

# Nuclear Education and Knowledge Management in Czech Republic

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## ABSTRACT

Czech Republic, as a user of nuclear energy, needs a number of nuclear specialists for NPPs operation and also for R&D of new nuclear devices. They are educated in few technical universities and educational institutions of industrial companies. The main role in the nuclear education plays the Faculty of Nuclear Sciences and Physical Engineering of the Czech Technical University in Prague, which operates a training reactor VR-1. The "Czech Nuclear Education Network" (CENEN) was established for better cooperation, preservation and further development of a higher nuclear education and expertise.

## 1. INTRODUCTION

Peaceful (non-military) atomic energy has long term tradition in Czech Republic, involving not only nuclear facilities performance but also variety of research and development projects and supply of devices.

Four reactors VVER-440 in the Dukovany NPP and two VVER-1000 reactors in the Temelin NPP are currently working in Czech Republic. Both of the NPPs are operated by the CEZ Group.

There exist other three research nuclear facilities in Czech Republic. Two of them are the LVR-15 and the LR-0 reactors in the Nuclear Research Institute Rez plc. The third one is the VR-1 Sparrow reactor operated by the Faculty of Nuclear Sciences and Physical Engineering CTU in Prague. Main production fundament represents the Skoda JS company in Pilsen.

A regulatory body responsible for governmental administration and supervision in the fields of uses of nuclear energy and radiation and of radiation protection is represented by the State Office for Nuclear Safety residing in Prague. This office also delegates Czech Republic in the International Atomic Energy Agency in Vienna.

Nuclear energy experts' education and related research in Czech Republic is performed at technological universities and in educational and training centres of industrial organizations.

## 2. EDUCATION AT CTU

The fundamental role in czech nuclear education plays the Czech Technical University and it's Faculty of Nuclear Sciences and Physical Engineering, Faculty of Mechanical Engineering and

Faculty of Electrical Engineering. Part of nuclear education is also provided by the Brno University of Technology, the University of West Bohemia in Pilsen, the Institute of Chemical Technology in Prague and the Technical University of Ostrava.

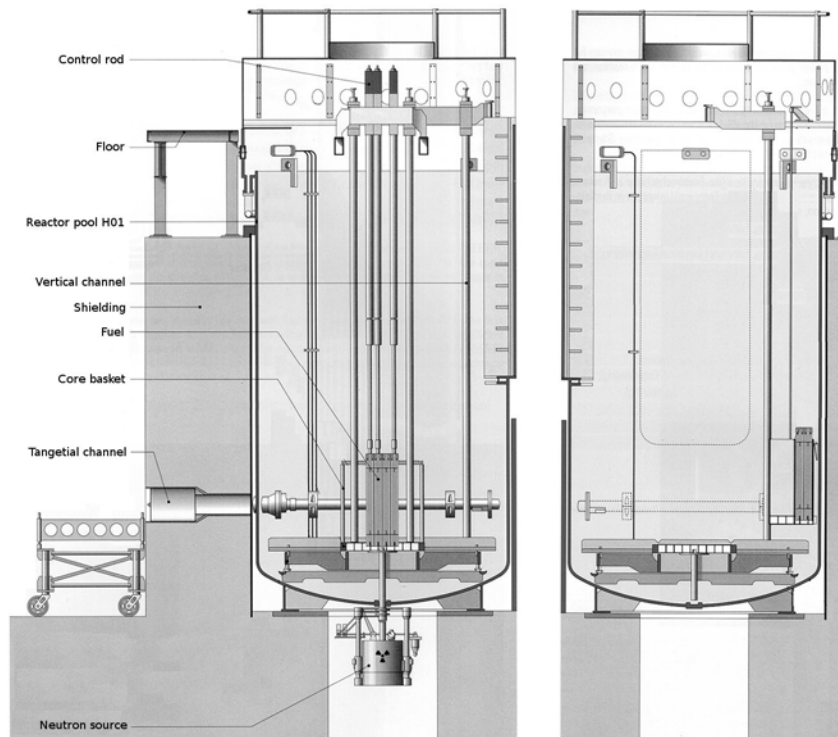
Current Faculty of Nuclear Sciences and Physical Engineering CTU was founded in 1955, named as the Faculty of Technological and Nuclear Physics. It was part of the well-known Charles University in Prague. Presently, the Faculty (FNSPE) is responsible for education of following branches:

- Nuclear engineering
  - Theory and technology of nuclear reactors
  - Nuclear energy and the environment
  - Nuclear facilities
  - Dosimetry and application of ionizing radiation
  - Radiological physics in medicine
  - Experimental nuclear physics
  - Radiation protection and environment
- Nuclear-chemical engineering
  - Applied nuclear chemistry
  - Chemistry of the environment
  - Nuclear chemistry in biology and medicine

Faculty also provides branch named Radiological technology.

## 3. VR-1 TRAINING REACTOR

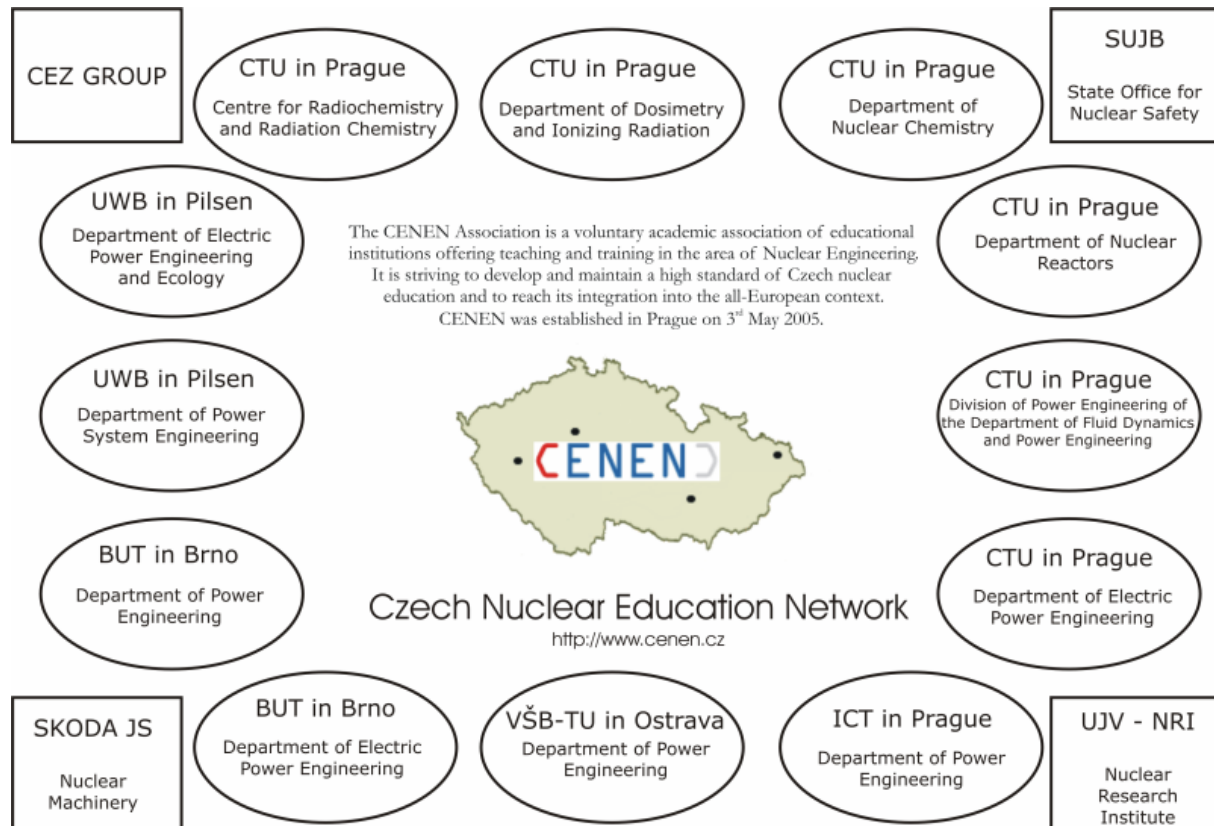
This chapter presents basic information about utilization of the training reactor at FNSPE, CTU in Prague, signed VR-1 and named VRABEC (which means "Sparrow"). The reactor has been used very efficiently especially for education of university students and specialists in favour of the Czech nuclear programme for more than 15 years. It is the only reactor of this type in the



**Fig. 1 Schematic drawing of the VR-1 training reactor**



**Fig. 2 Students at the VR-1 training reactor**



**Fig. 3 A Scheme Diagram of Cooperation in CENEN Framework.**

Czech Republic. Therefore, students from several Czech technical universities and also from universities in Central Europe participate on its use. The operator and main user of the VR-1 Reactor is the Czech Technical University in Prague.

The VR-1 Reactor is well equipped for education and training not only by the experimental facility itself but also by carefully developed training methods. These are divided into several basic areas. Typical examples of them are as follows:

- Nuclear reactor control (start-up, operation, power changes, shut down),
- Reaching the critical state and critical parameters measurement,
- Dynamic experiments (periodical reactivity changes, delayed neutrons examination, examination of "bubbly boiling" influence on reactivity),
- Reactivity measurement and control rods calibration,
- Measurement of spatial distribution of neutron flux density,
- Neutron detection,
- Simulation of selected operational states of WWER type of power reactors,
- Neutron activation analysis.

The education experiments can be combined into training courses attended by students according to their study specialization.

These methods enable to choose an appropriate level of student participation in task completion and result evaluation. The training programme of university students at VR-1 Reactor covers overall information on nuclear safety, radiation protection, emergency preparedness, and physical protection principles.

Every year, approximately 250 university students undergo training at VR-1 Reactor. Their stay at reactor site means an enormous benefit for their study process. The Czech Republic has a well-developed system of university nuclear education. In addition to the education of university students, the utilization of the VR-1 Reactor covers selected parts of training of specialists under the Czech nuclear programme and it also covers a supplemental research programme. The research programme is limited by a relatively small reactor power, however, a large variety of experiments and tests is still possible to be performed (from neutron detector calibration to verification of selected components developed for the transmutation technologies). The visits to the VR-1 Reactor are very popular. Part of the visit is a performance of reactor operation.

Overall experience with VR-1 Reactor utilization is very good. There is a big call for reactor training. Detailed instructions and report forms for record and evaluation of measured values are available for every exercise. The forms usually exist in digital template. The operation organization and reactor utilization is ruled by safety culture principles.

#### 4. CENEN

The CENEN Association is a voluntary academic association of educational institutions offering teaching/training in the area of Nuclear Engineering. It is striving to develop and maintain a high standard of Czech nuclear education and to reach its integration into the all-European context.

The Association aims to develop effective co-operation among its members, to support communication and information transfer about the studies of nuclear branches in the Czech Republic, to organize meetings of academic staff and their further pedagogical and professional training, to encourage the introduction of new courses and lectures in the branch of nuclear engineering, to make this branch more popular and open to a larger number of students, to integrate Czech nuclear education into the European network ENEN - "European Nuclear Education Network" and into international co-operation within WNU - "World Nuclear University", to actively co-operate with similar national networks and other educational organizations in Europe and world-wide.

The objective of the Association is to define high quality nuclear education and maintain the level of education thus defined. Based on the standard of "European Master of Science in Nuclear Engineering", represented especially by the projects ENEN and BNEN, the national standard of the Master's Degree Course in the branch of nuclear engineering will be designed in the link to the Bachelor's Degree course in general technical studies.

In this way the profile of a Czech Nuclear Engineer will be defined. The Association will strive to achieve full integration of Czech nuclear education into the worldwide standard (according to the rules of ENEN and WNU).

The main tasks, with respect to the above set of goals, are: establishment of a system of effective co-operation among members of the Association, mutual communication, and transfer of information about the courses/subjects offered in nuclear branches in the Czech Republic. Effective co-operation will be ensured by meetings of academic staff, where joint study programs will be proposed, as well as mutual students' exchanges, lectures, seminars, workshops and conferences.

#### 5. REFERENCES

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