1.3 The Current Status of Utilization of Research Reactors in China

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Abstract

Seminars on utilization of research reactors were held to enhance experience exchanging among institutes and universities in China. The status of CARR project is briefly described. The progress in BNCT program in China is introduced.

A brief overview on utilization of research reactors in China has been given in [1]. The main research reactors in China conduct most of utilization on research reactor although many of them are facing the aging problems.

The newly designed and under constructed research reactor, China advanced Research Reactor (CARR), is expected to take over the utilization tasks for the aged reactors in CIAE. In order to achieve this aim, we have to make our efforts in preparedness on utilization of research reactor, including all resources in technology, manpower, instrumentation, and budget, so as to make the reactor to be used in an effective way once it is completed.

In this paper, four aspects will be dressed about the related status of utilization of research reactors in China. They are: the status of CARR construction, the intention utilization on CARR, exchange on utilization of research reactors in China and the recent progress in BNCT program in China.

1. Status of CARR project

Having finished the reviewing work of the preliminary safety analysis report and environmental impact statement, the first construction license for the CARR project has been granted and the construction work with its first concrete pouring started on August 26, 2002. According to the schedule, the project will be completed within a total duration of 52 months.

Up to now, the irradiation test of single small plates of U_3Si_2-Al fuel and

then irradiation test of a fuel assembly have been finished in the MIR reactor of the Research Institute of Atomic Reactors, Russia. The metallographic inspection work is under way now. The results obtained are satisfactory and show that the performance of the CARR fuel design can meet the requirements of the conditions in CARR.

Some important evaluation and verification tests, such as the integrated reactor core flow-induced vibrations, the critical heat flux, flow distribution and flushing tests of the fuel assembly, critical velocity of the coolant are being conducted or under plan.

Now, seeking the vendors of a variety of devices and materials, the bidding for the design and fabrication of some subsystems is processing in due course.

Worth of mentioning is that the operation mode of the emergency ventilation for some severe accidents has been changed in the CARR design according to the safety review by the regulatory body. During an accident with radioactivity release, the emergency ventilation system will be completely switched off. The radioactivity is being held in the confinement building for a proper period of time. During this period, no venting flow via the stack and only a very low release of radioactivity corresponding to the leakage rate of the confinement building, say, 2.5 vol.% per day, is adopted. So, the design of very low leakage rate of the confinement building is the key point.

It is expected that the civilization construction work will be finished this year, 2003, and in 2004 and 2005 installation job will be completed then from the late 2005 to year 2006, the commissioning work will be conducted, and the power operation will start at the end of 2006.

2. Utilizations intended on CARR

In order to make the CARR to be effectively used once it is completed, many jobs have to be conducted in advance. A special symposium was organized and chaired by the president of CIAE last September. There are 17 papers, involving fundamental research, utilization of nuclear energy, radioisotopes production, science and technology in variety of fields, are presented on the meeting. Almost all utilizations are involved, such as neutron scattering research in life science and material science, preparing and their

application technology of transuranic elements, the application in health physics, development of new and high performance fuel, radioisotopes production including high purity ^{125}I, fission ^{99}Mo, ^{238}Pu and NTD silicon, nuclear data measurement for long life nuclides, on line isotope separating (ISOL), etc. It is emphasized that these utilizations on CARR should be better conducted through domestic and international collaboration and cooperation.

3. Enhancing experience exchanging in China

On aware of the importance of experience exchanging to promote the further utilization of limited research reactors resources, we organized a domestic symposium this year composed of experts from variety of Institutions or universities over China, which runs research reactor or nuclear facilities. They get together to present and discuss what they are doing and going to do in the area of utilization of research reactors. We found that the symposium is valuable for participants in their research work by the information and experience exchanging. So, such kinds of meetings or activities are asked to be periodically held later on by the participants. Some relevant organization to promote the experience exchange in utilization of research reactors will be set up in China.

4. Recent Progress in BNCT Program

Having passed 10 years of pacing up and down, the development of BNCT program in China rises again in Beijing, now headed by Dr. Zhou Yongmao, member of the Chinese Academy Engineering (CAE). The aim of the BNCT program is on the real treatment. The China's neurosurgery has got good foundation and relevant facilities. With a full figure of brain cancer patients in China, our first starting point for developing BNCT program is set to the treatment for brain glioblastoma at superficial position following the regularity of success or failure with long period international BNCT research, especially, drawing the achievements of clinical trial got by Japanese experts. The irradiation facility is a miniature neutron source reactor, which possesses "user affinity safety nature". The characteristics of its inherent safety have been fully reflected and verified in many such miniature reactors used for neutron

activation analyses in China. The irradiation facility under design provides two neutron beams, one thermal neutron and the other epithermal one. The later one can be available for the treatment for deep position brain cancer patients. The power of the facility is about 30 kW and scheduled to be placed in the basement of Tiantan Hospital of Beijing. Now the design of this facility is underway by the BNCT Research Group CIAE with the scheme comparation calculation, while the calculation of tiny-dose distribution in brain is performed by the Institute of Application Physics and Compute Math and the dose imitation tests are conducted by the China Institute of Radiation Protection. With the Safety limited value to ensure health, the thermal neutron flux at the exit position of thermal neutron beam is about 1×10^{9} n/cm^{2}·sec, while the epithermal neutron flux at the exit point of epithermal neutron beam 5×10^{8} n/cm^{2}·sec. The new funding pattern of state support combined with nongovernmental people is adopted for this program development, if the fund arrives in due time, this facility will be erected and puts into running in the year of 2004-2005.

5. Conclusion

Although many research reactors in China are now facing the aging problems, the utilization of research reactors is still subjected to pay great attention to.

Once the new designed and constructed research reactor CARR is erected, its utilization will certainly be prosperous.

The research and development on BNCT program in China has been paid great attention and highly concerned recent years.

References:

[1] Yuan Luzheng, A Brief Overview on Utilization of Research Reactors in China, Proceedings of 2001 Workshop on Utilization of Research Reactors, Nov. 5-9, 2001. Beijing, China, P87-90.