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Australian Standard[®]

Telecontrol equipment and systems

Part 1.1: General considerations— General principles

[IEC title: Telecontrol equipment and systems, Part 1: General considerations, Section One — General principles]

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OF

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Telecontrol equipment and systems

Part 1.1: General considerations—General principles

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PREFACE

This Standard was prepared by the Standards Australia Committee IT/24, Supervisory Control and Data Acquisition.

The Standard is identical with and has been reproduced from IEC 60870-1-1:1988, *Telecontrol equipment and systems, Part 1: General considerations, Section One—General principles*.

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This Standard is identical to a pre-1997 document; therefore, it uses the old series of numbers.

The objective of this Standard is to provide manufacturers and users of telecontrol equipment and systems with an explanation of their structural elements, configurations and basic functions in order to provide an introduction to the more detailed standards of the series to be adopted in Australia.

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INTRODUCTION

Telecontrol systems serve for monitoring and control of processes which are geographically widespread. They include all equipment and functions for acquisition, processing, transmission and display of the necessary process information. The performance of a telecontrol system is determined basically by:

- 1) the data integrity of information transfer, from a source to its destination, and
- 2) the speed with which information is transferred to its destination.

The data integrity is defined as the unchangeability of an information content from a source to its destination, while the speed of information transfer is measured by the overall transfer time.

The high responsibility which is associated with the transmission of information such as commands and the occurrence of adverse environmental conditions necessitate standards for data acquisition and of data transmission which fulfil stringent requirements of data integrity and transmission efficiency.

It should be noted that although this series of standards has been produced specifically for telecontrol systems used in electrical power systems, they may also be applied to other fields of application, e.g. gas and water supply and distribution, etc.

The aim of these standards is to provide adequate information for correct planning and reliable operation of telecontrol systems. The standards are divided into different parts, listed in Clause 2 of this report.

This part of this series of telecontrol standards is intended to give the user a general survey of the systems and their elements, thus presenting the necessary basic information for a thorough understanding of the following parts of these standards.

AUSTRALIAN STANDARD

Telecontrol equipment and systems**Part 1.1:****General considerations—General principles****1. Scope**

This series of standards applies to telecontrol equipment and systems with coded bit serial data transmission for monitoring and control of geographically widespread processes.

2. Object

This series of standards describes configurations and functions of telecontrol systems and of related elements. It defines the functional requirements, logical characteristics and interface conditions of the basic elements and the rules those elements shall follow in co-existing with other elements.

These standards do not define the internal physical characteristics of such elements nor the layout, construction or material used.

The following subjects are outside the scope of these standards:

- ripple control systems;
- properties of transmission channels and local bus (highway) systems for communication between process input/output elements;
- teleprotection and locally automated functions even though they may sometimes be implemented within a telecontrol system.

These standards are subdivided into several parts, which are sub-divided into several sections and issued as separate publications bearing the following titles and scopes:

IEC Publication 870-1-1: Part 1: General considerations, Section One - General principles (which constitutes this report)

This report explains the structural elements, configurations and basic functions of telecontrol systems.

It gives an overview of functional elements which contribute to basic structures and possible choice of telecontrol systems configurations.

It deals with functions which are typical for any process to be monitored and controlled but emphasizes the specific problems which characterize geographically widespread processes, such as the dominant influence of telecommunication links with restricted bandwidth and often low signal-to-noise ratio.

However, this report shall only serve as an introduction to the detailed standards and recommendations laid down in Parts 2-5 quoted below.

IEC Publication 870-1-2: Part 1: General considerations, Section Two - Guide for specifications (under consideration)

This Section Two of Part 1 will describe guidelines for planning and defining specifications of telecontrol systems and equipment in order to accommodate individual application demands.

IEC Publication 870-1-3: Part 1: General considerations, Section Three - Glossary (under consideration)

This Section Three of Part 1 will present the specific terms of telecontrol techniques as defined in the International Electrotechnical Vocabulary [1EV] [IEC Publication 50 (371)] as well as other terms which are necessary for the understanding of this series of standards.

IEC Publication 870-2-1: Part 2: Operating conditions, Section One - Environmental conditions and power supplies

This Section One of Part 2 defines the environmental and power supply conditions to which the telecontrol equipment should be designed in order to fulfil its specifications. It establishes classes for different conditions and also defines test procedures.

IEC Publication 870-2-2 will constitute Section Two and it will deal with electromagnetic compatibility as well as corrosive and erosive influences.

IEC Publication 870-3: Part 3: Interfaces (in preparation)

This part will define the interface conditions that have to be met in order to correlate the different pieces of equipment needed to form a telecontrol system and to allow the user to manage such a system.

IEC Publication 870-4: Part 4: Performance requirements (in preparation)

This part will deal with those characteristics that have to be met by telecontrol equipment and systems to accomplish the functions for which they are intended in a continuous, secure and precise manner, and in addition to be flexible enough to accommodate future demands.

IEC Publication 870-5: Part 5: Transmission protocols (in preparation)

This part will describe the functional characteristics of data transmission that shall be met in order to implement a telecontrol system by means of links or networks. Data integrity requirements for information transmission, distinct data formats and transmission methods, which fulfil these requirements, will be defined.

This part will include several sections.

The standards listed above will be completed by additional parts and sections as appropriate.

3. General aspects related to telecontrol systems

The fundamental aspects relating to the operation of geographically widespread processes including the generation and optimum transportation and distribution of a product are very similar for the different kinds of products (e.g. gas, water, oil or electricity). Telecontrol systems employed in the operation of electric power systems have been developed to a very advanced state and often serve as examples for applications in other areas. For this reason, the general aspects relating to the operation of any geographically widespread process are explained in the following sub-clauses by reference where appropriate to the operation of an electric power system.

3.1 *The role of telecontrol systems in power systems operation*

The quality of the power supply, which includes its reliability, depends to a large extent on the existence of a coordinated telecontrol system which assures all the necessary supervisory and control functions. The structure of such a telecontrol system is dictated by the power system's architecture and by the strategy of operation adopted by the user(s). It is in essence a distributed process control system conforming to the hierarchical structure of the geographically widespread power transportation and distribution networks. A typical case of a telecontrol system is depicted in Figure 1, page 55.

A system can, from the operational point of view, service a whole power network or be split up into different levels of responsibility or even into partially or fully independent sub-systems.

The local control systems of power stations are usually independent of the power network telecontrol system but certain monitored information is fed from the power stations control systems into the power network telecontrol system. Conversely, certain control information, such as set points for power generation, are transmitted into power stations (e.g. in the case of automatic load/frequency control).

Telecontrol system configurations range from a few point-to-point monitoring and control functions up to multilevel systems covering vast geographic areas. The use of computer technology on all levels of the system allows telecontrol systems and architectures to use distributed intelligence with possibilities of preprocessing information to avoid superfluous data flow. Redundancy is provided for vital functions in order to fulfil specified availability and reliability requirements.

Extended processing functions, such as load/frequency control, security analysis, state estimation and short-term predictive energy management, may be carried out either by a separate real-time computer system or by the telecontrol system itself, according to the choice of the systems architecture.

It has also to be noted that equipment and subsystems are often manufactured by different suppliers and/or stem from different generations of technology. Their integration into telecontrol systems thus creates interface problems which are sometimes difficult to solve.

3.2 *The role of the data transmission system*

One of the important factors which has to be taken into account in the planning stage of a telecontrol system is the specification of the data transmission system.

Private or public communication cables, microwave channels and power line carrier (PLC) are most widely used. Since telecontrol systems have to operate in real-time mode, limitations imposed by the telecommunication channels may heavily impair the overall system efficiency. The implication is restricted bandwidth and hence restricted bit rates to be transmitted under noisy environmental conditions, which cause distortion of transmitted signal elements. Conversely specifications of the overall channels have to be chosen to allow optimization of the overall system performance. The data transmission system has to be considered in this sense as an integrated part of the telecontrol system.

In addition, all transmission equipment located in the vicinity of high voltage equipment such as circuit breakers and isolators, is prone to intermittent high noise levels of the burst type and transient voltages. This is especially true for PLC channels.

The performance requirements and boundary conditions for some telecontrol applications, such as teletripping in transmission line protection, generation/load rejection schemes, etc., where instantaneous response in real-time mode is critical, dictate the permanent direct logical connections between data sources and their destinations. This means that the application of store and forward techniques or packet switching are explicitly prohibited in such systems.

There are however telecontrol functions with less demanding performance requirements which may adopt the general techniques and standards which have been developed for office automation applications. Data exchanges among central stations for regions, districts or even nations may fall into that category.