Substation Automation System

MANAGING A SERIES OF SUBSTATIONS
Managing a series of substations requires overseeing a complex set of solutions including local and remote user interfaces, engineering configuration tools, integration to legacy IEDs with multiple protocols, hardware and application services. The Invensys Substation Automation System combines all of these elements to simplify your automation projects and most importantly provides and ensures reduced capital and operations costs, enhance operational efficiencies, reduced and shorter outages, and improved customer service.

Customers turn to the Invensys Substation Automation System for automated power management and monitoring, field service protection and line sectionalizing, asset management, fault localizing and other applications to ensure safe, secure and robust operation of your distribution station.

SUBSTATION AUTOMATION SYSTEM COMPONENTS

- User interface and engineering environment
- Gateway modules
- 61850 data modeling environment
- RTUs
- Simulators
- Engineering services
- Training

InFusion SCADA
The Invensys Substation Automation System consists of the InFusion® SCADA platform which provides a single platform for all the SCADA, Supervisory HMI, Production and Performance Management needs. InFusion SCADA provides a common and strategic industrial application services platform on top of virtually any existing system, and it is built upon the industry-standards based, Invensys WonderwareArchestrA® real-time Service Oriented Architecture (SOA) technology. The InFusion SCADA platform’s diverse functionality extends the client’s software investment in a SCADA platform, and encourages flexibility in application development. It supports consistent and reliable operations across all users of the system, including operations, planning, management, technicians and casual users.
User Interface
The InFusion SCADA user interface portion of the Invensys Substation Automation System is based on the award winning Invensys Wonderware InTouch product which extends client support for capabilities such as:

- Multiple client interfaces [i.e., Thick Client, Terminal Services Edition (TSE) or Web Client]
- Information Analysis and Reporting
- Automatic data retrieval calculations
- Reduction and aggregation methods
- Security access across firewalls

Visualization can extend between one and typically four heads on a single workstation, depending on the graphic card chosen for the workstation. The cursor automatically moves from screen to screen, and windows can easily be dragged across screens as desired.

In order to maximize value and simplify the configuration and training for the user, we offer local panel computers which extend the automation system to the local substation. In essence the substation becomes a separate node with all the security needed to enforce local activities. The savings and benefits of this kind of configuration are huge and affordable.

Open Gateway Environment
The InFusion SCADA platform provides cost-effective communications to virtually any information source. Over 800 I/O connectors are available through Invensys or 3rd party Integrators. Some types of available connections include:

- Automation devices
- Control systems
- HMI systems
- Historians
- Relational databases
- Quality and maintenance systems
- Enterprise business systems
- Manufacturing execution systems (MES)

Software and Device Connectivity
- Easy information integration - With a global unified namespace, the InFusion System Platform provides a clear separation of application code from device communications management so that both can be easily managed and updated. It takes individual communications paths and makes them available globally for any application to use, allowing communications and device naming to be different for the same application and allowing re-use on any machine or application.
- Easy import and migration of legacy systems and external system configurations using the latest technology and industry standards
- Easy conversion of non-structured device-communication models into structured systems to increase the maintainability of applications and systems
- Easy connectivity with a huge selection of 32-bit I/O Servers for hundreds of the most popular control devices, PLCs, RTUs and DCSs - including Rockwell, Siemens, GE, Schneider, Foxboro, Fisher-Rosemont, Honeywell and more.
**Substation Automation Applications**

- LS  Load Shedding
- PFC Power Factor Control
- SO  Switching Order
- LF  Load Flow
- PFM Power Flow Management
  - Bus Load Allocation
  - V / Var Optimization
  - Short Circuit Analysis
  - Contingency Load Transfer
  - Fault Analysis
  - etc.
- SM  Switching Management
- TCM Trouble Call Management
- FLI Fault Location & Identification
- SA  Substation Automation
- DTS Dispatcher Training Simulator
- CM  Crew Management
- SM  Storm Management
- PFM Power Flow Management
- GIS Geographical Information System
- WS  Web Slinger
- WCE Web Call Entry

**61850 Data Modeling**

As your SCADA system grows, it will be important to have a system that is capable of being modified as technology changes. InFusion SCADA has IEC 61850 functionality designed into it today. The 61850 data model delivers rules about how to represent the data in those models and ways to manipulate that data. The following definition of IEC 61850 is from a recent IEEE meeting:

- IEC 61850 is a framework for substation automation that addresses more of what is required for interoperability of intelligent electronic devices (IEDs) beyond just the protocol:
  - Standardized object models and naming conventions
  - Standardized meaning of data
  - Standardized services and device behavior models
  - Self-describing devices
  - Common configuration language
  - Profiles for
    - Control/SCADA
    - Protection messaging
    - Transducers and I/O

Purchasing a system that has 61850 built-in compliance today preserves the capital you are spending today in preparation for tomorrow’s inevitable upgrades to your substation hardware in order to stay current with technology.

**Benefits of IEC 61850**

- Defines a set of standard object-oriented data models with a structured naming convention
- Provides interoperability between devices
- Specifies a common configuration interface
- Creates data interfaces instead of hard-wired interfaces
  - Reduced cost of installation
  - Increased architectural flexibility
Benefits of InFusion SCADA & IEC 61850

Within the InFusion SCADA environment, Invensys has created application objects that define the IEC 61850 substation. These objects are:

- **IEC 61850 Device**
  - Represents an IED from any vendor with compliant .ICD file
  - Produces the corresponding .CID file for all IED parameters

- **IEC 61850 Substation**
  - Represents graphical substation one-line diagrams (based on the .SSD file data)
  - Associates equipment layer and IEDs
  - Produces the .SCD file defining the substation

**IED Vendors and Invensys Cooperation: ICD File Management**

IED Vendors provide 61850-compliant Substation Configuration Language (SCL) files defining their device’s capabilities (IED Capability Description or .ICD file). The InFusion 61850 Substation Configuration Tool uses these .ICD files as the basis for IED templates.

These templates can be customized as required and substation configurations containing 61850 Device objects inside InFusion SCADA are built from these customized templates. As new devices are developed or the firmware and capabilities of existing devices are updated, the revised .ICD files can be imported into the InFusion Development Environment and added to the library of supported devices.

**Invensys Substation Automation RTUs**

The SCD5200, a millennium era Station Computing Device (SCD) is specifically designed for use with substations meeting all IEEE and IEC Surge Withstand requirements. The SCD5200 supports all of the programmability functions of a PLC, including graphical and structured text configuration using the ISAGraf IEC 61131 configuration tool. But the SCD5200 is a true RTU guaranteeing critical communications and control functions are processed in an orderly fashion demanded by substation automation applications.

The SCD5200 can be IEC-61850 enabled by purchasing the advanced IEC-61850 COPE card. The SCD5200 when accompanied by the IEC-61850 object makes the SCD5200 a valuable product for substation automation and data acquisition applications.

The SCD5200 combines a variety of features and benefits to achieve higher levels of communications, integration, and package engineering. A key development of the SCD5200 is the integration of CPU, OptoNet™, Power, and dual Ethernet into the main processor board (COPE) to provide a compact single module for specialized communications, local networking, applications processing and integration of station devices and meters.

The SCD5200 features options for communicating with SCADA Master Stations, human machine interfaces, Intelligent Electronic Devices (IEDs) and equipment. The Dual Communications Modules
allow communication over a wide variety of media such as Ethernet, leased lines, radio, microwave, fiber optic, power-line carrier and other such infrastructure with the following media standards:

- ITU V.28 (RS-232)
- ITU V.23/Bell 202 Modem
- ITU V.11 (RS-485 and RS-422)
- Fiber Optic

**Dynamic Simulator for Substation Automation**
The Invensys Substation Automation System also includes a dynamic simulation package in addition to simpler tie-back simulation. Elecsolve allows users to perform a wide and dynamic variety of ‘what if’ scenarios. For example, if a breaker is tripped in a test scenario, all ‘downstream’ actions that cascade can be evaluated. Developing emergency tactics and actions will allow you to handle outages during the working hours effectively and efficiently in order to supply your customers with a steady and reliable power supply.

To model electrical systems, Invensys has specially developed software called ElecSolve. ElecSolve was developed to make advancements beyond standard single phase electrical models. We wanted to be able to monitor engineering principals such as phase imbalance or electromagnetic transients. The ElecSolve software is now standard with our DYNSIM Software.

![ElecSolve Simulation](image)

ElecSolve software adds a DYNSIM library for modeling three phase electrical networks. The solver algorithms make the following important assumptions:

- Phases are balanced
- Electromagnetic transients happen much faster than solver time steps

These assumptions allow us to solve networks while neglecting electromagnetic transients and out of balance currents. The solver works out a steady state electrical solution at every time step given boundary conditions from the generators and loads. There are only a few important electromagnetic effects that exhibit transients slower than our typical solver time constant. These slow transients are represented as time-variable impedances.

The electromechanical dynamics are represented in first principles. The complex impedance of each component and transmission line is taken into account.

The library has two co-operating solvers:

- The Power Flow solver - calculates a consistent set of voltages for the network that satisfies the voltage and load boundaries.
- The Machine Dynamics solver - integrates synchronous machine and voltage controller states to solve machine speeds and AVR dynamics.

At each DYNSIM calculation step the power flow solver is executed before the machine dynamics solver. At the end of the step we arrive at a consistent set of bus voltages, power flow and machine speeds.
SUBSTATION AUTOMATION SYSTEM SERVICES

Turnkey Project Management and Delivery
Invensys will take your project from its inception including Design Specification all the way through training of your personnel once the system has been installed. Invensys engineers have designed and commissioned thousands of installations in virtually every country around the world with the same consistent project management practices that make us one of the most respected project management and delivery organizations in the power and automation world.

On-Site Assistance and Engineering Services
Highly trained, locally available Field Service Representatives provide product installation and startup support, corrective and preventive support, upgrade planning and implementation assistance plus engineering services to help you optimize use of Invensys equipment at your facility.

Panel Construction
Invensys utilizes a state-of-the-art panel construction service built on standards developed within our company. This ensures repeatable quality, minimum risk and lowest cost. With substation automation systems, however, unique designs are also required to fit legacy products or fit existing space requirements and local displays. Our in-house panel shop can meet virtually any requirement for your project.

Start-Up and Commissioning
Following the successful completion of the Factory Acceptance Testing (FAT) Invensys provides site installation supervision, a fully site-tested system (SAT), operator training, site management and cut-over and follow-up remediation.

Training
Invensys has an excellent reputation for providing highly reliable solutions, extensive training, and award-winning customer support and services. Our global Support and Services team offers extensive expertise in automation solutions for substation automation applications.

Remote Monitoring Support Services (DRM)
The ability to remotely connect Invensys experts to your SCADA system to provide performance monitoring and on-line diagnostic assistance provides a key opportunity to save time and money. It offers the ability to help pro-actively identify Invensys system anomalies before facilities upsets occur and can be used for reactive diagnosis purposes.

Making the Right Choice
Choosing the Invensys Substation Automation System will guarantee that you have selected a set of products, applications and services that will protect your customers by reducing your System Average Interruption Frequency Index (SAIDI), System Average Interruption Frequency Index (SAIFI) and Customer Average Interruption Duration Index (CAIDI). The Invensys Substation Automation System will provide you and your organization with one of the most Powerful, Comprehensive, Open, Scaleable and Flexible substation automation systems on the market today.