RESEARCH REACTOR SPENT FUEL IN UKRAINE

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Abstract

This paper describes the research reactors in Ukraine, their spent fuel facilities and spent fuel management problems.

Introduction

Nuclear science, technology and industry are highly developed in Ukraine. There are 5 NPPs in the country with 14 operating reactors which have total power capacity of 12,800 MW. Great attention is paid to development of research connected with the peaceful uses of atomic energy, which is concentrated mainly in the Academy of Sciences. Research reactors are actively used for this purpose. However, for the reasons mentioned in this paper, Ukraine has at present considerable difficulties in development of its nuclear programme.
There are 2 research reactors in Ukraine:

1. Kiev Research Reactor

Research Reactor VVR-M (water-water, modernized) belongs to the Ukrainian Academy of Sciences and is located at the territory of the Institute for Nuclear Research. This is a pool type reactor with 10 MW nominal capacity. Flux of fast neutrons in the core is $1.7 \cdot 10^{14}$ n/cm^{2}s; that of thermal neutrons is $6 \cdot 10^{13}$ n/cm^{2}s. Research in nuclear physics, neutron physics, radiation physics, radiation material science, radiobiology, radioecology, different applied fields and isotope production are carried out on it. Special channel filters which permit to obtain quasi - monochromatic neutron beams are widely used in research. At the end of 1980s, 30 organizations from Ukraine and other Republics of the former USSR participated in research at this reactor.

This is a heterogenous reactor on thermal neutrons. Light water is moderator and cooler; beryllium serves as neutron reflector. Reactor has 9 horizontal channels adapted for research in particular fields, a thermal column and 25 vertical channels for research in radiation technologies and isotope production. Normal operation duration is 5 days a week.

The fuel for reactor was supplied from Russian Federation. There is enough of fresh fuel for several years of reactor operation. Two types of fuel are used: with 36% and 90% enrichment in ^{235}U. Fuel assemblies are of hexagonal cross section and can be used in single or tripple configuration. Average fuel burnup is 40-50%.

Spent nuclear fuel storage capacities are designed for 50 single and 246 tripple fuel assemblies. Irradiated fuel is stored in a cooling pond for a period not less than 3 years. Now it contains 272 fuel assemblies of both types. A new large storage facility was designed and its construction started in 1990. However, due to financial difficulties it was postponed. The same difficulties limit the volume of work on reactor at present.

2. Sevastopol Research Reactor

Research reactor IR-100 belongs to the Sevastopol Navy Institute. It is a pool type reactor with 200 kW nominal capacity. Flux of thermal neutrons in the core is $6 \cdot 10^{12}$ n/cm^2 s. Reactor has 3 horizontal and 8 vertical channels. It usually operated 5 days a week; but now it is temporarily shut down.

There are laboratories for physical measurements, activation analysis, technical dosimetry, radiochemistry, radiobiology and a computing centre. Research in nuclear and molecular physics, solid state physics, nuclear engineering and technology, radiation chemistry, radiation stability of materials, biology, ecology as well as training of specialists in nuclear technology and radioisotope production is carried out there.

Fuel with 10% enrichment in ^{235}U which was supplied from Russia is used. Each fuel assembly contains 7 fuel pins.

Spent fuel is stored in a pool which is located near the reactor. Its capacity is up to 114 fuel assemblies. In the case that the reactor is operated with the same intensity as in past years (lectures, training, research work), there will be no necessity for a storage capacity increase. At the moment there are no technical difficulties with regard to spent fuel storage, but considerable financial problems connected with the normal reactor operation exist.

Physical protection of fission materials at reactors is organized corresponding to the International Convention and regulations acting in the country. Both reactors will be put under the IAEA safeguard system as soon as Ukraine joins the Non-proliferation treaty.

3. General Remarks

At the moment Ukraine has no the long-term nuclear power programme development. Chernobyl disaster in 1986 which resulted in radioactive contamination of large territories and evacuation of about 150,000 inhabitants from the contaminated areas has greatly influenced public opinion and this has stopped for many years any activity related to development of power and research reactors.

Considerable political and technical problems arose besides the social ones. Ukraine does not have its own base for nuclear industry development, for fuel enrichment, for radioactive waste final storage etc. All such facilities are located in Russia and after the collapse of the USSR, a number of various problems related to the Ukrainian nuclear programme has appeared. Many of them need urgent solution.

The problem of radwastes is among the most urgent issues of the GOSATOM, organization which is responsible for nuclear power use in Ukraine. In 1993 a "Concept of Radwaste Management" was adopted. According to it, a National programme on establishing the radwaste management in Ukraine should be elaborated, in which the responsible executives, scope and sources of financing will be defined, new technologies of radwaste processing and new containers for long term storage will be designed. It is planned to create a centralized radwaste processing facility which will be able to provide a reliable storage of all spent fuels at one site. Temporary container storages (up to 5 years) as well as dry storage facilities for the period 40 - 50 years will be constructed.

This situation is strongly reflected in the management and storage of research reactor spent fuel. In the former USSR this fuel was transported to Russia and left there for long term storage. Now, in compliance with the Russian Law "On environment protection", which prohibit the access of radwastes on its territory, not a single fuel assembly has been sent from Ukraine for more than two years at the time of writing. It is expected that the storage capacities for irradiated fuel, which are available at the VVR-M research reactor, will be filled within the next 3-5 years. The problem of processing and storage of this fuel remains open.

The final solution of research reactor spent fuel storage depends on the general solution of nuclear problems in Ukraine, which is under consideration by the Government.

One of three solutions or a combination thereof appear to be possible:

1. Development of a new structure of the Ukrainian National nuclear complex, which will also include the problem of research reactors;
2. Conclusion of an Agreement with the Russian Federation about renewal of previous co-operation in nuclear programmes;
3. Organization of co-operation with Western countries.

All these possibilities are investigated at the moment. However, due to the difficult financial situation in Ukraine, a radical improvement in nuclear policy in the nearest future can hardly be expected. Therefore any assistance from the IAEA would be greatly appreciated.

With regard to research reactor operation and spent fuel storage in particular, this assistance could be provided, for instance, under the IAEA technical cooperation programme or in any other form. A detailed description of the needed assistance can be submitted to the Agency.