Portuguese Research Reactor (RPI) Exploitation and Operation

Introduction

The main task of the RPI Exploitation and Operation Group was to assure *a safe and reliable operation of the reactor*. With this objective the articulation of the activities of the RPI Operation Group with those of the Modelling and Simulation Group and with those of the Radiometry Group, of the RPI, is of paramount importance as it also includes:

- updating of the safety conditions of the reactor equipment and installations, and
- technological assistance to the reactor users.

The Portuguese Research Reactor (RPI) was operated in a two shifts per day schedule, from 9 a.m. to 12 p.m. In 1997 it was operated 227 days, accumulating a total of 2322 hours.

The reactor was mainly utilised by ITN research groups (Chemistry, Physics and Research Reactor groups) and to a smaller extent by Faculties of Science of Universities of Lisbon and Coimbra, to perform 360 irradiations, corresponding to 630 hours of utilisation.

Other activities carried out in order to fulfil the main objectives include training of personnel. Training Course for Reactor Operators was initiated with 11 potential candidates.

Team

Researchers–	3 (PhD or equivalent)
Reactor Operators –	4
Technicians –	1

Publications

Conf. Commun. –	3
Internal Reports –	4

	10^3 PTE
Expenditure:	**14.613**
Missions:	1.254
Others Expenses:	4.365
Hardware & Software:	222
Other Equipment:	8.772

		10^3 PTE
Funding:		**14.613**
OE/ITN	OF	7.227
	PIDDAC	7.386

Operational Limits and Conditions of the Portuguese Research Reactor (RPI)

J. Oliveira, J. Menezes[†] C.R. Carlos, E. Martinho, R. Trindade
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

(See RPI - Modelling and Simulation)

ITN/RPI-R-97/46

Estudo do Reactor Português de Investigação (RPI)

J. Menezes[†]
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
A description of the Portuguese Research Reactor including the reactor proper and its control and main auxiliary systems (radiation monitoring and ventilation) is presented.
A description of the theoretical bases and the procedures used for control rod calibration is given. Details about a critical experiment and the measurement of the thermal power of the reactor are also presented.

ITN/RPI-R-97/48 (in portuguese)

Determination of Hydrogen in Steel Through Neutron Dispersion

A J.G. Ramalho
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
Experiments performed with a beam of neutrons extracted from the thermal column of the RPI, cross section 4x1 cm, aiming at determining the concentration of hydrogen in steel using the anisotropy of scattering in that element and an active detecting system must fulfil are analysed and emphasis is placed in the importance of maintaining fixed the counting geometry on the reproductively of the results. It is noted that the results are sensitive to the size of the sample and to the hydrogen concentration.
In the experimental conditions used a sample of 5 gr of Fe, containing 100 ppm of H will generate, in about 2000 s, a signal five times as large as the statistical error of the counting.
To increase the sensitivity and reproductivity of the results increasing the neutron flux, particularly the epithermal component, and assuring an sample positioning are required.
It is expected that using the beam to be extracted from the tube D1 and detectors more efficient for epithermal neutrons it would be possible to detect hydrogen at the ppm level in a counting time of a couple of thousand seconds.

ITN/RPI-R-97/47 (in portuguese)

[†] Deceased in July 25, 1997

The Tchernobyl Accident: 10 Years After

Fernando Cardeira
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
The disastrous accident that occurred at the Chernobyl nuclear power plant on 26 April 1986 has been presented in previous works in 1987 (O acidente na central nuclear de Tchernobyl - Nota Técnica DEEN nº 42, Fevereiro 1987) and in 1994 (O acidente de Tchernobyl: causas e consequências - ITN/DEEN-N-94-14). This work gives an updated view of the accident, its causes and consequences after 10 years of extensive scientific examination by the international community. The author attended the *International Conference on One Decade after Chernobyl: Summing up the Consequences of the Accident* held at Vienna, Austria on 8-12 April 1986 which recapitulated the International Chernobyl Project of 1990. The Conference also took account of the findings of two related conferences: WHO International Conference on the Health Consequences of Chernobyl and other Radiological Accidents (Geneva, 20-23 November 1995) and the First International Conference of the European Commission, Belarus, the Russian federation and Ukraine on the Consequences of the Chernobyl Accident (Minsk, 18-22 March 1996).

ITN/RPI-N-97/21

Status of Storage of Spent Fuel at the Portuguese Research Reactor (RPI)

Fernando Cardeira
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
A short description of the situation of the spent fuel stored at RPI reactor pool with information about fuel inventory, fuel specifications, fuel irradiation history, corrosion concerns and the existing facilities that could be used to prepare the shipment of spent fuel was made.
Information was provided about the type of assistance that may be needed to prepare spent fuel for shipment, the plans and status for replacement of the existing HEU core with an LEU fuelled core and the plans for final disposition of the spent fuel.

Communication to: *IAEA Interregional Training Course on the Technical and Administrative Preparations Required for Shipment of Research Reactor Spent Fuel*, Argonne, USA, 13 - 24 January 1997.

Portuguese Research Reactor - Overview 1996/97

Fernando Cardeira
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
A short review of all the activities related to the safe operation of the reactor is presented. Complete information about the utilization of the reactor and on the modifications and upgrading of the reactor is part of the report. The problems related to the fuel cycle, the maintenance, training and future developments are shortly described.

Communication to: 8th *Annual Meeting of EAES-RROG (European Atomic Energy Society - Research Reactors Operators Group),* Budapest, Hungary, 5-6 June 1997.

Instrumentation and Control of the Portuguese Research Reactor

J.G. Marques
Instituto Tecnológico e Nuclear e Centro de Física Nuclear da Universidade de Lisboa

Abstract
A short review was made on the status of the instrumentation and control of the RPI reactor. Discussions were held on the possible improvements of the current system taking into account its age and current safety regulations for research reactors.

Communication to: *IAEA Interregional Training Course on Instrumentation and Control of Nuclear Power Plants,* Forschungszentrum Karlsruhe, Germany, 3 June-3 July 1997

Current Work

Portuguese Research Reactor Safety Analysis Report

Fernando Cardeira
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
As recommended by the International Atomic Energy Agency, in the report of the INSARR mission, the RPI Safety Analysis Report has continued to be reviewed and updated, specially to take into consideration the refurbishment and modernization work done between 1987 and 1990. A final document will eventually be published as an internal document of the Institute after appreciation the RPI Safety Committee.

Portuguese Research Reactor Operating Procedures

Fernando Cardeira
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
The Operating Procedures, as well as the Safety Analysis Report, are an essential documents for the operation of reactors. Parts of the procedures are currently being appreciated by the RPI Safety Committee. Improvements resulting from this reviews will be implemented and a final document will eventually be published as an internal publication of the Institute.

Refurbishments and Modernization of the Portuguese Research Reactor

Fernando Cardeira
Instituto Tecnológico e Nuclear, Estrada Nacional nº 10, 2685 Sacavém, Portugal

Abstract
The report shortly describes the replacements of equipment and improvements that have been introduced since the beginning of the operation of the reactor, the most important of which occurred in the period (1987-1991), with the purpose of improving safety and reliability of the reactor exploitation.
The objective of this paper is to present an overall review of the works performed on RPI reactor during its life time concerning replacements, upgrading and modernization of reactor equipment and installations.

RPI Operation 1997

Month	Operation Time (hours)				Working days	Energy produced (MW.h)
	P < 100 kW	0,1≤P<1MW	P = 1 MW	TOTAL		
January	96,58	0	152,88	249,47	22	153,68
February	129,40	6,45	75,10	211,33	19	77,42
March	137,65	0,13	66,90	204,68	20	68,30
April	52,48	36,45	21,23	110,16	10	25,40
May	135,25	0,25	80,03	215,53	20	81,41
June	164,98	0	63,40	228,38	19	65,05
July	102,70	1,18	78,37	179,28	21	76,51
August	45,12	0,42	37,47	83,00	19	37,99
September	168,70	9,38	31,63	209,72	22	34,25
October	177,07	2,45	60,90	240,42	23	62,91
November	192,60	7,23	25,35	225,18	20	28,64
December	111,10	23,32	30,58	165,00	14	34,02
Total	**1513,63**	**87,26**	**723,84**	**2322,15**	**229**	**745,58**

Use of the RPI 1997
Departments of ITN

Department	Type of utilization	Time (h)	No. of irrad^{s}
Reactor	Dosimetry at RPI	65,41	24
	Th. Col.: Tests for the assay of elements	76,33	26
	Various, including training actions	75,04	26
	Sub-total	**216,78**	**76**
Chemistry	Pollution studies	57,08	7
	Studies for the preservation of rocks	28,17	13
	Studies of the origin of stoneware	47,03	9
	NAA of various samples	97,58	181
	Others, including training actions	39,00	33
	Sub-total	**268,86**	**243**
Physics	Sources for industrial application	26,5	6
	Time of flight spectrometer (ETV)	103,68	21
	Sub-total	**130,18**	**27**
	TOTAL	**615,82**	**346**

External Institutions

Institution	Utilization areas	Time (h)	No. of irrad^{s}.
F.C.T. Un. Coimbra	Sources for studying perturbed angular correlations	1,03	2
F.C. Un. Lisboa	Sources for studying hyperfine interactions	13,56	12
	TOTAL	**14,59**	**14**