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Hydroelectric power plant automation – Guide for computer-based control

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HYDROELECTRIC POWER PLANT AUTOMATION – GUIDE FOR COMPUTER-BASED CONTROL

FOREWORD

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International Standard IEC 62270 has been prepared by IEC technical committee 4: Hydraulic turbines.

The text of this standard is based on the IEEE Standard 1249 (1996) *IEEE guide for computer-based control for hydroelectric power plant automation*. It was submitted to the national committees for voting under the Fast Track procedure as the following documents:

FDIS	Report on voting
4/188/FDIS	4/190/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until 2005. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

Automation of hydroelectric generating plants has been a known technology for many years. Due to the relative simplicity of the control logic for hydroelectric power plants, the application of computer-based control has lagged, compared to other types of generating stations, such as fossil. Now that computer-based control can be implemented for comparable costs as relay-based logic and can incorporate additional features, it is being applied in hydroelectric power stations worldwide, both in new installations and in the rehabilitation of older plants.

HYDROELECTRIC POWER PLANT AUTOMATION – GUIDE FOR COMPUTER-BASED CONTROL

1 Overview

1.1 Scope

This standard sets down guidelines for the application, design concepts, and implementation of computer-based control systems for hydroelectric plant automation. It addresses functional capabilities, performance requirements, interface requirements, hardware considerations, and operator training. It includes recommendations for system testing and acceptance. Finally, case studies of actual computer-based automatic control applications are presented.

The automation of control and data logging functions has relieved the plant operator of these tasks, allowing the operator more time to concentrate on other duties. In many cases, the plant's operating costs can be significantly reduced by automation (primarily via staff reduction) while still maintaining a high level of unit control reliability.

Automatic control systems for hydroelectric units based on electromechanical relay logic have been in general use for a number of years and, in fact, were considered standard practice for the industry. Within the last decade, microprocessor-based controllers have become available that are suitable for operation in a power plant environment. These computer-based systems have been applied for data logging, alarm monitoring, and unit and plant control. Advantages of computer-based control include use of graphical user interfaces, the incorporation of sequence of events and trending into the control system, the incorporation of artificial intelligence and expert system capabilities, and reduced plant life cycle cost.

1.2 Purpose

This standard is directed to the practicing engineer who has some familiarity with computer-based control systems and who is designing or implementing hydroelectric unit or plant control systems, either in a new project or as a retrofit to an existing one. This standard assumes that the control system logic has already been defined; therefore, its development is not covered. For information on control sequence logic, the reader is directed to the IEEE guides for control of hydroelectric power plants listed in Clause 2 of this standard.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61158, *Digital data communications for measurement and control - Fieldbus for use in industrial control systems*

ANSI C63.4-2001, *Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz–40 GHz* [1]

IEEE Std 100-1996, *The IEEE Standard Dictionary of Electrical and Electronics Terms* [2]

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[1] ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

[2] IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

IEEE Std 485-1997, *IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications* (ANSI)

IEEE Std 610-1990, *IEEE Standard Glossary of Software Engineering Terminology* (ANSI).

IEEE Std 1010-1987 (Reaffirmed 1992), *IEEE Guide for Control of Hydroelectric Power Plants* (ANSI)

IEEE Std 1014-1987 *IEEE Standard for A Versatile Backplane Bus: VMEbus*

IEEE Std 1020-1988 (Reaffirmed 1994), *IEEE Guide for Control of Small Hydroelectric Power Plants.* (ANSI)

IEEE Std 1046-1991 (Reaffirmed 1996), *IEEE Guide for Distributed Digital Control and Monitoring for Power Plants* (ANSI)

IEEE Std 1147-1991 (Reaffirmed 1996), *IEEE Guide for the Rehabilitation of Hydroelectric Power Plants* (ANSI)

IEEE Std C37.1-1994, *IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automation Control (ANSI)*

IEEE Std C37.90.1-2002, *IEEE Standard for Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems (ANSI)*

IEEE Std C37.90.2-1995, *IEEE Trial Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers (ANSI)*

IEEE 1379: 2000, IEEE *Recommended Practice for Data Communications Between Remote Terminal Units and Intelligent Electronic Devices in a Substation (ANSI)*

ISO/IEC 8802-3:2001, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*[3] (ANSI/IEEE Std 802.3, 1996 Edition)

ISO/IEC 8802-4:1990 (Reaffirmed 1995), *Information processing systems – Local area networks – Part 4: Token-passing bus access method and physical layer specifications* (ANSI/IEEE 802.4-1990 Edition)

ISO/IEC 8802-5:1998, *Information technology –Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 5: Token ring access method and physical layer specifications* (ANSI/IEEE Std 802.5, 1995 Edition)

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[3] ISO publications are available from the ISO Central Secretariat, Case Postale 56, 1 rue de Varembé, CH-1211, Genève 20, Switzerland/Suisse. ISO publications are also available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.