Role of Training Reactor VR-1 in Nuclear Training in National and International Context

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Outline

- Training at VR-1 reactor
- Training of nuclear power plants’ staff
- Training for inspectors from regulatory body
- Training of IAEA trainees from new comer countries
- Conclusions
# Training at VR-1 reactor

<table>
<thead>
<tr>
<th>Reactor type</th>
<th>Pool, training reactor</th>
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<tbody>
<tr>
<td>Nominal power</td>
<td>1 kW (short time up to 5 kW)</td>
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<tr>
<td>Fuel</td>
<td>Concentric tubes, UO$_2$, 19.7 %</td>
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<td>Neutron flux</td>
<td>Up to $2.10^9$ cm$^{-2}$s$^{-1}$ (thermal)</td>
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<tr>
<td>Experimental facilities</td>
<td>2 horizontal channels</td>
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<tr>
<td></td>
<td>10 vertical channels</td>
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<tr>
<td></td>
<td>pneumatic transfer system</td>
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<td></td>
<td>D-D neutron generator</td>
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<tr>
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<td>MONTE-1 instrumentation devices for study of:</td>
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<tr>
<td></td>
<td>* delayed neutrons</td>
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<tr>
<td></td>
<td>* void coefficients</td>
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<tr>
<td></td>
<td>* temperature coefficients</td>
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<tr>
<td></td>
<td>* fast reactivity changes</td>
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<tr>
<td></td>
<td>* harmonic reactivity changes</td>
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<tr>
<td>Applications</td>
<td>Education and training</td>
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<td>Neutron activation analysis</td>
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<td>Research in neutron applications</td>
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<td>Neutron radiography</td>
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Training at VR-1 reactor

- First criticality 12/1990, trial operation 1991 and the first NPP operators' training in 02/1992

- Reactor provides various types of training
  - Training of NPP operators from Czech Republic
  - Training of NPP reactor physicists from Czech Republic
  - Training of NPP reactor physicists from Slovakia
  - Training of inspectors from Czech regulatory body
  - Training of IAEA trainees from new comer countries
  - Training of Czech RR operators from LVR-1 & LR-0 RRs
  - Training of managers from Kuwait
Training of nuclear power plants’ staff

- Training of NPP staff from Czech Republic (1992-2015):
  - NPP operators from 1992
  - NPP reactor physicists from 2001
  - Typical initial training
  - More than 90 courses and more than 500 participants
  - At the beginning mainly 5 days' courses, later 3 days' courses only and now back to 5 days’ courses

- Training of NPP staff from Slovakia (2003-2015):
  - NPP reactor physicists from 2003
  - Typical re-training/refreshing training in 3 days' courses
  - 10 courses and more than 20 participants (up to 5 times)
Training of nuclear power plants’ staff

**ČEZ - Operators**


- Theory
- Stay at NPP
- Simulator
- Exams
- State licence

Training at VR-1 - 1 week

**ČEZ - Physicists**

1. Module  8 w → 2. Module  6 w → 3. Module  2w

- Theory
- Stay at NPP
- State licence

Training at VR-1 - 1 week

Initial training of NPP operators and NPP reactor physicists in Czech Republic
## Training of nuclear power plants’ staff

<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>8.30 – 11.30</td>
<td>Welcome meeting, visit of the reactor</td>
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<td>12.30 – 15.30</td>
<td>Neutron detection</td>
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<td>Tuesday</td>
<td>8.30 – 11.30</td>
<td>Measurement of delayed neutrons</td>
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<td>12.30 – 15.30</td>
<td>Study of the reactor kinetics</td>
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<tr>
<td>Wednesday</td>
<td>8.30 – 11.30</td>
<td>Reactivity measurement</td>
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<td>12.30 – 15.30</td>
<td>Study of the reactor dynamics</td>
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<tr>
<td>Thursday</td>
<td>8.30 – 11.30</td>
<td>Control rod calibration</td>
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<td>12.30 – 15.30</td>
<td>Critical experiment – approaching critical state</td>
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<tr>
<td>Friday</td>
<td>8.30 – 11.30</td>
<td>Digital reactor I&amp;C, hands-on experience of reactor control</td>
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<td>12.30 – 15.00</td>
<td>Discussion and evaluation of the course</td>
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Typical 5 days course for NPP staff at VR-1 reactor
Training of nuclear power plants’ staff

Training of regulatory body inspectors

- 15 month training carried out in 2011-2012
  - 8 months theory
  - 7 months practical training at the VR-1 reactor
- 20 trainees attended course each month for 2-3 days
- Practical training at the VR-1 reactor in:
  - Safety
    - Nuclear safety
    - Radiation protection
    - Emergency preparedness
  - Security
  - Safeguards
Training of regulatory body inspectors
Group Fellowship Training Programme

- The course has been organised by Eastern European Research Reactor Initiative (EERRI) for IAEA fellows since 2009.
- The six-week GFTP course is focused on participants from non-nuclear countries, who wish to develop nuclear competence and infrastructure as the first step to development of a national nuclear power programme.
- The course is aimed at young technical professionals with little or no nuclear experience who can work in the future research reactor operating organization or in the respective national regulatory body.
Group Fellowship Training Programme

- The GFTP course is organised in the Czech Republic (VR-1, LVR-15, and LR-0 reactors), Austria (ATI TRIGA reactor), Slovenia (IJS TRIGA reactor), and Hungary (BME and BRR reactors).

- The VR-1 reactor plays an active role in the EERRI coalition and 8 from the total 12 courses were carried out at the VR-1 reactor where have 63 participants been trained from 25 countries:
  - Algeria, Australia, Azerbaijan, Brazil, DRC, Egypt, Ghana, Iraq, Jamaica, Jordan, Kenya, Lebanon, Libya, Malaysia, Mexico, Myanmar, Nigeria, Oman, Pakistan, Philippines, Saudi Arabia, Sudan, Syria, Tanzania, Tunisia & Yemen
Group Fellowship Training Programme

7. GFTP course at VR-1 reactor (2013)

Group Fellowship Training Programme

9. GFTP course at VR-1 reactor (2014)

Conclusions

- Research reactors play important role in professional training (of NPP operators & core physicists, RR - staff & researchers, regulatory body inspectors, etc.), which can't replay by the other types of the training.
- RR staff and lecturers have to clearly understand the NPP training program objectives as a necessary condition for effective training of NPP staff at RR.
- Training at the VR-1 reactor is an example of effective professional training and how to integrate research reactor with small power to the professional training at national and international level.