DE LA RECHERCHE À L'INDUSTRIE

ISIS TRAINING REACTOR: A REACTOR DEDICATED TO EDUCATION AND TRAINING FOR STUDENTS AND PROFESSIONALS

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instn

1. THE INSTN

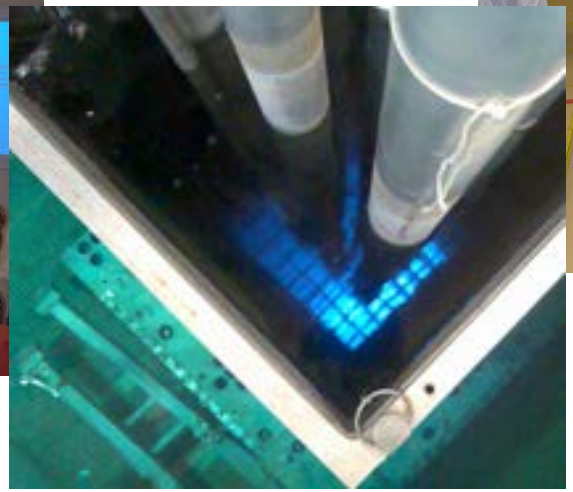
The National Institute for Nuclear Science and Technology

- The **National Institute for nuclear Science and technology** (INSTN) is part of CEA.
- The **mission** of the INSTN is to **provide to students and professionals a high level of scientific and technological qualification in all disciplines related to nuclear energy applications**.
- The **INSTN participates to the development of the human resources** needed by the French nuclear program **at two levels** :
  - **Academic degree programs** (for scientists, engineers, technicians, …),
  - **Continuing education** courses for professionals and PhD.
- The **INSTN's strategy has always been to complete theoretical courses by practical courses** carried out on an extensive range of training tools that includes software applications, codes, simulators, as well as the use of **research reactors such as ISIS reactor**.

2. THE TRAINING REACTOR ISIS

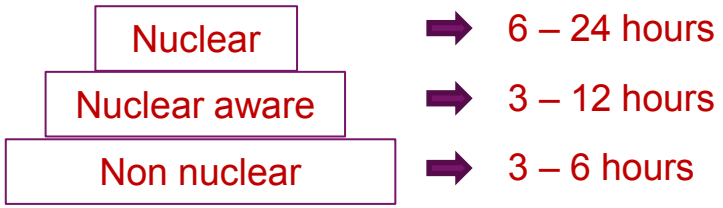
The training reactor ISIS

- Open core pool type reactor (700 kW).
- In 2006, he reactor went through a major refurbishment for its conversion to E&T activity. From March 2007, ISIS reactor is mainly used for E&T.
- **Major upgrade of the control system** (new licensing)
- Development of a **supervision system** used to show the evolution of the reactor parameters – Can be **used to broadcast training courses through internet**



Current Education &Training activity

- **Nine training courses with a duration of 3 hours** have been developed. They are mainly dedicated to the **practical aspects of the principles and operation** of nuclear reactors
- They are integrated in **academic** (~ 50 %) and **continuing education** (~ 50 %) :
  - Master in Nuclear Energy (French + 3 Swedish Universities)
  - Specialization course in Nuclear Engineering
  - Nuclear engineering modules of 7 Masters and Engineer degrees
  - Various 1 to 12 week courses for professional : operators, engineers, regulatory body, train the trainers
- **Depending on the public and pedagogical objectives, the trainees follow from 3 to 24 hours training courses**



- **Every year about 400 trainees participate to training courses, corresponding to 360 hours (40 % in English)**

3. EDUCATION AND TRAINING ACTIVITY ON ISIS

Main content of the Training courses

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

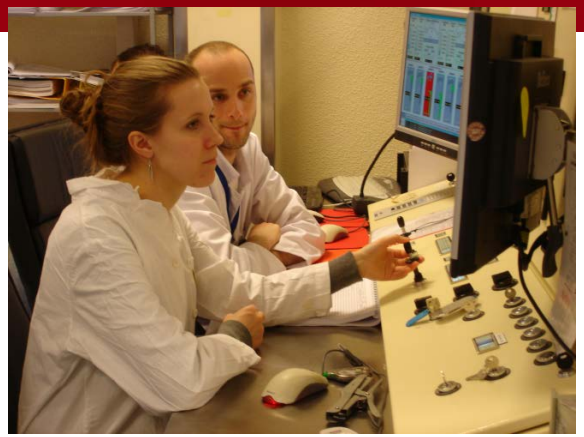
- Drawing of the calibration curve of a rod
- Evaluation of the global worth of a rod by the rod drop technique
- Influence of experimental devices on the core reactivity
- **Reactivity change in the core – shadow effect**

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

- **Study of the temperature effects (temperature coefficient , self-stabilisation)**

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

- **Reactor operation under the supervision of ISIS staff and INSTN instructors**



Training on ISIS reactor

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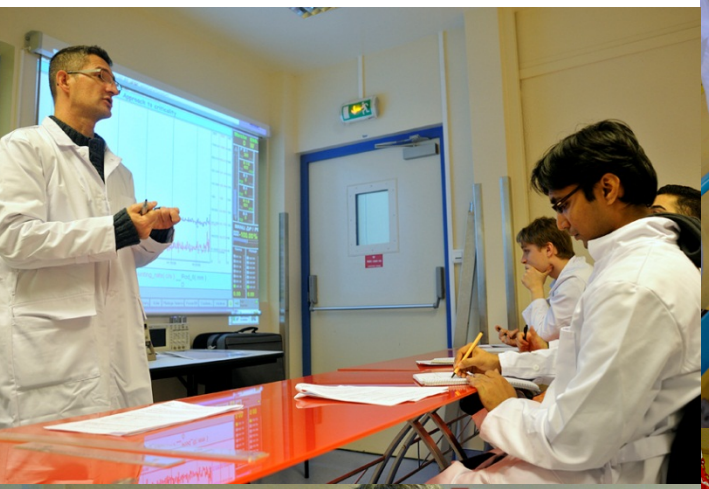
Fuel Loading experiment on ISIS Training reactor

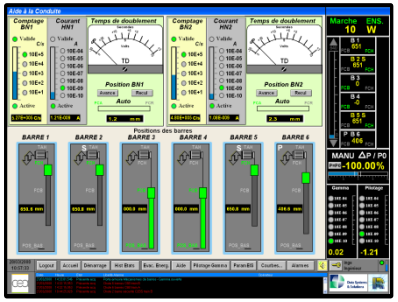


4. DEVELOPMENT OF INTERNET REACTOR LABORATORY

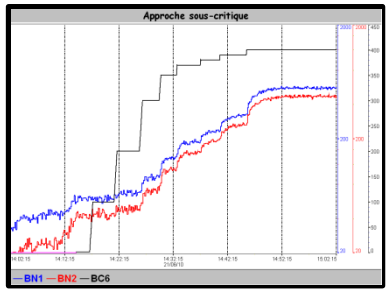
Use of the supervision system : information available

- Power point presentation

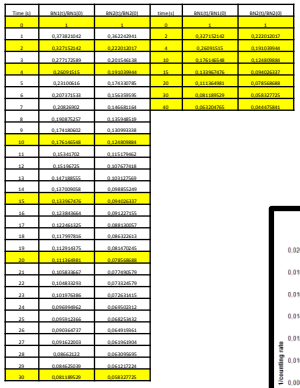
- General state of the reactor



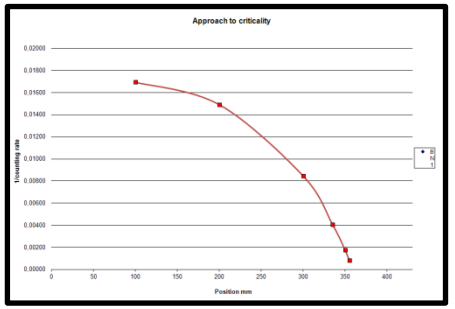
- Live histogram with the recording of relevant parameters and recorded curves (+ data)



- Listing of the recorded data and tables including relevant recorded data



- Calculated curves



4. DEVELOPMENT OF INTERNET REACTOR LABORATORY

System to be implemented on ISIS

ISIS reactor

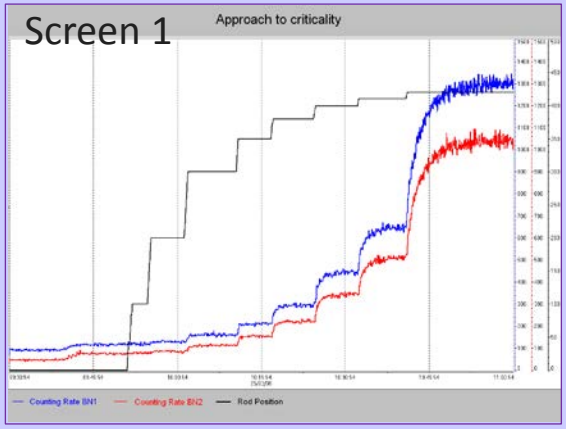
Signal for screen 1 (computer)
- Power point presentations,
- Reactor parameters - histograms,
- Interactive white board signal,
- Recorded data, drawn graphs
- Movies

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

Internet

Remote classroom

Screen 1



Screen 2

Signal from 1 camera

Contact with the trainees

Internet Reactor Laboratory project with IAEA

Objective : To schedule, perform and broadcast the following five (5) core experiments from the Host Reactor ISIS to the Guest Institutions once per academic year for each guest, or in parallel for groups of guest institutions as agreed amongst the CEA and the involved Guest Institutions:

- Lab 1 : Fuel loading
- Lab 2 : Approach to criticality ; Reactor start up ; Reactivity effect around criticality
- Lab 3 : Reactivity effect of devices (cylinders and box) placed in the core ; Rod calibration curve ; Global worth by the rod drop technique
- Lab 4 : Role of precursors ; Temperature effect ; Operating range of each detection system and associated OLC
- Lab 5 : Detection system in pulsed mode ; Detection system in current mode ; Neutron flux measurements with a micro fission chamber – Cartography

CEA and the Guest Institutions may agree to an arrangement with respect to broadcasting additional experiments.

5. CONCLUSION

- INSTN strategy : complete theoretical courses by practical courses on the ISIS research reactor.
- Training courses integrated both in Academic degree programs and Continuing education.
- 27 hours of training courses have been developed focusing on the practical and safety aspects of reactor operation.
- The Education & Training activity became the main activity of ISIS reactor: 400 trainees/year ; 360 hours/year ; 40 % in English.
- Remote access to the Training courses : Internet Reactor Laboratory under development to be started from 2014 to broadcast training courses from ISIS reactor to guest institutions.


Thank you
for your attention