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Building a 745 MWe pressure-vessel PHWR in the Argentine

The use of a pressure vessel in the Kraftwerk Union design of pressurized heavy water reactor enables many of the components and systems proven in PWRs to be used. Argentina's nuclear programme is notable for the rapid growth in the contribution of local industry and engineering effort, and with the setting up of the national engineering company, ENACE, the country will have its own architect-engineer.

Planning for nuclear self-sufficiency in Argentina

The development of commercial nuclear power in Argentina can be divided into four periods. During the first, which extended from 1950 to 1958, decisions were taken leading to the establishment of what is now the Comisión Nacional de Energia Atómica, Argentina's National Atomic Energy Commission, which is in charge of all Argentina's nuclear activities; r and d groups were set up; personnel were trained, mainly in foreign centres; the teaching of physics was established at the Institute of Physics, "Dr José Balseiro"; uranium prospecting began; and the first, 100kWt, experimental reactor, "Argonaut", together with its fuel elements, was built.

During the second period, from 1958 to 1967, a 5MWt irradiation and research reactor was designed and constructed, and associated metallurgical r and d and fuel manufacture carried out; Argentina's first uranium mill at Marlargüe, in the Province of Mendoza, was built; a heap-leaching plant for uranium ore was set up at Don Otto, in the province of Salta; the production of radioisotopes and techniques for their application in medicine, biology, industry and agriculture were developed; and CNEA performed a feasibility study on the installation of a first commercial nuclear power plant.

Following this feasibility study, a call for bids was issued during the third period, which lasted from 1967 to 1976. This ultimately led to a turnkey contract with Siemens for a natural uranium-heavy water 340MWe unit employing a pressure vessel, which started commercial operation at Atucha in June 1974.

In 1972 a new call for bids was issued for a natural uranium-heavy water pressure-tube unit of 600MWe capacity, to be sited at Embalse, in the Province of Cordoba. The contract was awarded in 1973 to a Canadian-Italian consortium, AECL-IT.

During the construction of Embalse, which began in 1974, CNEA took responsibility for the erection of critical components and systems such as the calandria, the fuel channels, the reactivity mechanisms and the fuel transfer system. CNEA also granted an extension of the take-over date to allow domestic engineering firms to take responsibility for the remaining erection tasks in both the nuclear and conventional islands. CNEA took the role of AECL's main subcontractor for the erection of the nuclear island, both to gain experience and to speed construction.

Also in the third period, uranium exploration was stepped up, and reasonably assured reserves increased to 25 000t U_3O_8. Meanwhile, the capacity of the Malargüe mill was tripled, another heap-leaching plant was built at Los Adobes, in the province of Chubut, and a purification plant for uranium concentrates was installed in the province of Cordoba.

During the fourth period, which began in 1977, there was an expansion and intensification of nuclear activity aimed at closing the fuel cycle and securing a domestic capability to design and construct nuclear power plants. To this end, CNEA's budget, and the number of qualified personnel involved in nuclear power, have since 1977, been significantly increased.

Policy and implementation. Decree 3183 of 1977 defined national objectives and policies in the nuclear field. The aim was a nuclear programme that would serve national objectives, such as satisfying future electricity demand (which is expected to grow at an annual rate of eight or nine per cent) by means of hydro and nuclear power, and achieving maximum autonomy in the nuclear field.

To achieve these objectives, the government, in decree 302 of 1979, approved a nuclear programme involving four new nuclear power plants scheduled to start commercial operation in 1987, 1991, 1994-5 and 1997, an industrial plant for the production of heavy water and the necessary installations to close the fuel cycle. By laying down long term policies and commitments, the government sought to promote the active participation of Argentine industry in the country's nuclear programme, thereby, it was hoped, creating the desired national capabilities in all aspects of the design, manufacture and construction of nuclear power plants and associated fuel cycle facilities.

The desire for nuclear self-sufficiency led to the adoption of the natural uranium-heavy water reactor because:

- Unlike the enriched uranium reactor, Argentina is able to develop a full domestic capability in its fuel cycle.
- Its uranium consumption per kilowatt-hour generated is lower than that of enriched uranium reactors.
- It offers the possibility of greater participation by domestic industry.

In May 1980 CNEA and KWU of Germany FR signed contracts for the import of supplies and services for a 745MWe natural uranium, heavy water, pressure-vessel unit, which is expected to start commercial operation at Atucha in 1988. The domestic supplies and services for this plant are the responsibility of CNEA. Atucha II is thus the first Argentinian nuclear power project not to be constructed on a turnkey basis.

In October 1980 an engineering company was established to take on the role of main contractor for design and as architect-engineer. This company is at present in charge of the construction at Atucha II. Equally, a private company is manufacturing the two steam generators, three moderator coolers and the pressurizer for Atucha II.

CNEA is at present planning a feasibility study of a pressure tube reactor that would both enable the experience so far gained by Argentina to be used in design, and allow maximum domestic participation in construction.

Keeping pace with these developments, the CNEA, which also performs a regulatory role, has gathered operational and regulatory experience in radiological protection and other aspects of safety. CNEA has established national safety criteria, and is an active participant in several international bodies on safety standards, such as the International Commission on Radiological Protection and the International Atomic Energy Agency (mainly its NUSS programme).

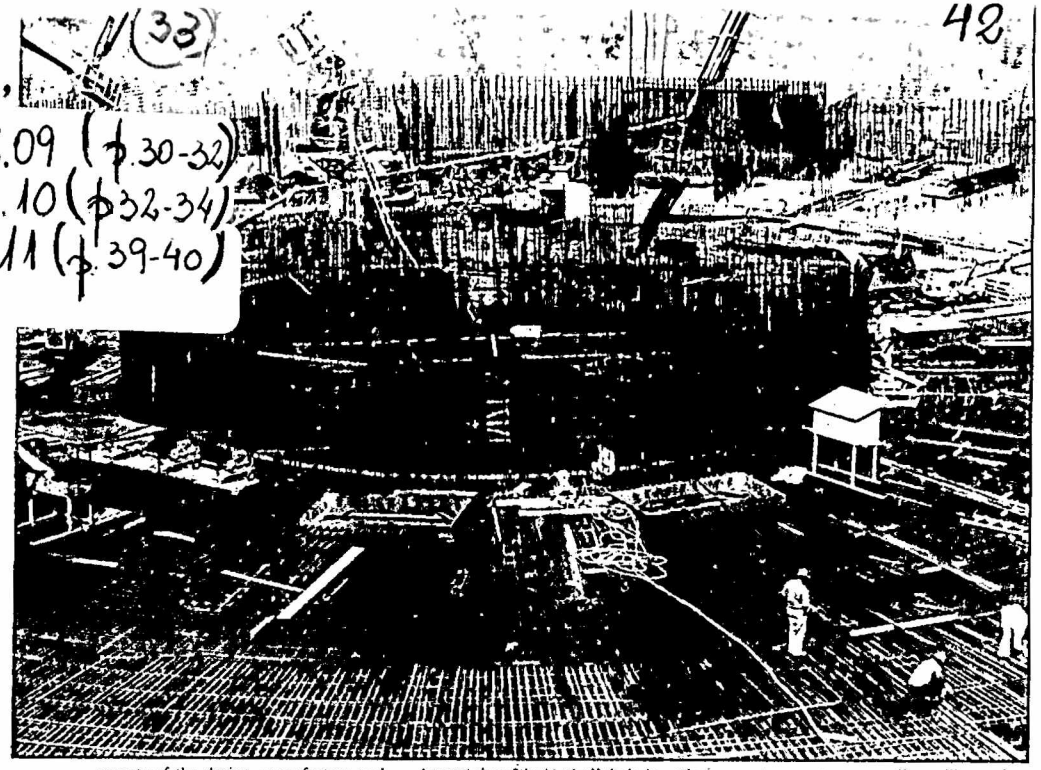
To support the industrial development of a nuclear power industry, a formal curriculum of nuclear engineering has been established at the Institute of Physics. A 500kWt research and teaching reactor was expected to be inaugurated in August.

Fuel cycle. An evaluation of Argentina's uranium reserves has suggested that, in spite of using natural uranium-heavy water reactors, supplies will not last beyond the first decades of the next century. As a result, it was felt necessary to make use of the plutonium in spent fuel, either by recycling or by future use in FBRs.

CNEA consequently has a pilot scale reprocessing plant in an advanced stage of construction, cold commissioning is scheduled for early 1983, with hot operation by mid-1984. This plant will help Argentina to develop the technology for the fabrication of mixed-oxide fuel.

Argentina has been the subject of strong external pressures seeking the abandonment of her reprocessing activities, which have been labelled as proliferation. Argentina's responses has been that in view of the severe restrictions on the transfer of sensitive nuclear technologies, she cannot leave to the good will of more technologically advanced countries her right to obtain plutonium and use it at the time and in the amounts she may deem necessary for solely peaceful applications. Further, Argentina seeks to become an exporter of nuclear technology, and does not wish to enter an increasingly competitive market deprived of a very important part of the fuel cycle.

Argentina has decided to prospect, mine and produce uranium concentrates



A recent view of the Atucha II site in Argentina

Authors

The articles in this feature are written by the following authors:

Planning for nuclear self-sufficiency
Carlos Castro Madero, President, Comision Nacional de Energia Atomica.

Contracts for plant and fuel
U. Fischer, Project manager, Kraftwerk Union; H. Golan, Project manager, CNEA; N. Pieroni, Project manager, CNEA.

Extensive use of PWR technology.
U. Fischer, K. Frischengruber, O. Martner, H. Lenz, C. Steinert, G. Ulrych, KWU.

Good experience of transferring technology
H. Leibovich, CNEA, J. Coll, ENACE, K. Backhaus, KWU.

sufficient to serve the needs of the nuclear programme. At present, reasonably assured reserves of 30 000t U_3O_8 have been established, and concentrates are being produced at the rate of 180 to 220t U_3O_8 per year. Argentina is installing plants for uranium concentrate purification and UO_2 production. CNEA will use two 150t/y UO_2 lines, both of which were due to start operation in 1982. One has been purchased from Germany FR, while the other is based on domestic technology.

Following successful fuel element production in a pilot plant (240 elements are presently in use at Atucha I with no problems) an industrial fuel fabrication plant at Ezeiza was inaugurated in April (see *NEI*, May 1982, p8). In developing domestic technology for the production of zircaloy cladding and other structures, zircaloy ingots have been produced, and an industrial zircaloy-tube manufacturing plant is expected to be commissioned in 1983.

Argentina also seeks to establish the necessary infrastructure for fuel element fabrication. High and low pressure test loops have been installed and preliminary designs for hot cells for the analysis and inspection of irradiated fuel elements have been completed. Meanwhile, to develop the technology for zirconium sponge production, a 1t/y pilot plant has been in operation at the Bariloche Atomic Centre since 1978.

A 2t/y pilot heavy water production plant, heavily instrumented for monitoring, is in an advanced stage of construction and is expected to start operation in 1983. Experience with this plant will serve as a basis for future plants that will complement the 250t/y industrial plant now being built in the province of Neuquen by Sulzer Brothers on a turnkey contract with the CNEA signed in March 1980. This plant is expected to start operation in 1984.

Argentina has also commenced the necessary studies to determine the appropriate site and design basis for a repository for high level waste. After a survey of 200 potential sites, a location in the province of Chubut has been selected for further studies to confirm its suitability.

International policy. Argentina does not recognise that any country should occupy a privileged position, especially if this position is based on the manufacture of a nuclear explosive before a given date. Argentina has thus refused to sign the Non-Proliferation Treaty, which pretends to maintain such privileges in perpetuity, thereby adversely affecting the principle of the legal equality of all States. Argentina considers the NPT to be discriminatory, in both its origin and its application.

Argentina supports world efforts towards total nuclear disarmament and vertical and horizontal non-proliferation, but does not renounce the right to develop nuclear explosives, with guarantees that they will be used only for peaceful purposes, if that may contribute to the development of the country.

Argentina proposes that the best way to prevent proliferation is the expansion of international co-operation through the transfer of technology concerning the peaceful uses of atomic energy, linked to the application of IAEA safeguards on transfers, but without discriminatory restrictions. The IAEA safeguards system is an adequate way to ensure non-proliferation: the technology and equipment transferred under safeguards generate naturally a network of controls involving an increasing proportion of national nuclear facilities. Additional requirements, such as restrictions on the transfer of certain technologies, or conditions such as "previous consent", especially when adopted unilaterally, introduce an element of arbitrariness and discrimination.

It is not reasonable to discriminate and expect the victim to make no attempt to free himself. As a result, such "antiproliferation" measures have an effect opposite to that which was intended.

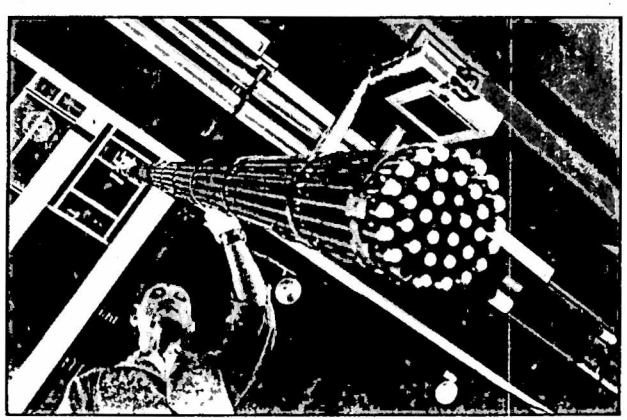
We maintain that non-proliferation assurances and assurances of supply are interconnected. It is unrealistic to expect developing countries having important nuclear programmes to extend a blank cheque on safeguards (such as the NPT or full-scope safeguards) without receiving assurances from relevant countries concerning the supply of technology, equipment and services.

Discriminatory antiproliferation measures have paralyzed international trade. Nuclear programmes in developing countries must be promoted by effective assistance, without connotations of hegemony or supremacy, and without trying to discourage important phases in such programmes.

The philosophy proposed is not merely declamatory. So far as has been possible, Argentina has put it into practice by giving support to Latin American countries who have requested it, through fellowships, expert and scientific visits and by financing some of the assistance projects submitted by these countries to the IAEA which the Agency did not fund.

A relevant example of this co-operation is the construction, jointly with the Peruvian Nuclear Energy Institute, of an Atomic Research Centre 30km from Lima. The centre has a 10MWt research and irradiation reactor with a radioisotope production plant, physics, chemistry and biology laboratories, and a national centre for radiological protection and nuclear safety. The experience of this joint project has opened the way for similar contracts with other countries.

A fuel element assembly made at the Ezeiza plant in Argentina



Contracts for plant and fuel

In October 1979 the Comisión Nacional de Energia Atómica (CNEA) signed a letter of intent with Kraftwerk Union (KWU) for the purchase of a nuclear