

PRESENT STATUS AND FUTURE DEVELOPMENT OF
QINSHAN NUCLEAR POWER PROJECT

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ABSTRACT

Qinshan 300 MWe Nuclear Power Project is the first domestically designed and constructed nuclear power plant in China. Here is a brief description of its progress in design work, equipment manufacture and site construction since the first structural concrete in March 1985. In Qinshan area four units of 600MWe each are planned to be built with collaboration of proper foreign partners.

I. INTRODUCTION

The first concrete pouring for the Qinshan NPP reactor building in March 1985 marked the start of plant construction. In my paper "Design and Construction of Qinshan Nuclear Power Plant" presented at the 5th Pacific Basin Nuclear Conference in May 1985 were introduced the design features and construction progress at that time. Since then more than two years have passed and construction at site is proceeding steadily, meanwhile fabrication of components and equipment is carried out in factories both at home and abroad.

II. SITE CONSTRUCTION

At present construction work is in progress on all buildings. The containment has been completed and the polar crane erected. Civil construction work for other buildings, such as reactor auxiliary building, fuel storage building, turbine building and main control building, will be completed in succession by the end of this year and will be followed by placement of prestressing steel strand tendons and erection and installation of main nuclear components and systems.

III. COMPONENT FABRICATION

The pressurizer manufactured by the Shanghai Boiler Works was completed. No. 1 steam generator is about to be finished. No. 2 is still under fabrication. The U-tubes of Incoloy-800 are imported from Sweden's Sandvik. The Shanghai First Machine Tool Factory contracted to manufacture reactor internals has finished 80% of work. The saturated steam turbine which was jointly designed by the Shanghai Turbine Works and the Westinghouse Electric Corporation is being fabricated by the former. The self-designed dual water-cooled electric generator is under manufacturing at the Shanghai Electric Machine Works., in addition, the reactor pressure vessel from Japan's Mitsubishi Heavy Industries, Ltd., the reactor coolant piping and in-core flux mapping system from France and the reactor coolant pumps from the Federal Republic of Germany have been delivered to the site. Other components such as pumps, valves, ventilators, heat exchangers for engineered safety features, RHR system, component cooling system, etc. are also being fabricated, of which a large part have been delivered to the Qinshan plant. In this year and the year next, all required components and equipment for the plant will be transported to the site and installed in position. Nuclear fuel with three different enrichments for the first reactor core has been delivered to the fuel manufacturing factory in Sichuan Province.

IV. DESIGN REVIEW AND SAFETY ANALYSIS

A design review to check the safety of Qinshan NPP has been conducted in Shanghai Nuclear Engineering Research and Design Institute (SNERDI) following the Chernobyl accident, which alerted us as never before to nuclear safety. On instructions from the National Nuclear Safety Administration, the design review put special emphasis on the containment design,

seismic resistance, flood control and fire protection, laying a good foundation for working out the Final Safety Analysis Report. To enhance plant safety, new systems such as loose part monitoring system, safety parameter display system and post-accident sampling system have been added in the design.

By now the test assembly of fuel rods has been irradiated in the heavy-water experimental reactor in Beijing Atomic Energy Institute to a burnup of 27000 MWD/tU, verifying the design of the fuel assembly. With the experimental data resulting from the hydraulic simulation test, the hydraulic design of the reactor internals has been modified. The alignment test for control rod cluster moving under operating temperature and pressure was completed with satisfactory results.

Besides, the Probabilistic Safety Assessment for the Qinshan plant has been undertaken with the cooperation of GRS of the Federal Republic of Germany.

V. COMMISSIONING PREPARATION

Commissioning preparation has been commenced to verify the quality of construction and ensure safe operation. Since 1985 groups of engineers and technicians have been dispatched abroad to be trained on operating nuclear power plants of Tsuruga in Japan, Krsky in Yugoslavia and Brokdorf in F.R.G. and the key operating personnel will also be trained on Krsky and nuclear power plant simulators in other countries to obtain operator licence. Up to this time commissioning program has been drafted by the engineers of SNERDI, on the basis of which the commissioning procedures and manuals will be worked out jointly by the SNERDI and the Qinshan NPP.

During the first two-year construction we have both gained experience and learned lessons, mainly as follows:

A. A proper QA system should be set up ranging from design, procurement, fabrication, construction up to commissioning and operation. Everyone involved in the project should bear in mind the significance and importance of safety. So far a QA program has been worked out by the Qinshan NPP and a QA/QC system has also been established at each factory contracted to manufacture nuclear equipment. The SNERDI has drawn up the engineering management procedures, so that traceability can be ensured covering

design, procurement up to commissioning and operation.

B. In light of current international practice, national nuclear codes, criteria and standards applicable to China's specific condition, should be established as early as possible. Some nuclear standards are now being worked out on the basis of IAEA codes, US 10 CFR, US NRC's regulatory guides and NUREGs, ASME and ASTM codes incorporating our own R & D results and manufacturing technology.

C. Design review should be constantly executed until the Final Safety Analysis Report is drawn up. At the same time safety related experiments and analyses must be carried out. Special emphasis should be laid on the coordination of all design and engineering interfaces.

The principle for construction of the Qinshan NPP is "Safety First" and "Quality First". Whenever this principle is not stuck to, corrective actions are taken in time.

VI. ROLE OF QINSHAN UNIT 1

The Qinshan Unit 1 is a prototype PWR nuclear power plant of 300 MWe capacity. However, its technical characteristics are parallel to those of larger plants, Building this plant enables us to acquire first-hand experience and to accumulate technical data in the process of R & D, design and engineering, component fabrication, construction and operation. This project also serves to train much needed technical people. We expect it will pave the road for further development of nuclear power in China.

Considering the real situation in China small and medium-sized nuclear power plants are preferable due to the following advantages:

A. Suitable for China's power grids, the capacities of which are still not large enough

B. Smaller total capital cost and easier gathering of money, therefore, more practical to build small and medium-sized nuclear power plants in case of limited fund.

C. Easier manufacturing and quality assurance due to smaller components, resulting in higher level of domestic share of supplies.

D. Shorter construction time with

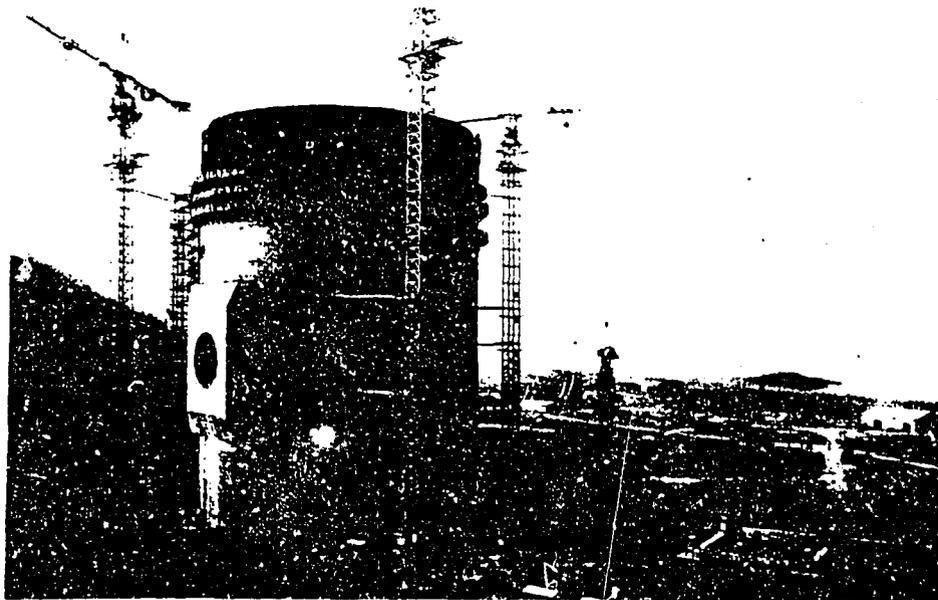


Fig. 1 Qinshan Site view in April 1987

earlier generation of electricity and repayment of loan as well as lower financial risk.

VII. FUTURE DEVELOPMENT

In view of the above-mentioned considerations, it was decided in January 1986 to first develop in China medium-sized PWR nuclear power units of 600 MWe capacity instead of 1000 MWe and these units should be standardized and suitable for series production.

Qinshan is an excellent site where is adequate room to further accommodate four units of 600 MWe. It is envisaged to undertake two further stages of construction at Qinshan site with two units in each stage. The 600 MWe units will be constructed by making full use of the acquired experience from the 300 MWe Qinshan unit 1 and incorporating proven international technology in order to reap the full commercial benefit. In accordance with the principle of "Relying on Ourselves and to Cooperate with Foreign Partners", China aspires to achieve self-sufficiency in the shortest period.

The feasibility of Qinshan Second Stage of 2 x 600 MWe PWRs has been studied for some time and is still being

investigated in depth. In the mean time, topographic survey and geological prospecting for the new units are underway.

The Qinshan 300 MWe project is playing a pioneering role in China's nuclear power development. We are fully aware of the difficulties which will surface in the course of advancement. We will do our utmost to complete the construction and put the plant into safe and reliable operation in due time.