Self Healing Network (Centralized Restoration Gateway)  
IEEE PES  
2015 General Meeting
Fault Isolation & Restoration

- Manual Fault Isolation & Restoration
  - The operator makes switching decisions

- Automatic Fault Location Isolation and Service Restoration
  - Distributed – InteliTEAM - $$$ - High speed/Peer to Peer, Static
    - Devices communicate among themselves to make switching decisions using current load data and static rules
  - Centralized – IDMS - $$$$$ - Dynamic/Complex
    - Devices communicate with the IDMS system.
    - The system makes switching decisions based upon the current system state
      - Nominal GIS with operator switching
      - SCADA telemetry
      - Calculated load flows.
  - Hybrid – Centralized Restoration Gateway (CRG) - $ - Simple/Static
    - Devices communicate to a central controller/SCADA system.
    - Switching decisions are made based upon current load data, and static rules
Centralized Restoration Gateway

- 1st CRG Scheme went on line on 12/17/2011
  - Albany Georgia

- Total of 23 CRG Servers
  - 18 Production
  - 5 Developmental/Backup

- Total of CRG Devices thru May 2015
  - 535 Feeder Breakers
  - 1,920 Devices

- 64 CRG Successful Operations 2014
  - 8,694,852 Customer Minutes Avoided

- 45 CRG Successful Operations thru May 2015
  - 6,494,781 Customer Minutes Avoided thru May 2015
What The CRG Does

PURPOSE

• Minimize Customer Outage Time
• Reduce the pressure on the Distribution Operators to quickly use automated switches following outage events

HOW THIS IS DONE

• Identify faulted section
• Isolate faulted section
• Restore service to customers on un-faulted sections
What It Communicates

- REMOTE Controlled DA Devices Communicate to One Central Computer
- CRG Computer monitors the system status

What It Does

- If the Scheme detects a Permanent Fault
- CRG Computer determines the Fault Location
- Transmits commands to Open and Close Devices to isolate the fault and pick up customers
CRG Comm Path Flow Block Diagram

Mapping

TCMS

Distribution SCADA

GATEWAY - CRG

DA

Current Production

GIS

Outage Management System

ICCP Production (OMS)

ICCP (SCADA) Production

SCADA

Protocol Translator

CRG's Production

IED

Future DNP

ICCP Production (CRG)

Future

ICCP

SES 92

DNP
What is CRG?
CRG stands for Centralized Restoration Gateway.
It is a computer application that sits on the front of the DSCADA system (between the DSCADA host and the field devices).
The computer controls field devices to isolate faults and restore service automatically.

What does CRG offer that cannot already be accomplished by DCC SCADA operations?
Where the control and decision functions are similar, the amount of information and the speed at which CRG can react to an outage should reduce overall customer outage time.
Also, protocols for restoration are pre-determined within the CRG similar to having switching orders in hand for each condition.
Operators always have oversight and can intervene if necessary.

How do field personnel know a device is part of a CRG scheme?
Placards are being installed on all CRG devices.

How does the CRG affect routine switching?
Since the CRG is not aware of manual switches, the CRG should be disabled during routine switching.

What circumstances prevent/disable automatic restoration?
There are 6 things that disable a scheme:

- Hot Line Tag (Work Permit)
- Communications Failure
- Switch from Remote to Local Mode
- Ground Trip Disable
- Reclose Disable
- Under Frequency Target

All 6 of the disable commands go to the same point in the CRG. In other words, a communications failure will be treated the same as a Hot Line Tag in respect to disabling a feeder. Of course except for the obvious difference that the Hot Line Tag has to be enabled to restore the scheme and the communications may come back on its own.
Do control diagnostic alarms cause the scheme to disable (battery alarms, diagnostics alarms, trip/close disabled buttons, etc.)?
Yes. There are 3 abnormal alarms that will disable a scheme:
• Trip Coil Failure
• Battery Status Monitor
• Relay Diagnostic Failure/Control Diagnostic Failure

If a scheme gets disabled due to manual operation, reclosing disabled, etc. will it automatically go back into Enabled when those conditions are cleared?
Yes. There are no additional steps that need to be taken to enable the scheme. It will go back to ready when the “Hot line Tag” switch is enabled.

What should (substation or line) personnel responding to outages be cautious of?
In most cases, the line regulators and the line side of the substation breakers will be energized. They will be de-energizing the regulators when they open the line side disconnect.

What information about each feeder is required to have it added to the CRG?
Device types, Device IDs, bi-directional pole mounted regulators, distributed generation on circuit, load limits of each line section, breaker load limits, topology, and customer counts of each line segment.

How will the CRG react if a particular scheme is called upon to reconfigure and the electronic devices are not in the “home” position (ex. N.O. device is closed or N.C. device is opened) due to previous system reconfiguration by an operator of field personnel?
The CRG scheme will recognize the current state of all electronic devices and will proceed to isolate the troubled section and restore service thru an alternate source.

• How will the substation and automatic restoration schemes be returned to normal after a faulted event has been corrected?
The operator clicks the “Return to Normal” command after all faults have been removed and all manual switches are closed.

How would disabling/enabling CRG schemes be incorporated in normal day to day switching? Would this be a step to be placed in the switching order? Would this be done on all circuits involved?
If the routine switching involved moving load between automated devices the scheme would not need to be disabled since it would know the condition of the system. But, if the switching involved creating new normal opens with manual devices, the CRG scheme should be disabled as part of the switching order. The CRG should also be enabled as part of the switching to return the system to normal.
Overhead DA Switch

Underground DA Switch
**DAWSON FOREST**
**SCHWEITZER 351S**
**RESTORATION BREAKER CONTROL**

**BK_H10824**

**12KV**

**NEW DATA**

**ESCA**

**REG/LTC**

**NOTE:**
**TO ADD A TAG**
**SELECT THE**
**ESCA BOX**

**Controlled by Automation Scheme**

**DC VOLTS** 134.1

**SETTINGS GROUP** 1

**MINIMUM PHASE TRIP** 600

**MINIMUM GROUND TRIP** 240

**Last Data** 0 : 0 : 0

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**BREAKER CONTROL**

**T** HOT LINE TAG
NORMAL

**RECLOSING**
ENABLED

**G** GROUND PROTECTION
ENABLED

**ALTERNATE SETTINGS**
DISABLED

**PEAK DEMAND**
RESET

**FAULT TARGETS**
RESET

**UFX ENAB/DISAB**
ENABLED

**UF RESET**
RESET

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**RESTORATION CONTROL**

**AUTOMATIC RESTORATION**
START

**RETURN TO NORMAL**
START

**RESTORATION SCHEME**
ENABLED

**FORCE GATEWAY INTEGRITY**
SCAN

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**BREAKER ALARMS**

**HIGH CURRENT LOCKOUT (SOTF)**
NORMAL

**PHASE C (1) TARGET**
NORMAL

**PHASE B (2) TARGET**
NORMAL

**PHASE A (3) TARGET**
NORMAL

**GROUND TARGET**
NORMAL

**#51 ELEMENT (T)**
NORMAL

**TRIP COIL MONITOR**
NORMAL

**RECLOSE POSITION**
NORMAL

**BATTERY STATUS**
NORMAL

**RELAY DIAGNOSTIC**
NORMAL

**CLOSE FAILURE**
NORMAL

**SLOW TRIP OPERATION**
NORMAL

**SUPERVISORY CONTROL**
ENABLED

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**RESTORATION ALARMS**

**RESTORATION SCHEME**
READY

**RESTORATION IN PROGRESS**
NORMAL

**RETURN TO NORMAL IN PROGRESS**
NORMAL

**RESTORATION STATUS**
RESET

**RESTORATION FAILURE**
NORMAL

**RELAY COMMUNICATIONS**
NORMAL

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**ANALOG VALUES**

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<tr>
<th>Phase C (1)</th>
<th>Instant</th>
<th>Max Demand</th>
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<tr>
<td>112</td>
<td>Amps</td>
<td>276</td>
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<tr>
<td>Phase E (2)</td>
<td>93</td>
<td>176</td>
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<tr>
<td>Phase A (3)</td>
<td>120</td>
<td>261</td>
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<tr>
<td>Ground</td>
<td>50</td>
<td>165</td>
</tr>
</tbody>
</table>

| 3 Ph MW     | 24.50   | 51.50      |
| 3 Ph Mvar   | -5.40   | 3.80       |
| 3 Ph PF     | 0.97    |            |

| Phase C (1) | 7.81    | 0.10       |
| Phase B (2) | 7.81    | -2.80      |
| Phase A (3) | 7.81    | -2.40      |
Switchgear with SEL 351 R2 Relay
Communicates with Cellular Modem Technology
Distribution Underground Network

Normally Closed Underground Switch
Scheme Name: Substation 1  W2722 – Substation 2  R0612

Contractor Digs into Underground Cable with Backhoe
Scheme Name: Substation 1 W2722 – Substation 2 R0612

Substation 1

- W2722 SEL 351
  - SEL 351
  - Phase Min. Trip = 720 A
  - Ground Min. Trip = 240 A

- Sel 351
  - Phase Min. Trip = 720 A
  - Ground Min. Trip = 240 A

- AH9126 Scadamate CX
  - 900 Amps

- V5258
  - 3-1000 ALLC
  - 635 Amps

- N5377
  - 3-1000 ALLC
  - 635 Amps

Manual Cubicle #5

- N.O.
- 3-1000 ALLC
- 635 Amps

Auto Cubicle #6

- N.O.
- 3-1000 ALLC
- 635 Amps

Substation 2

- R0612 SEL 351
  - Phase Min. Trip = 720 A
  - Ground Min. Trip = 240 A

- Sel 351
  - Phase Min. Trip = 720 A
  - Ground Min. Trip = 240 A

- AH2139 Elastimold
  - 600 Amps
  - Normally Closed

- Manual Cubicle #3
  - 3-1000 ALLC
  - 635 Amps

- Manual Cubicle #7
  - 3-1000 ALLC
  - 635 Amps

- Manual Cubicle #10
  - 3-1000 ALLC
  - 635 Amps

Breaker R0612 Locks Out with Permanent Fault
Scheme Name: Substation 1 W2722 – Substation 2 R0612

Normally Closed Underground Switch
Automatically Opens to Isolate the Fault
Scheme Name: Substation 1 W2722 – Substation 2 R0612

Normally Open Switch Automatically Closes picking up customers
QUESTIONS

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