Role of Slovakia within the IAEA Decommissioning Related Activities – 9031

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ABSTRACT

Slovakia has a long-term experience with the IAEA decommissioning related activities as a recipient of Agency assistance and then as a country offering assistance to others. Background, short "history" and current status of Slovakian national technical cooperation (TC) projects SLR/4/008 "Robotic Technologies for Decontamination and Decommissioning of the Bohunice A1 NPP" and SLR/3/002 "Management of Radioactive Waste from the A1 Nuclear Power Plant Decommissioning" will be described in paper. The first TC project SLR/4/008 was solved by the main Slovakian counterpart, company VUJE, Inc., from 2001 to 2006. Second TC project SLR/3/002 is ongoing with extension to 2011.

Thanks to the implementation of a long-term large-scale "Project of the A1 NPP Decommissioning – Stage I" (1996-2007), financed by Slovak National Nuclear Account (decommissioning fund), as well as implementation of the IAEA TC national projects a comprehensive know-how in the field of D&D and RAW management was obtained. Moreover, technologies and facilities necessary for implementation of decommissioning and RAW management projects were developed. Thanks to this development Slovakia offers donor assistance to other countries in subjected fields through IAEA TC program. The type and scope of assistance for Armenia, Bulgaria, Egypt, Latvia, Lithuania and The Ukraine is described in the paper.

The above-mentioned national projects are not only activities of Slovakia within the IAEA TC program. Regional TC project RER/3/005 "Support in Planning the Decommissioning of Nuclear Power Plants and Research Reactors" has been ongoing from 2007 with accepted extension to 2011. About nine countries from Eastern and Central Europe participate in the project (for the NPPs part) and Slovakia plays the role of LCC (Leading Country Coordinator). On the basis of suggestion of Nuclear Regulatory Authority of the Slovak Republic, VUJE is the coordinator of the regional project. Moreover, Slovakia would be the recipient of services as well as the provider of expert's support. The paper explains that this RER project represents an important part of International Decommissioning Network, which was established by the IAEA to bring together existing decommissioning initiatives both inside and outside the IAEA to enhance cooperation and coordination. Slovakia is a member of the IDN Steering committee and besides the overall planning of network activities proposes also hosting of several IDN events in the near future.

Lessons learned by Slovakia, as the IAEA member country "in transition", will be summarized in conclusion. Slovakia is a good example of a small country with a relatively comprehensive decommissioning program that was able to utilize effectively the Agency TC support, in combination with its own activities, for increasing of skills of personnel and improvement of technical equipment. The country was/is the recipient of the IAEA assistance but is also able to offer and implement donor assistance to other countries. More significant involvement in the International Decommissioning Network activities will be proposed during the next IAEA planning period (2009-2011).

INTRODUCTION

Nuclear power plant A1 (Fig. 1) decommissioning activities and namely Project of the A1 NPP Decommissioning – Stage I, represents national background for two technical cooperation (TC) national projects between Slovakia and the IAEA:

- Technical cooperation project SLR/4/008 “Remotely Operated and Robotic Technologies for Decontamination and Decommissioning of A1 NPP” (2001-2006)
- and consequent Technical cooperation project SLR/3/002 “Management of Historical RAW from the A1 NPP Decommissioning” (from 2007).

The first pilot nuclear power plant A1 in the former Czechoslovakia was built in the locality Jaslovske Bohunice near Trnava. NPP with the capacity of 143 MWel, was commissioned in 1972 and was running with interruptions till 1977. A KS-150 reactor with natural uranium as fuel, D2O as moderator and gaseous CO2 as coolant was installed in the plant. The outlet steam from the primary reactor coolant system was led to six modules of steam generators and from there to turbine generators. Refueling was carried out on-line at plant full power.

The first serious accident associated with refueling occurred in 1976, when a locking mechanism at a fuel assembly failed. The core was not damaged during that accident and after a reconstruction of the damaged technology channel, the plant continued in operation.

The second serious accident (level 4 according to the International Nuclear Event Scale) occurred in 1977, when a fuel assembly was overheated with a subsequent release of D_2O into the gas cooling circuit due to a human failure in the course of replacement of a fuel assembly. Subsequent rapid increase in humidity of the primary system resulted in damages of fuel elements in the core and the primary system was contaminated by fission products. In-reactor structures had been damaged, too. Activity penetrated

also into certain parts of the secondary system via leaking through steam generators. Radiation situation in the course of both events on the plant site and around it was below the level of limits specified.

Based on a technical and economical justification of the demanding character of equipment repairs for the restoration of plant operation, and also due to a decision made not to continue with further construction of gas cooled reactors in Czechoslovakia, a decision was made in 1977 to terminate plant operation. The decision on the A1 plant decommissioning was issued in 1979.

With regard to the fact that the transport of spent fuel was not resolved in the course of plant operation, all the fuel was stored in a spent fuel pool on the plant site. Even during plant operation it was found that the designed and implemented method for storing the spent fuel assemblies from A1 operation resulted in the corrosion of fuel elements associated with the release of fission products into the coolant in long-term spent fuel storage and deformation of their geometry. Following the accident in 1977 the problem became more complicated by the fact that other fuel with damaged cladding was stored in the spent fuel pool.

These conditions became an extremely complex matter requiring a gradual searching, verification and application of new technology procedures and technical tools for decontamination of materials, surfaces and components, their separation, disassembly, withdrawal and transport of the damaged spent fuel from the plant.

In the period following 1981, disassembly of technology equipment from the secondary system (process equipment in the machine hall, turbines with auxiliaries, feed water tanks, diesel generator station, pumps, cooling towers, electric equipment) was carried out. At the same time disassembly was going on other systems – turbine generators with auxiliaries, gas systems, oil systems and other equipment and systems in the main production building and in nearby buildings.

The areas following the disassembly were cleaned, decontaminated and prepared for the assembly of new technologies related to the subsequent phase of the plant decommissioning. Due to extensive decontamination works after the plant accident, the storage tanks of liquid radioactive concentrates have been filled up to 95% and no other storage volumes were available. A decisive action was the implementation of the Bohunice Complex for Radwaste Treatment and Conditioning and the completion of the National RAW Disposal facility, which covers the capacities needed also for other nuclear power plants in operation in the Slovak Republic. The main result of the solution of research and development projects was that the new technologies for RAW processing by means of bitumination, cementation, incineration and vitrification, including the construction of experimental and semi-operational facilities used up to now, were developed and mastered.

Management of damaged spent fuel assemblies was main project task from 1996 to 1999. Out of the total amount of 572 fuel assemblies, 440 fuel assemblies were withdrawn and transported into the Russian Federation in the period 1983-1990. For the treatment and removal of the rest of spent fuel, it was necessary to develop and produce special technology equipment by means of which the fuel was withdrawn from the long-term storage facility and transported in special containers into the Russian Federation. This phase proceeded in the period 1996-1999.

By removing fuel from the plant, conditions were established for the implementation of the following phase of the A1 decommissioning up to 2007/2008 “Project of the A1 NPP Decommissioning – Stage I” with main project fields / groups of tasks as follows:

- Protection of Environment
- Main Generation Building
- RAW Treatment and Conditioning
- Technical Support

The above-mentioned Project [1] was/is financed by Slovak National Nuclear Account (decommissioning fund). TC national projects described below are financed through the IAEA technical cooperation program.

TECHNICAL COOPERATION PROJECT SLR/4/008 "REMOTELY OPERATED AND ROBOTIC TECHNOLOGIES FOR DECONTAMINATION AND DECOMMISSIONING OF A1 NPP"

TC national project SLR/4/008 [2] was approved for 2001/2002 periods and its duration was extended up to 2006. The project with overall budget of 800 kUSD was used as additional technical support for the A1 NPP Decommissioning Project. Main goals of the project were as follows:

- To upgrade national capability with specific state-of-the-art technologies for decontamination and decommissioning
- To develop, test, adapt and apply CA robotic, remote handling and viewing systems for D&D of the Bohunice A1 NPP
- To perform CA simulations, 3D acquisitions and 3D modeling
- To reduce personnel radiation exposure and environmental impact during D&D work thanks to the better preparation of work procedures, CA simulations, acquisition of as-built data, creation of as-built models of equipment, etc.

VUJE, as the main counterpart, and SE VYZ (now it is JAVYS, Inc. – Nuclear and Decommissioning Company) had some key technologies (3D laser scanner SOISIC, CAD software, gamma camera Aladin1 etc.) as well as a special department with qualified personnel (basic training) from 2000. Nevertheless, improvement of technology and skills of personnel including creation of chain for acquiring and processing of geometrical and radiological data was necessary (see Figure 2). It was done mainly on the basis of technical cooperation with EDF (Electricité de France), CEA (France) and SCK.CEN (Belgium) with permanent support of the IAEA.

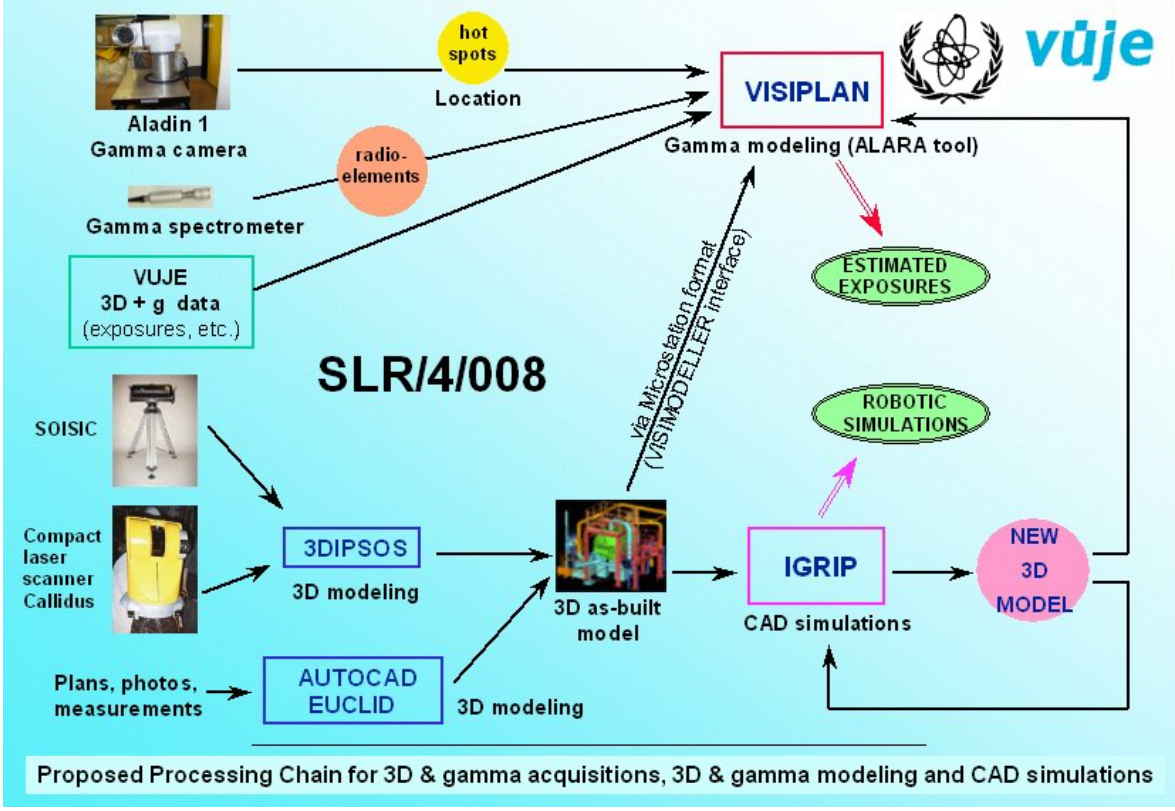

Figure 2. TC project SLR/4/008 overall layout

Brief summary of achievements of TC national project SLR/4/008 from 2001 to 2006 is as follows:

- Delivery of software system IGRIP (Interactive Graphics Robotic Instruction Program) used for advanced simulation and programming of robots and remote handling manipulators (hardware was also delivered and on-site training of personnel was organized)
- Laser scanner Callidus was supplied including modeling software 3Dipsos, training of personnel and support of common “scanning” mission with EDF
- Delivery of software Cyclone CloudWorx, that allows transfer of laser scanners cloud of points to CAD system
- Support of improvement of A1 NPP old gamma camera Aladin1 and corresponding software
- Delivery of ALARA 3D planning and modeling tool VISIPLAN developed by SCK.CEN. Software VISIMODELLER for transfer of complex 3D models (as-built 3D laser scanned models) from CAD software Microstation directly to VISIPLAN and training of personnel were also delivered and organized
- Supply of a gamma spectrometry system Canberra, High Performance Liquid Chromatography system for the A-1 NPP radioactive waste characterization and supply of the other equipment (e.g. sensors, dose ratemeter)
- Organization of expert missions to Slovakia; support of participation of Slovak experts at the international D&D conferences, training courses and scientific visits
- Support of preparation of a Feasibility Study for Regional Decommissioning Training Center in Eastern & Central Europe
- Support of organization of „National Workshop for Decommissioning Training Center“ (11/2004), WS „Broadening the basic technologies of nuclear dismantling / regional activity within CEEC“ (6/2005) and VISIPLAN workshops (10/2004, 10/2006).

TECHNICAL COOPERATION PROJECT SLR/3/002 "MANAGEMENT OF HISTORICAL RAW FROM THE A1 NPP DECOMMISSIONING"

TC national project SLR/3/002 "Management of Historical RAW from the A1 NPP Decommissioning" with budget about 300 kUSD was approved for 2007-2008 cycle. The main goal of the project is to implement state-of-the-art methodology, programs and equipment for treatment, conditioning and disposal of non-standard and historical radioactive waste (e.g. contaminated soil, contaminated concrete, residual sludges) from the A1 NPP decommissioning process. To train qualified personnel to improve safety in fields related to the project is also part of the TC project.

Phase II of the A1 NPP decommissioning project will start in 2008/2009 and the management of historical RAW will be still important part of the D&D and RAW activities. This is one of the reasons, why extension of TC national project SLR/3/002 for 2009-2011 cycle was proposed by VUJE and accepted by the IAEA.

Interactions between the A1 NPP decommissioning activities and TC national projects SLR/4/008 and SLR3/002 are shown on Figure 3.

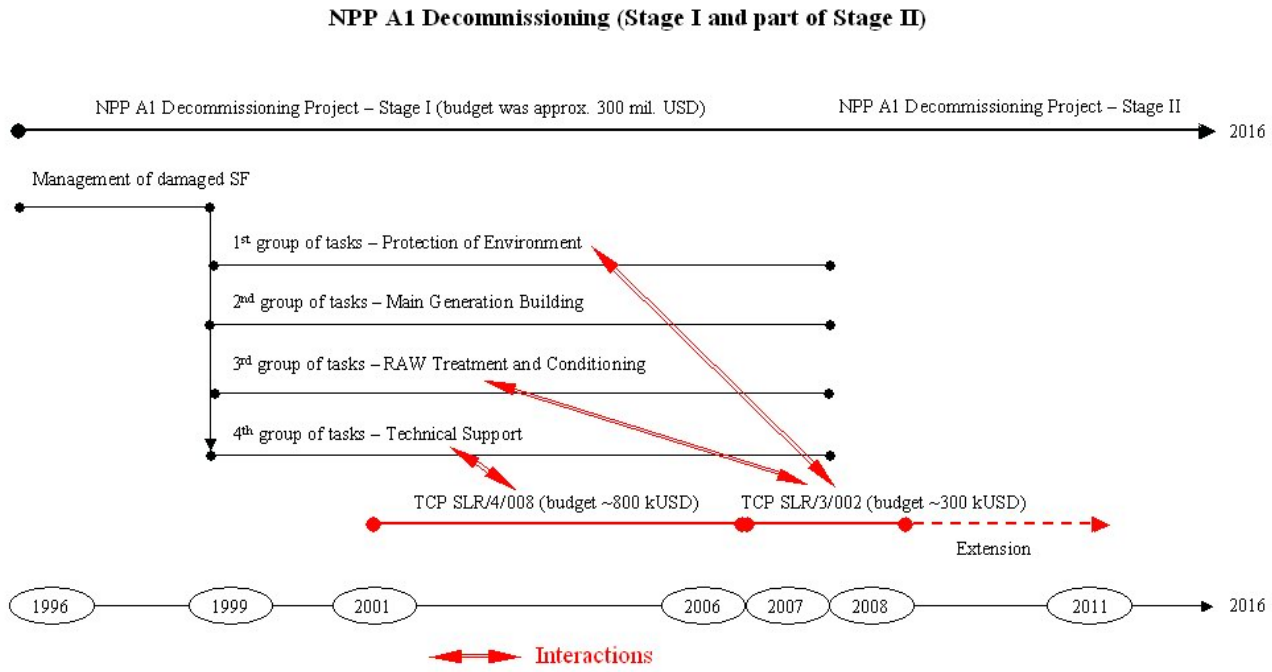

Fig. 3. Interactions between the A1 NPP decommissioning activities and TC national projects SLR/4/008 and SLR3/002

INVOLVEMENT OF SLOVAKIA IN TC PROGRAM FOR OTHER COUNTRIES

Thanks to its own development Slovakia can offer donor assistance to other countries in D&D activities through IAEA TC program. Types of assistance are mainly visits (scientific visits or "technical" visits as national consultants) of national specialists to Slovakia, expert missions of Slovak experts to country or delivery of technology (e.g. for RAW treatment). Assistance to following countries was provided:

- Armenia (several expert missions, several visits to Slovakia)
- Bulgaria (hosting of specialists for technical visits and discussions)
- Egypt (scientific visits to Slovakia)
- Latvia (several expert missions, several visits, delivery of technology)
- Lithuania (several visits to Slovakia)
- The Ukraine (several expert missions, several visits to Slovakia)
- Russia (expert mission)

The scope of assistance was/is very wide from organizational matters of decommissioning through practical experience from on-going activities to RAW management including disposal. Standard part of the visits is also showing of VUJE's and JAVYS's D&D and RAW management technical facilities including Bohunice RAW Treatment Complex and National RAW Disposal Facility in Mochovce.

REGIONAL TC PROJECT RER/3/005 AND IDN ACTIVITIES

The above-mentioned national projects are not only activities of Slovakia within the IAEA TC program. Involvement in the IAEA regional projects is another important area of cooperation. From this point of view the most significant is regional TC project RER/3/005 "Support in Planning the Decommissioning

of Nuclear Power Plants and Research Reactors", which has been ongoing from 2007 with accepted extension to 2011.

The main goals of this regional project are to assist Member States in developing adequate strategies and plans for decommissioning of nuclear power plants and research reactors consistent with IAEA recommendations, to facilitate the exchange of information, experience and lessons learned among Member States in the region and to increase the competence of experts involved in decommissioning these facilities. About nine countries from Eastern and Central Europe participate in the project (for the NPPs part, SR has not research reactor) and Slovakia plays the role of LCC (Leading Country Coordinator) within this part of the project. On the basis of suggestion of Nuclear Regulatory Authority of the Slovak Republic, VUJE is the coordinator of this regional project. Moreover, Slovakia would be the recipient of services as well as the provider of expert's support.

Regional project RER/3/005 represents an important part of International Decommissioning Network (IDN), which was established by the IAEA to bring together existing decommissioning initiatives both inside and outside the IAEA to enhance cooperation and coordination (see IAEA web site – goto.iaea.org/decommissioning). The IDN is expected to provide:

- Opportunities to support participating nuclear facilities or Member States, particularly those with less developed decommissioning industries, by providing access to relevant skills, knowledge and projects;
- Forum in which specialist advice and technical guidance may be provided on the Agency's program in the area of decommissioning;
- A mechanism whereby decommissioning experts may exchange information under the aegis of the Agency to pursue the promulgation of good practices and the longer term retention of knowledge in support of decommissioning plan implementation;
- An expanded range of training and demonstration activities, especially demonstration projects with a regional or thematic focus providing hands-on, user-oriented experience.

Slovakia is an active member of the IDN Steering committee and besides the overall planning of network activities proposes also hosting of several IDN events in the next planning period (2009-2011), e.g. costing workshop, practical demonstration of decommissioning of small nuclear facilities etc.

CONCLUSION – LESSONS LEARNED

Slovakia is a good example of a small country with a relatively comprehensive decommissioning program that was able to utilize effectively the Agency TC support, in combination with its own activities, for increasing of skills of personnel and improvement of technical equipment. The country was/is the recipient of the IAEA assistance but is also able to offer and implement donor assistance and expert services to other countries. More significant involvement in the International Decommissioning Network activities will be proposed during the next IAEA planning period.

IAEA TC projects can bring people together so that they may share specialized knowledge and experience and thereby learn new ways of solving problems. It is suitable to start simple and progress to more complex decommissioning problems mainly through exercises, which are the best way to learn. It can be also noted, that intensive and open communication between main counterparts and the IAEA technical and country officers is very important aspect of TC projects implementation success.

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