

TRAINING PERSONNEL FOR NUCLEAR POWER STATIONS IN ARGENTINA

*NELLY H.A. DE LIBANATI, MIGUEL A. BRUGO,
and ALBERTO J. LOBATO*

Training Department

Central Nuclear en Atucha - CNA

Direccion de Proyectos

Comision Nacional de Energia Atomic - CNEA

Argentina

ABSTRACT

This paper describes how the Comision Nacional de Energia Atomica-CNEA, an Institution with 26 years of experience in the fields of nuclear research, development and training, faces the problem of preparing the staff for the Central Nuclear en Atucha-CNA, already in operation, and for the other Argentinian Nuclear Power Plants still under project or construction.

1. HISTORY

This is simply a record of how a developing country is solving its specialized personnel training problems in a technology almost exclusive to developed countries.

When the CNA construction was decided upon, CNEA faced the problem of forming the professional and technical crew for a nuclear power station. Personnel with experience in conventional thermal stations were selected and taught nuclear reactor engineering, physics and basic concepts of radiological protection. The group was completed by CNEA personnel with experience in these subjects and in materials technology. The whole group obtained specific training for the CNA in Germany under the contractor's responsibility.

Back in Argentina, all of them took part in the Plant commissioning.

No calculation had been made for possible dropouts, thus by October 1973, when the reactor was first loaded with D_2O , the group trained abroad was smaller than at the outset. At this time the urgent necessity of beginning integral training, planned in accordance with the nuclear program requirements, became evident. The training had to be capable of being quickly put into practice to meet the most urgent needs, and also endowed with a strong dynamism to allow a search for better programs by trial and error.

This record describes action and programs which resulted from decisions made according to the circumstances at each moment; hence its commentary nature.

2. REFLECTIONS ON THE PLANT ORGANIZATION CHART ANALYSIS

The CNA Organization chart includes: A Plant Manager; one Operation and one Production Assistant; Operations, Mechanical Maintenance, Electrical Maintenance, Regulation and Control, Safety and Health Physics, Technical, Training, Civil Works, and Administration Department Superintendents. In order to simplify this comment we shall not consider the Administration and Civil Works Departments. The Operations Department operates in three shifts with 6 crews of 13 people per shift, requiring a total of 12 engineers, 42 technicians and 24 assistants. The rest of the Departments require a Chief engineer, assistant engineers, supervisors, technicians and workers.

This organization chart therefore demands personnel at the following levels:

- 1) experienced university level
- 2) experienced technical level and
- 3) specialized worker level.

In addition, the supply of assistants for some duties permits the incorporation of personnel at:

- 4) recently graduated university level
- 5) recently graduated technical level.

A promotion system based on the above mentioned possibilities was thus established

As progress is made in setting course programs, the knowledge level for each position and the theoretical and practical tests necessary for promotions are being determined.

It should be mentioned that the part of the organization chart taken into account requires 271 people, while the first organization chart presented by the contractors for the CNA consisted of 104 people to handle equivalent responsibilities.

Even if this minimum organization chart could assure short-term economic functioning, it eliminates the possibilities of incorporating personnel at levels 4 and 5. In the long-term it therefore would be harmful to the interests of a country depending on a single nuclear power plant to obtain experience and to train personnel.

As we said above, at the end of 1973, when the reactor was near to reaching criticality, the CNA could rely on a minimum of trained staff but there were no reserves to replace those who left to take up assistant positions. Besides, it was time to start personnel training for the Central Nuclear en Embalse-Cordoba.CNE -C.

Facing this demand, an ideal plan was written which included courses ranging from the management level down to adult primary education. Everyone knew that this plan should be implemented only gradually, according to the most urgent needs. The strongest restriction was to arise from dependence on a single nuclear power plant: the CNA, and a single group of professors: the engineers who knew how to operate it.

In fact we set up a permanent program of preparatory courses for engineers and technicians and a dynamic course program.

3. SCHEME FOR OPERATING PLANT PERSONNEL IMPLEMENTATION

3.1 University graduates

The experience of the original group engaged for the CNA showed that it was difficult to compete with the utilities or with industry in obtaining experienced engineers. In view of this, in 1973 it was decided to start a program for recently graduated or young engineers under thirty.

Despite the absence of regular programs for nuclear specialization^{*}, Argentine universities produce a considerable number of electrical, electronic, industrial, mechanical, and chemical engineers, physicists, and scientific computer specialists. This gives a choice of professionals with a good background in the engineering sciences.

It was then necessary to choose the appropriate training to produce Nuclear Power Plant engineers. A glance at the organization chart offered two options:

- a) to train specialists to fill specific positions with the exact knowledge needed to accomplish those duties and on the assumption that they will continue in that speciality;
- b) to train flexible professionals providing them only with sufficient knowledge to join the Plant as training assistants, and assuming that in the future they could choose specialties and even change them according to the nuclear plan requirements.

This second option was chosen and a unique program set up independent of the applicant's university career.

Looking again at the organization chart, the question arose of how to face plant training after the theoretical cycle.

The peculiar characteristics of the Operations Department led to the decision that, as a rule, work in the Plant would begin with assistantship to the Operations Shift Supervisor. In that duty, the trainee must be tested in the qualifications required to perform his duties efficiently, quickly, and safely. He must get the feeling of the plant and show knowledge of systems and components. While helping in the operation, he must show his leadership abilities, his reactions in cases of unexpected contingencies, and his attitude towards safety. Only then can he be assigned to other duties, with the assurance that, after having gone through the Operations Shift, he has a knowledge of the whole of the Plant, has witnessed the interdependence of all the systems, and has once seen that a small repair, a simple perforation or a welding, a simple operation such as valve opening, has resulted in a Plant Shutdown.

* (Except for the Physics Master's at the Institute of Physics Dr. J. Balseiro, Bariloche Atomic Center, from Cuyo University).

Whichever department to which he is appointed, he will have learnt that that department must work so that the Plant can operate safely and that the Operations Department has the production responsibility.

As regards methods of promotion, the sequence would proceed from the Operations through the Maintenance and Technical Departments after the Engineer has gained thorough plant operation experience.

3.2 Technical Personnel

The involvement of experienced technicians does not present as many difficulties as it does with professionals. This is partly due to the fact that in this case remunerations are competitive with those in the open labor market. It is possible to take on technicians with experience in the operation of thermal plants, or in mechanics or electrical maintenance and, after an accelerated training, to assign them to specific duties. For new technicians, a promotion system which plots their careers through the plant is planned in advance.

The high number of technical school graduates gives a wide choice.

After the basic courses described below, participants begin to carry out subordinate duties and gradually acquire general knowledge of the plant. They finally become qualified to perform duties at the technical level.

3.3 Workers

The fact that a plant has the necessary specialized workers for its operation and for its planned requirements for the near future does not justify the immediate commencement of training courses for that purpose. However, talks may be started with professional training schools on the possibility of starting courses such as welding or piping, by means of an accelerated training program.

4. STAGES FOR PERSONNEL IMPLEMENTATION FOR PLANT OVERHAUL, CONSTRUCTION AND COMMISSIONING

Facing the problem of carrying out the CNA maintenance and construction, and the CNA II project, a promotion procedure or a reconversion program for CNEA or CNA personnel is preferred to the induction of new personnel from industry.

Some CNA personnel could, according with their specialities, be assigned to maintenance overhaul, construction or commissioning groups. These different commitments would be challenging and must be considered as "on-the-job" training. The last step is to integrate specialist positions in the Technical Department of a Nuclear Plant or Plant design group. This makes it clear that the whole career of an engineer should be set as his own "continuing education" program.

That is why a developing country with one or few nuclear power plants in operation

should consider them as school plants or continuing training centers for managed selection and promotion.

This human resources policy is the best investment the country can make. It is unavoidable because turn key plants can be bought, and trained operation crews can be obtained for them, but no additional engineers or technicians can be obtained in the same way as are components spare parts.

The law which authorized the erection of CNA allowed for this: "That the nuclear plant to be constructed acquires a particular policy in the training of personnel that shall be required in the immediate future before the possible construction of great power reactors. At the same time it will permit and stimulate essential technological advance in a field in which the Nation must prepare itself adequately and at the proper time".

According to this policy, the effort made since 1973 for personnel training made it possible, in December 1976, to accept the responsibility of managing the CNA programmed overhaul.

Trainee engineers and technicians took part in the works more or less as qualified assistants, their tasks acquiring a true "on-the-job training" role. In addition, the utilities that are planning to construct Nuclear Power Plants are carrying out the reconversion of existing personnel or the training of new personnel through the programs described below.

5. PERMANENT ANNUAL PROGRAM OR PREPARATORY COURSES

5.1 For Engineers

Since 1974 four "Courses on Nuclear Power Plants Functioning and Operation" were dictated. Sixty-one engineers have been graduated after one year's study, and another twenty-eight will finish before 1978.

This course comprises:

- 1) A general cycle including: introduction to nuclear reactors; nuclear and conventional safety and health physics; and thermodynamics and fluids mechanics.
- 2) A CNA cycle starting with an introduction to the plant, during which the student becomes familiar with the plant through a combination of visits and classes, followed by a description of the CNA Reactor and a plant system description.
- 3) A practical selective cycle: This is carried out by trainees attached to the Shift Supervisor Assistant or in other assistant positions.

It was decided that, from the beginning, the course would be held in the training center near the plant so that the trainees start to get the feeling of life at a nuclear power plant. No special facilities have yet been needed. Temporary buildings from the construction stage are used as classrooms.

A Library documentation service and an electronic laboratory are also provided. Qualified CNA engineers with teaching ability are chosen as professors.

5.2 Technicians' Course

Up to the present only two courses of different level and purpose have been dictated; but with such experience a plan for "Introduction to Nuclear Plants" has been prepared and is working out at present. The purpose of such a plan is to introduce the technician trainee to the nuclear plants problem so that, whatever his speciality and career in the plant, he may obtain:

- 1) an overall view of the whole plant operation and simple knowledge of his place in it.
- 2) a basic knowledge of mathematics, physics, mechanics and other theoretical tools possibly acquired at school, or forgotten.
- 3) the safety knowledge necessary for work in the plant.

As with the engineers, this basic cycle comes before entrance to the plant and lasts about three months. The trainees then enter the plant as assistants to the positions it is assumed they will fill on completing the course.

5.3 Licensing

The engineers' and technicians' courses include all the theoretical knowledge necessary for the examinations for the license required for those occupying these positions.

Practical knowledge is acquired during plant training which follows the courses. This permits the trainee to obtain specific authorization to operate the CNA.

6. DYNAMIC PROGRAMS FOR PERSONNEL RETRAINING

Various programs allow the training and retraining of replacement personnel and the updating of experienced staff. Some examples follow.

6.1 A course on the "600 MW Candu Type Reactor", similar to the CNA reactor, to introduce people to the new power plant now under construction. Attendance is mostly from CNA, CNEA and by nuclear industry engineers connected with the construction.

6.2 New programs are started whenever one or more technicians or engineers are required to perform new duties. Of great help in "framing" these courses are the printed materials prepared for the permanent courses. In fact, more than 100 titles were published on subjects covered in every course. The Training Department Instructors selected the most practical and efficient program from these.

6.3 The Training Department watches for and announces details of courses and seminars dealing with subjects related to nuclear power plants held both at home and abroad, and promotes attendance at them by plant personnel.

6.4 Diffusion Seminars

From questions put by utilities personnel, there is clearly a need to communicate the significant features of, and differences between, nuclear and thermal power plants. Accordingly, a one-day Diffusion Seminar was organized. It consisted of a theoretical presentation of operation principles, radiological safety concepts and economic implications followed by a visit to the plant. Strong attendance from the nuclear industries, apart from the utilities personnel, necessitated several repeat seminars. Suppliers and manufacturing companies were asked to arrange seminars on their products, at which theoretical explanations by specialized engineers could be given.

7. OTHER CONSEQUENCES OF THE TRAINING

Certain goals beyond the simple teaching of courses for technical levels were achieved:

7.1 At the Plant

The work developed over the past two years tended:

7.1.1 To achieve effective participation of the staff in training. This participation was gradual, but of exponential growth. People realized that teaching in the courses obliged them to be informed and to go deeply into relevant subjects. Besides, the training plan favoring displacement and promotion produced an automatic growth of the plant personnel background.

7.1.2 To develop a receptive attitude in administrative and managing personnel. Although it looked as if the planning were assigned exclusively to the technical level, its influence taught all plant personnel. In fact, the administrative personnel that may attend diffusion seminars such as those described, or short courses on the Plant description, realize that their role (for instance, when quickly arranging the purchase of a spare part) is vital and may advance or delay a plant start-up. In a developing country, in which the infrastructure is generally deficient, this active and "clever" copartnership of the "whole" personnel can be encouraged by the Training Department.

7.1.3 To reinforce a responsible attitude towards safety. Safety, in nuclear plants is specific and particular in character, and should be taught from the beginning of individual training and revised through review courses. A deep safety program in the permanent courses, and a special recommendation to instructors to emphasize the way in which safety concepts are taken into account from the design and manufacture stage up to systems operation, contribute to the initial background on safety.

For retraining, compulsory half-yearly courses have been separated into two levels, one intended only to reaffirm basic concepts, and the other, for managing personnel,

which describes and discusses the last six months' experience in plant safety.

7.2 At CNEA

The work developed in these two years leads to:

7.2.1 Interaction with CNEA research and development groups through the same procedures interlinked for interaction with industry.

7.2.2 The reconversion of personnel from the R & D area who show aptitude for work in nuclear plant operation.

7.2.3 The assignment of technically competent engineers not suitable for nuclear plant operation to research and development duties.

7.3 Outside CNEA

The work developed in these two years has prepared the way for:

7.3.1 A fluent dialogue with the industries related to nuclear engineering, through oral communication between experienced professionals; training of fresh engineers through these programs and the exchange of written information.

7.3.2 The assignment of training for welders, pipe-fitters and other skills, as well as the continuing education for adults at public educational establishments and to have the universities arrange basic nuclear engineering courses.

8. CONCLUSIONS

In a developing country the nuclear training planning cannot be an exact replica of programs carried out by more developed countries, but original solutions must be found to solve the individual problems. The aim of our training program is, therefore, not only to fulfill the needs of the operational crew for nuclear power plants, but to use this experienced personnel for the construction, commissioning, and design of future projects.