Relion. Thinking beyond the box.

Designed to seamlessly consolidate functions, Relion relays are smarter, more flexible and more adaptable. Easy to integrate and with an extensive function library, the Relion family of protection and control delivers advanced functionality and improved performance.
ABB is pleased to provide you with technical information regarding protective relays. The material included is not intended to be a complete presentation of all potential problems and solutions related to this topic. The content is generic and may not be applicable for circumstances or equipment at any specific facility. By participating in ABB's web-based Protective Relay School, you agree that ABB is providing this information to you on an informational basis only and makes no warranties, representations or guarantees as to the efficacy or commercial utility of the information for any specific application or purpose, and ABB is not responsible for any action taken in reliance on the information contained herein. ABB consultants and service representatives are available to study specific operations and make recommendations on improving safety, efficiency and profitability. Contact an ABB sales representative for further information.
Migrating Brownfield Substations
Jared Gregory
12-17-2015
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Learning Objectives

- Introduction
  - Overview
  - Interesting Facts
- Migration Ideas
- Transformer Monitoring
  - Customer challenge
  - ABB’s solution
  - Advantages for the customer
- Annunciator Replacement
  - Customer challenge
  - ABB’s solution
  - Advantages for the customer
Introduction
Brownfield Substations

Two common terms: Brownfield and Greenfield
- Brownfield: Existing structure/installation
- Greenfield: No installation present

Characteristics of Brownfield Substations:
- Aged
- Defined Space
- Cramped
- Lack of communications and automation
- Little visibility into the station
- No feedback
Introduction

Interesting Facts

- Over 50% of work completed by those interviewed were related to brownfield substations.
- Less than 1000 greenfield stations had been built versus thousands of upgrades completed on brownfield station.

Biggest Challenges for a Brownfield Project:
- Missing/incomplete records
- Incorrect records
- Out of date records
- Design errors
- Construction delays
- Integrating the old with the new
Introduction
Interesting Facts

What are people putting into brownfield designs:

- New protective devices: 88%
- Communication devices: 71%
- Smart grid technologies: 44%
- IEC61850: 29%
Introduction
Brownfield Substations

What about the motto: “If it isn't broke, don’t fix it”

- In some scenarios…things are broken
  - Everything has a shelf life
- Sometimes you don’t have ground available to build onto and you are forced to work on Brownfield installations
- Improve efficiency
- More visibility and control into your system (comms with feedback)
- Improved intelligence
- Aging knowledge base
- Meeting new regulations and standards
Introduction
Brownfield Substations

What about the motto: “If it ain’t broke, don’t fix it”

- In some scenarios…things are broken
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Migration Ideas
Brownfield Substations

Transformer Monitoring
- Improved Intelligence
- Improved Efficiency
- Added Visibility

Annunciator Replacement
- Added Visibility
- Improved Efficiency
Transformer Monitoring Overview

- Add intelligence to monitor transformers for asset health purposes
- Communicate transformer monitoring data back to control house
- No existing communication cables or fiber between several transformers and the control house
- High trenching costs to pull communication cables or existing trenches may be full
Transformer Monitoring Solution - RTU

- Modern RTUs enable advanced remote monitoring and control applications that increase reliability and improve system efficiency
  - Cost-efficient
  - Standards-based
  - Easy engineering
  - HMI, PLC, and data archive functionalities
  - Cyber Security

- Communication via Serial and Ethernet on DNP3.0, IEC 61850, Modbus, and more simultaneously

Extensible and easy to combine, ABB’s RTU500 series is highly scalable making it a perfect solution not only for station reinforcement, but also retrofit applications and new installations

- Field-proven success
  - Installed for 20+ years
  - 2,000+ customers in 100+ countries
  - 100,000+ installed RTUs
Transformer Monitoring Solution – ABB Wireless

- Innovative wireless technologies and products used to build high-performance wireless IP networks for field applications
  - Cost effective
  - Standards-based
  - Rugged and reliable
  - Secure
  - Scalable from a small, single application network to large, multi-application system

- Utilities, oil and gas, mining, smart cities and industrial hub market verticals

- Field-proven success
  - Installed for 10+ years
  - 850+ customers in 50+ countries
  - 60,000+ installed routers
Transformer Monitoring Solution - Architecture

Transformer Cabinet 1
- RTU540 CID11 1410
- Control House

Transformer Cabinet 2
- RTU540 CID11 1410
- Maintenance Laptop

Transformer Cabinet n
- RTU540 CID11 1410

Control System/Asset Health Monitoring Software

6320
- RTU540 CMD11

Control House

- 2.4/5.8 GHz
- Ethernet Cat5
Transformer Monitoring Solution – Transformer Interface

Control System/Asset Health Monitoring Software

Non-ABB Interface Connection

Maintenance Laptop

Transformer Cabinet

1410 DIN-rail

AFS Switch

Dissolve Gas Monitor
Tap Changer
Bushing Monitor
Temperature Monitor

PSU40
RTU540 CID11

24…60 VDC
Hard-wired I/Os
Analog Inputs

2.4 GHz
Ethernet Cat5

Control House
Transformer Monitoring Solution

- ABB Wireless 1410 connected to a RTU540, both located in transformer cabinet
- Data collection from transformer monitoring devices (e.g. temperature, hydrogen-moisture, tap position) via RTU540
- Wireless communication back to the control room via 1410
- Reception of transformer data at control room via 6320 sitting outside
- Hardwired connection of 6320 and another RTU540
- Communication from the control room to network control center via RTU540
- Solution independent from transformer size and model
Communication unit **540CID11**

- DIN rail mounted base module
- Rugged metal housing
- 4 serial ports (RS-232, RS-485)
- 2 Ethernet ports (10/100 BaseT)
- Integrated I/Os (16 Binary Inputs, 8 Binary Outputs, 8 Analog Inputs (mA or V signals), 1 out of n check)
- Power supply: 24 V DC
- Process voltage:
  - R0001 24…60V DC
  - R0002 110 …125 V DC
- With connection interface to RTU500 I/O-extension modules
- Temperature range from -40 to 160 F
Transformer Monitoring Solution – Tropos 1410D

1410D Mesh Router

- Industry-standard DIN-rail mount package
- 802.11b/g/n wireless mesh router
- Serial and Ethernet client support
- ABB Wireless Mesh OS pre-loaded
- Two RS-232, One RS-485 (screw terminals)
- One 10/100Base-T (RJ-45)
- 11-55VDC power (PoE or screw terminals)
- Integrated firewall and IPsec VPN
- Alternative mounting configurations (side or rear mount)
- Supports automation protocols including DNP3, Modbus, SEL Mirrored Bits and IEC 61850 with GOOSE Messaging
  - Facilitates integration of field automation devices
Transformer Monitoring
ABB Solution – Tropos 6320

Outdoor Mesh Router 6320

- Dual-radio (2.4 GHz and 5 GHz)
  - Two wired Ethernet connections (backhaul and wired device support)
  - Powered by PoE 11-55VDC
  - Mesh OS pre-loaded
- 802.11a/b/g/n wireless chipset
  - Maximal Ratio Combining (MRC) receiver for 2.4 GHz radio
  - Enhances rate-at-range and increases overall mesh capacity
- Small, lightweight form factor
  - Integrated omnidirectional antennas
  - Reduces weight/wind loading concerns on mounting assets (2.3 kg with brackets)
  - Skyline gray radome
Transformer Monitoring
Advantages for the customer

- Remote access to transformers without pulling cables
- Much lower cost for a wireless solution
- Faster time of deployment
- Access to transformer monitoring data from anywhere within the substation
- Support for multiple applications on a single network
- Very little training for maintenance staff needed
- State-of-the-art communication equipment with Ethernet and IEC 61850 capability
- Cyber Security features included
- Space savings thanks to compact, rugged metal housing RTU540 with integrated I/Os
Annunciator Replacement
Annunciator Advantages

- Provides visible and audible notifications
- Contains a legend area that contains a unique description of the wired input
- Indication window illuminates during alarm condition (Usually via light bulbs in older stations)
- Pushbuttons allow for operators nearby to acknowledge the alarm
- Some require keys to enable the push buttons to restrict access to those with clearance for acknowledging the alarm
- Variable alarm sequences to define new, fleeting, and acknowledged alarms
Annunciator Replacement
Annunciator Disadvantages

- Difficult to expand
- No time stamping
- Can be acknowledged and silenced by any clearance level unless keys are used
- Aside from audible alarms, alarms are only visible to individuals within eye sight
- No communications
- Requires bulb replacement and someone present at the station to keep tabs on the unit
Annunciator Replacement Solution – RTU560

RTU560 product line

- RTU560 CMUs
- RTU560 Power supply units
- RTU560 I/O modules
- RTU560 Racks
- RTU560 Serial communication
- RTU560 Ethernet communication
- RTU560 Real time clocks
## Annunciator Replacement Solution – RTU560

<table>
<thead>
<tr>
<th></th>
<th>Swing frame</th>
<th>Mounting plate</th>
<th>560MPR01</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>560SFR02</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>560MPR03</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>560MPR01</strong></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Feature</th>
<th>560SFR02</th>
<th>560MPR03</th>
<th>560MPR01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slots for power supplies units</td>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Support of communication units</td>
<td>Up to 8</td>
<td>Up to 8</td>
<td>Max. 2</td>
</tr>
<tr>
<td>Mixed configurations</td>
<td>With CMU and I/O</td>
<td>With CMU and I/O</td>
<td>With CMU and I/O</td>
</tr>
</tbody>
</table>
RTU500 series
RTU560 Housing

- Available for
  - Swing frame (560SFR02)
  - Wall mounting (560MPR03)
- Supports 1 or 2 power supply units
- Support of up to 8 communication units (CMU)
- Solely CMU rack with 560CMU02 and 560CMU05
- Mixed configurations with CMU and I/O
- Mixed configurations with 560CMU05 and 560CMU02
RTU500 series
RTU560 power supply units

- Power supply unit **560PSU02**
  - Input: 48...220 V DC
  - Output total 85 W,
    - 5 VDC: 0…15 A and 24 VDC: 0...0.7 A
  - 1 LED for 5V, 1 LED for 24 V signalization
  - Electronic power limitation, short circuit proof, controlled load balancing
  - Alarm indication in case of failure
  - Redundant operation up to 8 CMUs
RTU500 series
RTU560 communication units

- Communication unit (CMU) **560CMU05** for RTU560
  - Interfaces
    - 4 serial interfaces (RS232C or RS485)
    - 2 Ethernet ports (10/100 Base T) for communication to
      - Host systems and/or
      - Subordinated devices and/or
      - RTU I/O
  - CPU
    - AMD ELAN520 CPU @133MHz
    - 128 MB flash memory
    - 64 MB RAM
    - Web server for diagnosis and maintenance via Ethernet ports
  - PLC capable
  - Bit protocols (Hitachi, Conitel) are supported
RTU500 series
RTU560 communication units

- Human machine interface (HMI) **560HMR01** for RTU560
  - Windows 7 Professional (32 bit)
  - 2x Ethernet interfaces (10/100 Base T)
  - 4x USB ports for mouse and keyboard
  - 1x VGA port for monitor
  - 1x Stereo audio-output
  - SSD harddrive
  - Occupies two slots of the rack
  - Runs Windows based operating system for RTU560 integrated HMI
  - Communicates via Ethernet LAN interfaces
  - No external PC necessary thanks to integrated solution
  - Fan free, no rotating parts
RTU500 series
RTU560 input/output modules

- Binary input board 23BE23
  - 16 binary input channels
  - One module for all types of binary input signals (single indications, double point indications, digital measured values, counters)
  - Galvanic insulation by optocouplers
  - Input voltage 24...60 VDC
  - LED signal for each input
  - Temporary storage of 50 time-stamped event messages
RTU500 series
RTU560 Connectors

- **560BCU05 R0001**
  - Bus Connection Unit for 560SFR02
  - Basic board for support of 2 units 560CMU0x
  - Alarm and warning contacts
  - Minute pulse in- and output

- **560BCU05 R0002**
  - Bus Connection Unit for 560SFR02
  - Extension kit for 10 additional 560CMU0x
  - Alarm and warning contacts
  - Minute pulse in- and output
RTU500 series

Up to 16 control systems

Up to 64 sub device lines (serial or Ethernet)

Up to 32 IEDs per sub device line (in total not more than 150 IEDs)

Up to 16 CMUs

Up to 32 segments via I/O bus

Up to 7 extension racks per segment
Annunciator Replacement

Solution Overview

SCADA Display
To Operations HMI

RTU560 Communication Rack (Quantity: 1)

<table>
<thead>
<tr>
<th>Module</th>
<th>Quantity</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>560FR02</td>
<td>1</td>
<td>RTU560 19” Rack Unit, 3U Ordering #1KGT022200R0001</td>
</tr>
</tbody>
</table>
| 560PSU02      | 2        | Power Supply Unit
Input Voltage: 48...220V DC
Output Voltage: 5 & 24V DC
Ordering #1KGT011900R0001 |
| 560CMU05      | 2        | Communication Unit
• 4xSerial Port (RS232 / RS485)
• 2xEthernet Port (RJ45)
Ordering #1KGT012700R0002 |
| License       | 2        | HMI license, 5000 data points Ordering #1KGT201439R0011                       |
| 560BCU05      | 1        | Bus Connection Unit
Ordering #1KGT022400R0001                                                     |
| 560HMR01      | 1        | HMI Unit
• 2xEthernet Port
• 4xUSB Port
• 1xVGA Port
Ordering #1KGT030500R0001                                                       |
| 560BIRD01     | 11       | Binary Input Unit
16 binary inputs for 125V DC Ordering #1KGT034000R0002                         |
Annunciator Replacement
Solution Overview

SCADA Display
To Operations HMI

Ethernet Switch
Connected through 560BCU05

RTU560 I/O Rack (Quantity: 5)

<table>
<thead>
<tr>
<th>Module</th>
<th>Quantity</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTU560 19&quot; Rack Unit, 3U</td>
<td>1</td>
<td>Ordering # 1KGT022200R0001</td>
</tr>
</tbody>
</table>
| Power Supply Unit    | 2        | Input Voltage: 48..220V DC  
|                      |          | Output Voltage: 5 & 24V DC  
|                      |          | Ordering # 1KGT011900R0001 |
| Binary Input Unit    | 12       | 16 binary inputs for 125V DC  
|                      |          | Ordering # 1KGT034000R0002 |
| Blanking Plates      | 5        | Ordering in pack of 100  
|                      |          | (ordering # 1KGT007700R1002) as one-time buy |
Annunciator Replacement Tools - Integrated HMI

RTU Demo - Alarms

<table>
<thead>
<tr>
<th>Class</th>
<th>Alarm status</th>
<th>Time</th>
<th>Type</th>
<th>Object</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2014-05-16 10:32:28</td>
<td>SPI</td>
<td>33kV H02 Protection Alarm</td>
<td>+</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2014-05-16 11:23:44</td>
<td>SPI</td>
<td>33kV H02 Trip Curc Super</td>
<td>+</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2014-05-16 11:28:16</td>
<td>SPI</td>
<td>33kV H02 DC supply fail</td>
<td>+</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>2014-05-16 10:30:21</td>
<td>DPI</td>
<td>33kV H02 Q0</td>
<td>Closed</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>2014-05-16 09:05:08</td>
<td>SPI</td>
<td>33kV H02 AC supply fail</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2014-05-16 12:19:44</td>
<td>DPI</td>
<td>33kV H02 Q1</td>
<td>Closed</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>2014-05-16 12:28:05</td>
<td>DPI</td>
<td>33kV H02 Q2</td>
<td>Closed</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>2014-05-16 10:52:60</td>
<td>DPI</td>
<td>33kV H02 Q3</td>
<td>Closed</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>2014-05-16 10:26:32</td>
<td>DPI</td>
<td>33kV H02 Q9</td>
<td>Closed</td>
</tr>
</tbody>
</table>
Annunciator Replacement Tools - RTUtil

CSPEC

- Rack 0: 560SFR02A [B1.R1]
  - Slot DIN 01: 560PSU02
  - Slot DIN 09: 560PSU02
  - Slot DIN 17: 23BE23 [S17]
  - Slot DIN 21: 23BE23 [S16]
  - Slot DIN 25: 23BE23 [S15]
  - Slot DIN 29: 23BE23 [S14]
  - Slot DIN 33: 23BE23 [S13]
  - Slot DIN 69: 560CMU05 [S4]
    - CPB: I/O bus: 1
    - HMI Server: PACHMI
  - Logic Function
    - Network Interfaces: Line T61850: RTU_SERVER
    - Network Interfaces: Line TDNP3 LAN/WAN: DNP_SERVER
- PROCESS ARCHIVE Function: Archive

- Slot DIN 77: 560CMU05 [S2]
Annunciator Replacement Tools – HMI Editor

Drag and drop premade alarm list component
Annunciator Replacement
RTU Added Value

- Completely Flexible and capable of being expanded
- Only authorized users allowed to clear alarms
- Time stamped data
- Ability to communicate information up to a SCADA system
- Can handle 1000’s of points
- Can easily identify health of the unit
- With the addition of ABB Wireless it is possible to review the alarm list anywhere in the station
- Can make hardwired inputs available for other usage in the system
- Can still identify alarm via the RTU unit even if the LCD screen goes out
- Ability to communicate via multiple protocols with newly added devices
Annunciator Replacement
Replacement Considerations

- Who are the intended users of this alarm information?
  - Access Rights
  - Training
- How important is the location of the annunciator window?
  - Centralized
  - Remote
- Is there sufficient space to place an RTU and an LCD?
- Does the existing system have the ability to time stamp?
Questions
This webinar brought to you by:
ABB Power Systems Automation and Communication

- Relion Series Relays – Advanced flexible platform for protection and control
- RTU 500 Series – Proven, powerful and open architecture
- MicroSCADA - Advanced control and applications
- Tropos – Secure, robust, high speed wireless solutions

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Thank you for your participation

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