ASSESSMENT OF IRRADIATED NUCLEAR FUEL TRANSPORT IN THE COMMONWEALTH OF INDEPENDENT STATES (CIS)

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SUMMARY

Irradiated nuclear fuels (INFs) are transported regularly in and between the New Independent States (NIS). Under the TACIS Programme (Technical Assistance to the Commonwealth of Independent States), the European Commission has funded this project devoted to the assessment of transports of INF in Russia, Kazakhstan and Ukraine in collaboration with local State Organizations, competent Authorities, nuclear facilities and transport companies.
This paper will present the development of this project during the two years of its implementation as well as its main results.

PROJECT OBJECTIVES

The overall objective of the project is to assess the current performance of the transportation of irradiated nuclear fuel (INF) in the New Independent States (NIS) and to compare the present situation with international standards: International Atomic Energy Agency (IAEA) recommendations and western practices. The aspects covered include the design, fabrication and maintenance of packagings, the preparation, consigning, handling, carriage, storage in transit and receipt at the final destination as well as quality control and quality assurance.
The specific objective is to provide the project partners with the contractor's expertise in the safety, technological and managerial aspects of INF transportation in and outside the different Nuclear Power Plants (NPP), storage and reprocessing facilities.

PROJECT ACTIVITIES

The project activities commenced in September 1995 have been completed in December 1997 with the presentation of the final report. Under the leadership of Transnucléaire, a team of European specialists from the U.K., Belgium, Germany and France has been set up to provide their professional experience and expertise for the completion of this complex project.
The European team has worked in close co-operation with experts of counterparts located in each recipient country. In Russia, Techsnabexport Co Ltd (TENEX) of the Ministry of Atomic

Energy, was associated to the Institute « VNIIGH » of the Ministry of Railways. In Ukraine, the Ukrainian Scientific Research and Design Institute for Industrial Technology (UkrNIPIPT) was associated to this project. In Kazakhstan the Kazakh Fund of Nuclear and Radiation Safety (under the Kazakh Atomic Agency) was assigned as project partner.

The assessment and analysis performed were based on technical information and translated documentation or regulations and procedures given by local counterparts in each NIS and on technical visits and meetings held at nuclear sites.

WORK PROGRAMME

According to the detailed objectives outlined in the terms of reference and the work programme contained in the inception report, four phases of project activities have been identified and implemented.

Phase 0: Organization of the Project

During phase O, which lasted longer than initially planned, the following activities were conducted:

- identification of the institutions and installation of co-ordinating groups
- identification of the local technical experts
- definition of responsibilities and obligations of the beneficiaries (or project partners) and the counterpart organisations (including contractual aspects)
- distribution of questionnaires for collecting information concerning handling and transportation of INF in the NIS
- setting-up an overall work plan for the project including site visits
- preliminary meetings in Russia, Ukraine and Kazakhstan.

Phase I: Analysis of the present situation

Phase I comprised the following activities or tasks :

- analysis of the existing national transport regulations and requirements within the three NIS countries
- global analysis of the packages : cask design, test results, conditioning practices
- analysis of the handling procedures and equipment
- analysis of the transport means, related equipment and selection of transport modes
- analysis of the quality assurance plan used by the operators
- technical meetings in Russia, Ukraine and Kazakhstan with the view to attend handling and transport operation
- analysis of the emergency requirement and emergency response planning
- general survey covering organizational and managerial aspects of transport organization.

The nuclear sites visited by West European experts are :
Aktau BN-350, Kazakhstan ; South Ukraine VVER-1000 and Rovno VVER-440 and VVER-1000, Ukraine; Novovoronezh VVER-440 and VVER-1000, Russia.
The RT-2 INF storage facility in Krasnoyarsk, Russia has also been visited.

Phase II: Elaboration of recommendations

The following activities were carried out in phase II :

- draft proposals for harmonization of the existing regulations within the NIS with IAEA standards
- draft proposals and recommendations based on uses in Western Europe to improve and modify existing transport practices
- discussions of proposals for harmonization with competent authorities and responsible institutes and transport organizations

During this phase visits of NIS specialists (project partners, counterparts in Russia, Ukraine and Kazakhstan) took place to show how the transportation of INF is carried out and managed in the EU and especially in France.
The following sites have been visited: EDF NPP (Nuclear Power plants): Gravelines (900 MW) and Flamanville (1300 MW), COGEMA reprocessing plant in La Hague, road-rail terminal in Valognes, port terminal of Cherbourg, road transportation company : Lemaréchal. The site visits were complemented by lectures and working sessions on all the transport aspects provided by representatives of the French Competent Authority, West European specialists, consultants and Transnucléaire executives.

Phase III: Implementation plan

The technical meetings held in Kiev, Moscow and Almaty and the subsequent discussions with the NIS specialists, lead to elaborate time schedule, budget estimates and follow-up measures for the implementation plan of the proposals and recommendations.

OVERALL REPORT ON THE GLOBAL PROJECT

During phases I and II, a systematic evaluation of the present situation with regard to existing standards and European practices has been performed, in the three NIS countries and for each task. Areas for improvement were pointed out and subject to an in-depth analysis. We summarise hereafter the results of our analysis.

Task 1: Global transport plan or present transport situation in the NIS

As of today, there are 29 reactors operated in Russia, 14 in Ukraine and 1 in Kazakhstan.
The purpose of this task aims at giving a general description of the existing transports of spent fuel within the three NIS countries involved in this project. Its goal is to provide a comprehensive overview of the current situation in these three countries while giving some elements which could enable to identify some trends for the near future.
Spent fuel (SF) transportation started in 1974, on a regular basis from Russian and Ukrainian Nuclear Power plants (NPP). The number of shipments has steadily increased to reach a peak in the 80s. The collapse of the Soviet Union in the early 90s has marked the decline of the activity.

RMBK spent fuels are not reprocessed and consequently stored for the time being at the NPP in Russia and Ukraine.

Both VVER-440 and VVER-1000 INF are transported within Russia, in transit in Ukraine and between these two countries. Although both the VVER-440 and 1000 INF offer the same interest for reprocessing, only the VVER-440 INF are sent for reprocessing to the RT-1 (Mayak) facility in Chelyabinsk. It is also the case for fuel from Rovno, the only VVER-440 NPP in Ukraine.
The VVER-1000 INF was initially due to be reprocessed at a new plant located in Krasnoyarsk,Russia and called RT-2. This ambitious project started in 1986 was never achieved and the only unit currently in service is the storage pool with a capacity of 6000 t.
There is no more spent fuel shipment from the BN 350 reactor currently in operation in Aktau (Kazakhstan). Until 1991 INF from this reactor was sent on a regular basis to the RT-1 reprocessing plant in Mayak, but it is now kept on the NPP site.

Mayak enterprise plays a significant role in the spent fuel transportation in Ukraine and Russia as well as between these countries, being the owner of the wagons and casks used for the corresponding transportation. The same situation is observed with Krasnoyarsk taking the responsibility of the transport between its customers facilities and providing wagons and casks.

At this stage it was important to note that the Russian Regulations establish a share of responsibilities between the three main actors:: the nuclear power plant, the reprocessing or storage plants (Mayak and Krasnoyarsk) and the railway authorities since all the INFs are transported by rail.

Task 2: Package

The analysis of the packages with respect to the IAEA requirements is based on the review of package design approval certificates, attendance to cask unloading operation, discussion with NPP personnel. The safety reports have not been accessible to the contractor due to its confidential character, and some statements based on visual observations and oral information could be mitigated by the review of the safety documentation.

Conformity of Russian Regulations (BRSP 83) with IAEA 1985 for B(U)F and B(M)F packages
As far as transport of spent fuel in B(U)F packages is concerned, it can be seen that both regulations are equivalent and that a package complying with Russian regulations could in principle be approved in western countries. However, since the safety of the transport only relies on the package for the two regulations, the contribution of the wagon to the safety as described in some Russian certificates of approval (forced cooling or heating) is not acceptable for a B(U) F package and not advisable for a B(M) F package.

Comparison between Russian and western European certificates of approval
Instructions concerning tests before shipment, maintenance and retesting , as well as quality assurance applied to design, test and fabrication are missing in the certificate of approval.

Demonstration of performances of the package
The demonstration of compliance of performances required by the IAEA Regulations, in normal and accident conditions of transport and more generally the documentation supporting the application for approval is based on independent notes (presentation, justification,

calculation) listed in each certificate of approval. All the technical notes which currently exist should be gathered in a comprehensive safety analysis report in conformity with the international practices.
We also noted that the demonstration of compliance with the performance standards was made mainly by calculations rather than by performance of tests with model. Although this is acceptable according to the regulations, it requires detailed qualification of the calculation tools which may be difficult for all the regulatory tests.

Improvements were suggested in the following fields:
- physical and administrative changes to be applied to the current casks (TK6, TK 10, TK13) which would improve safety,
- establishment of a standard certificate of approval including all the regulatory points with the proposition of a standard format,
- preparation of a guideline for design and licensing of a package (including preparation of safety report and application to competent authority).

Task 3: Fuel handling/cask loading/transport

Fuel handling which includes fuel acceptance, fuel integrity checking, fuel identification, fuel compliance with the package design approval, loading into cask and cask preparation to transport appears to be well managed and complete with respect to western practices, with a few exceptions identified below:
- TK6 loading in non standard VVER 440 type reactor: improve safety of fuel transfer in cylinder from cooling pool to cask,
- TK6/TK11 loading in Aktau BN 350: improve safety of operation in order to avoid possible transfer of contamination and potential worker irradiation,
- lifting: in addition to yearly inspection of lifting equipment, documented visual inspection should be carried out upon each transport.

We also propose to complete the numerous individual and isolated technical and operational instructions for each of the activities by a formal paper organization, like an operational procedure starting with a detailed quality plan or check-list referring every sequence to a technical document and to a date and signed record.

Task 4: Radioprotection

We noted several differences with respect to IAEA or western practices on the following points:
- contamination measurements reported in transport file in beta particle/mn/cm2 and not in Bq/cm2,
- contamination results given for beta emitters and not for beta/gamma emitters,
- no alpha contamination measurement recorded,

In this field, there is a need to prepare a radioprotection programme as well as a quality plan to identify each sequence of a given transport with an applicable procedure listing when contamination and or dose rate measurements have to be performed and documented, including the name of the responsible agent and his signature.

Task 5: Quality assurance

According to the safety standards, organizations involved in the transport of radioactive materials are advised to develop and maintain adequate quality assurance programme to ensure compliance with the regulations and demonstrate this compliance to the competent authority.
The quality assurance implemented at the NPP and at the railway organization is based on technical procedures covering all operations of preparation for loading and of shipment. It appears that the general quality assurance programme developed at Mayak RT-1 facility is a proper approach of a quality assurance system.
A full quality assurance system has to be set up in each organization by the creation of an independent quality assurance department and by drawing up of a written quality assurance manual describing mainly the organisational structure, the responsibilities, the procedures implemented, the processes and the resources. Details about the qualified (ISO 9001) quality system developed by Transnucléaire have been presented and explained to our NIS partners.

Task 6: Organisation, management and training

Application of national regulations, method and organization of transport look complete as covering all aspects of INF shipment under safety requirements.
The lack of formal paper organization like a specific transport procedure prepared and implemented by each party participating to any spent fuel shipment, covering all the activities, is the main observation made with respect to IAEA standards.

Task 7: Assessment of the emergency requirements

The NIS have regulated, defined and implemented emergency response planning in a way similar to the guidance recommended in the IAEA, except for Kazakhstan where only a few information has been collected, but where the last shipment took place in 1991.
We pointed out that the emergency response planning mostly relies on the consignee: Mayak and Krasnoyarsk. However in Russia, since the Government order n° 761 of June 20, 1997, a NPP like Novovoronezh became directly involved in emergency response as one of the five regional emergency teams created by Minatom. In Ukraine and Kazakhstan also, NPPs are given more responsibilities.
It was therefore recommended for the CIS countries that a formal paper organisation based on detailed written procedures be prepared and implemented by the consignor, the consignee and the carrier in agreement with the local and national authorities. The procedure should cover all actions before and after a transport accident. There also seems to be a need to intensify training and emergency response activities as it is done in western Europe.

PROPOSALS AND GENERAL RECOMMENDATIONS

Summarising the activities and results achieved in the course of the project, and based on the assessment of the present situation, several objectives, proposals and recommendations for future activities in the partner countries have been defined to improve the situation of INF transportation:

Regulations
The national regulations of the partner countries in the NIS are still mainly based on the regulations of the former Soviet Union. It was recommended to introduce in each country a national regulation based on the latest international regulations:

- IAEA Safety series n°6, replaced by ST-1 in the 1996 edition,
- International regulations concerning the Carriage of Dangerous goods by rail: RID.

Packaging
A detailed feasibility study must be conducted for each type of packaging, to evaluate and justify from an industrial, safety and economic point of view the interest of the modification of the existing casks or the need to design a new family of casks.

Fuel handling and preparation for shipment
The design and the manufacture of a new transfer cylinder seems necessary in some NPPs. A preliminary feasibility study should be conducted to identify sites and needs, make an assessment of the risks, evaluate alternative solution and estimate the costs.
For defective BN 350 fuel assemblies the design and the manufacture of transport capsules is also proposed.
Regarding inspection and test after loading, the present situation should be improved with the preparation of some specific inspection procedures, the design and the supply of equipment necessary for their implementation

Quality assurance
Any organization and body involved in the INF transportation should develop and implement a quality assurance system as soon as possible including also systematic controls and inspections. It must be aimed at providing adequate confidence that the standard of safety prescribed in the regulations is achieved in practice.
Organization, technical and operating procedures have to be prepared covering every transportation phase (cask loading/unloading, preparation of transport, periodic inspection plan and maintenance of wagons and casks, radioprotection program, transport operations, etc).
Seminars should be organised with the participation of EU specialists to explain and train NIS specialists belonging to NPPs, transport companies, storage and reprocessing facilities to every aspects of quality assurance.

Emergency response
Different stages of improvement plans have been identified: determination of potential hazards on casks, wagons and routes, identification of human resources and organizations, identification of responsibilities and interfaces, drafting and checking of an overall plan of emergency response, establishing a co-ordinating centre for alerts, training and exercises.

Transport management
Throughout this project work, it became obvious that there is a need for more communication between institutions and specialists from the three partner countries. It is recommended to improve the co-operation by means of regular contacts and by meetings of NIS specialists, through for instance a standing working group, etc. The present project was a first step in this direction and should be pursued in the future.

More NIS specialists should be given the opportunity to improve their knowledge by site visits in western Europe in combination with seminars in the partner countries. Visits to the relevant nuclear facilities in western Europe and in the NIS should be carried out on a routine basis including an active participation of the fuel cycle industry representatives.

Based on the present situation of relations between the public and the nuclear industry in western countries it is also recommended to the NIS industry and competent authorities involved in INF transport to review their approach to public relations. It is essential to encourage the public to acknowledge that the transport of nuclear fuel is being carried out safely.

IMPLEMENTATION OF PROPOSALS AND RECOMMENDATIONS

In co-operation with the NIS specialists, the EU experts have drafted proposals and recommendations for the measures and actions required to improve the present situation of spent fuel transportation in the three NIS or to bring it in compliance with the western practices.
Recommendations for the implementation of the measures with regard to the required administrative structure, personnel requirements, time schedule and budget have been outlined. The total budget for all the actions we have identified is equivalent to 1500 man-days CIS senior experts, 280 man-days senior EU experts and about 400 man-days junior CIS experts.
The implementation process and the follow-up of actions need to be organized and monitored by the responsible ministries in each partner countries in close co-operation with all the actors involved in transportation activities under the supervision of an « administrative and technical committee ».

CONCLUSION

In the course of this project an atmosphere of confidence and good working relationship have been established between NIS specialists and EU consultants. For a successful implementation of the recommendations given in the final report the relationship must be continued with all three partner countries. No major time gap should exist between the completion of the final report and the implementation of the proposed measures.
The continuous co-operation with our NIS partners should be strengthened by the development of common projects in this field with the financial support of the EU. Several subjects of interest have been identified and should be pursued. The industry is willing to co-operate actively.

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SESSION 3.4

Criticality