Soviet-German Cooperation in Safety Improvements of Spent Fuel Transport Casks

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Abstract

The paper gives a survey of the Soviet (Russian)-German activities which started in 1988 with the objective of creating a long-term scientific-technical cooperation in the field of transport and storage casks for spent nuclear fuel. The first step, i.e., the step of informing each other about the state of development is done. The more complicated second phase with concerted common activities of both the Russian and German Competent Authorities and industrial enterprises is intended to start the in near future.

Background of the Cooperation

One of the results of the Chernobyl accident was the declared will of the former CMEA (Council of Mutual Economic Assistance) member states and of the western IAEA member states to improve cooperation in the peaceful use of nuclear energy. Among others, the problems of transport of spent fuel irradiated in nuclear power plants to interim or final storage and the storage problems themselves were two of the items in which both sides were interested. Besides the more general interest to find safe technical solutions for the design of spent fuel shipping and storage casks, special interest for a cooperation between the former Soviet Union and the reunified Germany arose from the problem of the "Entsorgung" of the Soviet VVER type reactors constructed and operated in the former GDR.

The general basis for the Soviet-West German cooperation that started in 1988 was a contract between the Soviet State Committee of Science and Technic and the German Federal Ministry of Research and Technology. One of the items of this contract was addressed as "experience and prospective methods of spent fuel storage and transport".

A first phase of a planned long-term cooperation between the Soviet Union and the Federal Republic of Germany should include primarily an exchange of information on the state of development in both countries. This should be performed in the

form of seminars on problems to be settled between both countries represented on the Soviet side by the All-Union Scientific Research and Design Institute for Comprehensive Energy Technologies Leningrad (VNIPIET) and on the German side by the Federal Institute for Materials Research and Testing (BAM) and by the Federal Office for Radiation Protection (BfS). In addition to these institutions, German industry has participated in the cooperation from the beginning.

The more practical and possibly commercial cooperation should be started after the information phase. This second phase should include as well discussions and settlements about a common legal base for the design and the approval of spent fuel shipping casks and storage facilities as the final goal of common development activities in this field.

Up to now, the first phase can be considered as successfully finished. Two seminars were organized, one in Leningrad in 1988 and one in 1990 in Germany (Berlin, Gorleben und Essen). The seminar lectures had been accompanied by useful excursions to nuclear facilities (Leningrad nuclear power plant with RBMK reactors and wet spent fuel storage site; Gorleben interim spent fuel and radioactive waste storage; German cask manufacturing at KWU, Mülheim, and Siempelkamp, Krefeld). The start of the second phase was delayed obviously by problems which probably arose primarily from the political process now under way in the former Soviet Union.

The First Phase of Cooperation: Exchange of Technical Information

The sets of problems discussed in the presentations of the experts during the first seminar were as follows:
- regulations, technical and management requirements for spent fuel transport and storage,
- design of spent fuel transport and storage casks including safety aspects,
- German approach to radioactive waste handling,
- radiation safety for spent fuel transport in the USSR,
- investigation of thermal and mechanical cask impacts,
- experience with spent fuel storage and storage facility design,
- radiation safety during spent fuel storage.

Table 1 shows in an overall view the titles of all presentations in the frame of the first seminar.

The topics of the second seminar were the following sets of problems
- applied measures of quality assurance and compliance assurance,
- cask testing in the frame of cask qualification proof,
- handling of defective fuel assemblies,

- handling of fast breeder fuel assemblies,
- experience with storage and transport of irradiated fuel assemblies,
- new conceptions for interim and final storage of irradiated fuel assemblies.

An overall view of the titles of all presentations during the seminar is given in table 2.

The papers of the seminars translated in both languages will be published next time together with an annexed report about the BAM activities in the field of cask testing with conditions beyond the IAEA requirements.

F.R. Germany

1. The waste management concept in the Federal Republic of Germany
2. Technical and administrative requirements for transport and storage of spent fuel.
3. Safety evaluation of transport casks.
4. Safety evaluation of dry spent fuel storage casks.
5. Casks for transport and storage - compliance with safety requirements.
6. Spent fuel behaviour under dry storage and dry cask storage design.
7. Safety concept for modular cast iron casks.

USSR

1. Main regulations and procedures for transport of spent fuel in the USSR
2. Main considerations on providing nuclear safety in transport of VVER reactor spent fuel from NPP.
3. Fuel cask for transport of spent fuel from research nuclear reactors.
4. Experimental research and natural convection mechanisms in calculating thermal modes for fuel assemblies.
5. Experience in storage of spent fuel from light water reactors in the USSR.
6. Nuclear safety in storage facilities and methods of compact fuel arrangement for VVER reactors fuel.

Table 1: List of presentations during the first Soviet-German seminar

F.R. Germany

1. Measures of quality assurance and compliance assurance in connection with manufacturing and operation of shipping casks for irradiated fuel assemblies.
2. Control and measuring methods used for testing of storage and transport casks for radioactive materials.
3. Handling and storage of defective fuel assemblies in German nuclear power plants.
4. Sipping equipment for the inspection of VVER-440 fuel assemblies.
5. Procedures for the limitation of possible radioactive releases from dry shipping and storage casks loaded with irradiated fuel.
6. Storage of spent fuel assemblies from VVER reactors.
7. Experience with transport of irradiated fuel assemblies.
8. Description of the German concept of final storage casks.
9. The development status of CASTOR ductile iron transport storage and final disposal casks in the F.R.G.
10. (Special)refueling system for SUPER-PHENIX .

USSR

1. The system of quality control used in the USSR in manufacturing of transport casks for spent fuel assemblies.
2. Testing of spent fuel casks in nuclear power plants.
3. Procedures and equipment for handling of defective fuel assemblies in nuclear power plants.
4. Experience with storage of spent fuel assemblies in the Leningrad nuclear power plant.
5. Experience with transport of spent VVER fuel assemblies.
6. Transport and storage of unirradiated and spent fast breeder fuel assemblies.

Table 2: List of presentations during the second Soviet-German Seminar

The second phase of cooperation: Common projects

The preparation of the third meeting ist now under way, a preliminary agenda has already been agreed upon. The objective of this meeting with participation of representatives of Russian and German Competent Authorities for testing and approval of transport and storage casks and of the Russian and German industry should be a discussion about possible common future projects. The cooperation shall include not only activities in the field of mechanical and thermal testing of casks but also the agreement of common points of views concerning design and safety aspects of casks and possibly common projects of cask

development. In this context, concepts for a transport cask for spent VVER-440 fuel assemblies shall be discussed with the participants of the Russian and German industry in the light of the necessary "Entsorgung" of the East-German nuclear power plants.

Generally, the basic design and safety principles for transport and storage casks are similar in both countries. The national Russian and German regulations used, e.g., for the transport of radioactive material, are based in both countries on the "IAEA Regulations for the safe transport of radioactive material" (Safety Series No. 6). However, the transport casks used today in Russia and Germany are different in some details. Fig. 1, 2 and 3 illustrate this by the shipping casks for which application for the transport of spent German PWR fuel assemblies and spent Russian VVER fuel assemblies has been made. The differences concern, among others, the design of the containment system, the principle of neutron shielding and the use of impact limiters. A detailed discussion of the background of the realized concepts for transport and storage casks is one of the first objectives of the cooperation in order for each participant to understand the position of the other side. Moreover, it is necessary to get to know the experimental and theoretical methods used in both countries for design calculations and for performing the safety proofs necessary to meet, for example, the IAEA requirements for shipping casks.

Acknowledgements

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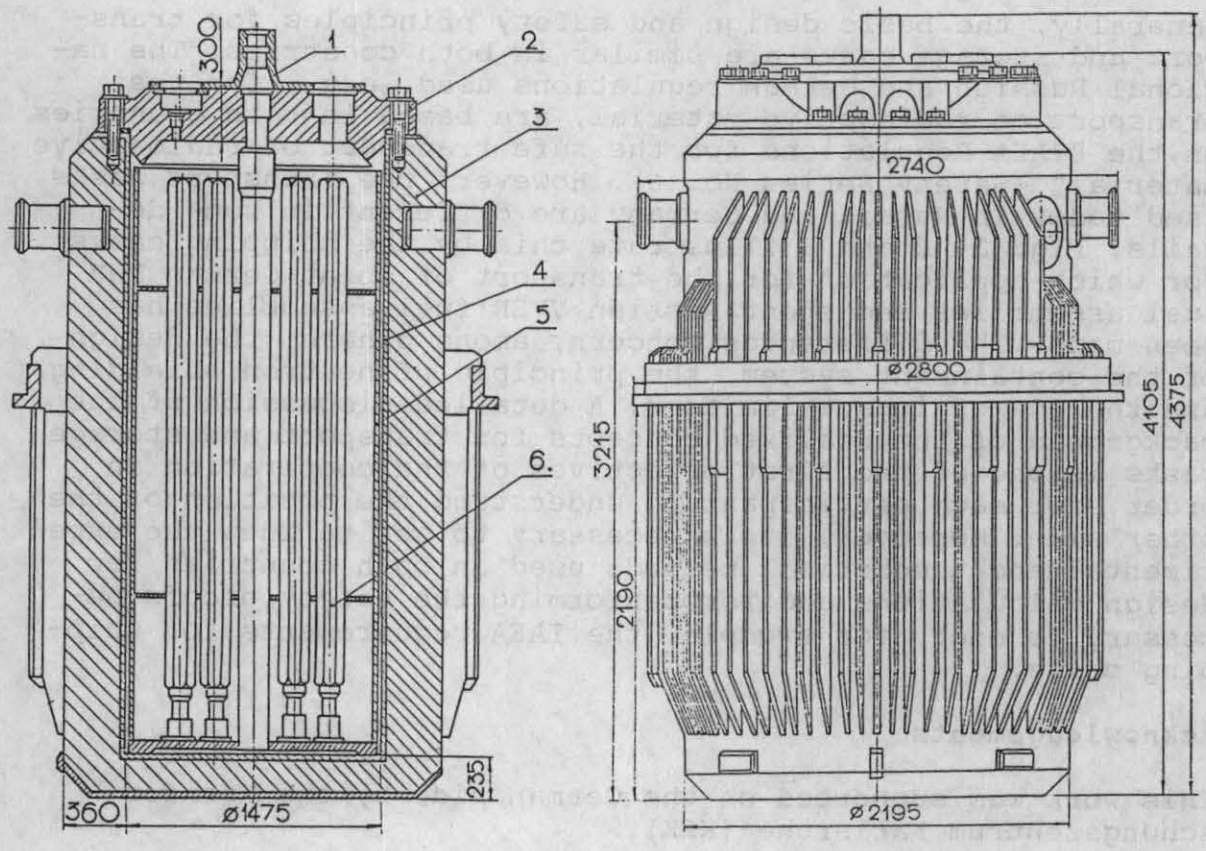

Fig. 1: Shipping cask TK-6 (VVER-440 fuel assemblies)
1 - plug, 2 - lid, 3 - cask, 4 - liner, 5 - basket, 6 - fuel assembly

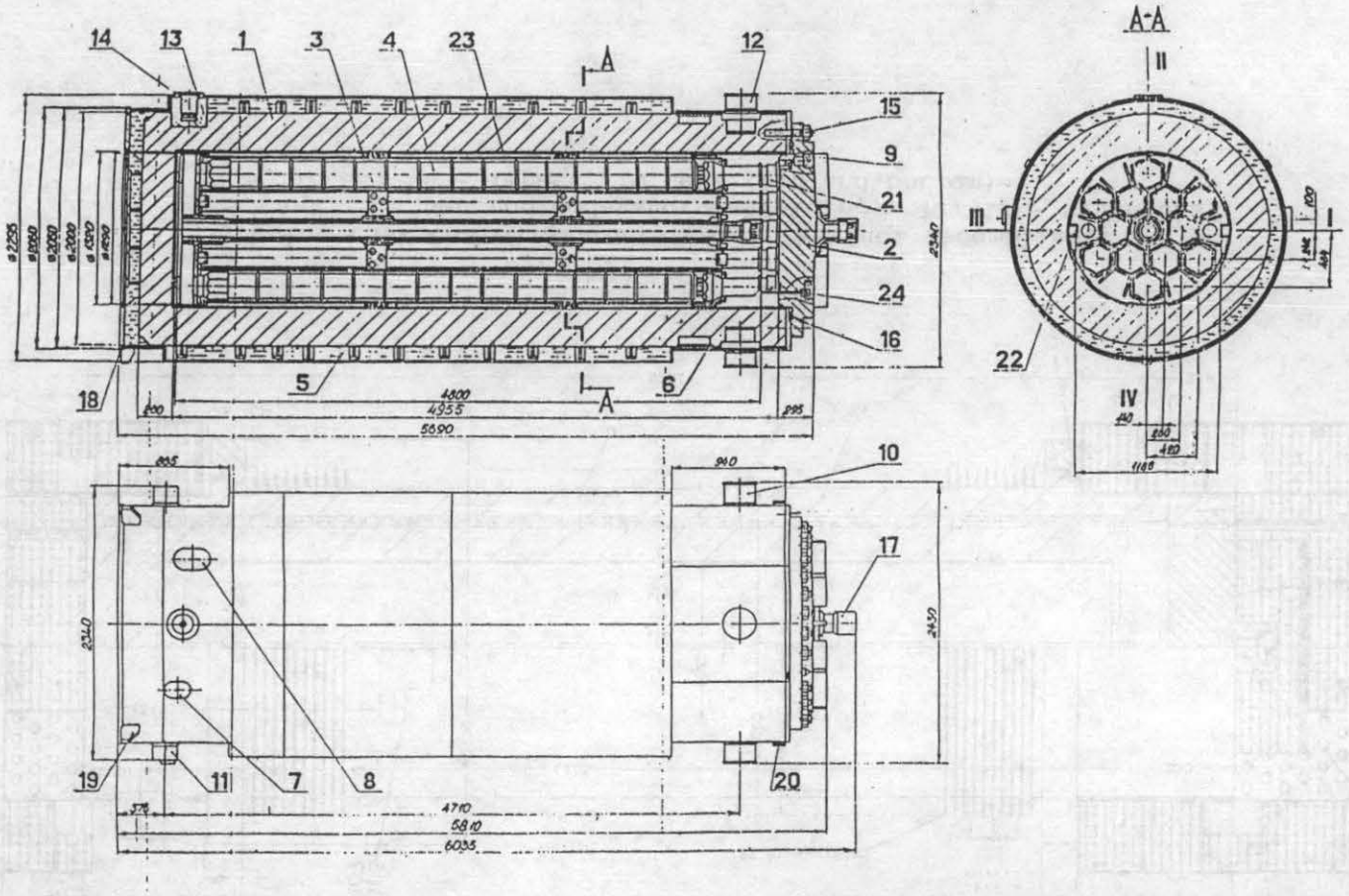

Fig. 2: Transport cask TK-13
(VVER-1000 fuel assemblies)
1 - cask, 2 - lid, 3 - box, 4 - fuel assembly, 5 - neutron shielding, 10 - trunnion for crane transport, 11 - trunnion for attaching and erection, 16 - lid seal

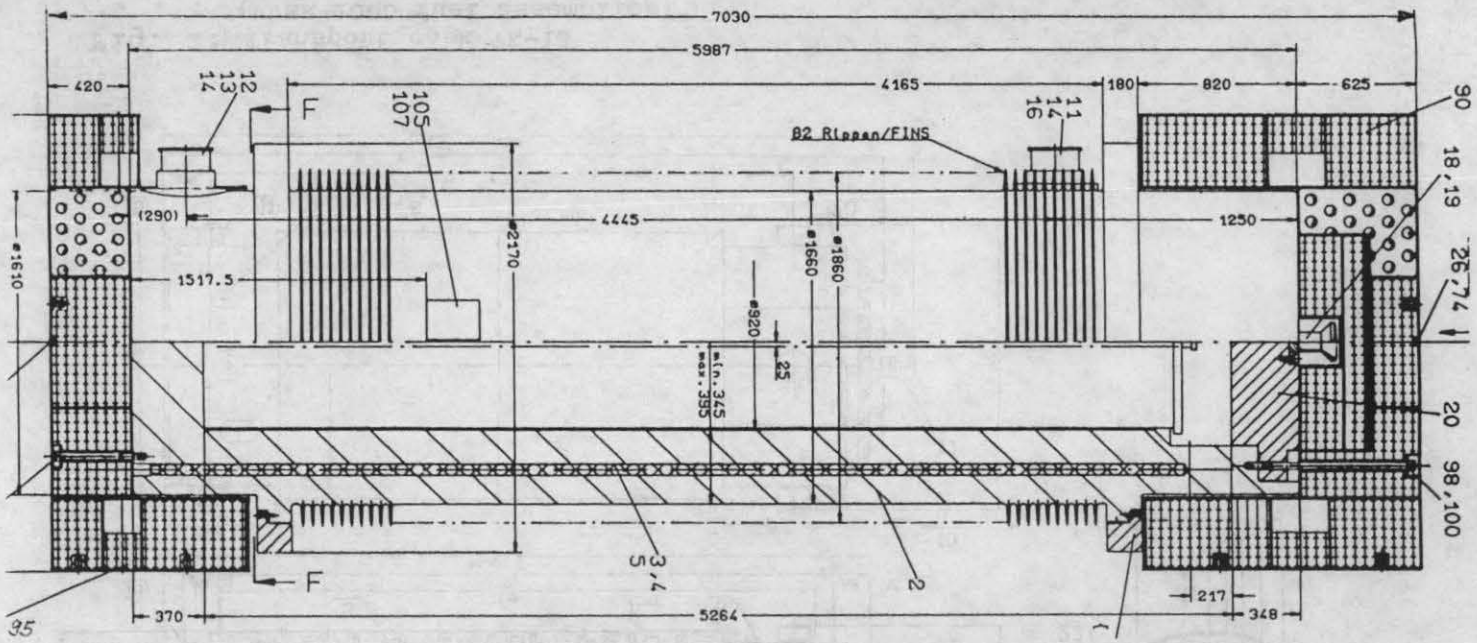

Fig. 3: Shipping cask CASTOR S1 (Unterweser PWR fuel assemblies); 2 - cask; 3 - neutron moderator (shielding), 11, 12 - trunnions, 20 - lid 90; 95 - impact limiters (lid and bottom)

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