# THE PREPARATION AND PROGRESS FOR THE DECOMMISSIONING PLAN OF THE DALAT NUCLEAR RESEARCH REACTOR

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## ABSTRACT

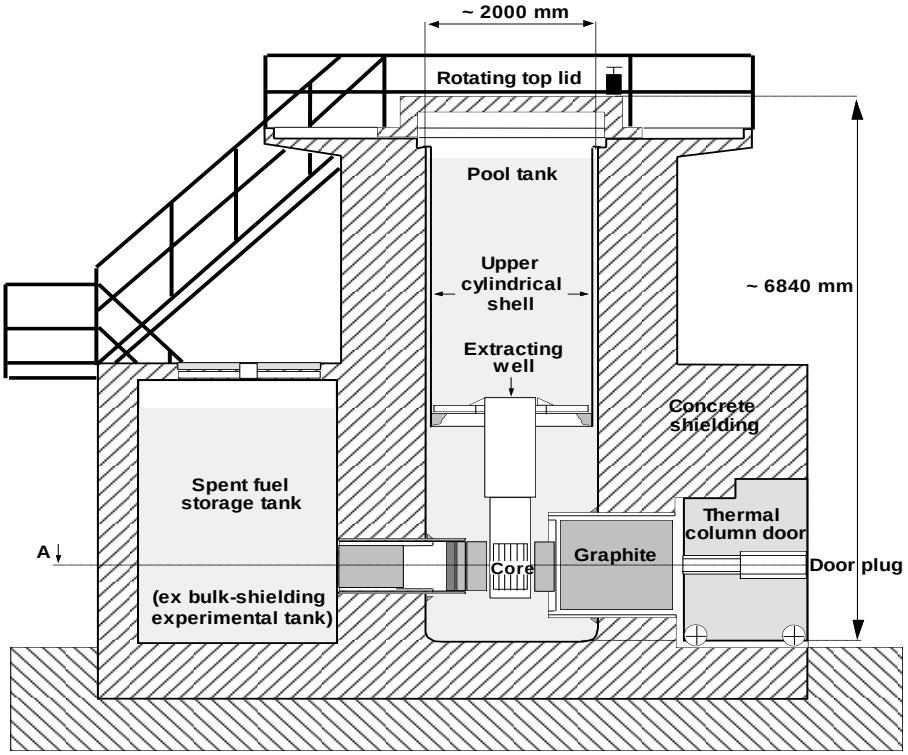
Recently, after 25 years of operation, a decommissioning plan for the DNRR and other relevant facilities is not yet carried out and the decommissioning plan proposed for DNRR is still under study. However, from the early phases of facility design and construction and during operation, the aspects that facilitate decommissioning process have been considered. The ongoing decommissioning plan of the DNRR are being prepared by the operator within the national project and will complete in September 2011.

## I. BRIFT OVERVIEW OF DNRR

The 500-kW pool-typed, light water cooled and moderated, Dalat Nuclear Research Reactor (DNRR) was reconstructed and upgraded from the USA made 250-kW TRIGA reactor. The upgraded reactor reached the first criticality on 1 November 1983. And then, since March 1984, the reactor has been officially put into operation for the purposes of radioisotope production, neutron activation analysis, basic and applied research in nuclear physics, research on reactor physics, and manpower training. The summary description of the DNRR is shown in Table 5.1.

**Table 5.1.** Summary description of the DNRR

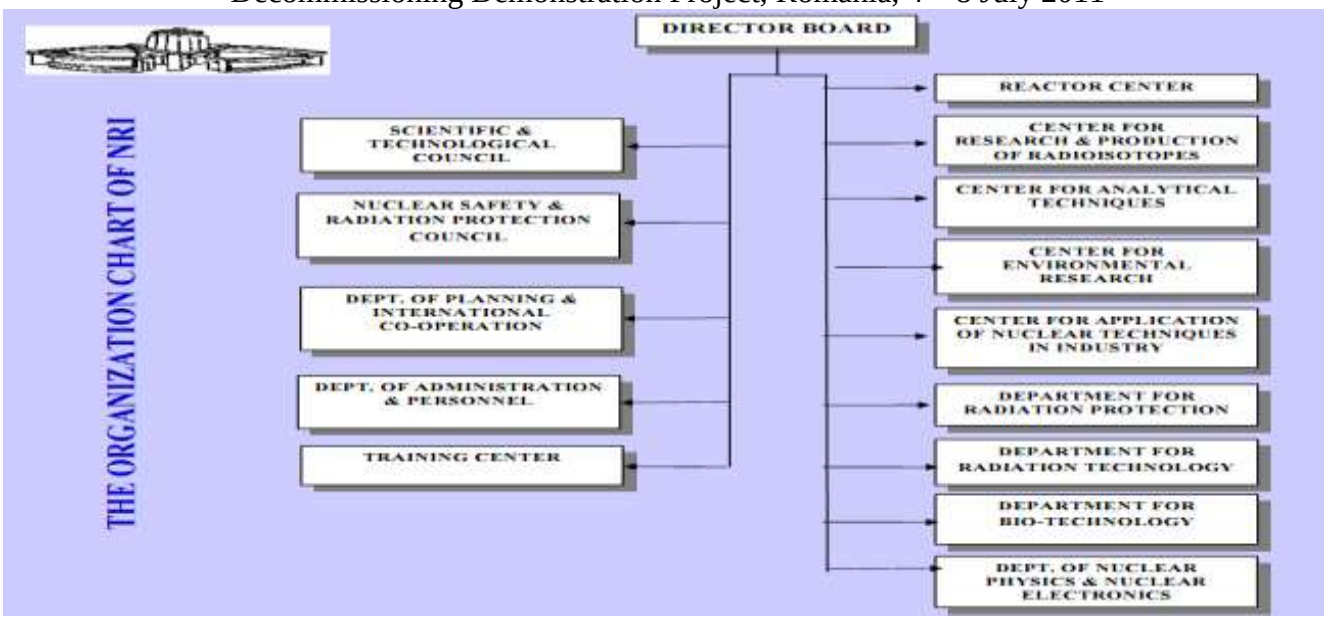
| Parameter | Description |
|---|---|
| Reactor | Swimming pool type (tank in) |
| Nominal power | 500 kW |
| Neutron flux (thermal, max.) | $2\times10^{13}$ neutrons/cm$^2$.s |
| Fuel | VVR-M2 type, tube form |
| Fuel meat | Al-U alloy, 36% enrichment |
| Fuel cladding | Aluminium alloy |
| Moderator | Light water |
| Reflector | Graphite, beryllium and water |
| Coolant | Light water |
| Core cooling | Natural convection |
| Heat rejection | Two-loop cooling system |
| Shielding | Concrete, water and steel cover |
| Control rods | 2 safety, 4 shim and 1 regulating |
| Safety and shim rod material | $B_4C$ |
| Regulating rod material | Stainless steel |




The reactor is installed on the floor at ground elevation in the center of the reactor hall. The reactor tank and major components are surrounded by a thick concrete shielding structure.

## II. HISTORICAL REVIEW

The present reactor has been reconstructed from the former TRIGA Mark II reactor. The TRIGA reactor, supplied by General Atomic (GA, San Diego, California, USA), was built in early 1960s, put into operation in 1963 and operated until 1968 at nominal power of 250 kW. In 1975, all fuel elements of the reactor were unloaded and sent back to the USA.




During the 1976-1980 period, a programme to reconstruct and upgrade the reactor, as well as to enlarge the reactor facility, was set up with the co-operation and assistance of the former of Soviet Socialist Republics (USSR). The new reactor was re-designed by the State Design Institute of the USSR State Committee for the Utilization of Atomic Energy. It was first named Reactor IVV-9, the ninth reactor of this series built by USSR around the world. In 1982, the reconstruction work commenced by the main contractor of General Company of Construction No. 14, Ministry of Construction (Vietnam), under the supervision of the Project Managing Board, Vietnam Atomic Energy Commission (VAEC). The reactor facility equipment was supplied by the Atomic Energy Import and Export Company (ATOMENERGOEXPORT, Moscow, USSR). The reactor fuel was purchased from the USSR by the International Atomic Energy Agency (IAEA) and offered as an IAEA assistantship to Vietnam. A number of structures from the original TRIGA reactor, such as the aluminium tank with the surrounding concrete shield, the beam-ports, the thermal column and the graphite reflector, have been retained. The first criticality was achieved on 1 November 1983. The nominal power of 500 kW was attained in February 1984, and then, on 20 March 1984 the present DNRR was officially inaugurated and its activities restarted.

After ten years of the operation, in 1993, the reactor instrumentation and control system was renovated within the IAEA TC Project VIE/4/010 entitled “Renovation of the Dalat reactor control system”. The renovation of the reactor control system has improved its reliability, while its original basic design principles are kept unchanged.

During the 1998-2002 period, two national research projects were implemented by the Reactor Center’s staffs. The main purposes of these projects are to carry out studies on reactor physics and thermal hydraulics, reactor ageing problems, reactor core management including fuel burn-up calculations and measurements, as well as safety aspects of reactor itself and its technological systems.

During 2005 - 2007 period, national project with the co-operation and assistance of the IAEA and Russia had upgraded the control system of the research reactor.

From 2005 till now the partial and full core conversion of Dalat Nuclear Research Reactor from HEU to LEU fuel is being implemented.

## III. LEGAL AND REGULATORY FRAMEWORK IN VIETNAM REGARDING THE DECOMMISSIONING OF NUCLEAR FACILITIES

According to the National Atomic Energy Law:

Article 39 states that a safety assessment report for construction of a nuclear facility shall include a proposed plan for operation termination, decommissioning and decontamination.

Following Article 40 regarding decommissioning and decontamination of nuclear facilities, handling nuclear fuel, nuclear equipment, radioactive waste states that:

1. When a nuclear facility is planning to terminate its operation, the facility shall apply to the agency for radiation and nuclear safety for approval of the plan for decommissioning, decontamination, handling nuclear fuel, nuclear equipment, radioactive waste, and shall organise to execute the approved plan.
2. The agency for radiation and nuclear safety shall organise to inspect the decommissioning, decontamination, handling of nuclear fuel, nuclear equipment and radioactive waste and shall certify that the nuclear facility is released from its responsibilities for ensuring safety.
3. Nuclear facilities shall bear all the cost associated with dismantlement, storage and handling of radioactive waste resulted from decommissioning process
4. Decommissioning, decontamination, handling of nuclear fuel, nuclear equipment and radioactive waste shall be complied with national technical standards.
5. The Ministry of Science and Technology shall specify procedures, formalities of verification and approval of plan for decommissioning, decontamination, handling of nuclear fuel, nuclear equipment and radioactive waste.

Regarding construction and operation of nuclear research reactors, Article 41 states that application dossier for permit of construction of nuclear research reactors shall include Plan for decommissioning nuclear reactors

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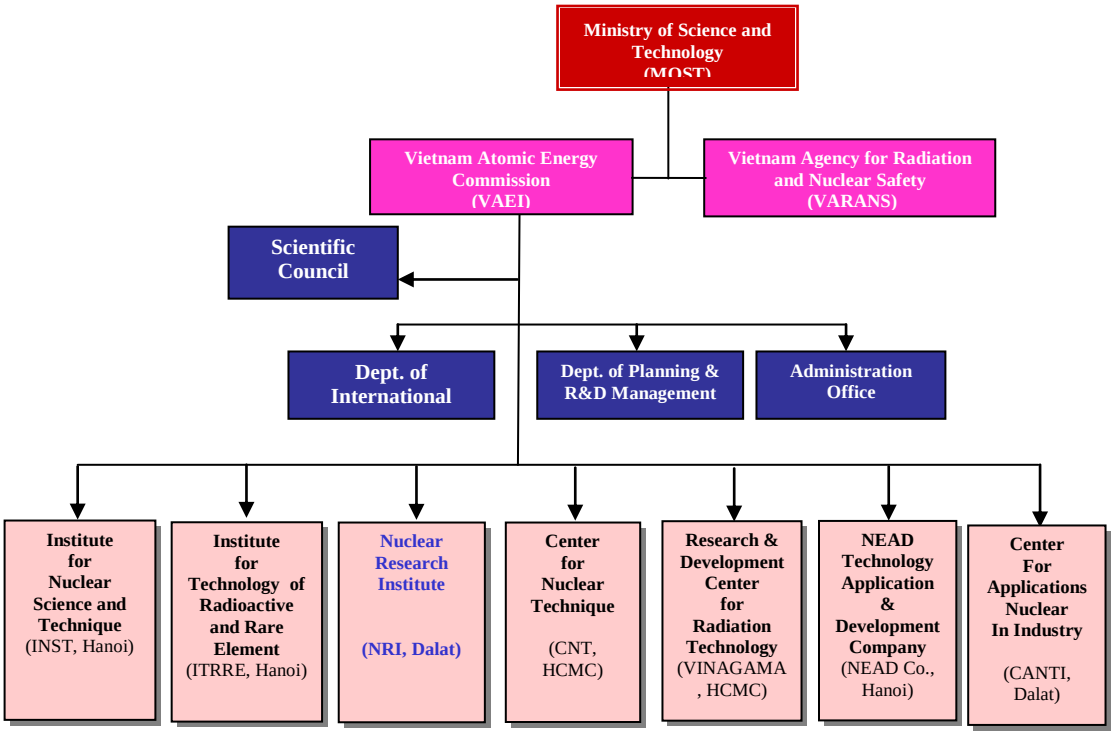

## IV. PREPARATION AND PROGRESS FOR THE DECOMMISSIONING

The contents of the ministerial project for preparing the decommissioning plan of the DNRR:

1. Radionuclide inventory assessment and characterization:
- Calculating the neutron distribution within structures, systems and equipment of the reactor (such as beryllium and graphite reflectors, alluminium tank, concrete structure…) using MCNP computer code;
- Determining the activation activity of radionuclides (maximum and average levels) present in the structures, systems and equipment of the reactor based on the reactor operating history and using ORIGEN2 computer code;
- Carrying out the sampling when necessary
2. Development of the decommissioning plan for the DNRR based on the IAEA guidance (Safety Reports Series No.45)

**The major topics of the decommissioning plan:**

1. Introduction to the name and address of the reactor and licensee's name and address.
2. Facility description, including:
   - site location and description,
   - building and system description,
   - current radiological status, and
   - facility operating history
3. Decommissioning strategy:
   - alternatives considered (immediate decommissioning or deferred dismantling or entombment)
   - rationale for chosen strategy
4. Project management:
   - legal and regulatory requirements
   - project management organization and responsibilities
   - Task management organization and responsibilities
   - Safety culture
   - Training
   - Schedules
5. Proposed decommissioning activities (contaminated structures, contaminated systems and equipment, soil, surface and groundwater)
6. Waste management (solid radioactive waste, liquid radioactive waste, and waste containing both radionuclides and other hazardous material)
7. Cost estimate and funding mechanisms
8. Safety assessment
9. Environmental assessment (background data, environmental protection program, effluent monitoring program, effluent control program)
10. Health and safety (Radiation protection program, nuclear criticality safety, dose estimation and optimization for major task, clearance criteria, etc…)
11. Quality assurance
12. Emergency planning
13. Physical security and safeguards

In 2010, the transition from operation to decommissioning has inserted to Decommissioning Plan.

## V. CONCLUSIONS

The Decommissioning of Nuclear Facilities is included in the national legal and regulatory framework.

The primary decommissioning plan of the DNRR will be completed in September 2011 and review in December 2011.