EDUCATION AND TRAINING USING LOW POWER REACTORS

INTERNET COURSES FROM ISIS TRAINING REACTOR

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1. Education and training on the ISIS reactor
2. Example of “on site” courses
3. The “Internet” courses
4. Live connection with the ISIS reactor (Murphy’s law ?)
5. Conclusion
1. EDUCATION AND TRAINING ON THE ISIS REACTOR

- **Since 1956**, CEA’s strategy **complete theoretical courses by practical courses to avoid this**! Optimistic

- **Since 2007**, after major refurbishment, the **ISIS reactor** is mainly used for education and training: 400 h/year, 400 “on site” trainees/year.

- Open core pool type reactor, 700 KW, powerful **supervision system implemented in 2006 to record and process the reactor parameters**.

- In **2014**, **4 cameras and a video conference system implemented** to broadcast practical courses carried out on the reactor.

- Preliminary demonstrations from Q3 2013 and Q4 2014.

- **Start of the internet courses in Q1 2015.**
Education and training on ISIS research reactor

Since 1956, CEA’s strategy complete theoretical courses by practical courses or this!

Pessimistic
1. EDUCATION AND TRAINING ON THE ISIS REACTOR

Schematic of the reactor

Control rod moved from the top of the pool

Core
Main content of the Training courses

- Control of the reactivity during fuel loading
- Approach to criticality
- Reactor start up and stabilization

- Drawing of the calibration curve of a rod
- Evaluation of the global worth of a rod by the rod drop technique
- Influence of experimental devices on the core reactivity
- Reactivity change in the core – shadow effect

- Demonstration of the role of precursors (delayed neutrons) for the control of the reactor

- Study of the temperature effects (temperature coefficients, self-stabilisation)

- Radiation protection applied to reactor operation
- Study and setting of the Neutron detection systems
- Applications: Neutron cartography / Neutron activation analysis

- Reactor operation under the supervision of ISIS staff and INSTN instructors (on site)
Fuel loading experiment

2. EXAMPLE OF “ON SITE” COURSES
3. THE “INTERNET” COURSES

The system implemented for internet courses

- Signal for **Screen 1** (computer)
  - Power point presentations,
  - Reactor parameters - histograms,
  - Interactive white board signal,
  - Recorded data, drawn graphs
  - Movies

- Signal for **Screen 2** (4 cameras)
  - Contact with the lecturer,
  - Control desk - operators
  - Reactor hall
  - Reactor pool
  - and core

**ISIS reactor**

**Internet**

**Remote classroom**
3. THE “INTERNET” COURSES

Use of the supervision system: information available

- Power point presentation
- General state of the reactor
- Live histogram with the recording of relevant parameters and recorded curves (+ data)
- Listing of the recorded data and tables including relevant recorded data
- Calculated curves
Content and characteristics of the demonstration

- Use of the 4 cameras:
  1. Control room (different views possible)
  2. Control desk
  3. Reactor hall
  4. Reactor core
  + 5. Video signal from supervision system

- Reactor started up this morning and critical at 500 W
- Showing the approach to criticality results from the 20 of November
- Power increase from 500 W to 50 kW, natural convection, automatic control at 50 kW
- Observation of T feedback effect (Doppler and Water expansion)
- Switch to manual control: self stabilization of the reactor
- Reactor stop (SCRAM): power decrease - residual power
4. LIVE CONNECTION WITH THE ISIS REACTOR

Up to now, 9 uses of the broadcast system were carried out:

- Side event at the IAEA General Conference – September 2013
- ENEN General Assembly – March 2014
- Conference on the Nuclear Energy at HEC (famous business school) – May 2014
- World Nuclear Energy (WNE) exhibition (6 demonstrations in 3 days) – October 2014
- Conference on the Nuclear Energy at HEC, in parallel with WNE exhibition : 2 Guests at a time

The system was improved step by step

These 9 broadcasts were completely in contradiction with the Murphy’s law even if we were sometime very close to observe the Murphy’s law.

This time (10th broadcast) everything will come back to normal or not …
4. LIVE CONNECTION WITH THE ISIS REACTOR
5. CONCLUSION

A large panel of experiments has been developed on ISIS reactor: up to 27 hours educational and training programs.

“On site” practical courses are now completed by “Internet” practical courses.

An Agreement has been signed in September 2014 between AIEA and CEA for the broadcast of practical courses (exercises) to guest Institutions in Europe and neighbouring countries under the IAEA “Internet Reactor Laboratory” project.

Additional courses will be broadcasted through bilateral agreements between CEA and institutions.

The broadcast of Internet practical courses will start in January 2015.
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