NUCLEAR RESEARCH INSTITUTE

Reactor Physics & Engineering Department

NINR -- E 011-89 .

SAFETY EVALUATION

OF THE DALAT RESEARCH REACTOR OPERATION

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DALAT 1989

INTRODUCTORY DOCUMENT

SAFETY SITUATION OF THE DALAT NUCLEAR RESEARCH REACTOR

Reactor Physics & Engineering Department
Nuclear Research Institute, Dalat-Vietnam

After an introduction presenting the essential characteristics of the Dalat Nuclear Research Reactor, the document presents i) the safety assurance conditions of the reactor, ii) its safety behaviour after 5 years of operation, and iii) safety research being realized on the reactor. In the conclusion is underlined the reaffirmation of the safety of this reactor in its different assigned tasks in developing peaceful applications of nuclear technology throughout Vietnam.

1. Introduction

The Dalat Nuclear Research Reactor has been renewed from the Triga Mark II constructed in 1963. Its first start-up realized in Nov. 1983 and its power divergence in Feb. 1984 together with its following operation during the one year warranty period were assumed by Soviet specialists with the participation of Vietnamese staff. In order to increase its power to 500 kW and the thermal neutron flux to 2.E13 n/cm2.s at the central trap, an additional new beryllium reflector has been juxtaposed to the graphite reflector and the natural convection adopted for heat removal has been reinforced by an extracting well installed over the reactor core. This constitutes the principal characteristics of the new reactor together with a complete new reactor control system and a reinforced radiation protection.

The main tasks of the reactor consist of isotope production, neutron activation analysis, reactor physics research and training of reactor staff .

2. Safety assurance

The reactor has been redesigned with an utterly new type of fuel element of hexagonal form. Each fuel element is composed of Uranium-Aluminum alloy of 36 % U-235 enrichment in 3 concentric layers clad with 0.9 mm thick aluminium and with cooling water flowing between the layers and between juxtaposed fuel elements. This fuel assembly structure allows for easy heat removal under natural convection . The heat exchange and the associated air refrigeration tower with a water flow rate of 90 m3/h on the secondary cooling circuit permit to keep the temperature of inlet

water at some degrees over the ambiance temperature for all seasons, as well as to assure the surface temperature of fuel element far below the boiling temperature (cf. table 1).

The control system of the reactor consists of 7 control rods /2 safety rods, 4 compensation rods and 1 shim rod/, an electronic system AKNP (" Apparatus Control Neutron Power ") processing the informations given by 9 neutron detectors and a control - command safety system purposely designed for this reactor by USSR and working on the basis of a 2 over 3 logic .

Table 1. Reactor characteristics

Parameters	:	Values
Fuel	:	Al-U alloy (36 % U-235)
Loading	:	3576 g U-235 (89 elements)
Nominal Power	:	N = 500 kW
Minimum Period set at	:	> 20 sec
Reflector	:	Graphite + Beryllium
Moderator	:	Distilled water
Cooling	:	Natural convection + extracting well
Surface Temp. of Fuel	:	98 degree C max
Temp. of Inlet Water	:	< 32 degree C
Control Rods worth (7)	:	
- Safety Rods (2)	:	4.6 % dk/k
- Compensation Rods (4)	:	10.7 % dk/k
- Regulation Rod (1)	:	0.36 % dk/k
Excess Reactivity	:	8.97 %
Rod Insertion Time	:	< 0.5 sec
Contr.Syst.Response Time	:	< 1sec for Power range 1%N - 110%N

The remaining structural components of the old Triga Reactor in the present reactor, such as graphite reflector, aluminum tank etc..., have been inspected before assembling the new core. The quality of water in the reactor tank is under constant surveillance for pH, conductivity and different ion concentrations during reactor operation or during shutdown period. Before each run the reactor control system is checked for its safety assurance.

All safety specifications and regulations are furnished by USSR in different printed documents, including physical and engineering characteristics as well as construction and operation drawings and descriptions . This document set constitutes the equivalent of a Safety Analysis Report but not writen in the IAEA reqired SAR form.

The last but not least important factor contributing to the safety assurance is the reactor staff. All the twelve operators and shift supervisors have engineer's degree on nuclear physics or nuclear engineering , half of them graduated from abroad.

Other technical staff assuming service and maintenance consists of 4 electronical engineers, 4 chemist engineers, 2 mechanical engineers, 3 electrotechnical engineers, and 10 electricians (among them, 4 technicians for the Diesel generator) and 6 mechanicians.The staff has been trained on the job during reactor construction and assembling period as well as during the start-up and the warranty period in addition to training on Soviet research reactors before these periods for some of them. Furthermore, they are all submitted to yearly control as required by the regulation. Finally, the whole of the reactor staff is highly conscious about the fact that they have in hand the unique and most expensive scientific instrument of the country to promoting the application of nuclear technology for everyone's wealth-fare . So they have always a strong wish to do the best to preserve the reactor safety conditions.

3. Safety behaviour

From the safety viewpoint, after nearly five years of operation, the Dalat Nuclear Research Reactor has shown a satisfactory behaviour. The following figures assert this good perfor-mance (cf. Table 2 , Column 2). The salient contributions to the counterperformance are mainly due to the weakness of electrical network and the effect of humidity in the raining season (cf. Table 2, Cols. 3 & 4) . These are reflected in the numerous shutdowns caused by electrical supply failures (especially due to lightning during the raining-storming season, Dalat being at the 1500 m altitude). Electrical devices and electronic components suffer a lot of humidity. There had been breakdowns of the refrigeration tower ventilator motor and some other pumps, they were replaced by reserve elements during repairs, so that the reactor operation was not affected.

Table 2. Reactor Operation Behaviour

Year (months)	Hours at Power	Number of Failures of	
		Elec.Supply System	React.Contr. System *
1984(9 mths after start-up)	1400 h	10	17 (4)
1985	1722 h	5	17 (4)
1986	1405 h	11	19 (6)
1987(6 weeks for mainten.)	1022 h	14	14 (9)
1988 (to October)	1115 h	11	11 (4)

(*) In parenthesis is the number of failures of control system during operation of the reactor leading to shut down.

For the reactor control system, the most serious events have happened in 1987, one during control system maintenance (12/3/87) and one during pre-starting check up (23/9/87) ; it consisted of an upward movement of one safety rod (AZ-1) after pressing the button DEBL (debloking). It was then decided to shut down the reactor for maintenance during 6 weeks after the first appearance of this kind of event. The phenomenon has not yet been totally understood. It may be due to a random alias in the electronic circuit perhaps due to humidity effect. In Oct.1987 an electronic safe-lock was added to the motor driver the of safety rod AZ-1 in order to forbid its unwanted upward withdrawal. The event is thought not to have possibly affected the safety assurance of the whole system.

Moreover, a programme of inspection of the reactor and its technological systems is planned after four years of operation as postulated by the regulation. In agreement with a Soviet expert mission, this inspection and maintenance programme is postponed to 1989, waiting for the delivery of replacement materials, specially tropicalized electronic components . In the meantime an air conditioner will be installed in the reactor control room.

4. Safety Research

After the Tokyo Symposium on Asian Research Reactors, and specially after the Chernobyl accident, a safety research program was set up for the Dalat Reactor. It was also incited by the fact that the Dalat Reactor is a mixed-type with bulk components heredited from the 25-year old Triga reactor.

The main parts of this programme are :
a) Studying neutron and thermo-hydraulic characteristics and parameters of the reactor, its behaviour under basic accident conditions (theoretical study),
b) Measuring parameters related to safety such as fuel surface temperature with instrumented fuel element,
c) Telescope inspection of reactor tank, horizontal canals and in-core components ,
d) Failed fuel detection,
e) Application of PSA to the Dalat Reactor, from a developing country viewpoint, with a special type of reactor and a severe climatic condition,
f) Writing a Safety Analysis Report of the Dalat Reactor in due form. This SAR had not been written at the moment of the reactor commissioning.

This programme was encouraged by the Agency in the occasion of a short visit to IAEA of the Head of the Reactor Physics and

Engineering Dept. in Nov. 1987, and concretized by i) a granted Research Contract on the principal aspects of the Dalat Reactor Safety (Mr. W. BYSZEWSKI), and ii) a Technical Assistance of the Agency for reactor inspection with an underwater telescope. It was also known about the existence of a research reactor PSA study group composed of 12 countries under IAEA supervision. Such a programme is very interesting to the Dalat NRI.

In Feb. 1988 in meeting the IAEA safety mission conducted by Mr. E. IANSITI in HO CHI MINH city, the motivations of the above mentioned safety research programme were clearly explained, emphasizing the desire of realizing PSA on the Dalat Reactor. It was also discussed the possibility of some hypothetical accidents such as leakage of horizontal beam tube leading to a LOCA or water flooding into the void volume inside the graphite reflector leading to a reactivity accident.

All these and other hypothetical accidents are only pure suppositions that we have in mind in order to investigate their PSA schemes or their deterministic behaviour. Prevention is the best remedy and safety research must be planned in consequence, but it <u>does not</u> mean in any case that the Dalat Reactor is on the edge of an eminent catastrophe as erroneously reported afterwards !

5. Conclusion

It is firmly believed that the Dalat Nuclear Research Reactor entirely meets safe operation criteria of the Agency and provides satisfactory conditions for various tasks of promoting nuclear technology in Vietnam. For its future development, the Assistance of the Agency in scientific instruments and equipments is highly appreciated and will be efficiently exploited as in the past with confidence and co-operation.

Dalat, 31 October 1988

VU HAI LONG

Q U E S T I O N N A I R E

SAFETY EVALUATION OF THE DALAT RESEARCH REACTOR OPERATION

I - GENERAL DATA ON THE REACTOR FACILITY

1. Name of facility THE DALAT NUCLEAR REACTOR

2. Facility operator DALAT NUCLEAR RESEARCH INSTITUTE

3. Facility supplier URSS

4. Reactor type Swiming pool

5. Initial criticality date 1 November 1983

6. Power level
   - a. Steady state 500 kW
   - b. Pulsing no
   - c. Pulse FWHM -

7. Neutron flux
   - a. Thermal 2, E13 n/cm2.s
   - b. Fast 1,7E12 -

8. Fuel element

8.1 Type: U-Al alloy in 3 concentric tubes (VVR-M type)

8.2 Number and other Specifications

8.2.1 In core

a. Number of standard fuel elements	89
b. Number of control fuel elements	none
c. Form of uranium in the meet	U-Al alloy
d. Enrichment	36%
e. Plates per element	/
f. Rods per element	/
g. Tubes per element	3, external hexagonal, internal cylinder
h. Cladding material	Al, 0.9 mm thick
i. U-235 loading per element	40.2 g
j. Total uranium density, g/cm3	0.58 (3576g/6100cm3)
k. Fuel element drawings (Attachment £ 1)	

8.2.2 In fresh fuel storage

a. Number of standard fuel elements	48
b. Number of control fuel elements	none

8.2.3 In spent fuel storage

a. Number of standard fuel elements	
i. totally used	none
ii.partially used	3 (in reactor tank)
b. Number of control fuel elements	none

8.3 Fuel element storage

8.3.1 Drawings of fuel element storage no (not yet used)

8.3.2 Are criticality calculations for the fuel element storage performed ? NO (not furnished by supplier)

9. Control rods

9.1	Type	safety	control	regulation
9.2	Number 7	2	4	1
9.3	Material	B4C	B4C	stainless steel
9.4	Reactivity worth per rod, $	i. 2.81 (1989)	i. 3.03, ii. 2.81	0.46
		ii. 2.70 (1989)	iii.2.81, iv. 3.03 (1988)	

10. Reactor core

10.1 Drawing of the layout of the present core (attachment £ 2)

10.2 Burnup on discharge
1. Max % /
2. Average % /

10.3 Average frequency of refueling: not yet

10.4 Minimum critical mass, kg of U-235: 2.781

10.5 Core loading, kg of U-235: 3.576

10.6 Excess reactivity of the core, $ 1989: 4.38 -500 kW Xe equil.
7.12 -2.5 kW no sample

11. Facility utilization

11.1 Average use of reactor
hours/day -
hours/year 1400 (1988) (at full power: 1286 h)
MWh/year 606 (1988)

11.2 Activities for which the facility is utilized :
Isotope production, Activation analysis, Experiments

12 Major modifications or replacement of equipment
- repair of one ventilator of the 2nd cooling loop,

13 Other comment: The present reactor was rebuilt from the Triga reactor in keeping main bulk components such as aluminum tank, graphite reflector...

II- REGULATORY SUPERVISION

1. Is the safety of the reactor a subject to review by a regulatory organization / safety committee which is independent of the operating organization ? YES (Review requested by NIAE-Hanoi acting as regulatory authority)

2. Has the regulatory body an inspection programme aimed at both the technical and management aspects of reactor safety? YES

2.1 The frequency of regular inspections: AFTER 4 YEAR OPERATION

2.2 The date of the latest inspection: NOT YET,2nd quarter of 89

2.3 Were any non-compliance observed by the inspectors? NOT YET

3. Does a reactor committee, or a equivalent advisory group, exist to review safety problems arising in reactor operations And in planning of experiments? YES

3.1 Composition of the safety committee (Attachment £ 3)
3.2 How often this group meets? MONTHLY
3.3 Date of last meeting 19/1/1989

III- SAFETY REPORT

1. Does a Safety Analysis Report of the reactor exist? NO
1.1 Date of the first edition for June 1989
1.2 Date of any revision Vietnamese version for March 1989
1.3 Table of contents of the SAR under preparation (Attach. £ 4)

IV- SAFETY SPECIFICATIONS

1. Is there an official copy of the approved safety specifications that include limits and conditions for the conduct of operations and experiments ?
YES (such specifications exist in Reactor Operation Documents, see Attachment £ 5 for Table of contents of safety specifications).
2. Do these safety specifications cover the following:
2.1 Safety limits which should ensure protection of the integrity of certain physical barriers that will guard against uncontrolled release of radioactivity ? YES
2.2 Safety system settings (e.g. trip settings) which would actuate automatic protective action to correct the most severe abnormal situation anticipated before a safety limit is exceeded YES
2.3 Limiting conditions for safe operation which are the lowest functional capability or performance levels of equipment required for safe operation ? YES

3. Have safety limits ever been violated ? YES. If yes, then
3.1 Was the reactor shut down and maintained in a safe condition ? (see also Attachment No 9) YES
3.2 Was the regulatory body notified ? YES
3.3 Were corrective actions taken before subsequent startup of the reactor ? YES

V - PERIODIC TESTING AND INSPECTION

1. Are surveillance tests performed ? YES. If yes, indicate the frequencies of the tests for the following systems:

1.1 <u>Reactor core</u>
a. Excess reactivity EACH RUN
b. Shutdown margin YEARLY

1.2 Reactor control and safety system

a. Reactivity worth of control rods	YEARLY
b. Rod withdrawal and insertion speeds	YEARLY
c. Test and inspection of pulse rod & mechanism	Not used
d. Scram times of control rods	YEARLY
e. Scram channels:	
- Operability check including trip action	YES
- Calibrations	YEARLY
f. Thermal power verification	YEARLY

1.3 Coolant systems

a. Starting function of emergency, shutdown & sump pumps	NO
b. Test of emergency coolant source	not applicable
c. Chemical analysis of coolant	EACH RUN
d. Hydrogen concentration in off-gas	NO

1.4 Confinement or containment

a. Containment	
- Functional closure test	YES
- Integrated leak rate test	YES
b. Confinement	
- Functional test	YES

1.5 Emergency ventilation system

a. Operability check of emergency exhaust system	NO
b. Emergency filter efficiency measurements	
- Absolute filters	NO
- Charcoal filters	Not used

1.6 Emergency power

a. Diesels	
- Starting function	EACH RUN
- Under load	EACH RUN
b. Emergency batteries (voltage & discharge test)	Not used

1.7 Radiation monitoring systems and effluents

a. Monitoring systems	
- Operability including, where possible, source checks	ALMOST EACH RUN
- Calibrations	YES
b. Effluents : Environmental monitoring of air, water, soil, vegetation, etc..	QUARTERLY

2. Are there written procedures for the above periodic testing and inspection ? YES (in reactor operation document)

3. Are the results of the surveillance tests reviewed to verify compliance with the safety specifications? YES

VI- MANAGEMENT

1. Organogrammes of the Atomic Energy Authority (NIAE, Hanoi), the Research Center (DNRI, Dalat) and Reactor Department, see Attachment £ 6.

2. List of reactor operating personnel, their specialities and number and specialities of personnel in each shift, see Attachment £ 7.

3. Are duties and responsibilities of the management and the operating staff clearly set out in writing ? YES
(English copy not available)

4. Are only staff members, with the specific qualification required, authorized to control and supervise reactor operation ? YES
Is there a list of currently authorized persons available in the control room ? NO

5. Is a training programme conducted for new operators & technicians, and re-training programme for current operation personnel ? YES, NO

6. Are there formal examinations conducted to test the proficiency of the trainees ? YES
(available in Vietnamese)

7. Is there a staff of adequate size and training in health physics provided to ensure radiological protection and monitor radioactive effluents & wastes ? YES.
If yes, is this personnel independent of the reactor operating group ? YES, R.P Dept.

8. The number of health physics personnel at the reactor: 5 pers.

9. Are reactor operators licensed by the regulatory body? YES

10. Is there a capability within the reactor management to review independently the safety of proposed operations, modifications or experiments ? YES

11. Is the programme for operation and experimental use of the reactor prepared in advance and is it approved by the reactor manager ? YES

VII- OPERATING INSTRUCTIONS

1. Are there written and approved operating procedures for guidance of the operating personnel available ? YES
If yes, do they include the following :

1.1	Pre-startup and start-up procedures with checklists	YES
1.2	Procedure for operation under constant power level	YES
1.3	Shutdown procedures with a checklist	YES
1.4	Procedures for loading fuel, unloading and movement of other core components and experimental devices	YES
1.5	Procedures for responding to abnormal operational occurrences	YES
1.6	Procedures for sample irradiation (in the core, beam ports, bulk shielding, thermal column)	YES
1.7	Water chemistry	YES
1.8	Maintenance procedures and checklists	YES
1.9	Procedures for surveillance tests and calibrations	YES
	In particular for such tests and calibrations as :	
	a. control rod calibration	YES
	b. power calibration	YES
	c. testing of control instrumentation	YES
1.10	Emergency procedures for such emergencies as :	
	a. fire	YES
	b. loss of containment/confinement	YES
	c. loss of electric power (blackout)	YES
	d. rupture of cooling systems	YES
	e. contamination of building/area outside the building	NO
	f. high radiation	NO
	g. malfunction of safety system	YES
	h. other credible emergencies	YES
1.11	Operating procedures for the auxiliary systems (e.g. demineralizer systems)	YES
1.12	Physical security plans	YES
2.	Are personnel adequately and properly trained in these instructions ?	YES
3.	Are adequate arrangements made for regular review of all procedures and for the communication of any revisions to the operating personnel and other holders of the document ?	YES
4.	Is one copy of the approved procedures kept in the control room ?	YES

5. Are all other copies occasionally checked against a master copy to ensure completeness and updatedness ? YES

VIII- RECORDS AND REPORTS

1. Are records kept of all essential informations concerning the design and operation of the reactor ? YES
If yes, are the following records available :

1.1 Records of operation
- a. reactor operation (i.e. log books, reading sheets and checklists, automatically recorded data) YES
- b. facility operational status (e.g. components out of service) YES
- c. periodic inspection and testing, maintenance and modifications YES
- d. location and movement of radioactive sources and fissile materials (accountancy and criticality control) YES
- e. fault data and unusual occurences YES
- f. staff responsibility and training YES

1.2 Radiation safety records
- a. radiation surveys YES
- b. personnel radiation exposures YES
- c. radioactive waste management YES

1.3 Records related to safety
- a. periodic reports on the facility operations (kWh of operation, experiments performed, samples irradiated...) YES
- b. reports on modifications YES
- c. Abnormal occurrences, including equipment malfunctions and radiation and contamination incidents YES
- d. fuel burnup and fuel balance reports YES
- e. are records on matters relating to safety available to the regulatory body ? YES

1.4 Other records
- a. "as built" installation drawings and diagrams YES
- b. design changes or modifications YES
- c. reactor experiments and irradiations performed YES
- d. manuals and tests of important equipment and systems YES

IX- MAINTENANCE

1. Is there a preventive maintenance programme undertaken for the reactor ? YES

2. Are maintenance procedures drawn up ? YES

If yes, do maintenance procedures specify :

a. preventive maintenance checks and inspections — YES
b. frequency of inspections — YES
c. acceptable limits of the values checked — YES

3. Is there a system set up to ensure that the preventive maintenance programme is performed on schedule ? — NO

4. Is there a stock of spare parts, particularly for safety-related equipment available ? — NO

5. Are there good maintenance records maintained and kept in sufficient detail so that previous failures and corrective actions taken are available ? — YES

6. Is there some form of work permit, signed by an appropriate authority such as reactor manager, used before proceeding with the maintenance work ? — YES

7. Is a similar system of approval existing after the maintenance is completed and tests have been performed ? — NO

8. Is operation personnel supervising maintenance operations closely when they concern safety-related systems ? — YES

X- EXPERIMENTS and MODIFICATIONS

1. List of routine experiments and irradiations done in the reactor, Attachment £ 8.

2. Are new experiments or modifications in the reactor system with safety significance subject to prior review and approval by the regulatory body ? — YES

XI- PHYSICAL SECURITY

1. Does a physical security plan exist for the facility ? Has it been approved by the regulatory body ? — YES

2. Are periodic audits of all radioactive sources and fissile materials carried out ? — YES

3. Has any breech or attempt to breech the security of the facility occurred ? — NO

XII- QUALITY ASSURANCE PROGRAMME FOR OPERATIONS

1. Has the operating organization a quality assurance programme duly reviewed and approved by the regulatory body that will govern the quality of all safety related items during the operations ? NO
If yes,...

XIII- CONDUCT OF OPERATIONS

1. Answer according to your opinion the following :

1.1 Housekeeping in the facility,
Good <> Acceptable <x> Needs improvement <>

1.2 Operational status of components and equipment important to safety - area radiation monitors, communication and public address systems, chart recorders and meters, ventilation dampers, exist indicators, fire extinguishers, etc..
Good <> Acceptable <x> Needs improvement <>

1.3 Leak tightness of containment/confinement (esp. access doors into reactor building),
Good <x> Acceptable <> Needs improvement <>

1.4 Proper demarcation of high radiation areas, e.g. experimental facilities, spent fuel storage, etc..
Good <x> Acceptable <> Needs improvement <>

1.5 Following up the approved procedures by the operators and accomplishment of the required checklists and forms,
Good <> Acceptable <x> Needs improvement <>

1.6 Function and calibration of instruments and systems,
Good <x> Acceptable <> Needs improvement <>

1.7 Knowledge of operating limits of the reactor (e.g. shortest allowable reactor period, scram settings, etc.,) and, more importantly, of its operational characteristicsby the operators,
Good <x> Acceptable <> Needs improvement <>

2. List of the reactor abnormal occurrences with safety significances and incidents, with brief description of the causes and the actions taken, Attachment £ 9.

3. The average number of unplanned scrams per year for the last three years and their main causes : 7 / year, mainly caused by electrical supply failures due to lightning during the raining-storming season.

4. Are there any future plans for the reactor facility, e.g. conversion to lower fuel enrichment, increase in power level YES.

List of Attachments

1. Fuel element drawings
2. Layout of the present core
3. Composition of the safety committee
4. Table of contents of the SAR
5. Table of contents of the safety specifications
6. Organogrammes of NIAE, DNRI and Reactor Physics & Eng. Dept
7. List of reactor operating personnel, their specialities and number
8. List of routine experiments and irradiations done in the reactor
9. List of the reactor abnormal occurrences and brief description of the actions taken

Da Lat, 15 Feb. 1989

Attachment No 1

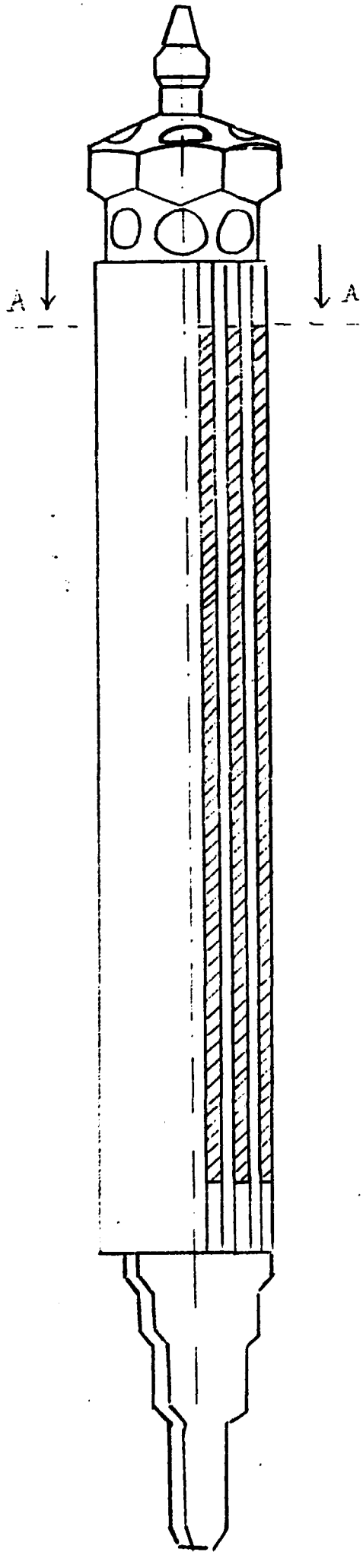
FUEL ELEMENT

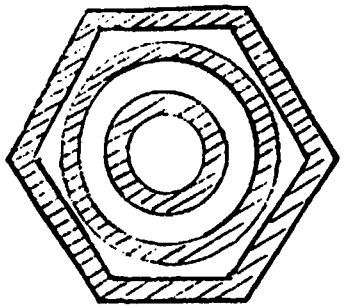
Total length	865 mm,
Hexagonal external width	32 mm,
Separation gap between tubes	3 mm,
Aluminum cladding thickness	0.9 mm,
Uranium thickness	0.7 mm,
Uranium height	600 mm,
U-235 weight approx.	40 g.

Attachment No 2

LAYOUT OF THE PRESENT CORE

Number of fuel elements	89
Number of Be elements	15
Experimental channels	3





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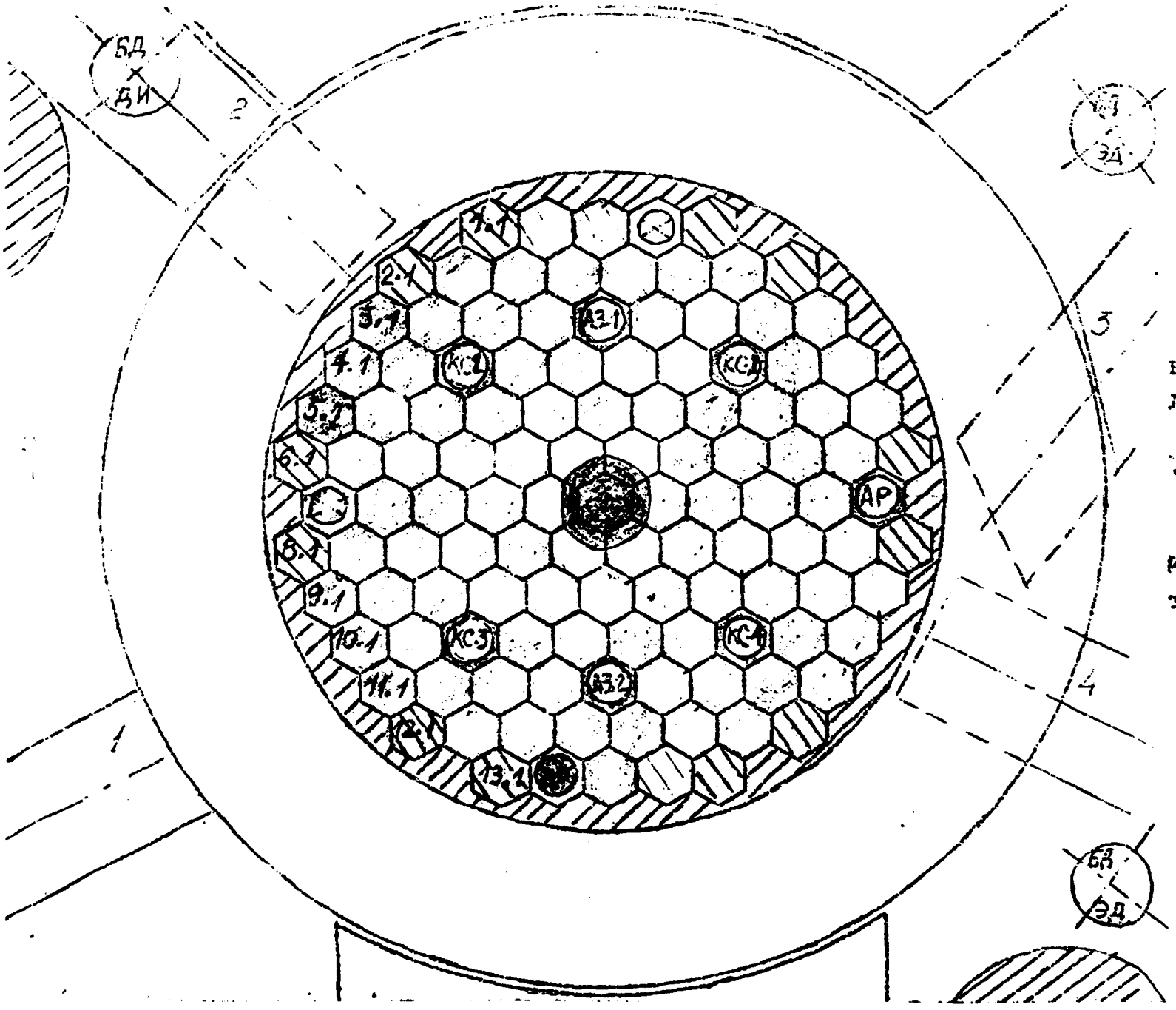
Attachment No 1
FUEL ELEMENT



КАРТОГРАММА ЗАГРУЗКИ
РЕАКТОРА

№ _____

" " _____ 1983 г.

1. Загрузка реактора соот
ветствует, изображенной на
данной картограмме.

В активной зоне находятся
.....ТВС;

2. Погружение стержней А
КС, и АР при критическом сос
тоянии (по УП):

АЗ-1	–	см,
АЗ-2	–	см,
КС-1	–	см,
КС-2	–	см,
КС-3	–	см,
КС-4	–	см,
АР	–	см,

3. Запас реактивности –

Attachment No 2

LAYOUT OF THE PRESENT CORE

Attachment No 3

COMPOSITION OF THE SAFETY COMMITTEE

After the modification of the directorship of the DNRI, a new safety committee has been nominated in May 29, 1988 by decision No 45/TCCB-QD signed by Prof. Pham Duy Hien, Director.

Its composition is

- Tran Ha Anh, Deputy Director,	President
- Nguyen Tho Nhan, Dep.Director NTC-HCM City,	Vice President
- Vu Hai Long, Head RP&E Dept,	"
- Duong Quang Tan, Deputy Head RP Dept,	"
- Tran Khanh Mai, Physicist,	Secretar
- Nguyen Thanh Binh, Engineer Environment Gr.	Member
- Hoang Van Nguyen, Engineer Pers.Dosimetry Gr.	"
- Nguyen Le Son, Engineer NTC - HCM City	"

Appended to the decision is the document defining the responsibilities and activities of the Safety Committee.

Attachment No 4

CONTENTS OF THE S.A.R

The 1988 Safety Analysis Report, Vietnamese version, contains 7 chapters :

Introduction

Chapter 1 - Characteristics of Reactor Site

1. Goegraphy - Population - Economics
2. Climatic conditions
3. Hydrology
4. Geological conditions
5. Environmental Radiation Data

Chapter 2 - Reactor Building

1. General Construction Design
2. Reactor Building
3. Ventillation Systems
4. Water Supply and Sewage System
5. Electricity Supply

6. Laboratories and Administration Services

Chapter 3 - Reactor

1. Design Basis
2. Reactor Description
3. Experimental and Irradiation Facilities
4. Reactor Water System
5. Reactor Design and Analysis

Chapter 4 - Instrumentation and Control

1. General Description
2. Reactor Control System
3. Reactor Safety System

Chapter 5 - Radioactivity Control & Radiation Protection

1. Reactor Room Containment & Ar-41 Release
2. Shielding
3. Waste Management
4. Area Monitoring
5. Personnel Monitoring

Chapter 6 - Safety Analysis

1. Reactivity Accident
2. Loss of Reactor Coolant
3. Fission Product Release
4. Other Hazards

Chapter 7 - Administration Procedures

1. Organisation and Responsibilities
2. Operational Practices
3. Emergency Procedures

Attachment No 5

TABLE OF CONTENTS OF THE SAFETY SPECIFICATIONS

1- Warning and Scram Limits of Principal Operational Parameters

Parameters	Warning	Scram
Power	105 %	110 %
Period , sec	40	20
Water level in reactor tank , m	5.9	5.6
Water flow rate of primary loop , m3/h	45	40
Water flow rate of secondary loop , m3/h	80	70
Water temperature at core entry, degree C	33	
Water temperature at core exit , degree C	53	
Water pressure at primary pump exit, kg/cm2	3	

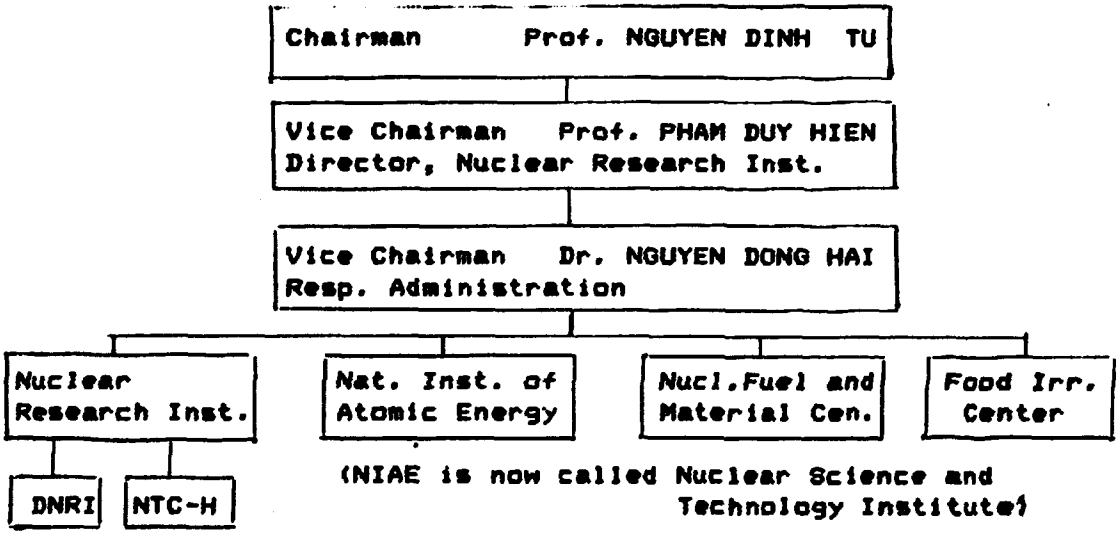
2- Control Parameters of Reactor Water

Parameters		Normal limits
Conductivity ,	uSm/cm	< 2
pH		5.5 - 6.0
Content of Cl-	mg/l	< 0.05
Content of SO4-	mg/l	< 0.05
Content of Fe++	mg/l	< 0.05
Content of Al+++	mg/l	< 0.05
Mineral content	mg/l	< 1
Residue concentration	mg/l	< 5
Residue activity	uCi/l	< 10

Attachment No 6

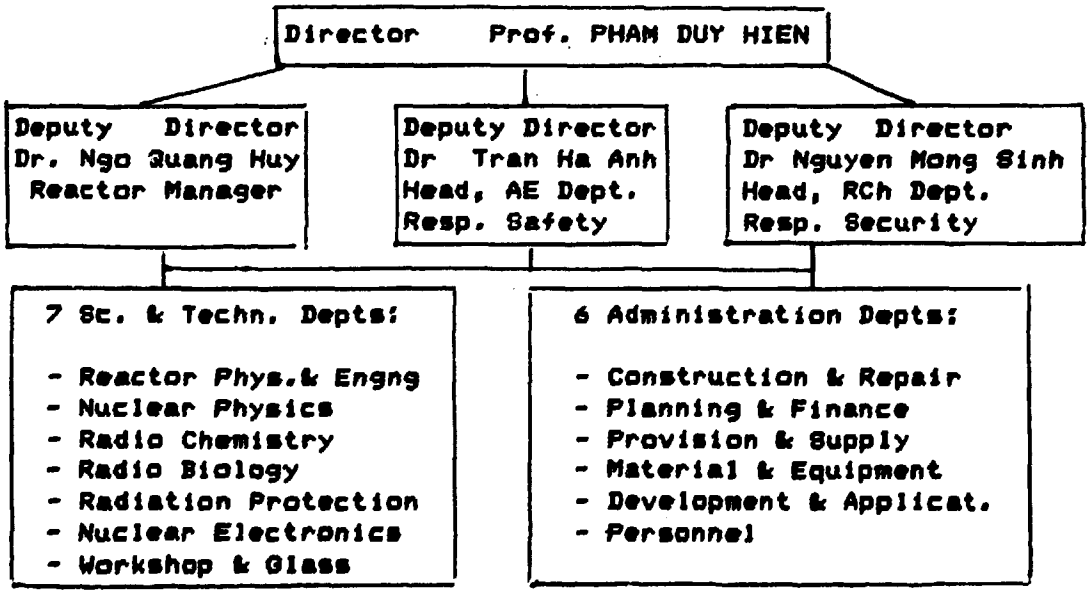
ORGANOGRAMMES

1- National Atomic Energy Committee - NAEC -

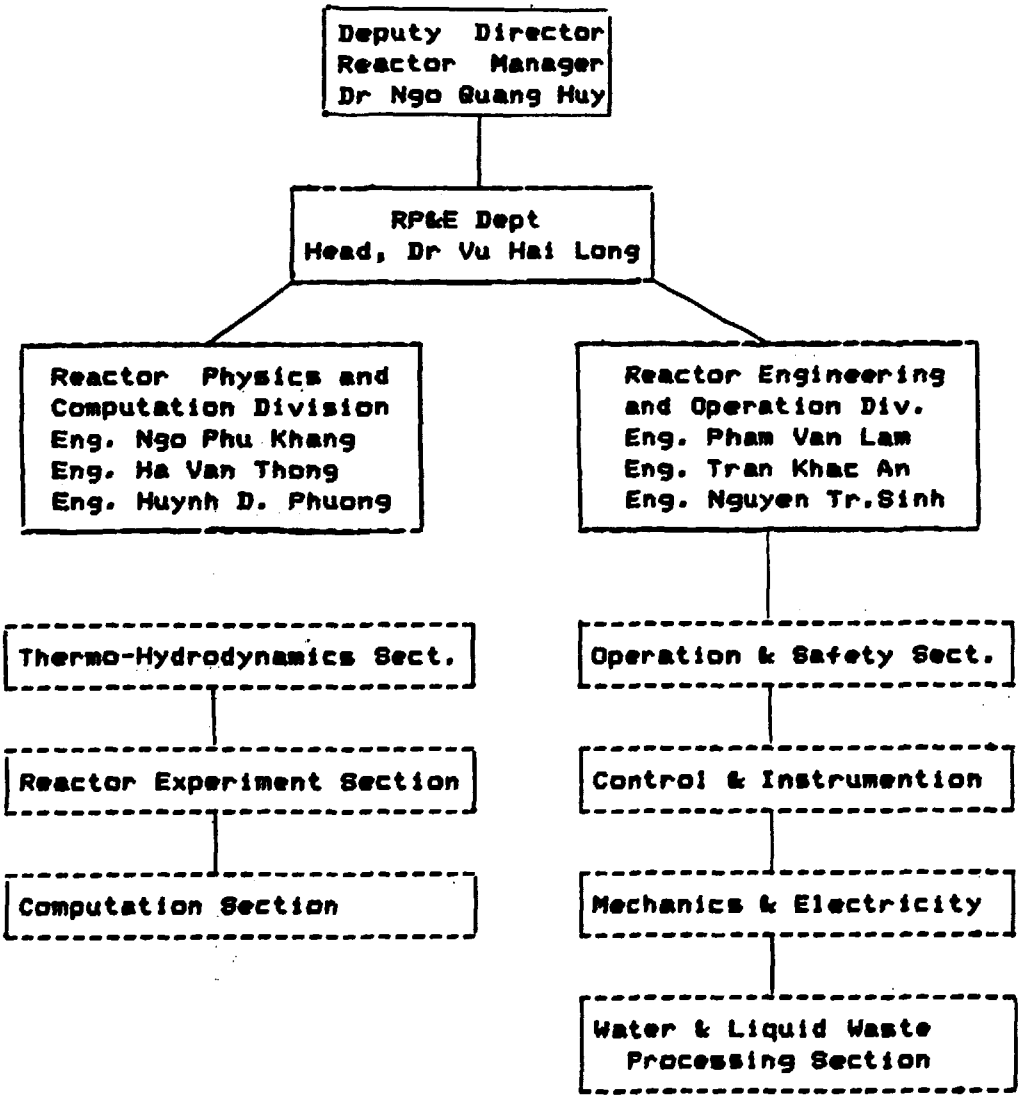


(NTC-H : Nuclear Technique Center, Ho Chi Minh City)

2- Dalat Nuclear Research Institute - DNRI -



3- Reactor Physics and Engineering Department - RP&E -



Total staff : 50 (29 engineers)
Equipment : USSR
Computer : 1 PC-AT

Attachment No 7

LIST OF REACTOR OPERATING PERSONNEL,

THEIR SPECIALITIES AND NUMBER

The reactor operating personnel has been nominated by the Director of DNRI, decision No 18/TCCB-QD 18 Jan. 1989. The Knowledge Control Commission created by decision No 20/TCCB-QD 18/01/89 is composed of Reactor Manager N.Q. Huy, President , and 3 members: Head of RP&E Dept. V.H. Long, Dep.Head of RP&E Dept. P.V. Lam, and Dep.Head of RP Dept. D.Q. Tan.

1. Head of Shift
   1- Pham Van Lam, Eng.
   2- Ngo Phu Khang, Eng.
   3- Huynh Dong Phuong, Eng.
   4- Nguyen Manh Hung, Eng.
   5- Nguyen Duc Binh, Eng.

2. Operator
   1- Le Vinh Vinh, Eng.
   2- Luong Ba Vien, Eng.
   3- Ha Van Thong, Eng.
   4- Nguyen Thai Sinh, Eng.
   5- Nguyen Minh Tuan, Eng.
   6- Do Quang Binh, Eng.

3. Control & Instrumentation -
   1- Tran Khac An, Eng.
   2- Trinh Dinh Hai, Eng.
   3- Pham Viet Thom, ng.
   4- Pham Ngoc Tuan, Eng.

4. Mechanics
   1- Do Van Hiep, Eng.
   2- Mrs Tran Thu Ha, Eng.
   3- Phan Cong Thuyet, Tech.
   4- Pham Xuan Phuong, Tech.
   5- Nguyen Tien Lam, Tech.
   6- Tran Van Hoa, Tech.

5. Electrotechnics
   1- Nguyen Truong Sinh, Eng.
   2- Nguyen Manh Hoanh, Eng.
   3- Hoang Cong Bang, Tech.
   4- Nguyen The Ky, Tech.
   5- Trang Cao Tri, Tech.
   6- Truong Nhu Hien, Tech.
   7- Trang Cao Su, Tech.
   8- Tran Van Quy, Tech.
   9- Mrs Nguyen Thi Thanh, Tech.
   10- Mrs Le Thi Hang, Tech.
   11- Mrs Do Thi Van, Tech.
   12- Mrs Nguyen Thi Tuoc, Tech.

6- Water Chemistry
   1- Mrs Nguyen Thi Nang, Eng.
   2- Mrs Nguyen Thi Thuan, Eng.
   3- Nguyen Quoc Hung, Eng.
   4- Ms Nguyen Thi Thu, Tech.

7- Dosimetry

1- Duong Quang Tan, Eng.
2- Truong Cam Ranh, Eng.
3- Nguyen Van Hung, Eng.
4- Le Van Cong, Eng.
5- Pham Van Dung, Tech.
5- Phan Dinh Sinh, Tech.

Furthermore, a Knowledge Control Commission for annual examination of all workers on Radiation Protection was created by decision No 43/CCB-QD 24/05/88 and composed of Dep.Dir T.H. Anh, President and 4 members: V.H. Long, Head of RP&E Dept., D.Q. Tan, Dep. Head of RP Dept., T.C. Ranh, Head of Radiation Control Gr. and H.V. Nguyen Head of Personnel Dosimetry Gr.

Attachment No 8

LIST OF ROUTINE EXPERIMENTS

1. Control rod worth determination

2. Neutron flux measurement by foil activation

3. Measurement of safety parameters of reactor control system

4. Reactor water analysis

5. Failed fuel detection (in preparation)

Furthermore, an Inspection and Review Commission has been established by decision No 38/QD of 15 May 1988 of the NIAE in order to prepare and carry out the general inspection programme for the Dalat reactor after 5 years of operation.

Attachment No 9

LIST OF REACTOR ABNORMAL OCCURRENCES

AND BRIEF DESCRIPTION OF THE ACTION TAKEN

The listed events occurred during reactor operation causing reactor scrams or alike consequences (marked *). Events taken place during reactor maintenance or shut-are not listed here.

Date		Cause and Action
1984		
3 Apr.	-	Relay default in 1-ary pump cooling branch; repair
9 May	*	Cancel start-up due to 2-ary flowmeter; repair
10 July	*	Abnormal in-course of sram rod AZ2; motor replaced
24 July	-	SEND (Short Electrical Network Deficiency)
"	-	Personnel error in power scram limit setting
"	-	END (Electrical Network Deficiency)
25 July	-	SEND
23 Aug.	-	Personnel error in power scram limit setting
29 Aug.	-	SEND
31 Aug.	-	Action of 1-ary pump protection relay; replaced 4-1
14 Sept	-	Personnel error causing 2-ary pump 29-5 stop
26 Sept	-	END
4 Oct.	-	END
16 Oct.	-	SEND
4 Nov.	-	END
15 Nov.	-	Action of 1-ary pump protection relay; replaced 4-2
29 Nov.	-	SEND
11 Dec.	-	1-ary flowmeter default; repair
18 Dec.	-	Action of 1-ary pump protection relay; replaced 4-1
1985		
12 Apr.	-	END and =24 V supply default; repair
15 Apr.	*	2-ary flowmeter out of work, start-up cancelled;rep.
6 May	-	Abnormal 2-ary flowmeter recorder; repair
7 May	-	-id-
10 May	-	END by bird entry into the HV station; fenced
11 May	-	END
24 May	-	Personnel error in power scram limit setting
3 June	-	END and no Diesel commutation, 2 fuses cut
4 Oct.	-	END
27 Nov.	-	Default in control circuit of 2-ary pump & fire pump
1986		
8 Apr.	*	Default of water level meter, start-up cancelled
2 May	-	Personnel error on reactor control system AKNP
13 May	-	END
"	-	Low level in water bassein of 2-ary loop

21 May * Crane cable broken; reused old cable
23 May - Personnel error on 2-ary pump
6 June - SEND
9 June - Personnel error on 1-ary pump
10 June - SEND
" - END
26 Aug. * Default of water level meter, start-up cancelled
14 Oct. - SEND
13 Nov. - Breakdown of AZ1 motor; replaced
9 Dec. - END
1987
5 Jan. * 2-ary pump 29-4 out of work, earth connection cut
20 Feb. * Control rod KC2 not go down by planned shut-down
(23 Feb. * KC2 not go down by scram AZ during maintenance)
25 Feb. - Power scram at 40% by starting 2-ary pump (expermt)
(12 Mar. * AZ1 going down and up by scram AZ during maintenance)
17 Mar. * Default in UNO-3 circuit; replaced
18 Mar. - END and Diesel commutation after 3 mn; batterie weak
19 Mar. * 4-2 pump cable heated; down P to 50% to exchange 4-1
26 Mar. * KC1 rod not go up by step in manual command at 0.5%N
** up to 5 May 87 inspection & maintenance of Reactor Control System SUZ **
19 May - SEND
" - END by storm raining
28 May - END
17 June - Scram due to default in 2-ary flow rate meter; repair
7 July - SEND
" - SEND
2 Nov. - SEND
23 Nov. - Personnel error in power scram limit setting
1988
22 Jan. - SEND
29 Feb. - END
29 Mar. - SEND
30 Mar. - END
31 Mar. - END
11 Apr. - SEND
22 Apr. - END
26 Apr. - Action of 2-ary flow rate scram limit (expermt)
19 July - SEND
15 Aug. - Pers.error, over power consumption due to torch flash
24 Aug. - END
25 Aug. - END
" - END
" - END
12 Sept - Self scram due to water level meter default; repair
11 Oct. - END
" - END
" - Personnel error in power scram limit setting
1989
24 Feb. - END