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GOVERNMENT OF INDIA

AERB SAFETY CODE

EMERGENCY RESPONSE PLANNING AND PREPAREDNESS FOR TRANSPORT ACCIDENTS INVOLVING RADIOACTIVE MATERIAL

ATOMIC ENERGY REGULATORY BOARD

EMERGENCY RESPONSE PLANNING AND PREPAREDNESS FOR TRANSPORT ACCIDENTS INVOLVING RADIOACTIVE MATERIAL

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Atomic Energy Regulatory Board
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FOREWORD

The wide-spread utilisation of ionising radiations in multifarious applications - in industry, medicine, agriculture and research - has brought in its wake the need for exercising regulatory control to ensure safety both of the user and of the general public. The Atomic Energy Regulatory Board (AERB) is entrusted with the responsibility of developing and implementing appropriate regulatory measures aimed at ensuring radiation safety in all applications involving ionising radiations. One of the major objectives of AERB is to develop and publish specific codes, guides, standards and manuals which deal with radiation safety aspects of various applications of ionising radiations including transportation of radioactive materials in the public domain. Such codes and guides cover the entire spectrum of operations starting from planning, design and installation of radiation equipment to their ultimate decommissioning/disposal and associated transportation activity.

Accordingly, AERB has constituted Advisory Committees and Task Groups which will review the codes and guides developed by AERB. A Task Group on Codes and Guides for the safe transport of radioactive materials has been constituted as follows.

1.	Shri G. Subrahmanian (Chairman)	-	Division of Radiological Protection, Bhabha Atomic Research Centre, Bombay. (since retired)
2.	Shri J.S. Bisht	-	Division of Radiological Protection, Bhabha Atomic Research Centre, Bombay.
3.	Shri S.R.K. Iyer	-	Board of Radiation & Isotope Technology, Bombay.
4.	Shri P.S.A. Narayanan	-	Enriched Fuel Fabrication Plant, Nuclear Fuel Complex, Hyderabad.
5.	Shri P. Seetharamaiah	-	Fuel Reprocessing Division Bhabha Atomic Research Centre, Bombay.
6.	Shri S. Vedamoorthy	-	Nuclear Power Corporation, Bombay.
7.	Dr. D. Singh (Member-Secretary)	-	Atomic Energy Regulatory Board, Bombay.

The AERB has issued a safety code on Transport of Radioactive Materials (AERB Code No. SC/TR-1) in 1986, prescribing safety standards governing the package design and operational aspects. These standards need to be supplemented with technical and administrative procedures for normal as well as emergency situations.

A safety code entitled "Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material" has been prepared by Shri P. Seetharamaiah, Shri S. Vedamoorthy and Shri S.R.K. Iyer, members of the Task Group, and Shri V.G.R. Subramanian of Division of Radiological Protection, Bhabha Atomic Research Centre, Bombay. This code specifies the requirements relating to the establishment of emergency provisions, identifies emergency response organisations and prescribes response measures, and it is intended to be the basis of the emergency response action plans to be drawn up by organisations/individual consignors of radioactive materials.

Dr. I.S. Sundara Rao and Shri K.D. Pushpangadan have contributed significantly in the review and finalisation of this document.

(A.K. De)
Chairman,
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ANNEXURE

1. INTRODUCTION

Purpose and Scope

1.1 The purpose of this code is to specify requirements to relevant organisations involved in transport of radioactive materials for establishing emergency provisions in order to protect human health and minimise danger to life and property.

1.2 In this code the procedures for emergency response planning and preparedness are outlined, including identification of emergency response organisations and emergency services that would be required during a transport accident.

1.3 The emergency planning and preparedness needed for responding to transport accidents involving radioactive materials is, to some extent, similar to that required for responding to accidents involving other hazardous materials. The code is developed to deal specifically with radioactive materials, but the information in it might also apply to other types of hazardous materials.

1.4 The loss or theft of radioactive material is specifically not addressed in this code. However, the code is partly applicable also to a case of loss or theft using the procedures developed for notification by various organisations involved.

1.5 Detailed information concerning the nature and hazards of radioactivity and radioactive materials is not included in this code.

1.6 For the purpose of this code, transport must be deemed to comprise all operations and conditions associated with and involved in the movement of radioactive material. These include design, fabrication, testing and type approval by the competent authority and maintenance of packaging, and preparation, consigning, handling, carriage, storage in transit and receipt at the final destination of packages containing radioactive materials by all modes of transport on land,water or in air.

1.7 The provisions in this code do not apply to (a) transport of radioactive material within establishments where they are produced, used or stored and (b) to human beings who have been implanted with radioisotopic cardiac pacemakers or other such permanently implanted devices, or who have been treated with radiopharmaceuticals.

1.8 The provisions in this code are applicable to transport of radioactive materials in the public domain, including storage during transportation.

2. DEFINITIONS

In this document, unless the context otherwise requires,-

(i) "A_1" means the maximum activity of special form radioactive material permitted in a Type A package.

(ii) "A_2" means the maximum activity of radioactive material, other than special form radioactive material, permitted in a Type A package.

(iii) "competent authority" means any officer or authority appointed by the Central Government by Notification under the Radiation Protection Rules, 1971. ?

(iv) "compliance assurance" means a systematic programme of measures specified by the competent authority, aimed at ensuring that the provisions of this document are met in practice.

(v) "consignee" means any individual, organisation or government receiving a consignment.

(vi) "consignment" means any package or packages, or load of radioactive material, presented by a consignor for transport.

(vii) "consignor" means any individual, organisation or government which presents a consignment for transport, and is named as consignor in the relevant transport document.

(viii) "containment system" means the assembly of components of the packaging specified by the designer as intended to retain the radioactive material during transport.

(ix) "contamination" means the presence of a radioactive substance on surface in quantities in excess of 0.4 Bq/cm^2 (10^{-5} $\mu Ci/cm^2$) for beta and gamma emitters or 0.04 Bq/cm^2 (10^{-6} $\mu Ci/cm^2$) for alpha emitters. Fixed contamination means contamination other than non-fixed contamination. Non-fixed contamination means contamination that can be removed from a surface during normal handling.

(x) "design" means the description of special form radioactive material, package, or packaging which enables such an item to be fully identified. The description may include specifications, engineering drawings, reports demonstrating compliance with requirements and other relevant documents specified by the competent authority.

(xi) **"Emergency Response Agency" (ERA)** means an executive agency appointed by the National Emergency Response Committee to effectively co-ordinate and deal with all exigencies resulting from transport accidents involving radioactive materials.

(xii) **"Emergency Response Team"** (ERT) means a team under ERA consisting of qualified experts in radiation protection, fire fighting, police, civil defence, medical and engineering fields to evaluate and effectively control exigencies resulting from transport accidents involving radioactive materials.

(xiii) **"excepted package"** means a **packaging** containing excepted **quantities of radioactive material** that is designed to meet the general requirements for all packaging and packages.

(xiv) **"exclusive use"** means the sole use, by a single consignor, or of a large freight container with a minimum length of 6m, in respect of which all, initial, intermediate, and final loading and unloading is carried out in accordance with the direction of the consignor or consignee.

(xv) **"fissile material"** means uranium-233, uranium-235, plutonium -238, plutonium-239, plutonium-241 or any combination of these nuclides. Unirradiated natural uranium and depleted uranium and natural uranium or depleted uranium which has been irradiated in thermal reactors only, are not included in this definition.

(xvi) **"freight container"** means an article of transport equipment designed to facilitate the carriage of goods, either packaged, or unpackaged by one or more modes of transport without intermediate reloading of the contents. It must be of permanent enclosed character, rigid and strong enough for repeated use, and must be fitted with devices facilitating its handling, particularly in transfer between conveyances and from one mode of transport to another.

(xvii) **"low specific activity (LSA) material"** means radioactive material which by its nature has a limited specific activity, or radioactive material for which limits of estimated average specific activity apply. External shielding materials surrounding the LSA materials must not be considered in determining the estimated average specific activity.

(xviii) **"maximum normal operating pressure"** means the maximum pressure above atmospheric pressure at mean sea-level that would develop in the containment system in a period of one year under conditions of temperature and conditions of transport in the absence of venting,

external cooling by an ancillary system, or operational controls during transport.

(xix) **"multilateral approval"** means approval by the competent authority both of the country of origin of the design or shipment and of each country through or into which the consignment is to be transported. The term "through or into" specifically excludes "over", that is, the approval and notification requirements shall not apply to a country over which radioactive material is carried in an aircraft provided that there is no scheduled stop in that country.

(xx) **"National Emergency Response Committee"** means a national committee constituted by the Government of India to formulate policies governing Emergency Response Planning and preparedness for establishing emergency provisions for all types of accidents to protect human and minimise danger to life and property.

(xxi) **"overpack"** means an enclosure, such as a box or a bag, which need not meet the requirements for a freight container and which is used by a single consignor to consolidate into one handling unit a consignment of two or more packages for convenience of handling, storage and carriage.

(xxii) **"package"** means the packaging with its radioactive contents as presented for transport.

(xxiii) **"packaging"** means the assembly of components necessary to enclose the radioactive contents completely. It may, in particular, consist of one or more receptacles, absorbent materials, spacing structures, radiation shielding, and devices for cooling, for absorbing mechanical shocks, and for thermal insulation. The packaging may be a box, drum, or similar receptacle or may be also a freight container,or tank.

(xxiv) **"public domain"** means places or premises other than establishments where radioactive materials are produced, used or stored.

(xxv) **"quality assurance"** means a systematic programme of controls and inspections applied by any organisation or body involved in the transport of radioactive material which is aimed at providing adequate confidence that the standards of safety prescribed by the competent authority are achieved in practice.

(xxvi) **"radiation level"** means the dose-equivalent rate expressed in millisieverts (or equivalent millirem) per hour.

(xxvii) **"radioactive contents"** means the radioactive material together with any contaminated solids, liquids and gases within the package.

(xxviii) **"radiation protection team"** means a team of persons qualified and experienced in the field of radiation protection for carrying out evaluation, monitoring, control and salvage operations in the event of transport accidents involving radioactive materials.

(xxix) **"surface contaminated object (SCO)"** means a solid object which is not radioactive by itself but which has radioactive material distributed on its surfaces.

(xxx) **"shipment"** means the specific movement of a consignment from origin to destination.

(xxxi) **"special arrangement"** means those specific provisions, approved by the competent authority, under which a consignment which does not satisfy all the applicable requirements of the transport safety code, may be transported. For international shipment of this type multilateral approval is required.

(xxxii) **"special form radioactive material"** means either an indispersible solid radioactive material or an ordinarily unbreakable metallic sealed capsule containing the radioactive material.

(xxxiii) **"specific activity"** means the activity of a radionuclide per unit mass of the corresponding element. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the activity per unit mass of the material.

(xxxiv) **"tank"** means a tank container, portable tank,a road tank vehicle,a rail tank wagon or a receptacle with a capacity of not less than 450 litres to contain liquids, powders, granules or slurries and not less than 1000 litres to contain gases. A tank container shall be capable of being carried on land or on sea and of being loaded and discharged without the need of removal of its structural equipment, must possess stabilising members and tie-down attachments external to the shell,and must be capable of being lifted when full.

(xxxv) **"Transport Index (TI)"** means a single number assigned to a package, overpack, tank or freight container or to unpackaged LSA or SCO, which is used to provide control over both nuclear criticality safety and radiation exposure. It is the maximum radiation level at a distance of 1m from the external surfaces of the package,overpack,tank,freight container, or unpackaged LSA and SCO determined in 10^{-2} mSv/h (mrem/h).

(xxxvi) "transport worker" means any person directly handling packages containing radioactive materials.

(xxxvii) "Type B package" means a package designed to withstand accidental conditions of transport and to conform all the test requirements and maximum permissible radiation levels as specified in the relevant code.

(xxxviii) "Type B(M)" means a Type B package whose design or shipment has the approval by the competent authority of both of the country of origin or each country through or into which the consignment is to be transported.

(xxxix) "Type B(U)" means a Type B package whose design or shipment has the approval by the competent authority of the country of origin only.

(xl) "unilateral approval" means an approval of a design issued by the competent authority of the country of origin of design only.

(xli) words and expressions not defined in this document, but defined in the Act, Rules and Surveillance procedures shall have the meanings respectively assigned to them in the Atomic Energy Act 1962, Rules and Surveillance Procedures.

3. TRANSPORT SAFETY REQUIREMENTS

GENERAL

3.1 The intent of the transport safety requirements stipulated in the AERB Code SC/TR-1 (1986) is to ensure the safety of persons, property and the environment against radiological hazards involved in transport.

3.2 The basic safety requirements in the code are:

(a) effective containment of the radioactive material to be transported;

(b) effective control of radiation emitted from the package in order to limit exposures;

(c) a sub-critical condition for any fissile material;and

(d) adequate dissipation of any heat generated by the radioactive content of the package.

3.3 Radioactive materials are transported in a variety of types of packages. The intent of the code is that the package be designed, manufactured and maintained in such a way that even in the event of accidents the radiological impact would be acceptably small considering both loss of shielding and loss of containment and ,if appropriate the prevention of accidental criticality. Effective quality and compliance assurance programmes are required to ensure that the code is applied correctly in practice.

3.4 The code is applicable to a wide variety of radioactive materials that span a large range of radiotoxicity values. The package requirements take into account the quantity of the radioactive material to be contained within the package as well as its radiotoxicity. Radioactive materials and packages of radioactive materials may also be transported in freight containers, overpacks and tanks, for which the code provides the specific requirements.

3.5 Radiation protection principles are provided in the code for the limitation of the exposure of transport workers and the members of the public as indicated below:

(a) no practice shall be adopted unless its introduction produces a positive net benefit,

(b) all exposures shall be kept as low as reasonably achievable, economic and social factors being taken into account and,

(c) the dose to the individuals shall not exceed the limits for the appropriate circumstances.

3.6 The code requires that emergency provisions shall be observed in order to protect human health and minimise danger to life and property and that other dangerous properties that may relate to radioactive materials be taken into account.

TYPES OF PACKAGES

3.7 The types of radioactive material packages are described in the following sections. The technical standards and requirements for these packages are specified in the AERB Code SC/TR-1 (1986).

3.8 The AERB Code SC/TR-1 (1986) specifies the normal and accidental conditions during transport as a series of tests and acceptance criteria. The fulfillment of the requirements for the design of any package should be verified by tests or other methods described in the relevant code. In many cases both analytical assessments and package prototype or scale model tests are used to demonstrate compliance with code requirements.

Excepted Packages

3.9 Excepted Packages are permitted to contain small quantities of radioactive materials and are excepted from various specific packaging and labelling requirements provided that they meet the general requirements specified in the code with respect to radiation and contamination levels and to packaging.

LSA and SCO Packages

3.10 Low Specific Activity (LSA) materials and Surface Contaminated Objects (SCO) are often carried in large quantities in containers such as boxes, steel drums, and tanks. Although the specific activity of these radioactive materials is very low, the total activity in consignment could be significant. The type of package which is permitted to be used depends on the radioactive material to be transported. These packages are required to meet general package requirements for normal conditions of transport without loss or dispersal of their contents or loss of adequate radiation shielding integrity.

Type A Packages

3.11 The total activity of radioactive material in Type A package is limited. The activity limits are determined on the basis of maximum acceptable radiological consequences following failure of the package as a result of an assumed accident.

3.12 Type A packages are required to withstand the normal conditions of transport without loss or dispersal of their contents or loss of adequate shielding integrity.

Type B Packages

3.13 Radioactive materials in quantities greater than those allowed in Type A packages are shipped in Type B packages. Type B packages must withstand both normal and accidental conditions of transport.

3.14 Type B package designs are subject to the approval of the relevant competent authority or authorities. With respect to approval of design, Type B packages are divided into two basic categories. Type B(U) packages meet the most stringent requirements; it is considered that safety is entirely built into these packages. Type B(M) packages do not meet all the requirements applicable to Type B(U) packages; however, they must incorporate alternative design features and operational controls must be instituted so as to achieve the same level of safety as for Type B(U).

3.15 The design of the Type B(U) package is subject to the approval by the competent authority of the country of origin only.

3.16 The design and shipment of a Type B(M) package is subject to multilateral approval,i.e. to the approval by the competent authority of the country of origin and also by the competent authorities of all the countries through, or into, which the package is to be transported. The application for approval is specifically required to include information on any proposed supplementary operational controls which are necessary to ensure the safety or to compensate for any deficiencies of the package.

Packages containing fissile material

3.17 In addition to the requirements for the packages mentioned above, the code includes specific provisions for packages containing fissile materials.

3.18 Criticality safety in transport of fissile material is ensured by limiting the quantity and geometric configuration of the fissile material, by package design features and by controlling the number of packages to be carried on a single conveyance or to be stowed together in transit.

3.19 Packages containing fissile materials, which may be LSA,SCO, Type A or Type B packages are subjected to multilateral approval.

3.20 The code provides some exception from the requirement for packages containing fissile material. However as for regular fissile packages, the other relevant requirements related to the radioactive nature of the contents are applicable.

PACKAGE RADIATION LEVELS

3.21 Radiation levels under normal transport conditions are limited so that maximum radiation level at the package surface should not be greater than 2 mSv/h (200 mrem/h) and the maximum radiation level at 1 metre from the surface should not be greater than 0.1 mSv/h (10 mrem/h).

APPROVAL OF SHIPMENTS AND SPECIAL ARRANGEMENT

3.22 The shipment of Type B(M) packages designed to allow controlled intermittent venting or containing radioactive material with an activity exceeding limits prescribed in the code and certain shipments of packages containing fissile material are subject to multilateral approval. Radiation protection programmes for shipments by special use vessels are also subject to multilateral approval.

3.23 A consignment which does not satisfy all the applicable requirements of the code may be transported under special arrangement. In such a case, however,precautions are required to compensate for deviations from requirements to ensure that the overall safety in transport and in-transit storage is at least equivalent to that which would be provided if all the applicable requirements of the code have been met. Under certain circumstances,part of the special arrangement may be the requirement that special escort personnel who are able to maintain the consignment within certain limits at all times be provided for these shipments. Each international consignment shipped under special arrangement is subject to multilateral approval by the competent authorities of the countries involved.

MARKING,LABELLING AND PLACARDING

3.24 Each package which conforms to a Type A package design is required to be marked on the outside surface with the words " TYPE A ".

3.25 Each package which conforms to a design approved by a competent authority is required to be marked on the outside surface with the competent authority identification mark and serial number and, in the case of a Type B(U) or Type B(M) package design, with the words "TYPE B(U) " or " TYPE B(M) " respectively. In addition each package which conforms to a Type B(U) or Type B(M) design should be marked, in a manner resistant to the effects of fire and water,with a trefoil symbol as shown in Annexure IV.

3.26 Packages containing radioactive material (other than excepted packages) are required to bear labels indicating the category (I-WHITE,II-YELLOW,III-YELLOW) as well as the content and activity of the package. For categories II-YELLOW and III-YELLOW, the label should indicate the transport index. Freight containers and rail or road

vehicles,carrying packages other than excepted packages, and tanks are required to bear placards indicating the presence of radioactive material.

3.27 Each consignment is required to have, in the transport documents, information concerning the package and its radioactive contents.

3.28 Annexure IV describes the labels, placards and shipping documents, referring the relevant paragraphs of the code.

4. EMERGENCY RESPONSE PLANNING

4.1 Emergency plans and preparedness must consider:

a) The transportation systems used for transport of radioactive materials,

b) The type of packages used for transport, and

c) The consequences of transport accidents.

4.2 Clear, step-by-step procedures must be prepared to implement the emergency plan in a graded manner as required by the severity of the accident and its consequences.

4.3 The National Emergency Response Committee shall appoint an Emergency Response Agency and this agency shall be the executive body for emergency response planning and preparedness during transport accidents involving radioactive materials. This agency shall be directly responsible for dealing with transport accidents involving radioactive materials. In the event of any emergency, the Emergency Response Agency will seek assistance from different organisations and effectively co-ordinate in the management of transport accidents involving radioactive materials. The organisational chart detailing the set-up is given in Annexure III.

5. TRANSPORT ACCIDENTS AND THEIR CONSEQUENCES

5.1 Transport accidents are classified as a) low-hazard, with high probability of occurrence and b) high hazard, with low probability of occurrence.

5.2 The consequences of an accident involving radioactive materials depend upon their physical form, radiotoxicity & amount of the contents, type of package and the mode of transport, the severity of the accident including damage to the package, weather conditions and the site of the accident.

5.3 If there were a breach of packaging involving excepted, LSA SCO, and Type A packages destroying its integrity, the area affected from a radiological health and safety standpoint would normally be limited to the general vicinity of the accident and there would be no radiological reasons for taking protective actions for general public beyond this immediate area.

5.4 In most cases of Type B package,like Type A packages, the radiological impact would be limited to the general vicinity of the accident site. However, if a Type B package containing large quantities of radioactive material were damaged and its integrity somehow destroyed, a relatively large and rapid response would be required.

5.5 If a transportation accident involving a dispersible material were to occur, the conditions encountered by emergency response personnel could possibly include high radiation fields, contaminated victims, vehicles, wreckage, road and earth surfaces, actual or potential fire and other hazards normally encountered in transportation accidents. Because the material could also become airborne in the form of particulate material or aerosols, there might also be an inhalation hazard and contamination to varying degrees, surrounding the accident site and particularly downwind of it. Radiation protection personnel as well as Emergency Response Team members should use personnel monitoring devices when entering the accident area.

5.6 If the materials were non-dispersible, probably there would not be any contamination or significant contamination, but there might be localized areas with radiation fields which could be hazardous. This might be caused by loss of or rearrangement of the shielding materials within the package. Direct exposure to radiation by being within a radiation field can occur in accidents involving both dispersible and non-dispersible forms of radioactive materials.

5.7 Emergency response personnel must be prepared to deal first with the typical characteristics of any serious accidents, rescue, saving life, medical aid for the injured, fire fighting and traffic control. Prevention of spread of

contamination in such accidents is of secondary consequence.

5.8 Emergency response personnel must track contamination around the scene of accident covering all vehicles such as train,truck, or aircrafts to prevent spread of contamination to distant places.

5.9 The spread of contamination due to dispersible radioactive materials to agricultural products,drinking water supplies, and domestic animals must also be tracked thoroughly.

Fissile Materials

5.10 In the case of transportation accidents involving fissile material,specific hazards and consequences of criticality accidents depending on the fissile material in question, on the packaging used and on the accident conditions must be considered.

Other Dangerous Properties of Radioactive Material

5.11 In addition to the radiation and criticality hazards, some radioactive materials have other dangerous properties and in such cases the subsidiary hazards must also be considered.

6. RESPONSE TO TRANSPORT ACCIDENT

6.1 In responding to transport accidents involving radioactive materials, following main actions must be taken in sequence:

(a) to rescue and provide emergency medical aid to all victims,

(b) to control fires and other common consequences of transport accidents like traffic control,

(c) to control any radiation hazard and prevent the spread of radioactive contamination,

(d) to decontaminate personnel, and

(e) to decontaminate and restore the through fare and to delineate the boundaries of other contaminated areas,

(f) to decontaminate the vicinity and restore to a safe state.

6.2 The Emergency Response Agency must have an emergency handling team comprising of staff members experienced in management of radiation accidents, transport of radioactive materials and other radiation safety related problems. The emergency handling team must have proper and effective communication system. This team must also be authorised to seek help from local police and wireless communication. This team must also have appropriate radiation monitoring instruments and other safe handling accessories as outlined in Annexure I.

ROAD TRANSPORT ACCIDENTS

INITIAL PHASE

6.3 In the event of an accident the vehicle crew must take minimum measures to control or mitigate the consequences of accident and inform the carrier's head office and the police about the accident immediately. The carrier must in turn inform the consignor and the Emergency Response Agency without time delay.

6.4 The area around the accident site must be immediately cordoned off upto a distance of 200m depending upon the severity of the accident or as specified by the consignor, either by the vehicle crew or by the police or by the rescue personnel. The entry into cordoned area must be restricted only to persons involved in rescue and life saving activities. The public must be kept away from the accident site.

6.5 The initial investigative procedure should enquire into the following:

a) location and access to the site

b) radioactive materials involved and details of papers or labels found on the packages

c) any visible damage to radioactive material package

d) any loss/theft of radioactive material package

e) any evidence of leakage from the radioactive material package

f) fire near the radioactive material package

g) presence of any flammable liquids or gases or toxic materials or explosives in the immediate vicinity of the package

h) detection of any contamination/radiation fields

i) precipitation or high winds in the vicinity of accident site

j) any injuries to the personnel

6.6 Initial radiological assessment of a transportation accident should comprise three basic observations as detailed below:

a) confirmation of the presence of radioactive material

b) ascertaining whether or not the integrity of the packages or containers has been breached

c) assessing the existence of radiation hazard by monitoring with appropriate instruments by radiation protection personnel

Confirmation of the Presence of Radioactive Material

6.7 Information concerning radioactive material package must be obtained from the label and/or marking on the outside of the package, from the transport documents, and for certain shipments, from placards on the vehicle. (except in the case of `Excepted Packages')

6.8 In the absence of the above, distinctive containers such as metal casks or flasks, drums or heavy shielded containers must be suspected as containers of either radioactive or other hazardous material until it is confirmed otherwise by the emergency personnel attending to the radiation accident with the help of appropriate radiation monitoring equipment.

Ascertaining The Integrity Of Shipping Containers Or Packages

6.9 The visual inspection of the consignment indicates whether the shipping containers or packages have been damaged. The presence of fire, smoke and fumes could preclude an initial determination in this regard. The presence of other toxic materials which might have been released as a result of the accident will also hamper the assessment.

6.10 External damage to a container or package of radioactive materials does not necessarily mean that containment system has been breached, but external damage is an indication that the package should be thoroughly examined by properly equipped and qualified experts. Leaking liquids, gases or powders may indicate that package integrity has been destroyed and all released material should be considered hazardous unless and until confirmed by radiation protection personnel.

Assessing the Radiation Hazards

6.11 A thorough evaluation of radiological conditions at the accident site must be made by radiation protection personnel. Cases involving contamination of persons, objects and the site must be carefully assessed. If the accident is very serious, containers and packages may have been damaged. In such cases, necessary emergency work such as rescuing the injured must be performed quickly followed by cautious assessment of any radiological hazards.

ACCIDENT CONTROL PHASE

6.12 As a part of the emergency planning process, prior arrangement must be made to contact qualified or experienced and properly equipped persons or teams from Governmental authorities, nuclear establishments or other organisations where radiological protection services exist.

6.13 The following radiation monitoring must be made to initiate protective and recovery actions:

a) Measurements of radiation and local contamination levels

b) Measurements of airborne radioactivity and ground contamination around the scene of accident

c) Assessment of exposure of members of the public, transport workers and emergency personnel (including , if appropriate, internal contamination).

If required, help of a mobile radiological laboratory may be sought.

6.14 Based on the measurements mentioned in para, 6.13,

radiological hazards must be evaluated and advice sought.

6.15 Based on the evaluation of accident situation a decision must be taken regarding the movement of the package and further remedial action if necessary. If fissile material is involved, special consideration must be needed for ensuring criticality safety.

PROTECTIVE MEASURES

Control of Access

6.16 Control of access to the site of the accident must be accomplished using standard police procedures. In addition to blocking the roads, the accident site should be cordoned off using rigid barricades, ropes tapes etc. Factors affecting the shape and size of the controlled area are the severity of the accident as well as weather conditions, direction of prevailing wind and monitoring results.

6.17 Access to and egress from the cordoned off area should be made only through an established checkpoint. This checkpoint should be located in the upwind direction and should serve as a radiological control station for people and equipment and materials as well as assembly point for emergency personnel. A preliminary personnel decontamination point should be established near the checkpoint if it is needed.

6.18 Traffic should not be allowed to proceed through a contaminated area. This will prevent contamination of vehicles and their occupants and diminish further spread of the contamination.

Protective Actions Within Cordoned-Off Areas

6.19 Injured persons who need to be taken to hospitals must be wrapped in blankets or other available covering which will help to control the spread of contamination. The doctors attending on such patients should be informed in advance about the patient condition. Emergency workers and other persons involved in the accident who are not critically or seriously injured must wait to be radiologically monitored at a safe distance upwind from the accident scene.

6.20 Packages or containers of radioactive material which have been ejected from the vehicle as a result of the incident must also be cordoned off awaiting the arrival of radiation protection team to examine these and conduct radiological monitoring.

6.21 Run-off water from any fire-fighting efforts,or leakage from damaged containers or packages, must be diked within the cordoned off area, using shovels or available tools.

6.22 Vehicles,material,equipment or other items suspected of

being contaminated must not be permitted to be removed from the area unless released by radiation protection team.

6.23 Eating,drinking and smoking must be prohibited in an area suspected of being contaminated.

6.24 Emergency response team must approach from the upwind direction,any accident site where radioactive materials have been released, to minimize inhaling any airborne radioactive material. Plastic sheets or tarpaulins can be used to cover loose materials to help minimize their dispersion by wind or rain.

Personal Protective Measures

6.25 Personal protective measures detailed below must be followed to minimise radiological exposure while handling transport accidents involving a release of or loss of shielding of radioactive materials.

a) minimising the time in a radiation field

b) maximising the distance from radioactive materials

c) using shielding, whatever available

d) using respiratory protective equipment to reduce the possibility of inhaling radioactive materials and

e) using protective clothing followed by careful washing to reduce possibilities of skin contamination or ingestions

6.26 The Emergency Response Team must carry adequate number of standard protective clothing and respiratory protective equipment for use by the police,emergency medical services personnel, and emergency workers.

Sheltering and Evacuation

6.27 In the event of an accident, with release of dispersible radioactive materials under high wind condition, shelter of individuals and precautionary evacuation of a limited area must be ordered if necessary while awaiting the arrival of radiation protection team which would then be able to assess any hazard that might exist.

6.28 In the event of any damage to the integrity of the package and subsequent release of radioactive material,the decision regarding cleanup action must be taken by the radiation protection team. This needs to be decided based on the type of release,the severity of the accident, the terrain and weather conditions etc. Where a release of radioactive material in a transportation accident necessitates a decision concerning evacuation of persons from certain

areas, the decision and subsequent actions must be made in consultation with local government agencies and Emergency Response Agency.

Decontamination of Persons

6.29 Persons suspected to be contaminated must be taken to an appropriate facility to be monitored and decontaminated. If a change of clothing can be provided to them at the accident site, their contaminated clothes must be collected in suitable containers for subsequent washing or disposal. If no change of clothing is available, wrapping in blankets or other covering will help to limit the spread of contamination while they are being taken for decontamination.

POST EMERGENCY PHASE

Termination of Emergency

6.30 In most cases the emergency may be terminated when points (a) to (e) in para. 6.1 are accomplished. Termination should be declared by local responsible authorities on the advice of the Emergency Response Agency. Before the declaration, it should be ensured that no further hazard exists in the accident area and all the necessary protective measures have been taken, and are continuing to be taken to protect the public and the environment from further contamination and minimise exposures which may result from the long term consequences of the accident. The termination of the emergency should made public by the National Emergency Response Committee using the news media.

Decontamination and Restoration

6.31 The emergency response team must arrange for the removal of damaged packages, any radioactive contamination, tracing of missing packages and restoration of the area to its original state. Depending upon the type of contamination, the most suitable decontamination methods listed in Annexure II must be employed while cleaning the accident site.

Control of Food and Water Supplies

6.32 The contaminated agricultural products must be quarantined and disposed off under controlled conditions. If potable water supply is contaminated by dispersed radioactive materials, it must be tested for the contaminants and control of the supply at its sources must be invoked. In case the accident takes place near a water way or on a bridge the control of water is a must.

SPECIAL CONSIDERATION RELATING TO OTHER THAN ROAD TRANSPORT

Water Transport

6.33 Emergency response planning and preparedness arrangements for road transport of radioactive materials may be generally applicable to inland waterway transport. The spread of contamination in a waterway might be much greater than that involved in a road accident. The finding and collecting of radioactive debris might pose problems.

6.34 Similar considerations should be given to an accident involving radioactive material which happens within a sea port. Emergency teams must be an integral part of the harbour personnel. These teams which are usually trained to cope with other emergencies in a timely manner should be able to cope more rapidly with a radiological emergency.

6.35 Emergency planning to deal with accidents aboard a ship should comply with relevant regulations of the ship's flag state as well as the regulations of countries which might be involved.

6.36 In order to deal with a serious accident at sea, the crew should be provided with a detailed emergency plan specific to the consignment duly approved by the Competent Authority prior to transport. Further, the crew should have in their possession, the appropriate instruments as specified in the International Maritime Dangerous Goods (IMDG) code. The consignor should instruct the carrier to make sure that the master of the ship is fully aware of the details of the consignment being carried and must be prepared for emergency procedures in case of any off-normal situation.

6.37 The ship's master should be in possession of information concerning the authorities to contact in the event of an emergency in those ports at which he is likely to call. Maritime authorities with whom he may be in contact during a voyage should also know whom to contact in an emergency so that, should the ship need to go into a port, the emergency service will have been alerted in advance. While at sea, emergency advice can be given to the ship by radio.

Rail Transport

6.38 All the emergency response planning and preparedness arrangements applicable for road transport are applicable for rail transport. The National Emergency Response Committee must be contacted without any time delay for any advice in the event of any emergency. The railway emergency system must be properly integrated with Emergency Response Agency.

Air Transport

6.39 Emergency response planning and preparedness arrangements for road transport are generally not applicable to air transport except in the case where the accident occurs at an airport. As regards accidents involving air transport of radioactive materials, the Emergency Response Agency must be contacted immediately with all the relevant details of the radioactive material packages involved in the accident for advice to the members of the rescue team who would be arriving at the site first. Based on the information received from the site, the emergency response team must be alerted.

7. RESPONSIBILITIES FOR EMERGENCY PLANNING AND PREPAREDNESS

Emergency Response Agency's Responsibilities

7.1 Immediately upon receipt of information regarding any transport accident involving radioactive materials, it is the responsibility of the Emergency Response Agency to effectively co-ordinate and deal with all exigencies resulting from the accident. It is the responsibility of the ERA to arrange to send the Emergency Response Team to the site of accident expeditiously with necessary equipment in order to evaluate the extent of the hazard and effectively control the radiation hazard resulting from the accident.

7.2 A mobile radiological laboratory must be always available with the Emergency Response Agency in order to carry out evaluation, monitoring, control and salvage operations without any time delay.

Consignor's and Carrier's Responsibilities

7.3 Although the prime responsibility for safe transport is with the consignor,the carrier also has responsibilities both for safety during transport and for proper & prompt response in the event of any accident. In general, both the carrier and the consignor should be prepared to respond to an accident. They must have adequate arrangements between them to meet with the above requirement. It is the responsibility of the carrier to know and comply with all applicable national regulations on the safe transport of radioactive materials, emergency response planning and providing appropriate resources for response. Carrier personnel must know the types and quantities of the hazardous material they are carrying and must have the emergency procedures with them which outlines the basic steps which must be taken by them in the event of an accident. Carrier must make arrangements to inform the `First-on-the-scene' individual even in the case of the crew being incapacitated.

7.4 The consignor must know and comply with all applicable National and International regulations on the safe transport of radioactive materials and must be prepared to assist in an emergency response to an accident and must know as to how to deal with such an accident. It is also the consignor's responsibility to instruct the carrier regarding his responsibility in transporting the packages properly and responding to accidents.

Governmental Responsibilities

7.5 For developing governmental response plans and procedures for transport accidents involving radioactive materials, it is necessary to :

a) define areas of responsibility and functions of various

national authorities having expertise in this field,

b) define responsibilities of national, state and local governments,

c) establish necessary radiation protection services,

d) identify authorities to be notified when a transport accident involving radioactive materials occurs and establish a communication and notification system,

e) determine and periodically review and test the adequacy of the plans, as well as the trained personnel and equipment available,

f) provide for periodic revision of the plans,

g) establish, where appropriate, the necessary liaison with authorities in relevant countries for notification about accidents whose consequences may extend beyond national boundaries,

h) define the responsibility for public information and education concerning transportation of radioactive materials,

i) establish applicable training programmes,and

j) provide the necessary resources to implement the plans when required.

7.6 Central, state and local governments should develop their own emergency response plans which would cover the operation of their own organisations and deployment of their own resources. Co-ordination in the development of these plans is necessary among local, state and national levels. The local and state response plans should be in conformity with the national emergency plan.

8. EMERGENCY RESPONSE TEAM

Team Response and Functions

8.1 To support the emergency response organisations who generally respond to all transport accidents, specially trained and equipped teams are needed to properly assess any consequences of an accident involving the release of radioactive materials. The team should be formed as a part of the emergency plan. Team members should be experienced persons with adequate training in radiation safety.

8.2 The Emergency Response Team should be authorised, prepared and equipped to:

a) travel to the site, with necessary equipment in an expeditious manner,

b) evaluate the radiological hazard,

c) minimize personnel exposure to radiation and/or radioactive materials,

d) minimize the spread radioactive contamination

e) provide technical information and advice to appropriate authorities that would help in the treatment of affected people in the radiological environment, and

f) carry out other general emergency measures as required.

COMMUNICATION AND NOTIFICATION

General

8.3 The communication and notification system must facilitate contacting the Emergency Response Agency at all times. The communication system needed is similar to that required for the handling of transport accidents involving other hazardous materials and must include a radio-link between people inside and outside the cordoned off area.

Communication

8.4 Regional alert centres for any kind of accident being manned 24 hours a day by trained staff must be established. They must provide a liaison centre to alert the appropriate agencies as to the action required. The centre must have information on the areas of jurisdiction of all the agencies that might become involved, and must have on the hand updated lists of names and phone numbers of agencies to be notified and team of experts who can be dispatched to the accident site.

8.5 Communication capability must exist on a 24 hour basis so that the team members can be expeditiously and reliably notified when their assistance is required at an accident scene. Rapid means of transport for the team and its equipment must be available from their locations to the site of an accident.

Notification

8.6 A simple notification scheme, which can be implemented upon the recognition that an accident involving the transport of radioactive materials has occurred, must be available to the consignors, carriers and governmental emergency response authorities.

8.7 The notification scheme must be geared to both the severity of the accident and the resources required to mitigate the consequences. The notification must also include the names, addresses and telephone numbers of the persons to be contacted in the event of an accident.

9. TRAINING, EXERCISES AND UPDATING

Training

9.1 It is essential that all those persons involved in the regular transport of radioactive materials must be given practical training in the safe transport of radioactive materials and emergency procedures in the event of accident. This training programme must be done on a regular basis. Refresher training programmes should also be done on a continued basis.

9.2 The "First-On-The-Scene" personnel such as police and fire brigades must be trained on (a) the rudiments of first aid, (b) basic principles of how to protect people from radiation exposure and radioactive contamination, (c) to control the spread of contamination, (d) transport documents, markings, labels and placards, (e) fire control, (f) crowd control and (g) press relations.

9.3 A more extensive training programme is necessary to maintain, skills of personnel with radiation protection or nuclear technology background who would be called upon for technical support and response. Training for these persons should include accident assessment technique using radiation monitoring instruments, implementation of protective measures, use of protective clothing and equipment, basic meteorology and further instructions on the transport regulations and packaging of radioactive materials.

Exercises

9.4 Exercise scenarios and drills must be designed to develop, test and maintain special skill of individuals and also to test the response capabilities and skills of the overall emergency response organization and to mobilise agencies and services involved. The results of drills and exercises must be used as a basis for improving the emergency plans, as appropriate. All equipments such as radiation monitoring instruments,communication equipments handling accessories and other equipments required for use during such accidental situations must be periodically calibrated/tested in conjunction with drills and exercises and all faults must be rectified immediately.

Updating of Emergency Plans

9.5 A person must be appointed to be responsible for the maintenance,review and updating of the emergency response plan based on feed back information from exercises, drills and actual accident management situations at least once in a year. The telephone numbers and addresses of persons to be contacted during emergency must be regularly updated at least once in six months.

10. PUBLIC INFORMATION

10.1 The Emergency Response Agency must take appropriate steps in educating the members of the public regarding safe transport of radioactive materials and simple emergency steps to be taken in the event of an accident. The radiation symbol and radioactive material transport label must be widely publicised to create awareness among the public. The fear in the minds of the public about radiation hazards must be alleviated through such educational programmes, information films, exhibitions, radiation safety measures and existence of regular radiation monitoring and emergency plans. In the event of any accident in public premises all communication to the mass media must be channeled through Emergency Response Agency to avoid conflicting and confusing reports which are likely to create unnecessary apprehension in the minds of public.

ANNEXURE I

RADIATION MONITORING INSTRUMENTS AND SAFE HANDLING ACCESSORIES

1. Radiation Monitor with 3m long extension probe (Range 0 - 1000 R/hr. with audio alarm) - 2 Nos
2. Radiation Monitor (Range 0 - 50 R/hr.) - 2 Nos
3. Pocket Radiation Alarm (10 - 100 mR/hr) - 20 Nos
4. Low level radiation survey meter with audio alarm (Micro R meter) - 2 Nos
5. Pocket dosimeter (0 - 1 R) - 10 Nos
   and charger - 2 Nos
6. Contamination Monitors with Alpha, Beta and Gamma Probe - 2 Nos
7. TLD badges - 25 Nos
8. Decontamination kit - 10 Nos
9. Remote handling tongs - 2 Nos
10. Lead pot of different sizes - 1 No each
11. Lead shots in cloth bags /Lead wool - 20 kg
12. Lead sheets 1.6 mm thick, about (1mm x 1mm) - 20 kg
13. Forceps - 2 Nos
14. Polythene bags (Small size - 1 No and big size 1 No) - 20 Nos
15. Hand gloves and shoes - 6 Nos each
16. Respirators and Protective clothing - 6 Nos
17. Radiation warning labels and labels with "Skull and Bone" marks
18. First Aid Box
19. Emergency Van.
20. Air Sampler (Battery Operated) - 2 Nos
21. Flash Light - 2 Nos
22. Filters for Air Sampling - 30 Nos
23. Spare Batteries - 2 Sets
24. Spare Bulbs - 2 Sets

ANNEXURE II

RECOMMENDED DECONTAMINATION METHODS

a) The outer clothing and shoes of persons suspected to be contaminated must be removed which will remove great deal of the contamination. Skin decontamination requires shower and washing facilities and possible some medical assistance, and these are unlikely to be available at the site of a transport accident. Persons suspected to be contaminated should be decontaminated at the accident site. Later they should be thoroughly monitored and decontaminated in an appropriate facility. A change of clothing should be provided to them at the accident site, if possible and the contaminated clothes should be collected for later washing or disposal.

b) Washing with water (with proper collection of waste water) or vacuum sweeping of roads and other objects and surfaces. This can be done with fire fighting or industrial equipment

c) Fixation of contaminants using paints, liquid to solid strippable plastics and painting materials or asphalt. Depending upon the type of radiotoxicity involved, this technique may involve subsequent removal of fixative agent after it has solidified or the fixative agent may be left in place.

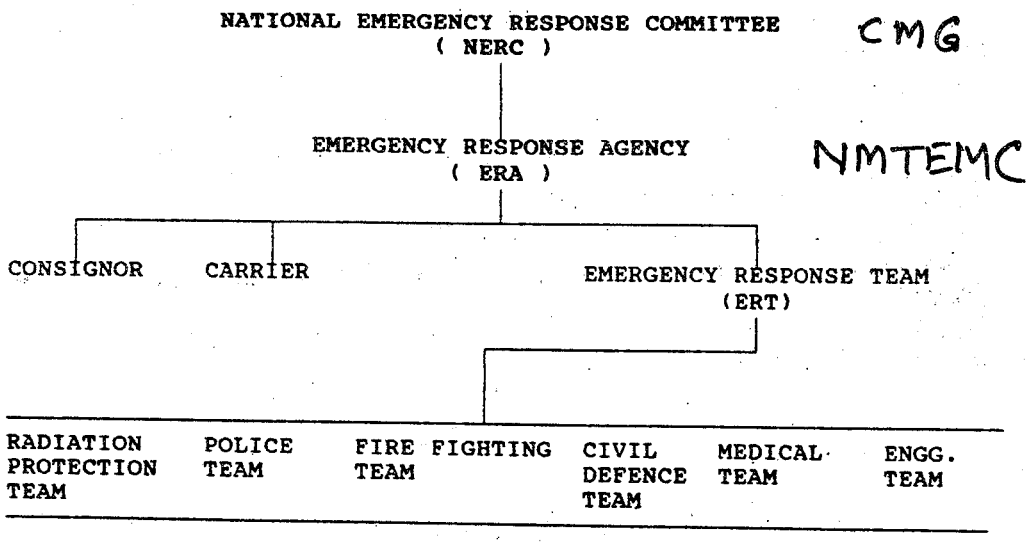
d) Washing (with collection of waste water) and cleaning of hard surfaces and equipment with water and appropriate detergents or other chemicals accompanied by collection of as much of the water as possible.

e) Removal of surface layers of road or earth to a suitable storage place.

f) Ploughing agricultural lands and other earth does not remove contamination, but dilutes and at least temporarily relocates it to deeper layers in the soil.The future use of agricultural land after ploughing under these circumstances is dependent upon a variety of factors such as the radiotoxicity, quantity, and radioactive half-life of the contaminants.

ANNEXURE III

ORGANISATIONAL CHART FOR EMERGENCY RESPONSE PLANNING AND PREPAREDNESS FOR TRANSPORT ACCIDENTS INVOLVING RADIOACTIVE MATERIALS



ANNEXURE IV

MARKINGS, LABELS, PLACARDS AND DOCUMENTS

MARKINGS

The following should be marked on the surface of packages:

TYPE A

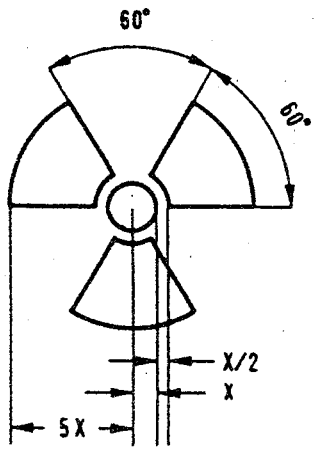
A marking given to each package which conforms to a Type A design

TYPE B (U)

A marking given to each package which conforms to a Type B (U) design

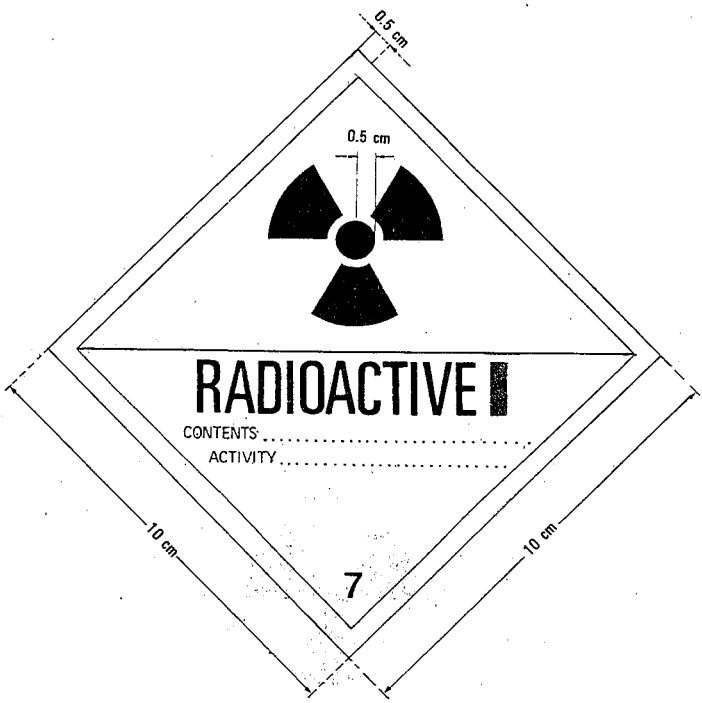
TYPE B (M)

A marking given to each package which conforms to a Type B (M) design



Basic trefoil symbol

The basic trefoil symbol has proportions based on a central circle of radius X. The minimum allowable size of X shall be 5 mm. The basic trefoil symbol is required to be embossed or stamped to the outermost receptacle of a Type B(U) or Type B(M) package.



Category I- WHITE Label

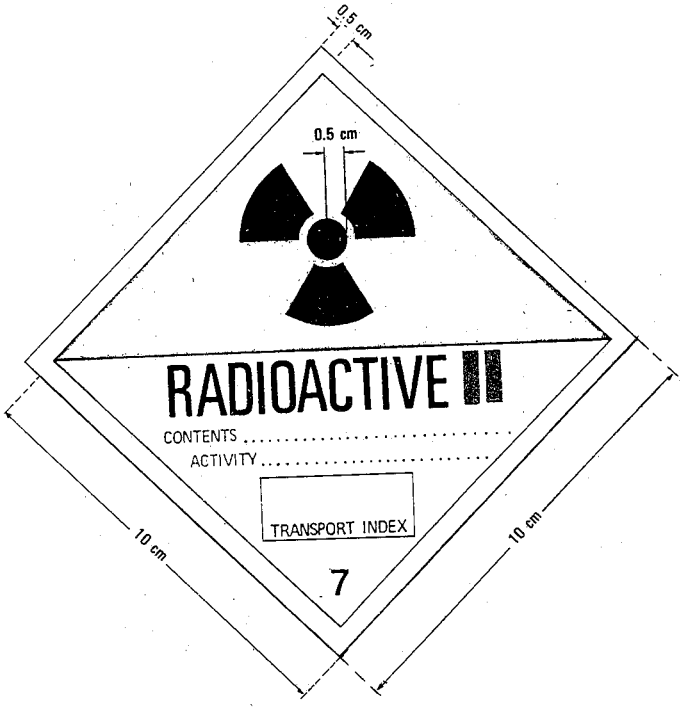
For the Category I- WHITE label the background colour of the label shall be white, the colour of the trefoil and the printing shall be black, and the colour of the category bar shall be red. The I- WHITE label is to be affixed to:

- two opposite sides of a package having a transport index of 0 and maximum radiation level at any point on external surface which is not more than 0.005 mSv/h (0.5 mrem/h), or
- four sides of freight container or a tank having the same limitation, or
- two opposite sides of an overpack having a transport index 0.

Additional information which is supplied on the I- WHITE label includes:

- description of the contents including the name of the radioactive nuclide (or nuclides) together with its classification as LSA II, LSA III, SCO I, SCO II as appropriate. LSA I does not include the name of the radionuclide. In the case of consignments which are neither LSA nor SCO only the name of the radionuclide is to be listed.

- the maximum activity of the radioactive content is listed in units of becquerels (Bq) or curies (Ci). In case of fissile material the activity might be replaced by the weight. The number '7' in the label indicates the classification number given for radioactive material among hazardous goods.



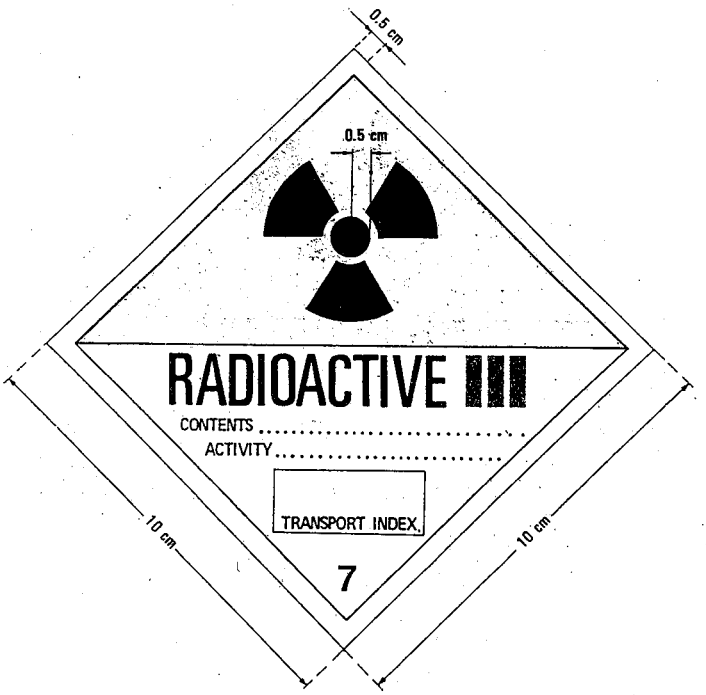
Category II- YELLOW Label

For the Category II- YELLOW label the background colour of the upper half of the label shall be yellow and of the lower half white, colour of the trefoil and the printing shall be black, and the colour of the category bars shall be red. The II- YELLOW label is to be affixed to:

- two opposite sides of package having a transport index greater than 0 but not exceeding 1 and a maximum radiation level at any point on the external surface which is not more than 0.5mSv/h (50mrem/h) and as in the case of I- WHITE label.

Additional information which is supplied on the II- YELLOW label includes the following apart from the information applicable for I- WHITE label.

- for this category the transport index is given on the label



Category III- YELLOW Label

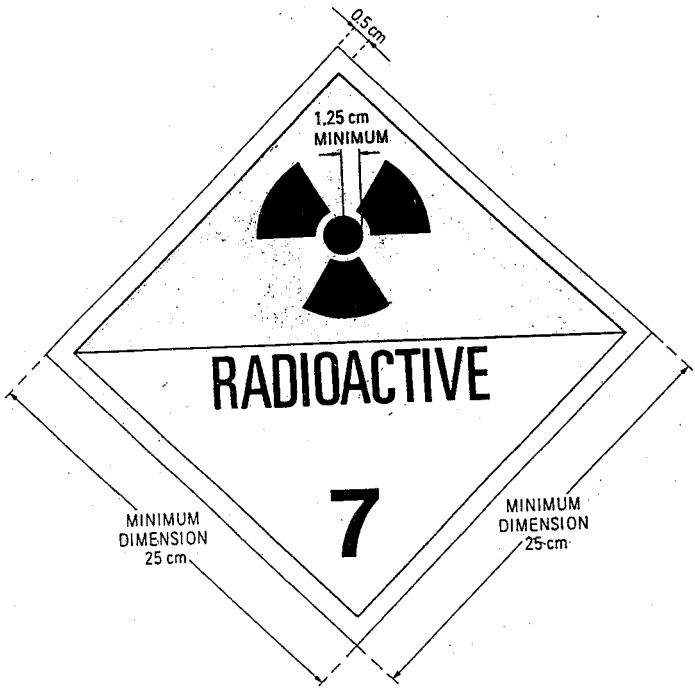
For the category III- YELLOW label the background colour of the upper half of the label shall be yellow and of the lower half white,the colour of trefoil and the printing shall be black, and the colour of the category bars shall be red. The III- YELLOW label is to affixed to:

- two opposite sides of package having a transport index greater than 1 but not exceeding 10 and the maximum radiation level at any point on the external surface

is not more than 2mSv/h (200mrem/h) or, if under exclusive use, having transport index higher than 10 and maximum radiation at any point on the external surface which is not greater than 10mSV/h (1000 mrem/h) and as in the case of I- WHITE.

Additional information which is supplied on the III- YELLOW label must be as in the case of II- YELLOW label.

PLACARDING

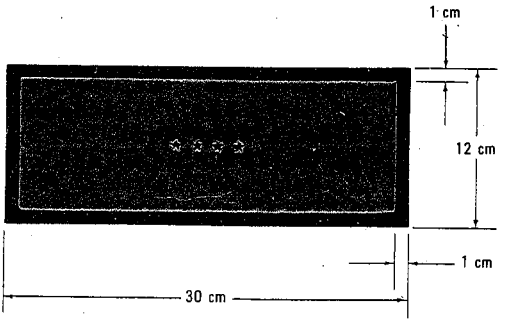


Placard

The minimum dimensions are given in the above figure. When larger dimensions are used the relative proportions must be maintained. The figure `7' shall not be less than 25mm high. The background colour of the upper half of the placard shall be yellow and of the lower half white, the colour of the trefoil and the printing shall be black.

A Placard shall be affixed to the four sides of large freight containers carrying packages other than excepted packages and tanks.

In some cases the United Nations Number (UN Number) is also displayed on the lower half of the placard or using a subsidiary displayed either on the lower half of the placard or using a subsidiary placard as shown in the figure below. The background colour of the placard shall be orange and the border and the UN Nations Number shall be black.



Placard for separate display of the United Nations Number

TRANSPORT DOCUMENT

The following information, as applicable, is included in the transport document:

(a) the proper shipping name;

(b) the United Nations Class Number `7';

(c) the words `RADIOACTIVE MATERIAL' unless these words are contained in the proper shipment name;

(d) for LSA material, the group notation `LSA I' `LSA II' or `LSA III' as appropriate;

(e) for SCO, the group notation `SCO I' or `SCO II' as appropriate;

(f) the name or symbol of each radionuclide;

(g) a description of the physical and chemical form of the material, or a notation that the material is special form radioactive material. A general description is acceptable for chemical form;

(h) the maximum activity of radioactive contents during transport expressed in units of becqurels (Bq) or (curies (Ci)) with an appropriate SI prefix. For fissile material, the mass of the fissile material in units of grams (g), or appropriate multiples thereof, may be used in place of activity.

(i) the category of the package i.e.I- WHITE, II- YELLOW, III- YELLOW;

(j) the transport index (categories II- YELLOW & III- YELLOW only);

(k) all items and materials transported under the provisions for excepted packages shall be described in the transport document as `RADIOACTIVE MATERIAL, EXCEPTED PACKAGE', and shall include the proper shipping name of the substance or article being transported from the list of United Nations Numbers;

(l) for a consignment of fissile material, where all of the packages in the consignment are excepted, the words `FISSILE EXCEPTED';

(m) the identification mark for each competent authority approval certificate (special form radioactive material, special arrangement, package design, or shipment) applicable to the consignment; and

(n) for consignments of packages in an overpack or freight container, a detailed statement of the contents of each package within the overpack or freight container and, where appropriate, of each overpack or freight container in the consignment. If packages are to be removed from the overpack or freight container at the point of intermediate unloading, appropriate transport documentation must be made available.

ANNEXURE V

EXCERPTS FROM LIST OF UNITED NATIONS NUMBERS, PROPER SHIPPING NAME AND DESCRIPTION AND SUBSIDIARY RISKS

Number	Name and description	Subsidiary risks
2910	RADIOACTIVE MATERIAL, EXCEPTED PACKAGE - INSTRUMENTS OR ARTICLES, - LIMITED QUANTITY OF MATERIAL, - ARTICLES MANUFACTURED FROM NATURAL URANIUM OR DEPLETED URANIUM OR NATURAL THORIUM, - EMPTY PACKAGING	
2912	RADIOACTIVE MATERIAL, LOW SPECIFIC ACTIVITY (LSA),	
2913	RADIOACTIVE MATERIAL, SURFACE CONTAMINATED OBJECTS (SCO)	
2918	RADIOACTIVE MATERIAL, FISSILE, N.O.S.[a]	
2974	RADIOACTIVE MATERIAL, SPECIAL FORM, N.O.S.[a]	
2975	THORIUM METAL, PYROPHORIC	Liable to spontaneous combustion
2976	THORIUM NITRATE, SOLID	Oxidizing Substance
2977	URANIUM HEXAFLUORIDE, FISSILE containing more than 1.0 percent Uranium-235	Corrosive
2978	URANIUM HEXAFLUORIDE, FISSILE excepted or non-fissile	Corrosive
2979	URANIUM METAL, PYROPHORIC	Liable to spontaneous combustion
2980	URANYL NITRATE HEXAHYDRATE SOLUTION	Corrosive
2981	URANYL NITRATE, SOLID	Oxidizing substance
2982	RADIOACTIVE MATERIAL, N.O.S.[a]	

Note: [a]N.O.S.'Not Otherwise Specified'