After the Storm:
Using GIS for Damage Assessment and Restoration

October 2004
**business focus during a hurricane**

1. Utilities need to provide **fast response** times and **minimize extra work** for restoration crews in the field by knowing where their assets are in times of network outages.

2. Utilities must provide a **safe work environment** for their employees and the surrounding community.

3. Utilities need to make **work processes** more **efficient** in such areas as damage assessment and materials handling in order to best utilize the human resources available.

4. Utilities need to **educate and inform** the community regarding preparations and disaster recovery before and after the storm.
The BELCO Case Study

Friday, September 5, 2003: Hurricane Fabian Hit
• One of the Strongest to ever hit Bermuda

Category 3 Hurricane:
• Sustained Winds of 120 mph
• Gusts to 164 mph, the last measurement before wind damaged the equipment
• Hurricane Force Winds battered the island for 8 hours!

Damage:
• Approximately half of the 150 main line circuits were lost
• Approximately 25,000 out of 32,000 customers without power
• 4 people killed
The Response

Electric Supply restored within 3 weeks

- BELCO staff, retirees, and former employees were dispatched
- Caribbean Association of Electric Utilities (CARILEC) crews dispatched from Barbados, Bahamas, Jamaica, Cayman Islands, Dominica, and Belize.
- Emergency Measures Organization (EMO)
- Bermuda Government
- The Bermuda Regiment
- Bermuda Telephone Company (BTC)
- Privately owned landscaping and construction companies
GIS at BELCO before and during Fabian

Note:
Out of the IT systems in place at BELCO, only the CIS and GIS were integrated at the time of the hurricane.

GIS: ArcGIS and ArcFM
CIS: CIS/OV
OMS: CES Centricity
SCADA: ACS
WMS: Avantis
GIS at BELCO before and after Fabian

BEFORE:

- GIS was used to print map books that were given to each of the crews in preparation for restoring the system outages.

- GIS was used to update the CES Centricity Outage Management System.

AFTER:

- GIS was used to analyze the results of the damage assessment.

- GIS was used to prioritize restoration activities after the initial restoration was complete.

- GIS was used to inform BELCO management and the community of the progress that BELCO was making through the development of maps and reports.
Damage Assessment: The Steps

1. Print map books to be used by retired BELCO employees in a system-wide survey.
2. An Excel spreadsheet was developed and printed for collecting Pole State and Equipment information.
3. Survey the system beginning with the main line circuits fed from the substation and progressing out to the large branch lines, small branch lines, and individual service taps.
4. Pole State and equipment information was collected and loaded into Excel.
5. Missing Pole numbers were entered into the GIS.
6. Excel data was batch loaded into GIS on a daily basis for analysis.
7. Reports and maps were generated and distributed to management.
Damage Assessment: The Steps
Damage Assessment: The Steps
Damage Assessment: The Steps
Damage Assessment: The Steps
**BELCO: Lessons Learned**

1. This was the first time GIS was used to support hurricane restoration activities in Bermuda and management feels that the combination of GIS, CIS, and OMS were an essential reason for their ability to respond and restore customers quickly. GIS is a critical business system.

2. Although the process worked, a more efficient means to collect, manipulate, and analyze the damage data was needed.
   - The process used after Fabian required the expertise of a GIS Analyst with a high level of skills.
   - The average end user was required to ask for help to get information into and out of the system.

3. Integration with the Work Management System is necessary for Work Order generation as well as material requisition.
GIS at BELCO after Fabian and into the future

GIS: ArcGIS and ArcFM
CIS: CIS/OV
OMS: CES Centricity
SCADA: ACS
WMS: Avantis

Note:
IT systems are now fully integrated.
The BELCO GIS environment

- IVR: Avaya
- Outage Management: CES
- AM/FM/GIS: ArcFM
- Customer Information: CIS/OV
- SCADA: ACS
- Billing and Accounting: SAP
- Work Order Management: Avantis
The Toolset

ArcFM Mobile
Maintenance Link
Incident Survey Application
Custom Reports
Custom Queries

OneSolution
Incident Survey Application

AM/FM/GIS: ArcFM

Customer Information: CIS/OV

Billing and Accounting: SAP

Work Order Management: Avantis

ArcFM Mobile

Maintenance Link
The Toolset
### OneGIS Incident Survey Tool

#### Search Incidents

<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Name: Hurricane Fabian 2003</th>
<th>Show Closed/Canceled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Event</td>
<td>Owner:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open Date:</td>
<td>On</td>
</tr>
<tr>
<td></td>
<td>Close Date:</td>
<td>On</td>
</tr>
<tr>
<td>GIS Feature</td>
<td>Layer:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Feature ID:</td>
<td></td>
</tr>
<tr>
<td>Priority</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Status</td>
<td>Active</td>
<td>Complete</td>
</tr>
<tr>
<td>Avantis W.O.</td>
<td>Survey:</td>
<td></td>
</tr>
<tr>
<td>Dispatch</td>
<td>To:</td>
<td>On</td>
</tr>
<tr>
<td>Data Entry</td>
<td>By:</td>
<td>On</td>
</tr>
</tbody>
</table>

**Search Rules**
- And
- Or

[Image: OneGIS Incident Survey Tool interface]
# The Toolset

## OneGIS Incident Survey Tool

<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Event</th>
<th>Feature ID</th>
<th>GIS Layer</th>
<th>Priority</th>
<th>Status</th>
<th>Survey Date</th>
<th>Survey By</th>
<th>Dispatch To</th>
<th>Avantis Work Order</th>
<th>Dispatch Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRD-7</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRD-6</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRD-5</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRD-4</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRM-5/C</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRPM-3</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRPM-5/E</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BELCO Pole</td>
<td>Hurricane Fabian 2003</td>
<td>QRPM-5</td>
<td>POLE</td>
<td>1</td>
<td>ACTIVE</td>
<td>9/14/2004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Default Survey and Event
- **Survey Type**: BELCO Pole
- **Event**: Hurricane Fabian 2003
- **GIS Layer**: POLE
- **Priority**: 1
- **Status**: ACTIVE

## Additional Features
- Add From Map
- Select All
- Unselect All
- Remove Selected
- Select On Map
- Auto Zoom
- Clear Current Selection
- Export List
- Reports

- Clear List First
- Include 'Complete'
- Include 'Canceled'

- ToolTips
  - Hide
  - Close
The Toolset

### OneGIS Incident Survey Tool

<table>
<thead>
<tr>
<th>Pole Number</th>
<th>Event</th>
<th>Survey Date</th>
<th>Priority</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>QRM-5/D</td>
<td>Hurricane Fabian 2003</td>
<td>9/14/2004</td>
<td>1</td>
<td>ACTIVE</td>
</tr>
<tr>
<td>QRM-5/C</td>
<td>Hurricane Fabian 2003</td>
<td>9/14/2004</td>
<td>1</td>
<td>ACTIVE</td>
</tr>
<tr>
<td>QRM-5/A</td>
<td>Hurricane Fabian 2003</td>
<td>9/14/2004</td>
<td>1</td>
<td>ACTIVE</td>
</tr>
<tr>
<td>QRM-5/E</td>
<td>Hurricane Fabian 2003</td>
<td>9/14/2004</td>
<td>1</td>
<td>ACTIVE</td>
</tr>
<tr>
<td>QRM-5</td>
<td>Hurricane Fabian 2003</td>
<td>9/14/2004</td>
<td>1</td>
<td>ACTIVE</td>
</tr>
</tbody>
</table>

**Default Survey and Event**
- **Survey Type**: BELCO Pole
- **Event**: Hurricane Fabian 2003

**Categories**
- Pole Down
- Pole Leaning
- Crossarm Broken
- Conductor Down
- Conductor Pin Off
- Conductor Slack
- Trees in/near Conductors
- Splices in Conductors
- ABS Damaged
- Cutouts Damaged
- Transformer Damaged
- Transformer Taps Out
- Transformer CP Tripped
- Transformer Leaking
- Transformer Solid to Line
- Transformer Cutouts Open
- Branch Line Cutouts Open
- HV UG Cable Cutouts Open

**Accessibility**
- None

**Classification**
- Main Line
- Branch Line 1Ph
- LV Line
- Branch Line 2Ph
- Streetlight
- Branch Line 3Ph

**Notes:**
- Nothing to Report
The Solution

1. The Incident Survey Application provides a solution for data maintenance, editing, and reporting that fits into the high pressure business routine that occurs during and after a hurricane or other natural disaster.
   - Work Flow based editing and analysis environment
   - Map Production, Analysis, and Reporting

2. The Incident Survey Application provides integration that allows GIS, Work Management, and CIS data to be integrated which will support the effective operation and management of network and inventory assets during and after the storm.
   - GIS - ArcGIS and ArcFM
   - Work Management Management - Avantis, Maintenance Link
   - Customer Information System - CIS/OV

3. The Incident Survey Application provides a means for distributing data across the enterprise to:
   - Improve the quality of asset data by allowing the people who use the data to maintain the data,
   - Provide a faster turnaround for service requests and work order generation,
   - Provide a means for better material handling;
   - Eliminate redundancy; and
   - Support better decision making.
Questions?