DEPARTMENT OF TRANSPORTATION

Research and Special Programs Administration

49 CFR Parts 173 and 177

[Docket No. HM-164; Notice No. 80-1]

Highway Routing of Radioactive Materials

AGENCY: Materials Transportation Bureau (MTB), Research and Special Programs Administration, DOT.

ACTION: Notice of proposed rulemaking.

SUMMARY: This notice proposes to establish routing requirements to apply to carriers by highway of radioactive materials when placarding is required. General requirements would apply to all such carriers, and more specific requirements, concerning use of Interstate highways, written route plans, and driver training, would apply to carriers of large quantity packages (which would include commercial shipments of irradiated reactor fuel). Recent action by the Nuclear Regulatory Commission regarding physical security of irradiated reactor fuel offered for transportation by its licensees would be recognized and extended to all shippers of irradiated reactor fuel. Certain actions by State governments concerning radioactive materials routing by highway would be recognized. This proposal is intended to reduce the possibility of exposure and inadvertent releases in normal and accident situations in transportation, and to clarify the scope of permissible State and local action.

DATE: Comments must be received by May 31, 1980. Public hearings will be announced later.

ADDRESS: Comments should be addressed to: Dockets Branch, Materials Transportation Bureau, U.S. Department of Transportation, Washington, D.C. 20590. It is requested that five copies be submitted. Dockets may be reviewed in Room 8426, 400 Seventh Street, S.W., Washington, D.C. between 9 am and 5:30 pm weekdays.

FOR FURTHER INFORMATION CONTACT: Marilyn E. Morris, Regulations Specialist, Standards Division, Office of Hazardous Materials Regulation, Room 8102, 400 Seventh Street, S.W., Washington, D.C. 20590, phone 202-426-2075.

SUPPLEMENTARY INFORMATION:

I. Historical Background

In 1976, truck shipments of irradiated reactor fuel (spent fuel) from Brookhaven Nationald Laboratories' Long Island facility were interdicted by an amendment to the New York City Health Code. The Health Code amendment had the practical effect of banning most commercial shipments of radioactive materials in or through the City. Associated Universities, Inc., which operates Brookhaven National Laboratories, asked DOT whether that ordinance was preempted by Federal transportation safety requirements issued under the Hazardous Materials Transportation Act (HMTA) (49 U.S.C. 1801 *et seq.*). On April 20, 1978, DOT published an Inconsistency Ruling (43 FR 16954) in which it viewed the City's Health Code amendment as an extreme routing requirement intended to protect the very dense urban population found inside the City. DOT concluded that the HMTA could preempt local requirements such as New York City had implemented, but because highway routing authority had not yet been exercised under the HMTA, the City's health code was not preempted by HMTA requirements.

A number of other State and local governments have either passed, or proposed, legislation that severly restricts transportation of certain radioactive materials through their jurisdictions. These actions do not seem to be based on the relative significance of previous accidents involving radioactive materials transportation. The information available to DOT through the Department's Hazardous Materials Incident Reporting System, to which carriers report incidents involving any release of a hazardous material in transportation, or any suspected radioactive contamination, indicates that radioactive materials transportation has a good safety record. In 1977 the DOT estimated that 2.5 million packages of radioactive materials were being transported by all modes yearly. This estimate closely approximates the 2.19 million packages reported in the study "Final Environmental Statement on the Transportation of Radioactive Material by Air and Other Modes" (December 1977) (NUREG 0170) (p. 1-18) as being shipped in 1975. From 1971, when the reporting system was established, until August 1979, a total of 463 incident reports were received involving radioactive materials (0.5% of the total reports received). In comparison, approximately 45,000 incident reports were received which involve flammable liquids (51% of the total). Of the 463 reports filed since 1971 involving radioactive materials, 323 concerned highway transportation, and of this number approximately 275 were reports of minor or suspected contamination to the container and/or transport vehicle due to improperly prepared shipments. The more severe of the reported highway incidents involved vehicle accidents which resulted in packages of radioactive materials being burned, thrown from the vehicle, or rolled on by the vehicle. These events occurred in about 15% of the reported incidents. Examples of such incidents reported last year include:

(1) The January 10 collision near Morristown, Tennessee of a truck tractor and flat-bed trailer carrying 5 cylinders, each containing 6800 pounds of radioactive material fissile, n.o.s. (Uranium Hexafluoride UF_6) into the rear end of a tank truck. The crash resulted in the total loss of the truck power unit and personal injuries to the driver. The cylinders however, remained intact and the trailer sustained very limited damage. The load was returned to Oak Ridge, Tennessee using another power unit. No loss of contents or increased radiation levels were detected.

(2) A single vehicle accident on March 22 involving a truck tractor and enclosed semi-trailer carrying 54 steel drums of 55 gallon capacity, each containing approximately 810 pounds of Radioactive Material, LSA, n.o.s. (yellowcake). In this incident the vehicle was travelling on a portion of I-235 near Wichita, Kansas. The shoulder of the road was composed of soft dirt due to a recent excavation required for the construction of an interchange. Travelling at a speed of 50-52 MPH the right rear wheels went into the soft shoulder on the right side of the road. When the driver attempted to steer the truck back onto the road, the truck began to swerve to the left, overturned, and landed across the road on its right side. As a result of the accident, 51 drums came through the roof of the trailer and scattered as far as 100 yards from the truck in the direction the truck was initially travelling. About 1800 pounds of the 43,782 pounds of yellowcake was spilled. Cleanup operations and recovery of the yellowcake required 9 days to complete. This incident resulted in personal injuries to the driver but no radiological damage occurred to personnel and essentially none to the environment.

(3) The loss of a package of radiopharmaceuticals (radioactive yellow-III label) from the rear of a local delivery truck on August 16 onto a city street in Des Moines, Iowa. The package weighing 29 pounds consisted of a lead shielded generator (Molybdenum 99/Technetium 99) and glass vials of a

sterile saline solution. Extensive damage was incurred by the package from the wheels of passing motor vehicles resulting in the scattering of its contents. While several of the glass vials were broken the generator itself was not damaged to the point of releasing its contents, nor was there an increase in radiation levels.

None of these or any of the radioactive materials incidents reported to date resulted in radiological health consequences as severe as the consequences reported sometimes to result from the behavior of flammable liquids in transportation accidents. Nonetheless, it seems likely that State and local interest in radioactive materials transportation will continue. Reasons for this interest involve qualitative differences between transportation hazards posed by radioactive materials and transportation hazards posed by other materials.

Transportation accident risk and estimates of population doses from normal accident-free transportation for radioactive materials have been made in NUREG 0170 and in the preliminary report "Transport of Radionuclides in Urban Environs: A Working Draft Assessment" (May 1978, SAND77–1927) (Urban Environs Draft) (both documents are available for review in the public docket). Those estimated risks are within the magnitudes of other socially accepted risks, such as evidenced in highway traffic fatality rates.

Public concern with radioactive materials transportation, however, is more profound than those estimates would suggest is justified. In part this concern reflects the distinction between risks which are likely to be concentrated and similar risks spread over differing times and locations. The annual death rate from passenger car accidents, for example, usually is perceived as less catastrophic than major aircraft accidents, although far more people die in automobile accidents. This distinction may reflect the perceived limits of society to deal with catastrophic occurrences.

Discomfort from a lack of public familiarity with radiation hazards also increases the likelihood of local responses to radioactive materials transportation risks. Accident risk, for example, may be expressed in such unfamiliar terms as numbers of latent cancer fatalities, early deaths or morbidities, and genetic effects. Unlike other hazardous materials, radioactive materials present an impact during accident-free, or normal, transportation. This impact, called normal dose, results from the fact that under normal circumstances, some small amounts of radiation penetrate the outer surfaces of most packages of radioactive materials. Normal dose is very small, but it is statistically significant in terms of the overall impacts that result from radioactive materials transportation.

Radiation hazards themselves are comprised of a number of phenomena. A radioactive material may be solid, liquid, or gaseous, and thus may or may not easily be dispersed in a transportation accident. A radioactive material may be ingested or absorbed selectively and retained in plant, animal, and human tissues for varying lengths of time due to the basic chemical and physical characteristics of the different radioactive materials as well as the nature of the tissues. A person also can be exposed to radiation by being near an exposed radiation source. Radiation ordinarily cannot be detected except by instrumentation, unlike the well understood flammability hazard of such materials as gasoline.

Radiation health effects are not widely understood but include genetic effects and latent cancer, conditions which may not be mainfested until many years after exposure (which may not be recognized at the time it occurs). A thorough understanding of radiation and its known health effects requires a significant degree of technical knowledge. Other materials possess similar hazards, but the combination of these characteristics in the case of radioactive materials has produced a degree of public concern which has affected actions taken or being considered by State and local governments.

II. Discussion of Public Comments

In August 1978, DOT issued an advance notice of proposed rulemaking (43 FR 36492, August 17, 1978) opening this docket and asking for public comment to assist in deciding whether rules to govern highway routing of radioactive materials should be developed and proposed, and if so, what the rules should say. The advance notice did not propose any action but asked for comment on whether any action should be taken by DOT. Over 550 comments were received, falling principally into six groups.

A. Individuals; Public Interest and Environmental Organizations

This group comprises almost 70% of all comments received and falls into two subgroups:

(1) Individuals and organizations opposed to the transportation of nuclear materials or Federal involvement in local affairs. These commenters made two major points: local laws which are stricter than Federal regulations should be allowed to stand, and radioactive materials, particularly spent fuel, are inherently dangerous and should not be transported through heavily populated areas. One commenter urged MTB to adopt a full licensing scheme to apply to shipments involving a large number of curies (a unit of radioactivity) with an expressly reserved right in State and local governments to impose stricter standards. This commenter suggested banning large curie shipments from urban areas with population densities above 10,000 persons per square mile.

(2) Individuals and organizations favoring wider Federal preemption of State and local laws. These commenters stressed the excellent transportation safety record of radioactive materials and urged that additional requirements not be imposed. Many commenters in this group asked MTB to adopt a general routing rule which would specifically preempt unnecessary local restrictions that impede commerce.

B. State Governments and Political Subdivisions

Views were expressed by approximately 19 States, 7 counties and 10 cities or towns. Several States endorsed existing DOT requirements and supported a general routing rule such as that found at 49 CFR 397.9(a). Most commenting States appear to favor a general routing rule with provision for some State input. Most States also appear to be interested in obtaining more information on the types, quantities, and forms of radioactive materials shipped, and the routes actually used. Local governments, on the other hand, generally opposed any type of Federal interference with local laws and ordinances. Commenters from both urban and rural counties, as well as from cities, generally opposed transportation of radioactive materials through their jurisdictions.

C. Motor Carrier Industry

Commenters in the motor carrier industry were concerned with inconsistent State and local laws. The American Trucking Associations, Inc., (ATA) suggested that MTB establish a general routing rule which would give carriers some degree of flexibility within certain guidelines to use their own discretion over choice of routes. To provide for State input, ATA suggested that MTB prioritize highways for routing purposes by characteristics that States could use in determining specific routes within their jurisdictions. ATA also suggested the use of a "circuity limit" to establish maximum rerouting distances that could be required by States under this scheme. Finally, ATA states that any such routing requirements should be keyed to vehicles carrying sufficient amounts of radioactive materials to require placarding. (When certain amounts of any hazardous material are carried in a motor vehicle, DOT requires that a placard, or warning sign, be affixed to the vehicle. For radioactive materials, the placard bears the word "RADIOACTIVE" and an appropriate symbol.)

D. Shippers of "Low-Level" Radioactive Materials and Other Hazardous Materials

This group includes commenters representing manufacturers, users, and shippers of radiopharmaceuticals, medical and industrial isotopes, and other "low hazard" radioactive materials. It also includes shippers concerned with possible future routing controls on other hazardous materials (a matter beyond the scope of this docket). These commenters generally saw little reason to impose more stringent rules, but felt that if such rules were to be imposed, low-level radioactive materials should be excepted because of their time-critical nature (many medical radioisotopes lose their radioactivity over a relatively short period of time), low transport hazard, and medical/research value. Suggestions ranged from excepting all Type A quantity (from 0.001 to 1,000 curies of material per package, depending on the material) and limited quantity packages (small amounts otherwise generally excepted from DOT specification packaging, marking and labeling requirements) to excepting all non-placarded shipments.

E. Shippers of Large Quantity or "High-Level" Radioactive Materials

This group primarily includes shippers or shipper organizations associated with the nuclear power industry. Although there were only nine commenters in this category, one commenter represented 24 electric utility companies which are operating 39 nuclear power generators and planning the construction of 61 new generators. This commenter maintained that routing controls applying only to radioactive materials cannot be justified on the basis of safety alone, but that the proliferation of local restrictions on trnasportation justify the imposition by MTB of a general routing requirement to preempt State and local requirements. One commenter suggested a general rule that would require avoidance of heavily populated areas when possible, would provide for "voluntary licensing" of carriers for specific routes, and would permit State and local governments to seek an order from MTB prohibiting transportation of certain radioactive materials over specific routes.

F. Bridge and Turnpike Authorities

Comments were received from bridge and turnpike authorities, and from the International Bridge, Tunnel and Turnpike Association. These commenters expressed concern that their facilities might become part of a "designated hazardous materials route" established by MTB and pointed out that such action might raise their insurance rates.

III. Regulatory Background

A. Synopsis of Proposed Rule

The proposal presented in this publication would establish a general rule which would apply to any motor vehicle carrying radioactive materials requiring placarding. The general rule would require such a vehicle to be operated on a route that presents a risk to the fewest persons unless there is not any practicable alternative highway route available or unless it is operated on a "preferred" highway as subsequently defined. Subject to this provision, the motor vehicle would have to be operated on a route which minimizes transit times, so as to minimize unnecessary exposure. The carrier would be responsible for notifying the driver of the presence of radioactive materials in the shipment and for indicating generally the route to be followed.

A second, additional and more specific rule would apply to any motor vehicle transporting a package containing a large quantity of radioactive materials, as defined by existing DOT regulations. Such a motor vehicle would be required to operate on "preferred" highways, defined as any highway approved for that purpose by an appropriate State agency, and any Interstate highway for which an equivalent substitute has not been provided by such State agency. The vehicle would operate in accordance with a written route plan prepared by the carrier before departure. State agencies could designate preferred highways, after consultation with local jurisdictions, based on the policy of an overall minimization of radiological and nonradiological impacts of both normal transportation and transportation accidents. When necessary, a motor vehicle containing a large quantity of radioactive materials could operate away from preferred highways under the provisions of the general rule. The driver of a motor vehicle containing a large quantity package would be required to receive specific training. Each shipper of a large quantity package would be provided by the carrier with a copy of the written route plan, which the shipper would file with MTB (except for irradiated reactor fuel covered by NRC requirements). The filed route plans would be used by MTB to provide data on routes, amounts and shipment frequencies for use in State and local emergency response planning. Information on the movements of irradiated reactor fuel would be available after the MTB received this information from the NRC.

The specific large quantity rule would require use of an Interstate urban circumferential or bypass route to avoid cities if available, instead of an Interstate through route, notwithstanding a minor transit time increase. For cities with Interstate through routes without Interstate circumferential or bypass routes, a State could designate any available circumferential or bypass route if it is essentially equivalent in performance or design to an Interstate circumferential or bypass situated in some other urban location.

B. Existing DOT Requirements for Transport of Radioactive Materials

This document focuses on routing and related operational controls for highway transportation of radioactive materials. Existing provisions in the DOT Hazardous Materials Regulations address required packaging and related transportation controls, which constitute the primary safety measures in radioactive materials transportation. A brief summary of those existing rules follows.

Packaging for radioactive materials transportation is based on amount, kind, and physical form of the radioactive material to be transported. Each radionuclide is assigned to a Transport Group, of which there are seven that are ordered to reflect the various radionuclides' degree of radiotoxicity and relative hazard in transportation. For each Transport Group, two quantity limits are established which define Type A and Type B quantities, for which Type A and Type B packaging then is prescribed. If the radionuclide is in "special form" rather than "normal form", quantity limits for Type A and B quantities are larger, because materials in special form are difficult to disperse, either because of the inherent properties of the materials (such as a solid metal) or because the materials are specially prepared (as through encapsulation).

In most cases, a warning label must be applied to each package of radioactive material. The kind of label required depends on the radiation dose rate at or near the surface of the package. The dose rate, in turn, is determined by the type of packaging and shielding used within the package, and by the type and quantity of radionuclides present in the package. There are three labels which may appear on a package of radioactive materials: White I, Yellow II, and Yellow III. The amount of surface radiation allowed for each type of label is identified subsequently in the discussion of radioactive materials covered by this rulemaking. It is sufficient to state here that any vehicle which carries a package labeled Yellow III must show the radioactive material placard on all four sides of the transport vehicle. In addition, all vehicles which carry Fissile Class 3 (certain fissile radioactive materials which require special transportation arrangements for that reason) and large quantity packages must be placarded regardless of the dose rate of the package.

Three other terms that affect packaging are "limited quantity", "low specific activity" (LSA), and "large quantity". Limited quantities of radioactive materials are small amounts, such as may be found in certain manufactured articles (instruments, electronic tubes). Limited quantities of the various radionuclides also are defined generally by an activity limit in millicuries or curies associated with each Transport Group. Such amounts are excepted from many transportation controls, such as requirements for specification packaging, marking of the shipping name on the package, and labeling the package for a radiation hazard.

LSA materials are materials that contain very little radioactivity per unit weight. Uranium ore, for example, may be shipped as LSA. These materials frequently are shipped in large volume shipments and are transported in Type A packaging unless moved in an exclusive use vehicle (*i.e.*, where a single shipper alone uses the vehicle and all loading and unloading occurs under the direction of the shipper or the consignee, a practice through which larger shipments are permitted).

"Large quantity" amounts of radioactive materials are defined by Transport Group and vary from a minimum of 20 or more curies (for materials such as plutonium, Transport Group I) to 50,000 or more curies (certain radioactive gases, Transport Groups VI and VII). Large quantity amounts must be shipped in Type B packaging, most of which require approval for that purpose, prior to use, by the Nuclear Regulatory Commission.

The distinction between Type A packaging and Type B packaging is significant. In addition to having adequate radiation shielding, Type A packaging is designed to withstand normal transportation conditions as simulated by tests described in the Hazardous Materials Regulations: exposure to the equivalent of extreme climatic conditions; and drop, penetration, compression and vibration tests representing other conditions encountered in normal transportation. Type B packaging, on the other hand, often must be heavily shielded and is designed to withstand extreme accident conditions as simulated by a 30-foot drop onto an unyielding surface; a 40-inch drop onto the end of a pointed steel bar; exposure to a temperature or fire of 1,475° F. for 30 minutes; and submersion in three feet of water for eight hours.

In the vast majority of possible accidents experimental work has indicated that in the event of an accident a release of 0.1 percent of the contents would be a reasonable assumption for Type A packages. On the basis of general handling experience it is further assumed that the actual intake of radioactive material into the body by a person coming into contact with air or surfaces contaminated by such a release is unlikely to exceed 0.1 percent of the amount released from the package. Thus, it is unlikely that any one person would ingest more than one-millionth of the maximum allowable package contents in the event of an accidental release. Stated differently the Type A package quantity limitations are such that an intake of one-millionth of the maximum allowable package contents would not result in a radiation dose to any organ in the body exceeding internationally accepted limits; nor a radiation level of 1 rem per hour at 10 feet from the unshielded contents.

Type B packaging, in a severe transportation accident, would be expected to survive without any significant release of its contents. Spent fuel assemblies, for example, are shipped by highway as large quantity shipments in massive packagings (casks) that may be five in diameter, fifteen feet long and weigh up to 35 tons. Casks are practically impervious to small-arms fire and small explosive charges.

In a highway accident near Oak Ridge, Tennessee, on December 8, 1970, a spent fuel cask was thrown more than 100 feet when a truck driver while negotiating a wide turn lost control after swerving to avoid another vehicle. Although the driver was killed in the impact, there was no release of spent fuel or increase in radiation. Spent fuel casks of an earlier design also have been subjected to destructive testing simulating severe, high speed highway and rail accidents. The casks survived with only minor damage that would have posed little or no risk to the public if the events had been real rather than simulated.

Associated with irradiated fuel and present during its transportation by highway are certain decay gases and volatile fission products along with the essentially solid materials. Given a set of circumstances in which the cask is subjected to extreme crushing forces of 200,000 pounds and a subsequent fire of 1875° F. for 2 hours duration, estimates have been made of the resulting radiological consequences. In Section 5-6 of NUREG 0170 some of these "worst-case" shipment scenarios were considered. One such hypothetical case involves a shipment of spent fuel being transported through a high-density urban area (15,444 people per square kilometer). It was hypothesized that if such an incident were to occur, 100% of the gaseous and volatile materials would be released as an aerosol and then dispersed into the atmosphere where wind currents and other weather conditions would influence both the area and degree of radioactive contamination. Under these particular circumstances it is estimated that the contaminated area would require evacuation for 10 days and the cost of clean-up, lost incomes and temporary living expenses would amount to $200 million (1975). Radiological health consequences are estimated to be minimal with no early or latent cancer fatalities. While an event such as this is likely to occur only once in 3 billion years, the data is significant when weighing its risk against other risk levels which are determined to be acceptable. Extreme incidents which involve the release of as little as 1% of the solids as an aerosol would have extremely serious consequences. Such an incident, however, is likely only once in 25 billion years and is thought by MTB not to warrant undue concern. A more typical high speed collision and fire in a highway accident is not likely to result in extensive radiological injuries or damage from the presence of either Type A, Type B or large quantity packages of radioactive materials.

C. Normal and Accident Exposure Resulting From Transport of Radioactive Materials

This proposal was developed after consideration of impacts from both transportation accidents and accident-free (normal) transportation. Accident risk includes both radiological risks and nonradiological risks (such as impact damage in a motor vehicle collision). Normal transportation is considered principally from the radiological standpoint of normal population dose. Nonradiological impacts of normal transportation are considered secondarily and largely consist of the costs associated with motor vehicle operation (such as fuel use).

Normal dose is the amount of radiation exposure received generally by persons who come near packages of radioactive materials during accident-free transportation, such as package handlers, truck crews, pedestrians and other passers-by. Normal dose usually is expressed in terms of rems (Roentgen Equivalent in Man, a measure of biological damage from radiation) or units thereof. The term "person-rem" is used to express total (integrated) population dose. The normal dose from a package of radioactive materials is dependent upon the amount of radiation emitted through the package surfaces, which is described by the Transport Index (usually a measure of radiation at three feet from the package surface). Essentially all packages of radioactive materials, from small Type A packages to spent fuel casks, emit at least small amounts of radiation even when in compliance with all Federal packaging requirements. The amount of radiation exposure received by the population as normal dose is proportional to the time during which exposure occurs. It declines at least geometrically with distance from the package. A longer trip means a longer period of exposure which results in greater normal doses to truck crews (drivers) and also may mean greater doses to the surrounding population. In highway transportation, the dose received by the truck crew is the largest single component of normal dose that can be changed by modifying transportation practices. The health effects discussed in this publication are those predicted by a health effects model used in NUREG 0170. Commenters wishing to address the validity and degree of certainty associated with that health effects model will find a brief discussion in NUREG 0170 on p. 3–11.

In NUREG 0170, the impact of normal dose from radioactive materials transportation is summed up in the following way for all modes of transportation.

> The estimated total annual population dose [from radioactive materials transportation] is 9,790 person-rem in 1975 and 25,400 person-rem in 1985. This dose has the same general characteristics as other chronic exposures to radiation such as natural background. The predicted result of public exposure to this radiation is approximately 1.19 latent cancer fatalities and 1.7 genetic effects in 1975 and 3.08 latent cancer fatalities and 4.4 genetic [effects] in 1985. When the value of 9,790 person-rem may seem large, it is small when compared with the [forty million] person-rem received by the total U.S. population in the form of natural background radiation . . . [T]he average annual individual dose [from radioactive materials transportation] is approximately 0.5 [millirem], which is a factor of 300 below the average individual dose from background radiation. [p. 4–19]

Total accident risk is an estimate that combines both the chance that an accident will occur and the probable consequences if it does. Total risk sums both radiological consequences and nonradiological consequences. Accident risk from radiological hazards depends on a variety of factors, but principally on the severity and rates of accidents on the roads traveled (other factors contribute to the accident probability, such as driver training and vehicle condition) and on the density and proximity of the population along the route. All else being equal, unsafe highways, long trips and dense populations near the highways result in higher accident risks. Accident risk also includes the nonradiological hazards, such as the injuries and damage that may be realized in any motor vehicle accident. Nonradiological accident risks generally appear to be much greater than radiological accident risks, but the prediction of radiological accident risks involves more variables than nonradiological accident risks and therefore is less confident.

Regarding radiological risk from potential transportation accidents in all modes of transportation, NUREG 0170 estimates that

> The accident risk for the 1975 level of shipping activity . . . is very small: roughly 0.005 additional [latent cancer fatalities] per year, or one additional [latent cancer fatality] every 200 years, plus an equal number of genetic effects. This number of [latent cancer fatalities] is only 0.3% of those resulting from normal transport population exposures.
>
> * * * * *
>
> The projected accident risk in 1985 is . . . about 3.5 times the 1975 risk, but is still very small in comparison to the [latent cancer fatalities] resulting from normal transport.
>
> * * * * *
>
> The principal nonradiological impacts are those injuries and fatalities resulting from accidents involving vehicles used exclusively for the transport of radioactive materials. The number of expected annual nonradiological fatalities [in 1975] is almost 50 times greater than the expected number of additional [latent cancer fatalities] resulting from radiological causes [in transportation accidents] but is less than one fatality every five years. [pp. 5–52, 53]

D. Related Factors Affecting Route Selection Under Proposal

In view of statistics showing lower accident rates and reduced travel times in travel on Interstate highways, this proposal favors use of the Interstate System. MTB believes that in most cases this policy will produce the most significant transportation safety impact reduction and it offers a clear standard for compliance and enforcement purposes. However, the policy is modified by two other considerations which should be kept in mind by persons reviewing this proposal.

First, for reasons of cargo security discussed later in this document, the Nuclear Regulatory Commission (NRC) recently established interim physical security rules (44 FR 34466, June 15, 1979) for transportation of irradiated reactor fuel (spent fuel). Those rules include the following requirements for NRC licensees who ship spent fuel:

(a) Advance notice to and approval from the NRC for each shipment of spent fuel.

(b) Advance arrangements with law enforcement agencies along the route for emergency assistance.

(c) Use of routes that avoid heavily populated areas where practicable, and additional protective measures approved by the NRC where that is not possible.

(d) A trained escort accompanying each shipment.

(e) Motor vehicles that are equipped with radiotelephone and CB radio communications equipment and that are capable of being immobilized.

(f) Procedures for coping with threats and physical security emergencies.

The security of spent fuel in transit was a major concern to commenters in the 1978 hearing on the advance notice of proposed rulemaking in this docket and in the hearing in 1977 regarding the inconsistency ruling on the New York City Health Code amendment. Development of the current DOT proposal reflects existing arrangements between DOT and NRC wherein NRC exercises responsibility for any necessary physical security requirements during transportation. The DOT proposal is therefore directed at reducing impacts associated with normal and accident situations arising in transportation, while NRC is concerned with preventing malicious or deliberate release of radioactive materials. The DOT proposal, however, would extend the NRC physical security requirements to nonlicensee shippers, such as the Department of Energy.

Second, the proposal acknowledges that some local conditions may justify special routes for shipments of large quantity packages. One such condition is expressly recognized in the proposal and concerns cities which have an Interstate direct route and an Interstate (or equivalent) circumferential or bypass route. The proposal also provides for State action to establish or modify routes for carriers of large quantity packages.

The benefit of routing that avoids cities, or heavily populated areas generally, is difficult to predict, but involves a trade-off between the increased impacts due to longer shipment distances and the decreased impacts due to avoiding dense populations. Avoidance of heavily populated areas is a requirement that currently applies to all shipments of hazardous materials by motor vehicle if the amounts are sufficient to require placarding:

> Unless there is no practicable alternative, a motor vehicle which contains hazardous materials must be operated over routes which do not go through or near heavily populated areas, places were crowds are assembled, tunnels, narrow streets, or alleys. Operating convenience is not a basis for determining whether it is practicable to operate a motor vehicle in accordance with this paragraph. [49 CFR 397.9(a)].

Requiring motor vehicles to avoid heavily populated areas usually will increase trip distance and travel time. For the transportation of radioactive materials, under some circumstances those increases can result in an increased normal dose. If use of less safe highways or increased travel times are necessary to avoid heavily populated areas, accident risk also may be increased. The extent of the safety benefit that might result from motor vehicles avoiding heavily populated areas (such as a possible decrease in normal dose or in accident consequences) is influenced by factors such as differences in population densities, effectiveness of local emergency planning, physical features and weather conditions along the various routes that might be used and the times and days they are used. These factors are site-specific and hard to generalize on a national scale except on a statistical basis.

Some generalizations, however, can be made. Because of their lower accident rates and greater efficiency, use of Interstate highways usually will result in fewer accidents and in reduced travel times. Given equivalent roadways, routing radioactive materials carriers on longer Interstate circumferential roads, with adjoining populations that are less dense than those adjoining a shorter Interstate through route, usually will increase normal truck crew dose and the probability of an accident but usually will decrease total normal dose and accident consequences. The possible reduction in radiological accident consequences in such a situation depends on variable factors including population distribution in the area and meteorological conditions which can affect the movement of airborne debris.

Differences exist between Interstate routes through and around a city. A circumferential Interstate route may have a higher average speed and lower accident rate than an Interstate through route, but the accidents may be more severe. Because of the cost and availability of land, and greater access requirements, the design standards of some urban freeways may be less than optimal and possibly less than those of a suburban circumferential Interstate highway. Data from NUREG 0170 and recent traffic accident statistics indicate that routing to avoid cities may offer a slight reduction in overall radiological risk, but at the probable expense of a greater number of fatalities and injuries resulting from an increase in traffic accidents associated with increased distances. However, even though the resultant increase in nonradiological fatalities appears to be larger than the decrease in radiological fatalities anticipated, the difference is small in terms of absolute numbers (a difference of possibly one fatality every 100 years at 1985 levels of shipping activity). There also is necessarily more uncertainty in the prediction of radiological consequences from transportation than in the prediction of traffic fatalities, due to the number of variables involved, so a conservative approach also suggests circumferential routing.

There also are sound administrative reasons to require that Interstate circumferential and bypass routes be used. Circumferential routing around cities is more consistent than direct routing with requirements that apply to other hazardous materials transported by highway (49 CFR 397.9(a)).

The proposed required use of circumferential routes by large quantity carriers, however, is predicated on the safety and efficiency of transportation on Interstate highways. Where other highways are designated to establish an urban circumferential route, they should offer the same advantages as comparable Interstate circumferentials. For the designation of preferred highways other than urban circumferentials, the proposal would assume an evaluation of all factors pertinent to reducing the impacts of highway transportation of radioactive materials, rather than the abbreviated method of relying on the similarity of the perferred routes to Interstate highways. State action is more fully discussed later in this document.

From a regulatory standpoint, consideration must be given to the need for requirements which are efficient and comprehensible, which encourage compliance and which can be enforced. The term "heavily populated areas", not used in the proposal, is disfavored for this reason. Instead, an attempt has been made to state the routing factors which would be used for placarded vehicles, and to state that the carrier would be responsible for acting to ensure those factors are observed in the operation of its motor vehicles. MTB also must consider the extent to which State and local site-specific participation can be useful in establishing or modifying routes used by highway carriers of radioactive materials.

IV. Analysis of Proposed Rule

A. Radioactive Materials Subject to Routing Requirements

The proposal in this notice is based on the type of radioactive material shipped and the quantity (activity) per shipment. Essentially there are three transportation situations that would require different treatment under this proposal (see table "Examples of Radioactive Materials Under Proposal"):

(1) Packages for which the carrier is not required to placard his vehicle would be excepted from any routing restrictions. These packages comprise the majority of all radioactive materials shipped and include packages excepted from labeling or bearing the White I or Yellow II radioactive material label as a result of a relatively low radiation dose rate at or near the package surface (see CFR 172.403). A package is excepted from labeling under certain conditions if it contains limited quantities of radionuclides (identified in 49 CFR 173.391(a)), manufactured articles (clocks, smoke detectors, or electronic tubes) which contain limited quantities of radioactive materials, or certain other manufactured articles (identified in 49 CFR 173.391(c)). Also excluded from labeling are some low specific activity (LSA) radioactive materials when shipped in an exclusive use motor vehicle (see 49 CFR 173.392).

A radioactive White I label is required on all other packages which have a dose rate measuring up to 0.5 millirem per hour at any point on the external surface of the package (excluding Fissile Class II or III or large quantity radioactive materials). A radioactive Yellow II label is required on any package measuring more than 0.5 millirems but not more than 50 millirems per hour at any point on the external surface of the package, and not exceeding one millirem per hour at three feet from any point on the external surface of the package, (*i.e.*, the Transport Index may never exceed 1.0 for these packages). A wide range of radioactive materials thus would be excepted from any routing requirement since they are either excepted from labeling or carry the White I or Yellow II label and thus are excepted from placarding.

(2) Packages for which placarding is required would be subject to a general routing requirement. This category of packages includes those requiring a Yellow III label or containing Fissile Class III materials or a large quantity of radioactive material. Also, any package which measures more than 50 millirem per hour at any point on the package surface or which exceeds one millirem per hour at three feet from any point on the external surface of the package (i.e., the Transport Index is greater than 1.0; see 49 CFR 173.389(i)) requires placarding. The proposal would require all such packages, if not transported on an Interstate or specially designated highway, to be transported so as primarily to risk exposure to the least number of people and secondarily to minimize travel times.

Many commercial shipments of radioactive materials fall within this category. For example, many medical-use shipments, both Type A and B quantities, require a Yellow III label and must be placarded. Medical isotopes used for scanning procedures in hospitals such as Tc-99M, Au-198 or I-131 are occasionally packaged such that the Transport Index exceeds 1.0. Isotopes used for teletherapy and medical research such as Co-60 and Cs-137 usually require a Yellow III label. Many industrial-use shipments would also fall into this category. Isotopes such as americium, berylium, Cs-137, and Kr-85 are used by the well-logging industry—to determine properties of rock formations. Ir-192 and Co-60 are used in radiography to measure structural integrity of welded joints. Isotopes which are used in industrial gauging devices include Ra-226, Sr-90, Am-241 and others. Many of these industrial isotopes would require a Yellow III label when packaged according to accepted practice.

In short, radioactive materials subject to the general routing requirement in proposed § 177.825(a) include any packaged radionuclide, regardless of quantity, which has a Transport Index of 1.0 or greater.

(3) Shipments of packages containing a large quantity of radioactive materials (defined at 49 CFR 173.389(b)), including spent fuel, would be subject to additional Federally imposed restrictions as well as the possibility of Federally recognized State restrictions. This category includes the most toxic radionuclides, which are found in Transport Groups I and II, when shipped in quantities over 20 curies per package as well as larger quantities in the other Transport Groups. Included in Transport Groups I and II are many shipments of nuclear fuel cycle material, plutonium, polonium, mixed fission products, some isotopes of uranium, and certain commonly shipped isotopes such as Am-241, Ra-226, and Sr-90. A large number of shipments of materials in the first two Transport Groups are already subject to stringent physical security requirements during transportation established by the NRC. Special nuclear materials, potential theft targets which include many shipments of plutonium and the uranium isotopes U-233 and U-235, as well as spend fuel, a possible terrorist target, when shipped by NRC licensees are subject to the physical security requirements in 10 CFR Part 73.

BILLING CODE 4910-60-M