TRANSPORT OF RADIOACTIVE MATERIALS

The increasing use of radioactive substances, not only in reactor operations but also in medicine, industry and other fields, is making the movement of these materials progressively wider, more frequent and larger in volume. Although regulations for the safe transport of radioactive materials have been in existence for many years, it has now become necessary to modify or supplement the existing provisions on an international basis. It is essential that the regulations should be applied uniformly by all countries. It is also desirable that the basic regulations should be uniform for all modes of transport so as to simplify the procedures to be complied with by shippers and carriers.

Uniformity can be achieved only by international agreement on the basic standards of safety. The International Atomic Energy Agency has been engaged in the establishment of safety standards to cover all activities involving ionizing radiation, and transport is one of the first subjects being dealt with.

Under its Statute, the Agency is required to provide for the application of safety regulations to all operations undertaken by it or with its assistance, and many of these operations are likely to involve the transport of radioactive substances. The Agency is in a unique position to examine the technical problems involved as well as the wider problems that may arise in formulating regulations to cover intergovernmental practices, and last year the United Nations Expert Committee for Further Work on the Transport of Dangerous Goods recommended to the Transport and Communications Commission of the United Nations that the task of drafting recommendations on the transport of radioactive substances be entrusted to the Agency. It is therefore reasonable to expect that the regulations framed by the Agency for its own operations will find wider acceptance and eventually become the basis of an international convention.

Levels of Activity

Technical considerations for safety may differ widely in accordance with the levels of radioactivity of the materials being transported. Most of the shipments will be of radioactive materials with a low or medium level of activity. But there may be shipments of irradiated nuclear fuel elements which are highly radioactive, or of large quantities of fissionable materials which may become "critical" unless special precautions are taken. However, such shipments will be relatively few and generally made to or from technical centres; this may make it possible to frame rules for special precautions on an ad hoc basis within the framework of the general principles. So far as shipments of low and medium activity materials are concerned, there should, on the other hand, be a precise technical and administrative "common law" for uniform and universal application.

Considering the different technical and administrative aspects of the problem, IAEA convened two panels* to draft comprehensive regulations for the safe transport of all types of radioactive materials. One of the panels has examined the safety problems of transporting materials of high activities or those presenting risks of criticality, while the other has studied the transport of sources of low and medium activity. The work of the two panels has been complementary and the regulations drafted separately by them are to be put together in a single set of provisions to cover all aspects of the problem.

The panel on the transport of materials of low activities first met at IAEA headquarters in Vienna in April 1959, while the other panel met in July. At these first meetings the experts prepared sets of draft regulations which were later sent to the Agency Member States for comment. Both panels met again last February to give final shape to their drafts in the light of the comments received. While the regulations will be made public after they have been examined and approved by the Agency's Board of Governors, it would be interesting at this stage to review the nature of the problems examined by the two panels.

Aims of Regulations

The aim of regulations for the safe transport of radioactive materials is to limit and control the irradiation and radioactive contamination of people, animals and goods as a result of their proximity to the materials being transported. The regulations must ensure that transport workers, passengers or the public at large are not exposed to the radiations given off by the materials in a manner or to a degree that may be harmful. It is also important to prevent damage to or contamination of animals and goods; radiation-sensitive materials like undeveloped photographic

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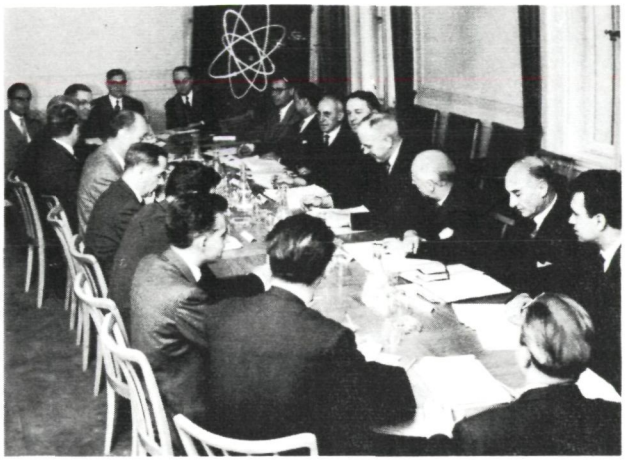
* *(1) Panel on the Transportation of Radioisotopes and Radioactive Ores of Low Specific Activity. Chairman: Mr. G.E. André, Union Minière du Haut-Katanga, Belgium. Other members from Federal Republic of Germany, Mexico, Pakistan, Poland, United Kingdom, United States, Central Office of International Railway Transport, and International Air Transport Association.*

(2) Panel on the Transportation of Large Radioactive Sources and Fissile Materials. Chairman: Mr. H.N. Sethna, Atomic Energy Establishment, India. Other members from Canada, Czechoslovakia, France, India, Netherlands, Sweden, Switzerland, United Kingdom, United States, USSR, Central Office of International Railway Transport, and International Air Transport Association.
The meetings were also attended by representatives of the United Nations and specialized agencies..



Panel of experts on the safe transport of radioisotopes, radioactive ores and residues of low specific activity

Experts discussing problems of safety in the transport of large radioactive sources and fissile materials

films are particularly liable to damage, and contamination of foodstuffs could cause a health hazard that must be guarded against.

The basic means of ensuring safety are also clear. In the first place, the dose rates of external radiation from shipments of radioactive materials must be strictly limited to values that may be considered safe in the light of the maximum permissible levels of radiation. In limiting the dose rates, one must also take into account the foreseeable conditions of transport, handling and storage as they may affect the duration and distance of exposure for persons. Secondly, steps must be taken to limit the quantities of materials per package and per shipment so as to reduce the likelihood of contamination of persons, animals or goods in the event of an accident. Determination of permissible quantities will, of course, be largely dependent on the nature of the materials and their levels of activity.

Apart from these two principal requirements, attention must be paid to the manner of packing as well as to general administrative precautions. For example, one must limit the external contamination of the packages themselves and thereby control any resulting contamination of the means of transport. Again, in order to prevent the release of the radioactive materials, the packages must be resistant to fire, water and shocks in foreseeable normal and accidental circumstances. A further requirement is to provide adequate warning signs so that people in the neighbourhood who are liable to be exposed may be aware of the presence of danger. And finally, those who carry and receive the materials must be supplied with all relevant information about the materials being transported.

Technical and Administrative Factors

It will be readily seen that the technical considerations involved in meeting these requirements are highly complex because there will always be wide variations not only in the nature of the materials but also in the circumstances under which they are carried. As already indicated, special precautions are necessary for the movement of materials which are highly radioactive or which are liable to become critical. Transport of materials of the latter type, i. e. substances which are fissionable, needs detailed precautions. Chances of criticality would, of course, be largely dependent on the amount of the actual fissile substance involved (for example, the percentage of fissile atoms in enriched uranium), but a number of other factors, such as the shape and density of the material and the presence or absence of a moderator, would significantly affect the possibility of a fission chain reaction. All these factors must be taken into account in devising regulations for criticality control.

Apart from these technical considerations, a major problem is to evolve an internationally acceptable set of administrative procedures that would meet all the requirements of safety. If the regulations are too restrictive or the procedures too cumbersome, the whole system may be unworkable in practice. Besides, it must not be forgotten that certain national and international regulations are already in operation, and drastic changes in the existing systems may create serious administrative and operational problems. In recommending a set of revised international regulations, the Agency experts have, therefore, had to maintain a fine balance between the needs of the situation created by the movement of ever-increasing quantities of radioactive materials and the desirability of avoiding any major disruption of established practices and procedures.

As far as possible, the Agency panels have retained, at least in their meaning, the essential requirements of existing national and international regulations and sought compromises between the various formulations. At the same time, they have found it

necessary to propose certain different considerations in view of the rapid increase in the number and importance of shipments of radioactive materials. In doing so, they have tried to avoid unnecessary restrictions while maintaining, and if necessary improving, the levels of safety achieved by the existing regulations. Moreover, an attempt has been made to frame and put together the provisions in such a manner that they could be applied, in their essence and as minimum safety requirements, to all modes of transport. The aim has been not only to elaborate but also to harmonize and simplify.

POWER PROGRAMMES REVIEW

POWER REACTORS IN THE FEDERAL REPUBLIC OF GERMANY

This is the fourth in a series of articles on the nuclear power programmes in the Member States of IAEA

Compared with work in some other industrialized countries, the atomic energy programme in the Federal Republic of Germany got off to a somewhat late start. Nevertheless, after about four years of research and training of scientists, the country is today on the threshold of a major phase in atomic energy development. While research and training are being continued, the first concrete steps are also being initiated for the commercial utilization of nuclear energy as a source of power. Several experimental nuclear power stations are being set up, designed or planned.

It must be pointed out, however, that the immediate plans for nuclear power reactors in West Germany have not been dictated by any urgent power requirements. The country has no cause for worry over lack of primary energy sources, at least not for the time being. The conventional resources of primary energy, especially coal, are enough to meet present as well as a good deal of future requirements.

The total electricity generation in the Federal Republic was some 52 000 million kWh in 1950, about 85 000 million kWh in 1955 and about 95 000 million kWh in 1958. Late in 1958 the total power output was made up as follows: pit coal 64 per cent, lignite 20 per cent, water power 14 per cent and other sources 2 per cent. It is estimated that the average rate of increase in power generation over the next few years will be approximately 7 per cent per year. Since it is not expected that power demands will increase at a rate out of proportion to this increase in generation, nuclear plants will not be required to make an important contribution before the end of the 1960s.

Guiding Considerations

Despite this relatively favourable outlook for conventional power, the West German Government and industry have taken vigorous measures for the development of power reactors for two important reasons. In the first place, they recognize the role of atomic power in the country's economy in the more distant future and consider that the foundation of an adequate power supply to meet future needs must be laid well in advance. Secondly, they also recognize the immediate role of atomic power in certain other areas of the world and feel that as a highly industrialized country West Germany should master the new technology immediately so that it may be able to play an active part in international atomic trade.

It is these considerations that led the Federal Government to establish in 1955 a Federal Ministry for Atomic Affairs, redesignated in 1957 as Federal Ministry of Nuclear Energy and Water Economy. The Minister of Nuclear Energy and Water Economy is charged with the exploitation and utilization of nuclear energy for peaceful purposes and is advised by an Atomic Affairs Commission composed of scientists, economists and representatives of public institutions. The power reactor programme in West Germany is based on co-operation between Government and private industry; Government provides the initial scientific and financial assistance but it is left to the initiative of private enterprise to develop and carry out the actual projects. Several industrial reactor development groups and groups of power supply companies have started intensive preparatory work in this direction, and some major projects have already come into being.

Experimental Power Reactors

Among experimental power reactors, a 15 MW (e) reactor of the boiling water type is under construction near Kahl on Main. This reactor, which is based on plans of the General Electric Company (USA), is being built by the Allgemeine Elektrizitätsgesellschaft (AEG) of Frankfurt am Main and Hochtief AG of Essen on behalf of the Rheinisch Westfälisches Elektrizitätswerk AG of Essen, which has provided the necessary funds. Construction work is well advanced and the reactor is expected to go into operation in the second half of this year. It will provide operational experience from both technological and economic points of view; this will be of