

**EUR 4884 e**

COMMISSION OF THE EUROPEAN COMMUNITIES

**CRITICAL ANALYSIS OF APPLICATION OF THE  
EURATOM BASIC SAFETY STANDARDS  
TO THE TRANSPORT OF NATURAL  
AND ARTIFICIAL RADIOACTIVE SUBSTANCES  
WITHIN THE MEMBER STATES**

by

L. FAILLA, C. FALOCI and A. SUSANNA  
(CNEN)

1972



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Comitato Nazionale per l'Energia Nucleare, Rome - Italy

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- IV — Conclusion and proposals.

A particular discussion is centered around some aspects of the basic standards which are considered of particular interest for the field of transport of radioactive materials. These are :

- information, authorisation and inspection;
- controlled area and protected area;
- classification of workers employed on the transport and of the population affected by it.

The four sections are supplemented by three appendices which give usefull informations to people interested in this field. Appendix A compares the various international standards, Appendix B the standards in force in the six States. Appendix C deals with the specific Italian experience in this sector.

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## **ABSTRACT**

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## **KEYWORDS**

EURATOM  
TECHNICAL SPECIFICATIONS  
TRANSPORT  
RADIOACTIVITY  
SAFETY

LEGISLATION  
INTERNATIONAL AGREEMENTS  
PERSONNEL  
CONTROL  
INSPECTION

## F O R E W O R D

One of the tasks of the European Atomic Energy Community (EURATOM) is to establish uniform safety standards to protect the health of workers and of the general public. The Basic Standards for the Protection of Health against the dangers of ionizing radiation, which were adopted as a Directive by the Council of Ministers of EURATOM pursuant to this mandate in 1959, contain the essential principles for effective radiation protection in the Community. As well as establishing maximum permissible exposure and contamination levels, to which workers and population may be exposed, the Basic Standards provide a framework for the creation of an effective system for medical and physical surveillance of workers.

According to Article 2, the Directives apply to the production, treatment, handling, utilization, possession, storage, transport and elimination of natural and artificial radioactive materials and to any other activity involving hazards from ionizing radiation.

Among all these factors, the transport of radioactive substances constitutes a special case. Owing to the dynamic nature of this factor, it is of paramount importance to the Commission to know whether the principles of radiological protection embodied in the EURATOM Basic Standards are really effective in this area and are able to guarantee adequate protection for the health of the population and personnel. The Commission therefore felt it appropriate to approach Dr. Failla, Head of the Bureau for Radioisotopes, Transport and Environmental Radioactivity of the Comitato Nazionale per l'Energia Nucleare, who has particularly extensive knowledge of matters concerning the transport of radioactive materials, and to entrust her with a critical investigation into problems of radiological protection in the transport of radioactive materials.

Dr. Failla, together with her co-workers, Dr. C. Faloci and Dr. A. Susanna, have done excellent work, not only in dealing with the problems relating to this subject and in subjecting national and international regulations to a detailed comparison and analysis, but also, wherever possible, in drawing conclusions and presenting interesting proposals for better application of the provisions of the EURATOM Basic Standards to the transport of radioactive materials.

Dr. P. RECHT  
Director of Health Protection



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PREFACE

The basic standards of the Commission of the European Community establish the standard regulations for safety and health of populations and workers against the hazards from ionising radiations. These are binding for the six community states by acceptance within the scope of the specific judicial structure of each state. Hence they are commonly called Euratom Directives.

Standards come under five titles, dealing respectively with definitions, scope, maximum permissible doses with an adequate safety factor, maximum permissible exposure and contamination, and the basic principles of workers' health supervision.

Article 2, title II states that they are applicable to the production, processing, handling, use, holding, storage, transport and disposal of natural and artificial radioactive substances and to any other activity which involves a hazard arising from ionising radiations. Explicit mention is made of transport activity for which consequently the directives must be taken as valid in their totality, as issued at the time.

Practical application to transport activity has however given rise to some confusion. For this purpose and in order to provide the most detailed account possible of the problem, this study has been carried out.

The work is classified under four sections dealing respectively with the following subjects:

- Section I : Scope of the basic standard;
- Section II : Application of the basic standards in the community states;
- Section III : Comparison between the basic standards and the international standard.
- Section IV : Conclusions and proposals.

During the course of this study a particular discussion was centred around those aspects of the basic standards which were considered of particular interest for the field of transport of radio-active materials.

These are:

- 1) information, authorisation and inspection;
- 2) controlled area and protected area;
- 3) classification of workers employed on the transport and of the population affected by it.

Regarding other aspects of the standard on the other hand we have not singled out specific problems affecting their application to transport. For example, the maximum permissible dose levels or concentrations, methods of physical and medical supervision etc, are directly applicable to the field of transport also, while in the case of the three subjects quoted above, automatic application did not appear possible.

In section I however it is considered useful to discuss the "philisophy" of the scope of the standards to transport within the field of the three separate subjects.

In section II an analysis was carried out of the standards of the six states as regards inclusion in the national legislations. In section III we have compared the standards with the recommendations issued by the other international organisations. In section IV concrete proposals have been made for adapting the standards so as to provide easier application to the field of transport.

The four sections are supplemented by three appendices which, while they can be read independently, also form an integral part of the study, supplementing it with information useful to people interested in this field.

The first and second of the appendices (appendix A and B) are essentially technical insofar as they compare the standard specification for the transport of radioactive materials, the first (appendix A) the various international standards, and the second (appendix B) as in force in the six states. The third appendix (appendix C) deals with the specific Italian experience in this sector. It was felt that this could provide particular points of interest particularly since it has been the subject of numerous studies.

A fourth appendix, which would have appeared to be very important, concerning the number of persons affected by the transport of radioactive materials, both workers and those interested in transport in various ways, in

addition to forecasts of the expansion of the sector had to be dispensed with. Unfortunately exhaustive information regarding this was not available in the community states.

In addition we have not dealt with postal transport for two basic reasons. Firstly international agreement by the Universal Postal Union (U.P.U.) for admission of radioactive material for postal transport, although stipulated, has not yet taken force in the community states. The other reason is that the problems which this may give rise to from the standpoint of radiation protection are much more diverse than other means of transport and therefore should form the subject of individual study.

In addition to Doctors C. Faloci and A. Susanna, the co-authors, Doctors F. Lucci and F. Nocera and Mr. A. Roselli, specialists in standardisation and particularly transport standardisation, have participated in this study.

I wish to thank all of them, in addition to Messrs. Recht and Eriskat of Euratom, who, having proposed this study, have provided me with a valuable opportunity to study a problem which has been felt for many years in Italy. While working on this subject I have collected much information which, if I may say so, has meantime taken on great importance in the six community states for radiation protection problems associated with the transport of radioactive materials.

Lidia Failla.



SECTION I

SCOPE OF THE BASIC EURATOM STANDARDS

## SECTION I

### SCOPE OF THE BASIC EURATOM STANDARDS

#### I-1. INTRODUCTION

The directives of the Commission of the European Communities which form the basic standards relating to health and safety for population and workers against the hazards of ionising radiations explicitly include transport of radioactive substances within their scope (article 2, title II).

This section provides a critical analysis of the scope a priori, in the field of transport, of these directives. This will therefore involve theoretical considerations, arising either from the particular form of their reception in the community states or from considerations resulting from comparison with the international recommendations in the field of health and safety of populations and workers from ionising radiations, with reference to transport.

The text refers to the text of the directive 2 February 1959 (G.U., C.E. no.11, 20 February 1959) amended by the directive 5 March 1962 (G.U., C.E.no.57, 1962) and the directive 27 October 1966 (G.U., C.E.no. 216, 26 November 1966). These directives will be indicated synthetically as basic standards.

I-2. TRANSPORT OF RADIOACTIVE SUBSTANCES

In the course of general goods transport, three phases may be distinguished, namely loading, unloading and transport properly speaking from the place of dispatch to the destination, which is classified in accordance with the means employed, whether air or surface, which is in turn divided into sea, land or mixed. The loading and unloading phases are differentiated on the basis of the means employed (conveyor belts, crane, manual), with the resulting differences in the time during which the workers remain in the vicinity of the packages. This is important if the packages contain radioactive substances. It should be noted, however, that the persons performing the various operations are not usually the same, with the exception of road transport, in which case the drivers of the motor vehicles frequently are the same. It should also be pointed out that rail, sea or air transport presuppose prior and subsequent road transport, which renders the latter particularly important.

This brings out the importance of establishing to which group of persons must or should be allocated workers for transporting radioactive material, according to the classification set out in the basic standards.

The particular features of transport of radioactive substances is such that the methods for performing it form the subject of specific recommendations on the part

of international organisations, primarily the IAEA (International Atomic Energy Agency).

I-3. EURATOM CLASSIFICATION OF WORKERS AND POPULATIONS

Title 1, section 2 of the basic standards defines as "occupationally exposed persons" those who, in a controlled area habitually carry out work which exposes them to hazards due to ionizing radiations. In the special groups of the population, still according to title I, section 2, there is a distinction between:

- a) persons who, by reason of their work, are occasionally in the controlled area but who are not considered as "occupationally exposed persons";
- b) persons handling equipment emitting ionizing radiations or containing radioactive substances in quantities such that the radiations emitted do not exceed the maximum permissible dose for this class of person;
- c) persons habitually in the vicinity of the controlled area and who, for these reasons, may be exposed to radiation exceeding that established for the population as a whole.

Workers employed in the transport of radioactive substances, considering that application of the basic standards explicitly provide for them, must therefore be entered among "occupationally exposed" workers or classified in one of the three "special groups of the population".

With the exception of the special group provided for under item b), to which apparently they cannot be assimilated, in so far as their work does not involve manipulation of equipment emitting ionizing radiation or containing radioactive substances, workers employed in the transport of radioactive substances must be classified in groups whose definition presupposes the existence throughout of the "control area". Consequently, the problem of the solution rests on the definition of such a zone within the scope of the basic standards. It is necessary, therefore, to discuss the existence or otherwise of the "controlled area" in the field of transport of radioactive substances.

#### I-4. CONTROLLED AREA AND PROTECTED AREA

Title I, section 2 of the basic standards defines as "controlled area" a given location in the space where there exists a source of ionizing radiation and in which occupationally exposed persons may receive a radiation dose greater than 1.5 rems annually.

Now referring to such definitions either for occupationally exposed persons or special groups a) and c) of the population, it is evident that the basic standards run into tautology. This is particularly evident in the case of the binomial controlled area-occupationally exposed person, since it is impossible to establish a classification for occupationally exposed persons without previously defining what is meant by

controlled area neither is it possible to speak of a controlled area without having defined what is meant by occupationally exposed person.

In order to dispense with tautology, therefore, it is essential to make the two concepts independent, which can be achieved, for example, by substituting the expression person for the expression occupationally exposed person. This substitution can be applied already in this study and moreover, it will be convenient to so refer, both since it does not change the basic concepts and because, on the other hand, it is analogous with what has been laid down by the concept of "protected area", which is defined as "any area surrounding a controlled area where there is a permanent risk of the maximum permissible dose for the whole population being exceeded", and is not in any way associated with the existence at the position of a particular class of person.

#### I-5. CONTROLLED AREA AND PROTECTED AREA IN THE TRANSPORT OF RADIOACTIVE MATERIALS

In order, therefore, to discuss a priori the scope of the basic standards in the field of transport of radioactive materials, a careful examination should be made, after accepting substitution of the expression "occupationally exposed person" by the term "person"

in the definition of "controlled area, the significance of this definition when referring to the transport operation.

The Euratom definition of controlled area implies in fact the simultaneous verification of two circumstances, namely the presence at a given position in the space of a source of ionizing radiation and the possibility that "persons" may there take up a radiation dose greater than 1.5 rem annually.

The first circumstance, that is to say that the controlled area is a given position in the space in which there is a source of ionizing radiation, is indubitably verified. Indeed, particularly when dealing with a mobile area such as the platform of a road vehicle or railway truck, the hold of a ship or the baggage space of an aircraft, this is always a given location, instant by instant, in which there is a source of ionizing radiation represented by the package or packages containing radioactive substances.

The second circumstance, that is to say in a certain position there exists the possibility that "persons" will receive a radiation dose greater than 1.5 rem annually can also be verified, depending on the intensity of irradiation from the packages the mode (time and distance) during which they remain in the vicinity of personnel. According to the IAEA recommendations<sup>(1)</sup>, the maximum permissible irradiation

in a single transport is for example 50 mR/h at 1 metre from the load. For this type of load, therefore, 30 hours sojourn at 1 metre distance without screening is sufficient to receive a dose of 1.5 rem.

It is therefore impossible, at any rate in principle, to exclude the fact that, in the case of transport also, the presence of a controlled area as defined in the basic standard can be represented. There is, however, a problem of formulation which has to be discussed.

It should in the first place be remembered that transport activity, from the technical standpoint, can be considered as completed, once transfer of a merchandise has been carried out from one given place to another. This means that each individual transport can be considered in itself, which means that everything resulting from carrying out the transport, once this has been completed, has no reason for being considered further. It should therefore be possible to state that, assuming the existence of the controlled area for transport of radioactive materials, this may exist only during the period of time between loading, transport properly speaking and unloading at the consignee's premises, and that, once transport has been completed, the controlled area no longer exists. If indeed, the same carrier performs another transport, it will be necessary to consider a fresh controlled area which would be, in almost all cases, different



from the preceding.

Consequently, considering this interpretation as valid, in practice there would rarely be a controlled area to be defined in the course of a single transport. The example considered above, of a transport with 50 "transport index" (50 mR/h at 1 metre), carried out in an overall time of 30 hours, with the driver at a distance of 1 metre from the load and without screens, is in effect fairly rare. Experience indicates that, generally speaking, one of the assumed conditions at least is absent. However, in principle, it is possible that the presence of a controlled area can be specified even in a single transport.

This interpretation of the existence of the controlled area confined to the single transport can at the same time be associated with another which takes into account the transport activity as a whole, and not only during the single event. In this case it may be possible to consider as the controlled area, for example, the driver's cabin of a road vehicle used for the transport of radioactive materials, therefore frequently used for this purpose. In this case there is an analogy with what occurs, for example, in the surroundings of a machine generating radioactivity for which the controlled area, in addition to existing only when the machine is operating, may also differ in accordance with the type of usage of the machine or of the particular experiment being performed. If, for example, an X-ray diffractometer is involved, in accordance with the anticathode employed, there is an

energy spectrum and exposure distribution differing from time to time. Similarly, in the case of a motor vehicle employed for the transport of radioactive materials, there would be a controlled area only during the period when radioactive material is being transported, and the area may differ each time. It is evident, however, that analogy only is involved, and not coincidence. Indeed, while the transport activity is completely terminated when it has been carried out and therefore it can be considered that the geometry of the controlled area changes totally from one transport to another, on the other hand in the case of a machine-generated radiation, equipment generally remains the same, is installed in a fixed position and not variable in time, and consequently simply a variation or adaptation is carried out in order to perform a different operation.

As a result of the greater difficulties, including legal, due to the acceptance of the second interpretation, it would appear more logical in principle to give more weight to the first interpretation and to conclude that, as regards transport, the controlled area may exist only during the single transport operation. There would, however, be a serious difficulty in both cases in respect of the possibility that, leaving out the existence or otherwise of the controlled area, the persons employed in the transport receive greater doses than those permissible for the population as a whole or for special

groups of the population, consequently requiring physical control or medical control. In practice, therefore, it may happen that a worker employed in the transport of radioactive materials will be affected by transports which, even if individually do not involve the presence of a controlled area, render necessary as a whole, for that particular worker, a classification as occupationally exposed person.

In these considerations, therefore, it must be deduced that, from the essential standpoint, it is important to establish not so much whether, in the course of a transport, he is or is not in a controlled area, than rather to which group should the workers employed be allocated. From the moment when the groups involved are associated with the concept of controlled area in the basic standards, difficulties of application arise.

A second consideration representing a further problem for the subject dealt with here, is that physical control of protection against radiation and medical control are connected with the definition of controlled area. Indeed, apart from the discussion on the presence of a controlled area for individual transports or any coincidence with the driver's cabin of a road vehicle, there still remains the fact that the controlled area is variable and this presents appreciable difficulty in demarking it or controlling access of persons. This variability, connected in

addition with the possibility of workers employed on the transport alternating, involves the practical impossibility of the routine performance of such controls, excluding perhaps the ambient, provided for such area or for the persons affected by it.

Again, therefore, the circumstance arises where the actual importance from the standpoint of the protection expert is not in ascertaining the presence or otherwise of a controlled area but rather in carrying out control of the workers employed in the transport.

From the analyses carried out, it is seen how the inherent problem in the controlled area extends to "protected area", as defined in the basic standards and therefore inside a controlled area.

It may on the other hand be observed that, by removing from the definition of the protected area (title I, section 2, basic standards) the words: "at the periphery of a controlled area" an area would be singled out in which there would exist a hazard of receiving a radiation dose greater than the maximum permissible for the population as a whole. A minor hazard area would thus be involved, perhaps associated with the controlled area only by the different dose level, equal to the lower limit established for the controlled area. A strict spatial connection would not be essential between the two.

In any case, it can be stated that the concept of "protected area" on the basis of the previous discussion and therefore strictly connected above all with the conception of "controlled area" does not appear to be important and significant in the field of transport of radioactive materials.

At this point it would appear essential, before drawing conclusions, to study the classification of workers and individual groups, in accordance with the content of the basic standards, applying this to the field of transport of radioactive materials.

#### I-6. CLASSIFICATION OF WORKERS AND THE GENERAL PUBLIC IN THE FIELD OF TRANSPORT

The previous section, following a critical analysis of applicability to the field of transport of controlled zone in accordance with the basic standards, led to the following conclusions:

- 1) the definitions of "controlled area" and "occupationally exposed persons" contain a manifest tautology which can be resolved only by separating the two concepts and hence the two definitions;
- 2) for transport, there can be at least two possible definitions of "controlled area", respectively considering a single transport or portion of space which may represent a constant in the case of a number of transports (for example the driver's cabin);
- 3) the presence or otherwise of controlled area in the

transport of radioactive materials does not appear so important as regards the substance of radiation protection, which must directly affect the persons on the basis of the possibility of exceeding certain doses.

Having adequately discussed in the preceding item I-5 the problem connected with the presence or otherwise of controlled area in transport, we will now deal with the analysis of definitions regarding the classification of workers, either as reflected in the analysis carried out on the concept of controlled area or in order to establish the extent to which the basic standards may be valid for the purpose of effective radiation protection in transport.

The basic standards, as previously stated, distinguish between:

occupationally exposed persons, special groups of the general public and the population as a whole. Apart from group b) of the special groups of the general public, for the reasons already stated, we still have to consider, for persons directly affected by transport activity, groups a) and c) under title I of the basic standards already quoted, and occupationally exposed persons.

All three categories, according to the basic standards, are connected with the definition of controlled area. At the same time, despite the discussion under the preceding item, it would appear possible to apply these to persons affected by transport of radioactive material without any modification.

If it is desired to take into account the first hypothesis concerning application of the definition of controlled area to transport, as discussed in the preceding section I-5, it can be readily deduced that the definitions under items a) and c) of the special groups of the population and "occupationally exposed persons" do not involve any difficulty of interpretation where the controlled area can mean a geometric series variable in time and space.

Also taking into account the second interpretation of controlled zone discussed in the preceding section I-5, now meaning by controlled area a geometry which, while being variable in space and time in respect to external points of reference, there is at the same time a constant point of reference for example in the motor vehicle, for which standards could be accepted "in toto". At the same time, in both cases there remains the difficulty of including situations where, while not appearing as controlled area, the workers, for example, by the fact of carrying out loading and unloading, may receive doses in excess of 1.5 rem annually.

Considering that the same considerations "mutatis mutandis" may be encountered also for activities differing from transport, it appears important at this point to ask whether minor modifications should be introduced into the basic standards in order to render them applicable to the field of transport, when this does not appear at present sufficiently to affect other activities. In effect, developing this

aspect of analysis "a priori" of the basic standards, it does not seem possible to ignore the fact that these have been constructed primarily from information emerging from the situation of nuclear plants which were the main cause of radiation hazard.

This situation is nowadays historically past, in the sense that radiation hazard extends significantly to many other activities (radioisotopes, gamma rays and accelerators for diagnostic and therapeutic purposes, industrial and research gammagraphy, n-graphy, etc.) for which interdependence between the "controlled area" concept and groups of persons working within its ambit does not appear so close.

By analogy with what has been stated regarding the definition of controlled area, which takes on a more general and effective significance when linked with the presence of occupationally exposed persons, it appears appropriate and more so when dealing directly with radiation protection of persons, that the definitions of the basic standards regarding persons should be connected in turn with the controlled area concept.

Precise proposals in this respect are dealt with and developed in section IV of this study.



#### I-7. CONTROLS BY NATIONAL AUTHORITIES

Considering now the basic standards as affecting controls carried out by the national authorities, it is possible to set out synthetically the following facts, emerging from these standards:

- 1) transport activities, as listed in the scope of the standards (article 2) are subjected to controls (article 18, section 2);
- 2) these controls are listed in the working code and in advance authorization by reason of the gravity of the resulting hazard (article 3);
- 3) in order to ensure protection of the populations, the national authority must adopt measures for protection, inspection and action in the case of incidents (article 17);
- 4) in order to carry out physical and medical control supervision of workers and to promote measures for protection and action in all cases where this is necessary, the national authority sets up one or more inspection systems (article 18, section 2) and entrusts physical and medical control for protection respectively to qualified experts and authorised medical practitioners (articles 19 and 23). Prohibitions are drawn up for the employment of workers, together with criteria of suitability and procedures for the revision of personnel health records (articles 24, 25 and 26).

Passing on to a more detailed study of these points, two different considerations arise, the first

for items 1) and 2) above, referring to a general "hazard resulting from ionizing radiation" and the second for points 3) and 4), which take account more directly of the controls to be established for the population and workers.

As regards the first, it does not appear necessary to place any emphasis on the particular field of transport of radioactive materials. It does, however, appear appropriate (item 3) to draw attention to measures for the health and protection of the general public, as specified in article 17, section 1 of the basic standards on the overall arrangements and controls for specified factors which can create an irradiation hazard to the general public. On the basis of article 17, section 2, these are operative in the "protected area" for the special group c) of the population and for the territory as a whole for the population as a whole.

As discussed above, since the protected area is not very important for the field of transport, measures for protection, inspection and action lose substance, the more so since, if it is theoretically possible to carry out some of the operations described in section 3 of article 17, a), it does not seem either possible or important to carry out the assessment as under b) in section 3 for each transport, assuming the first hypothesis regarding the controlled area.

This difficulty exists in practice also when considering the second hypothesis for "controlled area" for which, at a rate suitably assessed, the evaluations would be carried out. If indeed it is unthinkable that these can be carried out on the occasion of each transport, as would be required taking into account the first hypothesis regarding controlled area, it is equally unthinkable that they could be carried out within a controlled area which, although referring to a given zone in the space, such as for example the platform of a transport vehicle, is by nature variable.

Transports are so varied and unpredictable that not only under the conditions of any action and damage but even in the normal conditions, the only system reasonably complying with the problem of protective measures for the population is to abandon the controlled and protected area concepts and to rely, as previously stated, for affected workers, on accurate statistical analysis of transport frequency and the transport indices of the packages. It must be the responsibility of the competent authorities to select any items of high traffic intensity of the packages and, if necessary, to impose the necessary measures in order to safeguard the population as a whole and so that any single individuals do not at any time exceed the given maximum doses.

For item 4, regarding workers, the criterion must

be finally dispensed with as set out in the first section of article 18 of the basic standards, by which health inspection for workers is tied to the controlled zone. It is necessary, on the other hand, to provide a correct classification of personnel affected by the field of transport as a function of dose hazards, where necessary accompanied by statistical evaluations. In the case where the need arises either for physical or medical control, these must be carried out as set out in chapters I and II of title V of the Euratom directives, regarding the basic principles of health inspection of workers, articles 19 and 23.

It emerges from these considerations that each member State which has placed transport activities under an advance authorisation and declaration system can, through the inspection systems thus brought into action, control a-posteriori by statistical analysis of the transport carried out by the carrier and with appropriate evaluations, if classification of the personnel involved is or is not correct and may require to be modified; it can also control the conduct of the qualified expert and authorised medical practitioner. This applies particularly to the qualified expert in so far as the development of transport activity could result in the established classification being amended from the standpoint of the protection expert for workers affected by the transport activity.

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SECTION II

ADOPTION OF THE BASIC STANDARDS BY THE COMMUNITY STATES  
AS REGARDS THE FIELD OF TRANSPORT.

SECTION II

ADOPTION OF THE BASIC STANDARDS BY THE COMMUNITY

STATES AS REGARDS THE FIELD OF TRANSPORT

PRELIMINARY CONSIDERATIONS

Prior to the issue of the basic standards, the national legislations were fairly complicated and diverse as regards radiation protection.

The issue of the Euratom directives, 2 February 1959, drawn up on the basis of article 30 of the Founding Treaty of the Commission of the European Community, represented an important act not only as regards content, being based on the already existing international recommendations (ICRP) but for the harmonization which their adoption has brought about in regard to the standards already existing or in course of preparation within the range of the six Community States.

Such harmonization, consequent upon the statement that the basic standards stipulate adoption in the national legislations, had been brought about having in mind primarily the existence of various technical legislative measures available in the States. This fact has again brought about the necessity for conferring upon the regulations of the individual countries an "individual" character, either where the general juridical disposition of the State requires it or for

the purpose of better adaptation of such concepts of the basic standards to the national situation in the sector.

It should be observed that, with the exception of Italy, the legislations of the six States, on adopting the Euratom protection directives, have not taken into particular consideration transport activity as regards the detail of the protection standards, but have considered it in a global fashion, together with other activities. Each State, on the other hand, has separately a standard for the transport of dangerous materials which includes standards for radioactive materials. These standards, generally speaking, as will be specified more strictly in appendix b), do not contain particular and detailed conditions on the legislative level for radiation protection. Consequently, it shall be understood how difficulties emerging from application of the basic standards for transport have been encountered in Italy before other Community States. Indeed, Italian legislation, not having considered transport activity on the adoption of the protection directives, has been confronted with the necessity of preparing an "ad hoc" standard for this field and therefore has had to study its applicability to this field item by item.

This section II will analyse adoption of the basic standards in the legislations of the member States

for those items which may, directly or indirectly, affect transport activity. After close study and on the basis of discussion in section I, the conclusion has been reached that these items can be synthesised into the following groups:

- a) declaration, authorisation and inspection;
- b) controlled area and protected area;
- c) classification of workers and special groups of the population.

A part of this section is devoted to each of these groups of items.

## PART I

### ADOPTION OF THE CONCEPTS OF DECLARATION, AUTHORISATION AND INSPECTION

#### II-I-1. INTRODUCTION

It should be recalled that the field of application of the basic standards as defined in article 2 includes all possible uses of radiations for peaceful purposes, including transport; article 4, on the other hand, provides for the possible exemption from the condition of declaration and advance authorisation for carrying out such activities with a fairly limited hazard. It appears obvious, from the spirit of the text of the basic standards and from what has been written, that such possibility is left to the choice and decision of



the member States, taking into account throughout the sanctor criteria in the community text. It is, however, evident that they can also adopt more restricted standards and, according to article 5, even prohibitions.

We will limit ourselves here to a study of the method of adoption of the system of declaration and advance authorisation in the various Community States as regards the field of transport of radioactive materials, with reference also to any subsequent restrictions or prohibitions.

It was considered that interest could be attached to a study, where possible, of the system of "inspection" which is strictly connected obviously with the particular authorisations.

## II-I-2. ANALYSIS OF THE LEGISLATIONS OF THE MEMBER STATES

### II-I-2.1. Belgium

The BELGIAN legislation, on adopting the Euratom directives, included within its general regulation (+) a detailed system of advance authorisation for all activity containing a hazard of ionizing radiation, including transport, in application of the general principle already sanctioned by law regarding the health and safety of the general public (++) against the hazards of ionizing radiations.

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(+) Royal decree 28 February, 1963, containing the general regulation for protection of the general public and workers against the hazards of ionizing radiation.

(++) Statute of 29 March, 1958, relating to the protection of the general public against the hazards of ionizing radiation.

In view of article 5 of the basic standards, the prohibition faculty is exercised by the Belgian legislatures for the use of radioactive substances in the activity intended in this article, maintaining an exceptional condition which, however, does not affect the field of transport.

As regards supervisory inspection, the Belgian law does not provide for the establishment of an "ad hoc" body for nuclear activities. Inspection is therefore entrusted to public administration services already existing, based on the type of activity or installation. The standards relating to bodies charged with inspection functions, their powers and any penal actions are contained in the general regulation already recorded for the protection of the general public against radiation, particularly for application of the specific arrangement provided for by the decrees for enforcement of the law. Such inspection standards refer also to the transport of radioactive materials to which, as stated, the legislation for adoption of the basic standards apply without exception.

#### II-I-2.2. France

In FRANCE, the fundamental text relating to adoption of the basic standard can be identified in the decrees: 11 December 1963, 20 June 1966 and 15 March 1967. Other legal arrangements, although important for the

general standards affecting radiation hazards, do not appear significant for the field of transport.

Among the accomplishments relating to the system of declaration and authorisation there is a detailed standard for the use of substances and instruments having an ionizing radiation hazard and, within the scope of this standard, (+) explicit reference is made to transport, for which however, the standard establishes regulations on the application level. Inspection and supervision controls are entrusted essentially to inspectors under the Ministry of Social Affairs, who are also responsible for control in the application of radiation protection laws to the field of transport of radioactive materials.

### II-I-2.3. Italy

As regards ITALY, the particular fact is recalled that the Italian law for adoption of the basic standards, i.e. DPR 185, 13 February 1964, does not rule the sector of transport of radioactive substances apart from a reservation contained in DPR, 30 December 1965, No.1704 as regards the technical-administrative authorisation standards (permanent and "ad hoc") on the transport of

(+) See decree No. 475, 3 May 1954 of the CIREA (Inter-ministerial Commission for Artificial Radioactive Elements) and the succeeding decree No.512, 11 May 1955 and decree No.1197, 26 November 1956.

radioactive substances, which will be dealt with later.

The text of 1965 quoted above contained the declaration and authorisation system for the transport of radioactive substances. Authorisations, general or particular, are granted by the Ministry of Industry, Commerce and Trade, in conjunction with the Ministry of Transport and Civil Aviation, if involving road or air transport, and the Ministry of Mercantile Marine if sea transport is involved. A simple system of advance declaration is available for each particular case (occasional transports below certain amount of radioactivity).

The DPR No.185, for the functions of supervision and control of an inspection nature as regards radiation protection, introduces the new inspectors body of the National Committee for Nuclear Energy (CNEN) in conjunction with those already existing from other administrations involved. The inspectors have right of access wherever sources of radiation are stored or used in a quantity such as to present a hazard. The creation of the new authority constitutes a solution sui generis which has not been encountered in the corresponding legislations of other States. There is, however, a problem not yet resolved as regards the extent of the inspectors authority in the field of radioactive transports, while the competence of supervision in general in the CNEN has not been discussed in the sector affected.

II-I-2.4. Luxembourg

Adoption of the basic standard by Luxembourg was accomplished substantially by a fundamental law (25 March 1963) and with the regulation on protection against radiation (8 February 1967). This regulation, however, foresees the issue of subsequent standards of application which will include the procedures for transport authorisations.

II-I-2.5. The Netherlands

In the Netherlands the standard texts for adoption of the basic standards form the fundamental law of 21 February 1963 and decree of 18 March 1963, which amend the public administration regulation provided by the law for the prevention of works accidents and for industrial health of 1934. Operation of the law of 21 February 1963 was governed by the issue of certain execution and integration provisions of the arrangements concerned therein. Among the various decrees thus issued, attention is drawn to the decree of 10 September 1969 relating to the transport of fissile materials, minerals and radioactive substances, in which there are several standards dealing with the system of declaration and authorisation.

In virtue of the power arising from the fundamental law quoted above, the Ministry for Social Affairs and Health is responsible for the supervision and control of activity involving radiation, in order to prevent damage to public health. Control is entrusted to various

specialist bodies which, under the coordination of this Ministry, function in relation to their own field of competence (environmental hygiene, industrial medicine, human and veterinary medicine, etc.). Provision is not therefore made for setting up appropriate bodies, and supervision devolves on those already existing for conventional activities. For transport, the existence of two bodies should be noted in particular, namely a body of controllers of dangerous substances, supervising transports within Dutch territory and a body of mercantile marine inspectors acting in conjunction with the former. These bodies, who come under the Ministry of Transport and Water, are responsible for carrying out, jointly where appropriate, the necessary controls over the transport of dangerous substances.

#### II-I-2.6. German Federal Republic

It can be stated that in the German Federal Republic the fundamental standard text for adoption of the basic standards takes the form of the law of 23 December 1959, completed in the "First radiological protection regulation" of 24 June 1960 and amended by the text of 15 October 1965.

This law subjects the various activities, including the transport of radioactive substances, to a system of authorisation (and in certain cases exemption) governed by the degree of confidence which the applicants offer, on the

personnel or technical level, as regards adequacy of apparatus, the submission of financial guarantee in the event of nuclear damage and the absence of consequences contrary to the public interest. With reference to article 5 of the basic standards, prohibitions are not introduced but the system of authorisation is extended also to levels below the thresholds of exemption stated in article 4 of the said standards.

Regional (Länder) authorities are responsible for the inspection and supervision of nuclear activities, including transport, carried out on behalf of the Federal Authority (Bund).

## PART II

### ADOPTION OF THE "CONTROLLED AREA" AND "PROTECTED AREA" CONCEPTS

#### II-II-1. INTRODUCTION

The first part of this section dealt with the adoption of the basic standards in the separate national legislations of the Community States as regards systems of declaration, authorisation and inspection with reference to transport.

The second part will consider the protected and controlled area concepts as appearing in the legislations of the member States, particularly for the purposes of comparison and analysis in the light of their application to the transport field, bringing out the difficulties encountered in the practical application of these concepts.

II-II-2. CONTROL AND PROTECTED AREA IN THE LEGISLATION OF  
THE MEMBER STATES

II-II-2.1. Belgium

Article 1 of the decree quoted, 28 February 1963, regarding the general regulation for protection of the general public and workers against hazards from ionizing radiation, states that this applies also to the transport of radioactive materials. The definitions of controlled area and protected area reported there consequently apply also to transport. These are:

controlled area: location where there exists a source of ionizing radiation capable of supplying an individual dose in excess of 1.5 rem/year;

protected area: any location in the space at the periphery of a controlled area where there exists a permanent danger of the maximum permissible dose being exceeded for the population as a whole. Such a dose, as reported in another part of the decree, has been established at 5 rem per head accumulated during a period of 30 years. In evaluating this, account must be taken, for purposes of weighting, of the doses received by occupationally exposed persons and those habitually within the vicinity of the controlled area.



### II-II-2.2. France

The decree of 20 June 1966 relating to general principles of radiation protection states in article 2 that the provision contained in the decree applies to the transport of radioactive materials. Consequently, standards issued in application of this decree must be applicable to transport. In particular, in appendix 1 of the decree of 15 March 1967, containing the regulation for the protection of workers, there appears only the definition for controlled area: controlled area: location where access is regulated for reasons of protection against ionizing radiation.

The decree, in chapter II, title II, specifies the technical characteristics governing this zone. No reference is made to protected area.

### II-II-2.3. Italy

As regards Italy, the Presidential decree of 13 February 1964, No. 185 does not directly embrace transport activities; at the same time, article 2 of the Presidential decree 30 December 1965, No. 1704, in amendment of article 5 of the law 31 December 1962, No. 1860, final clause, states that, pending the appropriate regulating standards, transport of radioactive materials must be carried out in accordance with the various special provisions (Ministerial circulars) apart from the health protection standards contained in the Presidential decree 13 February 1964, No. 185 which remain in force.

The definitions set out under article II, decree No. 185, quoted above, including controlled area and protected area, can, however, apply but with the limitation specified in the phrase: "which remain in force", also in the case of transport. Article 9 of the Presidential decree No. 185, in particular sets out definitions for controlled area and protected area as follows:

controlled area: a certain location where there exists a source of ionizing radiation and where occupationally exposed persons can receive a radiation dose in excess of 1.5 rem annually. In such a zone, physical supervision and medical supervision shall be carried out for radiation protection;

protected area: any location at the periphery of a controlled area where there exists a permanent danger of the maximum permissible dose being exceeded for the population as a whole and where physical supervision must be carried out against radiation protection.

#### II-II-2.4. Luxembourg

The Grand Duchy regulation 8 February 1967, in application of the law 25 March 1963 regarding protection of the general public against the hazards of ionizing radiation, states in article 1.1, chapter I, scope, that this applies also to the transport of radioactive materials.

Appendix I of the above regulation sets out definitions

for controlled area and protected area as follows:

controlled area: given location in the space where there exists a source of ionizing radiation and where occupationally exposed persons may receive a radiation dose in excess of the maximum permissible dose for occasionally exposed persons. Physical control shall be carried out in such a zone for radiation protection together with medical controls;

protected area: location in the space at the periphery of a controlled area where there exists a permanent risk of exceeding the maximum permissible dose for the population as a whole and where physical control must be carried out for radiation protection.

#### II-II-2.5. Netherlands

The decree on protection against ionizing radiation, 18 March 1963, amending and completing the public administration regulation provided in the law for the prevention of incidents and for industrial hygiene, 1934, states that the formulation of the protection standards is such as not to require a definition for controlled and protected area.

#### II-II-2.6. German Federal Republic

The health protection regulation against radiation hazards, 15 October 1965, states in part I, section 1, scope, that the regulation shall apply to the transport of radioactive materials.

Part III, section 22, defines controlled area and protected area as follows:

controlled area: location where, by reason of the handling of radioactive substances, there exists the possibility for persons occupying that position for 48 hours per week of receiving a radiation dose exceeding 1.5 rem/year by external irradiation or inhalation, the latter being verified if the concentration of radioactive substances in the air exceeds one third of the value stated in appendix II (setting out the concentrations of radioactive substances in water and in air). The same definition states also that such areas must be indicated by notices carrying the word "radioactive";

protected area: location directly adjacent to controlled areas where, by reason of the handling of radioactive substances, there exists the possibility for persons stationed there permanently receiving a dose exceeding 0.15/rem year. Such areas must be protected in the manner set out in section 35 of the decree (regarding measurement of dose intensity and determination of radioactive concentrations)

Section 22 again states that access to controlled areas shall be permitted only to those persons who must enter them in order to carry out their work or whose position requires access to such areas. The competent authority may grant

access to other persons possessing an authorisation (on the basis of section III). The competent authority for issuing the authorisation or the control authority shall be responsible for establishing that certain areas must be classified as controlled or protected where this is necessary for the protection of individuals and the general public as a whole. The authorities quoted may, in particular cases, issue exemptions from the provisions laid down in the definition of controlled area on condition that these do not constitute a hazard for individuals or the population as a whole.

#### II-II-3. COMPARISON WITH THE EURATOM DEFINITION

A study of the definitions of controlled and protected area as laid down in the legislations of the six Community States has brought out the following facts.

In the Netherlands, the radiation protection regulation does not include the concepts of controlled and protected zone.

Italy and Luxembourg have adopted the definitions of controlled and protected area in their entirety from the basic standards, with the reservation, as regards Italy, of the possibility of their application to transport.

The remaining Community States (Belgium, France and the German Federal Republic) deviate to different extents from the Euratom definition, also in accordance with the state of progress of their standardization.

More precisely, the definition adopted by Belgium for controlled area is substantially different from the Euratom definition, associating the controlled area concept with the presence of occupationally exposed persons.

The definition of protected area, however, is that of the basic standards.

The solution adopted by France is different, in the regulation for the protection of workers, 15 March 1967. The definition of protected area disappears, while the definition of controlled area is associated not only with the presence of occupationally exposed persons but also with the possibility of exceeding a radiation dose. Without entering into detailed discussion, it is seen that this definition has the advantage of ready adaptation to the various practical situations but, on the other hand, has the disadvantage of excessive arbitrariness in determination.

For the German Federal Republic, the definition of controlled area differs from the Euratom definition in so far as it does not explicitly quote occupationally exposed persons and whether the maximum doses laid down apply to such persons. The definition of protected area, on the other hand, is taken almost entirely from the basic standards, with the difference that the maximum permissible dose level for the population as a whole, also taken as 5 rem in 30 years, is distributed with suitable roundings in each year and is therefore fixed at 0.15 rem annually.

PART III

ADOPTION OF THE CONCEPT OF CLASSIFICATION OF WORKERS AND  
GENERAL PUBLIC

II-III.1. INTRODUCTION

This third part of section II will study, in the same way as the controlled area and protected area concepts in the second part, adoption of classification of workers and general public from the basic standards in the standards of the six Community States, then analysing the relationships existing between those adopted and the basic standards.

Before undertaking the analysis, it is recalled that the radiation protection standards apply to the field of transport in all the Community States with a restriction in the case of Italy as already discussed.

II-III-1.1. Belgium

As regards workers and the general public, in the decree of 28 February 1963 regarding the general regulation for protection against ionizing radiation hazards, two classes of occupationally exposed persons are defined, apart from a special group of the population.

The first category, indicated with the letter A, embraces workers who regularly carry out their work in a controlled area. Category B, on the other hand, includes those workers, not included in class A, who may also be exposed to ionizing radiation by reason of their work.

As regards the definition of special group of the population, this means persons who are habitually in the vicinity of the controlled area and who, for this reason, may receive irradiation in excess of that laid down for the population as a whole.

#### II-III-1.2. France

As regards the workers and general public, appendix I, definitions of the decree of 15 March 1967 quoted previously sets out four categories into which the workers and general public can be classified. These are: persons directly employed on work involving radiation, defined as persons habitually working in the controlled area; persons not directly employed on work involving radiation, defined as persons, occupationally exposed to radiation, but who do not work regularly in a controlled area; the general public, defined as individuals not forming part either of persons directly employed on work involving radiation nor persons not directly employed on work involving radiation; the population as a whole, comprising all the population, i.e. persons directly or indirectly on work involving radiation and the general public.

#### II-III-1.3. Italy

As regards Italy, with the reservations in the introduction to this part and what was stated in section II-II.2.4, the following are considered, within the meaning of article 9 of the DPR, 13 February 1964 No. 185:



Occupationally exposed persons: persons who habitually carry out work in a controlled area which exposes them to the ionizing radiation hazard.

Special groups of the population:

Group 1) persons who by reason of their work are occasionally in a controlled area, but who are not considered as occupationally exposed persons;

Group 2) persons who handle apparatus emitting ionizing radiation or containing radioactive substances in amounts such that the radiation emitted does not exceed the maximum permissible dose for this class of person;

Group 3) persons who are habitually in the vicinity of the controlled area and who, for this reason, may receive irradiation in excess of that laid down for the population as a whole.

#### II-III-1.4. Luxembourg

In the Grand Duchy regulation 8 February 1967, two classes of person are defined in appendix I as follows:

Occupationally exposed persons: persons who habitually carry out work in a controlled area which exposes them to ionizing radiation hazards.

Occasionally exposed persons: persons who, by reason of their work, are occasionally in the controlled area but who are not considered as occupationally exposed persons, or persons who handle sources such that the radiation emitted cannot exceed the maximum permissible dose for this class of person.

#### II-III-1.5. The Netherlands

The decree on radiation protection, 18 March 1963, in article 2 defines radiological work, not including transport operations. Article 4, however, establishes groups of workers who, in accordance with the various definitions of the statute, are classified as follows: workers carrying out radiological work; workers not carrying out radiological work but who regularly occupy locations where radiological work is being carried out; workers outside the above two categories for whom it is difficult, by reason of their activity, to lay down a maximum dose of 0.5 rem annually for the hematopoietic organs, the gonads and crystalline organs for which a dose of 1.5 rem annually has been established (subject to the approval of the departmental head); and finally workers not included in the above categories for whom the maximum dose is 0.5 rem/year for the hematopoietic organs, gonads and crystalline organs.

Since, however, workers employed on transport must be included in one of the categories classified above, these are allocated to the two latter categories. Consequently, the possibility is excluded of classifying workers employed on transport as occupationally exposed.

#### II-III-1.6. German Federal Republic

Section 24 of the regulation on protection against radiation hazards defines as occupationally exposed persons persons who:

1) in the handling of radioactive substances may be exposed

to radiation emitted by the substances; or  
2) habitually remain in controlled areas for reasons of work.

Occasionally exposed persons, however, are not explicitly defined but a maximum permissible dose of 1.5 rem annually is laid down for persons who, being in the controlled area, do not handle radioactive substances. This dose must not be exceeded by those persons who are occasionally in the controlled area for training; if they are below 18 years of age, the maximum permissible dose is laid down as 0.5 rem annually. Persons permanently in the protected zone must not take up a dose exceeding 0.5 rem annually.

#### II-III-2. COMPARISON WITH THE EURATOM DEFINITIONS

From the above it emerges that the basic standards are scrupulously observed, as regards classification of workers and special groups of the population, by Italy. Luxembourg has made substantial changes in the classification of personnel. The Grand Duchy decree quoted above actually omits definition of the special group c) in the basic standards, while definition of the special group b) refers to "persons handling sources such that ...." also as in the basic standards, as "persons handling apparatus emitting ionizing radiation or containing radioactive substances in amounts such that ....". Incidentally, it may be observed that this difference could perhaps offer readier application of this group to transport workers.

Belgium defines two categories of person, placing in category A workers habitually carrying out their work in a controlled area, including however in this definition, as indicated by Euratom and in category B, all those workers not included in A, who, for reasons of work, may be exposed to ionizing radiation. With this latter definition of workers, the Belgian standard definitely escapes from the strict classification of special groups of the population set out in the basic standards, thus providing a possibility of application to transport. The Euratom definition c) relating to the special group of the population habitually in the vicinity of the controlled area is, however, retained.

As regards France, the difference consists in a different structure, on which classification in accordance with the basic standards can only be partially superimposed. In particular, persons not directly employed in work involving radiation differ from the special group a) of the basic standards as regards definition as exposed to occupationally exposed persons; the concept of general public in particular is completely new, meaning individuals who are neither directly nor indirectly employed on work involving radiation.

It should be emphasised that persons not directly employed on work involving radiation, according to the French definition, include all those who, on account of their occupation, may take up an ionizing radiation dose even if not working habitually in a controlled area. The special group a) of the population,

according to the Euratom definition, comprises only those persons who, for reasons of work, are occasionally in the controlled area but who are not considered as occupationally exposed persons. In other words, the Euratom definition is much more restrictive just because its strict statement includes in that group only persons who are occasionally in the controlled area and not those who, while not in the controlled area, may take up an ionizing radiation dose. The difficulty again arises of strictly relating exposed persons and controlled area.

As regards the Netherlands, it has been seen already that the definitions of the decree of 18 March 1963 differ markedly from the basic standards in so far as the comparison is rather complicated.

It can, however, be stated that workers carrying out radiological work are largely those classified as occupationally exposed in the basic standards. It is interesting to observe, however, that as regards workers employed on transport operations, these must be classified as workers defined under item c) or d), clause 2, article 4 of the decree quoted above, while these workers, distinct from those carrying out radiological work, are subjected to a restriction of the dose, which must be less than 1.5 rem annually.

As regards the German Federal Republic, occupationally exposed persons are not only those who habitually carry out their work in a controlled area, still for the purpose of their work, but also all those who, when dealing with radioactive substances, may be exposed to radiation emitted by such substances. This category therefore may comprise all

persons who are involved in activities with a radiation hazard, while the category of occasionally exposed persons for which, however, no explicit definition is given, may be classified among those for whom the maximum permissible dose is laid down as 1.5 rem annually or 0.5 annually, where the age is below 18 years. It should be noted finally that the definition of the special group c) of the population is retained, as set out in the basic standards.

SECTION III

COMPARISON BETWEEN THE BASIC EURATOM STANDARDS AND THE  
INTERNATIONAL STANDARDS

SECTION III

COMPARISON BETWEEN THE BASIC EURATOM STANDARDS AND THE  
INTERNATIONAL STANDARDS

III-1. INTRODUCTION

The study of the basic standards, with particular reference to transport of radioactive materials has so far dealt with the range of their significance "a priori" apart from their adoption in the laws and regulations of the Community States.

The information drawn from this study has brought out many difficulties, even important ones, regarding the possibility of application of the basic standards to transport. At the same time, information has not emerged with sufficient clarity regarding how any amendments should be developed. It seems appropriate therefore to carry out a study of the extent to which other international bodies have developed the subject in order to obtain a better understanding of the proposed formulation in section IV of this work.

This section will compare the basic standards with the recommendations issued by the ICRP, the IAEA and the OCDE-ENEA for the purpose of bringing out international trends in the field of radiation protection as regards those factors which mainly affect the field of transport of radioactive materials and similarly to the previous sections, for control, including the systems of declaration and authorisation, on the part of the national authorities, for the controlled and protected area concepts and classification of personnel.

The choice of recommendations compared, indicated below systematically by the initials ICRP<sup>(1)</sup>, IAEA<sup>(2)</sup> and



OECD-ENEA<sup>(3)</sup> is strictly justified.

In the first place, the work carried out by the International Commission for Radiological Protection (ICRP) is well-known as regards radiation protection standards and more generally health guides, their publications having been an authoritative guide for more than 30 years in the field of protection against ionizing radiations. Consequently, in developing a comparative study of the basic standards with recommendations issued by other international bodies, it was natural to carry out an initial comparison with the ICRP which, among other things, has the reputation of forming the vanguard in this sector.

It was also considered useful to carry out a comparison with the recommendations issued by the International Atomic Energy Agency (IAEA) which, although also inspired by the ICRP, has issued recommendations in the field of transport of radioactive materials<sup>(4)</sup> which have significantly inspired the drafting of regulations both international and national.

It was also considered appropriate to carry out a similar comparison with the recommendations issued by the Organisation for Economic Development and Cooperation, of which the European Atomic Energy Agency forms part (OECD-ENEA) as regards protection against ionizing radiation, in view of the fact that the six Community States form part of it.

For each of the three subjects for which the comparison is carried out (control on the part of the national authorities, controlled and protected area, classification of personnel) a table has been prepared setting out in synthetic form the definitions adopted by the publications of the bodies quoted.

III-2. CONTROLS ON THE PART OF THE NATIONAL AUTHORITIES

Table I sets out the information given in the basic standards, the ICRP, IAEA and OECD-ENEA recommendations regarding controls on the part of national authorities, with the intention of including the systems of declaration and authorisation.

A critical comparison as regards this specific subject does not appear very important simply because, while the basic standards constitute directives which the member States must adopt, the ICRP, IAEA and OECD-ENEA recommendations are not of an obligatory nature on account of the institutional scopes of these bodies.

In addition, the ICRP states that the attitude adopted by the Commission in preparing their own recommendations was to consider the basic principles on which appropriate radiation protection provisions could be founded, leaving the various national bodies the responsibility of formulating legislative arrangements and regulations best adapted to the needs of the individual countries. On the subject of controls by the national authorities, however, the ICRP does not formulate specific recommendations for the national bodies nor suggest what action they should undertake.

The OECD-ENEA also invites the member States only to adopt the necessary measures for ensuring that adequate protection against ionizing radiation is adopted and maintained as regards both workers and general public in relation to activities for which irradiation hazards may occur, including the transport of radioactive materials.

TABLE I

CONTROLS ON THE PART OF THE NATIONAL AUTHORITIES

EURATOM	<p>Each member State shall subject operation of the activities indicated in article 2 to declaration and, in cases determined by the member State, by reason of the gravity of the risk resulting from such activities, through a system of advance authorisation ....</p> <p>Each member State shall set up one or more systems of inspection for the purpose of exercising supervisory controls and to promote measures for the supervision and action in all cases where these are rendered necessary.</p>
ICRP	<p>The basic attitude adopted by the Commission in preparing its own recommendations is that of taking into account the basic principles on which these can be based and appropriate provisions for radiation protection, leaving to the various national protection bodies responsibility for formulating particular suggestions, technical standards, legislative arrangements and regulations best adapted to the needs of the individual countries.</p>
IAEA	<p>..... these operations must be notified or registered as required by the competent authorities and if necessary subjected to a system of authorisation by the authorities in accordance with the gravity of the resulting danger .....</p> <p>An appropriate system of inspection must be established by the competent authorities for controlling the safety specifications both within and without the establishments in which the radioactive sources are present and in order to apply the suitable standards.</p>
OECD - ENECA	<p>The ENECA member States must undertake the necessary measures for ensuring that adequate protective measures are adopted and maintained against ionizing radiation hazards to occupationally exposed persons and to the general public in all cases where radioactive materials are produced, ..... transported,.....</p>

Only the IAEA, by reason of its more precise functions in this matter, gives some indications to the national authorities in the field of controls for operations and activities involving radioactive materials, including transport; in particular, it advises the activities be notified or registered, but only in the manner which the competent national authority considers more suitable, also providing any systems of authorisation for certain activities in accordance with the gravity of the resulting hazard. It also recommends appropriate systems of inspection by the competent national authorities for the control and application of protection and safety standards.

The basic standards, on the other hand, consistent with the competence ensuing from the institutional suggestions, specify the declaration for the exercise of activities involving the risk of exposure for workers and the general public to ionizing radiation, including transport and, in cases determined by the member State according to the gravity of the risk resulting from such activities, a system of advance authorisation. They also require that each member State sets up one or more systems of inspection in order to exercise control supervision and to promote measures of supervision and action in all cases where this is rendered necessary.

As regards controls by the national authorities, a closer comparison between the Euratom directives and the

ICRP, IAEA and OECD -ENEA recommendations does not appear useful by reason of the different institutional functions.

Considering more particularly the field of transport, but also in general all activity involving radiation hazards, it should be noted that there is an analogy between the IAEA and Euratom positions as regards the merit of controls. There follows from this a well-founded requirement for a control exercised by the competent authority, which is daily found to be increasingly necessary.

### III-3. CONTROLLED AND PROTECTED AREA

Table II, in a similar way to the preceding section, sets out the definitions in Italian of the Euratom, ICRP, IAEA and OCDE-ENEA controlled and protected areas,

A prime consideration is that the definition of protected area appears only in the basic standards. This fact is brought out from a study of the definitions of controlled which, in the form adopted by the ICRP, by the IAEA and by the OCDE-ENEA render superfluous the definition of protected area.

Before discussing this point, however, it is appropriate to compare the definitions of controlled area.

It can be directly seen that the ICRP, IAEA and OCDE-ENEA definitions start by stating that the controlled area is a location to which access is controlled for the purpose of protecting persons against exposure to radiation. Following this statement of a general nature, only the IAEA adds that the controlled area must be placed under the supervision of a person with competence and responsibility

TABLE II  
CONTROLLED AND PROTECTED AREA

EURATOM

Controlled area a given location in the space where there exists a source of ionizing radiation and where occupationally exposed persons may take up a radiation dose in excess of 1.5 rem annually; in such a zone physical control shall be exercised for radiation protection, together with a medical control.

Protected area any location in the space at the periphery of a controlled area where there exists a permanent risk of exceeding the maximum permissible dose for the population as a whole and where physical control for radiation protection must be carried out.

ICRP

Controlled area: zone to which access is controlled for the purpose of protecting persons against exposure from external radiation or radioactive materials. Access can be controlled by a wide variety of methods, the most simple being the use of warning signals. The extent of a controlled area is a subject of professional judgement but in each case the extent must be such that it is extremely improbable that workers outside the controlled area will receive a dose exceeding 3/10ths of the appropriate maximum permissible doses. Considerations of another type may on the other hand require an extension of the controlled area.

Protected area: no definition

IAEA

Controlled area: zone classified in such a way for the purposes of controlling individual exposure of persons under the supervision of a person possessing the competence and responsibility of applying appropriate health and safety regulations ..... controlled areas must be established where separate individuals may receive doses exceeding 3/10ths of the maximum permissible doses annually. Such areas must be marked and the warning signals must be properly situated at the entry and within the zone ....

Protected area: no definition.

OECD - ENEA

Controlled area: zone to which access is controlled for the purposes of radiation protection. This must be established where workers may take up doses exceeding 3/10ths of the maximum permissible doses annually. Considerations of another type may require an extension of the controlled area. Access to such a zone may be controlled by a wide variety of means, the simplest being the use of appropriate warning signals.

Protected area: no definition.

for applying the appropriate health and safety regulations. At the same time, the ICRP, OECD -ENEA and the basic standards contain the supervision concept as expressed in another part of the context.

Regarding the basic standards, which define the controlled area as a given location in the space where a source of ionizing radiation exists, there is a marked difference in the ICRP, IAEA and OECD -ENEA. The Euratom definition indeed, is the only one which does not emphasise the fact that the controlled area is a location to which access is controlled for the purpose of protecting persons against exposure to radiation, but rather the fact that there is a source of radiation at a certain location. Evidently, confining comparison to these initial statements, the Euratom definition is more precise and less general but because of this, more restrictive. In addition, what appears to be really important is not so much the presence of a radioactive source but, as frequently stated, the fact that persons may receive radiation doses and that it therefore appears necessary to make reference to such doses.

In the light of these circumstances, however, the definitions of the remaining bodies would appear to be better orientated and more adequate in accordance with section I, for applicability of the controlled area concept to transport.

Continuing to read the definition of controlled area given by the ICRP and, although with a postponement of

Finally, the ICRP, IAEA and OECD -ENEA statements, in respect of the Euratom statement, are completely dissociated from the concept of occupationally exposed persons while reference is made more generally to persons or workers, occupationally exposed or otherwise. In addition, the definitions of the three international bodies quoted above emphasise the fact that the controlled area is a location subject to control for the purposes of protecting individuals of the general public against radiation; protection of the person is thus brought out while Euratom specifies, whether for the same purpose, first the spatial fact and then reference to the dose. In the case of all four international bodies, on the other hand, the value of the maximum dose for which the establishment of a controlled area is considered necessary is practically the same, being 1.5 rem for Euratom and 3/10ths of the maximum permissible doses for the remaining bodies.



statements, by IAEA and OECD-ENEA, it is seen that access can be controlled by a variety of means, the simplest of which is the use of warning signals. The IAEA also indicates the positions of the signals.

The most obvious difference between the Euratom definitions and the ICRP, IAEA and OECD-ENEA is in the relationship between controlled area and occupationally exposed persons, which is specifically indicated in the basic standards, as already exhaustively discussed in section I of this work, while it is not considered in the definitions of the remaining organisations. With the exception of this, the definitions given by the four bodies do not display substantial differences. Only the ICRP, for example, states that the extent of a controlled area is a matter of professional judgement but adds that in each case the extent must be such that it is extremely improbable that workers outside the controlled zone will take in a dose exceeding 3/10ths of the appropriate permissible maximum doses, actually corresponding to 1.5 rem annually. The ICRP finally states that considerations of another type may, however, require an extension of the controlled area, equivalent to stating that the criterion of probability of exceeding the dose must not be the sole and exclusive one in determining the extent of the zone. There is a similar statement in the OECD-ENEA definition of controlled area but it is absent in the IAEA definition.

#### III-4. CLASSIFICATION OF PERSONNEL AND THE GENERAL PUBLIC

Table III, as previously, synthesises the definitions regarding classification of personnel as set out in the basic standards and in the ICRP, IAEA and OECD-ENEA recommendations. On this subject again, there are marked similarities between the definitions of the three international bodies, while certain differences are observed between these and those of the basic standards.

The ICRP, IAEA and OECD-ENEA definitions indeed, consider two different situations in which persons may find themselves in respect of ionizing radiation, that is to say, exposure to radiation by reason of the occupation of the persons and exposure to radiation of separate individuals of the population or of the population as a whole, apart from the work carried out. The basic standards, on the other hand, define occupationally exposed workers, special groups of the population and the population as a whole; the special groups of the population, however, combine persons exposed by reason of the work (groups a) and b)) and separate individuals of the population (group c)) who are in a particular situation, not working, in respect of ionizing radiation. It is appropriate therefore, when carrying out a comparative study, to consider for the moment not the special group c) of the population (the only group which considers persons exposed other than for purposes of work) as defined by Euratom, considering this, on the other hand whenever restrictions of doses for separate individuals of the population are being spoken of. The case of

the population as a whole will not be discussed, since this factor takes in all human activities with radiation and can certainly not be limited to the restrictive field of transport.

Table III shows that there are two situations for the ICRP, the IAEA and OECD-ENEA for which workers may be exposed to radiation, according to which the respective probabilities of doses will or will not exceed 3/10ths of the maximum permissible doses.

The Euratom classification, on the other hand, apart from the reasons quoted above under case c) of special groups of the population, considers two categories, namely occupationally exposed persons and the special groups a) and b) of the population.

Occupationally exposed persons are those who, in a controlled area, habitually carry out work which exposes them to the danger of ionizing radiation. The definition, several times falling into underlined tautology, refers explicitly to the controlled area, differing from what is found in the ICRP, IAEA and OECD-ENEA definitions, where emphasis is placed on the doses. The difference between the definitions is of basic importance as regards applicability of the basic standards to transport. Indeed, the interesting point is that the individual worker may take up a dose exceeding 3/10ths of the maximum permissible doses annually. It is not important, however, whether the dose was taken up by an habitual worker in the controlled zone or under several different situations, each of which may not involve the existence of a controlled zone as defined by Euratom.

TABLE III  
CLASSIFICATION OF PERSONNEL

EURATOM	<p><u>Occupationally exposed persons:</u> persons who, in a controlled area, habitually carry out work which exposes them to the danger of ionizing radiation.</p> <p><u>Special groups of the population:</u> the following form part of these groups:</p> <p>a) persons who, for reasons of work, are occasionally in the controlled area but who are not considered "occupationally exposed persons";</p> <p>b) persons who handle apparatus emitting ionizing radiation or containing radioactive substances in amounts such that the radiation emitted does not exceed the maximum permissible dose for this class of person;</p> <p>c) persons who are habitually in the vicinity of the controlled area and who, for this reason, may be exposed to irradiation exceeding that fixed for the population as a whole.</p>
ICRP	<p>For purposes of the organisation and management of protection, two different situations should be considered where the workers are exposed to radiation:</p> <p>i) situations where the doses may exceed 3/10ths of the maximum permissible doses annually;</p> <p>ii) situations where it is extremely improbable that the doses exceed 3/10ths of the maximum permissible doses annually.</p>
IAEA	<p>For administrative purposes, two situations should be considered where the workers may be exposed to radiation during the course of their work ..... the two situations are:</p> <p>i) situations where the doses may exceed 3/10ths of the maximum permissible doses annually ....</p> <p>ii) situations where it is extremely improbable that the dose can exceed 3/10ths of the maximum permissible doses annually .....</p>
OECD-ENEAC	<p>For the purposes of radiation protection and health policy, distinction should be made between:</p> <p>i) persons employed in situations such that the dose may exceed 3/10ths of the maximum permissible doses annually;</p> <p>ii) persons employed in situations such that it is extremely improbable that the dose can exceed 3/10ths of the maximum permissible doses annually.</p>

It therefore appears reasonable to state that occupationally exposed persons are those for whom, independently of the fact that they carry out their activity in a controlled area, there exists a probability by reason of their work activity of taking up doses exceeding 3/10ths of the maximum permissible doses annually.

The difficulty is in the estimation "a priori" of situations where workers may take up doses exceeding 3/10ths of the permissible maximum doses annually. This is particularly important in the case of transport. An evaluation of such situations may however be carried out a posteriori, either by individual measurement of the dose taken up or a statistical enquiry into transports carried out and into the methods by which they were performed. In addition, a reasonable forecast can be obtained from this as to the trend in future years, allowing the initial estimate to be amended where necessary.

As regards workers classified according to Euratom in special groups of the population, it is recalled that there are two special groups of the population, namely group a) comprising "persons occasionally in the controlled area for reasons of work but not considered as occupationally exposed" and group b) comprising "persons handling apparatus emitting ionizing radiation or containing radioactive substances to amounts such that the radiation emitted does not exceed the maximum permissible dose for this class of person".

With the exception of group b), comprising a specific class of person, all others receiving a radiation dose less than 1.5 rem annually by reason of their work must be classified in group a). This latter group, however, similar to occupationally exposed workers, contains explicit reference to the controlled area, leading to the anomalies already discussed on several occasions in this work. This category therefore cannot include those persons who, while not entering the controlled area and not handling apparatus emitting ionizing radiation or containing radioactive substances, may take up, by reason of their work, doses less than 1.5 rem and greater than 0.5 rem annually, a fact which can be encountered fairly frequently in transport.

Exclusive reference to doses in the ICRP, IAEA and OCDE-ENEA definitions, on the other hand, permits all possible cases of various work activities to be included and hence transport also, when workers, whether in the controlled area or otherwise, may take up doses less than 1.5 rem annually.

It is important also to note that both in the ICRP, IAEA and OECD-ENEA recommendations and the basic standards, reference to the dose relates to the possibility of exceeding certain levels rather than the levels actually encountered, with the important practical consequences necessarily implying the problem of professional judgement.

Another interesting observation emerges from the com-

parative analysis of the definitions supplied by the four international bodies being considered, referring to individuals of the general public for whom the maximum dose is fixed at 0.5 rem annually. While no reference is made by the ICRP, the IAEA and the OECD - ENEA to their location, in the case of Euratom, they are restricted to those (case c) of the special groups) who are habitually in the vicinity of the controlled area and who, for this reason, may be exposed to irradiation exceeding that fixed for the population as a whole.

This consideration particularly affects transport which, by its nature, is such that single individuals may take up doses exceeding those fixed for the population as a whole while there is the problem already discussed as regards the existence or otherwise of a controlled area as defined in the basic standards.

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SECTION IV  
CONCLUSIONS AND PROPOSALS

## SECTION IV

### CONCLUSIONS AND PROPOSALS

#### IV-1. INTRODUCTION

The first section of this study discussed the problem of applicability a priori of the basic standards, on the basis of general theoretical considerations, justifying rejection of actual application of the standards in the Community States.

The second section discussed adoption of the standards by the six States with particular regard to concepts of major interest as regards transport, that is to say declaration, authorisation and inspection (part I), controlled and protected area (part II) and classification of workers and general public (part III).

The third section compared the same concepts as laid down in the basic standards with the analogous definitions issued by the international bodies affected by this sector (ICRP, IAEA and OECD-ENEA).

This section, after briefly recapitulating the conclusions arrived at in the preceding sections, formulated a number of proposals for improving the applicability of the basic standards to the field of transport of radioactive materials.

#### IV-2. CONTROLS ON THE PART OF THE NATIONAL AUTHORITIES

As regards controls on the part of the national authorities, the only observations regarding the basic

standards are those of section I of this work. As already recorded, uniformity within the Community States as regards such controls does not appear to be a reasonable proposal on account primarily of the diversity of the standards in force in the various countries where strict autonomy prevails in this field.

Again, a comparison with analogous recommendations issued by the ICRP, IAEA and OECD-ENEA has not brought out any useful indication by reason of the institutional scopes of the international organisations.

#### IV-3. CONTROLLED AND PROTECTED AREA

Following on a critical analysis of the controlled area concept as defined in the basic standards within the scope of applicability to the field of transport, the following conclusions were reached in section I:

- 1) the definitions of "controlled area" and "occupationally exposed persons" contain a manifest tautology which can be resolved only by separating the two concepts and therefore the two definitions;
- 2) by rendering the definitions independent, two possible hypotheses may be obtained for transport regarding the configurations of the controlled zone, on the one hand the environment connected to each individual transport considered as an activity starting and finishing with that transport; on the other hand the portion of the space (for example, the interior of a motor vehicle) considered as a continuing activity in the case of several transports;

3) neither of the two configurations appears to represent an important fact as regards the substance of radiation protection which, particularly as regards transport, should be related to the dose for the person rather than to a criterion of location in space.

Of these observations, the latter is fundamental, which, in substance, renders less significant the discussion regarding the protected and controlled zone concepts.

However, if it is decided to accept the existence of a controlled area during the course of transport for one or other hypothesis, the definition stated in the basic standards, as quoted under item 1 above, is inapplicable, not only in the field of transport but also in other sectors of radiation protection.

Confirmation arises not only from the theoretical discussion but also on the practical level, from the manner in which this concept has been received by a number of Community States. Some countries, indeed, have adopted the Euratom definitions as a whole, probably considering that they cannot be amended partially and, as in the case of Italy, after having adopted them, have sought to amend them directly within Euratom. Other countries, on the other hand, have not adopted them in their entirety in the respective national legislations, probably because of the difficulties which could arise. These have introduced a number of amendments which, as discussed in section II, are nearly always substantial.

The case of France is particularly interesting from this standpoint, where the regulation for radiation protection modifies a number of definitions, including the definition of controlled area, completely rejecting the definition of protected area. The amended definition of controlled area includes elimination of the tautology of the Euratom definition.

In Belgium and the German Federal Republic, on adopting the concept of controlled area, the definition has been transformed by substantial modifications, probably in an attempt to free the controlled area from the existence of occupationally exposed persons there.

These amendments, however, are quite in harmony with the definitions of controlled area set out in the recommendations issued by the international bodies considered in section III.

The protected area concept, which has not been adopted in the French standard, does not exist in the ICRP, IAEA and OCDE-ENEA recommendations. As was studied in section III, the absence of definitions of protected area is a consequence of the definition of the controlled area established in the recommendations of the three international bodies quoted, for which emphasis is placed primarily on the risk of exceeding or otherwise  $3/10$ ths of the maximum permissible dose. As already discussed, freeing the protected area concept from the controlled area concept, some use could also be derived

from retaining the concept in order to characterize the area where persons located there could take up a radiation dose greater than that laid down for separate individuals of the population or for the population as a whole, but less than 3/10ths of the maximum permissible doses.

The controlled area, according to the definitions laid down by the international bodies quoted, is, as distinct from Euratom, a place to which access is controlled for the purpose of protecting persons against exposure to radiation and where persons or workers may take up a dose exceeding 3/10ths of the maximum permissible doses.

It should be observed that this definition is quite different from the French, where no reference is made to control of access to the controlled area, although this area is defined as a regulated location for the purposes of radiation protection, that is to say, a location where certain arrangements are in force for radiological protection without any reference to the doses which persons may take up there. The Euratom definition, on the other hand, emphasises the existence of a source of radiation at a certain location, being consequently much more restrictive.

In conclusion, in the light of the considerations set out so far, it may be stated that:

- 1) the controlled area concept, as defined by the basic standards, does not appear useful as regards transport of radioactive materials. Hence, it can either be stated explicitly that this concept does not apply to transport or a definition of controlled area can

be formulated which can be adapted to the transport of radioactive materials, dissociated from the case of occupationally exposed persons.

- 2) On the basis of what has been said so far, it can be stated that the definitions of the international bodies considered are better adapted to the requirements of transport. In addition, if these definitions were adopted, a fairly important uniformity would be obtained in the international field as regards aspects of radiation protection.

#### IV-4. CLASSIFICATION OF WORKERS AND THE GENERAL PUBLIC

The Euratom definitions regarding classification of workers and general public, as stated on a number of occasions, differentiates three categories of person, that is to say, occupationally exposed workers, special groups of the population and the population as a whole. From the discussion of section III regarding comparison with the definitions of the international bodies, it emerges that workers and general public are still separated into three categories as follows: in the first the workers who, by reason of their activity, may be exposed to ionizing radiation; in the second, single individuals of the population who, for various reasons, may take up a radiation dose greater than that laid down for the population as a whole; and the third, the population as a whole.

This classification distinguishes homogeneous categories of persons and allows greater simplicity in application to the transport of radioactive materials while not raising difficulties for other activities. The distinction between workers who may be exposed to radiation by reason of their activities and the single individuals of the population is particularly useful in the field of transport. The first category can indeed include workers actually employed on the transport of radioactive materials, while the second may include those single individuals of the population who, by the nature of transport, may take up doses in excess of those laid down for the population as a whole.

The Euratom classification, on the other hand, contains a group of occupationally exposed workers, while other workers, not occupationally exposed but who may none the less take up doses by reason of their work, are included in special groups, together with single individuals of the population who may take up doses by reason of the location they occupy and not by reason of the work performed; this involves group c) of the population in the basic standards, that is to say those persons who are actually in the vicinity of the controlled area.

However, in analogy with the recommendations of the international bodies considered, it is logical to propose the division of the whole of the population into three groups in respect of the possibility of exposure to radiation, namely:



- 1) workers who, in the course of their activity, may be exposed to ionizing radiation;
- 2) single individuals of the population who may take up a radiation dose in excess of that laid down for the population as a whole;
- 3) the population as a whole.

Within the scope of group 1) it is proposed that two categories be distinguished, namely:

- a) workers carrying out work which exposes them to the hazard of ionizing radiation and who, for this reason, may take up a radiation dose exceeding 1.5 rem annually (or 3/10ths of the maximum permissible dose annually).

This definition, which is in harmony with those of the ICRP, IAEA and OECD-ENEA, emphasises the dose hazard without any reference to controlled zone.

Consequently, occupationally exposed persons in the basic standards would again fall into this category.

- b) workers who carry out work which exposes them to the hazard of ionizing radiation but who cannot take up a radiation dose greater than 1.5 rem annually (or 3/10ths of the maximum permissible dose annually).

This definition again, as in the preceding case, is analogous to the international standards and emphasises the dose risk, likewise dispensing with reference to controlled area. As regards the basic standards, groups a) and b) of the special groups of the population would again fall into this category.

Hence, the first of the three proposed groups would include all those, occupationally exposed or otherwise, who may take up doses by reason of their working activity. The second group would include single individuals of the population who may take up doses on account of their particular geographic location but not for reasons of work. This group would also include group c) of the special groups of the population in the basic standards.

The third group would include the entire population as a whole for the purpose of calculating the genetic dose. Comparison between the classification of the basic standards and that proposed is set out in the following table:

TABLE

CATEGORY OF THE POPULATION	CLASSIFICATION OF THE BASIC STANDARDS	PROPOSED CLASSIFICATION
Workers in a controlled area : > 1.5 rem/year	Occupationally exposed persons	1-a)
Workers not in a controlled area : > 1.5 rem/year	-	1-a)
Workers occasionally in a controlled area : < 1.5 rem/year	Special group a)	1-b)
Persons handling apparatus : < 1.5 rem/year	Special group b)	1-b)
Persons in the vicinity of a controlled area : < 1.5 rem/year	Special group c)	2
Single individuals < 0.5 rem/year	-	2
General public: 5 rem in 30 years	Population as a whole	3

This classification, apart from providing a substantial analysis of the international recommendations, would have ready application for the field of transport, both for workers employed and for any of the general public affected.

For the specific transport sector, application of the proposed groups may be proposed as follows.

The first, category a), could include those workers who, habitually employed on transport, may find themselves in situations which, taken together, could result in exceeding the dose of 1.5 rem/year (or 3/10ths of the maximum doses).

Again the first group, category b), could include those workers employed on transport who, however, do not run the risk of taking up a dose exceeding 1.5 rem/year (or 3/10ths of the maximum permissible dose).

The second could include those single individuals of the population who may occasionally find themselves in the vicinity of packages containing radioactive materials and who may therefore take up a dose exceeding that fixed for the population as a whole.

The third group would include the population as a whole, to whose genetic dose transport activities also contribute.

For the purpose of selecting the most suitable classification, the carrier could carry out individual measurements, over a certain period, of the dose taken up by the workers employed or, in a forecast manner, an estimation of the number of transports intended during the year, the number of persons involved in carrying them out and an analysis of the methods generally employed for

carrying out the transport operations, and assessing the distances employed - packages and the hours occupied on these distances. In this way, it is in effect possible to arrive with some approximation at an estimation of the doses which the workers employed on transport may take up. It is clear that this advance estimate can be subsequently made more precise when the number of transports carried out in a period of any year is known.

As regards single individuals of the population who may occasionally be within the vicinity of packages containing radioactive material, reasonable estimates have already been carried out by international bodies such as the IAEA, for example<sup>(1)</sup> which, taking into account the maximum number of permissible transport indices per load, clearly demonstrate that it is highly improbable that such individuals may take up a radiation dose approaching orders of magnitude of 500 mrem annually.

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APPENDIX A

SYNTHETIC COMPARISON OF INTERNATIONAL TRANSPORT REGU-  
LATIONS WITH PARTICULAR REGARD TO SAFETY REGULATIONS

APPENDIX A

SYNTHETIC COMPARISON OF INTERNATIONAL TRANSPORT REGULATIONS WITH PARTICULAR REGARD TO SAFETY REGULATIONS

PRELIMINARY CONSIDERATIONS

On the international level the transport of radioactive materials is governed, with particular reference to technical aspects, by numerous international regulations and agreements. As affecting the Community States and according to the form of transport, these are:

- the A.D.R. (European agreement on international road transport of dangerous goods) and the A.D.N. (European agreement on the international transport of dangerous goods by inland waterway) which lay down standards respectively for road transport and inland waterways;
- the C.I.M.-R.I.D. (International convention for the rail transport of goods - International regulation governing the rail transport of dangerous goods) which lays down the standards for rail transport;
- the I.M.C.O. (Inter-governmental Maritime Consultative Organization) which lays down the standards for sea transport;
- the I.A.T.A. (International Air Transport Association) which lays down the standards for air transport.

Each of these international bodies possesses different legal structures which therefore impose different degrees of rigidity in respect of the standard which in fact is always imposed for the technical aspects of transport in

the various countries. These standards refer in particular to the transport of radioactive materials but are included for each of the bodies quoted within the framework of the regulation for the transport of dangerous materials in general.

In addition, it should be stated that the countries belonging to the various bodies are not always the same. At the same time, for the purpose of the present study, it is noted that they involve all the countries of the European Community.

The A.D.N. is not considered, in so far as this displays characteristic aspects interesting only some of the Community States.

Discussion of the legal capacity of the bodies quoted, and consequently the force of the standards issued by them, does not fall within the scope of this study, which is limited to a comparison of technical aspects of the various standards and of the arrangements, including formal, which may have an influence as regards the protection of workers and general public.

Within the above context, the following items for study and comparison are enumerated:

- I. Technical specifications regarding packaging and mode of dispatch;
- II. Specifications regarding nuclear safety;
- III. Administrative specifications regarding the approval of packaging and parcels;
- IV. Authorisation for dispatch and advance notification;
- V. Marking and labelling requirements;
- VI. Requirements of the personnel carrying out the transport;

VII. Regulations applicable to incidents occurring during transport.

For each of these items a comparison has been drawn up between the standards provided in the texts quoted, paying particular attention to disagreements arising. As will be seen in detail, such disuniformities, frequently marginal or formal, are also numerically very few.

In particular, while certain discrepancies arise from the diverse methods of transport, several others are based on the adoption of the specifications contained in different editions of the IAEA recommendations (International Atomic Energy Agency) which in principle are taken as the basis by all the bodies quoted and to which the IMCO refers explicitly for certain aspects.

I. TECHNICAL SPECIFICATIONS REGARDING PACKAGING AND MODE OF DISPATCH

A study of these specifications does not bring out substantial differences between the four regulations examined.

An analysis is provided of the arrangements which differ between themselves, together with synthetic comments on those which are in common, for the purpose of better understanding where necessary.

I-1. General packaging specifications and general construction characteristics.

It is first seen that the specifications provided by the ADR are practically identical to the RID. Hence these



regulations will be considered jointly below.

Regarding the weight of parcels and provisions relating to the handling of parcels, the specifications are the same for the RID, ADR and IMCO regulations, while they are not in fact provided in the IATA regulation.

The IATA and the IMCO specify that the form of outer wrapping of the packaging must be designed so as to prevent the entry of rainwater. This specification is not provided by the RID and the ADR.

For all four international regulations, the packagings which must perform the functions of containing and screening radiation may be of the industrial type, type A and type B.

Of the four regulations, however, only the IMCO and the IATA expressly provide for industrial type packaging while the RID and ADR do not define it but quote it in the case of transport of materials for which it is required that the packaging correspond to the general specifications and for which tests are not necessary as provided for type A and type B, and define it implicitly by establishing the characteristics of packages of neither type A nor type B.

The RID, in addition to the ADR, as distinct from the IMCO and the IATA, provide that "all the constituent elements necessary for ensuring observation of the provisions of the above regulations regarding packaging shall be

considered as forming part of the packaging. Packaging can in particular consist of one or more vessels, an absorbent material, structural members ensuring separation, a radiation protection screen and arrangements for cooling, damping mechanical impacts and thermal insulation. For materials under 2° and 4°(+), these arrangements and members may include the carriage with anchorage system if these form an integral part of the packaging".

The four regulations specify that in the choice of materials for making up the packaging, account must be taken of temperature variations to which the packages may be exposed during transport or storage. These temperature limits are -40°C and +70°C for IMCO, RID and ADR, while for IATA they are -40°C and +54.4°C. The IMCO also accepts, on principle, the use of mild steel in the construction of packaging. At the same time, particular attention is recommended to brittle fracture in accordance with the lower temperature range limit quoted above.

Precautions to be taken are provided in order to prevent damage due to acceleration, vibration and

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(+) Large fissile and non-fissile sources respectively.

resonance encountered during transport.

For type A and type B packaging a hermetic outer container is also necessary, kept closed by a safe device. Outer container means the vessel provided for ensuring containment of the radioactive material if the vessels inside the outer container suffer fracture or cease to be hermetically sealed.

There is one difference between the specifications regarding characteristics of the outer container. While the IMCO, RID and ADR specify that "the outer container must be sufficiently robust to remain watertight (or hermetically sealed) in the event of the ambient pressure falling to 0.5 atmospheres absolute", the IATA specifies that "the outer container and its closing devices must be such as to remain watertight with a pressure of 0.5 kg/cm<sup>2</sup> (above ambient) in the case of solid materials and 1 kg/cm<sup>2</sup> in the case of liquids. Gases under pressure must be held in suitable cylinders or other metal containers constructed expressly for this purpose".

#### I-2. Supplementary specifications for type A packaging.

The supplementary specifications for type A packaging provided by the four international regulations are substantially the same. The only specifications differing partially are those relating to the transport of gamma-emitting materials with an activity exceeding 3 Ci. In particular, the four regulations examined establish a

series of tests for type A packaging and specify that these must prevent any loss or dispersion of the radioactive content and maintain its screening function under the conditions of such tests.

In the case of type A packaging intended for the transport of liquids or gases, it is established that these must also prevent any loss or dispersion of the radioactive content under the conditions of supplementary tests laid down for such types of packaging unless, in the case of liquids, the casing contains internally a quantity of absorbent material sufficient to absorb twice the volume of liquid contained and one of the following conditions is met:

1. the absorbent substance is inside the protective screen,  
or
2. the absorbent substance is outside but it can be checked that the liquid content is absorbed by it, and the intensity of the dose does not exceed 1000 mR/h or equivalent, at the surface of the parcel.

The specifications contained in the regulations for type A packaging intended for the transport of gamma-emitting radioactive materials are as follows:

IMCO: In a type A packaging designed for gamma-emitting radioactive materials with an activity exceeding 3 Ci and comprising a radiation screen made from material with a melting point below 800°C, the radioactive material must be enclosed in a closed

metal container (which may be the casing), the outside dimensions of which must be less than 5 cm. The model must possess characteristics such as to allow the container to maintain its own integrity after exposure to fire in an oxidizing atmosphere at 800°C for 30 minutes. (Note: gamma-emitting radioactive materials requiring such specifications are only those the decay of which is such that gamma-radiation with an energy greater than 100 keV is emitted in more than 10% of the total disintegration)".

IATA: "A packaging designed for a gamma-emitting radioactive material to an amount greater than 3 Ci and comprising a screen against radiation made from material with a melting point below 850°C must include a steel container in which the material is enclosed. This container must possess outside dimensions not less than 5 cm and steel thickness not less than 2 mm".

RID and ADR: "In a type A packaging intended for the transport of gamma emitters with an activity exceeding 3 Ci and containing a screen made from material with a melting point below 850°C, the radioactive material must be inside a closed steel casing, (which may be the outer container). No outside dimension of the casing must be less than 5 cm and in thickness must be at least 2 mm. (Note: for the purpose of this provision, emitters of gamma rays means only radioactive materials which in disintegration supply more

than 10% gamma emissions with an energy exceeding 100 keV).

It is seen that the above specifications differ essentially:

in the choice of melting point of the screen;

in the material from which the internal metal container must be made;

in the statement, not in the IATA, that gamma emitters for the purposes considered mean only radioactive materials which in disintegration supply more than 10% of gamma emissions with energy exceeding 100 keV.

### I-3. Supplementary specifications for type B packaging

The four international regulations provide that type B packages must satisfy the following specifications, apart from the general packaging conditions:

- a) a type B package, under the conditions of penetration, mechanical, heat and immersion tests, must:
  - i) prevent any loss or dispersion of the radioactive content;
  - ii) sufficiently maintain its protective screening function so that the intensity of irradiation does not exceed 1000 mR/h at 1 m from the surface of the packaging on the assumption that the parcel contains a quantity of Iridium-192 sufficient, prior to the test, to emit a radiation of 10 mR/h at 1 m from the surface of the parcel. If a type B package is

intended for containing a given radionuclide, this can be assumed as referring in place of Iridium-192.

- b) a type B packaging must also be such as to guarantee that the outer container maintains its hermetic tightness, even if the packaging is immersed in water to a depth of 15 m.

I-4. Supplementary specifications for parcels containing large radioactive sources.

As regards supplementary specifications for parcels containing large radioactive sources, it can be stated that the RID, ADR and IMCO provide fairly similar indications. The IATA, on the other hand, while setting out substantially all the specifications of the remaining regulations, omits certain explanatory statements and includes a number of provisions relating to the particular characteristics of air transport. The IATA regulation provides that:

Large sources must be transported only by cargo aircraft and prior agreements must be reached with each of the carriers affected.

Large sources must be of a type not requiring operational controls during transport and/or transit, apart from controls which must be carried out by the shipper prior to presenting the parcel to air transport, controls which are also provided by the remaining regulations.

Packages containing large sources must be protected

so as not to require vents during transport. In order to meet this requirement, auxiliary external cooling systems are permitted.

Another disagreement between the IATA and the remaining regulations is as follows:

IATA: "The temperature of the accessible surfaces of the package must not exceed 50°C in the shade at any time during transport, assuming a typical 38° ambient temperature under normal conditions of transport."

RID, ADR, IMCO: "The temperature of the accessible surfaces of the parcel shall not exceed 50°C, but if the parcel is being transported as the full load, this limit may be increased to 82°C". However, for application of this standard, it is assumed that the parcel is in the shade.

All regulations also specify that the heat produced inside a parcel by the radioactive materials contained in it shall not lower the efficiency of the package during transport, laying down those ambient conditions considered.

The RID, ADR, IMCO (IAEA) later state that particular attention must be paid to the effects of heat which may:

- i) modify the arrangement, the geometric form and physical state of the contents or, if the material is contained in a metal casing or vessel, bring about melting of the metal casing, the vessel or the material itself;
- ii) reduce the efficiency of the packaging by cracking due to thermal stresses or as the result of the radiation protection screen melting;



iii) accelerate corrosion in the presence of humidity.

It is finally noted that the design principles for the container and screening function, test procedures for the packaging and all tests provided for approval of parcels, are the same in the four regulations.

#### I-5. Limitation of external irradiation

The four regulations studied provide that, in regard to external irradiation, the parcels fall into one of the following categories:

- a) category I-WHITE, when the radiation dose intensity emitted by the parcel does not exceed 0.5 mR/h or equivalent at any time during transport, at any point on the outer surface of the parcel and the parcel does not belong to fissile class II;
- b) category II-YELLOW, when the limit indicated under point a) above is exceeded, or, if this limit is exceeded or not reached, the parcel belongs to fissile class II, and when:
  - 1) the radiation dose intensity emitted by the parcel does not exceed at any time during transport:
    - (i) 10 mR/h or equivalent at any point on the outer surface of the package; and
    - (ii) 0.5 mR/h or equivalent at a distance of 1 m from the centre of the parcel ; and
  - (2) the transport index does not exceed 0.5 at any time during transport;

- c) Category III-YELLOW when one of the limits indicated under point b) above is exceeded and:
- (1) the radiation dose intensity emitted by the parcel does not exceed at any time during transport:
    - (i) 200 mR/h or equivalent at any point on the outer surface of the parcel; and
    - (ii) 10 mR/h or equivalent at a distance of 1 m from the centre of the parcel; and
  - (2) the transport index does not exceed 10 at any time during transport.

In particular, according to the RID, ADR and IMCO, the limits laid down under point c) (1)(ii) and c) (2) can be exceeded on condition that the parcel is transported as complete load and in conformity to the particular specifications providing for this case. The IATA does not provide for this excess of dose intensity in the case of complete load.

It is noted that references to nuclear safety class II, parcels included for completeness, do not apply for the purpose of the material treated in this section.

## II. SPECIFICATIONS CONCERNING NUCLEAR SAFETY

### II-1. General specifications

The general nuclear safety specifications as set out in the four international regulations studied, coincide, taking into account that the IMCO refers to the IAEA recommendations on this item as others.

In particular, it is noted that the regulations,

after stating that all fissile materials in amounts less than the exemption limits (see table I, page 111) must be packed and dispatched so that the critical state cannot be reached under any foreseeable circumstances of transport, are limited to stating incidents requiring major attention and setting out the hypotheses to be considered in the case of irradiated nuclear fuels and unspecified fissile materials (for example, residues or scrap).

It is further laid down that parcels must fall into one of the following classes:

Nuclear safety class I: parcels which do not possess any nuclear hazard, whatever their number and arrangement , under all foreseeable circumstances of transport;

Nuclear safety class II: parcels which do not possess any nuclear hazard, if restricted in number, whatever their arrangement and under all foreseeable circumstances of transport;

Nuclear safety class III: parcels which do not possess any nuclear hazard, but which cannot be considered as parcels of nuclear safety classes I or II.

#### II-2. Particular specifications for Fissile Class I parcels

The particular specifications for fissile class I parcels are the same in the four regulations. All the regulations provide the same provision regarding fissile class I parcels.

The only differences in the methods to adopt in respect of the nuclear safety criteria set out for fissile class I parcels:

RID (and ADR): Observation of the nuclear safety criteria

"set out for fissile class I parcels" must be ensured by one of the following methods:

- a) following the calculation procedure indicated in marginal note 1621 of Appendix VI of the RID (marginal note 3621 of Appendix A.6 of the ADR);
- b) satisfying the data of the physical model indicated in the marginal note 1622 of Appendix VI of the RID (marginal note 3622 of Appendix A.6 of the ADR).

IATA: Observation of the nuclear safety criteria "set out for fissile class I parcels" must be guaranteed by one of the following methods:

- a) following one of the systems of calculation indicated in Appendix III, I-1 (IAEA);
- b) corresponding to one of the physical models indicated in Appendix III, I-2 (IAEA);
- c) observing the specifications of one of the packaging projects described in Appendix III, I-3 (IAEA).

IMCO: Nothing is stated on this point apart from reference to the IAEA recommendations, whose specifications on this point are the same as those of the IATA. It is also observed that, with the sole exception of point c) provided by IATA, and implicitly by IMCO, these criteria also coincide completely, the calculation procedure and data contained in the tests, repeatedly quoted, being identical.

II-3. Particular specifications for Fissile Class II parcels.

The particular specifications for fissile class II parcels are the same for the ADR, RID and IATA regulations. The IMCO does not give specifications but, for this purpose, the specifications provided in the IAEA recommendations apply, coinciding with the specifications provided in the remaining regulations.

II-4. Particular specifications for Fissile Class III parcels.

The RID and ADR do not provide particular specifications for fissile class III parcels.

The IATA, on the other hand, specifically mentions the general nuclear safety specifications. -

III. ADMINISTRATIVE SPECIFICATIONS REGARDING APPROVAL OF PACKAGES AND PARCELS

III-1. Type A packages

The four regulations do not require approval of type A packages apart from those cases provided following point III-4.

III-2. Type B packages

The four regulations require the packaging model be approved by the competent authority of the country of origin of the model. Only in the case of the RID and ADR is it specified that the above applies if the country of origin of the project is a member respectively of the CIM (RID) or the ADR. Otherwise, transport is possible on condition that:

- a certificate issued by that country testifying that the package corresponds to the technical specifications and that this certificate is validated by the competent authority of the first member country of the CIM (RID) or of the ADR through which the shipment passes;
- if no certificate is supplied, the packaging model must be approved by the competent authority of the first member country of the CIM (RID) or the ADR through which the shipment passes.

III-3. Approval of models of parcels for large non-fissile radioactive sources.

For the purposes of approval for models of parcels containing large radioactive sources a distinction is made by the four regulations studied, in accordance with the technical characteristics of the parcels.

III-3.1. Unilateral approval

Approval of the competent authority of the country of origin of the model of the parcel is sufficient, or, where applicable, of the country provided in the preceding point III-2, when the following technical conditions are observed:

- a) in the conditions of the tests provided for type A and B packages, the parcel must prevent any loss or dispersion of the radioactive contents;
- b) the model must satisfy the provisions indicated in a) without filters being employed;
- c) a parcel containing a primary heat carrier medium must not employ a system allowing continuous decompression during transport;

- d) the parcel must not contain any arrangement for decompressing the outer casing so as to liberate radioactive materials to the ambient under the conditions of the tests provided for type A and B packages;
- e) when the maximum working pressure of the outside container under normal conditions, with any pressure difference below atmospheric pressure at sea level, to which it may be subjected, exceeds  $0.35 \text{ kg/cm}^2$ , the outer container must be capable of withstanding a pressure at least equal to one and a half times the sum of this pressure. The stress at this pressure must not exceed 75% of the unit yield load nor 40% of the load to failure of the material from which the outer container is made at the maximum working temperature provided; (+)
- f) assuming that, at maximum pressure in normal service, the parcel is subjected to the thermal test provided for type A and B packages, the pressure in the outer casing must not exceed that corresponding to unit yield load of the material of the casing at the highest temperature attainable during the test;
- g) for a parcel requiring the use of the primary heat

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(+) Maximum pressure in normal service means maximum pressure above atmospheric pressure at sea level which may be set up inside the outer container under conditions of temperature and solar irradiation corresponding to the mean conditions during transport, based on a period of one year.

carrier medium or containing a liquid or gaseous source, the maximum pressure in normal service must not exceed  $7 \text{ kg/cm}^2$ ;

h) under the conditions of the type tests provided for type B packages, a parcel containing a primary heat carrier medium must not lose, during the period of 1 week, a quantity of this medium greater than the smaller of the following values:

- if the agent is in the gaseous or vapour form, 0.1% by volume, or 5 litres at  $0^\circ\text{C}$  at a pressure of 760 mm Hg;
- if the medium is liquid, 0.1% by volume or 0.5 litres;

i) the absence of any leak on the part of the source under normal conditions must not depend on a mechanical cooling system;

k) in order to satisfy the provisions under c), recourse must not be had to an external auxiliary cooling arrangement;

l) for a parcel containing a primary liquid heat carrier medium or containing a liquid radioactive material, the outer container must be able to maintain its integrity at a temperature of  $-40^\circ\text{C}$ ; (+)

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(+) For application of conditions (2) and (3) and of the above specifications regarding pressure, it is assumed that the ambient conditions are as follows:

i) temperature:  $38^\circ\text{C}$ ;

ii) exposure to solar irradiation:

- parcels with flat surfaces transported horizontally,  
base: zero

other surfaces:  $800 \text{ cal/cm}^2$  for 12 hours daily; transported other than horizontally  $200 \text{ cal/cm}^2$  for 12 hours daily;

- parcels with curved surfaces:

$400 \text{ cal/cm}^2$  for 12 hours daily.

At the same time, for parcels which must be transported only in certain particular countries, different conditions may be allowed from those indicated in this note, if the competent authority of each of the countries allows it. Equally in this case, a temperature differing from that indicated above may be allowed by common agreement.



It is observed that in fact the IATA recommendation does not include conditions c) and k) as regards parcels excluding air transport. The same regulation, on the other hand, formulates condition e) from the standpoint of particular conditions of transport, in the form:

"the outer container must be such as to withstand a pressure not less than  $0.84 \text{ kg/cm}^2$  plus one and a half times the maximum working pressure, and the stress at this pressure must not exceed 75% of the load to failure of the outer container at the maximum working temperature provided".

### III-3.2. Multi-lateral approval.

Models of parcels not corresponding to the requirements set out under point III-3.1. (a)-e)) must be approved by the competent authorities of the countries of origin and of all the countries through which or in which the parcel must be transported.

The four regulations subordinate issue of approval to the condition that activity which may be released within a week, under the conditions resulting from the mechanical and thermal tests provided for type B packaging, in the form of contaminated gas, vapour or liquid liberated by primary heat transfer medium and the space originally occupied by it, does not exceed predetermined values.

Issue of approval as above is also subordinated in the ADR, RID, IMCO-IAEA regulations to the condition that, in the case where the model of the parcel is designed so as to liberate, by continuous decompression, contaminated gas or vapour resulting from the primary gaseous or liquid heat carrier medium under the condition resulting from the water spray test followed by impact, of the free-fall test, of the compression test and penetration test, taking into account the ambient conditions assumed during transport (temperature, solar irradiation), activity which must not exceed the values provided. Such a parcel must be transported alone as the complete load.

This condition is not provided in the IATA regulation, which however does not provide for transport of this type of parcel.

It is observed that in this case, as distinct from what is provided for models of parcels dealt with in the previous section, the certificate of approval must contain an indication of all the specifications to be observed during the course of transport which the competent authority considers necessary.

III-4. Approval of models of nuclear safety class I, II and III parcels.

As indicated below regarding authorisation procedures connected with the fissile nature of the material to be transported, it is seen that the specifications already studied in the preceding sections also apply, as is evident, for example, in the case of a large fissile source where, however, the quantity of material transported is less than the limits set out in table I:

TABLE I

parcels not containing more than	15 g uranium-233 15 g uranium-235 15 g plutonium-239 15 g plutonium-241 15 g of any combination of these radionuclides
parcels containing natural or impoverished uranium	in any quantities
parcels containing homogenised hydrogenated solutions or mixtures (°)	U <sup>233</sup> or U <sup>235</sup> , when the ratio of numbers of atoms H: U <sup>233</sup> or U <sup>235</sup> is greater than 5200  plutonium, when the ratio of numbers of atoms H: Pu is greater than 7600
parcels containing materials in which the only fissile component is enriched uranium	the U <sup>235</sup> content must not exceed 1% of the weight of uranium and must be distributed homogeneously in the material considered on condition also that the material is not present in the form of lattice in the parcel.

(°) With the reserve that the quantities of fissile materials per parcel do not exceed at most:

U-235: 800 g    U-233: 500 g    Pu: 500 g

If the parcel contains more fissile materials, the ratio between the number of hydrogen atoms and the number of atoms of fissile materials must be greater than 7600 and the maximum

quantity of fissile materials must not exceed 500 g per parcel.

III.4.1. Models of nuclear safety class I parcels.

Approval of the model of the parcel is always necessary. In the case of designs based on the physical models quoted in section II-2e as regards maximum quantities of fissile materials provided for, approval of the competent authority of the country of origin of the design is sufficient. The CIM-RID and ADR regulations understand such countries within the meaning set out in section III-2.

For designs based on calculation procedures as quoted in section II-2, approval must be issued by each of the countries through whose territory the parcel must be transported.

The IATA regulation, on the other hand, states that models of the parcels designed in accordance with the design specifications contained in the text of the IAEA recommendations do not require approval.

III.4.2. Models of nuclear safety class II parcels.

Approval of the model of the parcel by the competent authority of the country of origin of the design and of all countries through whose territory the parcel must be transported is always necessary.

The IATA regulation, on the other hand, states that the models of parcels designed in accordance with the design specifications contained in the text of the IAEA recommendations do not require approvals.

III.4.3. Models of nuclear safety class III parcels.

Approval of the model of the parcel by the competent authority of the country of origin of the design and of all countries through whose territory the parcel must be transported is always necessary.

IV. AUTHORISATION FOR DESPATCH AND ADVANCE NOTIFICATION

A comparison of the international regulations (RID, ADR, IMCO and IATA) shows that these are not inspired by the same basic regulations and do not provide complete adoption of them. Nonetheless, the specifications governing transport authorisation and advance notification are substantially similar.

IV-1. Large sources: unilateral authorisation

For the transport of parcels containing large radio-active sources, including those of fissile classes I and II, conforming to certain technical conditions, laid down by the regulations, such as to render unnecessary additional working specifications, for example, such as controls and other human intervention during transport, despatch has to be authorised by the competent authority of the country of origin.

In the case of rail or road transport, the CIM-RID and ADR provide that, if the country of origin does not form part of these organisations, transport must be authorised by the first of the countries passed through forming part of such organisations and considered as country of origin of the transport. The application for authorisation must contain:

(i) either complete documentation issued by the manufacturer, by the shipper or the user testifying that the methods and materials employed for construction of the packaging are in accordance with the specifications of the approved design, or a document from the competent authority of the country in which the packaging was constructed, testifying that such complete documentation has been supplied by the manufacturer, shipper or user;

(ii) all information for demonstrating conformity with the corresponding parts of the respective regulations and all information regarding the type of transport proposed, in addition, where applicable, to any special loading, unloading and handling procedure.

When authorising despatch, the competent authority shall release a certificate:

- authorising despatch;
- specifying the measures which must be adopted by the shipper prior to despatch;
- confirming that additional working specifications are not necessary during transport.

The IATA and IMCO regulations, however, do not provide particular authorisation procedures but confine themselves to requiring that the shipper supplies such certificates.

Prior agreements must also be obtained with each carrier affected, so as to be able to undertake measures necessary for the transport in good time. The RID provides that the railways be informed if necessary of special measures to be adopted in the case of accident. In each case, advance notification of the

transport to the competent authority of each of the countries affected by it is specified. Such notification must contain the necessary information for identification of the transport by the competent authority.

IV-2. Large sources and nuclear safety class III parcels: multilateral authorisation.

For the transport of fissile class III parcels or parcels containing large radio-active sources (including those also of fissile classes I, II), the design of which requires multilateral approval as in section III-3.2, approval for despatch is necessary on the part of the competent authorities of the country of origin of the transport and of the countries through which the transport will take place and who have laid down special supplementary specifications for approval of the model of the parcel and its authentication, apart from those who have renounced such rights.

Application for approval of a despatch must indicate the method of forwarding, the means of transport, the itinerary considered and all supplementary specifications to be observed during transport.

The certificate of approval of the consignment issued by the competent authority shall indicate supplementary specifications to be observed during transport.

In particular, it is forbidden for any other consignments to accompany nuclear safety class III parcels, and this prohibition must appear expressly in the authorisation.

The RID and ADR also provide that if consignments pass through

countries of different language, the supplementary specification to be observed during transport must be drawn up in an official language of the country of origin of the consignment and in the language of each country, the competent authority of which has imposed such specifications.

## V. MARKING AND LABELLING REQUIREMENTS

### V-1. Markings

Each parcel of the types considered above must carry the following markings:

- Each parcel corresponding to a type A design must be marked in an obvious and indelible manner on its outer surface with the wording "Type A";
- For each parcel conforming to a type A packaging design and containing gamma emitting radioactive materials with an activity exceeding 3 Ci\*, the outer surface of the metal casing (for the IMCO-IAEA and steel for the RID, ADR and IATA) or whatever container is placed inside a radiation screen constructed from material with a melting point above 800°C (for the IMCO-IAEA or 850°C for the RID, ADR, IATA), the outer surface of the screen must be marked in an obvious manner with the clover leaf symbol and with the word "RADIOACTIVE" in letters not less than 10 mm high, cut, punched or in any case carried out in such a manner as to withstand the action of fire and water\*\*;

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\* See section I-2.

\*\* The RID and ADR explicitly require that the indication "Radioactive" be written in capital letters.



- Each parcel for which approval of the design is necessary must carry on its outer surface in an obvious and indelible manner, the identification mark attributed to the design by the competent authority which has approved it, the serial number and if the design is for type B packaging, the wording "type B";
- Each parcel conforming to a type B packaging design must be marked on the surface of the outermost vessel resistant to the action of fire and water, with the clover leaf symbol, cut, punched or otherwise stamped in such a way as to withstand the action of fire and water.

V-2. Labels and other indications

For all regulations, three types of label are provided, to be applied on the two opposite sides of parcels containing radioactive materials, relating to the category to which the parcel belongs, as follows:

on a I-WHITE category parcel, two labels shall be applied (on opposite sides of the parcel, representing the radioactivity hazard) white with a red stripe. Such labels shall carry the name of the main radioactive content and the activity in curies of the radioactive content.

on a category II-YELLOW parcel, two yellow labels with two red stripes shall be applied. Such labels shall carry the name of the main radioactive content, the activity in curies of the radioactive content and the transport index.

on a category III-YELLOW parcel, yellow labels with three red stripes shall be applied. Such labels shall carry the name of the main radioactive content, the activity in curies of the radioactive content and the transport index.

Each label must have dimensions 10 cm x 10 cm. Each parcel weighing more than 50 kg must also carry on its outer surface an indication of the weight in an obvious and indelible manner.

The four regulations finally provide:

- Empty packages: packages transported empty must carry the wording "empty package which has contained radioactive materials" and all symbols and labels must be cancelled or covered over (IMCO, RID, ADR)
- Exempt materials: labels need not be applied on the outside of a parcel containing only exempted materials. In this case, the wording "radioactive" must appear on the vessel constructed to ensure containment of the materials so as to appear clearly prior to proceeding to open the parcel (IMCO, RID, ADR, IATA).
- Radioactive materials with low specific activity: it is not necessary to label packages containing radioactive materials with low specific activity if they are transported as the "complete load". If not transported as complete load, they must carry a white or yellow label according to case (IMCO, RID, ADR).

#### VI. REQUIREMENTS OF PERSONNEL CARRYING OUT TRANSPORT

This section considers the requirements of personnel directly employed on transport, with reference on the one hand to their qualifications, and on the other any radio protection classifications

In this respect it is first noted that there is a common tendency in the international regulations studied to prevent risk, establishing the standards previously examined regarding packaging and at the same time to limit the specifications to be observed during transport and therefore the requirements demanded of the personnel employed on it.

VI-1. Qualifications of the personnel.

The four international regulations differ markedly on this point, even though the specifications are eventually all of a general nature.

The ADR agreement provides in general, for all dangerous goods, that written instructions be issued to the driver of the vehicle containing instructions on the nature of the hazard presented by the materials transported and on the measures to be adopted in the case of various types of accident. The carrier, on the other hand, is obliged to see that the personnel affected is familiarised with such instructions and is capable of applying them properly.

The IMCO for their part, does not provide any explicit specification on this point, nor on the other hand, make reference to the IAEA recommendation for such material. The latter, however, is limited to stating that workers must be given the necessary information and instructions relating to the hazards to which they are exposed and the precautions to adopt.

Neither the RID nor the IATA issue particular specifications on the subject.

It is also observed that the regulations contain a number of protection standards regarding limitation of the dosage to personnel and surface contamination of the parcels, together with standards, also general, to be adopted in the case of accident. In this way, a degree of knowledge of the hazards connected with the transport of radioactive material is implicitly imposed at least, for the purpose of guaranteeing application of the particular standards.

## VI-2. Classification of the personnel

The ADR convention, while not speaking of classification of personnel, places limits on the exposure intensities at positions on board the vehicle reserved for the driving and accompanying personnel. This limit, equal to 2 mR/h average for an exposure time of 15 hours per week, or otherwise 390 mR per week, coincides in fact with that provided by the basic Euratom standards for persons not occupationally exposed. Observation of the above limit was based principally on criteria based on the minimum distance between the load and the positions occupied by the personnel.

The IMCO regulation for its part lays down minimum distances separating parcels from persons, based on a limit of 1.5 R/year or equivalent and an occupation factor equal to 1/4. In this case also, the limit provided is the same as that provided in the Euratom basic standards, for workers not occupationally exposed.

The IATA regulation is confined also to laying down the minimum distances separating the passenger cabin or driving cabin from the parcels; in this way, the driving personnel is assimilated to passengers.

## VII. RECOMMENDATIONS APPLYING IN CASE OF ACCIDENT

The technical and administrative specifications provided in the regulations quoted, apart from guaranteeing the method of carrying out transports of radioactive materials which do not under normal conditions carry the possibility of injury to persons, also aim at restricting the possibility of accidents or ensuring that the gravity of such accidents is not increased by the dangerous nature of the materials transported.

This heading includes, for example, all technical specifications concerning packaging, nuclear safety and method of consignment.

On the other hand, in the regulations examined, the standards explicitly affecting the mode of action in the event of accidents are extremely brief. The ADR, for example, for radioactive materials, is limited to specifying that:

- if a parcel of radioactive materials displays fractures or losses of the content or if it is involved in an accident during transport, the vehicle or affected zone must be isolated in order to prevent persons coming into contact with radioactive materials and, if possible, must be suitably signalled and surrounded by barriers.

No one is authorised to remain in the isolated zone before the arrival of persons qualified in direct handling and rescue operations. The consigner and the authorities affected must be informed immediately. Despite such arrangements, the presence of radioactive materials must not impede rescue operations and fire fighting;

- if there is verified a leakage of radioactive materials or spilling or scattering of radioactive materials in a vehicle, premises, ground or on goods or equipment used for transport or storage, qualified persons must be called on as quickly as possible to direct decontamination operations.

Contaminated vehicles, premises, land or materials cannot be brought into use again without being declared safe by qualified persons.

It is pointed out, however, that, regarding dangerous materials in general, it is required that:

- in preparation for any accident which may occur during transport, written instructions must be issued to the driver setting out in detail:

- a) the nature of the dangers offered by the dangerous materials transported and safety measures which must be adopted to counter them;
- b) provisions to be adopted and precautions to be taken in the event of persons coming into contact with the goods transported or with products which may be released by them;
- c) measures to adopt in the event of fire and, in particular, means or groups of means of extinction, use of which is excluded;
- d) the measures to adopt in the event of breakage or deterioration of packages or of the dangerous materials transported, particularly when such dangerous materials are scattered on the road;

- these instructions must be drawn up by the manufacturer and consigner for each dangerous goods or class of dangerous materials; these must be in the language of the country of origin. If this language differs from the languages of the transit countries or countries of destination, they must be written also in the latter languages. A copy of these instructions must be placed in the driver's cabin;

- all measures must be adopted by the carrier in order to familiarize the personnel affected with such instructions and to render him capable of properly applying them.

The RID specifications are similar, with the obvious differences in nomenclature between "truck" and "vehicle" etc. The RID also requires, for the approval of despatch of parcels containing large fissile and non-fissile sources, that "the railway be informed if

necessary of the special measures to adopt in case of accident".

For air transports the IATA regulation does not provide any standard regarding this subject.

The IMCO regulation is the most complete regarding this subject and provides an entire section dedicated to the procedures to follow in the event of accidents. This section lays down, after an explanatory introduction on the characteristics of parcels which may be involved, a distinction between accidents during navigation and those in port.

In the former case, it is laid down that:

- When a parcel containing radioactive materials is involved in a fire, the normal methods of firefighting can be followed. Thus, for example, a down-wind fire will be fought as much as possible. Spraying the parcel with water will also contribute to preventing materials, for protection against irradiation such as lead, for example, being melted.
- During the firefighting operations, when there is risk of exposure to steam and smoke, contamination of the ambient and personnel will be avoided or reduced by protective clothing and in particular a gas mask. After the fire, the personnel must remove garments and equipment. Garments shall be isolated and the personnel shall be thoroughly washed by shower. The garments assumed contaminated shall be submitted to the competent authority after arrival in port.
- When a parcel containing radioactive materials suffers fracture or displays leaks, no one must approach it or move near to it until a qualified radiological control can be obtained at the first port of call or by the competent national authority.

Foodstuffs and drinking water which may be considered as possibly contaminated following an accident shall not be consumed before examination by qualified persons or before obtaining a competent opinion from qualified persons.

For accidents in port it is provided that:

- The port authorities must be informed when an accident damaging radioactive parcels has occurred on board ship. Provision for this has been adopted in several countries whereby experts in radiological subjects are consulted in the event of an accident.

It can be observed how the tone and type of specifications depend greatly on the possibility or otherwise of rapid intervention by the competent authorities or persons qualified in radiological protection action, as is particularly evident from the IMCO recommendations.



APPENDIX B

SYNTHETIC COMPARISON OF SAFETY SPECIFICATIONS IN THE MEMBER STATES

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SYNTHETIC COMPARISON OF SAFETY SPECIFICATIONS IN THE MEMBER STATES

PRELIMINARY CONSIDERATIONS

The legislative text and regulations governing the field of transport of radioactive materials in the member states of the Community present a rather complex picture. A clear tendency is however observed towards adaptation and homogenization of the various national legislations with the international regulations governing the transport of radioactive materials which, as already indicated in the preceding Appendix A, are now substantially similar between themselves.

The greatest disuniformity between the various national legislations studied originate in most cases from the delay with which such texts have been adjusted to the international regulations on the occasion of amendments, even substantial ones. It can therefore be stated substantially that such disuniformities are those which exist between the various versions of the international regulations, with particular reference to the different editions of the IAEA recommendations (1961, 1964, 1967), on which all international standards in the field of transport of radioactive materials are now based.

This appendix discusses national standards, isolating the subject treated in the preceding appendix A in the international field, again for the purpose of bringing out any irregularities.

It is appropriate before entering into the above analysis to list, country by country, the legislative texts and regulations considered. The system of declaration and authorisation in the field of transport has been examined elsewhere, since these

are directly affected by the basic standards. These standards, indeed, lay down (article 3) that each member State undertakes a system of declaration, and, where considered necessary, of advance authorisation of the regulated activities, including transport of radioactive substances when the total activity of the radioactive materials exceeds the limits laid down in article 4 and in appendix 1 of the basic standards. It can be seen that, since this subject devolves from the national regulation, it has not been dealt with in the preceding appendix A.

I. LEGISLATIVE PROVISIONS AND REGULATIONS REGARDING THE TRANSPORT OF RADIOACTIVE MATERIALS IN THE COMMUNITY STATES.

It appears appropriate first of all to list the legislative provisions and regulations in force in the Community States affected directly or indirectly by the transport of radioactive substances.

I-1. Belgium

- Ratification of the CIM-RID Convention: 29.4.1955.
- Act of 29.3.58 relating to the protection of the general public against the risks of ionizing radiation.
- Royal decree 28/2/63, general regulation governing protection of the general public and workers against the risk of ionizing radiation.
- Approval of the ADR: 10.8.60.

I-2. France

- Regulation governing rail, land and internal waterways transport of dangerous materials (Ministerial decree 15.4.45, amended several

times and in particular by the Ministerial decrees of 1.7.66 and 17.6.67.

- Regulation governing sea transport of dangerous materials (Ministerial decree 12.7.54, amended several times and in particular by the Ministerial decree 7.2.64).

- Ratification of the CIM-RID convention: 4.3.55.

- Ratification of the ADR convention: 2.2.60.

- Institution of the CIREA (Interministerial Commission for Artificial Radioelements) decree No. 475, 3.5.54, decree No. 512, 11.5.55 and decree No. 1197, 26.11.56.

### I-3. Italy

- Act 31.12.62 No. 1860, Peaceful use of nuclear energy (amended and supplemented by DPR No. 1704, 30.12.65 and the Act 19.12.65 No. 1008).

- DPR 13.2.64 No. 185, Plant safety and health protection of workers and general public against ionizing radiation hazards resulting from the peaceful use of nuclear energy.

- Ministerial decree 27.7.66.

- Ministerial decree 15.12.70.

- Circular No. 8/1965 prot.n. 1196/2381/1, 1 February, 1965, Ministry of Transport and Civil Aviation.

- D.G. Civil Motorization and Licenced Transport: Road transport of special radioactive and fissile materials, technical specifications.

- DPR 9 May, 1968, No. 108: Regulation for the loading, sea transport, unloading and transshipment of dangerous goods in parcels.

- Circular No. 316597/32.1, 1 August, 1968, Ministry of Transport

and Civil Aviation, D.G. Civil Aviation: Specifications for air transport of special radioactive and fissile materials with subsequent amendments.

- Conditions and tariffs for the transport of articles by the Italian State Railways.
- DPR, 3 July, 1969, No. 1285: Amendments to appendix A and B of the European Agreement relating to international road transport of dangerous goods, 20 September, 1957, adopted at Geneva, 15 December 1966.
- RID ratification of the CIM-RID convention: 9.11.55.

#### I-4. Luxembourg

- Grand Duchy regulation 8.2.67 on execution of the decree 25.3.67 regarding protection of the general public against ionizing radiation hazards.
- Ratification of the CIM-RID convention: 12.1.55.
- Ratification of the ADR convention.

#### I-5. Netherlands

- "Nuclear energy act" 21.2.63.
- Decree on entry into force of the nuclear energy act: 12.11.69.
- Decree 4.9.69 for bringing into effect articles 16, 19 first paragraph, 21, 29, 30 second paragraph, 31 and 32 of the nuclear energy act (fissile, mineral and radioactive materials transport decree).
- Ratification of the CIM-RID convention: 8.11.54.
- Ratification of the ADR convention.
- Dutch regulation for the rail transport of radioactive materials.

I-6. German Federal Republic

- "Act on the peaceful uses of atomic energy and protection against nuclear hazards", act 23.12.59, repeatedly amended subsequently, the last amendment being 28.8.69.
- "First ordinance for protection against damage due to ionizing radiation", decree 24.6.60, most recent version 15.10.65.
- Regulation on rail transport, appendix C, decree 17.10.68.
- Decree on the sea transport of dangerous goods 4.1.67, subsequently amended.
- Decree on air traffic, amended 4.11.68.
- Decree on admission to air transport, 28.11.68.
- Ratification of the CIM-RID convention, 21.12.64.
- Ratification of the ADR convention.

II. DECLARATION AND AUTHORISATION SYSTEM FOR THE TRANSPORT OF RADIOACTIVE SUBSTANCES

II-1. Belgium

The transport of special radioactive and fissile materials is governed by chapter 7 of the General Regulation governing protection of the general public and workers against ionizing radiation hazards, issued as Royal Decree 28.2.63.

As regards authorisation, this decree lays down that all transports of radioactive materials, whatever the means employed, including private vehicles, must be authorised in advance by the Ministry of Public Health and the family, with the exception of the cases listed in the following section II-1.1.

Three types of authorisation are provided:

- general, for carriers regularly undertaking the transport of radioactive materials;
- individual, for occasional transport;
- special, for those types of transport with an outstanding danger level as described in detail in the following section II-1.2.

It is observed that the authorising decree may specify special conditions for carrying out the transport and in particular, in the case of special authorisations, an escort may be required for the convoy.

The carrier, being the holder of a general authorisation, is subjected by virtue of article 59 of the above decree, to the requirement of declaring monthly all transport carried out during the period considered, indicating the consignment dates and addresses of the consignees, the amount and nature of materials transported, precautions taken and any accidents occurring during transport.

General authorisation, issued for periods not exceeding 5 years, and renewable on application from the carrier, as those of other types, may be withdrawn at any time by the competent Ministry with reason for the decision.

#### II-1.1. Exemptions

On the basis of article 56 of the above decree, no authorisation is necessary for the following types of transport:

a) transports of radioactive substances with activity below the following limits:

- for nuclides with very high radiotoxicity (group A): 0.1  $\mu$ Ci
- for nuclides with high radiotoxicity (group B): 1  $\mu$ Ci
- for nuclides of moderate radiotoxicity (group C): 10  $\mu$ Ci
- for nuclides with weak radiotoxicity (group D): 100  $\mu$ Ci.

b) transport of the following radionuclides in any quantities:

$^{114}\text{Nd}$ ,  $^{147}\text{Sm}$ ,  $^{87}\text{Sb}$ ,  $^{115}\text{In}$ ,  $^{187}\text{Re}$ ;

c) transport of natural uranium and natural thorium in quantities respectively below  $10^{-4}$  Ci and  $10^{-6}$  Ci;

d) transport of valves and electronic equipment, instruments and clocks incorporating radioactive substances in a form not lending itself to dispersion, on condition that such articles are enclosed in sufficiently robust packings and that the intensity of irradiation at any point on the outer surface does not exceed 10 mR per 24 hours (or equivalent).

It is observed here, as regards point a) that classification of radionuclides as a function of their radiotoxicity, set out in article 4, is the same as that of the Euratom basic standards, and that the quantitative limits are the same as the limits below which, according to these standards, the system of declaration and advance authorisation may not apply.

As regards points b) and c), however, such exemptions can be obtained by similar application of the note contained in article 3 of the decree.



II-1.2. Cases for which special authorisation is required

Special authorisation by the Ministry of Public Health and Family is required in all cases for each transport as follows:

a) with reference to activity of the radioactive materials:

a-1) transport of sealed sources comprising substances belonging to radiotoxicity groups A and B if the activity is greater than 200 Ci and groups C and D if the activity is greater than 2000 Ci;

a-2) transport of non-sealed sources comprising substances belonging to group A, if the activity is greater than 1 Ci, to group B if the activity is greater than 10 Ci and to groups C and D if the activity is greater than 100 Ci;

a-3) transport of mixtures of known composition when:

- for sealed sources: the sum of the activities of substances of groups A and B, multiplied by 10 and of substances of groups C and D does not exceed 2000 Ci;

- for non-sealed sources: the sum of the activities of substances of group A multiplied by 100, of substances of group B multiplied by 10 and of substances of groups C and D does not exceed 100 Ci;

a-4) transport of mixtures of unknown substances or mixtures in proportions not exactly known, when the calculated activity, assimilating the substances of the mixture with the known element of highest radiotoxicity (or if this is not known, to substances of group A) is greater than the values indicated respectively under a-1) and a-2).

b) with reference to intensity of external irradiation:

- transport of parcels, the screening of which is not sufficient to prevent the measured irradiation intensity in contact with the accessible outer casing of each parcel exceeding 200 mR/h or

the intensity of irradiation at any point situated at 1 m from the outer surface of the packaging exceeding 10 mR/h or equivalent;

c) with reference to the risk of dispersion of radioactive substances:

- transport of parcels for which the means of protection are not such as to ensure in a satisfactory manner the necessary guarantees against dispersion of radioactive substances outside the packaging;

d) with reference to the particular nature of radioactive substances:

d-1) transport of special fissile materials in quantities exceeding the minimum critical mass, with the exception of natural uranium and mixtures of natural isotopes when their purity is such as to prevent the possibility of a self-sustained chain reaction being maintained in an appropriate installation;

d-2) transport of radioactive substances which may display pyrophoric or explosive characteristics;

d-3) transport of radioactive substances which, in the case of an uncontrolled rise in temperature, may change the quantities of the packaging or bring about melting or destruction of the screening.

### II-1.3. International transports

For international transports, in the case of transit only, the provisions set out in articles 43 and 44 of the R.D. 28.2.63 quoted above apply, providing for general or individual authorisation which may be issued to persons residing in Belgium or having a responsible representative there.

Generally speaking, moreover, Belgium has ratified the ADR and CIM-RID agreements and therefore adopted regulations already studied in the preceding appendix A.

It should be mentioned that within the scope of the existing agreements between the Benelux countries, authorisations for the transit or transport of radioactive substances issued by the competent Luxembourg or Netherlands administrations are recognised as valid within Belgian territory.

## II-2. France

The transport of special radioactive and fissile materials in France is governed by two decrees, the one relating to land transport (road and rail) and inland waterway transport, and the other sea transport. As regards air transport, the IATA standards apply.

The regulation for land transport is substantially in agreement with the RID and ADR regulations in the editions at present in force. The regulation for sea transport, however, appears to be based on the international regulations in force at the moment of issue, and in particular, the IAEA recommendations issued 1961. It appears, however, that these are being updated.

As regards land transport, advance approval of despatch is necessary only in the case of large fissile sources in nuclear safety I and II parcels, while for the transport of special fissile materials in nuclear safety III parcels, special advance authorisation

is necessary. Such authorisations are issued by the Ministry of Transport.

It should be observed that, still in the case of land transport, for the despatch of:

- large non-fissile sources
- large fissile sources in nuclear safety I and II parcels
- fissile material in nuclear safety III parcels, the shipper is subject to the requirement of advance notification to the national civilian protection department. Notification must indicate a series of data and information relating to the transport and in the case of rail transport, shall be transmitted to all stations to be passed through under the supervision of the railway administration. No authorisation is required, however, for other types of transport if exempt from any approvals required for the packaging and for models of the parcel, which will be studied under the following point.

In the case of sea transport, for the despatch of special fissile materials in nuclear safety III parcels, special authorisation by the Ministry of Mercantile Marine is necessary. Similarly, for the case of large fissile sources in nuclear safety I and II parcels and non-fissile sources, approval of the method of shipment is required, which is also issued by the Ministry of Mercantile Marine.

It is observed that, for sea transport, the activity limits above which transported materials are classified as large sources differ from those provided for land transport (see table I), also in relation to the different classification for purposes of transport, which in this case provides for 8 groups, while for sea transport only 3 are provided.

Again for sea transport, the procedures for the approval of

packaging and models of the parcel are not considered under this head.

TABLE I

Lower activity limits for procedures required for large sources

Method of transport	Form	Radiotoxicity group for transport purposes							
		I	II	III	IV	V	VI	VII	VIII
Land transport	Special form		5000 Ci				5000	50,000 Ci	
	Non-special form	20 Ci	20 Ci	200 Ci	200 Ci	Ci			
Sea transport	Special form	2000 Ci			-	-	-		
	Any form	20 Ci		200 Ci (*)					

(\*) For tritium and crypton-85 these values rise to 2000 Ci

II-3. Italy

The system of declaration and advance authorisation in the field of transport in Italy is governed by the Act No. 1860 31.12.62 on the peaceful use of nuclear energy (subsequently amended and supplemented by DPR No. 174, 30.12.65 and by the Act No. 1008, 19.12.69), in conjunction with the Ministerial application decrees issued in accordance with the above legislative provisions.

On the basis of these provisions, the transport of special fissile materials and radioactive substances, apart from the exemptions which will be dealt with in the following section II-3.1, must be undertaken by land, air and sea carriers authorised by decree of the Ministry of Industry, Commerce and Trade in conjunction respectively with the Ministry of Transport and Civil Aviation and the Ministry of Mercantile Marine.

General authorisations or authorisations for an individual transport are issued.

Since observation of the statutory regulations quoted does not exempt the carrier from observation of special provisions applying to the individual forms of transport, the requirement for approval of despatch is superimposed on these authorisation procedures when necessary.

II-3.1. Exemptions from the authorisation procedure. Advance notification

On the basis of article 2, DPR No. 1704, of the Act No. 1008 and decrees referred to therein, the following may also be transported without authorisation:

- a) the following radioisotopes in any quantities:  $^{144}\text{Nd}$ ,  $^{147}\text{Sm}$ ,  $^{87}\text{Rb}$ ,  $^{115}\text{In}$ ,  $^{187}\text{Re}$ , natural potassium and its compounds;
- b) radioactive substances in quantities less than the following limits (\*):
  - 0.1  $\mu\text{Ci}$  for group I radionuclides
  - 1  $\mu\text{Ci}$  for group II radionuclides
  - 10  $\mu\text{Ci}$  for group III radionuclides
  - 100  $\mu\text{Ci}$  for group IV radionuclides;
- c) radioactive substances whose concentration does not exceed the following limits:
  - 0.01  $\mu\text{Ci/g}$  for natural solid radioactive substances
  - 0.002  $\mu\text{Ci/g}$  for artificial radioactive substances;
- d) special fissile materials which do not exceed in total amount the limits provided in b) and in any case 9 g in weight;

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(\*) Classification in groups coincides with the classification of radionuclides as a function of relative radiotoxicity, as set out in the Euratom basic standards.

e) natural uranium, natural thorium and impoverished uranium  
in quantities not exceeding 300 g uranium and 9 g thorium.

Article 2 of the DPR No. 1704 also states that individual occasional transports\* of radioactive materials in total amounts of radioactivity below the values established by the appropriate decree as set out below can be undertaken without authorisation:

10 mCi	for group I (for sealed sources of $^{226}\text{Ra}$ : 300 mCi)
100 mCi	for group II (for $^{131}\text{I}$ : 300 mCi)
1 Ci	for group III
10 Ci	for group IV
2000 Ci	for radioactive materials in the form of compact non-brittle solid, having a melting point at any point on the mass not less than $538^{\circ}\text{C}$ , insoluble in water and not reacting with air (in the case of sea transport only).

The undertaking of individual occasional transports carried out under the above conditions (without authorisation) must be notified by appropriate declaration at least 48 hours before commencing transport, to the provincial Prefect and Medical Officer in which the transport starts and finishes.

#### II-4. Luxembourg

On the basis of the Grand Duchy decree 8.2.67 relating to  
\* Individual occasional transports means individual transports undertaken by way of exemption, all concepts of frequency and continuity, however, being excluded from the comparisons.

protection of the general public against ionizing radiation hazards, any person transporting radioactive substances must be in possession of a general or individual authorisation. The procedure for the issue of the authorisation and the conditions which must be observed for transport will be defined, as previously described, by an interministerial decree, which has not yet been issued. Such provisions apply without prejudice to the legal provisions or regulations governing the various types of transport, apart from international agreements or conventions.

The following are exempt from transport authorisation:

a) radioactive materials to an amount less than the following limits:

- for nuclides with very high radiotoxicity (group A) : 0.1  $\mu\text{Ci}$
- for nuclides with high radiotoxicity (group B) : 1  $\mu\text{Ci}$
- for nuclides with moderate radiotoxicity (group C) : 10  $\mu\text{Ci}$
- for nuclides with weak radiotoxicity (group D) : 100  $\mu\text{Ci}$

b) the following radionuclides in any quantity:

$^{144}\text{Nd}$ ,  $^{147}\text{Sm}$ ,  $^{87}\text{Rb}$ ,  $^{115}\text{In}$ ,  $^{187}\text{Re}$ .

c) apparatus containing radioactive substances in quantities less than the limits provided under a) on condition that they are in sealed form and that the dose intensity at any point 10 cm from the surface of the apparatus does not exceed 0.1 mrem/h;

d) radioactive substances in any quantity when their concentration does not exceed:

- 0.01  $\mu\text{Ci/g}$  for natural solid substances,
- 0.002  $\mu\text{Ci/g}$  in other cases.

Essentially, activity or concentration limits are dealt with, above which the basic Euratom standards specify as essential a system of advanced declaration and authorisation.



The transit of radioactive substances is again subjected to general or individual authorisation issued by the Ministry of Public Health and valid for limited periods.

In the case of Luxembourg also it should be stated that an agreement is in force between the Benelux countries for mutual recognition of transit and transport authorisations (Grand Duchy decree 18.9.67).

#### II-5. Netherlands

The system of declaration and authorisation for the transport of radioactive or special fissile materials in the Netherlands is governed by the Nuclear Energy Act 21.2.63, in conjunction with the decree on the transport of mineral fissile materials and radioactive substances, 4.9.69. The structure of these standards is such as to render preferable a distinction between the transport of special fissile materials and the transport of radioactive substances.

##### II-5.1. Transport of special fissile materials and minerals

Article 15, paragraph a) of the Nuclear Energy Act subordinates transport and storage in relation to transport of special fissile materials and minerals to the possession of an authorisation. The authorisation may contain specifications.

This requirement does not exist for the transport of thorium, parcels containing fissile materials or minerals and conforming to the requirements for exemption from the regulation for rail transport of dangerous goods.

These requirements are the same as those for the RID: moderate quantities of special fissile materials, natural or

impoverished uranium, hydrogenated homogeneous solutions or mixtures with precise characteristics, uranium with enrichment below 1 % under specific conditions, fissile materials not comprising large sources in nuclear safety I and II parcels.

Exemption from authorisation also applies to the transport of large fissile sources in nuclear safety I and II parcels, undertaken on the basis of authorisation for despatch from a foreign country where the parcel corresponds to the RID requirements for unilateral authorisation, such as the transport of fissile materials in nuclear safety class III parcels, in the case where approval or authentication on the part of the Dutch authorities of the model of the parcel does not include the adoption of special measures to be adopted during transport, and despatch has been authorised by a foreign country.

As regards the foreign countries quoted under the last heading, the decree on transport provides that these shall comprise those indicated in the Official Gazette.

The decree on transport, on the other hand, regulates the transport of fissile materials and minerals according to the various forms of transport, stating that authorisation, when required, may contain various specifications, including observation of the specific national regulations in force for that form of transport (in the case of air transport, the regulation issued by the IATA, 11th edition). Transport not liable to authorisation on the basis of the above must, however, be undertaken observing these regulations apart from exemptions permitted by the Ministry of Social Security and Public Health.

As regards the transport of special fissile materials and minerals in the Dutch territorial waters, authorisation is not required in the sense of the nuclear law. A similar derogation is provided for transport in an aircraft when not landing on the territory of the Netherlands.

It is finally observed that authorisations for the transport of special fissile materials and minerals issued by the competent authorities of Belgium and Luxembourg are valid also on the territory of the Netherlands by reason of the special agreements in force between the Benelux countries.

#### II-5.2. Transport of radioactive substances

Article 29, paragraph 1, of the nuclear energy law, prohibits the transport or storage of radioactive materials in relation to their transport without authorisation of the Ministry of Social Security and Public Health. On the basis of the decree on transport, these prohibitions refer to:

- radioactive materials which may explode on contact with a flame or which are more sensitive to impact or to friction of dinitrobenzol;
- large nonfissile sources as defined in the regulation of rail transport of dangerous goods (definition coinciding with that of the RID).

At the same time, the transport of large radioactive sources is exempt from liability to authorisation when shipment is authorised by the competent authority of a foreign country and the parcel possesses characteristics such as to require only unilateral authorisation on the basis of the RID or, in the absence of the

second condition, if approval or authentication of the model of the parcel by the Dutch authorities does not contain special specifications to be observed during transport.

Regarding the foreign countries mentioned under the preceding heading, what was stated with regard to fissile materials or minerals also applies.

The decree quoted also governs the individual forms of transport, laid down in the application procedures for authorisation, and the specifications which may be contained in the document authorisation. It is also laid down that, for the various forms of transport, the provisions contained in the regulations regarding the transport of dangerous goods be observed (for air transport, the regulation issued by the IATA, 11th edition).

As regards the transport of radioactive substances on the Dutch maritime territory or non-Dutch waters, authorisation is not required in the sense of the nuclear law. A similar derogation is provided for air transport, on condition that the aircraft does not land on Dutch territory.

It should finally be noted that, by special agreements in force between the Benelux countries, authorisation for transport issued by the competent authorities of Belgium and Luxembourg are valid also for the territory of the Netherlands.

#### II-6. German Federal Republic

The transport of radioactive and special fissile materials in the German Federal Republic is regulated, generally speaking, by the Atomic Energy Act 23.12.59 (amended and supplemented recently 28.9.69) and the first and second decree on radiological protection,

to which must be added the regulations appropriate to each type of transport.

In view of the particular structure of the standards, it is preferable to distinguish between special fissile materials and other radioactive materials.

II-6.1. Transport of special fissile materials in the German Federal Republic

The transport of special fissile materials outside of closed areas where they are guarded by the government or held for activities otherwise authorised above the amount specified in appendix I of the first ordinance on radiological protection must be authorised in advance by the Brunswick Federal Physical-Technical Institute, obligation sanctioned in article 4 of the Atomic Law. Such authorisation can be issued to the consignor or to the person responsible for the shipment or transport and must be limited to the individual transport. Its validity cannot exceed 3 years.

The transport of small quantities of special fissile materials within the limits and under the conditions provided by the regulation for rail transport is exempt from such authorisation by exemption from application of nuclear safety criteria. It is stated on this point that on account of the date of issue of the first ordinance, this is referred to in the marginal notes 451<sup>a</sup> and subsection 3 (a) and b)) or the marginal note 456 of the railway regulation then in force, coinciding with the similar marginal notes of the RID, 1 June, 1962 edition. It is not therefore completely clear whether the less restrictive limits can be applied as

provided in the formulation at present in force of the railway regulation or the RID, marginal note 451<sup>a</sup>.

For the transport of fissile materials not entering this category, such authorisation procedure has to be added to that provided in the regulations for the particular type of transport (sea, air, etc.). This also applies in the case of international road transport with a dual administrative procedure, the ADR and as provided in the Atomic Law.

#### II-6.2. Transport of other radioactive materials

The "First Ordinance on protection against damage due to ionizing radiations" lays down that "any person transporting radioactive substances on the public highways or where the public has access must request authorisation". Such authorisations are issued by the competent authorities of the individual Länder.

However, there are a number of conditions of exemption to this standard. These include exemptions for small quantities of radioactive substances and for particular articles, and exemptions relating to specific standards for the individual types of transport.

Among the former, exemptions from liability to authorisation can be quoted for the transport of:

a) radioactive substances with total activity less than the limits fixed by appendix I of the First Ordinance (coinciding substantially with the Euratom limits for the system of advance declaration and authorisation);

- b) radioactive substances with concentration less than  $0.002 \mu\text{Ci/g}$ ;
- c) solids having a concentration of radionuclides of natural origin less than  $0.01 \mu\text{Ci/g}$ ;
- d) natural potassium or medicinal waters of natural origin having a normal concentration of radionuclides of natural origin ;
- e) apparatus, ceramic, porcelain and other articles specified under article 11 of the First Ordinance;
- f) apparatus containing sealed sources, calibration devices or measurement instruments for radiation or dosimetry, radiation detectors containing radioactive substances on the condition that the model of such devices is approved by the competent authorities in accordance with the Land legislation, as provided in article 14, 14a, 14b of the First Ordinance.

To this type of exemption, also valid, there are added, as mentioned, special cases avoiding the necessity of dual authorisation procedures. Such exemptions are contained in article 9 of the First Ordinance and affect:

- a) the transport of radioactive substances within the limits and under the conditions provided in marginal note 451<sup>a</sup> of appendix C, section 54 of the Ordinance on rail traffic(\*);
- b) the transport of radioactive substances undertaken in accordance with the provisions of the Ordinance on rail traffic or the RID, by persons acting as public railway operators;
- c) sea transport of radioactive substances packaged in accordance

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(\* ) For the transport of radioactive substances, the statement under the penultimate heading of section II-6.1. concerning fissile materials, also applies.

with the provisions of the Ordinance of sea transport of dangerous goods. In this case, however, loading and unloading of the substances in question must be notified in advance to the competent authorities in accordance with the Land legislation (not later than 24 hours before starting work);

d) air transport of radioactive substances undertaken on the basis of authorisations within the meaning of the air traffic law.

In the case also of radioactive substances, it is seen that, in the present state of German legislation, a dual authorisation procedure is necessary for international road transport within the meaning of the First Ordinance and respectively the ADR.

### III. TECHNICAL SPECIFICATIONS REGARDING PACKAGING AND MANNER OF SHIPMENT

#### III-1. Technical standards of the Community States

Before entering into the merit of the argument dealt with in this section, the situations in the individual countries are synthesised as regards existing technical standardisation within the specific field of transport.

##### III-1.1. Belgium

Rail transport is carried out on the basis of a national regulation based on the standards contained in the RID. Road transport is undertaken in accordance with the standards contained in the ADR.

Specific regulations do not exist for air and sea transport.



### III-1.2. France

Land transport (road and rail) and inland waterway transport are undertaken in conformity with the technical specifications contained in the Ministerial decree 15 April 1945 (repeatedly amended), based substantially on the standards contained in the ADR.

Sea transport is regulated by Ministerial decree of 7 February 1964, based essentially on the IAEA recommendations, 1964 edition.

Finally, for air transport, the IATA regulation applies, in virtue of the decree of 22 August 1957 on the classification of dangerous materials (radioactive materials) for air transport.

### III-1.3. Italy

Rail transport is regulated by the "Conditions and tariffs for the transport of goods on the State railway" substantially based on the RID, 1962 version, and hence, ultimately, the IAEA recommendations, 1961.

For road transport, circular No. 8/1965 applies "Road transport of radioactive or special fissile materials. Technical specifications", Ministry of Transport and Civil Aviation, 1 February, 1965, based on the 1961 IAEA recommendations.

Sea transport is governed by the "Regulation for loading, unloading and trans-shipment of dangerous goods in parcels", Ministry of Mercantile Marine, based on the 1964 IAEA recommendations.

Finally, air transport is governed by the "Specifications for air transport of radioactive and special fissile materials, circular No. 316597/32.1., 1 August 1968, Ministry of Transport and Civil Aviation, which adopts the technical specifications of the

IATA regulation.

III-1.4. Luxembourg

The intended inter-ministerial regulation on transport has not yet been issued.

III-1.5. Netherlands

The national regulations for the Netherlands are based on the standards contained in the valid regulations and international conventions.

III-1.6. German Federal Republic

The German national regulation for rail transport is identical with the RID, which has been adopted for international transport.

The ordinance for sea transport, 4 January 1960, is based practically on the IAEA 1961. Subsequent amendments do not affect the transport of radioactive materials. There is, however, a "circular" indicating the type of label adopted by IMCO. In the present state, the issue of a new ordinance is imminent, probably adopting the RID or IAEA 1967. This, however, has not as yet been approved.

As regards air transport, there is an "ordinance" automatically adopting the IATA. The Air Transport Act, however, is based on the more recent IATA regulation. Air navigation companies belonging to the IATA, however, do not require any authorisation for undertaking transport. If, on the other hand, a company does not belong to the IATA, authorisation is necessary. Special authorisation

must be requested, on the other hand, in those cases where the IATA specifications are not observed.

As regards road transport, there is no appropriate regulation in the German Federal Republic at the present time other than that provided in the First Ordinance on protection against dangers due to ionizing radiations. It should be observed, however, that section 3, article 4 of the Ordinance definitely stipulates that the packaging, for example, should conform to the ADR which is observed for international transport. In this case, again, the publication of an appropriate regulation is imminent, but this has not yet been approved.

### III-2. General packaging specifications and general characteristics of construction

All the regulations examined provide, as already seen for international standardisation, two types of packaging, namely type A and type B, for which the specifications are laid down by precise technical specifications.

It should also be observed that, in countries where specific regulations have not been issued for certain forms of transport, there is stipulated, frequently through the authorisation procedures, observation of the technical standard actually equivalent to those quoted. By way of example, in the German Federal Republic, where a regulation for internal road transport has not yet been issued, authorisation for transport is subordinated to the condition that, even in the absence of legal provisions, the transport of special fissile materials and radioactive substances shall be undertaken observing "all precautions necessary in the light of existing scientific and technological knowledge for the prevention of potential risks due to transport".

For the greater part of the national regulations, based, as already seen, on the analogous international specifications, what was stated in the previous appendix A applies. Regarding the points dealt with specifically there, it can be stated that the French decree on sea transport, the Italian regulations for internal road and rail transport and the German regulation for sea transport do not provide predetermined values for temperature variations during transport and storage, limiting themselves to specifying that "the vessels must withstand .... temperature variations ....." . The Italian circular on air transport, for its part, lays down limits of  $-40^{\circ}\text{C}$  and  $+70^{\circ}\text{C}$ , coinciding with those of the RID, the ADR and the IMCO (IAEA) as distinct from the IATA standards.

These regulations do not explicitly provide for the existence of an outer container, restricting themselves to giving specifications relating to the containment and screening function. The principal ones are as follows:

a) packagings must be enclosed and hermetically sealed so as to prevent any dispersion of the content and for this purpose, they must be closed by an efficient device.

The vessels must be placed, when necessary, in a radiation protection screen. The screen must be constructed and closed so that the vessels in it cannot emerge by accident and cannot change position in respect of the screen during transport.

The packaging must be of such a type as to maintain efficiency of the protective screen. The vessels must be constructed so as to form the protective screen themselves. They must, in particular, withstand the action of fire, impact and water, in addition

to temperature variations and pressure variations which may develop internally, having in mind the presence of air.

b) the packagings, closures and absorbent materials if necessary, must not be attacked by the content nor form noxious or dangerous compounds with them.

The regulations considered, with the exception of the French for maritime transport, also provide that the smallest outside dimension of the packaging must not be less than 15 cm instead of 10 cm, as distinct from the international standards and the regulations quoted based on them.

### III-2.2. Supplementary specifications for type A packaging

As distinct from the international regulations and the national regulations, which, being modelled most nearly on these, specify that type A packaging must withstand a series of tests without loss of containment functions for the radioactive materials, the French and German regulations for sea transport, like the Italian regulations for inland rail and road transport, are restricted to establishing that type A packaging must satisfy the conditions regarding containment and screening functions under normal conditions of transport and in the event of "minor accidents". Supplementary specifications are not provided for the transport of gamma-emitting materials with activity exceeding 3 Ci in type A parcels.

As regards specifications for type A packaging intended to contain liquid or gaseous materials, the 4 national regulations quoted above, while not providing supplementary specifications for gaseous materials, lay down for liquid materials that:

- a) the materials must be contained in a first vessel placed inside a second vessel. Each vessel must be hermetically sealed and closed with an efficient locking device. The inside vessel must have a filling margin sufficient to prevent an increase in pressure bringing about failure of the vessel;
- b) the inside vessel must be surrounded by a sufficient amount of absorbent material to absorb all the content. If the inside vessel is made from fragile material which can be easily perforated, the absorbent material must provide effective protection against impacts; if there is a protective screen, this must always surround the absorbent material.

It is observed in particular that the international regulations, like the remaining national regulations, specify that the absorbent material must be able to absorb twice the content. The final specification regarding the position of the screen refers explicitly also to type A parcels only in the Italian regulation for road transport.

### III-2.2. Supplementary specifications for type B packaging

The 4 regulations not adopting the international standards in their most recent form (i.e. the French sea transport regulations, the German sea transport regulations and the Italian rail and road transport regulations) are restricted to specifying that type B packaging must satisfy the general packaging conditions also in the case of the most serious foreseeable accident or series of accidents during transport for the manner and conditions of transport considered. The French regulation for sea transport, moreover, states explicitly that the packaging must be fire resistant.

The same regulations impose special specifications for type B packaging intended for containing liquid radioactive materials, providing in particular that: the inside vessel, when made from fragile material or material which is easily perforated, must be surrounded by a sufficient amount of absorbent material to absorb the entire content. If the inside vessel is not made from fragile material or material which is easily perforated, the packaging may, in certain cases, be not of absorbent material and the vessels may not be materially separated, with the approval of the competent authority of the country affected.

It is observed that these supplementary specifications governing packaging for liquids are not provided either in the international regulations discussed in appendix A nor the remaining national regulations which are restricted to specifying the tests which type B packaging in general must withstand.

### III-2.3. Supplementary specifications for parcels containing large radioactive sources

The national regulations examined are in best agreement with the international standards governing the various types of transport with the exception of the 4 regulations repeatedly quoted.

In particular, as regards limitation of the temperature of the outer surface of the parcel, the Italian regulations for road and rail transport provide that the parcel must be designed and constructed so that, under the most unfavourable conditions, the temperature of the outer accessible surfaces of the packaging does not exceed 50°C during transport.

Before despatch, the parcel must be held in storage by the shipper until the temperature of the system has reached equilibrium

unless it has not been laid down that the state of the parcel shall continue to conform to the specifications of the regulations quoted above throughout transport. This limit may be raised to 82°C in the case of complete load transports.

The French sea transport regulation lays down similar specifications, but standardising the temperature limit at 82°C.

It is observed that the regulations quoted do not refer to ambient conditions as regards the above limits.

All the national regulations, like the international (RID, ADR, IAEA-IMCO) lay down that the heat produced inside the parcel by the presence of radioactive materials shall not at any time reduce the efficiency of the packaging. However, when stating the effects to be considered particularly, the 4 national regulations above do not quote those which may accelerate corrosion in the presence of moisture.

The national regulations studied, with the exception of the 4 above quoted, provide the same container design principles and screening function, the same test procedures and the same tests for approval of the parcels as quoted in the preceding appendix A.

The Italian road transport circular lays down that if a refrigerating fluid or system is used, this fluid or system must conform to the following conditions:

- a) the primary gaseous or liquid refrigerating fluid (refrigerating fluid making contact with the source of irradiation) must not circulate outside the protective screen;
- b) if the packaging is provided with a mechanical refrigerating system, failure of this mechanism must not result in an excessive increase in pressure or liberation of radioactive materials to an injurious amount;



c) if a liquid is used as the refrigerating fluid, measures must be adopted to prevent freezing during transport;

d) if a liquid is used as the refrigerating fluid and if the temperature inside the packaging may at any time during transport reach the boiling point of the liquid, the packaging must be designed and constructed so as to withstand the increase in pressure without loss of liquid, reduced efficiency of the packaging or liberation of radioactive materials. If the packaging is not so designed and constructed, the system must be studied so that the temperature of the liquid inside the packaging and in proximity with the radioactive materials are always at least 10°C below the boiling point of the liquid, taking into account the external conditions which may be encountered during transport. If pressure-reducing devices are used, measures must be taken to prevent the liberation of particles of radioactive material in injurious quantities.

The remaining 3 regulations quoted above contain fairly similar specifications. For example, the French sea transport regulation, under point b) also considers loss of refrigerating fluid and, under point c) adds: "or prevent, by means of a filling margin or expansion device or any other appropriate means, the packaging or its content being damaged in the event of freezing".

This type of specification does not exist in the remaining regulations examined, either national or international, in so far as the material dealt with is governed by the standards for the approval of models of the parcel providing two types of administrative procedure according to the characteristics of the parcels (see appendix A).

III-2.4. Limitation of external irradiation

Also as regards limitation of external irradiation, the only national regulations which differ from the international regulations are:

- the German sea transport regulation;
- the Italian road and rail transport regulation ;
- the French sea transport regulation.

The first 3 provide that the parcels must fall into one of the following categories:

a) the white category when the total irradiation exposure intensity at any point on the outer surface of the transport packaging does not exceed 10 milliroentgen per 24 hours;

b) yellow category when the total irradiation exposure intensity exceeds 10 milliroentgen per 24 hours but without exceeding the limits of:

- 200 milliroentgen per hour at any point on the outer surface of the transport packaging and
- 10 milliroentgen per hour at 1 m from any outer surface of the transport packaging.

However, only in the case of complete load transport of large sources, the two Italian regulations quoted lay down, in derogation of the above, that:

- the irradiation exposure intensity may be 10 milliroentgen per hour at 3 m from the surface of any outer face of the packaging;
- the total X or gamma radiation intensity or its equivalent must not exceed:
  - 200 milliroentgen per hour at any accessible outer surface of the truck (or vehicle);
  - 10 milliroentgen per hour at 1.6 m from either of the two base walls of the truck, nor 10 milliroentgen per hour at 2 m from the other

The German sea transport regulation, on the other hand, still for large sources, allows transport which, on the basis of rail transport conditions, may be considered as complete truck, with total irradiation intensity reaching 10 mR/h at 3 m from the surface of any outer face of the packaging.

The standards provided by the French regulation for sea transport, while being formulated differently, provide the same limits and the same derogation as stated for the similar German regulation.

It is seen that the major differences between the national regulations examined and the international regulations (and therefore the remaining national regulations also) are as follows:

- they provide a single yellow category coinciding largely with the III-yellow category;
- the irradiation intensity limits at a distance refer to a distance of 1 m from the outer surface of the packaging, rather than the centre of the parcel;
- for the white category, the exposure intensity limit at the outer surface of the parcel is equal to 0.4 mR/h or equivalent, rather than 0.5 mR/h or equivalent.

#### IV. NUCLEAR SAFETY SPECIFICATIONS

##### IV-1. General specifications

As regards nuclear safety specifications also, the 4 regulations studied in particular in the preceding sections are the only ones which deviate from the international regulations dealt with in the preceding appendix A.

In the first place, conditions of exemption from the specific standards will be considered regarding fissile materials. Both the Italian regulations and the German sea transport regulation provide the following 3 cases:

a) plutonium to the amount of 9 grammes maximum per parcel

uranium-233	"	"	"16	"	"	"	"
uranium-235	"	"	" "	"	"	"	"

When a parcel contains more of one of the above materials, the limit applying to a parcel must be calculated from the following formula:

the total

(number of grammes plutonium)	x 16+
(number of grammes uranium-233)	x 9+
(number of grammes uranium-235)	x 9

must be equal to or less than 144;

b) non-irradiated uranium in which the only fissile radioisotope is uranium-235, the content of which must not exceed 0.72 % by weight, to an amount per parcel not exceeding that provided for type A or B parcels.

If more than one of these 3 materials are present, the total:

(Beryllium: uranium) x 15 + (graphite: uranium) x 1 +  
+ (hydrogen-2: uranium) x 3

must not exceed 15;

c) aqueous or other solutions in which the only fissile material is:

1. uranium-235 to an amount not exceeding 800 g. In this case the hydrogen: uranium-235 atomic ratio in the solution must not exceed 5,200. This atomic ratio, in ordinary aqueous solutions, corresponds to a uranium-235 concentration below 5 grammes per litre.

2. plutonium to an amount not exceeding 320 g. In this case, the hydrogen: plutonium atomic ratio in the solution must be greater than 7600. This atomic ratio, in ordinary aqueous solutions, corresponds to a plutonium concentration below 3.5 grammes per litre;

on condition that homogeneity of the solutions is ensured at all times during transport and that, at no time during transport, the concentration of any part of the solution exceeds the above. The effects of freezing and evaporation must be duly taken into account.

The French regulation, again, provides the same exemptions but under point b) does not stipulate quantity limits.

Comparison with table I in appendix A shows that the major differences reside in the amount of material, under point a), the quantity limit under point b) and the absence of exemptions for enriched uranium with  $^{235}\text{U}$  percentage not exceeding 1% by weight.

The 4 regulations above do not explicitly state that the fissile materials mentioned must be packaged and transported in such a way that criticality cannot be reached under any foreseeable circumstances of transport. This, however, is implicit in the context of safety standards.

The same national regulations, moreover, impose specifications regarding the hypotheses to be adopted for the transport of non-irradiated or irradiated fuel elements, with particular regard to the evaluation of radioactivity.

For unspecified fissile materials, such as scrap or residues, the French sea transport regulation provides the same specifications regarding hypotheses to consider in the safety calculations contained in the international regulations as in appendix A.

As regards nuclear safety class, the 4 regulations quoted provide definitions only formally different from those studied in

appendix A, specifying in fact that the consignment belongs to one of the 3 following types:

- Type I consignment. Each parcel of the consignment shall not be subject to any hazard due to neutron interaction under any foreseeable circumstance, whatever the arrangement of the load, in other words, no critical assembly shall be formed when such parcels, in any number, are stacked in any manner.

- Type II consignment. A number of parcels such as to make up a single consignment without a critical assembly being formed under any foreseeable circumstances, even if by chance, a number of parcels 5 times that authorised is combined together.

- Type III consignment. This type comprises all consignments not satisfying all the conditions of types I and II.

It is seen that the specifications cover consignment, but implicitly 3 different types of parcel are defined. Other differences are formal, or depend on the different distribution of the material dealt with.

#### IV-2. Particular specifications for nuclear safety class I parcels

The 4 national regulations repeatedly quoted, for nuclear safety I and II parcels provide that

- a) if the mass is the determining factor, the permissible amount in any parcel must not exceed 1.80 % of the critical mass evaluated for the most unfavourable conditions of moderation and reflection which can be encountered under the conditions of transport, taking into account the neutron absorbers incorporated;
- b) if geometry is the determining factor, the permissible size of any determining dimension must include a safety margin of at least 10 % on the critical dimensions evaluated under the most unfavourable conditions of moderation and reflection which can be encountered

under the conditions of transport.

The Italian road transport regulation and the French sea transport regulation provide in an appendix typical data for constructing packages satisfying the requirements of nuclear safety I and II parcels from the criticality standpoint. The French regulation quoted specifies that the packaging for nuclear safety class I and II parcels must be type B.

The remaining national regulations, like the international regulations discussed in appendix A, give much more detailed specifications regarding both isolated parcels and assemblies of parcels, damaged and undamaged. Tests are laid down, moreover, to which parcels must be subjected in order to determine the hypotheses on which to base nuclear safety calculations and the conditions of moderation and reflection to be considered.

#### IV-3. Particular specifications for nuclear safety class II parcels

The 4 national regulations of the preceding section, apart from the specifications already studied in regard to nuclear safety I parcels, lay down that as regards the number of type II parcels authorised, the effective neutron multiplication factor ( $K_{eff}$ ) of the system obtained, when a number of parcels 5 times that authorised is combined under the most difficult foreseeable circumstances, must not exceed 0.9.

On this subject also the remaining national and the international regulations are much more detailed, stipulating:

- the tests which each nuclear safety class II parcel must withstand, maintaining certain characteristics;
- the nuclear safety criteria for parcels of these classes taken individually and for calculating the permissible number of parcels, considering both sound parcels and damaged parcels.

IV-4. Particular specifications for nuclear safety class III parcels

None of the regulations studied lays down particular technical specifications regarding the characteristics of nuclear safety class III parcels taken individually.

Standards of this type, but referring to consignment and not specifically to the model of the parcel, are, on the other hand, contained in the French sea transport regulation.

It is noted also that, in the standards of both the international and national regulations, models and shipment of parcels of these classes must be approved by the competent authorities, who may specify all the precautions rendered necessary.

V. ADMINISTRATIVE SPECIFICATIONS REGARDING THE APPROVAL OF PACKAGINGS AND PARCELS

V-1. Type A packaging

All the national regulations issued by the Member States require no approval of type A packaging.

V-2. Type B packaging

All the national regulations examined specify that the type B packaging model must be approved by the authorities designated for this purpose by the national legislation.

Certain complications arise for models of parcels originating and approved in countries different from those where the transport is undertaken. The Belgian royal decree on transport provides nothing regarding the approval of parcels; the subject is governed within the framework of the transport authorisations.

As regards France, the land transport and inland waterway transport decree lays down that:



- "any parcel originating abroad for which the packaging is in conformity with these specifications may be transported, on condition that the shipper can supply a statement certifying that the packaging conforms to specifications conforming to the IAEA recommendations; certification must be authenticated by the Minister if not issued by the competent authority of the country of origin of the parcel design or shipment".

Again, the French decree on sea transport does not provide for this case.

In the German Federal Republic the railway regulation adopts the findings of the RID, while the sea transport ordinance does not expressly provide for these circumstances.

For Italy, the road transport circular, the air transport circular and the sea transport regulation provide that the national competent authority (CNEN) may authenticate a certificate of approval issued by competent authorities. The regulation for rail transport, on the other hand, does not provide for this case.

The Dutch regulations for various types of transport adopt the findings of the corresponding international regulations.

As regards Luxembourg, however, it is noted that the inter-ministerial regulation governing the transport of radioactive materials has not yet been issued.

### V-3. Approval of models of parcels for large non-fissile radioactive sources

Approval of the models of the parcels for large non-fissile radioactive sources is not provided for in the following regulations:

- French sea transport regulation;
- German sea transport regulation;
- Italian road transport circular;

The remaining regulations examined provide two types of approval, one relating to models of the parcel conforming to the requirements set out in section III-3.1. of appendix A, which is, so to speak, unconditional, and the other relating to models of the parcels corresponding to the requirements set out in section III-3.2. of appendix A, issued with supplementary precautions to be observed during transport, when the precautions must appear on the certificate of approval.

As regards recognition in the various countries of certificates of approval issued by competent foreign authorities, the circumstances are rather different, as in the case of approvals for type B packaging models dealt with in the preceding section.

#### V-4. Approval of models of nuclear safety class I, II, III parcels

The 4 national regulations quoted at the beginning of section V-3, with the exception of the French regulation for sea transport, do not provide for approval of models of nuclear safety class I, II and III parcels. All the remaining national regulations, like the international regulations (section III-4, appendix A), provide this type of approval.

In this case again, limited to models of nuclear safety class I parcels, much disuniformity may be encountered in recognition by the various countries of approval of parcel models issued abroad.

#### VI. AUTHORISATION FOR DESPATCH AND ADVANCE NOTIFICATION

The material to be dealt with is frequently superimposed on that affecting the system of declaration and advance authorisation as dealt with in the preceding section II.

The Belgian royal decree 28.2.63, as was seen, provides special authorisation to be issued from time to time in the case of transports of particular danger. The procedure is comparable with authorisation for despatch as provided in the international regulation. It is, however, noted that the Belgian regulation provides that the transport of radioactive materials must in every case conform to the international conventions in force.

The French regulation on the subject, which does not provide a particular system of authorisation, has already been examined in the preceding section II. This moreover conforms to the RID and ADR conventions for land transport and, for sea transport, provides for approval of the type of shipment for large sources and a special authorisation for nuclear safety class III shipments.

The German regulation on sea transport lays down that the means of transport for large sources must be approved by the competent authority and that shipments of parcels containing fissile materials in amounts exceeding the exemption limit must observe the provisions contained in the certificate issued by the competent authority. As regards other forms of transport, it is noted that, while a regulation governing road transport has not yet been issued, that for rail transport is completely similar to the RID. The IATA standards apply for air transport.

The Italian circular on road transport, in the case of parcels containing large radioactive sources (fissile and non-fissile) provides for approval of the technical means of transport, on the basis of a nuclear safety certificate issued by the CNEN. As previously stated, nuclear safety class I, II and III consignments are

subject to the issue of the CNEN nuclear safety certificate. Similar standards apply to rail transport.

The Italian circular on air and sea transport lays down that acceptance for transport of parcels containing large radioactive sources (fissile and non-fissile) or nuclear safety class III parcels shall be subject to the issue of an appropriate certificate by the CNEN.

As regards the regulations in force in the Netherlands, these coincide materially with the provisions of the national regulations examined in appendix A.

It is noted, finally, that for Luxembourg, the subject will be governed by the issue of an interministerial regulation on the transport of radioactive materials.

## VII. MARKING AND LABELLING REQUIREMENTS

### VII-1. Markings

The national regulations examined specify that each parcel conforming to a type A design shall be marked in an obvious and indelible manner on its outer surface with the wording "type A" with the exception of the following:

- \* French sea transport regulation;
- German sea transport regulation;
- Italian road transport circular;
- Italian rail transport regulation.

which do not provide such markings.

These 4 regulations do not provide particular indications for type A parcels containing gamma-emitting radioactive substances with activity exceeding 3 Ci, as distinct from the remaining national regulations, which standardise on the international standard as in appendix A.

All the regulations examined provide that parcels for which approval of the package or parcel model is necessary require, on the outer surface in an obvious and indelible manner, the identification mark assigned to the design by the competent authority which has approved it, the serial number and, for type B packaging, the wording "type B". As regards the wording "type B", this is not provided in the 4 regulations mentioned at the start of the section. Of these, only the French regulation for sea transport provides the wording "radioactive".

All the regulations examined lay down, with insignificant differences, that each parcel conforming to a type B packaging design must be marked, on the surface of the outermost fire and water resistant metal, with the clover leaf symbol, cut, punched or otherwise stamped so as to withstand the action of fire and water.

#### VII-2. Labels and other indications

The 4 regulations quoted at the start of section VII-1 provide only 2 types of danger label to be applied on the 2 opposite side faces of the parcel. The remainder provide 3 types of label, previously mentioned in connection with the international regulations. This relates to subdivision of parcels into only 2 categories.

It is observed that there are some differences in detail between the symbols reproduced on the labels. In particular, the label models provided in the above 4 regulations carry a skull.

These 4 regulations do not provide the wording "empty package which has contained radioactive materials". The remaining regulations

adopt the specifications of the international standards.

All the regulations, for parcels containing materials exempt from technical specification governing transport, provide the wording "radioactive".

As regards radioactive materials with low specific activity, the Italian regulations for rail and road transport and the German regulations for sea transport do not provide standards for labelling, while the French regulation for sea transport and the remaining regulations conform with the international standards.

## VII. REQUIREMENTS OF PERSONNEL UNDERTAKING TRANSPORT

### VIII.1. Qualifications of personnel.

The Belgian royal decree 28.2.63 governing in general the transport of radioactive substances in these countries does not provide particular specifications regarding the requirements of the personnel undertaking the transport. It however requires that the application for authorisation shall contain information regarding the qualification of such personnel and information be issued to them regarding measures to adopt in the event of accident. It is clear then that, through the authorisation procedure, guarantees can be obtained regarding the qualification of the personnel employed on the transport.

The French regulation examined, and particularly the regulations quoted above, do not contain any explicit standard regarding the qualification of personnel employed on transport.

As regards the German Federal Republic, one of the conditions to which the First Ordinance subjects issue of authorisation to transport is a guarantee that the transport is carried out by reliable persons possessing the necessary knowledge regarding any irradiation risks and protection methods to be adopted for the mode

of transport involved. Of the regulations on the various types of transport, the sea transport regulation does not provide anything on the subject; the remainder refer to what was stated in general in section III.

For Italy in general, the DPR 1704 lays down that, pending the issue of standard regulations for the transport of special fissile materials and radioactive substances, in addition to the standards contained in the regulations already examined, the health and safety standards contained in the DPR 185 which apply shall be observed. The DPR 185, article 61, lays down that "employers ... must make workers aware of the specific hazards to which they are exposed, the method of carrying out the work and the essential protection standards ....". This standard is repeated and adapted to the case of transport by the air transport section and sea transport regulation.

For the remaining member countries we will limit ourselves here to stating that, while in Luxembourg the intended inter-ministerial regulation on transport has not yet been issued, the Dutch regulations are in close agreement with the international regulations examined in appendix A.

#### VIII-2. Classification of radiation protection

The Belgian royal decree 28.2.63, governing also transport, provides that workers may be classified in class A or B (occupationally exposed and not occupationally exposed).

The French regulation on sea transport sets out a table of minimum distances separating the parcels and positions occupied by persons, while the regulation for rail, road and inland waterway transport is limited to stating that, for road transport, parcels to a maximum number, determined in accordance with the transport index, must be placed as far towards the end of the vehicle as

possible, opposite that of the driving seat.

As regards the German Federal Republic, the regulations examined do not provide details regarding the classification of personnel. It is, however, stated that the problem does not arise and, when it does, workers employed on transport may be considered as not occupationally exposed.

The Italian regulation, with the sole exception of rail transport, provides that workers employed on the operations of transport and handling of parcels must be classified either as occupationally exposed or not occupationally exposed. The land transport circular also allows classification as single individuals of the general public (group 3).

As regards the Netherlands and Luxembourg, the preceding section VIII-1 applies.

#### IX. REGULATION APPLYING IN THE EVENT OF ACCIDENT

The national standards of the Member States governing the transport of special fissile materials and radioactive substances normally limit themselves to laying down, for the case of any accidents occurring during transport, specifications of a general nature similar, as will be seen below, to those provided in the international regulations already examined in the preceding appendix A.

It is, however, found that in each case it is the responsibility of the authorities of the individual countries to organise the mode of action of the public bodies (fire services, civilian protection services, police, etc.) for the purpose of limiting as far as possible the damage due to any accidents.



The standards contained in the laws and regulations of the various countries are briefly described below.

#### IX-1. Belgium

The Belgian royal decree 28.2.63 (article 60) expressly provides, for the case of accidents occurring during transport, that the responsible person must immediately inform the public authorities designated for this purpose if it is found that a hazard endangering public safety exists. It is also specified that such declaration does not relieve the carrier from immediately adopting all protective measures stipulated by the circumstances.

It is also noted that every month, when submitting the quarterly summaries, the holder of the authorisation must notify, a posteriori, all accidents which may have occurred during the transports undertaken.

#### IX-2. France

The French regulation for land or internal waterway transports devotes Title VI of class IVb of the regulation governing transport of dangerous goods to the procedures to follow in the event of accidents. Article 23 of the same regulation also applies, referring to any dangerous goods. The provisions of article 4, sub-title IV, class IVb of the regulation for sea transport of dangerous goods also apply to sea transport.

In the case of road or internal waterway transports, for the specific case of radioactive materials, in the event of an accident occurring during handling or transport on the public highway or if the packaging or materials have suffered evident or probable damage and, more generally, each time there is a probability of radioactive contamination or accidental irradiation hazard, the person responsible

for undertaking the transport must:

- notify the shipper and the authorities designated for this purpose or see that they are informed immediately, supplying all the information on the case;
- establish if possible an isolation perimeter around the point of the accident and take all precautionary measures useful and compatible with his material possibilities.

Similar specifications, but adapted to the type of transport, are provided for rail transport.

For sea transport, it is provided that:

- in the event of damage to parcels containing radioactive materials occurring during transport, the affected zone must be isolated (in the case of a hold, this shall be closed off and any ventilation prevented). The authorities affected and the shipper must also be informed immediately;
- in the event of fire occurring in a compartment of the hold adjacent to that occupied by radioactive material, the Captain shall take the necessary steps to remove them from the fire;

In general, the presence of radioactive materials must not be considered as preventing rescue or firefighting operations;

- persons who may have been contaminated shall be subjected to control and appropriate examinations;
- contaminated materials, goods and areas shall not be returned to service without prior authorisation by competent persons.

### IX-3. Italy

The regulations governing the individual types of transport provide, in the event of accidents, specifications substantially similar to those of the RID and ADR, with the additional statement that persons for whom the possibility of contamination is suspected

must be subject to appropriate controls.

It should be noted in particular that the specifications for sea transport and air transport, as distinct from the road transport circular, provide that:

- apart from situations of serious urgency, any discharge of radioactive materials following accidents must be carried out on the basis of arrangements issued by the provincial medical officer;
- reuse of means of transport, premises or materials which have been contaminated entirely or in part and have been subsequently decontaminated, must be declared in advance as exempt from risk by a "qualified expert" as defined in article 70 and 71 of the DPR 13.2.64, No. 185.

#### IX-4. Luxembourg

Arrangements to adopt in the event of accident must be laid down in the interministerial regulation quoted above (not yet issued).

#### IX-5. Netherlands

As previously noted, the Dutch national regulations applying to the individual types of transport have incorporated the standards provided in the international regulations (CIM-RID, ADR, draft ADN) or refer to these (IATA). As regards the regulations applying to accidents, the previous appendix A therefore applies.

#### IX-6. German Federal Republic

Without prejudice to the provisions of the specific regulations regarding the individual types of transport, the First Ordinance, article 53, lays down that any person subject to liability for authorisation to transport must immediately inform the supervisory authorities of any mishap or accident resulting from the transport

of radioactive substances.

A similar obligation exists, within the meaning of article 45 of the same Ordinance, in the case of loss of radioactive substances during transport.

It is also indicated, for rail transport, that the particular regulation provides standards entirely similar to the RID.

APPENDIX C

PRACTICAL EXPERIENCE IN ITALY IN RADIATION PROTECTION IN  
THE TRANSPORT OF RADIOACTIVE SUBSTANCES

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TRANSPORT OF RADIOACTIVE SUBSTANCES

PRELIMINARY CONSIDERATIONS

This appendix provides a synthetic description of experience in radiation protection gained in Italy during more than a decade of activity in the sector of transport of radioactive substances.

Before taking up the subject, however, it should be noted that the transport of radioactive substances in Italy, in accordance with the basic standards, independently of the technical provisions which must be observed when undertaking transport, is subject to advance authorisation or simple declaration in accordance with the level of risk of the radioactive substances transported.

On the basis of article 2 of the DPR, 30 December 1965, No. 1704 amending and superseding article 5 of the act 31 December 1962, No. 1860, the transport of special fissile materials in any quantity and of radioactive materials to a total quantity of radioactivity or by weight exceeding the values determined in accordance with article 1 of the DPR, 13 February 1964, No. 185, must be undertaken by authorised land, air or sea carriers by decree of the Ministry of Industry and Trade respectively in conjunction with the Ministry of Transport and Civil Aviation and the Ministry of Mercantile Marine. This article was amended in turn by the act 19 December 1969, No. 1008, which lays down that exemption from authorisation may be granted for moderate quantities of special fissile materials and prime source materials. The ministerial decree 15 December 1970 (G.U. 15.2.71, No. 39) establishes the limits of such exemption.

By article 2 of the DPR No. 1704 quoted, individual occasional transports of radioactive materials can be undertaken without authorisation to a total quantity of radioactivity or by weight not exceeding the value determined by decrees of the Ministry of Industry 27.7.66 and 18.7.67. In such cases, however, at least 48 hours before starting the transport, information must be submitted to the Prefect and to the provincial medical officer of the provinces in which the transport starts and finishes.

Individual transports of special fissile materials and radioactive materials, occasional or not occasional, but to a total quantity of radioactivity or by weight exceeding the limits laid down in the acts and decrees referred to above, must be undertaken by land, air and sea carriers, if necessary authorised by decree of the Ministry of Industry and Trade in conjunction with the Ministry involved.

By decree of the President of the Republic, ultimately in accordance with article 2 of the DPR, 30 December 1965, standard regulations must be issued relating to the transport of special fissile materials and radioactive materials in accordance also with the basic standards laid down by the European Atomic Energy Community. Until this regulation is issued, still in accordance with the provisions of article 2, the transport of special fissile materials and radioactive materials must be undertaken in observance of the instructions issued by the Ministry of Transport and Civil Aviation for land and air transport and by the Ministry of Mercantile Marine for sea transport, observing also the health and safety standards contained in the DPR, 13 February 1964, No. 185 which apply.

Transport is therefore subject to advance authorisation or simple declaration in accordance with the quantity, classified into groups of radiotoxicity and hence level of risk for the given

transport, in harmony with the basic standards. There is an interesting distinction in the legislation between individual occasional transports and individual transports; the purpose of this is to distinguish the occasional nature of an individual transport, undertaken by way of exception, below the limits for which authorisation is required, leaving the carrier the possibility of undertaking individual transports from time to time which should, however, be authorised in advance. It is a subtle distinction and presents considerable difficulties of interpretation. The major difficulty is, however, the fact that the regulation provided has not yet been issued. In the present state, moreover, the only reference as regards radiation protection is in the statement contained in article 2 of the act 1704, regarding the application of the standards of the DPR No. 185, 13 February 1964, with the limitation of the expression "which are applicable", which poses a problem not easy to resolve.

Into this legal framework there are grafted controls on the part of the Italian bodies existing for this purpose, the explanation of which emerges from experience gained in this sector.

#### I. THE SYSTEM OF DECLARATION FOR THE TRANSPORT OF RADIOACTIVE MATERIALS

As stated in the previous section, individual occasional transport of radioactive materials with activity below certain values can be undertaken without authorisation, by simple notification to the Prefect and the provincial officer of health of the provinces in which the transport starts and finishes. Such notification, in harmony with the provisions of the basic standards, aims on the one hand at ensuring action by the competent peripheral authority in the event of accidents, and on the other hand, making it pos-



sible for that authority to be acquainted with the movements of radioactive materials.

Such a system of notification, moreover, makes available the information necessary to draw up traffic statistics for radioactive materials, particularly useful in specifying any points of high intensity in this traffic, for which specific action would be necessary from the standpoint of radiation protection in order to protect the general public or individuals of the public against undue radiation.

Finally, analysis of the reports may indicate carriers contravening the "occasional" concept and who should therefore be issued with authorisations in accordance with the act.

The outcome of experience as regards the system of advanced reporting does not, however, appear very comforting for various reasons.

Firstly, substantial negligence is encountered on the part of occasional carriers, so that a large proportion of transports undertaken by them are not reported as they should be to the competent authorities. This negligence arises both from widespread ignorance of the legislative provisions and particularly the nuisance to the occasional carrier of notifying in advance the undertaking of a transport to the peripheral authority.

Secondly, a lack of usefulness can be noted, other than for the case of accidents, of regular notifications to the peripheral authorities. They indeed, by Italian law loaded with numerous and the most varied burdens, have not drawn up statistics regarding any nodal traffic points for radioactive materials nor singled out cases of carriers whose activities cannot be considered as occasional, except for a few exceptions.

It is worth noting, however, that the system of declaration, even with the difficulties of application brought to light, continues to be a useful tool, in particular as regards protection of the general public against the risk of undue irradiation following an accident or strong concentrations of radioactive traffic. At the same time it is a tool which could better reflect its effectiveness in the field of wider familiarity with the law on the part of the users and a more specific functioning of the peripheral authorities.

## II. THE SYSTEM OF AUTHORISATION FOR THE TRANSPORT OF RADIOACTIVE MATERIALS

As regards the system of authorisation, it should be noted that this is divided between permanent authorisation, valid for one year and renewable each year, and authorisation for a single transport.

For the purposes of protection and nuclear safety, the application for permanent authorisation by the carrier must contain, as indicated in the circular 16-F, 21 April 1965, Ministry of Industry, Commerce and Trade, in addition to a list of protection and nuclear safety equipment, explicit information regarding the qualification of the personnel employed on both the organisation and carrying out of the transport and the use of instrumentation. This, however, is not necessary in the case where application is made for authorisation for an individual transport, for which it is sufficient if the applicant declares himself familiar with the technical standards for undertaking the transport.

Authorisation, both permanent and individual, is issued by means of a decree which renders binding the technical standards for that type of transport, under penalty of loss of authorisation with

the application of the consequent penal provisions.

The above differences between the documentation required for the two types of authorisation are due to the fact that, while in the first case there is continuity in carrying out transports, in the second case transport is carried out only rarely.

The former case presupposes a systematic activity involving the necessity of having available a qualified person who can put into force the protective arrangements, which does not appear relevant in the second case, naturally excluding accidents.

It is obviously at this point that supervision on the part of the competent authorities must come into play.

Permanent authorisation for transport on the basis of the circular of the Ministry of Industry, Commerce and Trade No. 16-F, 21 April 1965, laying down the procedures, is subjected, as regards protection and nuclear safety, to favourable opinion by the National Nuclear Energy Committee.

In this respect, the CNEC has drawn up for discussion an advance instruction procedure which is explained when the carrier requests authorisation for the first time, together with an enquiry supplement on renewal of the permanent authorisation. The advance instruction procedure examines the information provided by the carrier, i.e. the whole of the activity intended, in order to assess the classification of the workers involved in the event of any physical and medical controls, the instrumentation which must be made available to the carrier, etc. This information, carried out on a-priori evaluations, is then usually checked at the end of 1 or 2 years activity, at the conclusion of which it is possible to establish more accurately, on the basis of the frequency of transports undertaken, and on the whole and method of execution, what should be the most appropriate protective arrangements to apply for

In the case of authorisations for individual transport, any requirements regarding protection organisation, according to the circular quoted above, will be undertaken by the CNEN and imposed on issuing the authorisation, obviously varying as a function of its importance and the level of risk of the transport in question.

The results of practical experience gained in Italy as regards the system of authorisation do not appear to be completely positive.

For permanent authorisations, indeed, an increase was observed during 1966-1970 in the authorisations issued, rising from 3 in 1966 to 8 in 1967, to 15 in 1968, to 20 in 1969 and to 21 in 1970.

It is worth considering that practically all transports of radioactive materials involving important activities were carried out by firms or companies carrying permanent authorisation, the number of which actually appears sufficiently high to ensure competitive costing, and sufficiently limited to allow a certain degree of specialisation with a high standard of radiation protection.

Parallel with this, there was a reduction during the early months of 1971 in applications for permanent authorisation relating to radioactive pharmaceuticals, being released only to 4 manufacturing or importing companies.

This development, although still in its beginnings, displays undoubted positive features. It would seem therefore possible that the big gap in retail distribution of radiopharmaceuticals is being bridged. In other words, the majority of transports involve an activity which could fall within the system of advance notification of occasional transports but which are assumed not to be of this character.

Again, as regards authorisations for individual transports, practical experience gained in Italy displays some quiet comforting notes. Relative to the transport of radioactive materials subject to individual authorisation indeed, there is not very great casuistry (approximately 100 transport/year) which confirms, with reserves for possible transports undertaken in abuse, that the large majority of transports relating to important activities are undertaken within the scope of permanent authorisations.

It seems possible, therefore, with the reserves indicated, to state that the authorisation system has enjoyed sufficient acceptance in the countries on the part of the users affected, as the result of awareness of the risks connected with the activity being performed, which could continually improve in the future, particularly if the procedures are accelerated and certain individual conditions freed, largely respecting the radiation protection standards.

### III. TECHNICAL MEANS FOR UNDERTAKING THE TRANSPORT OF RADIOACTIVE SUBSTANCES

As repeatedly stated, the authorisation system for transport of radioactive substances does not exempt the carrier from adopting suitable precautions for carrying out the transport in a correct manner from the technical standpoint and carrying out on the transport a protection analysis based on the instructions issued by the competent ministries.

These instructions, based on the IAEA recommendations for the transport of radioactive materials, are pertinent only partly to the subject of this appendix, and it is therefore opportune to draw attention only to that part of the instructions affecting radiation protection in particular.

The technical regulations, while largely dealing with containers, or the tests to which they must be subjected in order to conform to certain standards, or questions of a purely nuclear nature, such as for example the problems of facility, do not touch on several aspects regarding protection, such as for example maximum permissible contamination on parcels, maximum irradiation intensity per parcel and load, etc.

From the standpoint of radiation protection, moreover, particularly as regards the consequence of any accident during transport, the IAEA recommendations refer to a standard accident, which, apart from major catastrophes, may be normally accepted during transport in the sense that, when transport is carried out in complete observation of the specifications contained in the technical recommendations, this will not represent serious risks.

Analysis of radiation protection therefore aims firstly at ensuring that transport is performed in a manner conforming with the dictates of the technical provisions and, in this case also, that the ambient conditions in which it occurs, for example particular highway routes, are not such as to run counter to the hypotheses forming the basis of the IAEA recommendations. If on the other hand, it does not conform to the provisions of the regulations (for example container not capable of withstanding the mechanical or thermal tests provided where this is considered under type B) then radiation protection analysis must be more accurate. In particular, all those preventive measures must be brought into play largely replacing engineering deficiencies of the transport in question.

Mature experience in the field of transport has indeed recently brought about an ever increasing conviction that this is an adequate "policy" in this sector. In effect, the standards required for containers of either type A or type B are sufficiently high in relation to the probable risk consequent on the danger level of the substances transported. Italian experience has in fact shown that the risk consequent upon undertaking transport, particularly for the general public or single individuals of the public, is largely acceptable. When, however, these standards appear less cautious, measures must be provided (such as for example a reserve of expert personnel on hand both from the nuclear standpoint and, where appropriate, firefighting) which in cases of this type are necessary on the part of the competent authorities.

#### IV. CONTROL BY THE COMPETENT AUTHORITY

Control and supervision by the competent authority, which, as already seen, is entrusted also to the National Committee for Nuclear Energy in Italy as regards protection against ionizing radiation, is explained on the basis of the activities described in the preceding sections, namely on the one hand permanently authorised carriers and on the other hand visits during individual transports.

It is also the responsibility of the CNEN to check all those measures necessary for safeguarding, apart from workers, single individuals of the public or the public as a whole directly.

As regards the control of carriers authorised permanently for the transport of radioactive materials, it should be immediately noted that this takes on a radiation protection character. In effect, as frequently emphasised, the carrier, on applying for

permanent authorisation, lists the equipment for radiation protection which he has available, making use or otherwise of the collaboration of the qualified expert obviously in accordance with the frequency and size of the transports he intends to undertake, draws up, a priori, a classification for the personnel employed and the frequency of contamination controls.

The control body, moreover, is responsible for supervising and assessing that the protective devices employed are in proportion to the transport activity which the carrier intends to undertake and once having more concrete data, such as for example, statistics of the transports undertaken or the manner in which these are carried out, etc., seeing that the protective measures previously established are adequate, requesting where appropriate integration or, in some cases, suggesting suitable limitations.

On-the-spot investigations during individual transports, on the other hand, are normally of a more technical nature, in the sense that these also require the collaboration of specialist transport engineers, also agreed in the conventional sense, apart from radiation protection experts for the control of irradiation levels and contamination levels of the parcel.

The control body is also responsible for seeing that single individuals of the general public or, more generally, the public as a whole are not exposed to undue irradiation beyond the limits laid down for them.



## V. CONTROLS AND INSPECTIONS, PRACTICAL EXPERIENCE

Practical experience obtained in Italy in the field of controls is particularly rich. It is therefore appropriate to study it in some detail in order to establish, if possible, those working parameters which may guarantee a high standard of radiation protection.

In this respect, the National Nuclear Energy Committee has directed its own activities along distinct lines:

- a) direct control activity: undertaken both on the authorised carrier's premises and on transports on the road;
- b) research activity: based on the analysis of data collected and aimed at suggestion initiatives emerging from the analysis;
- c) accident activity.

### V-1. Direct control activity

As regards direct control activity, this is aimed at practical instruction in the issuing of permanent authorisation and by visits on the site; during the course of such visits, the availability of instruments is ascertained, together with the physical and medical control services available, personnel instruction and the competence of the responsible engineer. It is worth noting that all this can contribute towards the expression of a valuation of the organisation and the efficiency of physical health and safety supervision brought into play by the carrier. From the visits so far carried out in this respect (more than 20) it has been possible to note a discrete efficiency in the organisational structure in the great majority of cases.

At the time of technical assessment for renewal of permanent

authorisations, at an approximately annual rate, the on-site visits take on a more practical character. In particular, compliance of the carrier is found regarding the following points:

- a) Working capacity of the person responsible for physical supervision of health and safety;
- b) Control of physical supervision of personnel;
- c) Control of medical supervision of personnel (when necessary);
- d) Use of instrumentation;
- e) Contamination control on the motor vehicles;
- f) Quarterly reporting of transports undertaken;
- g) Instructions for exposed personnel.

Visits carried out for this purpose (more than 50) have always disclosed a high standard of protection, with insignificant doses taken up by the personnel employed.

As a consequence of analysis of the situation, a substantial awareness has been obtained which, at any rate as regards authorised carriers, matches up with an efficient radiation protection structure to the point where it is possible to attain a greater time extension for the renewal of permanent authorisations.

As regards road transport, on which direct control activity is carried out on those occasions where it is considered that transport should be undertaken with particular caution, practical experience obtained does not at the moment go beyond a brief casuistry regarding the transport of irradiated fuels or  $^{60}\text{Co}$  for large irradiation plants. The results in this respect appear however to counsel more direct control action.

V-2. Research activity

For the purpose of checking that, as the result of the transport of radioactive materials, certain individuals of the public or, in the more general case, the public as a whole, do not take up irradiation exceeding the limits fixed for them, the National Nuclear Energy Committee has systematically performed a series of research studies and activities for the purpose of estimating:

- a) The mean dose taken up by single individuals of the public, and particular nodal points where the radioactive traffic intensity is high;
- b) The mean dose taken up by personnel employed on transports;
- c) The implications of traffic intensity and route configuration on such accidents;
- d) Improvements in the international regulations governing the transport of radioactive materials.

As regards point a) reference is made to the following works:

- 1) Radiation protection in the transport of radioactive materials on railway crossings (P. Cagnetti and A. Susanna)<sup>(1)</sup>;
- 2) Parcels containing radioactive materials at the Saluggia railway station and doses taken up by personnel employed (A. Susanna)<sup>(2)</sup>;
- 3) Estimation of the ionization radiation dose taken up by airport personnel employed on operations connected with the air transport of parcels containing radioactive materials (A. Perini and A. Susanna)<sup>(3)</sup>;

As a consequence of these studies, it has been possible

to establish that regarding certain conditions, there is no risk of exceeding the dose for single individuals of the population; it should be noted, however, that in certain situations it has been necessary to impose certain limitations on the number of parcels in transit.

As regards point b), reference is made in particular to the following works:

- 1) On the Radiation Average Dose Absorbed by Truck Drivers in Italy (1967-1968) (C. Faloci and A. Susanna)<sup>(4)</sup>;
- 2) On the Average Dose Absorbed by Truck Drivers in Italy (1969-1970) (M. Roberti, A. Roselli and A. Susanna)<sup>(5)</sup>.

the results of which confirm what is generally recognised, in other words transport of radioactive materials, if suitable precautions are taken, does not present a substantial risk of exceeding the permissible doses, particularly since a reduction in the mean transport index is shown.

As regards point c), reference is made to the following works:

- 1) Experience in the transportation of radioactive materials in Italy (C. Faloci and A. Susanna) (on the general situation)<sup>(6)</sup>
- 2) Health Protection analysis of transportation of radioactive substances through tunnels, the Mont Blanc tunnel (C. Faloci, F. Lucci and A. Susanna) (at a particular modal point)<sup>(7)</sup>.

These works attempt an analysis of protection, taking into account the characteristics of the route configuration and conventional traffic intensity statistics, extrapolated to radioactive materials, in order to evaluate the implications of accidents implicitly defined by the technical characteristics of the containers.

The conclusions reached appear to demonstrate, with certain reservations regarding the characteristics and the present volume of traffic, that the probability of a serious accident occurring is very slight and that the present situation is therefore broadly acceptable.

As regards item d), reference is made to the following documents:

- 1) Recent developments in the regulations governing the transport of radioactive substances (L. Failla)<sup>(8)</sup>;
- 2) A proposed presentation of the 1970 draft IAEA transport regulations in schedule form (Draft II) (O'Sullivan and A. Susanna)<sup>(9)</sup>.

In the light of practical experience in Great Britain and Italy affecting the transport of radioactive materials, the latter document reformulates the IAEA recommendations, presenting them in the form of a "schedule", which appears greatly to simplify the tedium of consultation, to the benefit of the user.

Research carried out so far, considering the extreme complexity in defining the parameters, appears to contribute significantly to the knowledge on problems connected with the transport of radioactive materials. It is to be hoped that similar research will be carried out in the other Community States, since improved conditions of transport should emerge from the comparison and from the various opinions.

### V-3. Accident activity

The activity of the National Nuclear Energy Committee has developed along a third direction in relation to the accident possibility and for the purpose of ensuring a qualified technical consultancy in such an event.

In this respect, the CNEEN has set up a consultancy body (24 hours daily) grafted on to the peripheral structures (Prefettura, VV.FF) and the departments of the Home Office. This organisation functions on the occasion of information from the central or peripheral authorities. Shift officials are able to establish, at a very high speed from the Central Office files, the characteristics of the given transport, and to make this available to the authorities for necessary action. For this purpose, a number of orders of magnitude have been set up for the working levels of activity for which reference should be made to the article "Average "accident" in the transport of radioisotopes and reference doses for individuals of the population" ( L. Failla and A. Susanna)<sup>(10)</sup>.

The above consultancy body has been found necessary in relation to the possible disorientation, technical and in particular psychological, which could easily occur at the peripheral level in a field which displays features different from those of conventional accidents.

This is confirmed by the rare casuistry so far witnessed (nearly always involving false alarms) which has demonstrated how incidents involving radioisotopes still carry with them a marked burden of alarm on public opinion.

It should not be forgotten, however, in this respect that any possible serious accident in the field of transport, such as for example, the failure of a type B container on a motorway, could result in closure to traffic for long periods with incalculable economic damage, apart from the serious risk for the persons involved and the rescue teams, while such eventualities could be prevented by prompt and competent consultancy action, such as the consultancy body is able to provide.

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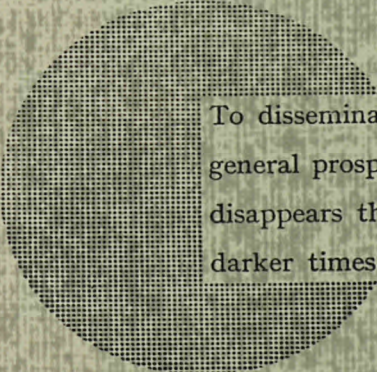
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Alfred Nobel

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