

# Addressing New and Advanced Reactors in Standards for Instrumentation, Control, Electrical and Control Room Systems

Dr. Richard Wood

Nuclear Engineering Department  
The University of Tennessee  
rwood11@utk.edu

Presented at  
Meeting on New & Advanced Reactors:  
Codes & Standards

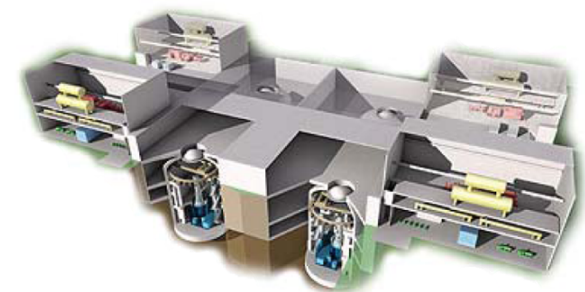
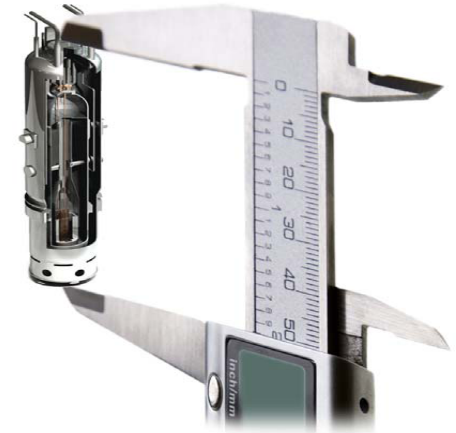
NRC Headquarters  
Rockville, MD

April 4, 2024



# A New Paradigm is Required to Offset Reduced Economy-of-Scale Savings for Small and Microreactors

- Plant design and management
  - Multiple units per site
  - Multiple product streams
  - More effective, efficient operation and maintenance
- Reduce capital costs
  - Extensive use of digital technologies
  - Optimized I&C
  - Reduce cable installation costs
- Reduce plant operations and maintenance costs
  - Plant availability
  - Efficiency of power conversion
  - Staffing requirements
  - Remote or near-autonomous operation
- I&C technology can enable this objective to be successfully realized



# Two Primary SDOs Address Application of I&C, Electrical and Human Factors Technology for Nuclear Power

- Institute of Electrical and Electronic Engineers (IEEE)
  - Nuclear Power Engineering Committee (NPEC)
  - 5 Subcommittees
  - More than 50 standards
  - Based on individual participation of technical experts
- International Electrotechnical Commission (IEC)
  - Subcommittee 45A (SC45A)
  - 9 Working groups
  - More than 70 standards
  - Based on participation of technical experts from national committees

# IEEE and IEC Acting to Harmonize Standards and Resolve Guidance Needs for New Reactors

- IEEE and IEC have an agreement to jointly develop standards
  - 11 dual logo standards have been published to date
  - 5 joint projects are underway
- IEEE and IEC are participating in the ARCSC effort
- IEC performed an assessment of guidance needs/gaps for SMRs
  - IEC TR 63335:2021, Nuclear power plants - Instrumentation and control systems, control rooms and electrical power systems - Specific features of small modular reactors and needs regarding standards
  - Working group roadmaps to address needs were developed

# Highlights of Assessment of Gaps/Needs to Accommodate SMRs in IEC Standards (1)

- Sensing and Measurement
  - Sensor technology (optical, ultrasonic, electromagnetic)
  - Qualification (harsh/unique environments, lifetime) and maintainability (access, longer operational intervals)
  - Implementation (physical constraints, interconnections/communication, embedded manufacturing)
- I&C architectures
  - Multi-unit or shared operational architectures
  - Integrated and/or wireless communications
  - Independence and defense-in-depth

## Highlights of Assessment of Gaps/Needs to Accommodate SMRs in IEC Standards (2)

- Controls and Plant Operation
  - Concepts of operations
  - Multi-unit control
  - Remote monitoring and/or control
  - Advanced control and monitoring for extensive automation or near autonomy
  - Functional allocation between human and machine (degree of automation)
  - Alternate approaches to human-system interactions
- Classification and graded approach to guidance for advanced reactors

## What's Next

- Findings from ARCSC survey will be assessed and action plans developed
- IEC will implement working group roadmaps from SMR assessment
- Approaches for incorporating flexibility into guidance are being investigated
  - Risk insights
  - Performance-based enhancements
  - Graded approach to criteria
- Harmonization efforts will proceed
  - Dual logo standard development
  - Common adoption by national industries and regulators