

NUCLEAR ENERGY SERIES

Provisional Title	Introduction of Systems Engineering Principles for Nuclear Power Plant Instrumentation and Control
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1. RATIONALE

Various industries such as aerospace, rail and shipbuilding have applied Systems Engineering (SE) for many years to address the complexity of modern technical systems, together with the need for competitiveness and innovation while meeting tight schedules and budgets. Systematic SE is still in its relatively early stages in the nuclear industry. This industry has to ensure extremely high levels of safety and security and has many specific constraints such as long construction times, very long lifetimes and high dependability targets.

SE covers the complete lifecycle of a system from conceptual studies to the end of the life cycle through all phases such as system requirements specification, design, construction, licensing, commissioning, operation and maintenance, outage management, renovation and decommissioning. Also, as the high level of complexity requires the contribution of many stakeholders, SE aims at breaking up silos and at rigorously coordinating the activities of all those involved, so that together they contribute adequately and efficiently to the engineering of the system despite differences in scientific and technical cultures and in viewpoints that might cause significant difficulties in communication and mutual understanding.

Instrumentation and control (I&C) is one of the disciplines to be considered. The role of I&C engineers in the systems engineering framework needs to be clarified. The specification and design of I&C architectures has to take the entire lifetime of the plant into account. Communication between I&C engineers and experts of other disciplines of importance to I&C, such as process engineers, electrical engineers, human factors experts and safety and security experts has to be established and maintained over all life cycle activities.

2. OBJECTIVE

The objective of this NE Series report is to assist Member States in understanding the philosophy and methodologies on SE in general (as introduced e.g. by INCOSE) and to promote the adoption of SE and its different applications for the overall engineering lifecycle of safety significant instrumentation and control (as described in IAEA SSG-39).

The goal of the document is to provide an overview on the current knowledge, up to date best practices, experiences, benefits and challenges related to the subject approaches (listed under “Scope”) on SE. The document is intended to be used by Member States to support the introduction of the SE methodology for all stakeholders involved in the engineering lifecycle of safety significant I&C for NPPs and to discuss how these activities can support the safe, reliable and long-term operation of nuclear power plants.

3. SCOPE

The scope of the publication will cover the essential activities to be performed through the whole engineering lifecycle of safety I&C with the involvement of various disciplines.

The tentative list of areas for the scope of this publication include:

- Systems engineering overview
- Use and value of systems engineering
- The various components of systems engineering (e.g. managerial, logistical, technical)
- Overall engineering lifecycle
- Systems engineering for I&C design
- Quality in the I&C life cycle
- Regulatory/licensing aspects
- Lessons learned from experience (previously completed projects, proven practices, etc.).