

Development of an IAEA Technical Training Program on Digital Instrumentation and Control for Nuclear Power Plants Around the World

Oszvald Glöckler

*Department of Nuclear Energy
International Atomic Energy Agency
Wagramer Strasse 5, P.O. Box 100
A-1400 Vienna, Austria
O.Glockler@iaea.org*

János Eiler

*Paks Nuclear Power Plant Co., Ltd.
7031 Paks, Hungary, P.O. Box 71
eiler@npp.hu*

Richard Wood

*Oak Ridge National Laboratory
P.O. Box 2008, MS-6010
Oak Ridge, TN 37831-6010
woodrt@ornl.gov*

Edward L. Quinn

*ANS Past President
Technology Resources
23292 Pompeii Drive
Dana Point, CA 92629
tedquinn@cox.net*

1.1 INTRODUCTION

The purpose of this paper is to provide an overview of the development of a technical training program on digital instrumentation and control for nuclear power plants around the world. This training is being developed based on the recommendation of the IAEA Technical Working Group on Nuclear Power Plant Instrumentation and Control (TWG-NPPIC). The recommendation for a training program came from the recognition that the prospective expansion of nuclear power to new countries and users creates a need for comprehensive, introductory courses on the systems, technologies, and issues related to the field of instrumentation and control (I&C) for nuclear power plants. The IAEA has published numerous technical documents describing specific aspects of the nuclear plant I&C; and most recently, a more basic, comprehensive introduction of I&C systems, components and functions that highlights the most important features and issues of this area, called the “Core Knowledge on Instrumentation and Control Systems in Nuclear Power Plants – A Reference Book” (Reference 1). The goal of this document and the associated training course is to provide a basic overview of I&C systems and functions in the nuclear power industry, as well as to identify current challenges and key I&C issues. Also, an important goal for this document and training is to serve as an integrating reference resource by linking the existing, I&C-related IAEA publications to the selected

areas of the high-level overview and description provided in this report. It is not the intention of the document to repeat the information previously published in other IAEA releases; however, some overlap may have occurred due to the comprehensive coverage provided here.

The document, and the associated training program it supports, is written at a sufficiently high-level to target a broad audience. Non-experts may gain general knowledge on the I&C area, while experienced readers may also profit from the more detailed introduction of some specific areas and issues. Licensing authorities are also concerned with nuclear I&C safety challenges, particularly with those arising from the transition to modern, digital technologies. The document puts emphasis on concerns from the regulators and focuses also on selected, licensing-related aspects of I&C applications. The report is also intended for persons interested in finding comprehensive lists of references, guides, codes, and standards in the nuclear I&C field.

The overview of digital I&C for nuclear systems is not directly tied to any specific nuclear power installation type. The contents are general enough to be applicable for pressurized-water reactors (PWRs), boiling-water reactors (BWRs), graphite-moderated, pressurized-heavy-water cooled reactors (PHWRs, e.g., CANDU) and other nuclear power generation facilities. It is recognized, however, that the IAEA Member States have their own unique infrastructures and, therefore, may have evolved individual solutions to a variety of I&C-specific issues. This report and associated training program endeavors to cover the most general solutions and must be interpreted at a high level, with general applicability for all nuclear power installations.

The document (Reference 1) was produced by a committee of international experts and advisors from numerous countries. These contributors are listed at the end of the text. The IAEA wishes to thank all participants and their Member States for their valuable contributions. The IAEA officer responsible for this publication was Oszvald Glöckler of the Division of Nuclear Power, while the chairpersons of the report preparation were Richard Wood from the USA and Janos Eiler from Hungary.

1.2 DESCRIPTION OF THE CORE KNOWLEDGE DOCUMENT AND THE ASSOCIATED TRAINING PROGRAM DEVELOPMENT

The objectives of this document and the associated training program are to present a basic overview of I&C systems, a guide to IAEA and related literature on the subject, and an explanation of the significant role I&C systems have in maintaining and improving safety, plant performance, and economic returns of nuclear power plants. In addition, the primary issues and topics related to NPP I&C systems are presented. Numerous IAEA publications have been prepared to address these issues and this document intends to place those technical documents within the context of a global view of NPP I&C systems and their lifecycles. Moreover, relevant documents related to the I&C area but published by organizations other than the IAEA are listed and referenced in this report to provide a comprehensive guidance for the reader.

The primary objectives of this document and the associated training program are:

- To provide knowledge transfer at an introductory level on the topic of NPP I&C systems, their functions and their lifecycles;
- To highlight the significant role I&C systems play in the safe, productive, and economical operation of NPPs;

- To present current challenges, most significant I&C and Human System Interface (HSI) issues today;
- To present a unifying document that sets the stage for and references all IAEA publications in the field of NPP I&C systems. Additional, related publications are also referenced in the appropriate sections;
- To present the primary issues and technical topics for NPP I&C systems, and refer to further documentation for those issues.

This document, and the associated training program, has been prepared for a general audience as well as I&C experts. The introductory material presents a summary of I&C systems and functions that will be useful to non-experts, while also presenting a concise overview which may be a useful reference for more experienced I&C specialists. There are numerous differences which make NPP I&C systems unique with respect to I&C systems in other processes (e.g., fossil power plants, industrial plants). These differences are mentioned in this document and may present useful information to persons just starting a career in the nuclear industry, or migrating from another industry.

All readers not familiar with IAEA publications in the I&C field may find the literature guide useful not only to learn of the available documents but also how those documents fit into a broad view of I&C systems, their lifecycle, maintenance, and management.

Highlighting the significant role of I&C systems in NPP operation may enlighten non-experts as well as provide justification to experienced I&C engineers seeking support to implement or modernize an I&C system.

In summary, the primary target audiences are:

- Research and development organizations;
- Vendors (including new companies and subcontractors in the I&C field);
- Utility technicians (not necessarily I&C only);
- New users (freshmen in the I&C area, developing countries, etc.);
- Decision makers (authorities and utilities).

1.3 PROGRESS TO DATE ON DEVELOPMENT OF THE TRAINING PROGRAM

IAEA staff has developed a technical training program with the Core Knowledge Report (Reference 1) and associated training materials developed by subject matter experts around the world. A training course was conducted in Beijing, China, in early December, 2009, for one week, with multiple instructors and over 40 attendees from Chinese industry, government and academia attending. A similar training course was held at the Atucha-2 NPP construction site in late November 2010 in Argentina. An additional training program was held in Portoroz, Slovenia in May, 2011. These training courses were implemented under the IAEA Technical Cooperation Program for China, Argentina and Slovenia, respectively. Regional workshops with a comprehensive I&C scope were held under the IAEA Technical Cooperation Program for the Europe Region in Portoroz, Slovenia in May 2008, 2009, and 2010. Additional courses are planned for 2012 and

beyond, with both general and specialized focus based on country and regional specific needs.

1.4 CONCLUSION

The path forward for the IAEA is to complete development and commence implementation of regular training programs using the Core Knowledge Report (Reference 1) to train personnel from Member States in this highly technical and evolving focus area. Both general and specific technical area training is envisioned for the coming years based on regional and country specific needs and associated requests.

1.5 REFERENCES

- (1) Core Knowledge on Instrumentation and Control Systems in Nuclear Power Plants – A Reference Book, IAEA Nuclear Energy Series Report (Draft) D-NP-T-3.12 (2010)