HOW TO TURN A FULL SCOPE SIMULATOR INTO AN INTRODUCTORY EDUCATIONAL TOOL
(PART 1)

May 2014 Meeting
Table of Content

1. PART 1: TECNATOM & Simulation Business
2. PART 2: HOW To turn a Full Scope Simulator into an IET
3. PART 3: TWO Case Studies
   3.1 A Generic Simulator for the University (Spain)
   3.2 A Classroom Simulator for a Training Center in UK
4. Understanding TMI (Video using VR as a HMI of a simulator)
Table of Content

1

PART 1: TECNATOM & The Simulation Business

1.1 ➔ Tecnatom & Simulation
1.2 ➔ Why Simulation technology in an Introductory tool
1.3 ➔ Alternative approaches to obtain an IET
1.4 ➔ Full Scope simulator concepts
1.5 ➔ Innovative solutions
1.6 ➔ Tecnatom position
Establishment of the Company

1.1
Main Milestones

1.1

Services

1957 Establishment of the Company

1973 The Spanish Electric Utilities Became the Sole Shareholders

1975-79 Acquisition of Automatic Inspection Systems

Services & Products

1980-89 Acquisition of Full Scope Simulators

1990-99 Technological Independence in Core Activities

Internationalization & Diversification

1990-99 Strategic Alliances

Expansion to Other Synergic Industries

2000-09 Acquisition & Control of Shared Companies

Expansion in Target Markets

2010-2011 Alliances & Acquisitions

Establishment of The Group

Proprietary & Confidential 2014 Tecnatom S.A.
All Rights Reserved
1.1 Tecnatom Capabilities and Sectors
Tecnatom Figures

Turnover (2008-2012)

- Capital (Thousand €): 4,026
- Equity (Thousand €): 61,250
- Workforce: 836
- Turnover: 115,812
- Investment (Thousand €) (69.683 M / H): 17,250 (14.9% Income)

Turnover (2008-2012)

- 2008: 11,000
- 2009: 12,000
- 2010: 13,000
- 2011: 14,000
- 2012: 15,000

- M.Sc University Degree: 62%
- B.Sc University Degree: 19%
- Specialists: 12%
- Technical-Administrative Support: 7%
Simulation at Tecnatom: over 30 years of active involvement

• **Simulators Supply:**
  Different Scopes and Technologies

• **Upgrades and Modernization of Simulators:**
  Best-estimate models implementation
  New Simulation Tools
  I&C Systems Upgrade
  New Input/Output Systems

• **Operation and Maintenance of Simulators:**
  Management System Configuration
  SW and HW Corrective Maintenance
  Plant Modifications Implementation

• **Simulator Assisted Engineering:**
  Plant Design Modification Assessment
  Plant Procedures and I&C Systems Validation
  HFE V&V
• **Tecnatom owns and maintains six Spanish replica simulators.** These simulators are certified by the Spanish Regulatory Body according to the ANSI-3.5
• Tecnatom participates in the **ANSI-3.5 Working Group**
• Member of the Utility Simulator User Group (USUG)
• Tecnatom participates in the **US-NRC CAMP** (Code Applications and Maintenance Program) with TRACE TH code analysis.

- Two GE BWR
- Three PWR-3L
- One KWU PWR
NPP Simulators Track Records

Full Scope Simulators
- Cofrentes - Spain; GE-BWR. 1990.
- Ascó - Spain; W-PWR. 1996.
- Vandellós II - Spain; W-PWR. 1999.
- Trillo - Spain; KWU-PWR. 2004.
- Garoña - Spain; GE-BWR. 2005
- Atucha II- Argentina; Siemens-PHWR. 2012.
- Angra I- Brazil; W-PWR. (In progress).

Part Scope Simulators
- Jose Cabrera - Spain; W-PWR. 1994.
- Atucha I- Argentina; Siemens-PHWR. 1996.
- Jules Horowitz Reactor – France 2013
- Angra I- Brazil; W-PWR. 2008.

Upgrades and Modernizations
- Smolensk - Russia; RBMK. 2001.

Others
- OSC- Temelin NPP (Czech Republic), ..
Simulation has demonstrated to be a good technology to exercise education and training concepts, such as:

Learning by Doing, Learning by Discovering, Learning by Failing, Learning by Teaching, Learning by Teaming, .......

![Learning Pyramid](image-url)

* Source: National Training Laboratories (Bethel, Maine)
There are several ways to get an Introductory Educational Tool based on simulation, some of them are:

1. To use an IAEA PC-Based generic simulator
2. To reuse and adapt an available Full scope simulator
3. To build a new simulator (it entails to develop and/or simplify models and $)

Every approach has advantages and disadvantages. Tecnatom’s experience is to use available Full scope simulators as Classroom Tools (SGI program 20 years ago)
Advantages:

- Application software available: models, instructor station, execution environment, databases, interface with other systems, other applications embedded
- Simulation technology available
- Simulator thoroughly validated
- Full documentation (Training, Design, Reference plant, Use..)
- Instructors experts in using the simulator

Disadvantages:

- Reference plant data disclosure (Prior approval)
- Technology licensing
- Export to some countries
- COMPLEXITY (can be alleviated)
Full Scope simulator concepts

Full scope simulator concept responds to requirements stated in the standards (the most known is the ANSI-ANS 3.5 Nuclear power plants simulators for use in operator training and examination).

The scope of simulation shall include systems of the reference unit to the extent necessary to allow the operator to perform the normal evolutions described in Sec. 3.1.3.2 and respond to the malfunctions described in Sec. 3.1.4. These systems shall be complete to the extent that the operator can perform these control manipulations and observe simulated unit response as in the reference unit.
IET & Innovative solutions

Advanced Human Machine Interfaces. Virtual Reality

From 2D to 3D
Advanced HMI examples: Virtual NSSS & Plant walkthroughs
IET and Innovative solutions: Virtual Panel Simulator (Glasstop)
IET and Innovative solutions: World Wide Training
Our position is:

- Whenever possible our preferred approach is to reuse an available full scope simulator as the basis to get an IET.

- To the largest extent, strengthen the IET with innovative and effective solutions, such as:
  - Innovative HMI: 3D virtual reality coupled with a real time simulation
  - Use of “new” devices to support training i.e. tablets, glasstop devices
  - To facilitate remote tutoring strategies
  - To pay special attention to redesign and adapt the training material.

TO ATTRACT AND MOTIVATE NEWCOMERS
(generational leap, digital generation)
End of Part 1