TECNATOM´S SIMULATION SOLUTION FOR EDUCATION IN NUCLEAR FUNDAMENTAL PRINCIPLES

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Antonio Sancho, Daniel Suarez, Elena Gil

1 Learning Station

TRAINING SIMULATORS

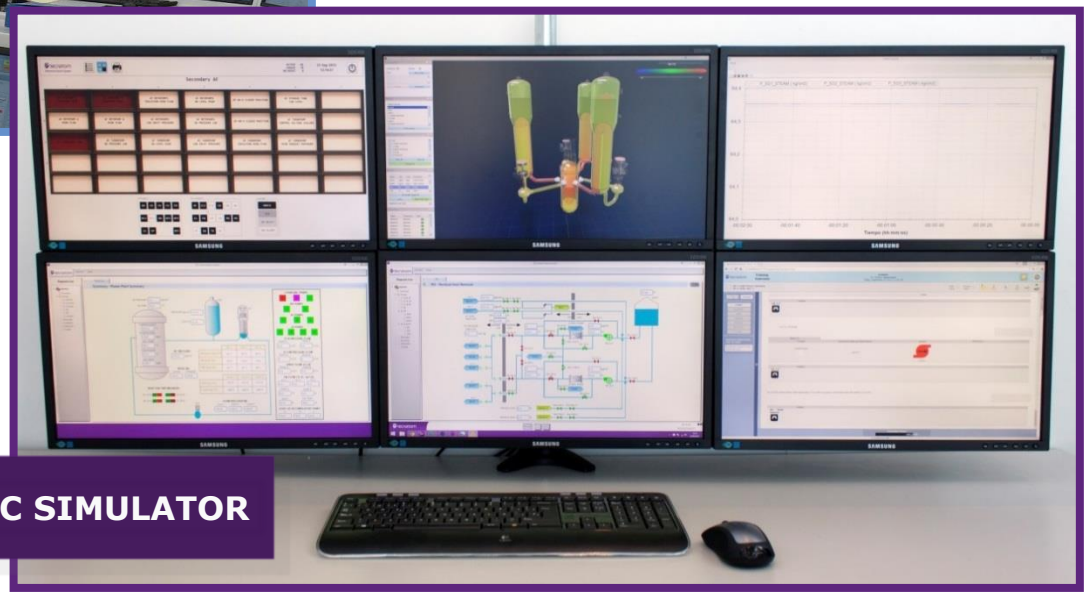
Full scope simulators / Generic simulators

FSS SIMULATOR

CUSTOM MODELS

CUSTOM HW PANELS

SPECIFIC PRODUCT



SIMPLIFIED SCOPE

MODELS ADAPTATION

NEW INTERFACES

GENERIC SIMULATOR

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LEARNING STATION

Generic PWR simulator

Simulator optimized for education and training in the fundamental principles of operation of a generic PWR power plant

One computer with six 23'' monitors executes all the different applications

Support applications

- Process diagrams
- Trending tool
- 3D visualization tool
- 3D generic components
- Training exercises tool
- Advanced alarm system

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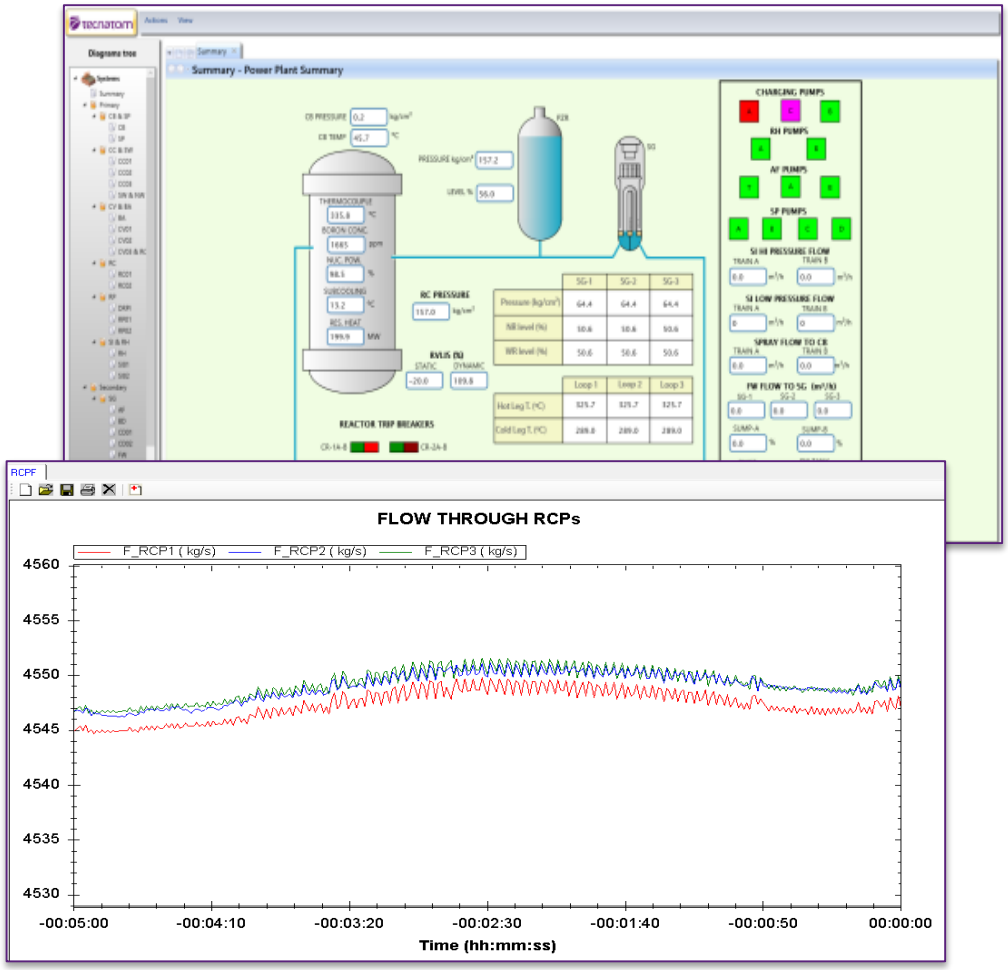
LEARNING STATION

Process diagrams & trends

Process diagrams of the 26 systems in the generic nuclear power plant according to their flow and instrumentation diagrams:
44 different diagrams
(10 summary + 34 interactive)

Trends to follow the evolution of the various parameters or properties

222 preselected variables



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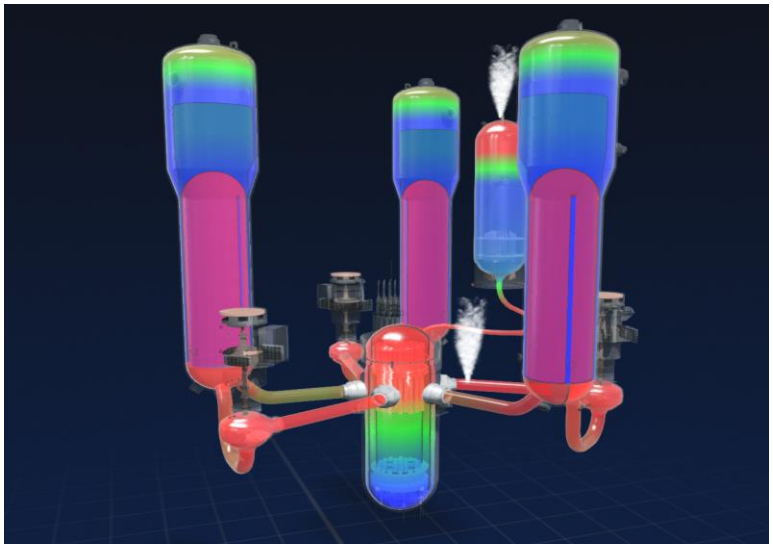
LEARNING STATION

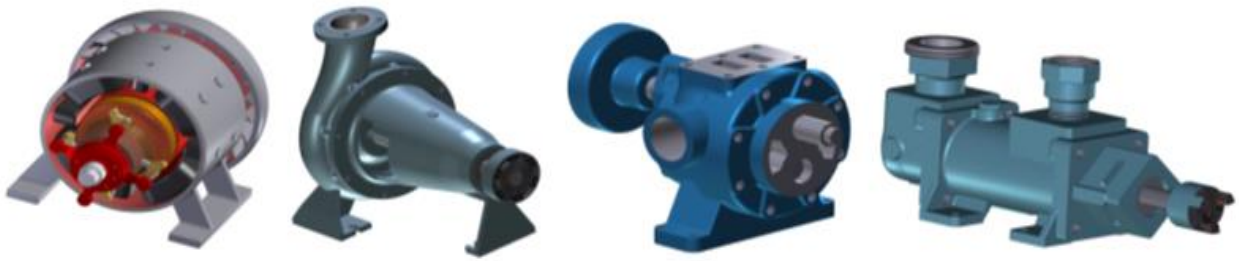
3D primary circuit visualization tool & generic components

The **3D primary circuit visualization tool** monitors the reactor vessel, steam generators, pressurizer and primary loops



Components can be made transparent and different flow regimes and properties can be observed

3D scan of the parts of the **generic components** scanned at Tecnatom's training facility



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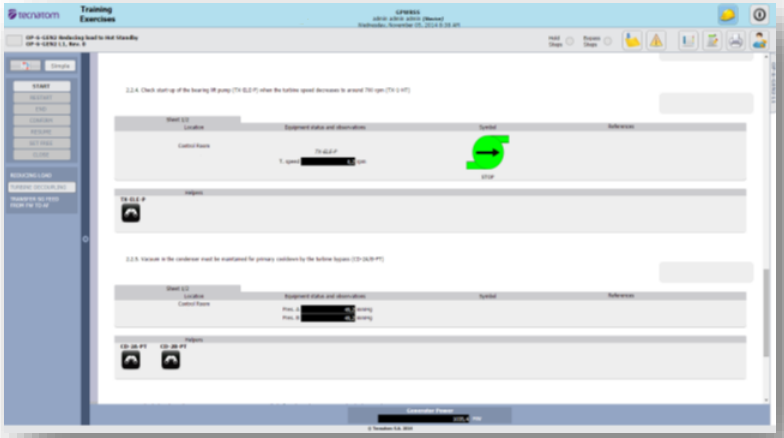
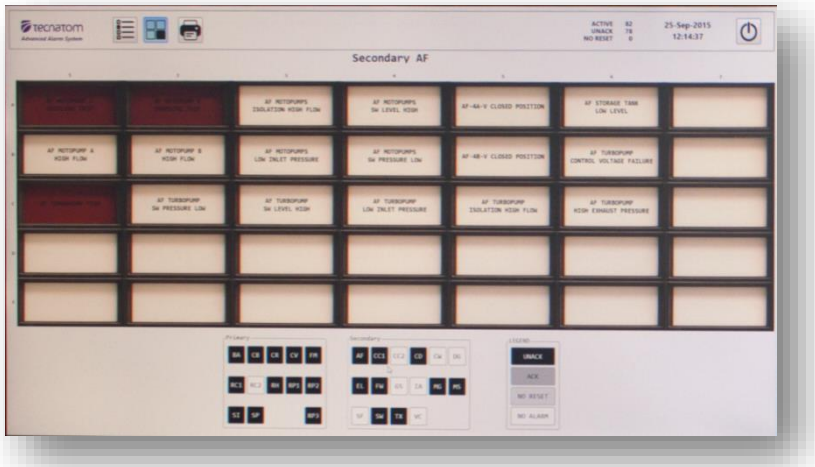
LEARNING STATION

Training exercises tool & Advanced alarm system

The **Training Exercises Tool** helps the students execute the training exercises by following the procedures in a webpage with feedback from the simulation

Two different types of exercises: Novice & Experienced





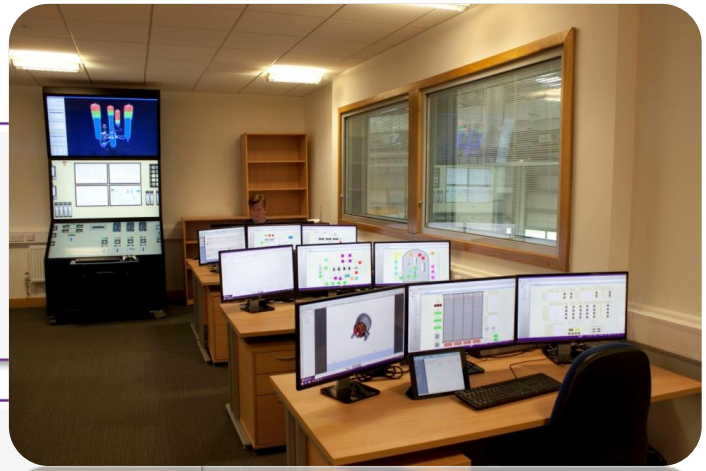
The **Advanced Alarm System** displays the active alarms in two different ways:

Listed by time or in 31 panalarms

2 Training experiences

TRAINING EXPERIENCES

Different approach to the conventional training



Learning methods

- Demonstration mode
- Operation mode

Configurations

- An instructor and several students with the same scenario
- Each student with an independent scenario

Approaches

- A priori knowledge justification
- A posteriori knowledge justification

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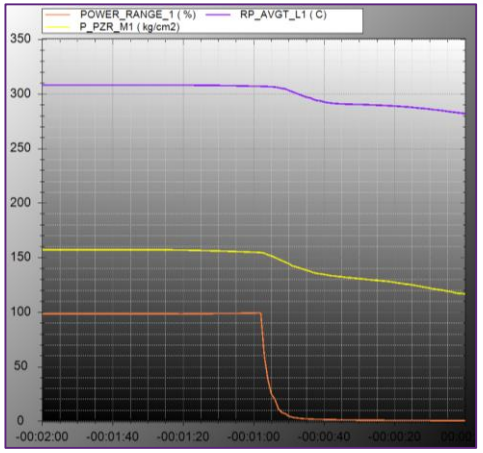
TRAINING EXPERIENCES

Examples of applications

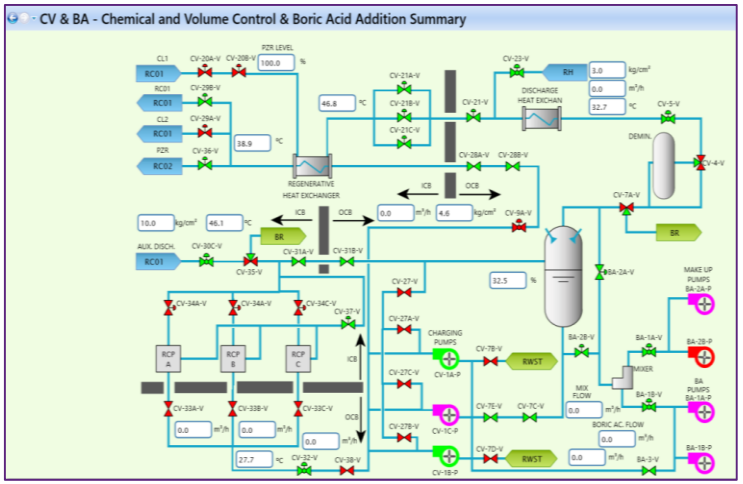
Nuclear Reactor Fundamentals

From an initial condition corresponding to MODE 1, load variations with and without the control rods movement enabled, variations in reactivity are taught.



Plant Systems

Interactions between systems are shown. Letdown temperature control actuation after a change in the charging flow, turbine runback after a main feed water pump trip from 100%.



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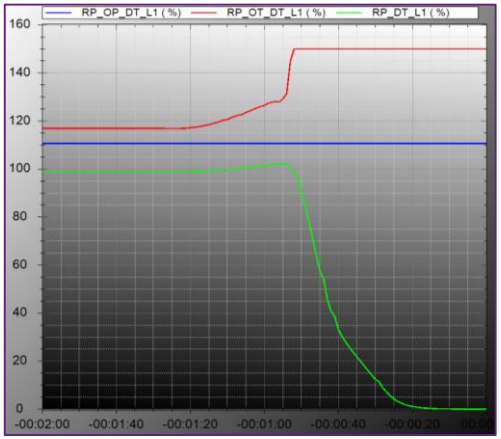
TRAINING EXPERIENCES

Examples of applications



Thermal-hydraulics

Learning station is used to show the evolution of over-temperature (OTDT) and over-power (OPDT) trip set-point after variation of plant conditions. It helps to teach what the thermal balance is and its evolution.

Accident analysis

Different severities of ruptures in the primary circuit (LOCA) or in the secondary circuit show different and very specific evolution of the main variables, such as pressure or void fraction. These and other particularly important parameters are displayed in the 3D primary visualization tool for the student to easily visualize the transient evolution.

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TRAINING EXPERIENCES

Plant personnel training

	PLANT OPERATORS	OPERATORS INITAL TRAINING	SUPERVISORS INITAL TRAINING	OPERATORS REQUALIFICATION
INTRODUCTION	✓	✓		
SYSTEMS	✓			
CONTROLS	✓	✓		
TRANSIENT THEORY		✓	✓	✓
SPECIFIC SUBJECTS		✓	✓	✓

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3 Conclusions

CONCLUSIONS

Advantages & Benefits

Benefits to the education and training in the nuclear technology:

- ✓ Training of different profiles with different backgrounds
- ✓ Students without in-depth prior knowledge of the plant systems are able to perform exercises with the complete plant model
- ✓ The complex phenomena that occurs in the reactor is more easily understood by using 3D visualization and trends
- ✓ Having a validated PWR model in any classroom
- ✓ Affordable for Universities and training centres

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