NUCLEAR ENERGY SERIES

Provisional Title	**Instrumentation and Control and Advanced Digital Technologies for the Support of Plant Performance**

1. RATIONALE

Many industries were able to improve the efficiency and the economic performance of their facilities and products through the judicious use of advanced digital technologies, while ensuring high levels of safety and security. The nuclear industry would greatly benefit from their experience to improve the economic performance and competitiveness of existing and future NPPs.

Many novel designs and advanced technologies are currently under study for both existing NPPs and new constructions to establish more efficient nuclear processes and design standardisation. The amount of data acquired at NPPs has gradually increased, and the continuous development of data-based, intelligent analysis technologies can support fault diagnosis and prediction of important equipment to set up adequate operation and maintenance strategies.

It is thus important that with the appropriate use of advanced I&C and digital technologies, nuclear power plants achieve a high-efficiency and competitive power generation in a more complex operational context.

2. OBJECTIVE

The objective of this Nuclear Energy Series (NES) report is to provide an overview of the current knowledge, up to date best practices, experiences, benefits and challenges related to the role of I&C and advanced digital systems in supporting the improvement and optimization of plant performance.

3. SCOPE

The scope of the publication will cover the essential activities to be performed through the whole engineering lifecycle of I&C systems, including the use advanced digital technologies. The involvement of the other engineering disciplines will also be discussed.

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

- Use of artificial intelligence to optimise operation (including maintenance, diagnostics and prognostics) and support surveillance of computer security.
- Use of digital process models, data validation and data reconciliation to reduce measurements uncertainty margins and to help identify failed or mis-calibrated equipment.
- Use of digital process models and data assimilation to determine the most likely state of the process and to help identify the most likely causes that led to an undesired state.
- Use of digital process models and simulation to help determine the most effective course of actions to bring the process to a given, desired state. Use of simulation to anticipate ageing in existing plants and to support the selection of the most robust, less ageing-sensitive solutions.
- Use of 3D modelling and virtual or augmented reality to train control room and field operators, and to better prepare interventions in the field.
- Safe and secure use of smart equipment to improve plant performance and maintenance.
- Use of big data, from a single unit, multiple units at the same site, or all the units of a fleet, to improve performance and maintenance.
- Use of advanced industrial standards and products for I&C functions of lower safety importance (cost-effectiveness, computer security, interoperability, portability of applications, etc.)
- Use of unification to reduce the number of different I&C platforms, solutions and spare parts.