FOWPI (https://www.fowpi.in/)
FIRST OFFSHORE WIND PROJECT OF INDIA

Project Funded by
European Union (http://eeas.europa.eu/delegations/india/index_en.htm)

SCADA & Communication

Supervisory Control and Data Acquisition (SCADA) and communication systems are important tools in the operation of any offshore wind farm.

Todays advanced monitoring and control system lets operators communicate to remote offshore wind farms, perform remote analyses and adjustments in order to monitor and control the behaviour of the wind turbine generators and the auxiliary equipment such as Balance of Plant components and systems.

The communication channel for information exchange with the offshore wind farm should be reliable as well as fast acting, where the fiber optical cable technology has proven to be the most suitable solution. The optical fiber cables are embedded within the power cables and are routed from each individual wind generator to the central communication hub.

The data from various measuring instruments across the offshore wind farm is collected by a central monitoring station through standard communication channels or ports (like RS232/ RS485/ Optical port/ Ethernet connectivity etc.) and via the optical fiber network. The measuring instruments may include electrical meters installed at various nodes, mechanical power measuring devices, weather monitoring devices etc.

Ideally, the International Electrical Commission standard (IEC 61400-25) is followed for offshore wind farm communications for a uniform information exchange in order to monitor and control the offshore wind power plants.

The objective of standardization (IEC 61400-25) is vital for offshore wind farm operators and investors who own assets from different manufacturers and wants to manage data generated by these assets from a central monitoring station on a single software platform. The SCADA data is generally encrypted by respective turbine manufacturers/OEMs and so standard protocols are required to collect all this information on a single database. A market of independent asset management software developers have developed which can allow to collect, process, and analyse SCADA data in a uniform way, irrespective to various turbine manufacturer.

Generally, the SCADA system records the various parameters on a temporal resolution of 10 mins. Along with this, other communication channels monitor and operate on a real time basis with a minimum delay time of 1 min. They act as an important tool for wind farm operators and energy traders.

Several designated communication and control systems are normally expected in a wind farm. This section will describe the main plant level systems based on the best practice obtained during the maturing of offshore wind farm installation and operational requirements.

Control Systems

The following describes systems designed to control Wind Turbine Generators (WTG) and Balance of Plant (BoP) components for wind farms.

Station Control System (SCS)

The SCS provides remote monitoring and control of high voltage (HV) and low voltage (LV) assets in the wind farm. Due to this, the system is considered highly critical and should be designed as a redundant system encapsulated in a safe network zone.

The main purpose of the SCS is to collect data and issue commands to control and monitor the asset at plant level. As a minimum, the control system user interface (UI) must include HV and medium voltage (MV) single line diagrams including dynamic states, preferably including first level LV breakers. The SCS UI must be accessible by simultaneous client sessions to facilitate client's access both locally and remote.

Operation of HV equipment implies risks of major damage if handled incorrectly. Thus, it is recommended that the SCS system support security functionality such as login hierarchy and audit trail. The SCS station level communication interface should comply with the protocol requested by the TSO to ensure that the wind farm interface towards the TSO is compliant.

For station level and process level communication, the communication network must be broken down into multiple subnets ensuring that faults cannot migrate on large scale and simplifying trouble shooting.

It is possible to include monitoring and control of all utility and ancillary systems into the SCS such as LV systems, diesel generators and storage systems. Alternatively a programmable logic controller (PLC) based control system could be considered, having a protocol interface to the SCS system for exchange of relevant signals.

Relevant standards for communication interface for SCS systems is IEC 608750-5-104, IEC 61850.

Wind Turbine Generator Control System

The Wind Turbine Generator (WTG) control system is normally a proprietary control system delivered as a standard package under the Turbine Supply Agreement (TSA). This system includes a control module and a SCADA module.

The control module is calculating and distributing park level set points to each WTG and possibly to third-party equipment such as STATCOMs (regulation device, commonly used for voltage stability purposes). The control module manages all control functions relevant for the wind farm grid compliance.

A WTG SCADA system is the operator user interface for monitoring and control of the WTGs at individual WTG or park level. This application is normally accessible via remote connection and provides several tools for the wind farm owner by providing access to various data streams from the WTGs or SCS interfaces. Typically, such data is available to the operator through an online UI with access to data tables, graphical presentations and statistics. Furthermore, data is normally stored in a database, datasheet or similar formats for further analyses.

VTMS, HSE and Planning

Although not mandatory, a recommended option for offshore wind farms is to include an integrated solution for wind farm management for handling marine traffic, site logistics and HSE aspects.

The system may include a vessel traffic management system (VTMS), which could consist of radar, Automatic Identification System (AIS), closed-circuit television (CCTV) and VHF radiotelephony to provide navigational safety of marine traffic in a limited geographical area surrounding the offshore wind farm.

Such a system, which must as a minimum cover a radius of 10 M surrounding the offshore wind farm site, including export cable routes and transport routes to and from the main ports, must automatically detect and track vessels within the defined geographical area and indicate risk of collision, closest point of approach and time of closest point of approach.

Such systems can implement HSE data through a permit to work system, and it can be used for planning crew transfer during the construction and operational phase.

Communication Systems

Communication systems within wind farms include both voice and data communication infrastructures. A brief description of typical communication systems for wind farm applications follows.

IP Telephone System

The IP telephony system should be considered mandatory for an offshore substation in order to allow simple communication without loading the radio transmitted communication system such as TETRA. The system should connect all IP telephones on site. Depending on the contractual setup, telephones in the WTGs are normally delivered as part of the WTG contract.

The IP telephone system works as a fallback communication link in case the TETRA system fail or coverage inside the WTG is not assured.

TETRA System

The Terrestrial Trunked Radio (TETRA) system is a professional mobile radio system with a two-way transceiver specification. The TETRA system is used for enabling voice and data communication within the wind farm, sailing route and at O&M/harbour facilities. In addition to voice and dispatch services, the system supports several types of data communication such as status messages and short data services (SDS).

This system is considered the primary system for voice communication for personnel working on site. Hence, coverage must be included in the entire tower and nacelle areas of the wind turbines. Furthermore, it is recommended to install the TETRA system in all crew boats and at marine coordinators office onshore, and to provide coverage for all sail routes.

VHF Systems

VHF radio infrastructure can act as a redundant primary communication between vessels and marine coordination. This is normally used for ship-to-ship communications as well as communication to coastal stations with respect to rescue services and communication with harbours, bridges and marinas.

The VHF system is used for enabling voice communication between Marine Coordinators and the ships working within an offshore wind farm, including its sailing routes. This system is also the first line of communication if any vessel is approaching the site on collision course.

AIS

An identification system making it possible to exchange ship-to-ship information with nearby ships, AIS base stations and satellites. Satellite AIS setups are normally called Satellite-AIS (S-AIS).

The AIS broadcasts information on position and type of offshore vessels to aid offshore vessel traffic. Furthermore, AIS AtoN (Aid to Navigation) is installed on offshore wind farms to alert any AIS equipped vessels that are within range.

AIS AtoN stations will broadcast their position, presence, identity and status at least every three minutes or as required. AIS AtoN systems are normally not included in the supply scope of offshore wind farms, unless it is specified by local authorities.

Backbone IT Network

The internal network or LAN, which manages all internal dataflow in the wind farm, should be designed based on the Open Systems Interconnection model (OSI), see ISO/IEC 7498-1.

The IT network, which should be part of the Balance of Plants scope, must be terminated to the Internet or WAN by a connection allowing sufficient bandwidth, redundancy and support from the public network operator. In order to assure reliability of the network, the network must be designed with multiple subnets to prevent faults to migrate on a larger scale. Cabling for the network system should be done using cables more flexible and suitable for pulling in complex and narrow environments.

In most cases, the IT network for the WTG communication is included in the WTG contract.

The IT network exists on a physical layer as well as a logical layer designed according to the guidelines given at corporate level by the owner IT department. These guidelines should include relevant information to make sure remote connections are possible for monitoring, control and diagnostic.

Optical Fibre Network

All subsea cables connected to either WTGs or substation must embed a number of single mode fibre cores. These are used to form a highly available and reliable communication network from the WTGs to the offshore or onshore substation.

The installation of the fibre optical network is normally divided between the cable termination contractors responsible for array and export cables, and the substation contractors responsible for onshore/offshore substations.

Line of Sight Micro-Link

A line of sight (LOS) micro link is normally considered as a backup solution to the export cable optical fibre infrastructure. The LOS are relevant for projects having only one export cable. The LOS technology is limited by distance due to the curvature of earth; however, a sufficient bandwidth of 100+ Mbps for a distance of approximately 50 km is expected, primarily depending on the installation height of the antennas.

For more information, refer the following informative links/material:

1. “FOWPI – Advisory Electrical Concept Design”, A073635-020-001, February 2018.

2. IEC 60870-5-104, “Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles”, 2006-06.

3. IEC 61850, “Power Utility Automation”, International Standard defining communication protocols for intelligent electronic devices at electrical substations.

4. IEC 62439-3, “Industrial communication networks - High availability automation networks - Part 3: Parallel Redundancy Protocol (PRP) and High-availability Seamless Redundancy (HSR)”

5. IEC7498-1, “Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model — Part 1”

6. ITU.T-L.12, “Series L: Construction, installation and protection of cables and other elements of outside plant, Optical fibre splices”

Updated on: **October 2018**

Disclaimer:

The content on this website is provided for information purposes only. No legal liability or other responsibility is accepted by or on behalf of FOWPI team for any errors, omissions, or statements on this site, or any site to which these pages connect.

Have any Questions? Send a Message.

FOWPI (https://www.fowpi.in/)

FIRST OFFSHORE WIND PROJECT OF INDIA

(https://www.facebook.com/FOWPI/) (https://twitter.com/FOWPI_India) (https://www.linkedin.com/company/first-offshore-wind-project-of-india-fowpi-/)

For more details on FOWPI project, please email:
info@fowpi.in (mailto:info@fowpi.in) or fowpi.india@gmail.com (mailto:fowpi.india@gmail.com)
Phone +91.124.4319500,
Telefax +91.124.4319501,
Direct +91.9687800983/8849012213

Nodal Ministry for Offshore Wind Energy

Ministry of New and Renewable Energy | MNRE (http://www.mnre.gov.in/)

Nodal Agency for Offshore Wind Energy

National Institute of Wind Energy | NIWE (http://niwe.res.in/)