



Annual Report ***of China Institute of Atomic Energy***

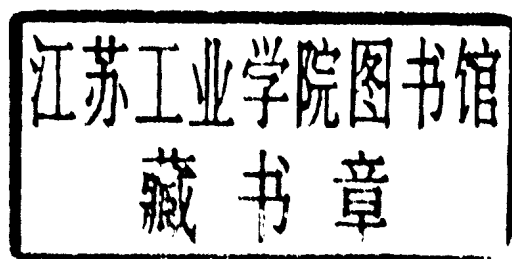
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PREFACE

In 2004, the scientific undertakings of China Institute of Atomic Energy (CIAE) were continuously concerned by the leadership of the country. Chairman, Hu Jintao and others of the top leaders visited the exhibit and listened to the work report of CIAE in “China Nuclear Industry Exhibition for the Fiftieth Anniversary”. And important instructions and more supports are coming to CIAE, which are inspiring us to fulfill year’s task. And remarkable results were achieved in scientific research, construction of gigantic scientific projects and key laboratories, R&D of nuclear applications, operation of nuclear facilities and others related. Mainly are as follows.

1 New progresses in the construction of gigantic scientific project and infrastructure project

The detail design of China Experimental Fast Reactor (CEFR) has nearly been completed. The compilation and the preparations of commissioning files and operation have been carried out. The large electromechanical equipments have been on order and the first batch of fuels and most of key equipments have been transported to the spot. The installation has fully begun and field building has gradually come to an end. Upgrading edition for 2nd grade network and adjusting reports for general estimate have been accomplished and submitted.

All the items of China Advanced Research Reactor (CARR) went on smoothly. The design has approached completion. The installation of a decay tank and main equipments for sub-items of 03 and 05 has been fulfilled. The transportation of reactor body and the design verification of driving mechanism for controlling rod have been completed.

The feasibility study report of Beijing Radioactive Ion-Beam Facility (BRIF) has been authorized and the primary design has started. All preparatory work for beginning construction is in process.

The feasibility study report of China Radiochemistry Reprocessing Laboratory (CRARL) has also been authorized and the evaluation reports for environmental influence and safety have been approved successively.

The primary design of a key laboratory, nuclear data measurement and evaluation program has been completed and submitted, meanwhile, detail design for the program has also begun. The proposal for another key laboratory, an ionizing radiation compartment of dosing and calibration laboratory has been approved, too.

The 1st phase of infrastructure facility remake has been successfully put into practice. And remakes including heating network, outdoor light current network and communication system have been completed. The remakes of network, physical safeguards and fire-fighting are going on. And the remakes for power supply system, drainage system, sewage disposal system and so on are all ready to construct.

Remake and regulation of some laboratories went on the schedule planned.

The feasibility study report of 2nd phase of infrastructure facility remake has been ready and it is full

of hope for approval.

The construction of the workshop for treating radioactive liquid waste has been accomplished and put into hot operation. 108 groups spent fuel from Reactor 101 and 48 tanks spent fuel from Reactor 49-2 have been transported to the set for storage. 4 proposals for the projects of remake of treating radioactive wastes have been approved, among of which a station for discharging of tritium contained liquid waste by atmosphere loading and a radioactive source storage are ready to construct and the primary design for ventilation system of radioactive wastes has been evaluated and accepted by the authorities concerned. The feasible research work for other projects of treating radioactive wastes is also being carried out.

The technical remakes of 45# experimental building and 46# laboratory have been completed fully and put into operation. The remake of hot cell 303 and the safety system about critical facilities is in process.

2 New achievements in research on science and technology

All projects of research on science and technology undertaken in 2004 were successfully conducted. And some of positive results were yielded again.

The contracts for the projects of pre-research on national defense programs undertaken in 2003 were fully checked and accepted by investor. Ones being performed in 2004 were successfully signed and all of the projects were smoothly carried on and a number of outcomes have been acquired.

As a project of R & D for key technique on applications of isotopes and radiation, developing an accelerator with the energy of 10 MeV for the purpose of radiation utilization went on successfully. Main part of the accelerator and vacuum system have been installed and tested. The major items of the study on advanced fuel assemblies for china PWR nuclear power plant were accomplished. Other projects of nuclear energy development go on smoothly as annual plan.

As a project of the major state basic research program in energy domain, the basic research on physics and related technology for accelerator-driven radioactive clean nuclear power system (ADS) has been successfully conducted. The construction of VENUS I facility, a zero power sub-critical neutron multiplying assembly driven by external 14 MeV pulsed neutrons, has been finished almost as the basic experimental platform for the neutronics study in ADS blanket. Another project of the major state basic research program, physics on radioactive nuclear beam & nuclear astrophysics, was performed very well under the annual plan, which laid down a solid foundation for the future.

The quality system attestation of a key laboratory for radio-metrology has been evaluated and accepted by the authorities. The project of a standard equipment for electron beam absorb dosimetry (rate) and other three ones have been fully completed and passed the examination organized by investors.

The explosive detection system has been successfully developed and the primary results have been achieved in the measurement method for long-life ultramicro assay by means of AMS.

With beam-smoothing technology, the output energy of "Heaven-I" KrF laser facility increased to 200 J and most important, the beam un-uniformity of total six beams on target reached 2%, which approached the results of Nike facility in Naval Laboratory. In 6 beams' laser-target experiment, more than 2 Mbar pressures were generated in fly-flayer.

8 projects of fundamental and applied research were subsidized by National Natural Science

Foundation this year. Moreover, all projects including continuing ones were conducted very well.

3 Remarkable achievements in R& D of nuclear applications

The remarkable achievements in the field of nuclear applications were acquired again. The output value is beyond the annual plan.

Beijing Atom Hi Tech Co. Ltd went on steadily and achieved positive results which are also beyond the annual plan.

The cooperation between CIAE and local authorities expanded and several joint projects has been put into practice.

The commissioning of the miniature neutron source reactor for Nigeria has been finished completely and delivered to the user successfully. The technical service contract about the examination on the first surveillance capsule for Pakistan Chashma Nuclear Power Plant has been fulfilled.

4 Safety in production ensured

Under the condition of hardware condition unchanged, the safety in production was powerfully ensured. The management of nuclear materials, radioactive substance and hazardous chemicals and the operation of nuclear facilities were in good condition. Moreover, the safety in traffics and fire fighting was also ensured.

The heavy water research reactor ran 11 periods, more than 4 700 h. The swimming pool reactor operated 5 times in high power condition for 52 d. The HI-13 tandem accelerator ran 3 590 h in beam condition, and 3 055.5 h for scientists performing their experiments. And other facilities such as a miniature neutron source reactor, radioactive wastes disposal installations, information and network system were in good status.

5 Prizes, publications and patents

A total of 13 prizes of National Defense Science and Technology Progress Award were awarded. They are 3 second class prizes and 10 third class prizes. 11 patents were applied for and 10 were authorized in the year. A total of 148 theses were published and 41 were published abroad and 68 were embodied by SCI among them. 310 GF reports were compiled. We also won several reputations in foreign affairs, asset and capital verification and traffic security.

6 Academic exchange

More than 4 155 guests from home and abroad were received in 2004. The international exchanges are kept good trends. In the year, a total of 655 foreign visitors from 25 countries or regions were received for academic exchanges or trade negotiation. And a total of 319 scientific workers were sent abroad for scientific visits, international conference or symposium and advanced training.

7 Others

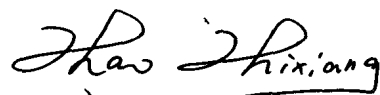
- 1) The forceful rear service was provided to meet the demand for the supply of electricity, water,

vapor, heating, goods and materials, medical treatment, accommodation, traffic, fire fighting and so on, which supports the scientific research and production in CIAE powerfully.

2) The new edition of quality control system in CIAE has been successfully completed and put into practice. And the certificate of quality control system ISO9001: 2000 was gotten.

3) The grade A certification of doctor's and master's degrees in the subject of nuclear science and technology passed the evaluation organized by Academic Degrees Committee of the State Council and got a good result which is the number 5 out of 42.

Professor
Editor in chief
President, CIAE

A handwritten signature in black ink, reading "Hao Shixiang". The signature is written in a cursive style with a horizontal line underneath the name.

June, 2005

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IMPORTANT NUCLEAR SCIENCE ENGINEERING

Beijing Radioactive Ion-Beam Facility

1 100 MeV H^- Cyclotron as an Rib Driving Accelerator

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1 General description

Beijing Radioactive Ion-beam Facility, more often referred as BRIF, is a new project of cyclotron base radioactive ion beam facility which consists of a 100 MeV cyclotron, a two-stages isotope separator on line system, modification of the existing tandem, a super conducting Linac booster, various experimental terminals and an isotope production station. As a driving accelerator, the 100 MeV H^- cyclotron CYCIAE-100(Fig.1) will provide a 75~100 MeV, 200~500 μA proton beam. For a final energy of 100 MeV or below and beam intensity of less than 1 mA, a compact magnet and H^- acceleration with stripping extraction might lead to a smaller and cheaper machine. This driving accelerator is a fixed field, four sectors cyclotron. The magnet is 2.6 m in height and 6.4 m in diameter. Two cavities installed into the valleys of the magnet will accelerate beam 4 times per turn.

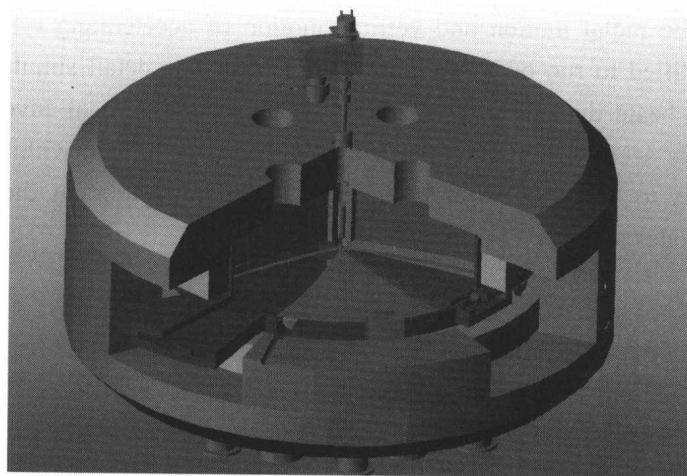


Fig.1 The structure of 100 MeV, H^- cyclotron CYCIAE-100

The machine will possess the following features:

- 1) The compact magnet will provide high enough flutter and lower first harmonic though the harmonic coils will be absent.
- 2) The H^- acceleration permits us to extract the beam by stripping from the compact machine.
- 3) The external source not only provides higher beam intensity, but also shows us a possibility to provide pulse proton beam by the cyclotron.
- 4) The magnetic field of less than 1.35 T in the hill region will guarantee a low rate of dissociation of H^- ions during the whole acceleration.