Plans				
	Carrier	Shipper	Federal	State	Local
j. Estimate of any surface radioactive contamination;	X	X			
k. Emergency response procedures and actions underway;	X	X			
l. Recommended emergency actions, including protective measures;	X	X			
m. Request for any needed on-site support by other organizations;	X	X			
n. Prognosis of worsening or termination of event based on current information;	X	X			
o. Injured personnel requiring off-site assistance;	X	X			
p. Verification procedure to confirm authenticity of call	X	X			
q. Methods should be established for providing updated information on a continuing basis concerning the progress and control of the accident and associated environmental conditions;	X	X			
4. Federal, state, and local government organizations shall establish a system for disseminating the information contained in the initial and follow-up messages received from the accident site. The procedures should include:					
a. Identification of specific individuals in organizations who will be responsible for notifying the affected population;			X	X	X
b. The methods to be used;			X	X	X

E. Notification Methods and Procedures (continued)

Evaluation Criteria	Applicability and Cross Reference to Plans				
	Carrier	Shipper	Federal	State	Local
c. The bases (i.e. emergency action levels) for notification;			X	X	X
d. A capability for 24-hour-day notification;			X	X	X
e. A general description of the information that would be communicated to the public under given circumstances;			X	X	X
f. Verification procedure to determine authenticity.			X	X	X
5. Each organization shall provide written messages indented for the public. In particular, messages should give instructions with regard to specific protective actions to be taken by occupants of affected areas. Such messages should include appropriate aspects of sheltering, thyroid blocking, or evacuation.	X	X	X	X	X
6. Procedures should be established for notification and exchange of information between contiguous states.				X	
7. Establish highway routing requirements for carriers.		X	X	X	
8. Establish procedures for communications with transport vehicles.		X	X		
9. Develop a classification system for radioactive materials which can be consistently used among all organizations and apply procedures as appropriate	X	X	X	X	
10. Develop a consistent manifest system among all organizations.	X		X	X	

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F. Emergency Communications (continued)

Evaluation Criteria	Applicability and Cross Reference to Plans				
	Carrier	Shipper	Federal	State	Local
h. Vehicle communicate with organization on a periodic basis which is specified by NRC;	X		X		
i. Establish appropriate field communication capability;			X	X	X
j. Provision for communication by the carrier with NRC headquarters, NRC Regional offices, radiological monitoring team, and other appropriate organizations;	X		X	X	
2. Plans for using public communications media or other communciations methods for issuing emergency instructions to the public living in areas surrounding the accident.				X	X
3. Each organization is to conduct periodic testing of the communication system.	X	X	X	X	X
4. Develop a classification system for radioactive materials and apply the procedures as appropriate.	X	X	X	X	

G. Public Information

Planning Objective

To establish mechanisms for dealing with news media and the general public during an accident to provide accurate and timely information.

Guidance

1. Central control over the issuance of post-accident public announcements should be established within State and local governments.

2. Each principal organization should designate a spokes-person who should have acess to all pertinent information and people and who should be kept informed of developments.

3. The identity of this person should be published and information provided on how the person can be contacted.

4. Methods and procedures should be established for coordinating public information releases with other organizations (Federal, State, local, shipper, carrier) to avoid erroneous or conflicting information.

5. Public information should be provided in layman's terms, and plans should be made to have releases reviewed for technical accuracy.

6. Plans should be made for providing early and complete information.

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Guide and Checklist
for Emergency Response to Transportation Accidents
Sections H, I & J

H. ACCIDENT ASSESSMENT

PLANNING OBJECTIVE

To identify, establish, and assure the adequacy of methods, systems, and equipment for monitoring a radioactive materials release and assessing its actual or potential consequences.

GUIDANCE

1. Methods to identify the routes used for transporting radioactive material, the types and amounts of material transported within the State, and previous accident records should be established. The information generated should be updated on a regular basis and should be used to determine:

   a. Where to place particular emphasis on the need for emergency response capability based on frequency, size, and type of materials shipped.

   b. The magnitude of equipment and personnel projected to be necessary at any particular location for an adequate response.

   c. Local areas where accident frequency is unusually high which either need to be avoided (in compliance with applicable Department of Transportation routing regulations) or intensely prepared for.

2. The first officials at the scene will probably be police, firemen, and paramedics. Plans for proper response by these personnel should be established and should include at least the following topics:

   a. Determination that radioactive materials are involved.

   b. How to obtain all possible information regarding the type, quantity, and chemical form of the radioactive material involved.

   c. Special procedures deemed necessary concerning first aid, and crowd and traffic control.

d. Accident description and location, condition of radioactive materials packages, fire potential, weather conditions, and any other problems or potential problems.

e. Which State and local officials (including any special emergency response team) should be notified and how and when to do so.

For further information refer to the course material for "Handling Radioactive Materials Transportation Emergencies" prepared by the Department of Transportation.

3. Trained State and local radiological assessment teams (RATs) should be established (a team may consist of one or more persons). Their composition and equipage (protective clothing and equipment and criteria for its use, assessment instruments, etc.) should be described. Provisions should be made for their rapid location and notification.

4. Guidance for the RAT should be provided regarding the following topics:

   a. Types of measurements to be taken as a function of accident type.

   b. Dose projection techniques based on accident type and field measurements.

   c. Control area procedures.

   d. Environmental sampling procedures.

   e. Methods of obtaining meteorological information.

5. Provision should be made for special radio or other rapid communications among RAT members and a central State or local government radiological assessment control point.

6. State the chain of command at the accident site explicitly. There should be one person with overall authority and responsibility, and all personnel onsite should know who it is.

7. Provision should be made for radiological assessment during periods of inclement weather.

8. Provision should be made for recordkeeping and documentation of the offsite effects of the accident.

For additional information refer to "Emergency Response Scenarios for Transportation Accidents Involving Radioactive Materials," NUREG/CR-1149.

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I. PROTECTIVE RESPONSE

PLANNING OBJECTIVE

Assure that methods or procedures for recommending protective actions under a variety of accident conditions are established.

GUIDANCE

1. Identify methods for rapidly obtaining information on the local environment, including population distribution, food crop types and distribution, surface drinking water sources, and alternate traffic routes.

2. Methods for projecting population dose should be established.

3. Identify and list Protective Action Guides (PAGs) for population protection and exposure limits for emergency workers. Also identify action levels for crowd and traffic control.

4. Guidance should be provided regarding when to implement protective actions based on the projected dose for inhaled radionuclides, whole body dose from airborne radionuclides, and ingestion of contaminated food and water.

5. Plans should include guidance on proper implementation of protective actions considering possible constraints such as weather, accident injuries, and other competing emergencies.

6. The benefits of protective measures, such as evacuation and shelter with improvised ventilation controls or respiratory protection, should be planned.

7. Provision should be made for possible administration of radio-protective drugs, e.g., prophylactic iodine compound to achieve thyroid blocking, to certain members of the populace and to emergency workers.

8. Methods should be established to control entrance to and egress from accident-affected areas.

9. Provision should be made for accounting for persons involved in the accident or evacuated from the accident environs.

For further information consult the following references:

a. EPA "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents."

b. NRC "Emergency Response Scenarios for Transportation Accidents Involving Radioactive Materials," NUREG/CR-1149.

c. IAEA "Planning for OffSite Response to Radiation Accidents in Nuclear Facilities," IAEA-TECDOC-225.

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J. RADIOLOGICAL EXPOSURE CONTROL

PLANNING OBJECTIVE

To assure that means for limiting radiation exposures are established.

GUIDANCE

1. Information should be assembled concerning criteria, based upon Federal guidance, for protecting emergency personnel from excessive exposure to radiation while in the course of accident assessment, rescue of endangered or injured personnel, lifesaving activities, evacuation of affected population, and protection or prevention of property damage or loss.

2. Describe acceptable procedures for monitoring persons potentially contaminated, either internally or externally, at the scene of the accident.

3. Describe procedures and equipment considered acceptable for proper personnel and equipment decontamination. Release criteria should be established.

4. Describe typical procedures for reducing radiation exposure from external and internal exposure pathways and for preventing the spread of contamination.

5. Equipment for personnel dosimetry for emergency workers should be described, and procedures for its use should be provided.

6. Identify medical facilities willing to accept contaminated persons. Determine whether patients would be accepted on an outpatient or inpatient, or both, basis.

7. Facilities for obtaining whole body count or bioassay analyses should be identified.

8. Provisions should be made for recordkeeping on all personnel, including emergency workers and evacuees, monitored for contamination. Include at least the following information:

   a. Monitored person's name and address.

   b. Location, time, and date of monitoring.

   c. Instrument used and date of last calibration.

   d. Radiation or contamination level found.

   e. Advice given to person.

K. Medical Support

PURPOSE: To assure that arrangements are made for medical services for injured persons who may be contaminated.

1. All hospitals having a written plan for adequately treating radiation contaminated patients should be listed and described. Maps should show the hospital locations throughout the state.

2. If possible, the appropriate state agency should provide training, upon request, for medical personnel involved with the plan.

3. Existing training and assistance programs should be described.

4. A list of qualified medical consultants who can, if necessary, assist state/local government medical authorities.

5. Emphasis should be given to training and encouraging smaller rural hospitals located near major highways to develop response plans.

L. Postaccident Operations

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PURPOSE

Plan postaccident operations, including cleanup and decontamination of property, vehicles, and equipment affected by the transportation incident.

GUIDANCE	PLAN REFERENCE
1. A state technical group should be established to plan, direct, and evaluate cleanup and decontamination operations	
Plans and criteria should include:	
2. A controlled area around the transportation incident. Control and radiological surveillance should be addressed. Criteria should be developed for decontrolling the area.	
3. General postaccident operations: Traffic control, Emergency personnel scheduling and transportation, Food and shelter, supply and distribution, Other operations.	
4. Technical assistance from nongovernmental sources.	
5. Control of possibly contaminated food and water supplies.	
6. Decontrol of possibly contaminated property, vehicles, equipment, food supplies, and water supplies.	

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M. Radiological Emergency Response Training

Planning Objective

To assure that training is provided to emergency response personnel who may be called upon to assist in a transportation accident involving radioactive material.

Guidance

1. Programs should be established for initial training and periodic retraining of all personnel who have responsibilities in responding to transportation accidents involving radioactive materials.

   These programs should include, at a minimum, basics of the following subject matters for all personnel:

   a. Radiation, Radioactivity, and Contamination*.

   b. DOT and NRC regulations on transportation of radioactive materials.

   c. Placards and labels*.

   d. Relative hazard of radioactive materials and other materials.

   e. General responsibilities of carriers, shippers, and licensees in emergencies.

2. Training should be provided for state and local personnel for specific problems which may be encountered relative to those items listed in section III B of this document. That is, the training should provide familiarity with major shipper and receiver locations, major routes, types and quantities of radioactive materials typically transported, transportation hubs, and any special factors which may influence the transport (such as geographical features of the route, timing of shipments, or meteorological conditions).

3. Training should be provided in all specific emergency plans of and carriers which would interrelate with state and local government plans.

4. Each state and local response organization shall participate in and receive training. Where mutual aid agreements exist, the training shall also be offered to the other organizations who are part of the agreement.

5. Specific training shall be provided to those individuals with specific roles in response such as radiological accident assessment, monitoring teams, first aid and rescue, police and fire fighting personnel, and medical support personnel. Topics shall include such things as protective measures, monitoring, communications, relationship to Federal response capabilities, and decontamination and cleanup.

* The DOT course "Handling Radioactive Materials transportation Emergencies" is sufficient for this training.

N. Periodic Review and Update

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Planning Objective

To assure that the plans are revised and kept current.

Guidance

1. Provision should be made for at least an annual review and updating of emergency plans.

2. Provisions should be made to update plans sooner than annually if major changes are deemed necessary, such as for example experience gained from actual response. Minor changes can wait to be included during the annual review.

3. When changes are made, and after the annual review, all persons with copies of the plan shall be notified of such changes and review. If no changes are made this fact shall also be made known to holders of the plans.

4. An official distribution list shall be kept for holders of the plans.

5. Provisions should be made for confirmation by plan holders to the lead agency that the holders have received and recorded any changes, or reviews.

6. Each plan shall contain a detailed listing of supporting plans and their source.

APPENDIX A

II. Example Interstate Agreement

A. Statement of Policy

Whereas, the party States recognize the desirability of cooperation, joint planning, and mutual aid in coping with radiological incidents affecting the citizens or territory of both party States and the political subdivisions thereunder; and

Whereas, the party States seek to develop and implement procedures for immediate notification to appropriate State, local, and other authorities and to otherwise provide for protective actions in the event of radiological incidents involving or potentially involving both of the party States; and

Whereas, the party States recognize the desirability of cooperation and information exchange in surveillance of radioactive effluents from fixed nuclear facilities located at or near boundaries of the party States;

Therefore, be it resolved, that the parties hereby agree to cooperate in the environmental surveillance of and in responding to any radiological incidents resulting from the transport of radioactive materials and from operation of fixed nuclear facilities located at or near boundaries of the party States; and

Be it further resolved, that the parties hereby enter into this agreement for accomplishing the above objectives.

B. Purposes and Scope

This agreement shall be for the purposes of: (a) providing procedures for cooperation between the party States in contingency planning for nuclear incidents which potentially affect both States; (b) providing a system for notification of proper authorities in the other party State in the event of a nuclear incident affecting or potentially affecting both party States; (c) coordination of protective actions, public notification, and other emergency response activities for those

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nuclear incidents affecting both States; and (d) fostering exchanges of information among the parties concerning environmental radiation surveillance of fixed nuclear facilities which affect the airsheds or watersheds common to both States.

This agreement shall not limit, diminish, or otherwise impair authority or jurisdiction exercised by the party States, the other parties to the Western Interstate Nuclear Compact, the federal government, or any other office or agency of a party State. Nothing in this agreement shall impinge upon the powers or other provisions of the Western Interstate Nuclear Compact; nor shall the parties to this agreement be relieved of their duties under Article VI ("Mutual Aid") of the Western Interstate Nuclear Compact.

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APPENDIX A

IV. DESCRIPTION OF AGENCY AND PRIVATE ORGANIZATION RESPONSIBILITIES

1. State Agencies

a. State Radiation Control Agency: Responsible for protection of public health and property; will:

(1) Develop and distribute an Emergency Radiation Response Plan.

(2) Designate an Accident Response Team(s).

(3) Coordinate a communications system of state, local and federal agencies involved in emergency radiation response.

(4) Negotiate agreements with contigouous states and localities in contiguous states concerning responses to accidents occurring close to common borders.

(5) Establish a system for receiving and cataloging assistance requests.

(6) Establish public information procedures.

(7) Develop an emergency radiation response training program for state and local agencies.

(8) Prepare or assist in preparing and distribute operating instructions and procedures for state, local and/or other emergency response personnel to use in carrying out their responsibilities.

(9) Develop procedures for controlling agricultural products and water supplies during emergencies.

b. State Civil Defense: Responsible for developing state and local recovery plans; will:

(1) Notify State Radiation Control Agency immediately, if this has not already been done.

(2) Assist in initial handling of accident, if necessary, with law enforecment officials on the scene having responsible authority.

(3) Designate Civil Defense radiation monitors to be called on by State Radiation Control Agency to assist in evaluation of radiological accident.

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(4) Refrain from releasing statements to the public about a radiation accident until cleared by the State Radiation Control Agency.

c. State Police: Responsible for rendering all necessary police assistance and life-saving measures; will:

(1) Notify State Radiation Control Agency.

(2) Initiate initial response actions.

(3) Arrange for transportation of injured, exposed, or radiation-contaminated individuals to a medical facility.

(4) Make transportation assistance available to the State Radiation Control Agency to escort and/or transport the Accident Response Team to the accident.

d. State Highway Department: In the event it is on the accident scene first, the Department will:

(1) Contact the appropriate law enforcement agency and the State Radiation Control Agency.

(2) Initiate initial response actions.

(3) Assist law enforcement agencies at their discretion, including directing traffic flow, rescuing injured, and controlling public access to and from the accident scene.

(4) Remove debris and/or vehicles, with the authorization of the State Radiation Control Agency.

e. State Agriculture and/or Commodity Control Agency: Responsible for controlling all agricultural products and associated production which may be affected by the accident.

f. State Environmental Control Agency: Responsible for management, control, treatment, and enforcement of quality standards for state waters which may be contaminated by spillage from an accident.

g. State Wildlife Agency: Responsible for providing sampling of game and fish suspected of being contaminated as a result of a radiological transportation accident.

h. State Radio Communications Agency: Responsible as the communications hub between the State Radiation Control Agency, law enforcement unit at the accident scene, and Accident Response Team enroute to the scene; will:

(1) Gather the initial information concerning the accident.

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(2) Relay the information to the State Radiation Control Agency.

(3) Maintain communications for relay of information from and instructions to the accident scene.

2. Local Agencies

a. Law Enforcement: Responsible for regular enforcement duties; will:

(1) Carry out only essential activities of the initial response action.

(2) Escort or provide transportation for the Accident Response Team to the accident site and keep lines of communication open, if so requested.

b. Fire Department: Responsible for fighting fires or performing rescue services at accident; will:

(1) Notify State Radiation Control Agency for assistance.

(2) Remain upwind of the fire and debris as much as possible and wear proper respiratory protection equipment.

(3) Attempt to determine the type of radioactive materials involved in the fire, reading vehicle placards or questioning the vehicle driver.

(4) Generally refrain from using water to fight the fire (see list of extinguishing agents for radioactive materials).

c. Municipal Airport Officials: Responsible for:

(1) Immediately notifying the State Radiation Control Agency and providing it with essential information.

(2) Detaining the other cargo and aircraft if it appears there may be contamination and rope off ramps or airport buildings if contaminated.

d. Municipal and County Health Agencies: Responsible for protecting life and property in their jurisdictional area, which may include the collection, under the direction of the State Radiation Control Agency, of environmental samples and performing radiation surveys.

3. Private Sector

a. Truck and Rail Freight Terminals: If a radioactive materials container is found to be damaged or the possibility of contamination exists, the supervisor of the terminal will:

(1) Notify the State Radiation Control Agency.

(2) Carry out only essential activities of the initial response action.

b. Carriers: Will:

(1) Initiate the appropriate initial response actions.

(2) Notify the nearest district office of the carrier, which in turn will notify the shipper and jointly develop and implement a cleanup procedure, subject to approval of the State Radiation Control Agency.

(3) Notify other relevant federal agencies (FEMA, DOT, NRC, etc.) and other state or local authorities as may be required by federal or other regulations.

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F. Emergency Communications

Planning Objective

To assure that provisions exist for prompt communications among principal response organizations, to emergency personnel, and to the public.

Evaluation Criteria	Applicability and Cross Reference to Plans				
	Carrier	Shipper	Federal	State	Local
1. The plan for emergency communications should include the following:					
a. Organizational names and titles and also alternates for each organization;	X	X	X	X	X
b. Establish reliable primary and backup means of communication for operators;	X	X	X	X	X
c. Systems among organizations must be compatible;	X	X	X	X	X
d. Provision for 24-hour-day notification to and activation of the Federal/State/Local emergency response network including 24-hour per day manning of communication links;	X	X	X	X	X
e. Provision for communications with contiguous state and local governments;				X	X
f. Provision for communications links among the carrier/shipper; federal, state and local emergency response organizations; and field assessment teams.	X	X	X	X	X
g. Vehicle must be equipped with a radio-telephone which meets FCC requirements;	X		X		