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Investigation and Comparison between International Standards for Information Integration and Control of ECSs based on RESs over IP-based Networks

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Abstract. Energy converting systems (ECSs) based on renewable energy sources (RESs) are penetrating rapidly in the power system including their associated software and hardware (SW/HW) systems. These systems are geographically dispersed, and related to different manufacturers. Therefore, the future power system can be considered as a distributed SW/HW system. Information integration and interoperability are two serious problems in distributed systems, which mainly include communication networks and communication protocols. The International Electrotechnical Committee (IEC) standards are proposed for this purpose and for the control as well. Indeed, some of these standard protocols can be used over IP-based WANs. However, future power systems, which contain many RESs in all voltage levels, could employ the Internet/Intranet WAN for both control and telemeter. This paper investigates the available standards related to power systems, discusses the possibility of applying some of these standard protocols for the control and telemeter of ECSs over Internet/Intranet WAN, compares between two legacy standard protocols and presents the factors for choosing the right protocol for such purposes. In addition, it covers the gaps, the last advances and projects related to these standards.

Key words

Power systems communications, Internet for renewable energy, information integration, DNP3, IEC standards.

1. Introduction

Energy converting systems (ECS) based on renewable energy sources (RES) are penetrating rapidly in the power system for environmental and economic reasons. Moreover, they support the conventional power plants and hence, increase the reliability of power systems. Conventional power systems include centralized power plants, the power mainly flows in one direction, and the active control takes place only in the high voltage levels. In contrast, smart power systems, as shown in Fig. 1, include centralized power plants, distributed energy resources (DERs) as well as RESs in all voltage levels, and characterized by actively controlled bidirectional power flow [1]. However, the ECS converts the energy

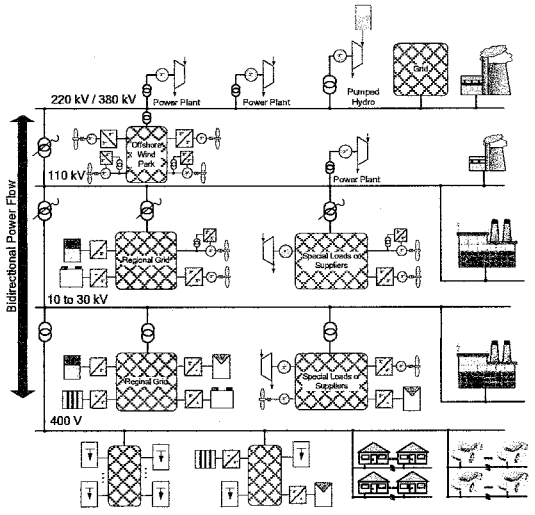

Fig. 1. A power system with actively-controlled bidirectional power flow [1].

from one form to DC current, which must be converted into AC in order to be fed to the grid. This can be done by the inverter, which is the interfacing unit that provides decoupling between frequency and voltages across the terminals of the ECS from one side and the grid voltage and frequency from the other side [2].

However, if ECSs of RESs are installed in large scale, they form power plants in the high voltage levels; otherwise they are installed in the distribution level and hence, called DERs. In both cases, some emerging international standards, mainly from the International Electrotechnical Committee (IEC), can be used for the control and telemeter over IP-based networks. While the IEC 61400-25 is proposed for data modelling in wind power plants, the IEC 62056 is proposed for telemeter and the IEC 61850 for communication and data modelling in substations, hydro power plants, and DERs.

On the other hand, the economic impact of DERs motivates many consumers to invest in this energy, and