



XFE SCADA

Simplify, connect, and monitor your turbine systems while increasing AEP



A fast, flexible, and reliable supervisory control and data acquisition system

Tailored for wind and hydrokinetic turbine systems

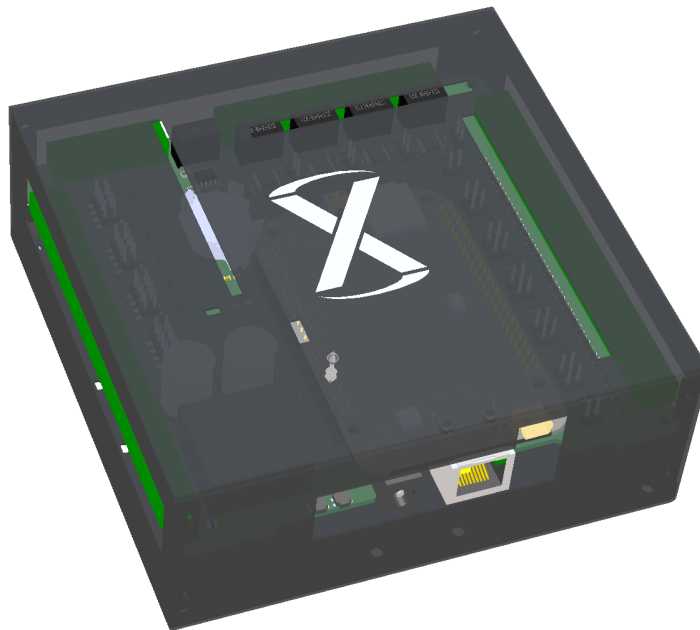
Integrate Control and monitor power conversion equipment, actuators, and sensors

Protect Detect and respond to system faults

Control Perform high-speed, high-complexity aero or hydrodynamic control
Control multiple turbines with one XFE SCADA

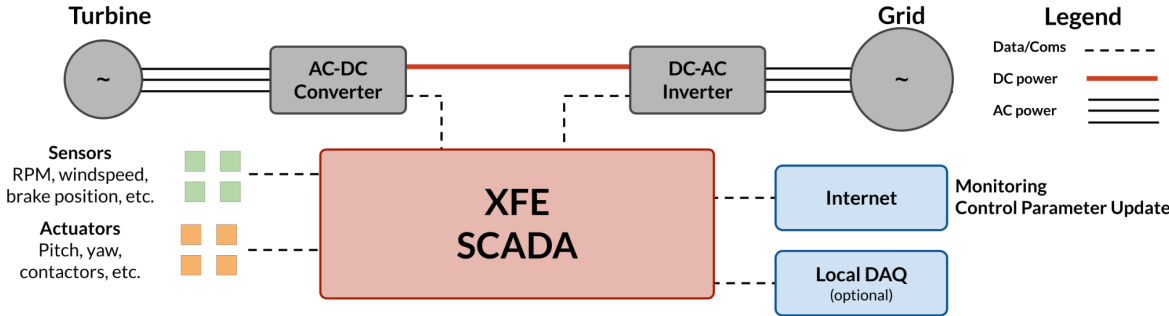
Interconnect Network nearby turbines:
Easily share equipment or sensors between turbines
Coordinated turbine array control

Monitor Web interfaces:
OEM/Maintenance - remote control and monitor
Power Consumer - power production and status

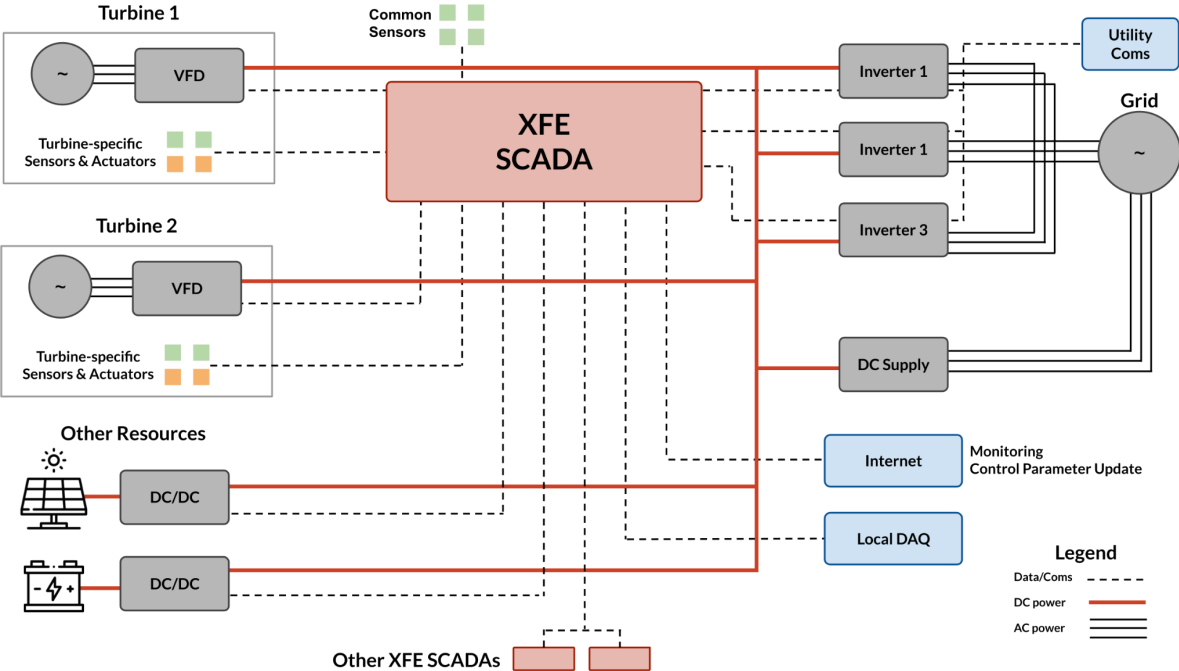


Flexible System Architecture

The XFE SCADA accommodates relatively simple system architectures, like this one:



But easily scales to more complicated systems, such as:



Connectivity

Internal

When a single XFE SCADA controls multiple turbines, sensor, and turbine operational data is shared internally for use in high-speed control and fault monitoring

Array

Local XFE SCADAs can share information, allowing for:

- Sharing a single sensor data among all XFE SCADAs and turbines in an installation
- Control of a shared resource, such as a grid-tie inverter, or battery system
- Array-level aero/hydrodynamic control optimization

Cloud

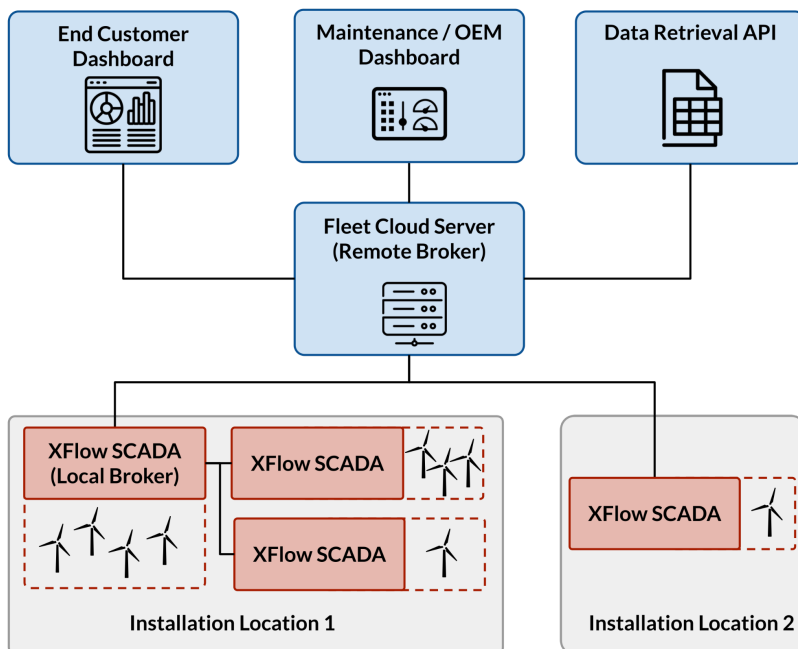
For internet-connected installations, XFE SCADAs communicate with a remote server for:

- Uploading fault, sensor, and performance data
- Receiving updates to control parameters and clearing faults (encrypted and authenticated)

Dashboard + Data API

Three methods are provided for remote interface to XFE SCADAs:

- 1) An end-customer dashboard, displaying statistics, status, and performance data
- 2) An OEM/Maintenance dashboard, providing access to data streams and allowing for clearing of faults and alteration of control parameters
- 3) An API for downloading historical data



Software Features

Turbine Control

- State-machine turbine control
 - XFlow works with you to define operational states and transitions during the onboarding process
 - *In development*: Graphical control logic interface so you can program edit your own control schemes
- Computational speed and algorithmic flexibility for aero/hydrodynamic control
 - If you can dream it, XFlow can implement it!
- The number of turbines controlled by a single XFE SCADA is limited only by hardware (e.g.number of I/O channels), not software
 - Inter-controller communication allows coordination between turbines with separate controllers
- Adjustable turbine control loop (up to 10 Hz) and sensor sample rates (up to 20 Hz)

Safety and Security

- Automotive OBD-II-like error code system
 - Handles external device (e.g. inverter, VFD) faults and internally detected faults
- Critical processes siloed with watchdogs
- Internet-connected processes sandboxed from turbine control processes
- Remote server communications are encrypted and validated using public/private key
- Customer-specific tests on every unit prior to shipment

Communications and logging

- Software is flexible with respect to communication hardware bus and protocol
 - Currently supported protocols: MODBUS TCP, MODBUS RTU
 - Other protocols available on request: MODBUS ASCII, ASCII Serial, EtherCAT, TCP/IP
- Configurable onboard data logging and/or use your own local data acquisition system via Modbus TCP

Hardware Features

The XFE SCADA is an ARM-based microcomputer with an array of galvanically isolated industrial I/O interfaces.

Basic Specification

Power Supply	21.6 - 26.4 V DC, 3.6 W (max)
Dimensions	5.3 x 5.3 x 2 in (135 x 135 x 53 mm)
Mounting	DIN rail or through hole
Hardware I/Os	4x Serial RS485 1x 10/100 Ethernet 12x General purpose digital inputs 8x General purpose digital outputs/relay coil drivers

Other features

- Short-duration supercapacitor power backup - Safe, controlled shut-down during power outages
- Real-time clock with battery backup - Maintain accurate data timestamps through power and network outages
- Indicator LEDs on all I/Os and power rails

Hardware I/O details

RS485 Serial ports

- Baud rate to 115,200 Kbps
- Jumper-selectable termination resistors

Digital Inputs

- 3-30V input range
- Possible uses include:
 - Binary state monitoring (e.g. brake closure, contactor state, etc.)
 - Pulse counting/frequency to 120 kHz (e.g. anemometers, encoders)

Digital Outputs

- Max current: 150mA
- Flyback diodes
- Output the main 24 V supply or provide an external supply up to 30V

Hardware Features in Development

- Analog input expansion board, for 4-20 mA, +/- 10V, RTDs
- Optional local user interface display and keypad, remote mountable