

TRAINING COURSES FOR LATIN AMERICAN HUMAN RESOURCES IN SUBJECTS
RELATED TO RERTR PROGRAM

T. Pérez, S. Harriague, E. Pérez
Comisión Nacional de Energía Atómica
Buenos Aires, Argentina

ABSTRACT

Between 1984 and 1986, the Atomic Energy Commission of Argentina organized three post-graduate courses on research reactors, aimed at the Latin American region. Twenty one university graduates from Brazil, Colombia, Chile, Mexico, Peru, Uruguay and Venezuela, and six from Argentina, attended the courses. Lecturers were in all cases staff members of CNEA.

These activities of Manpower Development in the Latin-American Region are part of an overall program starting in the early sixties at CNEA's Development Branch.

The interest shown by many Latin American countries in these courses, the technical training received and the technical cooperation established among the participants, are taken as a measure of the success obtained.

INTRODUCTION

Manpower development has been priority in the Development Branch of the Atomic Energy Commission of Argentina (CNEA) since its beginnings in the late fifties.

The Post-Graduate Courses on Metallurgy are probably the activity in this area showing more continuity. Since 1962, ten Pan-American Courses on Metallurgy, five Courses on Advanced Training in Metallurgy and six Courses on Metallurgy and Materials Technology have been organized. These yearly courses have not only been the basis for the training of most of the university graduates currently working at CNEA's Development Branch, but have been attended by personnel belonging to many Research and Development Institutes and private corporations of Argentina and of other Latin American countries. In 1969, the Organization of American States (OAS) Multinational Program on Metallurgy started. The OAS supported the course and, by a system of fellowships, made possible the participation of university graduates from all the Latin American countries.

Through the last twenty five years, more than three hundred attendants, with a high percentage of foreign graduates, prove that these courses are successful and necessary.

Since 1976, the Course has a modular structure, allowing for training on specific areas. More than two thousand five hundred graduates have attended different moduli of the Course.

In the sixties, most of the Faculty in the Course were experts from the developed countries, but during the last fifteen years, teaching responsibility is shared by the researchers of CNEA's Development Branch with some support from Argentinian Universities, Research and Development Institutes and Corporations.

CNEA has also organized the Post-Graduate Course for "Specialists in Welding Science and Technology". This special qualification did not exist in the country universities, and its need was a result of the technological demands arising from the construction of Nuclear Power Plants. In 1981 the First Course on Technology of Welding was organized together with the Argentinian Steel Institute (IAS); the Second Course was organized in 1983. Since 1984 the School of Engineering of the University of Buenos Aires has participated in the organization of these courses and a certificate of "Specialist in Welding Science and Technology" is issued to each participant. All professors are argentine experts on the different topics. Ninety university graduates, coming from government owned and private corporations, have attended the Welding Courses.

Another activity has been the work on Masters and PhD thesis done in the laboratories of the Development Branch, under the supervision of its staff. Seventy eight PhD thesis and seventy eight Master thesis have been completed since 1960.

The ten Post-Doctoral Seminars organized between 1975 and 1984 are another relevant precedent in the Manpower development activities. The aim was the updating of graduates already active in specific areas of materials science. Each seminar lasted two months, and each topic was presented by an international expert on the subject. A total of two hundred and sixty one graduates attended the seminars, 43% of them coming from Latin American countries other than Argentina. Since 1985 this activity has continued in the form of week-long Colloquia. Here, the aim is to promote the discussion of current research lines between Latin American specialists and international experts, in order to promote cooperation and updating according to the international latest developments. Two Colloquia have been organized in Argentina, and a third one in Chile by the Catholic University of Santiago.

A continuous activity of Manpower development has been carried on in areas of high technological interest, as Non-Destructive Testing and Welding Inspection. Initially, under the scope of the United Nations Development Program (UNDP) (from 1972 until 1979), and later

on under the Regional Project on Non-Destructive Testing (also supported by the United Nations), staff members from the Non-Destructive Testing Department of the Development Branch have lectured in approximately three hundred courses with six thousand attendants in the country, and in twenty one courses organized in the rest of Latin America and the Caribbean Area.

Three courses on Welding Inspection, with an attendance of forty five participants have been organized since 1983, the last one in coordination with the Misiones National University in the North-East of the country.

Both Welding and Non-Destructive Testing demand not only the training of personnel, but also a standardization procedure for the qualification and certification of the available human resources. In this respect, the CNEA-IRAM Standard Y500-1003 for "Personnel qualification and evaluation of Certifying Authorities for Non-Destructive Testing", currently under revision, was elaborated. Eight hundred and eighty certificates on different NDT techniques have been issued since 1978. CNEA has established in 1982 a system for training, qualifying and certifying personnel working in welding in the nuclear and high technology industries. More than six hundred certificates have been issued to welders.

It was within this wide program on Manpower Development that CNEA decided, in 1984, to organize and offer to the other Latin-American countries the Course on Technology of Fuel Elements for Research Reactors.

THE COURSES ON FUEL ELEMENTS FOR RESEARCH REACTORS

During 1984, 1985 and 1986, three Courses on Fuel Elements for Research Reactors were offered by the Development Branch of CNEA to the other Latin American countries. Both the organization and lecturing of the three courses was done by members of the staff of CNEA.

In what follows, a brief description of the courses, all of which lasted three months, is given:

- a) Courses on "Technology of Fuel Elements for Research Reactors" (1984-1985).

The first two courses in the series were very similar. In both cases, a series of lectures were given to present the basic knowledge necessary for the design and performance analysis of the fuel in a research reactor.

The areas covered in this introduction were:

- Physics of the core, covering: neutron physics in a research reactor and analysis of shielding.
- Thermal-hydraulics of the research reactor core, both under normal operation and in accident conditions.

These topics were presented by members of the staff of the Nuclear Reactors Department of the Nuclear Power Stations Directorate (DCN) of CNEA.

Afterwards, the following specific fuel topics were covered:

- Design and engineering of fuel elements for research reactors.
- Structural materials.
- Fuel materials: aluminide, silicide and uranium oxides.
- Materials for control devices.
- Fabrication and quality control of fuel for research reactors.
- Fuel performance in research reactors.
- Irradiation tests of fuel elements.
- Use of research reactors for experimental irradiation of materials and fuel elements. Irradiation devices and tests.

These subjects were covered mainly by members of the staff of the Fuel Elements Department with participation of some members of the Materials Department, both belonging to the Development Branch of the Research and Development Directorate (DID) of CNEA.

In both courses, the differences arising from the use of high enrichment fuel (approx. 90% U235) or low enrichment fuel (approx. 20%) were systematically pointed out. The steps necessary for conversion from high to low enrichment fuel were also presented.

Participants to the courses not only attended the lectures but also performed experimental work in the laboratories of CNEA's Development Branch. As an example, all steps in the production of a mini-plate were done by the attendants, starting from powder and ending in the final quality controls.

Seventy six percent of the attendants to both courses were from Latin American countries other than Argentina. Table I shows the origins of the attendants, which in all cases were staff members of the National Atomic Energy Agencies.

CNEA offered fellowships to all foreign attendants covering their living expenses in Argentina. In the first course, travel expenses were covered by each country, while in the 1985 course, thanks to the efforts of the International Affairs Office of CNEA, travel expenses were covered by the Organization of American States (OAS).

Table 1

Country	Number of participants		
	1st Course	2nd Course	3rd Course
Argentina	-	5	1
Brazil	1	2	2
Colombia	1	-	1
Chile	6	2	-
Mexico	-	1	-
Peru	1	1	1
Uruguay	1	-	-
Venezuela	-	-	1
TOTAL	10	11	6

b) Course on "Use of Computers in the calculation of research reactors" (1986).

The aim of the 1986 course was training in the computer analysis of research reactors. The course included lectures as well as calculations performed by running different codes in CNEA's Computer Center.

The topics covered in this course were similar to the ones in the previous courses:

- Neutron physics and shielding. Use of the codes: WIMS, EXTERMINATOR, MERCURE and ANISN.
- Thermohydraulics. Use of the codes: PARET, LOFA and others developed at CNEA.
- Fuel Elements for research reactors. Design criteria, steps and design evaluation. Use of the DISTEM code and others developed at CNEA for design and seismic analysis.

As in the previous courses, both the lectures and the computer work were under staff members of the Nuclear Reactors Department and Fuel Element Departments of CNEA.

Through the International Affairs Office of CNEA, this course was included in the ARCAL project of the IAEA of the United Nations, a regional project for Latin America and the Caribbean Area. The IAEA covered both the travel and living expenses of the foreign participants.

During the three courses, seminars on the research and development activities of CNEA in power reactors and fuel were presented. Visits to different nuclear facilities in the country were organized.

The interaction between foreign participants and CNEA's working groups was encouraged, with the aim of establishing future cooperation.

CONCLUSIONS

In this three courses, the experience of thirty years of work in CNEA in the development and production of fuel for research reactors was presented to the other Latin American countries. As a matter of fact, these courses became an open technology transfer from Argentina to the Latin American region.

On the other side, and as usual in this type of activities, the courses have become the basis for future technical cooperation in this area.