

"Already Available Training Solutions to the Global Challenges of the Nuclear Renaissance from the Simulation Industry"

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Introduction

The Nuclear Re-birth

- The crisis at Fukushima plant has refocused world's attention on the future of nuclear power → a review of nuclear safety standards is called for
- While still too early to estimate final impact of the accident on the forecasted nuclear expansion, the need to train a new generation of nuclear engineers and technicians is real
- We present 4 innovative applications already available from simulator providers:
 - End-user friendly simulation platform T-REX
 - Training & engineering EPR Simulator
 - PWR Basic Principle Simulator SIREP
 - On-line Micro Simulation tool MicroSEL







T-REX (I)

Most flexible full-scope training simulator environment

T-REX (Thunder Real Time Executive)

- The only **totally brand new** platform built in the last decade
- End-user friendliness as main design objective: engineers, instructors or students need minimal training to take the most of the tool
- Very low requirements, easy to set-up, install and upgrade, widening usage to classrooms and other staff
- Technology allowing simulators to be run off of storage media or remotely over the Internet







T-REX (II)

On the way to become a standard in the U.S. market

• Among all the simulator upgrading projects delivered or planned since the product was launched in 2006, only two plants have chosen a different platform:





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EPR simulator (I)

Next generation reactors, new generation simulators

Antecedent: Ling Ao II [CPR-1000, CGNPC, China]

V&V simulator was also used in specific training sessions, before full-scope training simulator –delayed for months – was ready

- Nowadays, both uses are possible with the same simulator thanks to advanced tools like ALICES
- Plant design evolves and **simulator role increases**, becoming significant from early stages
- Innovative strategy applied to: Flamanville 3 [EPR, EDF, France] & Taishan [EPR, CGNPC, China] Early identification of design mistakes and data voids ... therefore, time and costs savings

Simulator features	Training	Engineering
Scope of simulation	Full	Limited
Physical phenomena models	Simplified	Accurate
Real-time results	Yes	No
Instrumentation & Control	Accurate	Simplified

Engineering vs. Training



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EPR simulator (II)

Engineering and training support all-in-one

• **Engineering** and design:







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SIREP (I)

The need: Skilled new nuclear staff

- Many of the largest companies have started recruitment programs due to:
 - Retirement of senior professionals
 - Development of new projects
- Specific case: GDF SVez
 - Operates all reactors in Belgium (7x PWRs)
 - Currently employs about 4000 people with nuclear skills
 - 2015 hiring forecast: + 1000 engineers and technicians

«Nuclear Trainees Program» 1-year course since 2006:

- Mixing theoretical learning and field experience
- More than 400 hours of hands-on training
- Covering the entire nuclear chain: engineering & design, construction, operation, waste and fuel management, maintenance and dismantling
- − CORYS T.E.S.S. is in charge of the PWR training \rightarrow SIREP simulator







SIREP (II)

The tool: Basic Principle Simulator

- Developed with ALICES
- Scope:

Normal operation, start-up from cold shut-down to full power, stretch-out operations

- Although models are simplified, it comprises:
 - Main hydraulic systems:
 - SGs, PZR, BOP
 - RHR, CVCS
 - Turbine Bypass
 - Physical phenomena:
 - Feedback effects
 - Xenon poisoning
- Main control systems allow automatic and manual modes



SIREP-1300 is based on French 1300 MW PWRs





μSEL (I)

New concept: On-line Micro Simulation

- In 2008, EDF's Training Department (UFPI) requested CORYS T.E.S.S. to develop a new solution to address the gap between theory classes and simulator sessions:
 - Basic skills acquisition before focusing on more complex notions
 - Courses more attractive to the young audience
- MicroSEL:
 - Light weight self-contained modules dedicated to specific subjects
 - User interacts with a **real-time simulation model** in a virtual environment
 - 2 different applications:
 - Under instructor supervision in a classroom → theory support
 - Stand-alone learning tool managed with LMS → practical exercises
- 17 modules were delivered in 2010, 9 more are scheduled for 2011
 - After that, EDF engineers will be able to develop new modules in-house





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μSEL (II)

Better interaction, better learning

• Advantages:

- Interactive graphics
- Model scope can be adapted to the need
- Modules created using
 CBT multimedia content
 generation software
 → easy to update in-house
- Runs on standard PC or Web browser

• Limitations:

- Models are simplified
- Simulation scope to be taken into account during the pedagogical specification







Thank you

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