

STATUS OF THE VIND PROGRAM, SEPTEMBER 2004

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ABSTRACT

The Vinca Institute Nuclear Decommissioning (VIND) Program (earlier known as the "Green Vinca") was approved by the Government of the Republic of Serbia in July 2002. The main goal of the Program is to solve nuclear and radiation safety related problems currently existing in the Vinca Institute of nuclear sciences that were accumulated as a 'heritage' of various nuclear programs carried out in the country since 1960. This paper summarizes the achievements and status of the VIND Program, two years after its formal initialization. The Program is supported by technical assistance from the IAEA since 2003 and by a donation of an US NGO "Nuclear Treat Initiative", made in 2002. Four interrelated projects of the Program are supposed to be completed in next 10 years by about 40 experts and 40 technicians from the Vinca Institute. The total cost of the VIND Program is estimated at 40 million US\$.

1. Introduction

Nuclear and radiation safety conditions in the Vinča Institute of Nuclear Sciences, elaborated at the end of last century, were found as inappropriate. These problems were mainly arisen as results of various nuclear programs carried out from 1958 to 1990 at the former Yugoslavia and strong economic crisis during the last decade. The Vinca's and international experts have concluded that these radiation safety conditions had to be improved as soon as possible. The major problems, pointed out, were:

- Considerable amount of low and high-enriched uranium (HEU) spent nuclear fuel (SNF) accumulated during 25 years of operation of 6.5 MW heavy water RA research reactor. After storage period from 20 to 40 years in water, aluminium cladding some of the spent fuel elements is degraded and fission products (primarily ^{137}Cs nuclide) leak to water environment;
- RA research reactor was in the extended shut down since 1984, when its modernization was started, but never completed due to various technical, political and economic reasons;
- Different low level (LL) and medium level (ML) radioactive waste (RAW) was collected from whole ex-Yugoslavia and stored in two storage hangars at the Vinca site since 1960. Records on the waste description are inadequate or (in the most of the cases) are missing; the RAW is not properly stored and conditioned according to modern radiation safety standards, and,
- Significant amount of fresh HEU fuel elements were stored at premises of the RA research reactor.

To solve the problems mentioned above, new projects, latter known jointly as the "Green Vinca Program" were initiated firstly in the Vinča Institute in August 2001. The basics of these four projects (related to SNF shipment, RAW management, RA reactor decommissioning and RB reactor refurbishment) were announced at the International Atomic Energy Agency (IAEA) 2001 General Conference by the Yugoslav delegation. The projects were welcome by the IAEA officials. Initial program team was assembled from about 30 experts and the same number of technicians from the Institute and some relevant organisations. It was expected that the Program will be supported, besides++ the Government's funding, also by donations expected from foreign organizations and governments and by experts' help offered from the IAEA. The necessary equipment should be

obtained through the technical assistance from the IAEA and applications for few relevant projects were sent through the country official channels to the Technical Cooperation (TC) Department of the IAEA in late 2001. Close cooperation of the team members with experts and relevant companies from nuclear developed countries is expected. Preparation phase of these activities were started already in 2001.

Proposal for solutions of the radiation and nuclear safety problems at the Vinca Institute, mentioned above, prepared jointly by the Vinca's and international experts, engaged by the International Atomic Energy Agency (IAEA) in late nineties and at beginning of 21st century, was submitted to the Government of Serbia and to the Government of the Federal Republics of Yugoslavia, for consideration and support. Both Governments have had Expert Committees that have had evaluated the proposal and had promised support at various levels of organization and through appropriate decisions. Here are especially underlined the 'opinions' of the Government of the Republic Serbia about the 'Green Vinca Program', brought at July 2002:

- Research reactor RA shall be finally shut down and decommissioning process should be initiated;
- Fresh HEU fuel elements from both research reactors shall be sent back to Russian Federation (RF) for uranium down blending;
- Safety and storage conditions of SNF elements should be increased with the aim to ship safely all the spent fuel back to RF, as soon as possible;
- LL and ML RAW at the Vinca site should be properly managed and safely stored in new temporary storage at the site with the aim to ship it at the final disposal site, to be determined and constructed in future;
- RB critical assembly will continue operation with the Government's support, and
- The Vinca Institute of nuclear sciences was set in charge of organization and completion of the Program.

2. VIND Program activities in 2002 – 2003

Intensive negotiations on shipment fresh high-enriched uranium fuel elements from the Vinca research reactors back to Russian Federations were carried out in 2002. These negotiations have included different Ministries of the Government of the Republic Serbia and the Government of the Federal Republics of Yugoslavia, USA Department of the State and USA Department of the Energy, the MINATOM of the Russian Federation, representatives of the IAEA and an USA nongovernmental organization "Nuclear Treat Initiative" (NTI). Beside the Vinca Institute, expert organisations of other two involved countries and the Safeguards Department of the IAEA were involved too. As a result, the first shipment of fresh HEU fuel from the Vinca site back to the RF has occurred in August 2002 and, at the same time, the first considerably donation to the Program was obtained from the NTI.

Work with the IAEA experts had also resulted to establishment of three Vinca's projects supported generously by the IAEA TC Department from beginning of 2003. These projects are:

- Safe Removal of Spent Fuel of the Vinča RA Research Reactor, SCG/4/003 (ex-YUG/4/029),
- Safe Management of Waste in the Vinča Institute, SCG/4/005 (ex-YUG/4/031), and
- Decommissioning of the Vinča RA Research Reactor, SCG/4/004 (ex-YUG/4/030).

Further support to the Program was obtained though participation of the country in few IAEA TC regional projects.

The Federal Republics of Yugoslavia changed name to the Serbia and Montenegro (SCG) in March 2003, but general attitude to the Green Vinca Program had stayed unchanged. Ministry for Science, Technology and Development of the Republic of Serbia has appointed the Vinca Institute of nuclear sciences in charge of the Green Vinca Program and established an independent the Green Vinca Expert Committee with the main aim to monitor the program progress and to propose optimal attitude to solutions for the problems treated. Unfortunately, funding of the Program was at very low level, so the IAEA support, through the service contracts and requested equipment, was the main driving force for the program participants.

The project '**Safe Removal of Spent Fuel of the Vinča RA Research Reactor**' has a main task to prepare SNF of the RA reactor for shipment back to RF. Research heavy water reactor RA was operated in the Vinča Institute of Nuclear Sciences since 1959 to 1984 using 2 % enriched and 80 % enriched uranium fuel elements. The SNF, stored in the Vinča Institute of Nuclear Sciences, consist of about 8000 irradiated fuel elements – the total mass of about 2.5 tons of uranium. Both types of the fuel elements are known as the TVR-S type and are ex-USSR origin. Fuel elements have the same shape and dimensions and approximately the same initial mass of ^{235}U nuclide. Almost all SNF elements are stored in the spent nuclear fuel pool filled by ordinary water. About 500, last used, SNF elements are kept in the RA reactor core since 1984. Due to non-suitable chemical parameters of water in the spent fuel storage pool the corrosion processes penetrated 1 mm thick aluminium cladding and few millimetres thick aluminium walls of storage containers during storage period long from 20 years to 40 years. Activity of fission products (^{137}Cs nuclide) is detected in water samples since 1996. Measurements of water samples, made from 2000 to 2003 have found increased ^{137}Cs activity in about 1/3 of the storage containers.

Regular monitoring and maintenance of water quality in the spent fuel storage pool were established in 1996 and following actions to improve conditions in the existing temporary RA reactor spent fuel storage pool are finished or already in progress:

- Design and production of special equipment for underwater cutting of corroded iron steel construction in the basin 4 of the storage pool;
- Removal of the contaminated iron steel construction, its conditioning and storage at the temporary low and medium level radioactive waste storage at the Vinča site;
- Final removal of sludge from the spent fuel storage pool. Physical purification of pool water by mechanical filtering;
- Washing up corrosion deposits from all surfaces in contact with the pool water using technology and equipment already provided by Russian side;
- Chemical purification of pool water using the ion exchange resins;
- Increasing physical protection at the site, and
- A work on SCG – RF government-to-government agreement for repatriation of the SNF from the RA reactor is in progress since November 2003.

The project '**Decommissioning of the Vinča RA Research Reactor**' was initiated due to the fact that, for a number of both technical and political reasons, the RA reactor has not ever been restarted during long period of extended shutdown. All plans for the reactor RA refurbishment, initiated during last two decades, are abandoned. A proposal for decommissioning of the reactor RA in near future, based on economical, technical and legislation reasons, was approved by decisions on the final shutdown of the RA reactor and initiation of the decommissioning process brought by the Governments of the Federal Republics of Yugoslavia and of the Republic Serbia in summer 2002. Initial activities related to decommissioning of the RA reactor are started in 2003 within IAEA TC project with aim to establish in next 2-3 years detail decommissioning plan, including site characterisation, preparing and mastering with appropriate dismantling and decontamination techniques for waste management and to obtain all necessary licenses. At the same time, it is supposed that the spent nuclear fuel will be removed from the site and that appropriate waste management facilities and temporary storage will be established in the Institute with aim to allow uninterrupted decommissioning progress. These initial activities are followed after the establishing the decommissioning team and basic training of the personnel.

The project '**Safe Management of Waste in the Vinča Institute**' has to establish the appropriate organisation structure for initiation works and realisation of the forthcoming activities related to RAW management during transfer of the spent fuel and decommissioning of the RA research reactor. A new RAW processing facility and new temporary storage facility of large capacity ('hangar no. 3') are planned to be finished during first stage of the project. In next stage of the project, characterisation of large volume RAW stored at the hangar no. 1 and its safe packaging and storage at hangar no. 3 is

expected to be done in parallel with the RAW flow from the RA reactor decommissioning activities. Also, about 300 m³ of the liquid LL/ML RAW, stored at the Vinca site in two stainless steel underground storage tanks for almost 40 years, should be evaluated, appropriately treated and safely stored. High intensity radioactive orphan sources will be evaluated at the Vinca site too and properly stored in a well-protected bunker within the RAW storage area.

3. VIND Program activities in 2004

After country public elections in late 2003, new Government of the Republic Serbia was established in March 2004, but the previous Republic's Government has brought appropriate decisions related to the Green Vinca Program in February 2004:

- The only acceptable ('the final') solution for the Republic Serbia is shipment of the SNF from Vinca back to the RF for reprocessing, i.e., no long term storage of the SNF or high-radioactive waste at the country is foreseen in future;
- The 'immediate dismantling' is accepted as the decommissioning strategy to be applied at the RA research reactor;
- Government of the Republic Serbia will establish appropriate funding for the Green Vinca Program that will be managed by the Ministry for Science, Technology and Development, and
- The Vinca Institute of nuclear sciences will be in charge of realization of the Green Vinca Program.

New Government of the Republic Serbia has established a new Ministry of Science and Environmental Protection (MSEP) and had continue to support the previous Green Vinca Program through the new announced the Vinca Institute Nuclear Decommissioning (VIND) Program. The Green Vinca Program was restructured at the Vinca Institute and the VIND Program was proposed to the MSEP in July 2004 for further support. IAEA supported such approach of the MSEP in May and September 2004 and, also, by engaging two additional staff members with primary tasks related to monitoring progress of the TC projects and supporting the organisation structure of the VIND Program.

New VIND Program has included, beside three already existing projects, a new one related to radiation protection. The program was evaluated and accepted by the MSEP in September 2004 and funding of the VIND Program started October 1, 2004 for the following four projects:

- Shipment of the spent nuclear fuel of the RA research,
- Radioactive waste management at the VINCA Institute,
- Decommissioning of the RA research reactor, and
- Radiation protection.

To carry out efficiently activities specified within the projects mentioned above, the "Vinča Institute Nuclear Decommissioning Program" (VIND Program) established new integrated Program Team, assembled from about 40 experts from the Institute and about the same number of technicians. The Project team, lead by the Program manager and the Program Council assembled from the projects leaders and their deputies, works closely in cooperation with the Vinca Institute Director General, officials of the MSEP and the IAEA TC program manager, TC country officer and IAEA technical officers of each project. Close cooperation of the team members with experts and relevant companies from nuclear developed countries is stimulated within all projects. Currently, four interrelated projects of the VIND Program are supposed to be completed in next 10 years at the total cost estimated at 40 million US dollars.

Legal matters related to almost all activities of the VIND Program were identified at very beginning of the (Green Vinca) Program and pointed out to the both Governments to be properly solved in near future. It was recognized that only rudiments of the full-power Regulatory Body exist in the country. Especially, legal matters related to the safe transport of the SNF from the Vinca Institute to the RF through transit countries have to be addressed appropriately, with the help of the IAEA experts,

through bilateral or multilateral government-to-government agreements. Intermediate Regulatory Body of the Republic Serbia was established in the second half of 2004. Work on new integral country law on Nuclear Safety and Radiation Protection was initiated in 2003 and the draft, ready to be submitted to the public opinion and to Republic's Parliament for the approval, was finished in September 2004. This new law is expected to establish a solid ground for a legal introducing of the modern Regulatory Body in the country and to increase the culture level of the nuclear and radiation safety and regulative approach in all activities of the VIND Program.

4. Conclusion

As a general conclusion we can point out that solving the problem of safe disposal of research reactor spent nuclear fuel and decommissioning of a research reactor, including provision of adequate low-level and intermediate radioactive waste disposal site (even temporary one) is a difficult task for a country with no long-term nuclear power program and with limited potentials and resources. Factors that may cause delays or prevent implementation of the above projects are lack of manpower, lack of material resources and necessary equipment, lack of the appropriate legal structure and full and modern regulative in the field, as well as general economic difficulties in the country.

This paper describes process of establishment and initialisation of the Vinča Institute Nuclear Decommissioning (VIND) Program, known earlier as the "Green Vinča" Program. This Program, supported by Government of Republic Serbia, is supposed to solve all problems related to accumulated spent nuclear fuel, radioactive materials associated to the RA reactor facility and radioactive wastes from the research, industrial, medical and other applications generated in previous period which are stored in the Vinča Institute by proper repackaging and removal from the Vinča site to some other disposal site, to be decided yet. Beside that, a research and development program in modern nuclear technologies is carried out with the aim to preserve experts manpower and establish solid ground for new research in nuclear field.

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6. References

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