

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Technical guidelines for smart hydroelectric power plant

Lignes directrices techniques d'une centrale hydroélectrique intelligente



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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
4 General principles	11
5 System architecture.....	12
5.1 Architecture model.....	12
5.2 Logical architecture.....	14
5.2.1 Overview	14
5.2.2 Description of levels and zones	16
5.3 Information model	17
5.4 Network structure.....	18
5.4.1 General	18
5.4.2 Network structure of plant level and group-of-plants level	18
5.4.3 Network structure of unit level and process level	20
5.4.4 Variants for the network structure	22
5.4.5 Network configuration of retrofit engineering.....	26
5.4.6 External communication interfaces	27
6 Basic support system.....	27
6.1 Overview.....	27
6.2 Time synchronization system	28
6.3 Power supply system	28
6.4 CCTV system.....	28
6.5 Firefighting system.....	29
6.6 Access control system	29
6.7 Large screen display system.....	29
7 Smart transducer	30
7.1 Overview.....	30
7.2 General technical requirements.....	30
7.3 Structure of smart transducers	31
8 Functional requirements of IEDs	33
8.1 Overview.....	33
8.2 General technical requirements.....	33
8.3 Measurement and control.....	34
8.3.1 Data acquisition and control execution.....	34
8.3.2 Local control.....	34
8.3.3 Synchronization	35
8.3.4 Governor	35
8.3.5 Excitation	36
8.3.6 Speed measurement.....	36
8.4 Monitoring.....	37
8.4.1 Unit online monitoring.....	37
8.4.2 Online monitoring of transmission and transformation equipment.....	37
8.4.3 Hydrology telemetry.....	38
8.4.4 Meteorological information acquisition	38

8.4.5	Dam safety monitoring	39
8.5	Protection	39
8.5.1	Overview	39
8.5.2	Electrical protection	39
8.5.3	Mechanical protection	40
9	Platform and intelligent application	41
9.1	General	41
9.2	Integrated control and management platform	41
9.2.1	General	41
9.2.2	Data management	41
9.2.3	Basic service	43
9.2.4	Basic applications	46
9.3	Intelligent applications	48
9.3.1	Hydroelectric power plant economic operation	48
9.3.2	Decision support for Condition-Based Maintenance (CBM)	52
9.3.3	Dam safety analysis and evaluation	54
9.3.4	Security and safety interaction	54
9.3.5	Plant environment monitoring	55
9.3.6	Intelligent patrol	56
9.3.7	Operation and maintenance simulation	57
9.3.8	Intelligent alarm	58
9.3.9	Intelligent work sheet and operation sheet	59
9.3.10	Data analysis and trend forecast	59
9.3.11	Emergency command support	61
10	Cyber security	63
10.1	General	63
10.2	Network structure security	63
10.3	Data and communication security	65
10.4	Device and software security	67
10.5	Access control	68
10.6	IT infrastructure comprehensive supervision and management	68
10.7	Audit and modification	69
10.8	Emergency plan and response	69
10.9	Employee training and awareness	69
11	Commissioning, operation and maintenance	69
11.1	Commissioning	69
11.1.1	Overview	69
11.1.2	Testing scene management	70
11.1.3	Testing strategy management	70
11.1.4	Automatic testing execution	70
11.1.5	Testing record management	70
11.2	Operation and maintenance	70
11.2.1	Remote diagnosis	70
11.2.2	Product maintenance	70
11.2.3	Documents management	71
12	Implementation procedures of a smart hydroelectric power plant	71
	Bibliography	73

Figure 1 – System architecture model of a smart hydroelectric power plant.....	13
Figure 2 – Typical system logic architecture of a smart hydroelectric power plant	15
Figure 3 – Typical physical structure of plant level and group-of-plants level of a smart hydroelectric power plant.....	19
Figure 4 – Typical network structure schematic diagram of process level and unit level	21
Figure 5 – Recommended communication network structures (Variant A)	23
Figure 6 – Recommended communication network structures (Variant B)	24
Figure 7 – Recommended communication network structures (Variant C)	25
Figure 8 – Recommended communication network structures (Variant D)	26
Figure 9 – Example of external interfaces of a smart hydroelectric power plant.....	27
Figure 10 – Structure of smart transducers	31
Figure 11 – Adaption of conventional transducers	32
Figure 12 – Functional architecture of ICAMP	41
Figure 13 – Recommended network architecture.....	64
Figure 14 – Security categories, typical attacks, and countermeasures	66
Figure 15 – Correlations between IEC 62351 series and IEC TC57 profile standards	66
Figure 16 – Typical implementation procedures of a smart hydroelectric power plant.....	72

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TECHNICAL GUIDELINES FOR SMART HYDROELECTRIC POWER PLANT

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The text of this International Standard is based on the following IEC documents:

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

The language used for the development of this International Standard is English.

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INTRODUCTION

In the past few decades, the widespread use of automatic control systems in hydroelectric power plants, including computer-based control systems, brought a number of benefits including improved work efficiency, enhanced reliability and real-time capability, as well as optimized Operating Expense (OPEX).

Nowadays, tremendous changes occur in hydroelectric power plants and their external environment, thereby posing challenges in operation, maintenance, scheduling and management.

The evolution of power grid codes and electricity markets, the growing sensibility of the public about the environmental impact and such risks generated by operating hydroelectric power plants as control of flow variation downstream, and the increasing demand for multi-purpose utilization of water resources lead to the increasing difficulty in generation scheduling decision-making. Giant unit/plant capacity enhances the role of hydroelectric power plants in maintaining grid stability. The rationale for developing cascade hydroelectric power plants has been widely recognized, as integrated operation and maintenance requirements have become increasingly prominent. The latest technologies such as cloud computing, Artificial Intelligence (AI), big data, Internet of Things (IoT), mobile terminal, and Virtual Reality (VR) are triggering a revolution in hydroelectric power plant automation systems.

Newly installed, renovated and partially refurbished hydroelectric power plants and remote control centers need innovative technologies to strengthen information sharing and coordination among equipment and applications. With the goal to realize multi-dimensional information sensing, comprehensive data display, interactive applications and intelligent warnings and decisions, and to cope with the challenges of operation, maintenance, dispatching and management, innovation involving multiple elements regarding system architecture, information model, integrated standards, software structures, business procedure, applications, optimized models, etc., should be conducted. The innovation based on such elements is multi-dimensional, flexible and open to different demands, rather than a mere improvement of certain technologies, so that hydroelectric power plants and remote control centers where those innovations are put into use can be called a smart hydroelectric power plant.

In the present document, open architecture has been proposed for a smart hydroelectric power plant and technical requirements for each part have been specified, thus improving the safe, reliable, efficient and economic operation of hydroelectric power plants/remote control centers, enhancing the interaction with the smart grid and facilitating ecological and environmental responsibility. The overall system structure and functionality are mainly determined by the scales, types, importance and complexity of specific smart hydroelectric power plants. The document describes a representative set of architectures, components and functionalities. The appropriate selection, extension or modification tailored to the needs of a specific power plant shall be chosen in a specific project. The document can be used as a reference for engineers of hydroelectric power plants/remote control centers, consultants or automation system vendors in helping the design of smart hydroelectric power plants, development of hardware and software products, implementation of projects, and compilation of related documents.

TECHNICAL GUIDELINES FOR SMART HYDROELECTRIC POWER PLANT

1 Scope

This document describes the integrated control and management of smart hydroelectric power plants and groups of plants using the latest proven and widely accepted digital equipment. The descriptions are applicable to all types of hydroelectric power plants except tidal and ocean power plants.

Based on internationally standardized communication models, this document incorporates guidelines for communication networks, sensors, local monitoring and control equipment, Integrated Control and Management Platform (ICAMP) as well as intelligent applications. In addition, special attention is also given to cyber security.

This document considers the future structure of completely digitalized power plants equipped with digitalized sensors and actuators as well as the intelligent control and management of power plants with existing instrumentation.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply. ISO, IEC, and IEEE maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEEE Standards Dictionary Online: available at: <http://dictionary.ieee.org>

3.1

smart hydroelectric power plant

hydroelectric power plant or group of plants which is featuring digitalized information, networked communication, standardized integration, interactive applications, optimized operation, and intelligent decision

Note 1 to entry: Smart hydroelectric power plant uses Intelligent Electronic Devices (IEDs) and intelligent equipment for the automatic acquisition, measurement, control, protection and other basic functions, and possesses economic operation, analysis evaluation & decision support, security and safety interaction and other intelligent applications based on the Integrated Control and Management Platform (ICAMP) in compliance with grid and regulatory requirements.

3.2

process level

level of the architectural model which realizes data acquisition and command execution throughout the power generation process, typically consists of transducers/smart transducers, intelligent terminal, intelligent equipment, etc.

3.3

unit level

level of the architectural model which realizes monitoring, control and protection of equipment related to different units according to the pre-set strategy, typically consists of various IEDs