ATS
Leading of Integration

# @Station®

## Substation Automation System

Applied Technical Systems Joint Stock Company

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# A. Product Overview

**@Station® is an Integrated Control and Protection system designed for the operation of transmission and distribution substations. The system incorporates the latest technology in the field of substation automation to provide its users with innovative solutions to their requirements.**

@Station® integrates all monitoring, control, and automation functions in a flexible system structure for ease of operation. @Station® has been designed as a modular, its individual modules are specifically designed and tailor-made for each project.

## MAIN FEATURES

- Integrated solution to substation automation
- Fully compliance with international standards
- Flexible, modular and open structure
- Enables integration of protection systems
- Compatible with current international standards: IEC61850, IEC60870-5-101/102/103/104, UCA2, DNP LAN/WAN, Modbus, RP570/571
- Operated at high level of reliability and security
- User-friendly graphic interface
- Capable of expansion and upgrade; number of data points unlimited
- Programmable in accordance with IEC 61131-3
- Script languages support C#, Lua
- 24/7 maintenance services

## KEY FUNCTIONS

- Flexible configuration, seamless and scalable
- Monitoring of alarms, switchgear status, and measurement parameters for various voltage levels
- Control of switchgears at bay or substation levels as well as from remote control center with high level of security
- Checking of device control logic at bay and substation levels
- Checking of synchronization conditions before breaker tripping
- Ease of substation monitoring and control through user-friendly interface
- Storing of a full and complete historical database on all system events
- Substation Sequence of Event
- Data collection from all kind of IEDs including: Protection Relays, BCUs, Tariff Meters, Multi-meter, etc.
- Substation Fault Analysis
- Web-enabled design
- Tap position monitoring
- Online configuration
- Addition of new functions and features allowed

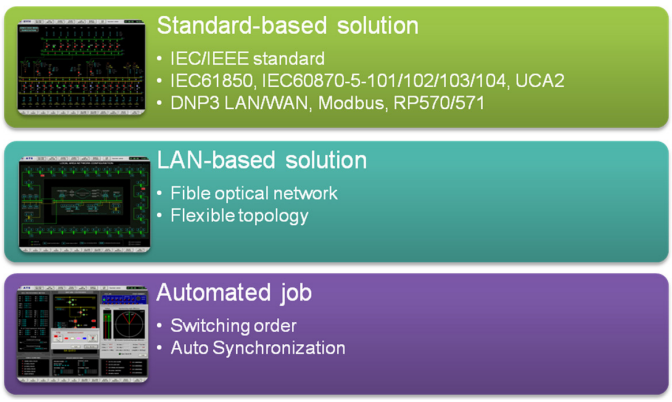
## ADVANTAGES

- Modular and scalable hardware and software
- User-friendly graphic interface
- Fulfills strict IT security requirements for use in the area of critical infrastructures
- Flexible, graphic project engineering for automation
- Openness from the use of standards

## CERTIFICATIONS

@Station® is fully certified for compliance with international standards:

- IEC 61850 Certificate Level A issued by KEMA DNV-GL
- IEC 60870-5-101 Master/Slave Certificate Level A issued by KEMA DNV-GL
- IEC 60870-5-104 Master/Slave Certificate Level A issued by KEMA DNV-GL



## APPLICABLE STANDARDS

- @Station® is fully complied with following standards:
- IEEE/POSIX (IEEE 1003.1, 1990; POSIX Federal Information FIPS- 151-1)
- ISO/OSI (Open System Interconnection) conforming to ITU
- IEEE 802.3 for LAN (or the equivalent ISO/IEC 8802-3)
- IEC 60870-5-104
- IEC 60870-5-101
- IEC 60870-4
- IEC 61850
- TCP/IP
- X.25

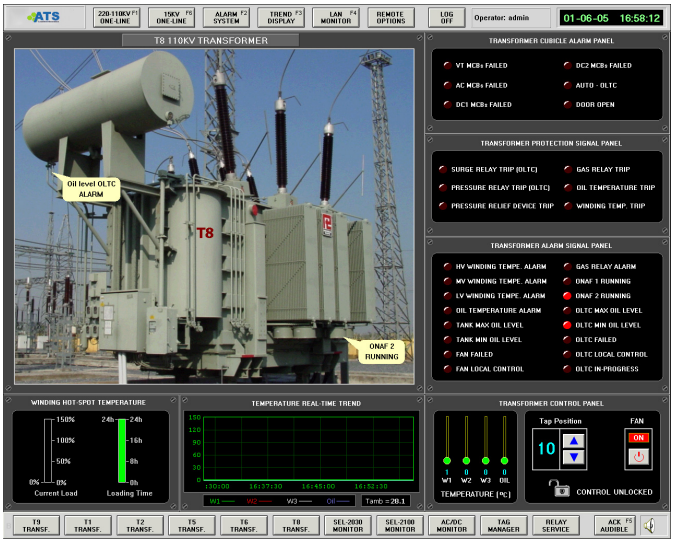
## SYSTEM ENTITLEMENTS

@Station® can serve various internal user functions and external partners within clients' corporate organization and related parties. Given appropriate authority, these types of users can be allowed to access, from any console, specific groups of functions or programs.

The console shall only execute functions related to the area of responsibility assigned to the logged users. Alarms shall be sent only to the console whose assigned area of responsibility encompasses the device that is being controlled.

Below are typical users types assigned with separate entitlement:

- Operators
- Operation Support Engineers
- Corporate Users
- System Maintenance Engineers




## FUNCTION HIGHLIGHTS

### (1) IEDs Integration

Relays, meters and other IEDs can be accessed via @Station® individually. The transparent access allows client to issue directives and receive responses from the relays as if directly connected to the devices. When operating in this mode, the Integration System will not interpret any directive or response to or from the relays or other IEDs.

### (2) Integration System Configuration and Management

Application elements and attributes can be defined with Software Configuration based on SmartHMI™ included in @Station®. Source definitions for the application elements (e.g. source code, display formats, etc.), the residency requirements (e.g. local or shared) and any access attributes shall be defined through the Software Configuration system.

Source definitions for all elements of an application shall be maintained in disk files under a code management system, which shall function at the minimum as below:

- Manage source code and binary images
- Allow tracking of code changes by date, author, and purpose
- Support multiple teams of programmers working concurrently on the same modules
- Provide an efficient linker

Procedures for completely regenerating executable images and run-time files shall allow individual applications to be rebuilt and installed within one or more application system contexts. Applications shall be made part of any application system by a straightforward procedure that requires no modification to application sources.

### (3) Status Indications

State of power equipment and its status changes are provided to the users via Status indications. These status indications shall be compared to the previously received data already saved in the database. If a status change has been detected which is not the result of a control action, an alarm shall be issued and announced on the displays where the related data are being monitored. Both the alarm condition and the return to normal shall be announced.

**Figure 1. Substation Asset Management with Online Monitoring**

# B. Technical Highlights

### (4) Time-Stamped Status and SOE

Within @Station® all Relays and BCUs are able to capture and record assigned events (trip signal, alarms, etc.) as well as to generate sequence of events (SOE) reports with time resolution at 1ms. Actual sequence of major events, such as protective relay pickup or circuit breaker opening, could be completely recorded.

SOE is synchronized using IRIG-B signal.

SOE Manager is shown in Figure 2.

### (5) Service and Analysis

It is possible to transfer information of system disturbance, SOE reports, meter records, power quality, etc. on demand to allocated system operators and engineers for further analysis and maintenance. Figure 3 is an example of a disturbance record file captured and performed by SEL5040 software.

### (6) Manually-Entered Data

In cases non-telemetered information such as portable Earth Switches installation, for example, is available, operators are able to manually update the status of devices.

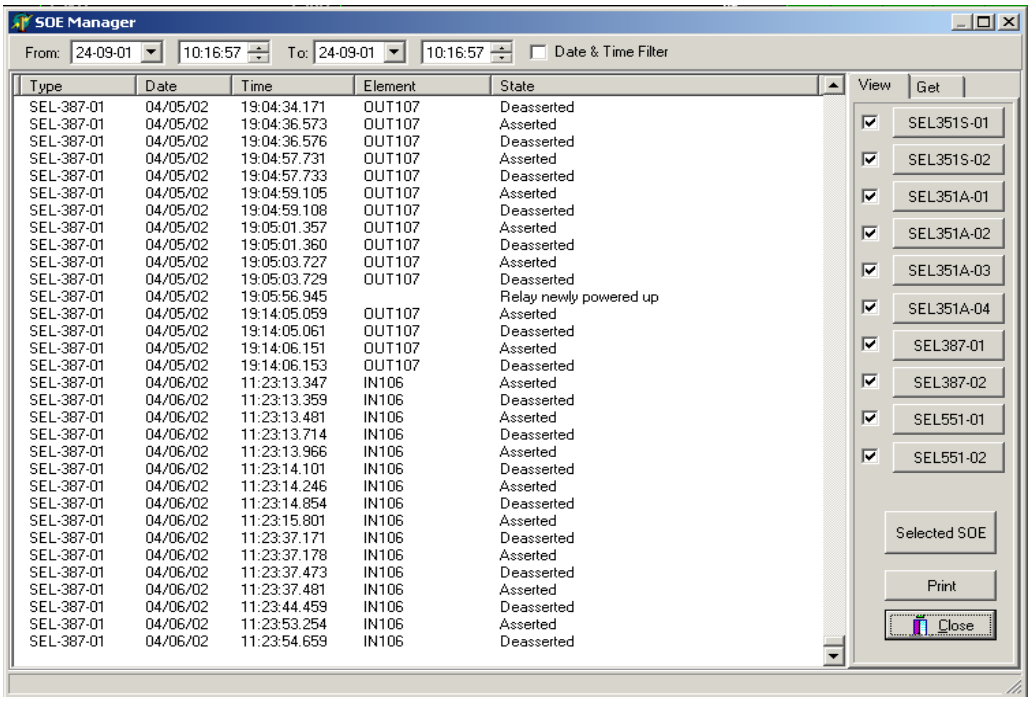



**Figure 2. SOE Manager**

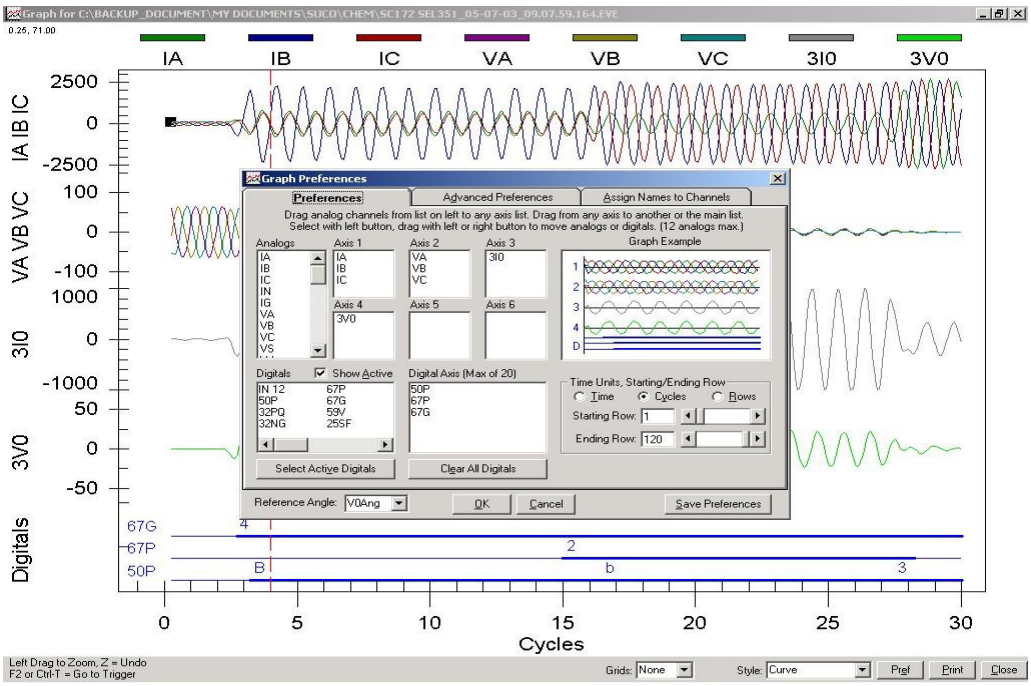



**Figure 3. Capture and Recording of Assigned Events**

### (7) Relays, BCUs and other IEDs Data Exchange Monitoring

@Station® is equipped with IEC-61850 servers that enables periodically acquire any value or status point stored internally in BCUs, IEDs. Figure 4 shows detailed information on all devices and functions.

### (8) Supervisory Control Functions

- Device Control: This function shall be enabled in accordance with the pre-defined areas of responsibility. Control commands entered by non-authorized users shall be inhibited. In order to avoid duplicate control operations from different consoles, the selected point shall be presented as busy to all the users that are accessing that point.

  The user that has performed the first selection shall be the only one authorized to control that point, and any attempts by other users to select that point shall be rejected until the first user has finished his/her selection.
- Forced Operation Interlocks Condition Verification: In order to prevent injuries to the personnel or equipment damages, no control action shall be executed before verifying the interlock conditions.
- Open/Close Command
- Set-point Command
- Step regulating Command

Figure 5 describes a screenshot of the Supervisory Control Functions.

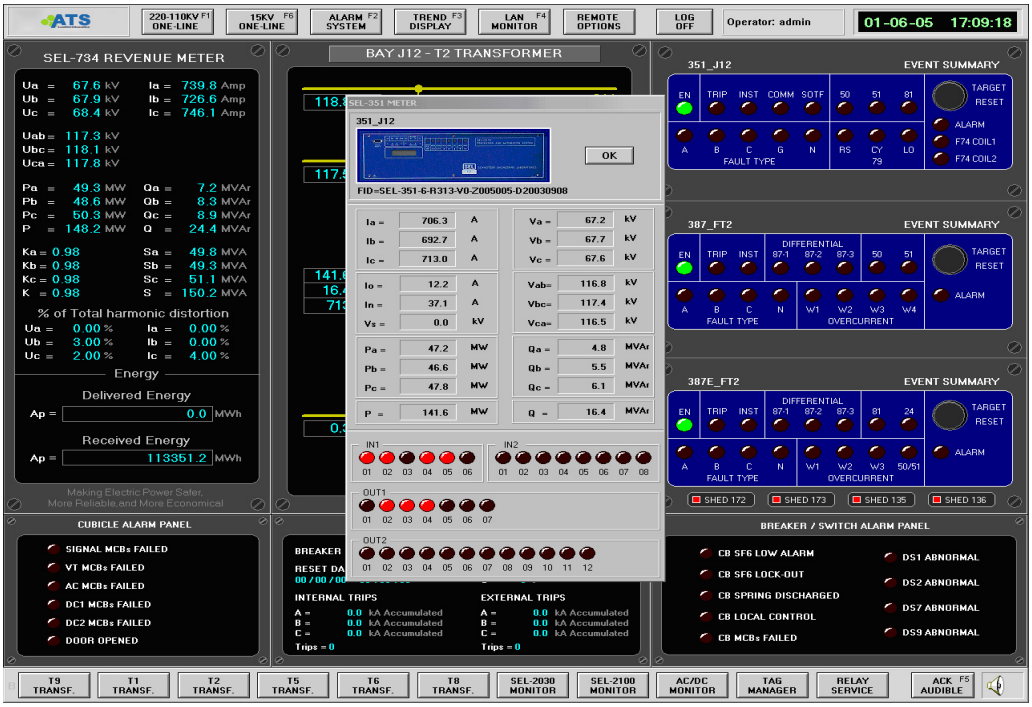



**Figure 4. Full Detailed Information on All Devices and Functions**

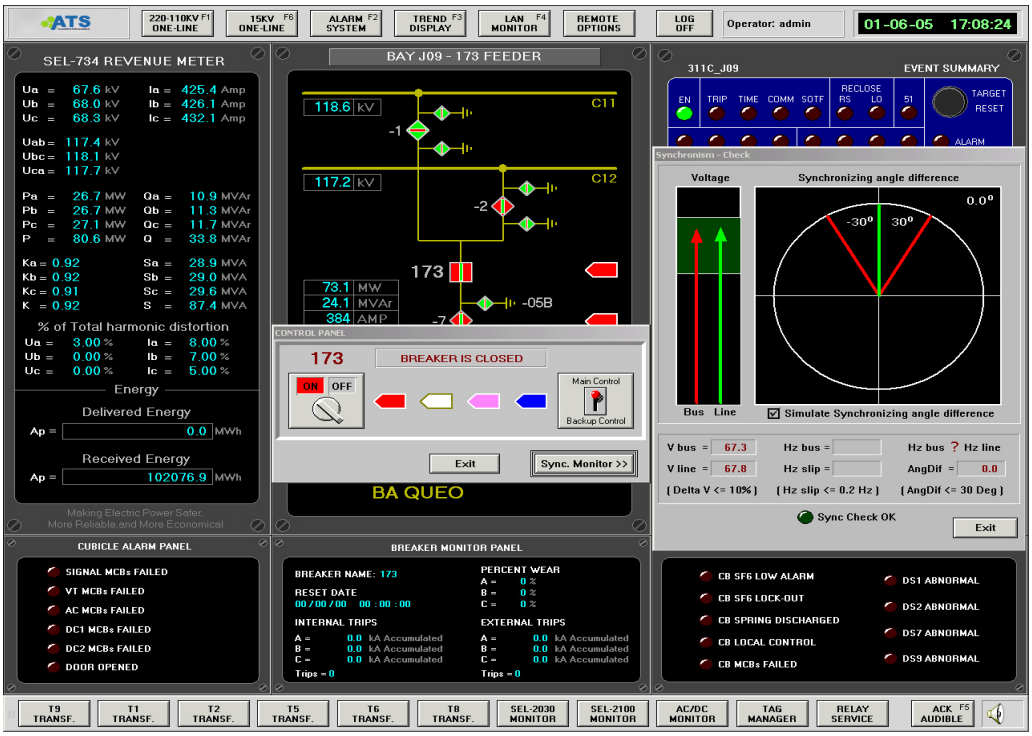



**Figure 5. Supervisory Control Functions**

# B. Technical Highlights

### (9) Device Control Sequence

@Station® can enable Operators to define Device Control Sequences for its immediate or future application to assist them in extensive operations of: devices control, labeling and replacement.

The control sequences may encompass one or more operations as well as other general operations such as waiting steps. Once the sequences have been prepared and stored, the Operator shall be provided with the ability to activate them at any time. These control sequences shall be generated for the entire system for planned switching operations.

The Device Control Sequence capability shall permit scheduling multiple control commands for being automatically execution in a predefined sequence and shall be used for:

- Closing and opening breakers and disconnect switches
- Raising or lowering the taps of transformers
- Suspending the execution of a command until the Operator sends the “continue” command
- Conditionally checking before execution

In order to facilitate the execution of Device Control Sequences, instructions shall be provided to Operators so that the adequate sequence of steps could be reviewed, prior to performing a control action.

### (10) Alarm Processing

Monitoring of alarms is important in substation operation, especially during significant events such as total or partial system outages. An event is defined upon any change during operation and a group of events would initiate an alarm. Any unsolicited status change or violation of any allowable limits of the power system variables shall initiate an alarm as well.

### (11) Event with Alarms

Events with alarms are:

- Any unexpected status change of an entry
- Any control point change request or indication that does not result in a change of the associated input (status) within a determined period of time.
- Any analog input that violates one of the alarm limits defined by the Operator
- An RTU does not answer correctly to a predefined number of interrogations
- The operating status of any substation equipment has changed without having been previously scheduled and/or requested by the Operator.

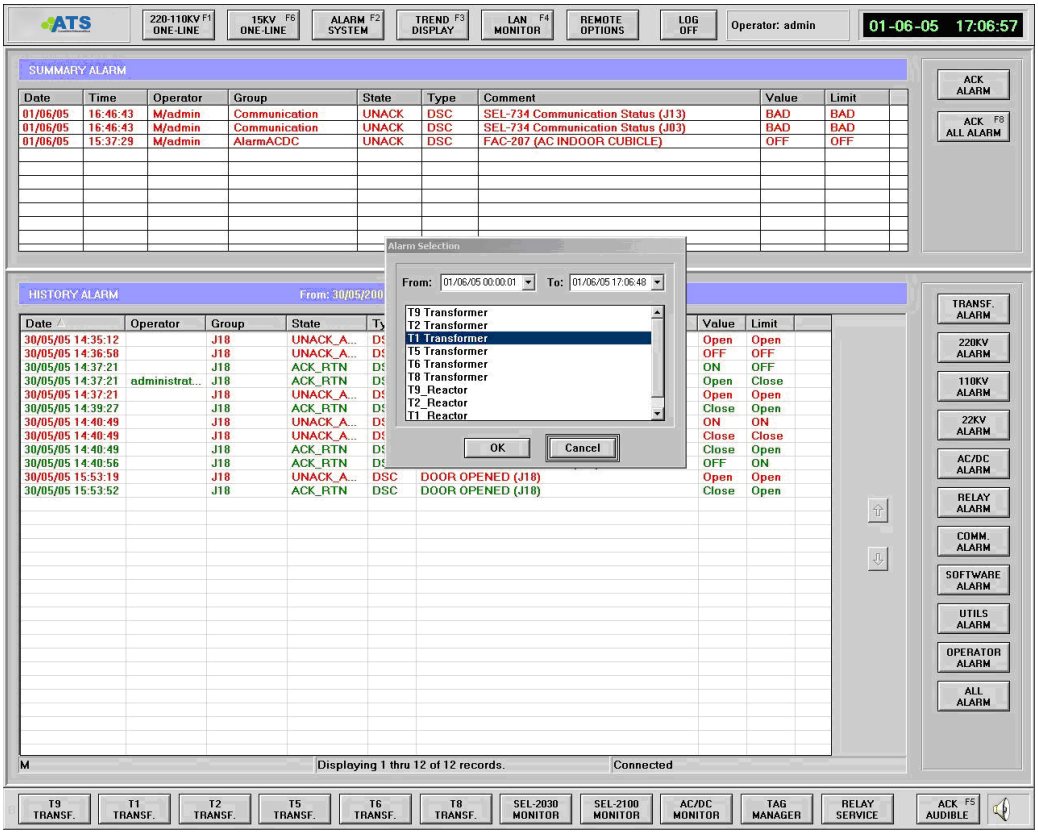



**Figure 6. Alarm Management System**

### (12) Trending

Trending tracking is included in the DAC Subsystem. It shall be possible to represent trends both from historical data, using the information stored in the HIS, and with real-time data. Refer to Figure 7.

### (13) Tagging

Tagging of the circuit breakers and disconnector switches for maintenance, hot line work or automatic re-closing is an important part of the @Station® design criteria. This will be accomplished by using a latch in the redundant Relay & BCU. Once set, the latch provides an indication to all remote systems (TCC), station computers and on the local Relay& BCU display indicating the breaker was tagged out.

Four colored tags (Red, Yellow, Orange, and Blue) are used in @Station®. The Red Tag applied on the Circuit Breaker (CB) or Disconnector Switch (DS) is used for blocking their operation. Yellow Tags are used for hot line work that a Yellow Tag applied to a breaker will block its the re-closing function. Once the Yellow Tag has been applied, the re-closing cannot be put back into service until the Yellow Tag is removed. Orange Tags are used for sectionalized lines that are used for indication only. Blue Tags are used on the Console display only and that is for the operator to provide informational comments. The Tagging function also allows the user to enter the following tag information:

- Job/Permit Number
- Date
- Purpose
- "Tagged by" and "Tagged for" Information

Refer to Figure 8.

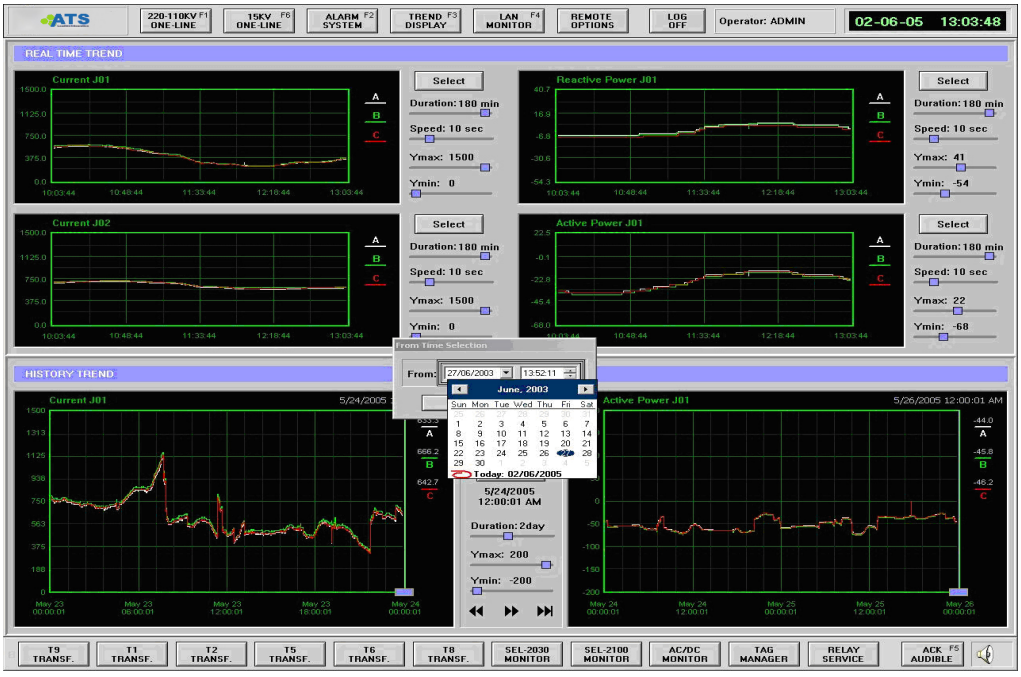



**Figure 7. Visualized Data with Trend Display**

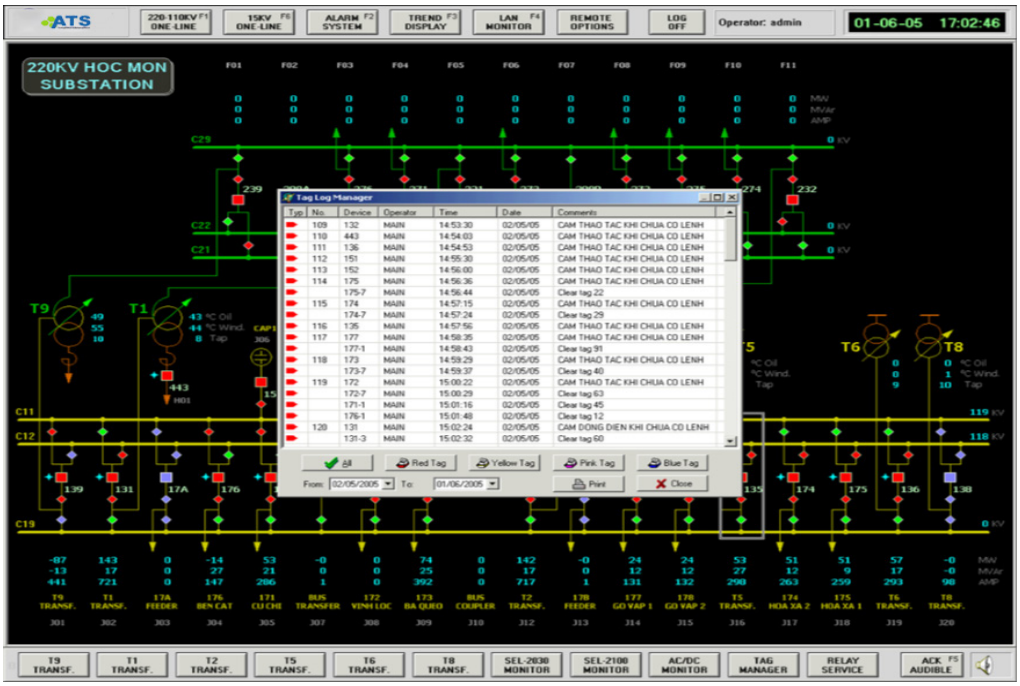



**Figure 8. Tagging Function**

# B. Technical Highlights

### (14) Breaker Data Monitoring System

This function provides various benefits to the customers, such as:

- Saving cost by reducing maintenance time
- Continuously monitoring circuit breaker data and condition in real-time
- Intuitive display for operators
- Fully integrated with HMI
- Right decision for Maintenance Scheduling

Figure 9 shows a screenshot of Breaker Monitoring.

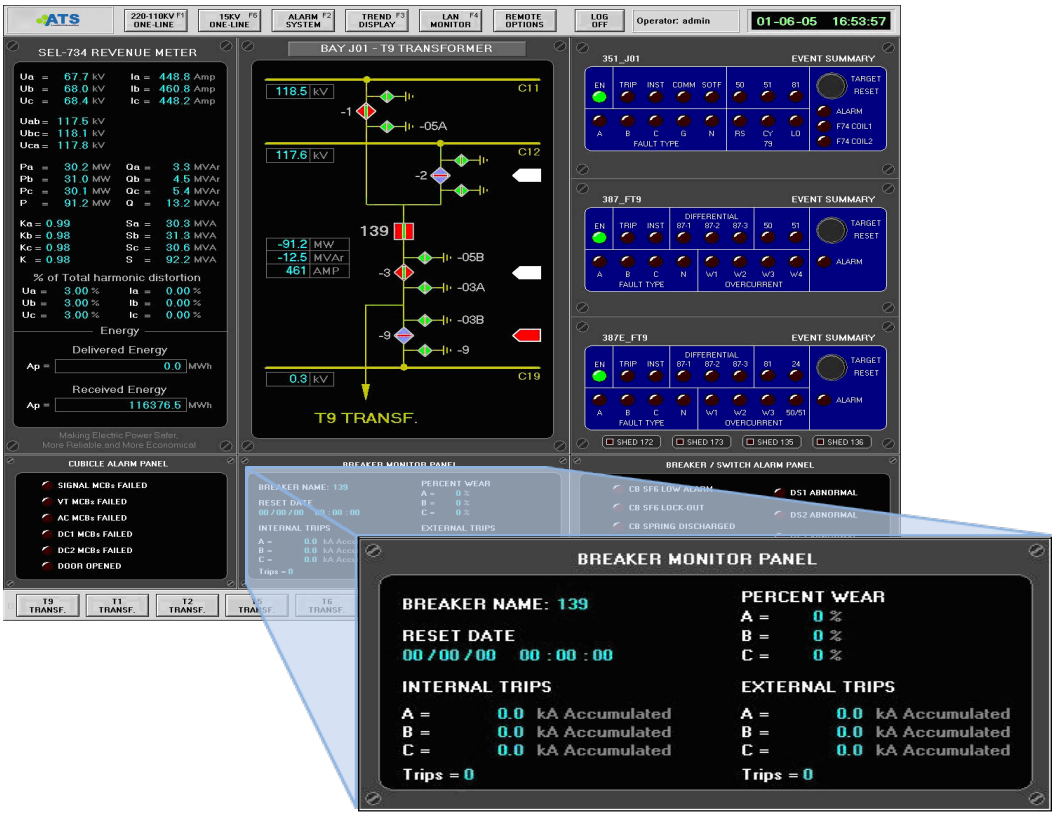



**Figure 9. Breaker Monitoring**

### (15) Substation Auxiliary Monitoring

@Station® monitors all necessary information related to Substation Auxiliary System, such as AC and DC, etc.

Figure 10 shows Indoor AC/DC Supervisory Window.

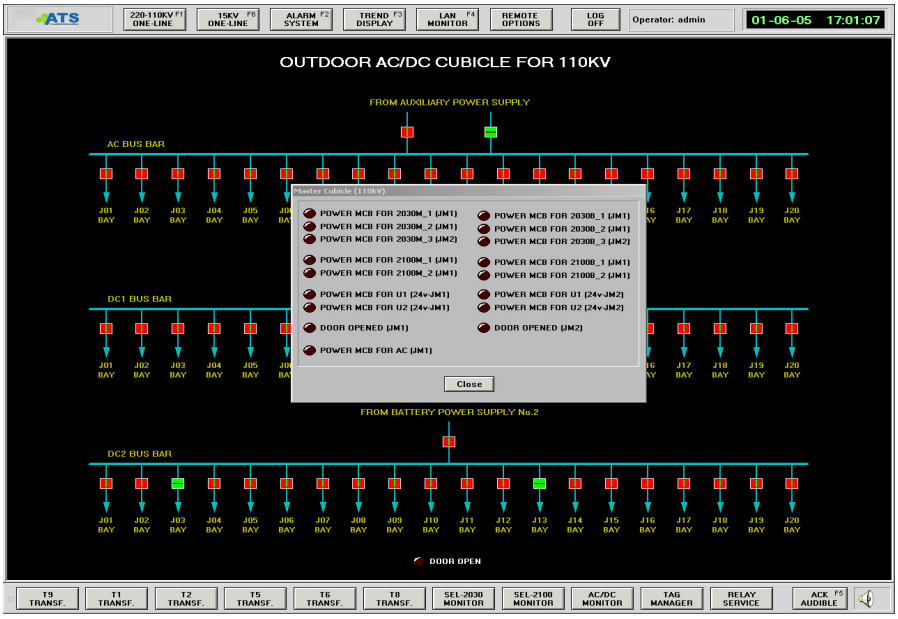



**Figure 10. Indoor AC/DC Supervisory Window**

### (16) Power Line and Transformer Monitoring Function

Transmission line and power transformer supervision capability of @ Station® can support Power and Transmission Companies in enhancing load capacity of power system, ensuring safe operation and economizing investment capital:

- Enhance loading capacity of Power Line and Transformer
  Study results show significant changes in load capacity of power transformer which varies with different operational environment conditions, especially weather temperature.
- Predict remaining life of transformer through calculation of cumulative aging of isolator
  With off-line calculation results, user can determine the decrement of insulating life of transformer, thus predicting the remaining operational time of the devices. Off-line calculation result may be used for planning on repair or replacement of power transformer on load diagrams and available environment mode.
- Predict allowable overload time for different operation cases with simulation functions
  This function can calculate with assumed data. Operators can switch to manual mode to run calculation simulation for define timeframes. For example, simulation function can be used to determined allowable overload time of transformers (or transmission lines) if a machine fails when two transformers are operating in parallel.
- Ease of Reporting
  The program allows for extracting calculation results in Excel format for reporting and storing.

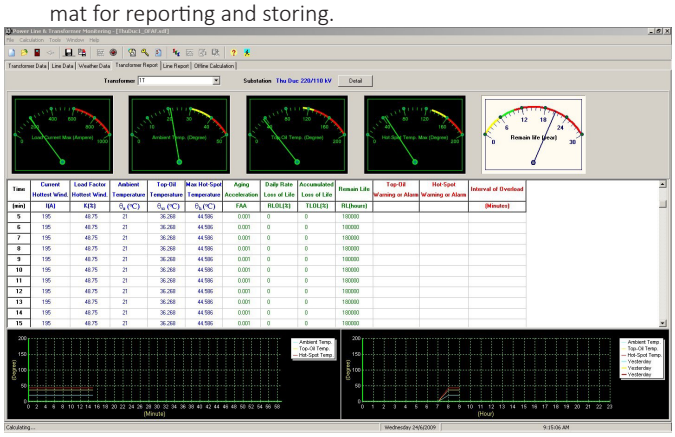


Figure 11. On-line Monitoring

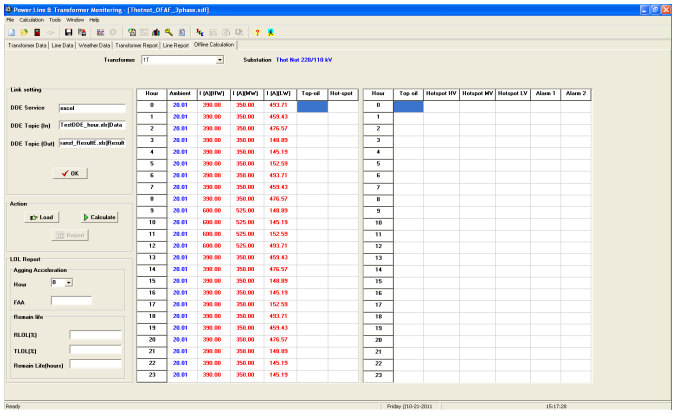


Figure 12. Off-line Calculation

### (17) Playback System

This function can:

- Provide seamless retrieval of any data from SmartHIS™
- Be configured to provide a complete picture of the power system from stored data (include playback of previously recorded monitored data, calculated system parameters, etc.)
- Be useful for root cause and impact investigation, improvement of system operations, exploration of alternative actions, and replay of “What if” scenarios
- Allow users to turn back to past data to review what happened to their system with data accuracy within few seconds.
- Display entire data from HMI with one-second time resolution by utilizing SmartHIS™ system
- Maintain data at high accuracy level

### (18) Operator Logbook

An Operator Logbook shall be provided with which Operators can record events, comments, remarks and notes pertaining to system operation. Based on appropriate jurisdiction, the entries in the Operator Logbook shall be accessible, for display and printout from any console that has access to the @Station® facilities.

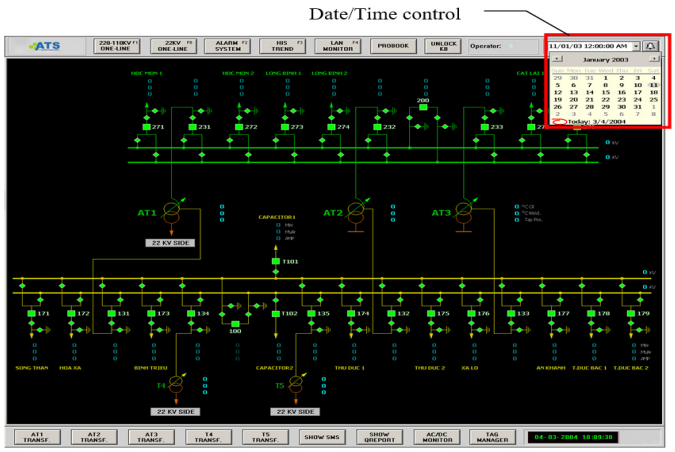



Figure 13. Playback System

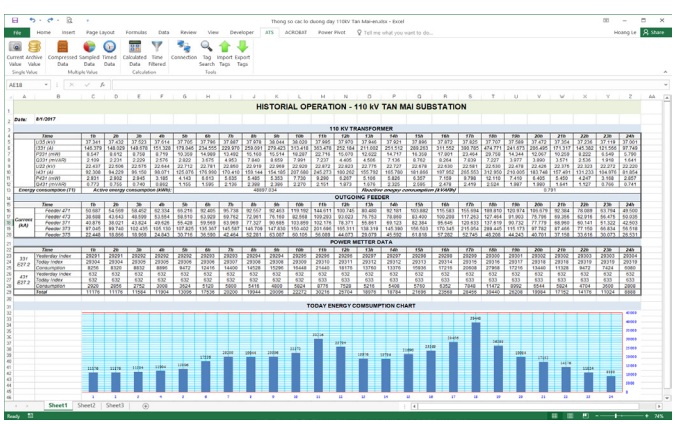



Figure 14. Operator Logbook

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