Czechoslovakia: Profile of radioactive material transport

by J. Štrba

The increasing use of atomic energy in member countries of the Council for Mutual Economic Assistance (CMEA) has naturally led to increased demands for the transport of various types of radioactive substances. These transports are carried out in CMEA member countries, and with other countries.

Various kinds of radioactive substances are transported, including compounds containing radionuclides in small quantities, radioactive sources for a variety of applications in the economies of CMEA member countries, and sealed radioactive sources for medical irradiators. In the last few years, as a result of the construction of nuclear power plants, the number of transports of spent fuel from nuclear power plants in CMEA member countries also has been increasing.

Quite naturally, different approaches are taken in applying and observing all safety precautions during the transport of the various kinds of radioactive substances. The transport of labelled compounds with low radionuclide activity for research purposes, or for use in medicine, for instance, is carried out under different conditions from those governing the transport of high-activity sources or of spent nuclear fuel.

Regulations adopted by CMEA members

CMEA member countries have paid great attention to the safe transport of the various types of radioactive substances since the very beginning. In 1960, the CMEA Permanent Commission on the Peaceful Uses of Atomic Energy was established as a body whose range of activities would also cover the solution of questions connected with the safe transport of radioactive substances. In the 1960s, recommended CMEA standards for transport packages were developed under a scientific and technical co-operation programme of the CMEA member countries, submitted to the Permanent Commission for approval, and later adopted by the member countries as national standards. These established and accepted standards were based on the *Regulations for the Safe Transport of Radioactive Materials* adopted by IAEA and published in its *Safety Series No. 6.*

At present, a new CMEA standard is being developed to replace out-of-date standards for transport packages for radioactive substances. It will include general technical requirements to be met by transport packages and methods of testing them. In developing this standard, the 1985 edition of the IAEA regulations will be taken into account.

The transport of radioactive substances by rail among member countries of the "Railroad Co-operation Organization" (OSZhD) is covered by the "Regulations for the Transport of Radioactive Substances" that were included in Annex 4 to the "Agreement on International Railroad Freight Traffic" (SMGS). This agreement was signed by representatives of the railways of Bulgaria, China, Czechoslovakia, the Democratic People's Republic of Korea, the German Democratic Republic, Hungary, Mongolia, Poland, Romania, the USSR, and Viet Nam. These regulations, based on the IAEA regulations, have been in force since a review in 1982. The transport of fissionable material and spent fuel is not covered by the SMGS regulations.

Spent fuel transport – CMEA

In the 1970s, the CMEA member countries, with the help of the USSR, embarked on the large-scale construction of nuclear power plants with 440-megawatt water-cooled and -moderated power reactors (WWER-440) developed in the USSR. This raised the problem of transporting the spent fuel from the nuclear power plants to the reprocessing plants. The solution of the problems connected with the safe transport of spent fuel was entrusted to the Scientific and Technical Council No. 2 (NTS-2) of the CMEA Permanent Commission on Co-operation in the Peaceful Uses of Atomic Energy.

Under a programme for scientific and technical co-operation between CMEA member countries co-ordinated by NTS-2, solutions were found to a large number of technical problems associated with the safe transport of spent nuclear fuel. "Regulations for the Safe Transport of Spent Nuclear Fuel from Nuclear Power Plants of CMEA Member Countries – Transport by Rail" were formulated. These were approved by the Permanent Commission on Co-operation in the Peaceful

Mr Štrba is on the staff of the Czechoslovak Atomic Energy Commission.

Uses of Atomic Energy and adopted by the CMEA Executive Committee in November 1977.*

The adopted regulations define the basic conditions that must be observed in the preparation, organization, and transport of spent fuel between CMEA member countries by rail. Such transports must also be in conformity with the "Technical Conditions for Spent Fuel Elements and Assemblies from Nuclear Power Plants of the Corresponding Types" developed under the scientific and technical co-operation of CMEA member countries and adopted by the CMEA Permanent Commission on Co-operation in the Peaceful Uses of Atomic Energy.

The established and adopted regulations indicate that to maintain radiation protection and nuclear safety during the preparation, organization, and transport of fuel assemblies, the IAEA regulations must be complied with. At the same time, the present regulations oblige CMEA member countries taking part in the transport of spent fuel to ensure observance of the requirements of the Treaty on the Non-proliferation of Nuclear Weapons (NPT) and of IAEA's requirements with regard to the transfer of nuclear materials from one country to another. Since the transport of spent fuel is carried out by rail, the SMGS provisions must also be observed.

The regulations contain technical requirements applicable to the transport of spent fuel, including detailed conditions for the transport of spent fuel with an indication of the equivalent radiation dose-rate at any point on the outer surface of the container wagon, and also limits for loose radioactive contamination of the outer surface of the container wagon.

In addition, the regulations include requirements for the escorting and physical protection of transports. An integral part of the regulations is also constituted by the organizational and technical measures for preventing possible accidents and dealing with their consequences. The annex to the regulations contains a list of the organizations of the various countries competent in matters of nuclear safety during the transport of spent fuel and responsible for co-ordinating transport problems.

A second part of the present regulations is also being prepared which will concern the safe transport of spent fuel from nuclear power plants in CMEA member countries by waterway, taking into account also the transfer to railway wagons. On the basis of the experience with the transport of spent fuel by rail gained by the CMEA member countries during the last years, the present regulations are to be revised. They also will take into account the 1985 edition of the IAEA regulations.

Experience in Czechoslovakia

The use of atomic energy in the national economy of Czechoslovakia has increased demand for the transport of radioactive substances.

Atomic energy has been in particularly wide use in the Czechoslovak national economy since the signing of the "Agreement Concerning the Provision of Assistance by the Union of Soviet Socialist Republics to the Czechoslovak Republic in Connection with the Development of Research into the Physics of the Atomic Nucleus and the Utilization of Atomic Energy for the Needs of the National Economy". The 30th anniversary of the signing falls this year.

Radioactive materials and sources of ionizing radiation are widely used in many sectors of Czechoslovak industry. A special place is occupied by medicine, where both labelled compounds with low radionuclide activity and powerful sources of ionizing radiation are in use. In Czechoslovakia there are several hundred scientific research institutions, medical facilities, and industrial enterprises which use radioactive substances for their scientific, therapeutic, and manufacturing purposes.

Institutions producing labelled compounds or various radioactive sources in Czechoslovakia include:

- Institute for the Investigation, Manufacture and Application of Radioisotopes, Prague (IIPPR)
- Nuclear Research Institute, Řež, near Prague (IYaI)
- Institute of Radioecology and the Utilization of Nuclear Technology, Košice (IRIYaT)

The radioactive compounds or radionuclides needed as raw material for the production of labelled compounds or radioactive sources are in general imported from abroad. More than half the shipments come from the USSR and other CMEA member countries. The number of shipments of radioactive compounds or radionuclides in the form of sealed or unsealed radioactive sources from foreign suppliers are shown in the accompanying table.

Sealed or unsealed radioactive sources from foreign suppliers

Year	Number of shipments*	
	Unsealed sources	Sealed sources
1981	1020	100
1982	1092	100
1983	1133	92
1984	1110	80

* A shipment includes several transport packages containing radioactive substances.

All shipments of radioactive substances arriving in Czechoslovakia are transferred to IIPPR, where the total radionuclide activity and the specific activity are verified and the loose surface contamination on the source is determined (see table at top of next page).

Some radioactive compounds or radionuclides are used directly at the institute for the manufacture of various products, which are then forwarded to other institutions. The remaining shipments are sent to the

* Personal communication of author with V. Machaček and F. Vesely.

Sealed radioactive sources checked at IIPPR in Prague

Year	Sealed sources for Medicine		Radiography		Industry		Other		Total	
	Activity*	No.	Activity*	No.	Activity*	No.	Activity*	No.	Activity*	No.
1981	3110	8	870	36	2125	422	132	232	4115	1306
1982	2488	8	1270	617	3474	958	1823	318	5584	1904
1983	1178	4	1365	625	884	411	5424**	1190	7668	2230
1984	2207	11	2153	698	1468	1206	8890**	901	13251	2816

* Represents the total radionuclide activity expressed in becquerel (Bq). One Bq is equivalent to one disintegration per second, or to approximately $2.7 \cdot 10^{-11}$ curies.

** This number includes resealed sources used earlier for radiotherapy.

Notes: IIPPR is the Institute for the Investigation, Manufacture, and Application of Radioisotopes.

Source: Personal communication of author with J. Vyskočil, V. Vondruška, and J. Klenka.

individual users, of which there are some 600 in Czechoslovakia. The sealed sources of radiation are checked at IIPPR in accordance with the regulations in force and sent on to users.*

Packages, mode of transport

Labelled compounds with low radionuclide activity are transported chiefly in Type-A packages. These packages are both foreign and Czechoslovakian made. The transports are carried out in accordance with the IAEA *Regulations for the Safe Transport of Radioactive Materials* (1978 edition). Where transports are by rail, the SMGS transport regulations are also observed.

The type of transport used depends mainly on the half-life of the radionuclide to be transported. Short-lived radionuclides are transported by air and by road in order to reduce the time of delivery from the manufacturer to the user of the radionuclides.

Sealed high-level sources of ionizing radiation are transported in the appropriate Type-B packages.

Sealed cobalt-60 or caesium-137 sources, which are used in medical irradiation facilities, are transported in special containers of Czechoslovak make, each of which holds several such sources. These containers are used at the same time both for supply to irradiation facilities and for the transport of spent sources to disposal sites. The containers are constructed in accordance with the IAEA regulations.

Before 1981, the containers did not undergo testing in accordance with the IAEA regulations. Czechoslovak Atomic Energy Commission (AEC) Decree No. 8 of 25 June 1981 obliges organizations or enterprises using any equipment for the transport of radioactive materials to obtain for such equipment a certificate issued by the Czechoslovak AEC on the basis of the results of tests carried out in accordance with the regulations or standards in force. The certificate is issued for a specified period. Tests of devices for the transport of radioactive substances are carried out at IIPPR, where the necessary conditions for this purpose have been created.

In recent years, Czechoslovakia has begun to manufacture equipment for the safe transport of radioactive materials, or equipment, that allows radioactive substances to be used safely in various sectors of industry. For users in Czechoslovakia and in CMEA member countries, such equipment is produced by the Nuclear Fuel Institute at Prague Zbraslav (IYaT). The raw material used for the manufacture of the shielding of such equipment is depleted uranium. The developed equipment is tested in accordance with IAEA regulations and receives a certificate.

Spent fuel from Czechoslovak plants

Most transports of radioactive substances are for the transfer of spent fuel from Czechoslovak nuclear power plants for reprocessing in the USSR. The transports are carried out in accordance with the "Regulations for the Safe Transport of Spent Nuclear Fuel from Nuclear Power Plants in the CMEA Member Countries, Part 1 – Transport by Rail". Responsibility for the observance of nuclear safety during the transport of spent fuel is borne by the Czechoslovak AEC in accordance with Law No. 28/1984 Sb concerning government supervision of the nuclear safety of atomic facilities.

From 1983 to the end of 1984, seven transports of spent nuclear fuel from WWER-440 and KS-150 reactors from Czechoslovakia to the USSR were carried out.*

* Czech Socialist Republic Ministry of Health Decree No. 59/1972 and Slovak Socialist Republic Ministry of Health Decree No. 65/1972 concerning the protection of health against ionizing radiation.

* Personal communication of author with Y. Lukavsky and A. Pulkrab.

A special wagon made in the USSR is used for the safe transport of spent fuel from WWER-440 power plants.* The wagon carries a special container consisting of a vertical cylinder with fins on its outer surface. The cylinder's diameter is 2.3 metres and its height is 4.4 metres. The total mass is 90 tonnes. The shielding material is steel, and the wall thickness of the container is 400 millimetres. The capacity of the container is 3.8 tonnes of spent fuel, which is equivalent to 30 fuel assemblies. The design of the container is such that the fuel carried can be cooled during transport. Cooling can be done by "wet" or "dry" methods depending on the burnup of the fuel carried.

Spent fuel from the KS-150 reactor is transported in a special wagon carrying a container developed and manufactured in Czechoslovakia.** The T-15 transport container is made of steel, has a mass of 78 tonnes and a steel shielding thickness of 385 millimetres. The cylinder is carried on the wagon in a horizontal position. The container capacity is 16 spent fuel assemblies from the KS-150 reactor. Cooling of the spent fuel carried is done by the "dry" method. The container has undergone testing in accordance with the requirements of the IAEA regulations and the Czechoslovak AEC has issued the appropriate certificate.*

During the loading and unloading of the fuel the transport container is moved into a vertical position by means of a special hoisting mechanism mounted on the wagon. The container is transported on a 10-axle freight wagon of the NKh series. The spent fuel is transported from Czechoslovakia to the USSR after three years of storage in cooling ponds at the power plant from the date of discharge from the power reactor.

The experience acquired with the transport of spent nuclear fuel shows that if all technical precautions and all transport regulations in force are observed, it is indeed possible to transport spent nuclear fuel safely.

* "Spent fuel transportation problems," by A.N. Kondratev, Y.A. Kosarev, and E.I. Julikov, IAEA-CN-36/316.

** Katrlík, J. et al., "Preprava vyhoreléno paliva z elektrárne A-1" (Transport of spent fuel from the A-1 power plant); *Jad. Energ.* (1985) (in press).

* Certificate No. CS/010/B(U)F (Rev. 1)-1/85 issued by the Czechoslovak Atomic Energy Commission in respect of a packaging for the transport of spent nuclear fuel.