

Welcome



Nuclear Power Plant Simulation Conference

Chattanooga, USA – January 2020



ANSI/ANS-3.5.1-20xx – new Standard

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ANSI/ANS-3.5.1-20xx

Nuclear Power Plant Simulators for Use in Simulation-Assisted Engineering and Non-Operator Training

- 2018 NPPS Conference, Houston, Texas
 - Evan Lloyd announced need to create new Standard
 - Volunteers requested for new Working Group

Working Group Members

- O. Ashy, *Western Services Corporation, Inc.*
- N. Bowerman, *EDF Energy (UK)*
- L. Cheng, *Individual*
- R. Deljouravesh, *Ontario Power Generation*
- J. B. Florence, *Nebraska Public Power District*
- D. P. Goodman, *Luminant*
- G. Grady, *GSE Systems*
- B. Holl, *Individual*
- K. Leung, *Bruce Power*
- A. Linsell, *EDF Energy (UK)*
- E. M. Lloyd, *Exitech Corporation*
- I. A. Lowe, *EDF Energy (UK)*
- W. Marquino, *Consultant*
- G. S. McCullough, *Exitech Corporation*
- A. Montgomery, *EDF Energy (UK)*
- B. J. Panfill, *Corys*
- H. D. Paris, *L3 MAPPs*
- E. Rau, *Duke Energy*
- J. A. Ruiz, *Tecnatom S.A.*
- D. E. Spielman, *Southern Nuclear Operating Company*
- D. A. Wang, *Shandong Nuclear Power Company, Ltd.*
- J. C. Yarbrough, *Excel Energy*
- K. Singh, *EDF Energy (UK) – Chairman*
- Background: Chief Executives, Directors, Vice-Presidents, Managers, Supervisors, Engineers, etc.

Other Industries using Simulators for Engineering and Training?

- Aircraft
- Motor-Car
- Medicine
- Manufacturing
- Space
- Airbus
- UK Smiths Aerospace – General Electric
- Tesla
- Google
- Netflix
- Uber

Papers at previous Nuclear Industry Conferences

- Barcelona, Spain, 2013
- Bristol, UK, 2015
- Birmingham, UK, 2018
- San Diego, USA, 2017
- Houston, USA, 2018
- Etc.

Advantages of using Simulators?

- ✓ Checking out engineering designs on NNB and plant modifications on existing NPP/stations
- ✓ Reducing nuclear safety challenges/ enhancing nuclear safety
- ✓ Optimizing existing engineering designs
- ✓ Trip Hardening, Single Point Vulnerabilities
- ✓ Identifying defects and deficiencies up-front, and resolving them
- ✓ Reducing installation and commissioning times
- ✓ Saving on overall budgets
- ✓ Longer breaker to breaker runs
- ✓ Checking out commissioning procedures

Advantages of using Simulators?

Typical nuclear utility with 16 reactors spends about \$600m per year on engineering works/plant mods/outages

\$37.5m/reactor/year

International Atomic Energy Agency (IAEA) – 448 operational reactors in world end 2017, generating 392 GWe, giving 2,503 TWh; 60 reactors under construction

Engineering work/year world-wide = $\$37.5\text{m} \times 448$
= \$16,800m/year

Tremendous scope for using Simulators to help Engineering and other Training (400 people on NPP/ Reactor?)

Nuclear Utilities – used Simulators for Engineering

- Palo Verde
- Duke Energy
- Southernco
- Exeloncorp
- Wolf Creek
- Sequoyah
- PGE
- Prairie Island
- Southern
- Cooper
- D.C.Cook
- Nucleoelectrica Argentina
- Krsko
- EDF Energy
- EDF, EPR Projects in the UK
- EDF, Flamanville 3
- Framatome – Taishan EPR

Vendors – used Simulators for Engineering

- Corys – EDF Flamanville EPR, EDF move from analogue to digital Main Control Rooms, Changes on existing stations, Technicatome, Framatome, CETIC Training Centre, Ling A0 II
- GSE – Upgrades to digital control systems, Bruce Power
- L3 Harris/MAPPS – INL , Dept of Energy, Okiluoto 3 EPR, Candu Energy, Engineering Design Analyzer to Shanghai Nuclear Engineering Research and Design Institute (SNERDI)
- Tecnatom – Almaraz, Angra 1, Asco
- WSC
- INPO

Progress on New Standard ANSI/ANS-3.5.1-20xx

- Started by Grassroots - USUG
- PINS – Project Initiation Notification Systems Form prepared on background and need
- Reviewed and Approved by various ANS Committees and Boards during 2018
 - The Simulators, Instrumentation, Control Systems, Software & Testing Subcommittee – approved 20 Aug 2018
 - Large Light Water Reactors Consensus Committee – approved 20 Sep 2018
 - Standards Board – approved 14 Dec 2018
- Registered with American Standards Institute (ANSI) – 14 Dec 2018

Progress on Drafting ANSI/ANS-3.5.1-20xx during 2019

- Brainstorming ideas
- Main headings listed
- Graded Approach
 - how good/capable is the simulator available?
 - What can be done on the simulator available?
 - Who will know what the existing simulator is capable of?
- Appendices – Typical examples of how simulators have been used, what for, by other nuclear utilities and vendors
- Funding for using simulators for such purposes / Tax breaks
- Several Drafts produced and reviewed
- Working Draft Issue – end 2021

Thank You

