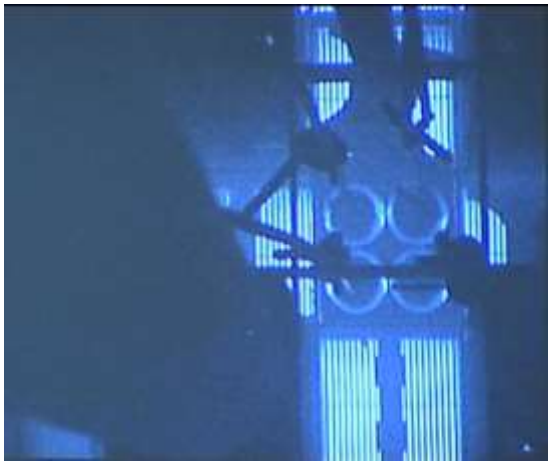
IAEA
International Atomic Energy Agency

THE IAEA'S INTERNET REACTOR LABORATORY PROJECT (IRL)



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OUTLINE

1. The Internet Reactor Laboratory (IRL)
2. The IRL implementation in Europe
3. The IRL implementation in Latin America
4. Further IRL implementation in Africa and Asia-pacific
5. Conclusion

1. THE INTERNET REACTOR LABORATORY (IRL)

The Internet Reactor Laboratory project from the IAEA

- The concept of the IRL project was pioneered internationally in 2010 through a link from the PULSTAR research reactor of North Carolina State University to teaching classes at the Jordan University of Science and Technology.

1. THE INTERNET REACTOR LABORATORY (IRL)

The Internet Reactor Laboratory project from the IAEA

- Project implemented and promoted by the IAEA. Supported by extra budgetary funds from the US Department of State.
- Aims at providing virtual access to research reactor (RR) experiments, connecting an operating RR in a country (host reactor) with universities classes in other countries (gest institutions).
- Intended to increase the global supply of nuclear education based on the use of RRs.
- Can benefit to countries engaged in educating human capital for future nuclear programmes (power and non-power).

1. THE INTERNET REACTOR LABORATORY (IRL)

The Internet Reactor Laboratory project from the IAEA

- Experiments are aimed at advanced undergraduate or postgraduate level of nuclear engineering or nuclear physics students.
- The IRL is under implementation in Europe and Latin America with the ISIS reactor (France) and RA-6 reactor (Argentina): broadcasting of the experiments will start in 2016.
- The IRL will be extended to Africa and Asia-Pacific : broadcasting of the experiments is foreseen in 2017.

2. THE IRL IMPLEMENTATION IN EUROPE

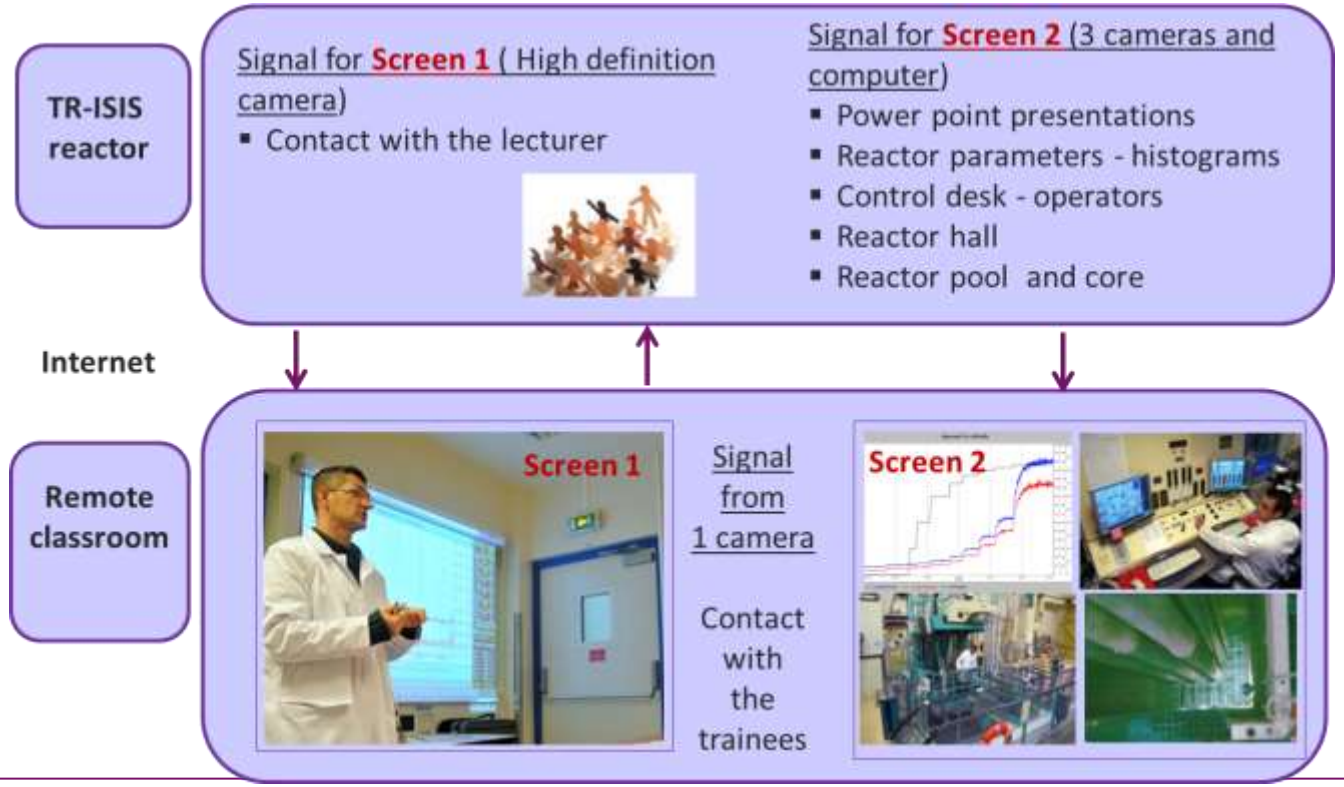
The IRL is implemented with CEA - National Institute for Nuclear Science and Technology (INSTN)

- Since 1956, the INSTN's strategy has always been to complement theoretical courses with practical courses on research reactors.
- The ISIS reactor : 700 kW open core pool type reactor
- The education and training (E&T) activity on the ISIS reactor: 400 on-site trainees/year, 400 hours dedicated to E&T
- For the implementation of the IRL project in Europe, the IAEA has been working with CEA since 2013.
- In the period 2013-2014, CEA integrated an advanced videoconference system on the reactor to carry out the IRL .

2. THE IRL IMPLEMENTATION IN EUROPE

The system implemented on the ISIS reactor

- The reactor parameters (recorded and processed by the supervision system), and the signals from 4 cameras installed on the facility can be broadcasted to trainees through the internet.



2. THE IRL IMPLEMENTATION IN EUROPE

Five “Core experiments” to be broadcasted from the ISIS reactor

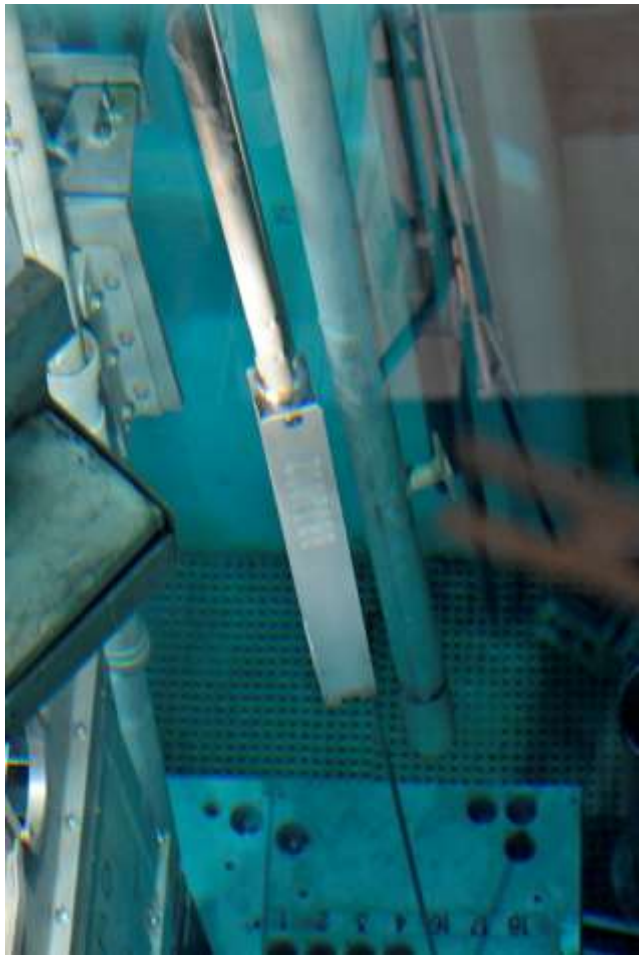
LAB 1:
- Fuel Loading

LAB 2:
- Approach to criticality
- Reactor start-up
- Reactivity effects – reactor kinetics

LAB 3:
- Reactivity effect of devices
- Rod calibration curve
- Rod drop technique

LAB 4:
- Fast Transient
- Temperature Effect – reactor dynamics
- Operating Range of Detection Systems

LAB 5:
- Neutron Detection



2. THE IRL IMPLEMENTATION IN EUROPE

The different steps of the project

- Signature of the agreement between the IAEA and the host reactor,
- Installation of the equipment on the reactor (in-kind contribution from the INSTN to the project),
- Development of a 25 min film in order to make a “walk through” of the facility as an introduction to the IRL (IAEA under PUI funding).
- Signature of an agreement between each guest institution and the IAEA,
- Procurement and installation of the equipment at each guest institution (equipment funded by the IAEA),
- Organization of two orientation workshops for the professors from the guest institutions (during the 5 year project), first one in S3 2015,
- Scheduling of the core experiment (should fit the academic program of all guest institutions), and broadcasting the five core experiments once a year in parallel to up to six guest institutions.

2. THE IRL IMPLEMENTATION IN EUROPE

First workshop for the guest instructors (October 2015)

- An orientation workshop for professors from the guest institutions was organized in October 2015 at the host reactor.
- The main objectives:
  - Train the guest professors,
  - Discuss technical and pedagogical aspects,
  - Provide practical demonstration,
  - Develop the broadcasting schedule for 2016.
- Countries that participated to this first orientation workshop: Belarus, Lithuania, Tanzania, and Tunisia.

2. THE IRL IMPLEMENTATION IN EUROPE

First workshop for the guest instructors (October 2015)

Workshop - In the control room of the host reactor, to get familiar with the reactor

Workshop - In a videoconference room at the host reactor, to experience what will be the IRL at their guest institutions

2. THE IRL IMPLEMENTATION IN EUROPE

First workshop for the guest instructors

- While being connected through internet to the host reactor, the guest instructors were able to experience what will be the IRL as if they were at their own institute,
- Their impression and feedback was very positive as they felt that they had proper information about the reactor state and operation through the videoconference system. They were also able to interact with the host instructor and with the staff of the reactor.
- Next step is to further develop the material (lecture notes, documentation, protocols) so that the guest instructors can prepare the students for the experiments. This work is done in collaboration with the host reactor.

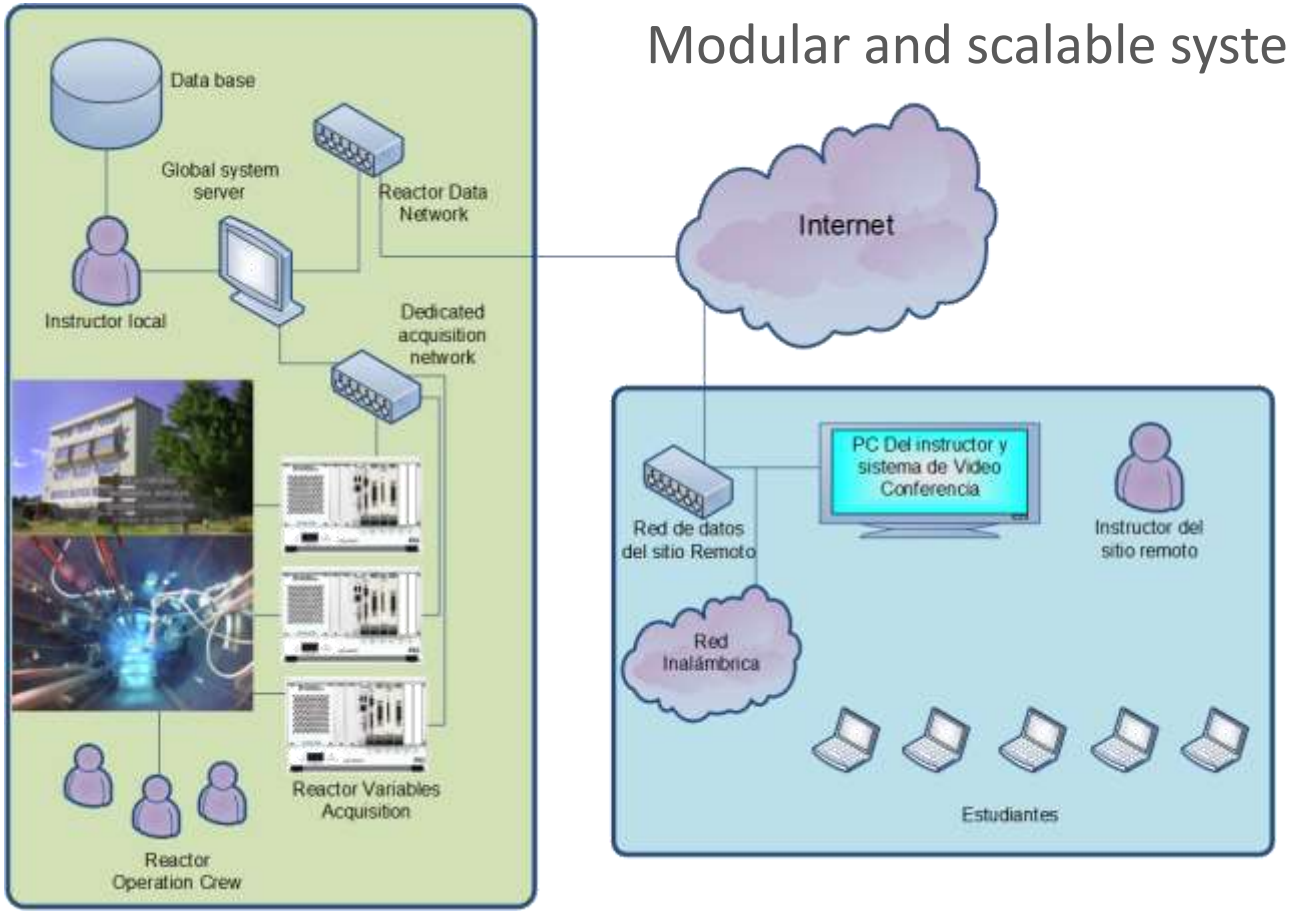
3. THE IRL IMPLEMENTATION IN LATIN AMERICA

The IRL is implemented with CNEA – Balseiro Institute

- The RA-6 reactor was designed and constructed as a school reactor to support Nuclear Engineering career at the Balseiro Institute which was created in 1977.
- The RA-6 reactor is a 1 MW MTR light water cooled and moderated reactor. It was commissioned in 1982.
- Teaching focuses on: (1) learning about experimental reactors, (2) developing experiences focused on engineering aspects of reactors, (3) integrating specific knowledge of the different areas related to nuclear engineering.
- For the implementation of the IRL project in Latin America, the IAEA has been working with CNEA since 2013.

3. THE IRL IMPLEMENTATION IN LATIN AMERICA

The system implemented on the RA-6 reactor



Modular and scalable system

- RA-6 operations signals
- Data Acquisition
- Data base recording
- Internet Connection
- Dedicated WEB platform

3. THE IRL IMPLEMENTATION IN LATIN AMERICA

The system implemented on the RA-6 reactor

Web Platform - Five Screens:

1. Welcome
2. Main menu
3. Laboratory interface
4. Historical data download
5. Bibliography

Screens in the platform

- Real Time Data
- One Tab dedicated to each experiment
- Control rod position always present
- Last 3 minutes of operation data
- Historical data with configurable time-base and auto-range

3. THE IRL IMPLEMENTATION IN LATIN AMERICA

Six "Core experiments" to be broadcasted from the RA-6 reactor

1 - Nuclear instrumentation on a Research Reactor

2 - Critical approach

3 - Control rod calibration

4 - Control rod reactivity measurement (rod drop)

5 - Temperature reactivity coefficient

6 - Void coefficient calculation

3. THE IRL IMPLEMENTATION IN LATIN AMERICA

The different steps of the project

- Signature of the agreement between the IAEA and the host reactor,
- CNEA: Develop and operate the platform,
- CNEA: Develop the laboratory protocols adapted to the IRL,
- CNEA: Prepare and conduct an orientation workshop for guest trainers,
- Gest Institutions: Equip their facilities to receive the IRL,
- Gest Institutions: Include the experiences within their curricula,
- AIEA: Coordinate the project and support financially the procurement of the equipment at the host reactor and guest institutions,
- The guest institutions:

  Universidad Mayor de San Andres (Bolivia)
  Escuela Politécnica Nacional de Ecuador
  Universidad Nacional de Colombia
  Instituto Superior de Tecnologías y Ciencias Aplicadas (Cuba), the
  Universidad Politecnica de Madrid (Spain)
  Universidad del Pais Vasco (Spain)

3. THE IRL IMPLEMENTATION IN LATIN AMERICA

First workshop for the guest instructors (September 2015)

- An orientation workshop for professors from the guest institutions was organized at the host reactor.
- The main objectives:
  - introduction to the RA-6 reactor as a machine
  - presentation of the six protocols developed for the IRL
  - host institution presented how they intend to include the IRL activities into their curricula
  - two reactor experiments were conducted, acting as local and remote instructors in order to show the guest instructors how should be the dynamic of the sessions
  - Develop the broadcasting schedule for 2016.

3. THE IRL IMPLEMENTATION IN LATIN AMERICA

First workshop for the guest instructors (September 2015)

4. FURTHER IRL IMPLEMENTATION IN AFRICA AND ASIA-PACIFIC

Implementation in Africa and Asia-pacific

- Consultations and selection process has been started with a number of research reactors in Africa and Asia-Pacific regions.
- Expert missions to assess the research reactor capabilities and suitability to host the IRL for the regional partners.
- As a result of the assessment process, based on comparative criteria, one host reactor will be selected in each region.
- The procedure will result in signing contractual agreements with these two host research reactor facilities.
- In parallel, the IAEA is collecting information from the Member States interested in receiving IRL courses through the internet. The contractual agreements also include the offer to receive the IRL classes at no cost for a limited period of time.

5. CONCLUSION

- IRL is a powerful tool for the development of the human resources needed for national nuclear programmes.
- Keeping in mind that IRL does not replace real hands-on experimentation at a research reactor, it is seen as a cost-effective way to expand the nuclear education for students that would not normally have access to a research reactor during their educational curricula.
- First IRL experiments will be broadcasted in Europe and Latin America from the second semester 2016.
- Expansion of the project in Africa and Asia-Pacific regions is also undergoing.
- This ensures that the IRL will contribute to the increase in the global supply of nuclear education and training based on research reactors.


Thank you
for your attention