Open Control of Wind Parks

Today’s wind turbines and wind parks grow increasingly larger as the demand for flexible controlled power in the grid increases. In order to control these wind parks, ensuring that they are balanced and able to comply with the grid codes all over the world, Mita-Teknik offers an open, reliable, flexible and intelligent Wind Park Control Concept that gives our customers the edge when selling their wind turbines for wind parks all over the world.

How it Works

The hierarchical Wind Park Control Concept consists of our field-proven hardware suitable for the harsh environment, and multiple software packages. All units are interconnected by an Ethernet network running the reliable M-Link protocol.

The wind parks is controlled by a Park Controller that dispatches the active and reactive power set points, as ordered by a Transmission System Operator (TSO) either directly to the Wind Turbine unit, or via a Cluster Controller that can be introduced in large wind parks or when there is more than one point of common coupling to the grid.

At the point of common coupling, a Grid Monitor can be installed to accurately measure the grid characteristics and send them back to the Park/Cluster Controller for further control.

As part of the concept, a Weather Monitor may supply the Park Controller with meteorological data. By doing so, you can, for example, produce a wind farm power curve or take special functions like humidity, ice and ambient light detectors into account (upon request). All functions can be setup, monitored and data extracted either directly on the unit or via complete remote control.

Highly Scalable Solution

Whether you are installing only a few or even hundreds of turbines, there is one solution that fits your needs! Our concept supports from 1 to 2500 turbines in 0 to 50 clusters with individual grid and weather measurements and output control in each cluster.

SCADA Integration

Naturally, the concept is fully integrated on all levels in the SCADA system, Gateway, so that you can monitor, supervise and setup the wind park control, no matter if you are on site or on the other side of the world.

Open Flexible System

The concept is designed to be open and flexible, supporting open configurable standards for control and supervision like:

- OPC
- IEC61400-25 (MMS)
- Modbus
Multiple TSO Interfaces
Communication with the TSO, e.g. the utility company, is often different from country to country and from TSO to TSO. To make things easier, Mita-Teknik offers a variety of configurable interfaces for exchanging data with the Transmission System Operator, e.g.:

- Analog inputs/outputs
- Digital inputs/outputs
- Modbus
- OPC
- IEC61400-25 (MMS)
- ... 

Built-in Grid Code Support
Often, grid codes vary from country to country, making it difficult to comply with all codes in one solution. The Wind Park Control Concept accommodates this by offering off-the-shelf grid codes support like European and Chinese etc. This makes it easy for you to enter new markets without having to think about compliance with local grid codes. Should a required grid code not be in our database, our grid experts can of course help to analyze and implement it.

Reliable Park Communication
The communication protocol used internally in the park control system is our reliable M-Link protocol. The protocol provides very stable and secure communication via cost-optimized network components.

Backward Compatible
If you have wind parks running on the WP3x00 platform, the new features of the Wind Park Control Concept can of course be utilized. By using the Mita-Teknik ES Ethernet switches and the M-Net communicator software, the previous generation of controllers can be brought up to speed with the newest grid codes requirements etc.

Concept Solution or Tailor-made
With close to 30 years of experience within the wind industry, Mita-Teknik has compiled a Wind Park Control Concept that will fit most needs concerning e.g.:

- Park/Cluster Controller, Grid Monitor and Weather Monitor
- Fully tested software for controlling the individual wind park components
- Accessories
- Installation and commissioning services
- Integration services
- Training services

However, should you require solutions for special purposes we are always prepared to compile a tailor-made solution that fits your specific needs.

Concept Features
- Scalable hierarchical concept
  Systems available from 1 to 2500 turbines in 0-50 clusters.
- Real-time control
  Regulation of set points is performed real-time.
- Active power control
  Controlling and limiting the active power output of the wind park/cluster.
- Reactive power control
  Controlling and limiting the reactive power production and/or consumption of the wind park/cluster.
- Frequency control
  Uses the active power output of the park to handle a configurable range of frequency deviations.
- Voltage control
  Uses the reactive power of the park/cluster to control the voltage level in the point of common coupling.
- Start-stop management
  Fully configurable start and stop handling of the wind park/cluster after e.g. a grid fault.
- Park output rate control
  Limitation of the increase of power output from the park as well as different levels of set point ramping.
- Active power reserve
  Allows the operator to run the park/cluster active power output with a constant production reserve based on the capability of the turbines.
- LVRT handling
  Offers surveillance of the voltage level with a configurable LVRT curve similar to the system found in the turbine controllers.
- Block of park automatic restart after grid error
  The turbines in a wind park can on request from the TSO be blocked from the automatic restart after a grid error.
- Intelligent set point dispatcher (patent pending)
  The set points are dispatched intelligently over the network.
- Alarm handling
  Offers one or more points of alarm handling for all units.
- Backward compatible
  IC/WP3x00 system can easily be integrated into the concept, utilizing many new features.
- Meteorological data integration
  Centralized weather data can be integrated into the concept.
Wind Park Control Concept

System Overview

Transmission System Operator (TSO) interfaces to the park via Modbus TCP, digital in- and outputs, analog in- and outputs.

The Park Controller handles up to 50 turbines or up to 50 Cluster Controllers (which handles up to 50 turbines each). Grid Monitor is available as a combined Park Controller and measurement unit or as a remote substation Grid Monitor.

The Cluster Controller handles up to 50 turbines. The Grid Monitor is available as a combined Cluster Controller and measurement unit or as a remote substation Grid Monitor.

A Weather Monitor can be added either on park or cluster level to supply the system with meteorological data.
WP4x00
With Double Cluster

This configuration example shows a setup with a Park Controller w/o internal grid measurements, a Grid Monitor which supplies the Park Controller with the grid measurements and 2 Cluster Controllers with their own grid measurements which controls up to 50 WP4x00 turbines each.
WP3x00
With Double Cluster

This configuration example shows a setup with a Park Controller w/o internal grid measurements and 2 Cluster Controllers with their own grid measurements which controls up to 50 WP3x00 turbines each. One Cluster Controller communicates via ArcNet and IC500’s to the WP3100 and the other via Ethernet and ES100’s to the WP3100.
WP4x00 Single Park
With Grid Monitor

This setup shows a configuration where the Park Controller w/o grid measurements is located in one place and the Grid Monitor is located in another place (e.g. substation or transformer building).
WP4x00 Single Park with Integrated Grid Measurement

This example shows a Park Controller with Grid Monitor functionality integrated. In this example it is not combined with any cluster controllers, so it can handle up to 50 turbines.

**Park Controller**

- Required softwares on the Park Controller with grid measurements:
  - Grid Controller Application
  - Grid Monitor Application

- Optional software:
  - TSO Client Application
  - Alarm Server/Client
  - MMS or Modbus
  - Panel Control Application

**Wind Turbine**

- Required software on the turbine controller:
  - Wind Turbine Control Application
  - Data Bridge Application

- Optional:
  - Alarm Server/Client
  - MMS or Modbus

Up to 50 wind turbines
Power generators than wind turbines, e.g. cluster of solar panels which could be controlled via analog or digital inputs and outputs or even a new or existing communication protocol.

Concept Solution or Tailor-made
With close to 30 years of experience within the wind industry, Mita-Teknik has compiled a Park Controller Panel that will fit most needs. However, should you require solutions for special purposes we are always prepared to compile a tailor-made solution that fits your specific needs.

Park Controller Standard Panel
The Park Controller is the main controller in the Wind Park Control Concept, controlling up to 2500 turbines in 0-50 clusters. As part of our flexible concept, we offer a Park Controller Panel with the necessary hardware suitable for the harsh environment, irrespective of whether the wind park is onshore/offshore in a hot or in a cold climate or situated in a high altitude.

Installation
The panel is typically installed in the park office, in the substation container or in a turbine where it connects to the park network.

Field-Proven Technology
The panel is designed with our field-proven WP4x00 controller that runs special designed software for controlling the individual turbines or clusters. Apart from the controller, a number of inputs and outputs are required to communicate to and from the Transmission System Operator (TSO). Additionally, and depending on the configuration, measuring equipment for grid characteristics can be installed.

Options
The Park Controller Panel comes with spare in- and outputs, which can, for example, be used for intruder alarms. The system is prepared for integration with other
Cluster Controller Standard Panel

The Cluster Controller is a sub-controller in the Wind Park Control Concept, controlling up to 50 turbines. As part of our flexible Wind Park Control Concept, we offer a Cluster Controller Panel with the necessary hardware suitable for the harsh environment, irrespective of whether the wind park is onshore/offshore in a hot or in a cold climate or on a high altitude.

Installation
The panel is typically installed in the cluster office, in the cluster substation container or in a turbine where it connects to the park network to communicate with turbines and the Park Controller.

Field-Proven Technology
The panel is designed with our field-proven WP4x00 controller that runs the specially designed software for controlling the individual turbines in the cluster. Apart from the controller, a number of inputs and outputs are installed to ensure communication, e.g. with UPS. Depending on the configuration, measuring equipment for grids characteristics can be installed.

Options
The Cluster Controller Panel comes with spare in- and outputs, which can, for example, be used for intruder alarms. The system is prepared for integration with other power generators than wind turbines, e.g. cluster of solar panels which could be controlled via analog or digital in- and outputs or even a new or existing communication protocol.

Concept Solution or Tailor-made
With close to 30 years of experience within the wind industry, Mita-Teknik has compiled a Cluster Controller that will fit most needs – however, should you require solutions for special purposes we are always prepared to compile a tailor-made solution that fits your specific needs.
Grid Monitor Standard Panel

The Grid Monitor is a sub-controller in the Wind Park Control Concept, monitoring the park or cluster output. As part of our flexible Wind Park Control Concept, we offer a Grid Monitor Panel with the necessary hardware suitable for the harsh environment, irrespective of whether the wind park is onshore/offshore in a hot or a cold climate.

Installation
The panel is typically installed in the park/cluster office, in the substation container or in a turbine where it connects to the park network in order to send its data to the Park/Cluster Controller.

Field-Proven Technology
The panel is designed with our field-proven WP4x00 controller that runs the specially designed software for monitoring the grid characteristics at the point of common coupling. Apart from the controller, a number of inputs and outputs are installed to ensure communication, e.g. with UPS. The accurate measuring equipment for grid characteristics supports 1-5A and various voltage inputs from substation, making it easy to integrate with all TSOs.

Options
The Grid Monitor Panel comes with spare in- and outputs, which can, for example, be used for intruder alarms.

The system is prepared for integration with other power generators than wind turbines, e.g. cluster of solar panels which could be controlled via analog or digital in- and outputs or even a new or existing communication protocol.

Concept Solution or Tailor-made
With close to 30 years of experience within the wind industry, Mita-Teknik has compiled a Grid Monitor that will fit most needs – however, should you require solutions for special purposes we are always prepared to compile a tailor-made solution that fits your specific needs.
Weather Monitor Standard Panel

The Weather Monitor is a sub-controller in the Wind Park Control Concept that monitors the ambient conditions like e.g. wind, temperature and humidity. As part of our flexible Wind Park Control Concept, we offer a Weather Monitor Panel with the necessary hardware suitable for the harsh environment, irrespective of whether the wind park is onshore/offshore in a hot or in a cold climate.

**Installation**
The panel is typically installed on a met mast, holding the sensors in various heights where it connects to the park network in order to send its data to the Park/Cluster Controller for further data processing.

**Field-Proven Technology**
The panel is designed with our field-proven WP4x00 controller that runs the specially designed software for weather monitoring. Apart from the controller, a number of inputs and outputs are installed to communicate with the different sensors like wind vanes, anemometers, hygrometer, PT100, ice detection etc.

**Accessories**
To the Weather Monitor Panel, we offer a wide range of field-proven sensors like temperature, anemometers, wind vanes, hygrometers, air pressure sensors, ultrasonic sensors and precipitation etc.

All sensors are fully tested and compatible with the Weather Monitor.

**Options**
The Weather Monitor Panel comes with spare in- and outputs, which can, for example, be used for intruder alarms, and for other types of sensors and protocols for exchanging data.

**Concept Solution or Tailor-Made**
With close to 30 years of experience within the wind industry, Mita-Teknik has compiled a Weather Monitor that will fit most needs – however, should you require solutions for special purposes we are always prepared to compile a tailor-made solution that fits your specific needs.
The Grid Controller Application (GCA) is responsible for handling the control of turbines or Cluster Controllers in the park.

**Installation**

The GCA will be installed on the WP4x00 controller inside the Park Controller and/or in the Cluster Controller.

**Intelligent Set Point Dispatching**

The GCA software takes set points (active and reactive power) from the TSO or as a local parameter set point. Then, it distributes the set points to its underlying units, relative to the capability of these.

The GCA makes combined values of capability, actual production/consumption, from the underlying clients to inform the overlying controller (either a Park Controller or a TSO).

Set point distribution takes place via a special algorithm or via the intelligent set point dispatcher (patent pending) and can if necessary be limited in rate by a configurable set of rate limiters. Set point handling is very flexible and can of course be made either individually for the single clients (turbines or clusters) or for all clients controlled by the GCA.

- Advanced active power control
- Advanced reactive power control
- Ramping rate limitation of individual turbines and complete park
- Capability calculation
- Grid measurements selectable from Grid Monitor inputs or sum of turbine/cluster values
The GCA receives set point commands from the TSO and distributes it to the Cluster Controllers and/or the turbines over M-Link.

Over M-Link

```
TSO
P09518
```

Set point I/O handling
Frequency Control
Voltage Control

```
GCA
P09531
```

Set point distribution
Ramping
Etc.

Production data

The GCA receives set point commands etc. from the CCA and distributes it over M-Link to the turbines.

Over M-Link

```
CCA
```

M-Link client for Cluster Controllers

```
GCA
P09531
```

Set point distribution
Ramping
Etc.

Production data

The GCA receives set point commands etc. from either CCA or TSO and distributes it via the MCA over M-Net communication.

Over M-Net

```
CCA/TSO
```

M-Link client for Cluster Controllers or TSO client

```
GCA
P09531
```

Set point distribution
Ramping
Etc.

```
MCA
P07538
```

M-Net Communicator

Production data
The Grid Monitor Application (GMA) is responsible for measuring the grid characteristics at the point of common coupling and delivering the information to the Grid Controller Application.

Installation
The application is typically installed on the WP4x00 inside the Grid Monitor.

Accurate Measurements
The GMA is able to measure the grid characteristics very accurately via the WP-Line 151 and WP3090 interfaces. From these inputs the GMA calculates all necessary grid parameters like current, voltage, active power, reactive power, frequencies, vector jump etc. which are required to fulfill many grid codes.
The GMA utilises measurements from the WP-Line 151/ WP3090 hardware to provide the GCA on a Park- or a Cluster Controller with accurate grid measurements over M-Link.

The GMA utilises measurements from the WP-Line 151/ WP3090 hardware to provide the GCA on a Park- or a Cluster Controller with accurate grid measurements via a shared variable interface on the same controller.
Transmission System Operator Application (TSO)

The Transmission System Operator Application (TSO) handles the interaction/communication with the operator of the grid, e.g. the utility company.

Installation

The TSO application will be installed on the WP4x00 controller inside the Park Controller where it acts as the TSO communication interface for the Grid Controller Application.

On a stand-alone turbine, the TSO client makes it possible to have the same interface to the grid operator as in larger systems. For most turbines, this requires no additional hardware but only additional software packages to be installed.

Wide Range of Interfaces

In combination with the Grid Controller Application on a Park Controller or directly on a stand-alone turbine, the TSO features a wide range of possible interfaces so that active and reactive power set points can be controlled from outside and necessary data can be signaled back.

Grid Code Support

The TSO client is designed so that a wide range of grid codes and grid operator interfaces can be accommodated simply by changing parameters in the software interface.

- Configurable digital active power set point input interface
- Configurable digital reactive power set point input
- Configurable analog active power set point input interface
- Configurable analog reactive power set point input interface
- Active and reactive power set point input via communication
- Configurable analog set point mirror output interface
In a Park Controller the TSO handles the communication to the Transmission System Operator via one of the many possible interfaces and supplies this communication to the GCA.

In a stand-alone wind turbine the TSO handles the communication to the Transmission System Operator via one of the many possible interfaces and distributes this to and from the wind turbine application via the DBA.
Data Bridge Application (DBA)

The Data Bridge Application (DBA) is the link between a wind turbine application and the Park Controller or Cluster Controller.

Installation

The DBA is installed on the WP4x00 controller in each turbine.

Added Value

The DBA supports the Grid Controller Application in the overlying control application with additional information normally not available in turbine applications, like active power capability based on theoretical power curve.

Easy Setup

The DBA is fully designed to match the default settings of the Mita-Teknik power management object for WP4x00 turbine applications so that installation and configuration is fast and easy.

- M-Link communication to Park Controller or Cluster Controller
- Interface to TSO client for stand-alone turbines
- Preconfigured settings match the Mita-Teknik power management object
- Easy parameterization to WP4x00 turbine applications
- Easy setup for turbine applications
The DBA handles the M-Link communication to a Park- or Cluster Controller on behalf of the turbine application.

Over M-Link

- P- and Q set points
- Start/stop commands
- Production data

The DBA handles the interface to a TSO on behalf of the wind turbine application in case of a stand-alone turbine.

- TSO
  - P10518
  - Set point I/O handling
  - Frequency Control
  - Voltage Control

- DBA
  - P10501
  - Linking WT to M-Link or TSO client

- WTG
  - Pxxxxx
  - Wind turbine application
Cluster Communicator Application (CCA)

The Cluster Communicator Application (CCA) links the Grid Controller Application of a Cluster Controller to the Grid Controller Application of a park or another higher level Cluster Controller.

Installation

The CCA is installed on the WP4x00 controller in the Cluster Controller where it communicates with the GCA in the higher level hierarchy.

Controlled Cluster

By installing the CCA, the Park Controller will perceive the underlying Cluster Controller as a very large turbine to which it can send set points and commands, and from which it can receive production data, capability estimation etc. The CCA acts on commands from the Park Controller as a Park Controller acts on commands from the TSO client.
On a Cluster Controller the CCA handles the M-Link communication between the GCA on a Park Controller and the GCA on a Cluster Controller.

Over M-Link

- P- and Q set points
- Production data

CCA

M-Link client for Cluster Controllers

GCA

P09531

Set point distribution Ramping Etc.
**M-Net Communicator Application (MCA)**

The M-Net Communicator Application (MCA) translates the communication from the GCA control interface on a WP4x00 controller to M-Net units/turbines like IC and WP3x00.

**Installation**

The MCA is typically installed on the Park Controller or the Cluster Controller. The MCA communicates via Ethernet. In order to interface to the serial M-NET protocol, the IC/WP3x00 controllers must have a Mita-Teknik ES Ethernet switch installed with either a serial card or an ARCnet card.

**Multiple Fast Communications**

By using Ethernet and multiplexing technology, the MCA also makes it possible to access the individual controllers much faster than the original network and with up to 10 clients per unit/turbine. This is a big step up for exiting parks that need multiple users to connect or stream real-time data via OPC or IEC61400-25.

**Added Value**

By using the MCA control of, for instance, WP3x00 turbines by a WP4x00 Park Controller, the MCA calculates the capabilities for the park turbines and set the active and reactive set point limited by ramp rates and set point limits.
The MCA handles the communication to and from turbines and controllers via M-Net. This gives the GCA possibility to control WP3x00 and IC controlled turbines.
Weather Monitor Application (WMA)

The Weather Monitor Application (WMA) is monitoring the ambient conditions in the wind park like wind speed, wind directions, temperature and humidity etc.

Installation
The application is installed on the controller the Weather Monitor where it connects to the wind park network.

Stand-Alone or Wind Park Integrated
The application supports the measurements of various meteorological values, either as a stand-alone unit or by connection to the Park Controller via the M-Link protocol.
Panel Controller Application (PCA)

- UPS handling
- Configurable I/O channels for
  - Panel heating control
  - Panel cooling control
  - Outdoor temperature
  - Panel humidity
  - Smoke detector
  - Lightning sensor
  - Door alarm sensor
- Complete signaling to other applications
- Alarm handling

Panel Controller Application (PCA)
The Panel Controller Application (PCA) controls and supervises panel-specific functionalities like control of UPS, heating, fans, humidity and surge protection etc.

Installation
The PCA is suitable for installation on all WP4x00 controllers and in many types of units like Wind Turbines, Park Controllers, Cluster Controllers, Weather Monitors, your special units etc.

Added Value
By using a ready-made tested concept solution for controlling the panels, you can, by using parameters, ensure that the panel is controlled correctly and similarly in all your units.
Gateway Park Controller Data Panel

The Park Controller Data Panel for Gateway gives a comprehensive view of the data from the Grid Controller Application (GCA), including data related to active and reactive power production etc.

Screen Functions

The data panel consists of several sections. The top section presents information on the four main components controlled by the application:

- **Set points**
  Set point mode, active and reactive power set points.

- **Output**
  The values of active and reactive power production, divided into controlled and non-controlled parts.

- **Capability**
  Active and reactive power capability, max values of active and reactive power and mean park wind speed.

- **Regulation details**
  Number of controlled, non-controlled and offline clients.

The panel also shows Active Power Overview and Reactive Power Overview as two charts, each of them showing actual values and park set points, power and capability. Under the charts, two graphs show active and reactive power for the last 120 seconds.
Gateway Park Controller
Data Panel
Log